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New and noteworthy records of lichen-forming and lichenicolous fungi from Abrau Peninsula (NW Caucasus, Russia)

Abstract

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98 species of lichen-forming and lichenicolous fungi are reported for the first time from Utrish Reserve, Abrau Peninsula. Fifteen species are new to the Northern Caucasus, of which ten species are reported for the first time for the Caucasus region and five are new to Russia: *Dirina fallax*, *Flavoplaca navasiana*, *Lecanographa lyncea*, *Melaspilea enteroleuca* and *Verrucaria elaeina*.

Key words: biodiversity, Utrish Nature Reserve, new records, sub-Mediterranean forests, Black Sea coast.

Introduction

To date, the lichen-forming and lichenicolous fungi of sub-Mediterranean forests of the Abrau Peninsula on the Black Sea coast of the Russian Caucasus have received only limited attention, despite the fact that this area is recognized as one of the most interesting and species rich of the Mediterranean and Mediterranean-Atlantic biogeographic elements in Russia (Otte 2005, 2007b). Some interesting lichen taxa known to occur in the areas are: *Candelariella viae-lacteae*, *Diploicia canescens*, *Koerberia biformis*, *Pertusaria ilicicola, Physconia grisea* subsp. *algeriensis*, *Ramalina canariensis*, *Roccella phycopsis*, *Teloschistes chrysophthalmus*, *Tornabea scutellifera, Waynea stoechadiana*, and the lichenicolos fungi *Abrothallus acetabuli, Arthonia diploiciae* and *Polycoccum rinodinae*. First data on the lichens of the Abrau Peninsula were published by Otte (2005, 2007a, 2007b), who reported c. 90 taxa for the Anapa-Novorossiysk coastal area in the vicinity of the projected Utrish Nature Reserve. C. 180 species were added by Urbanavichus & Urbanavichene (2015a, 2015b), and further records are added in other taxonomic and floristic studies (Vondrák & al. 2010; Zhurbenko & Otte 2012; Urbanavichus & Urbanavichene 2015c; Urbanavichus 2016a, 2016b). The present paper is a contribution to the lichenological exploration of the Abrau Peninsula and Utrish Reserve.

Study area

The Abrau Peninsula is located in the north-westernmost part of the Greater Caucasus Range. It is particularly interesting for the presence of relic arid sub-Mediterranean forests, the single occurrence of such vegetation in Russia (Seregin & Suslova 2007; Kuznetsova 2009). The climate of the Abrau Peninsula is sub-Mediterranean, with typically cool and rainy winters without persistent snow coverage, and hot dry summers. The mean annual temperature is 12°C. On the coast monthly averages range from 2.3°C in January to 23°C in July. The mean annual precipitation is ca. 600-700 mm, with a maximum in winter.

The arid sub-Mediterranean (semi-)natural forests of the lower altitudinal belt of the Navagir Ridge (0-200 m on S-facing slopes) are constituted by a pistacia-juniper community (*Juniperus excelsa, J. deltoides, J. foetidissima, Pistacia mutica, Quercus pubescens, Carpinus orientalis*), together with Christ's thorn (*Paliurus spina-christi*) and sumac (*Rhus coriaria*). The vegetation of the upper altitudinal belt (150-500 m, descending to 50 m in gorge bottoms) consists of broad-leaved forests with *Acer campestre, Carpinus betulus, C. orientalis, Fagus orientalis, Fraxinus excelsior, Quercus petraea, Tilia begoniifolia*, etc. Steep slopes are covered with *Pinus kochiana* forests. Currently 848 vascular plant and 128 bryophyte species are known to occur in the Abrau Peninsula (Ignatova & al. 2006; Seregin & Suslova 2007).

In 2011, the area was protected as a State Nature Reserve "Utrish", in order to preserve these sub-Mediterranean forests. The reserve, located in the central part of the Abrau Peninsula, between Novorossiysk and Anapa (Krasnodar Area), on the Russian coast of the Black Sea, covers 9065 ha. The rugged morphology, the variety of substrata, the climatic conditions, the abundance of old forests, with no industrial development, are responsible for a rich lichen flora.

