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PILOT INVESTIGATIONS OF LICHENS IN 20 BULGARIAN PROTECTED TERRITORIES ALONG THE BLACK SEA COAST, ALONG THE DANUBE RIVER, AND IN THE MOUNTAINS STRANDZHA, STARA PLANINA, SREDNA GORA AND VITOSHA. IMPLICATIONS FOR SPECIES CONSERVATION.

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Abstract. The studies of lichenized fungi (called hereafter with shorter common term *lichens*) in Bulgaria date back more than a century. However, according to the available literature, so far there are no specialized lichen studies in most Bulgarian protected areas. At the same time, lichens are included as a mandatory element of biodiversity in the templates of modern management plans of the Ministry of Environment and Waters of the country. Therefore, the purpose of this article is to give information on lichen species and their conservation significance in 20 Bulgarian protected natural areas, collected for the preparation of their first or updated management plans, with proposals for their conservation assessment and for considering the ecosystem services they provide in the harboring ecosystems. During the study totally 84 lichen species from 46 genera, 21 families, 8 orders and 2 classes were found. Their distribution by numbers and relevant ecological groups in each protected area with a complete species list is provided below. As it could be expected, the number of species varied strongly in different protected territories, depending on their areas and main subject of conservation. For almost

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all studied protected areas, the data provided in the present paper are practically the first ones. Exceptions are the Reserves *Bogdan*, *Bistrishko Branishte* and *Torfeno Branishte*. In addition, the threats on the species *Lobaria pulmonaria* and *Cetraria islandica* are discussed with underlining the need for their protection.

Key words: conservation, managed reserve, protected locality, reserve, threatened species

INTRODUCTION

The studies of lichenized fungi (called hereafter with shorter common term *lichens*) in Bulgaria date back more than a century (KAZANDJIEV 1900) and a specialized flora on these symbiotic organisms has been published (POPNIKOLOV & ZHELEZOVA 1964). At the beginning of the 21st century appeared a catalog of all lichenized and lichenicolous fungi of Bulgaria with showing their spread in 14 regions, outlined in accordance with the floristic zoning of the country (MAYRHOFER ET AL. 2005). In the paper of the fungal diversity of the Rodopi Mts, 484 lichens and lichenicolous fungi were included (DENCHEV ET AL. 2006). Later, the first checklist of lichens and lichenicolous fungi of Pirin Mts, which contained 514 taxa, was published (IVANOV 2010). Data on wetlands lichen species were collected in the first Bulgarian database on wetlands and their biodiversity (STOYNEVA & MICHEV 2007), and a summary of knowledge on lichens in wetlands and related protected areas was provided by STOYNEVA (2007). However, according to the available literature, so far there are no specialized lichen studies in most Bulgarian protected areas (the few exceptions related with studied areas are given in the discussion of the results). At the same time, lichens are included as a mandatory element of biodiversity in the templates of modern management plans of the Ministry of Environments and Waters of the country. Therefore, the purpose of this article is to give information on lichen species and their conservation significance in 20 Bulgarian protected natural areas, collected for the preparation of their first or updated management plans, with proposals for their conservation assessment and for considering the ecosystem services they provide in the harboring ecosystems.

MATERIAL AND METHODS

According to the geographic location and conservation status, the studied protected areas are distributed as follows (**Fig. 1**):

1. along the Black Sea coast – Reserve *Ropotamo*, Managed Reserves *Velyov Vir* (*Vodnite Lilii*), *Pyasuchna Liliya* and *Atanasovsko Ezero*;
2. along the River Danube – Reserve *Beli Lom*, Managed Reserve *Ibisha* and Protected Locality *Lomiya*;
3. in Strandzha Mt - Reserves *Silkosiya*, *Uzunbudzhak*, *Vitanovo*, *Sredoka* and *Tisovitsa*;
4. in Stara planina Mts – a) in Eastern Stara planina - Reserve *Orlitsata* and

Managed Reserve *Ardachluka*; б) in Western Stara planina - Reserves *Chuprene* and *Gornata Koriya*, Managed Reserve *Uchilishtna Gora*;

5. in Sredna Gora Mts – Managed Reserve *Bogdan*;
6. in Vitosha Mt. – Reserves *Bistrishko Branishte* and *Torfeno Branishte*.

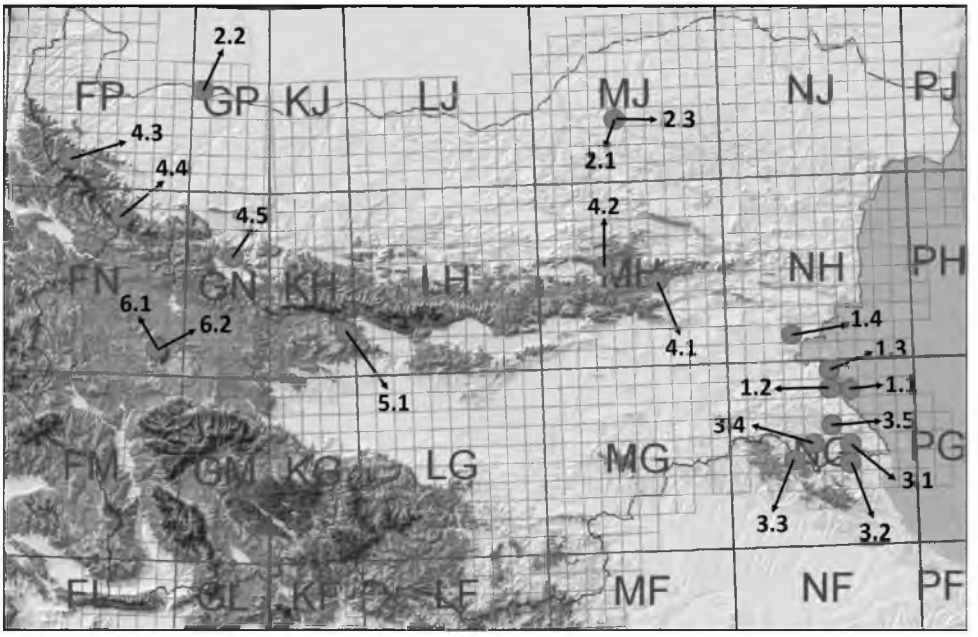

Fig. 1. Distribution of the studied protected areas in Bulgaria: **1.1** - Reserve *Ropotamo*; **1.2** - Managed Reserves *Velyov Vir* (*Vodnite Lilii*); **1.3** - *Pyasuchna Liliya*; **1.4** - *Atanasovsko Ezero*; **2.1** - Reserve *Beli Lom*; **2.2** - Managed Reserve *Ibisha*; **2. 3** - Protected locality *Lomiya*; **3. 1** - Reserve *Silkosiya*; **3.2** - Reserve *Uzunbudzhak*; **3.3** - Reserve *Vitanovo*; **3.4** Reserve *Sredoka*; **3.5** - Reserve *Tisovitsa*; **4.1** - Reserve *Orlitsata*; **4.2** - Managed Reserve *Ardachluka*; **4.3** - Reserve *Chuprene*; **4.4** - Reserve *Gornata Koriya*; **4.5** - Managed Reserve *Uchilishtna Gora*; **5. 1** - Managed Reserve *Bogdan;* **6.1** - Reserve *Bistrishko Branishte*; **6.2** - Reserve *Torfeno Branishte.*

All materials were collected in the periods June-September 2014 and April-June 2015 following the transect method, applied for collecting of all floristic and mycological materials at the same sites. Most materials were collected by the filed teams which participated in the preparation of the relevant management plans. Materials from *Torfeno Branishte*, *Uchilishtna Gora* and *Bogdan* were collected by three of the authors of this paper (GG, MSt-G and BU on 2-4.06.2015 on Vitosha Mt, 1.04.2015г. and 2-3.04. 2015, respectively for the last two areas), materials from the Reserve *Beli Lom* and Protected Locality *Lomiya* were collected by Dr K. Vassilev (10-17.06.2014), materials from the Reserve *Chuprene* were collected mainly by one of the authors (MSt-G on 3-4.07.2014) and some other were collected by Prof. D. Peev and Mag. N. Vulyovska on 7.07.2014, materials from

Gornata Koriya were collected by Prof. D. Peev and Mag. N. Vulyovska in the period 8-12.07.2014, materials from the Reserve *Ibisha* - Prof. D. Peev, Mag. N. Vulyovska and Prof. P. Mitov in the period 20-22.07.2014, and materials from the managed reserve Atanasovsko ezero – by the late Assoc. Prof. T. Michev on 8.08.2014. The materials were collected from different types of habitats (deciduous, mixed and coniferous forests, open rocky terrains, sands, etc.), relevant for each site and contained the following ecological groups of lichens: epilithic (on rocks and stones), epiphleodic (on tree barks) and epigeous (on the soil surface and among mosses) – **Table 1**. The paper contains data on species from all ecological groups, found personally by one of the authors (M St-G) in the months June-July during the annual summer student practices in the period 1988-2002 on the territory of the Reserve *Bistrishko Branishte* along the tourist path to the village Bistritsa.

The identification of the collected material was done in the lab due to the need for microscopic observations on lichen slits, for wetting and coloration of the thalli according to standard methods (Popnikolov & Zhelezova 1964; Nash III 1996, 2008; Wirth et al. 2013). The classification system used is based generally on Wirth et al. (2013) with considering the most recent update to the classification of lichen fungi in the Ascomycota and Basidiomycota to genus level, with species numbers and references to changes compared to the *2010 Outline of Ascomycota* and other recent classifications (Lücking et al. 2017) and consulting Index Fungorum.

For comparisons of taxa found in this study with literature data we took into account only species, which have been indicated for the relevant protected area or species supplied with some location details, which can indicate their presence in each of the studied areas but not species with distribution in the whole floristic region (*e.g.* Black Sea coastal region), or for the whole mountains (*e.g.* Stara Planina, Sredna Gora, Strandzha) or the whole river flow (*e.g.* Ropotamo).

In Bulgaria lichens have never been included in any lists of protected species and in the Bulgarian Red Data Books (Velchev 1984; Peev 2015). The single published proposal for protection of some lichen species was made in 1992 (Draganov & Stoyneva 1994), and a list of rare species was proposed by D. Ivanov in Vodenicharov et al. (1993). In the present paper, both publications were considered in the discussion of the conservational significance of the species.

RESULTS AND DISCUSSION

During the study totally 84 lichen species from 46 genera, 21 families, 8 orders and 2 classes were found (**Table 1**). Their distribution by numbers and relevant ecological groups in each protected area is shown in **Table 1**, and the complete species list is provided below. As it could be expected, the number of species varied strongly in different protected territories, depending on their areas and main subject of conservation. For example, it is easy to explain the finding of a single

species in the small sandy Reserve *Pyasuchna Liliya*, created to protect the plant *Pancratium maritimum* L., or in the Managed Reserves *Atanasovsko Ezero* or *Velyov Vir*, declared to protect peculiar coastal wetlands. By contrast, in larger and higher mountainous Reserves like *Chuprene* and *Bistrishko Branishte*, the diversity of lichens is significantly higher – 38 and 32 species, respectively **(Table 1)**.

Table 1. Taxonomic structure of the lichen flora in 20 Bulgarian protected areas according to the sampled ecological groups. Abbreviations: **EL** – epilithic lichens, **EP** – epiphytic lichens, **EG** – epigeous lichens; **Ord** – orders, **Fam** – families, **Gen** – genera, **Sp** – species. Note: *Incertae sedis* orders are counted as one.

Protected area	Ecological groups			Taxonomic structure				
				Total				
	EL	EP	EG	Class-es	Ord	Fam	Gen	Sp
Ardachluka		x	x	1	3	5	7	7
Atanasovsko Ezero		x		1	1	1	1	1
Beli Lom	x	x	x	1	3	5	8	9
Lomiya	x	x	x	1	2	5	5	8
Chuprene	x	x	x	1	6	10	22	38
Gornata Koriya	x	x	x	1	4	9	17	27
Ibisha		x	x	1	2	4	4	7
Orlitsata	x	x	x	1	3	6	9	13
Pyasuchna Liliya			x	1	1	1	1	1
Ropotamo	x	x	x	1	3	6	8	10
Silkosiya		x	x	1	3	3	5	5
Uzunbudzhak				1	4	7	9	10
Vitanovo		x	x	1	3	5	6	6
Sredoka	x	x	x	1	3	6	7	10
Tisovitsa		x	x	1	3	5	9	9
Velyov Vir		x	x	1	2	3	5	5
Uchilishtna Gora	x	x	x	1	4	10	17	20
Bogdan	x	x	x	2	5	9	11	12
Torfeno Branishte				1	4	9	15	20
Bistrishko Branishte	x	x	x	1	4	12	22	32
Total				2	8	32	56	84

Species list of lichens in diiferent protected areas, organised in alphabetical order at the level of classes, orders, families, genera, species and subspecies:

Class Arthoniomycetes
Order Arthoniales
Family **Arthoniaceae**
Genus ***Arthonia*** Ach.
Arthonia radiata (Pers.) Ach. - Bogdan
Class Lecanoromycetes
Order Candellariales
Family **Candelariaceae**
Genus ***Candelariella*** Müll. Arg.
Candelariella coralliza (Nyl.) H. Magn. - Bistrishko Branishte, Torfeno Branishte
Candelariella xanthostigma (Pers. ex Ach.) Lettau - Chuprene, Bogdan
Order Lecanorales
Family **Alectoriaceae**
Genus **Alectoria** Ach.
Alectoria spp. (juv.) – Chuprene, Gornata Koriya, Bistrishko Branishte
Family **Cladoniaceae**
Genus ***Cladonia*** Hill. ex G. H. Web
Cladonia caespiticia (Pers.) Flörke - Chuprene, Gornata Koriya
Cladonia coniocraea (Flörke) Spreng. – Beli Lom, Lomiya, Uzunbudzhak, Chuprene, Gornata Koriya, Ardachluka, Uchilishtna Gora, Bistrishko Branishte
Cladonia fimbriata (L.) Fr. – Orlitsata, Chuprene, Gornata Koriya, Bistrishko Branishte
Cladonia foliacea (Huds.) Willd. – Pyasuchna Liliya, Ropotamo
Cladonia furcata (Huds.) Schrad. - Ropotamo, Uzunbudzhak, Vitanovo, Sredoka, Orlitsata, Chuprene, Gornata Koriya, Bistrishko Branishte
Cladonia pyxidata (L.) Hoffm. subsp. *pyxidata* – Sredoka, Orlitsata, Chuprene, Gornata Koriya, Bistrishko Branishte
Cladonia pyxidata subsp. *chlorophaea* (Flörke ex Sommerf.) V. Wirth – Chuprene
Cladonia pyxidata (L.) Hoffm. s.l. - Uchilishtna Gora, Torfeno Branishte
Cladonia rangiformis Hoffm. - Sredoka
Cladonia stellaris (Opiz) Pouzar & Vězda - Chuprene
Cladonia spp. (juv.) – Tisovitsa, Chuprene, Gornata Koriya, Bistrishko Branishte
Family **Lecanoraceae**
Genus ***Lecanora*** (Ach.) Th. Fr.

Lecanora argentata (Ach.) Röhl. (Syn. *Lecanora argentata* (Ach.) Malme) – Ardachluka, Uchilishtna Gora, Chuprene, Gornata Koriya

Lecanora carpinea (L.) Vain. – Chuprene, Bogdan, Bistrishko Branishte, Torfeno Branishte

Lecanora cf. *conizaeoides* Nyl. ex Cromb. - Uzunbudzhak

Genus ***Myriolecis*** Clem.

cf. *Myriolecis dispersa* (Pers.) Śliwa, Zhao Xin & Lumbsch (Syn. *Lecanora* cf. *dispersa* (Pers.) Sommerf.) - Chuprene, Gornata Koriya

Genus ***Rhizoplaca*** Zopf

Rhizoplaca melanophthalma (Ram.) Leuckert - Torfeno Branishte

Family **Parmeliaceae**

Genus ***Brodoa*** Goward

Brodoa intestiniformis (Vill.) Goward - Torfeno Branishte

Genus ***Bryoria*** Brodo et D. Hawksw.

Bryoria capillaris (Ach.) Brodo & D. Hawksw. - Chuprene, Gornata Koriya

Bryoria fuscescens (Gyeln.) Brodo et D. Hawkw. – Chuprene, Gornata Koriya, Bogdan, Bistrishko Branishte

Bryoria implexa (Hoffm.) Brodo et D. Hawkw. - Bistrishko Branishte

Genus ***Cetraria*** Ach.

Cetraria islandica (L.) Ach. – Chuprene, Gornata Koriya, Bistrishko Branishte, Torfeno Branishte

Genus ***Cornicularia*** (Schreb.) Ach.

Cornicularia normoerica (Gunnerus) Du Rietz - Torfeno Branishte

Genus ***Evernia*** (L.) Ach.

Evernia prunastri (L.) Ach. – Atanasovsko ezero, Ropotamo, Velyov Vir, Beli Lom, Ibisha, Silkosiya, Uzunbudzhak, Vitanovo, Sredoka, Tisovitsa, Orlitsata, Ardachluka, Uchilishtna Gora, Chuprene, Bistrishko Branishte

Genus ***Flavoparmelia*** Hale

Flavoparmelia caperata (L.) Hale – Beli Lom, Silkosiya, Sredoka, Tisovitsa, Ardachluka, Uchilishtna Gora

Genus ***Hypogymnia*** Nyl.

Hypogymnia physodes (L.) Nyl. – Ardachluka, Uchilishtna Gora, Chuprene, Gornata Koriya, Bistrishko Branishte

Hypogymnia tubulosa (Schaer.) Hav. - Uchilishtna Gora, Chuprene, Gornata Koriya, Bogdan, Bistrishko Branishte

Genus ***Imshaugia*** S. L. F. Mey

Imshaugia aleurites (Ach.) S. L. F. Mey. – Silkosiya, Chuprene, Gornata Koriya

Genus ***Melanelia*** Essl.

Melanelia hepatizon (Ach.) A. Thell. - Bistrishko Branishte, Torfeno

Branishte

Genus ***Melanelixia*** O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. et Lumbsch

Melanelixia subaurifera (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch - Velyov Vir, Tisovitsa

Genus ***Parmelia*** Ach.

Parmelia saxatilis (L.) Ach. - Chuprene, Bistrishko Branishte,

Parmelia sulcata Tayl. – Ropotamo, Velyov Vir, Beli Lom, Lomiya, Uzunbudzhak, Vitanovo, Tisovitsa, Orlitsata, Uchilishtna Gora, Bistrishko Branishte, Torfeno Branishte

Genus ***Parmelina*** Hale

Parmelina carporrhizans (Taylor) Hale – Uchilishtna Gora, Bogdan

Parmelina quercina (Willd.) Hale – Orlitsata

Parmelina cf. *quercina* (Willd.) Hale - Tisovitsa

Parmelina tiliacea (Hoffm.) Hale – Uchilishtna Gora

Genus ***Parmeliopsis*** Nyl.

Parmeliopsis ambigua (Wulf.) Nyl. - Chuprene, Gornata Koriya, Bistrishko Branishte

Genus ***Platismatia*** W. Culb. et C. Culb.

Platismatia glauca (L.) W. L. Culb. & C. F. Culb. – Chuprene, Gornata Koriya

Genus ***Protoparmeliopsis*** M. Choisy

Protoparmeliopsis muralis (Schreb.) M. Choisy - Bistrishko Branishte

Genus ***Pseudevernia*** Zopf

Pseudevernia furfuracea (L.) Zopf - Orlitsata, Uchilishtna Gora, Chuprene, Gornata Koriya, Bistrishko Branishte

Genus **Pseudephebe** M. Choisy

Pseudephebe pubescens (L.) M. Choisy - Torfeno Branishte

Genus **Usnea** Dill ex Adans

Usnea dasypoga (Ach.) Nyl. - Chuprene

Usnea hirta (L.) Weber ex F. H. Wigg. (juv.) – Uchilishtna Gora

Usnea cf. *subfloridana* Stirt - Bogdan

Usnea spp. (juv.) – Chuprene, Gornata Koriya, Bistrishko Branishte

Genus **Vulpicida** Mattson & Lai

Vulpicida pinastri (Scop.) J.-E. Mattsson & M. J. Lai – Chuprene, Gornata Koriya, Bistrishko Branishte

Family **Ramalinaceae**

Genus ***Ramalina*** Ach.