Material and Methods

Lichen specimens were collected by the authors from typical arid sub-Mediterranean ecosystems and mesophilous broad-leaved forests within the Utrish Reserve in 2014-2015. The coordinates and altitudes of each sampling site were determined by GPS (WGS 84). Specimens were examined using standard identification methods (Smith & al. 2009; Wirth & al. 2013). Lichen substances were studied by thin-layer chromatography (TLC) using the methods of Orange & al. (2001). Reactions of the thalli with C (commercial bleach containing sodium hypochlorite), K (10% solution of potassium hydroxide), and Pd (alcohol solution of paraphenylenediamine) were also checked. All measurements were taken from material mounted in water. The specimens are kept in the private collection of G. Urbanavichus (hb. G. Urbanavichus), and duplicates of new finding, and some interesting species in the lichenological herbarium in LE (St-Petersburg). Species which were not included in the recent checklist of lichens of Russia (Urbanavichius 2010) are marked with an asterisk (*); taxa new to the Caucasus are marked with a plus (+), and those new to the Northern Caucasus a marked with two plus signs (++).

Collection sites

For all localities: Caucasus, Russia, Krasnodar Area, Abrau Peninsula, Utrish Reserve.

1 - N44°46'02.2", E37°26'26.4", 400 m alt., *Quercus-Fraxinus-Tilia* forest, 26.06.2014.
2 - N44°47'16.3", E37°24'59.0", 195 m alt., *Quercus-Carpinus* forest, 27.06.2014.
3 - N44°47'09.6", E37°26'45.3", 95-100 m alt., *Juniperus-Quercus-Carpinus* forest, 28.06.2014.
4 - N44°43'29.9", E37°26'24.7", 100-110 m alt., *Juniperus-Quercus-Pistacia* forest on S slope, 18.09.2014.
5 - N44°42'37.7", E37°28'00.7", 80-90 m alt., *Juniperus-Pistacia* forest with *Paliurus* on S slope, 23.09.2014.
6 - N44°44'15", E37°27'31.1", 205 m alt., *Quercus* forest, 24.09.2014.
7 - N44°46'17.5", E37°27'13.6", 325 m alt., *Fagus-Quercus-Carpinus* forest, 19.06.2015.
8 - N44°46'21.3", E37°27'57.5", 160 m alt., *Fagus-Carpinus-Tilia* forest, 21.06.2015.
9 - N44°46'45.5", E37°28'25", 190-200 m alt., *Juniperus-Quercus-Carpinus* forest, 22.06.2015.
10 - N44°46'26.9", E37°28'22.6", 270-280 m alt., *Quercus-Carpinus-Tilia* forest on N slope, 22.06.2015.
11 - N44°45'27.2", E37°28'19.3", 390-400 m alt., *Quercus-Pinus* forest on S slope, 23.06.2015.
12 - N44°47'06.3", E37°32'15.3", 270-280 m alt., shrubs, stony steppe, 24.06.2015.
13 - N44°47'00.6", E37°32'05.1", 280 m alt., shrubs, stony steppe, 24.06.2015.
14 - N44°46'45.1", E37°32'30.8", 315 m alt., stone steppe with solitary *Quercus* and *Carpinus* on S slope, 24.06.2015.
15 - N44°47'11.0", E37°31'59.1", 280 m alt., stone steppe with solitary *Quercus* on S slope, 24.06.2015.
16 - N44°45'53.9", E37°29'17.1", 340-360 m alt., *Fagus-Carpinus* forest, 27.06.2015.
17 - N44°42'37.4", E37°28'51.2", 70-120 m alt., *Quercus-Carpinus* forest on stony slope, 08.09.2015.
18 - N44°43'27.9", E37°29'07.5", 60-70 m alt., *Carpinus-Juniperus* forest on stony slope, 9.09.2015.
19 - N44°43'39.6", E37°29'17.6", 190-200 m alt., *Quercus* forest with *Paliurus* on stony slope, 9.09.2015.
20 - N44°42'30.2", E37°31'06.2", 350 m alt., *Quercus-Pinus* forest on E slope, 10.09.2015.
21 - N44°42'06", E37°30'37.1", 430-440 m alt., meadow steppe along *Juniperus-Pistacia* forest margin, 10.09.2015.
22 - N44°42'55.2", E37°27'59.6", 150-160 m alt., stony slope with solitary *Quercus* and *Paliurus*, 11.09.2015.
23 - N44°42'04", E37°29'54", 50-60 m alt., *Juniperus-Pistacia* forest on SE slope, 12.09.2015.
24 - N44°42'57.9", E37°30'27.7", 140-200 m alt., *Quercus-Carpinus* forest on stony slope, 12.09.2015.
25 - N44°43'16", E37°29'24.7", 200-240 m alt., *Juniperus-Pistacia* forest on S slope, 13.09.2015.

26 - N44°43'07.5", E37°29'52.9", 465-480 m alt., *Quercus-Carpinus-Tilia* forest, 13.09.2015.

27 - N44°43'01", E37°27'33", 95-110 m alt., *Juniperus-Pistacia* forest on S slope, 14.09.2015.

Lichenized species

Absconditella lignicola Vězda & Pišut: 10, on lignum.

Acarospora fuscata (Schrad.) Th. Fr.: 11, on sandstone.

Agonimia tristicula (Nyl.) Zahlbr.: 5, 12, on *Quercus*, *Fraxinus* and mossy sandstone.

+***Arthopyrenia cinereopruinosa*** (Schaer.) A. Massal.: 9, on *Carpinus*.

++***Athallia cerinella*** (Nyl.) Arup, Frödén & Søchting: 14, on *Carpinus*. Also reported from Armenia (Harutyunyan & Mayrhofer 2009) and Azerbaijan (Barkhalov 1983) in Transcaucasia.

Athallia cerinelloides (Erichsen) Arup, Frödén & Søchting: 25, on *Pistacia*.

Athallia pyracea (Ach.) Arup, Frödén & Søchting: 25, on *Fraxinus*, *Pistacia*.

Athallia skii (Khodos.,Vondrák & Šoun) Arup, Frödén & Søchting: 25, 27, on *Juniperus*, *Hedera*.

Bacidia circumspecta (Nyl. ex Vain.) Malme: 16, on *Quercus*.

Bacidina delicata (Larbal. ex Leight.) V. Wirth & Vězda: 8, 16, on *Quercus* and old roofing slate.

Blastenia hungarica (H. Magn.) Arup, Søchting & Frödén: 3, on *Juniperus*. New to Krasnodar Area. Also reported from the Republic of Adygeya in North-Western Caucasus (Urbanavichus & Urbanavichene 2014).

Calicium glaucellum Ach.: 16, on lignum of *Quercus*.

Caloplaca aegatica Giralt, Nimis & Poelt: 18, 23, 25, on *Juniperus*, *Pistacia*.

++***Caloplaca atroflava*** (Turner) Mong.: 11, 21, 23, 27, on sandstone. Also reported from Armenia in Transcaucasia (Harutyunyan & Mayrhofer 2009). Widespread throughout Europe and previously reported in Russia from the Voronezh region (Muchnik & al. 2014).

Caloplaca cerina (Hedw.) Th. Fr.: 21, on *Juniperus*.

Caloplaca chlorina (Flot.) H. Olivier: 23, on sandstone. Previously reported for the Abrau Peninsula by Otte (2005).

Caloplaca raesaenenii Bredkina: 15, on plant debris on calcareous soil.

Circinaria fruticulosa (Eversm.) Sohrabi: 13, on soil. New to North-Western Caucasus. Also reported for Northern Caucasus from the Republic of Dagestan (Ismailov 2015).

Circinaria hispida (Mereschk.) A. Nordin, S. Savić & Tibell: 13, on soil. New to North-Western Caucasus. Also reported for Northern Caucasus from the Republic of Dagestan (Urbanavichus & Ismailov 2013).

Cladonia parasitica (Hoffm.) Hoffm.: 11, on lignum of *Pinus*.

Coenogonium pineti (Ach.) Lücking & Lumbsch: 26, on *Tilia*.

Collema subflaccidum Degel.: 25, on *Fraxinus*, *Pistacia*.

Collema subnigrescens Degel.: 3, 17, 25, on *Quercus*.

Diplotomma hedinii (H. Magn.) P. Clerc & Cl. Roux: 15, on limestone.

*+***Dirina fallax*** De Not.: 18, 19, 22, on sandstone. This species has its main distribution in the western part of the Mediterranean Region and the Atlantic coasts of Europe and

Africa, north from Scotland and south to Morocco, with an outpost locality in the Canary Islands (Tehler & al. 2013). The current finding in Utrish Reserve significantly expand the boundaries of the known distribution of this taxon.