Ramalina capitata (Ach.) Nyl. - Torfeno Branishte

Ramalina farinacea (L.) Ach. – Velyov Vir, Sredoka, Tisovitsa (juv.), Uchilishtna Gora, Bistrishko Branishte

Ramalina fastigiata (Pers.) Ach. – Ropotamo, Sredoka, Orlitsata

Family **Stereocaulaceae**

Genus ***Lepraria*** Ach.

Lepraria incana (L.) Ach. – Uchilishtna Gora, Gornata Koriya, Bogdan, Bistrishko Branishte

Lepraria spp. - Beli Lom, Lomiya, Ibisha, Uzunbudzhak, Chuprene, Gornata Koriya

Genus ***Squamarina*** Poelt

Squamarina cartilaginea (With.) P. James (Syn. *Lecanora crassa* (Huds.) Ach.) - Orlitsata

Family Umbilicariaceae

Genus ***Umbilicaria*** (Hoffm.) Fw.

Umbilicaria crustulosa (Ach.) Lamy - Torfeno Branishte

Umbilicaria cylindrica (L.) Delise - Bistrishko Branishte,

Umbilicaria decussata (Vill.) Zahlbr. - Torfeno Branishte

Umbilicaria deusta (L.) Baumg. - Torfeno Branishte

Umbilicaria torrefacta (Lightf.) Schrad. - Torfeno Branishte

Order Ostropales

Family **Graphidaceae**

Genus ***Graphis*** Adans.

Graphis scripta (L.) Ach. - Sredoka

Family **Phlyctidaceae**

Genus ***Phlyctis*** (Wallrot.) Flot.

Phlyctis argena (Ach.) Flot. – Uchilishtna Gora, Chuprene

Order Peltigerales

Family **Lobariaceae**

Genus ***Lobaria*** (Schreb.) A. Z.

Lobaria pulmonaria (L.) Hoffm. – Uzunbudzhak, Gornata Koriya

Family **Peltigeraceae**

Genus ***Peltigera*** Willd.

Peltigera canina (L.) Willd. - Ropotamo, Sredoka, Bistrishko Branishte

Peltigera horizontalis (Huds.) Baumg. – Orlitsata, Ardachluka

Peltigera malacea (Ach.) Funck - Chuprene

Peltigera membranacea (Ach.) Nyl. – Chuprene, Gornata Koriya

Peltigera neopolydactyla (Gyeln.) Gyeln. – Chuprene, Bistrishko Branishte

Peltigera polydactylon (Neck.) Hoffm., ster. - Chuprene

Peltigera praetextata (Flörke ex Sommerf.) Zopf – Silkosiya, Vitanovo, Orlitsata, Chuprene, Gornata Koriya

Peltigera rufescens (Weiss) Humb. - Bistrishko Branishte

Order Pertusariales

Family **Ochrolechiaceae**

Genus ***Ochrolechia***

Ochrolechia arborea (Kreyer) Almborn (cf.!) – Bogdan

Family **Pertusariaceae**

Genus ***Lepra*** Scop.

Lepra amara (Ach.) Hafellner (Syn. *Pertusaria amara* (Ach.) Nyl.) – Uzunbudzhak, Vitanovo, Uchilishtna Gora

Genus ***Pertusaria*** DC

Pertusaria cf. *hymenea* (Ach.) Schaer. - Orlitsata

Pertusaria pertusa (Weigel) Tuck. - Uzunbudzhak, Vitanovo, Sredoka, Orlitsata, Ardachluka

Pertusaria pustulata (Ach.) Duby – Uchilishtna Gora

Order Teloschistales

Family **Caliciaceae**

Genus ***Amandinea*** M. Choisy ex Scheid. & M. Mayrhofer

Amandinea punctata (Hoffm.) Coppins & Scheid - Bogdan

Genus ***Buellia*** De-Not

Buellia schaereri De Not. – Uchilishtna Gora

Family **Physciaceae**

Genus ***Physcia*** Ach. emend. Vain.

Physcia adscendens H. Olivier - Ropotamo, Beli Lom, Lomiya, Ibisha, Chuprene, Gornata Koriya, Bistrishko Branishte

Physcia aipolia (Ehrb. ex Humb.) Fürnr. - Ropotamo, Ibisha

Physcia stellaris (L.) Nyl. - Beli Lom, Lomiya, Ibisha, Chuprene, Bistrishko Branishte

Physcia tenella (Scop.) DC. – Lomiya, Tisovitsa

Genus ***Physconia*** Poelt

Physconia distorta (With.) R. Laundon - Ropotamo

Physconia enteroxantha (Nyl.) Poelt. - Lomiya

Physconia grisea (Lam.) Poelt – Beli Lom, Uchilishtna Gora, Bogdan

Family **Teloschistaceae**

Genus ***Xanthoria*** (Fr.) Th. Fr.

Xanthoria elegans (Link) Th. Fr.) - Ibisha

Xanthoria parietina (L.) Th. Fr. – Ropotamo, Beli Lom, Lomiya, Ibisha, Uchilishtna Gora, Bogdan, Bistrishko Branishte, Torfeno Branishte

Orders incertae sedis

Family **Lecideaceae**

Genus ***Lecidea*** Ach.

Lecidea lapicida (Ach.) Ach. - Chuprene, Torfeno Branishte

Genus ***Lecidella*** Körber em. Hertel et Leuck.