*+***Flavoplaca navasiana** (Nav.-Ros. & Cl. Roux) Arup, Søchting & Frödén: 23, on sandstone. Det. J. Vondrák. A Mediterranean, recently-described and perhaps more widespread lichen found on horizontal faces of calcareous rocks in coastal situations.

Gyalecta derivata (Nyl.) H. Olivier: 1, 2, 16, on *Quercus*.

Gyalecta flotowii Körb.: 16, 17, on *Fraxinus*, *Quercus*.

Gyalolechia flavovirescens (Wulfen) Søchting, Frödén & Arup: 23, on sandstone.

Hazslinszkya gibberulosa (Ach.) Körb.: 16, on *Quercus*.

*+***Lecanographa lyncea** (Sm.) Egea & Torrente: 23, on *Juniperus*. This a mild-temperate, mainly western species, found on acid bark of very old isolated trees.

Lecanora bolcana (Pollini) Poelt: 21, on sandstone.

+Lecanora confusa Almb.: 15, on lignum of *Quercus*.

Lecanora hagenii (Ach.) Ach.: 16, on *Hedera.*

Lecanora horiza (Ach.) Linds.: 25, on *Fraxinus*, *Pistacia*.

Lecanora saligna (Schrad.) Zahlbr.: 16, on lignum of *Quercus*.

Lecanora subcarpinea Szatala: 14, on *Carpinus*.

Lecidea fuscoatra (L.) Ach.: 17, on sandstone. New to North-Western Caucasus. Also reported for Northern Caucasus from the Republic of Dagestan (Ismailov & Urbanavichus 2014).

++***Lecidea grisella*** Flörke: 11, on sandstone. Also reported from Georgia in Transcaucasia (Barkhalov 1983).

+***Lecidella achristotera*** (Nyl.) Hertel & Leuckert: 15, on lignum of *Quercus*.

++***Lecidella flavosorediata*** (Vězda) Hertel & Leuckert: 20, on *Pinus*. Also reported from Armenia in Transcaucasia (Harutyunyan & al. 2011).

++***Lepraria eburnea*** J. R. Laundon: 12, on lignum. Also reported from Armenia in Transcaucasia (Harutyunyan & al. 2011).

Lepraria finkii (B. de Lesd.) R. C. Harris: 10, 16, 18, 26, on *Carpinus*, *Fraxinus*, *Quercus*, *Tilia*.

Melanohalea infumata (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch: 4, 5, 22, 23, 25, 27, on *Carpinus*, *Fraxinus*, *Quercus*.

*++***Melaspilea enteroleuca** (Ach.) Ertz & Diederich: 16, on *Quercus*. This species has its main distribution in the Central Europe, Mediterranean Region (including of the North Africa) and in the Southern Asia (including of the Transcaucasia) (Ertz & Diederich 2015).

Micarea denigrata (Fr.) Hedl.: 16, on lignum of *Quercus*.

Micarea prasina Fr.: 10, on lignum of *Quercus*.

Nephroma laevigatum Ach.: 26, on *Tilia*.

Opegrapha niveoatra (Borrer) J. R. Laundon: 10, on *Quercus*, *Carpinus*.

Opegrapha vulgata (Ach.) Ach.: 9, on *Fraxinus*.

Parmelia serrana A. Crespo, M. C. Molina & D. Hawksw.: 21, on *Juniperus*.

Peltigera collina (Ach.) Schrad.: 26, on *Tilia*.

Pertusaria constricta Erichsen: 10, on *Fraxinus*.

Pertusaria flavida (DC.) J. R. Laundon: 4, 22, 24, on *Juniperus*, *Quercus*.

Pertusaria hymenea (Ach.) Schaer.: 1, 4, 17, 19, 25, on *Carpinus*, *Quercus*, *Tilia*.

Pertusaria rupestris (DC.) Schaer.: 11, on sandstone.

Phaeophyscia cernohorskyi (Nádv.) Essl.: 27, on sandstone. New to North-Western Caucasus. Also reported for Northern Caucasus from the Republic of Dagestan (Urbanavichus & Ismailov 2013).

Placopyrenium fuscellum (Turner) Gueidan & Cl. Roux: 12, on *Verrucaria nigrescens* on limestone.

Placynthiella dasaea (Stirt.) Tønsberg: 10, on lignum of *Quercus*.

Polycauliona phlogina (Ach.) Arup, Frödén & Søchting: 1, on *Quercus*. Also reported for the Abrau Peninsula by Vondrák & al. (2010).

Polysporina simplex (Taylor) Vězda: 6, on sandstone.

Pycnora praestabilis (Nyl.) Hafellner: 19, on lignum of *Juniperus*.

Pyrenula nitidella (Flörke ex Schaer.) Müll. Arg.: 8, on *Carpinus*.

Rhizocarpon distinctum Th. Fr.: 11, on sandstone.

Rinodina plana H. Magn.: 9, on *Carpinus*.

Rinodina teichophila (Nyl.) Arnold: 11, on sandstone.

Roccella phycopsis Ach.: 23, 27, on *Juniperus*. Previously reported for the Abrau Peninsula by Otte (2005).

Rostania occultata (Bagl.) Otálora, P. M. Jørg. & Wedin: 2, on *Quercus*. Also reported for Krasnodar Area by Himelbrant & Kuznetsova (2002).

Rufoplaca subpallida (H. Magn.) Arup, Søchting & Frödén: 1, 6, on sandstone.

+*Schismatomma graphidioides* (Leight.) Zahlbr.: 7, on *Fagus*.

Scoliciosporum umbrinum (Ach.) Arnold: 1, 6, 11, on *Quercus* and sandstone.

Scytinium aragonii (Otálora) Otálora, P. M. Jørg. & Wedin: 3, 18, on mossy trunk of *Quercus* and mossy soil. Additional specimens have been examined from Khosta yew-box grove, Caucasus Reserve, Krasnodar Area (herb. G. Urbanavichus): *Buxus* forest, N43°31’52”, E39°52’40”, 80 m alt., on mossy limestone, 10.10.2008. During an examination of a Caucasian *Scytinium* in herb. LE (St Petersburg), a specimen from Armenia determined by us as *S. aragonii* was discovered: “Trans Caucasus in humidis montain Murgus, 22.02.1844, leg. Dr. F. A. Kolenati”. This species was reported by G. Urbanavichus (2016) as new to Caucasus from Armenia and Krasnodar Area (as new to Russia without localities and annotation).

Scytinium leptogioides (Anzi) Otálora, P. M. Jørg. & Wedin: 5, 23, on sandstone. This species was reported by G. Urbanavichus (2016) as new to Caucasus from Krasnodar Area (as new to Russia without localities and annotation).

Scytinium palmatum (Huds.) Gray: 1, 3, on mossy soil and *Quercus*.

Scytinium schraderi (Bernh.) Otálora, P. M. Jørg. & Wedin: 3, on soil.

Scytinium subaridum (P. M. Jørg. & Goward) Otalora, P. M. Jørg. & Wedin: 5, 24, on *Juniperus*, *Quercus* and sandstone. This species was reported by G. Urbanavichus (2016) as new to Caucasus from Krasnodar Area (as new to Russia without localities and annotation).

Scytinium turgidum (Ach.) Otálora, P. M. Jørg. & Wedin: 5, on sandstone. Also reported from Armenia in Transcaucasia (Gasparyan & al. 2015).

Squamarina cartilaginea (With.) P. James: 22, on stone.

Staurothele guestphalica (J. Lahm ex Körb.) Arnold: 15, on limestone. New to Krasnodar Area. Also reported for North-Western Caucasus from the Republic of Adygeya (Urbanavichus & Urbanavichene 2014).

Teloschistes chrysophthalmus (L.) Th. Fr.: 5, 19, 22, on *Paliurus*. Previously reported for the Abrau Peninsula by Otte (2005). This species recorded from most parts of the world although lacking in Asia (but occurs in the western parts of the Arabian Peninsula), frequent in areas with Mediterranean climate (Nash & al. 2004).

+*Thelidium olivaceum* (Fr.) Körb.: 8, on limestone and old roofing slate.

Toninia opuntioides (Vill.) Timdal: 5, on soil.

Trapelia coarctata (Sm.) M. Choisy: 11, 16, on sandstone.

+***Trapelia placodioides*** Coppins & P. James: 17, 19, 24, on sandstone.