Lecidella elaeochroma (Ach.) M. Choisy – Velyov Vir, Uzunbudzhak, Tisovitsa

Lecidella stigmatea (Ach.) Hertel & Leucke - Chuprene, Gornata Koriya

Family **Ophioparmaceae**

Genus ***Hypocenomyce*** M. Choisy

Hypocenomyce scalaris (Ach. ex Lilj.) M. Choisy - Silkosiya

Family **Rhizocarpaceae**

Genus ***Rhizocarpon*** Ramond ex DC

Rhizocarpon alpicola (Wahlenb.) Rabenh. - Torfeno Branishte

Rhizocarpon badioatrum (Flörke ex Spreng.) Th. Fr. - Torfeno Branishte

Rhizocarpon geographicum (L.) DC - Bistrishko Branishte, Torfeno Branishte

For almost all studied protected areas, the data provided in the present paper are practically the first ones. Exceptions are: 1) the managed reserve *Bogdan*, for which three species were indicated by Železova (1960, 1963) – *Heterodermia speciosa* (Wulfen) Trevis. (Syn. *Anaptychia speciosa* (Wull.) Vain., *Leptogium saturninum* (Dicks.) Nyl. and *Nephroma parile* (Ach.) Ach.; 2) the reserve Ropotamo for which *Collema flaccidum* (Ach.) Ach., *Graphis scripta* (L.) Ach. (Syn. *Graphis scripta* var. *pulverulenta* (Pers.) Ach.), *Pertusaria flavida* (DC.) J. R. Laundon (Syn. *P. lutescens* (Hoffm.) Lamy) was pointed by Železova (1963) and 3) the both Vitosha reserves *Bistrishko Branishte* and *Torfeno Branishte*. Although the lichens of Vitosha Mt were the first investigated in Bulgaria (Kazandjiev 1900, 1906), and the mountain, due to its close situation to the capital Sofia, is one of the best studied in the country (*e.g.* p. Nikoloff 1931, 1932, 1935, Podpera 1911, Suza 1929, Cretzoui 1936, Suza 1929, Železova 1956, 1960, 1962, 1963, Lambrev et al. 1962, Kloss 1962, Motyka & Železova 1962, Shivarov & Stoykov 2012, Kovachev, unpubl.), only few data on the lichens of *Bistrishko Branishte* exist and there is no purposive detailed study, which covers its whole territory. In the Contribution to the lichen flora of Bulgaria, among the species found on Vitosha Mt, Železova (1960) pointed only *Diploschistes muscorum* (Scop.) R. Sant. (Syn. *D. bryophilus* (Ehrenb.) A. Z.) as found at altitude of 700 m a.s.l. in the territory of this reserve. In the monographic study of the genus *Usnea* in Bulgaria, Motyka & Železova (1962) provide data on Vitosha Mt, but especially for the reserve they indicate only one variety - *Usnea faginea* var. *cirrhosa* Mot. However, from the text of both authors, considering the substrates and altitudes pointed, it is possible to suppose that there were two more species found in the reserve *Bistrishko Branishte*. These are *Usnea barbata* (L.) Wigg. emend. Mot. and *Usnea florida* (L.) Wigg., the first of which was not proved by the authors. About 350 taxa are included in the unpublished Report: *The lichens of Vitosha* of Mag. A. Kovachev to the Directorate of the Nature Park Vitosha, but according to his descriptions of the studied sites (altogether 30), only two of them (numbers 29 and 30) with 32 lichen taxa found are relevant for the reserve. We prepared a list of all lichen taxa mentioned by Železova (1960), Motica & Zhelezova (1962) and Kovachev (unpubl.), for which the finding on the reserve territory was explicitly pointed, accomplished by taxa found in this study (***Appendix 1***). As a result, the

list contains 49 lichens, 15 of which are new for the reserve territory and 17 are in accordance with former studies. There are no purposive data on lichens of the reserve *Torfeno Branishte*. However, using the study by P. NIKOLOFF (1931), we prepared a list of lichen species for which he provided ecological details (including broad distribution, substrates and altitude) which allowed to suppose finding on the reserve territory, accomplished by taxa found in this study (***Appendix 2***). As a result, the list contains 69 lichens, 16 of which are new for the reserve territory and 4 are in accordance with former studies.

In most of the studied areas there were no species of conservation significance according to the papers by DRAGANOV & STOYNEVA (1994) and VODENICHAROV ET AL. (1993). Exceptionally, *Lobaria pulmonaria* (L.) Hoffm. (tree lungwort, lung lichen, lung moss, lungwort lichen, oak lungs or oak lungwort) was found in the reserves *Uzunbudzhak* and *Gornata Koriya*. This extremely sensitive epiphytic/epiphleodic species was proposed for protection in 1992 (for details see DRAGANOV & STOYNEVA 1994) because of two reasons: a) the species inhabiting of mesophyllous beech forests of high air humidity and clean air; b) its medicinal properties as a curative means against cough as long-ago known remedy for the treatment of lung diseases. Nowadays, the medicinal properties of the lichen are "rediscovered" by modern Bulgarians due to the broad advertisement and usage of the homeopathic anticough syrups (UZUNOV & STOYNEVA-GÄRTNER 2015). *L. pulmonaria* is accepted as threatened and included in the Red Lists in a number of countries and regions in Europe (*e.g.* TÜRK & HAFELLNER 1999; JÜRIADO & LIIRA 2010; JÜRIADO ET AL. 2011; BENESPERI ET AL. 2018). Therefore, we believe that this species, which is relatively rare in the territory of both reserves, should be subject to special conservation and permanent monitoring.

Cetraria islandica (L.) Ach. (Iceland moss) was found in small amounts (single specimens) in the reserves *Chuprene*, *Gornata Koriya*, *Bistrishko Branishte* and *Torfeno Branishte*. We believe that this species has long been among the endangered species in the country due to its including in herbal manuals among the folk medicines for treatment of different diseases (EUROPEAN MEDICINE AGENCY 2014; UZUNOV & STOYNEVA-GÄRTNER 2015). Modern Bulgarian people use the lichen mainly as herbal cough remedy (UZUNOV & STOYNEVA-GÄRTNER 2015). In the reserves *Bistrishko Branishte* and *Torfeno Bransihte* the population strongly decreased also due to collection of the species for students herbaria during students practices conducted there, according to our knowledge, for more than 25 years (1975-2000). Therefore, it can be argued that among the lichens in both reserves there is a species of conservation significance, the collection of which must be especially strictly forbidden.

Although during the present study we did not find new taxa for the territory of Bulgaria, and there are not officially accepted threatened species, our pilot results indicate the presence of significant number of lichenized fungi in the studied protected areas. Doubtless, further more detailed targeted studies could

reveal higher biodiversity of these organisms and therefore we can strongly recommend conducting of systematic inventories and continuous mapping of the species. Considering the extremely slow growth of these organisms (Nash III 2008) and their sensitivity to the air pollution which makes them valuable air quality indicators, combined with their low amounts in the studied sites, we find it necessary to outline the need of their permanent monitoring and taking measures for preventing any air pollution (and especially the appearance of acid rains) in the studied regions.

Lichenised fungi (lichens) are often neglected in analyses of ecosystem services and in nature conservation management, mostly due to the underestimation of their importance, to the lack of monitoring data for many regions, and to the difficulties in species identification (Zedda et al. 2014; Zedda & Rambold 2015). However, lichens and their symbionts underpin a great number of ecosystem functions, among which are the rock decomposition, soil formation, carbon, and nitrogen fixation. In addition, they support the diversity of numerous organisms through the provision of food, habitat, shelter, camouflage, or nesting material. Furthermore, lichens provide numerous direct and indirect ecosystem services (*e.g.* the provision of lichen secondary metabolites and other compounds for medicinal and other purposes, the use of lichens as bioindicators of environmental changes, and as inspiration source in the context of culture, arts and design) - Zedda & Rambold (2015). Although included in the templates of management plans of the Bulgarian Ministry of Environment and Waters, lichens have not been evaluated in any of them in respect of their ecosystem functioning and of their role as providers of ecosystem services. Therefore, we underline this omission and we believe that in future this aspect will find place in nature conservation documents and assessments.

CONCLUSION

Data on lichen biodiversity in 20 protected areas in Bulgaria, obtained during this study, revealed the need of conducting more detailed systematic and purposive inventory of these organisms, continuous mapping of species and their permanent monitoring in all Bulgarian protected areas. In addition, we propose assessment of their role as providers of ecosystem services in future natural legislative documents and urgent including relevant lichens in lists of threatened and protected species in Bulgaria. Since the general protection of habitats in the protected areas of the country is ensured by the law, we would like to stress the need for taking measurements for preventing any air pollution since it can harm in an irreversible way these slowly growing and very sensitive organisms, affecting in this way the function of their harboring ecosystems.

CONFLICT OF INTERESTS

The authors declare lack of conflict of interests. Identification of the lichen material was done by G. Gärtner and M. P. Stoyneva-Gärtner, who also collected part of the materials. B. A. Uzunov participated in part in the field work with collection of the materials and in the preparation of the illustrations. All authors worked equally in literature search and writing of the manuscript.

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References

Benesperi R., Nascimbene J., Lazzaro L., Bianchi E., Tepsich A., Longinotti S. & Giordani P. 2018. Successful conservation of the endangered forest lichen *Lobaria pulmonaria* requires knowledge of fine-scale population structure. – Fungal Ecology 33: 65-71.

Vodenicharov D., Dimitrova-Konaklieva S., Ivanov D., Kirjakov I., Mladenov R., Moncheva S., Petrov S. & Temniskova-Topalova D. 1993. Biological diversity of Bulgaria – algae, bryophytes, water plants (hydatophytes, neystophytes, helophytes), lichenized fungi. - In: Sakalyan M. & Meini K. (Eds), National Strategy for Conservation of the Biological Diversity. Main Reports. Volume 1. Sofia, 35-72 (In Bulgarian).

Denchev C., Gyosheva M., Bakalova G., Fakirova V., Petrova R., Dimitrova E., Sameva E., Stoykov D., Assyov B. & Nikolova S. 2006. Fungal diversity of the Rhodopes (Bulgaria). – In: Beron P. (Ed.), Biodiversity of Bulgaria. 3. Biodiversity of Western Rhodopes (Bulgaria and Greece). Pensoft & Nat. Mus. Natur. Hist., Sofia, 81-131.

Draganov S. & Stoyneva M. 1994. To the attention of MoEW. Proposal to declare protected some species of algae, fungi and lichens. - Ekologiya, Biologiya I Biotechnologiya (Sofia) 4: 62-64 (In Bulgarian).

European medicine agency 2014. Assessment report on *Cetraria islandica* (L.) Acharius s/l/thallus. Retrieved on 16.02.2018 from https://www.ema.europa.eu/documents/herbal-report/draft-assessment-report-cetraria-islandica-l-acharius-sl-thallus_en.pdf

Index Fungorum. http://www.indexfungorum.org (Last accessed on 23.01.2019).
Ivanov D. 2010. Checklist of the lichens and lichenicolous fungi from the Pirin mountains in Bulgaria. – Ber. nat.-med. Verein Innsbruck 96: 35-57.
Jüriado I. & Liira J. 2010. Threatened forest lichen Lobaria pulmonaria – its past, present and future in Estonia. – Forestry Studies 53: 5-74.
Jüriado I., Liira J., Csencsics D., Widmer I., Adolf C., Kohv K. & Scheidegger C. 2011. Dispersal ecology of the endangered woodland lichen *Lobaria pulmonaria* in managed hemiboreal forest landscape. – Biodiv. Cons. 20 (8): 1803–1819.
Kazandzhiev S. 1900. The Lichen flora of Bulgaria. – Periodichno Spisanie na Bulgarskoto Knizhovno Druzhestvo 61: 470-532 (In Bulgarian).
Kazandzhiev S. 1906. Additional contribution to the lichen flora of Bulgaria. – Godishnik na Sofiyskiya Universitet, Fiziko-Matematicheski Fakultet 2: 125-137 (In Bulgarian).
Kloss K. 1962. Beitrag zur Flechtenflora Bulgariens. – Repet. Spec. Nov. Regni Vegetab. 65: 141-149.
Lambrev Z., Jankov N., Bačvarova T., Adžarova E. & Železova B. 1962. Antibakterielle Wirkung mancher bulgarischer Flechtenarten. – Izvestiya na Botanicheskiya Institut 10: 121-129. (In Bulgarian, Russian and German summ.)
Lücking R., Hodkinson B. R. & Leavitt S. D. 2017. The 2016 classification of lichenized fungi in the Ascomycota and Basidiomycota – approaching one thousand genera. - The Bryologist 119 (4): 361-417.
Mayrhofer H., Denchev C. M., Stoykov D. Y. & Nikolova S. O. 2003. Catalogue of the lichenized and lichenicolous fungi of Bulgaria. – Mycologia Balcanica 2 (1): 3-61.
Motyka J. & Železova B. 1962. Monographische Untersuchung der Gattung Usnea in Bulgarien. – Izvestiya na Botanicheskiya Institut 10: 67-120 (In Bulgarian, Russian and German summ.)
Peev D. (Ed-in-Chief) 2015. Red Data Book of the Republic of Bulgaria. Vol. 1. Plants and Fungi. Bulgarian Academy of Sciences & Ministry of Environment and Waters, Sofia, 881 pp.
p. Nikoloff A. 1931a. Die Flechtenflora von Witoschagebirge. – Godishnik na Sofiyskiya Universitet, Fiziko-Matematicheski Fakultet 3: 29-74. (In Bulgarian, German summ.).
p. Nikoloff A. 1931b. Neue Flechten für Bulgarien. – Godishnik na Sofiyskiya Universitet, Fiziko-Matematicheski Fakultet 31: 331-333.
p. Nikoloff A. 1932. Neue Flechten für Bulgarien. – Izvestiya na Bulgarskoto Botanichesko druzhestvo 5: 87-89 (In Bulgarian).
Popnikolov A. & Zhelezova B. 1964. Flora of Bulgaria. Lichens. Narodna Prosveta, Sofia, 517 pp.
Nash Th. H. III (Ed.) 1996. Lichen Biology. Cambridge University Press, 303 pp.
Nash Th. H. III (Ed.) 2008. Lichen Biology. 2nd Edn. Cambridge University Press, 486 pp.

Podpera J. 1911. Ein Beitrag zu der Kryptogamenflora der bulgarischen Hochgebirge. – Beih. Bot. Zentralbl. 28. 173-224.

Shivarov V. V. & Stoykov D. Y. 2012. New records of pyrenocarpous lichenized fungi from Bulgaria. – Mycotaxon 121: 133-138.

Stoyneva M. P. 2007. Lichens of Non-lotic Bulgarian Wetlands. – In: Michev T. M. & M. P. Stoyneva (Eds), 2007. Inventory of Bulgarian Wetlands and their Biodiversity. Part 1: Non-Lotic Wetlands. Publ. House Elsi-M, Sofia, 173-175.

Stoyneva M. P. & Michev T. M. 2007. Data base. – In: Michev T. M. & Stoyneva M. P. (Eds), Inventory of Bulgarian Wetlands and their Biodiversity. Part 1: Non-Lotic Wetlands. Publ. House Elsi-M, Sofia, CD.

Suza J. 1929. Lichenes Bulgariae. I. - Acta Botanica Bohemica 8: 7-25.

Türk R. & Hafellner J. 1999. Rote liste gefährdeter Flechten (Lichenes) österreichs. 2 Fassung. – In: Niklfeld H. (Hrsg), Rote Liste gefährdeter Pflanzen österreichs, Graz 10: 187-228.

Uzunov B. A. & Stoyneva-Gärtner M. P. 2015. Mushrooms and lichens in Bulgarian ethnomycology. - Journal of Mycology; http://dx.doi.org/10.1155/2015/361053

Velchev (Ed.) 1984. Red Data Book of the P. R. Bulgaria. 1 Plants. Izd. BAN, Sofia, 447 pp. (In Bulgarian).

Wirth W., Hauck M. & Shultz M. 2013. Die Flechten Deutschlands. Band 1 und Band 2. Eugen Ulmer KG, 1170 pp.

Zedda L., Nöske N. & Rambold G. 2014. Ecosystem functions and ecosystem services underpinned by lichen diversity. - In: 1st International BION-conference „Biodiversity Today for Tomorrow", 17-19 September 2014, Wissenschaftszentrum Bonn, Germany. Retrieved on 16.02.2018 from: file:///C:/Users/Maya/Downloads/BION-Konferenz2014_BIO-Diverse_PosterResearch.pdf

Zedda L. & Rambold G. 2015. The diversity of lichenised fungi: Ecosystem functions and ecosystem services. – In: Upreti D., Divakar P., Shukla V. & Bajpai R. (Eds), Recent Advances in Lichenology. Springer, New Delhi, 121-145.

Železova B. 1956. Beitrag zur Flechtenflora Bulgariens. – Izvestiya na Botanicheskiya Institut 5: 387-403 (In Bulgarian, Russian and German summ.).

Železova B. 1960. Beitrag zur Flechtenflora Bulgariens. – Izvestiya na Botanicheskiya Institut 7: 351-357 (In Bulgarian, Russian and German summ.).

Železova B. 1962. Beitrag zur Flechtenflora Bulgariens. – Izvestiya na Botanicheskiya Institut 10: 195-198 (In Bulgarian, Russian and German summ.)

Železova B. 1963. Materialen zur Flechtenflora Bulgariens. – Izvestiya na Botanicheskiya Institut 12: 245-265 (In Bulgarian, Russian and German summ.).

List of lichens of the reserve *Bistrishko Branishte*. The list is organized in alphabetical order of the species Latin names. Data on lichen species provided by ŽELEZOVA (1960), MOTYKA & ŽELEZOVA (1962) and KOVACHEV (unpubl.), for which the finding on the reserve territory was explicitly pointed, were accomplished with taxa found in this study (indicated by * when they are reported for first time, and by (*) when they coincide with previously reported taxon). In quotes are indicated taxa taken from ŽELEZOVA (1960), MOTYKA & ŽELEZOVA (1962) and KOVACHEV (unpubl.), which were not found with the same writing, combinations or author names in INDEX FUNGORUM.

1. **Alectoria* spp. (juv.)
2. (*)*Bryoria fuscescens* (Gyeln.) Brodo et D. Hawkw.
3. (*)*Bryoria implexa* (Hoffm.) Brodo et D. Hawkw.
4. *Bryoria subcana* (Nyl. ex Stiz.) Brodo et D. Hawkw.
5. **Candelariella coralliza* (Nyl.) H. Magn.
6. *Candelariella vitellina* (Hoffm.) Müll. Arg. (as "*C. vitellina* (Ehrh.) Müll. Arg.")
7. (*)*Cetraria islandica* (L.) Ach.
8. *Cladonia coccifera* (L.) Willd.
9. **Cladonia coniocraea* (Flörke) Spreng.
10. (*)*Cladonia fimbriata* (L.) Fr.
11. **Cladonia furcata* (Huds.) Schrad.
12. (*)*Cladonia pyxidat*a (L.) Hoffm. subsp. *pyxidata*
13. **Cladonia* spp. (juv.)
14. *Diplochistes muscorum* (Scop.) R. Sant. (Syn. *D. bryophilus* (Ehrenb.) A. Z.)
15. (*)*Evernia prunastri* (L.) Ach.
16. (*)*Hypogymnia physodes* (L.) Nyl.
17. (*)*Hypogymnia tubulosa* (Schaer.) Havass.
18. *Lecanora albella* (Pers.) Ach.
19. *Lecanora allophana* (Ach.) Nyl. (as "*Lecanora allophana* (Nyl.) Röhl.")
20. (*)*Lecanora carpinea* (L.) Vain.
21. *Lecidella euphorea* (Förke) Hertel
22. (*)*Lepraria incana* (L.) Ach.
23. *Melanelia fuliginosa* (Fr. ex Duby) Essl. in Egan
24. **Melanelia hepatizon* (Ach.) A. Thell.
25. **Parmelia saxatilis* (L.) Ach.
26. (*)*Parmelia sulcata* Tayl.
27. (*)*Parmeliopsis ambigua* (Wulf.) Nyl.
28. *Parmeliopsis hyperopta* (Ach.) Vain. (as "*Parmeliopsis hyperopta* (Ach.) Arnold")
29. (*)*Peltigera canina* (L.) Willd.
30. **Peltigera neopolydactyla* (Gyeln.) Gyeln.

31. **Peltigera rufescens* (Weiss) Humb.
32. *Peltigera subcanina* Gyeln.
33. **Physcia adscendens* H. Olivier
34. **Physcia stellaris* (L.) Nyl.
35. *Platismatia glauca* (L.) W. Culb. et C. Culb.
36. **Protoparmeliopsis muralis* (Schreb.) M. Choisy
37. (*)*Pseudevernia furfuracea* (L.) Zopf.
38. (*)*Ramalina farinacea* (L.) Ach.
39. (*)*Rhizocarpon geographicum* (L.) DC
40. *Scoliciosporum umbrinum* (Ach.) Arn.
41. *Tuckermanopsis chlorophylla* (Willd.) Hale
42. **Umbilicaria cylindrica* (L.) Delise
43. *Usnea faginea* var. *cirrhosa* Mot.
44. *Usnea filipendula* Stirt.
45. *Usnea florida* (L.) Weber ex F. G. Wigg. (as "*U. florida* (L.) Wigg. emend Clere")
46. **Usnea* spp. (juv.)
47. (*)*Vulpicida pinastri* (Scop.) J. –E. Mattson et Lai
48. *Xanthoparmelia mougeotii* (Schaer. ex D. Dietr.) Hale
49. **Xanthoria parietina* (L.) Th. Fr.

Appendix 2

List of lichens of the reserve *Torfeno Branishte*. The list is organized in alphabetical order of the species Latin names. List of lichens for which the ecological data (incl. broad distribution, substrates and altitude) provided by P. NIKOLOFF (1931) allowed to suppose finding on the reserve territory, were accomplished with taxa found in this study (indicated by * when they are reported for first time, and by (*) when they coincide with previously reported taxon). In quotes are indicated taxa taken from P. NIKOLOFF (1931), which were not found with the same writing, combinations or author names in INDEX FUNGORUM.

1. *Alectoria implexa* (Hoffm.) Röhl. (as "*A. implexa* (Hoffm.) Nyl.")
2. *Alectoria jubata* (L.) Ach.
3. *Aspicilia cinerea* (L.) Körb.
4. *Baeomyces byssoides* (L.) P. Gaertn., G. Mey. & Scherb. (as "*B. byssoides* (L.) Pers.")
5. *Biatorella testudinea* (Ach.) Mass.
6. **Brodoa intestiniformis* (Vill.) Goward
7. "*Buellia etrata* Mudd."
8. *Buellia parasema* f. *saprophila* (Ach.) Stein (as "*B. parasema* f. *saprophila* Ach.")
9. *Caloplaca aurantiaca* (Lightf.) Th. Fr. (as "*C. aurantiacum* (Lightf.) Th. Fr.")
10. *Caloplaca ferruginea* (Huds.) Th. Fr. (as "*C. ferrugineum* var. *genuinum* (Kbr.) Th. Fr.")

11. *Caloplaca vitellinula* (Nyl.) Oliv.
12. **Candelariella coralliza* (Nyl.) H. Magn.
13. *Calvitimela aglaea* (Sommerf.) Hafellner (Syn. *Lecidea aglaea* Somf.)
14. **Cetraria islandica* (L.) Ach.
15. *Cetraria pinastri* (Scop.) Grey (as "*C. pinastri* (Scop.) Ach.")
16. *Cladonia coccifera* (L.) Willd. (as "*C. coccifera* (L.) Schaer.")
17. *Cladonia gracilis* f. *aspera* Boistel (as "*C. gracilis* f. *aspera* Flk.")
18. *Cladonia fimbriata* (L.) Fr. (Syn. "*C. fimbriata* f. *radiata* Schaer.")
19. *Cladonia fimbriata* var. *tubaeformis* (Hoffm.) Fr. (as "*C. fimbriata* f. *tubaeformis* Hoffm.")
20. *Cladonia fimbriata* f. *prolifera* Retz. (as "*C. fimbriata* f. *prolifera* Flk.")
21. *Cladonia furcata* f. *polyphylla* (Flörke) Jatta (as "*C. furcata* f. *polyphylla* Flk.")
22. (*)*Cladonia pyxidata* (L.) Hoffm. (as "*C. pyxidata* (L.) Fr.")
23. *Cladonia pyxidata* var. *neglecta* (Flörke) Mass. (as "*C. pyxidata* var. *neglecta* Schaer.")
24. **Cornicularia normoerica* (Gunnerus) Du Rietz
25. *Dermatocarpon miniatum* (L.) W. Mann. (as "*D. miniatum* (Lin.) Ach.")
26. "*Dermatocarfpum miniatum* var. *complicatum* (Sw.) Fr."
27. **Lecanora carpinea* (L.) Vain.
28. *Lecanora cenisia* Ach.
29. *Lecanora rupicola* (L.) Zahlbr. (Syn. *Lecanora sordida* (Pers.) Th. FR.
30. *Lecanora sulphurea* (Hoffm.) Ach.
31. **Lecidea lapicida* (Ach.) Ach.
32. **Melanelia hepatizon* (Ach.) A. Thell.
33. *Melanelia stygia* (L.) Essl. (Syn. *Parmelia stygia* (L.) Ach.)
34. *Parmelia conspersa* var. *latior* Schaer.
35. "*Parmelia encaustra* (Smrft.) Nyl."
36. *Parmelia isidiata* (Anzi) Gyel.
37. *Parmelia pubescens* Pers. (as "*P. pubescens* L. (Syn. *Parmelia stygia* var. *lanata* Sydow)")
38. *Parmelia saxatilis* (L.) Fr.
39. **Parmelia sulcata* Tayl.
40. *Parmelina tiliacea* (Hoffm.) Hale (Syn. *Parmelia tiliacea* (Hoffm.) Ach. as "*P tiliacea* (Hoffm.) Fr.")
41. *Peltigera leucophlebia* (Nyl.) Gyeln. (as "*Peltigera variolosa* (Mass.) Gyel.) (Syn. *Peltigera aphtosa* (L.) Hoffm.)"
42. *Peltigera canina* (L.) Willd. (as "*P. canina* (L.) Hoffm.")
43. *Peltigera horizontalis* (Huds.) Baumg. (as "*P. horizontalis* (L.) Hoffm.")
44. *Peltigera polydactyla* (Neck.) Hoffm.
45. *Peltigera polydactyla* f. *microcarpa* (Ach.) Mérat
46. *Protopannaria pezizoides* (Weber) P. M. Jørg. & S. Ekman (Syn. *Pannaria brunnea* (Sw.) Mass.)

47. *Protoparmeliopsis muralis* (Schreb.) M. Choisy (Syn. "*Placodium saxicolum* (Poll.) Kbr.")
48. **Pseudephebe pubescens* (L.) M. Choisy
49. (*)*Ramalina capitata* (Ach.) Nyl. (incl. Syn. *Ramalina strepsilis* (Ach.) A. Z.)
50. "*Ramalina carpathica* Kbr."
51. *Ramalina pollinaria* (Westr.) Ach. (as "*R. pollinaria* (Mester.) Ach.")
52. *Ramalina polymorpha* (Lilj.) Ach. (as "*R. polymorpha* Ach.")
53. **Rhizocarpon alpicola* (Wahlenb.) Rabenh.
54. **Rhizocarpon badioatrum* (Flörke ex Spreng.) Th. Fr.
55. **Rhizocarpon geographicum* (L.) DC
56. *Rhizocarpon geographicum* f. *contiguum* (Schaer.) Mass. (as "*R. geographicum* f. *contiguum* Fr.")
57. **Rhizoplaca melanophthalma* (Ram.) Leuckert
58. *Sporastatia cinerea* (Schaer.) Körb.
59. *Tephromela atra* (Huds.) Hafellner (Syn. *Lecanora atra* (Huds.) Ach.)
60. (*)*Umbilicaria crustulosa* (Ach.) Lamy (incl. Syn. *Gyrophora cirrhosa* (Hoffm.) Wain.)
61. *Umbilicaria cylindrica* (L.) Delise (Syn. *Gyrophora cylindrica* (L.) Ach.)
62. **Umbilicaria decussata* (Vill.) Zahlbr.
63. (*)*Umbilicaria deusta* (L.) Baumg. (incl. Syn. *Gyrophora deusta* (L.) Fw.)
64. **Umbilicaria torrefacta* (Lightf.) Schrad.
65. *Umbilicaria vellea* (L.) Ach. (Syn. *Gyrophora vellea* (L.) Ach.)
66. *Umbilicaria pustulata* (L.) Hoffm.
67. *Xanthoparmelia conspersa* (Ehrh. ex Ach.) Hale (Syn. *Parmelia conspersa* var. *stenophylla* (Ach.) Heugel.
68. *Xanthoparmelia pulla* (Ach.) O. Blanco, A. Crespo, Elix, D. Hawksw. & Lumbsch (Syn. *Parmelia prolixa* Ach.)
69. **Xanthoria parietina* (L.) Th. Fr.

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