Variospora flavescens (Huds.) Arup, Frödén & Søchting: 22, on sandstone. Previously reported for the Abrau Peninsula by Otte (2005).

*+***Verrucaria elaeina*** Borrer: 8, on old bone.

++***Verrucaria hydrophila*** Orange: 8, on sandstone in a stream.

Verrucaria muralis Ach.: 8, on limestone.

+***Verrucaria praetermissa*** (Trevis.) Anzi: 8, on sandstone in a stream.

Xanthocarpia crenulatella (Nyl.) Frödén, Arup & Søchting: 11, on sandstone.

Lichenicolous fungi

Intralichen christiansenii (D. Hawksw.) D. Hawksw. & M. S. Cole: 11, on apothecia *Candelariella* sp. on sandstone.

Lichenoconium erodens M. S. Christ. & D. Hawksw.: 10, on thallus *Ramalina obtusata* on *Quercus*. New to Krasnodar Area. Also reported for Northwest Caucasus from the Republic of Adygea (Urbanavichus & Urbanavichene 2014).

+*Roselliniopsis tartaricola* (Nyl.) Matzer: 4, on thallus *Pertusaria ilicicola* on *Juniperus*. Also reported for Asiatic Russia by Hafellner & al. (2002).

Sclerococcum serusiauxii Boqueras & Diederich: 25, on thallus *Parmelina tiliacea* on *Pistacia*. This species was known in Spain and has been also reported from Portugal, France, Austria, Slovenia and Poland (Kukwa & al. 2013). It was previously reported from Russia only from Krasnodar Area in the Northwest Caucasus (Zhurbenko & Kobzeva 2016).

Vouauxiella lichenicola (Linds.) Petr. & Syd.: 25, on apothecia *Lecanora horiza* on *Pistacia*. New to Krasnodar Area. Also reported for the Northwest Caucasus from the Republic of Adygea (Urbanavichus & Urbanavichene 2014).

Xanthoriicola physciae (Kalchbr.) D. Hawksw.: 25, on apothecia *Xanthoria parietina* on *Pistacia*. New to Northwest Caucasus. Also reported for Northern Caucasus from Stavropol Area (Zhurbenko & Kobzeva 2014).

Non-lichenized species

Chaenothecopsis pusilla (Ach.) A. F. W. Schmidt: 16, on lignum of *Quercus*.

Mycocalicium subtile (Pers.) Szatala: 12, 16, on lignum of *Quercus*.

Conclusions

The above list includes 98 species of lichen-forming and lichenicolous fungi that are new to the Utrish Reserve, of which 93 are new to the Abrau Peninsula. Hence, the number of species known to occur in the area is now c. 380, about one quarter of the taxa known to occur in Northern (Russian), the Caucasus. 15 species are reported for the first time from the Northern Caucasus, 10 of which are new to the Caucasus and 5 are reported for the first time from Russia: *Dirina fallax*, *Flavoplaca navasiana*, *Lecanographa lyncea*, *Melaspilea enteroleuca* and *Verrucaria elaeina*.

The lichen flora of the Abrau Peninsula is of great phytogeographic interest because it includes both Mediterranean-Atlantic species (occurring in arid sub-Mediterranean (semi-) natural forests of the lower altitudinal belt, e.g. *Caloplaca aegatica*, *Candelariella viae-lacteae*, *Diploicia canescens*, *Dirina fallax*, *Flavoplaca navasiana*, *Koerberia biformis*, *Lecanographa lyncea*, *Pertusaria ilicicola, Physconia grisea* subsp. *algeriensis*, *Ramalina canariensis*, *Roccella phycopsis*, *Scytinium aragonii, Scytinium leptogioides*, *Teloschistes chrysophthalmus*, *Tornabea scutellifera, Waynea stoechadiana*, and the lichenicolos fungi *Abrothallus acetabuli, Arthonia diploiciae*, *Polycoccum rinodinae* and *Sclerococcum serusiauxii*) and temperate-sub-oceanic species (mainly epiphytic species from the broad-leaved mesophilic forests of the upper altitudinal belt, e.g. *Collema flaccidum*, *C. nigrescens*, *Lobaria pulmonaria*, *Nephroma laevigatum*, *Parmotrema perlatum*, *Peltigera collina*, *Pyrenula laevigata*, *P. macrospora*, *P. nitida*, *Ricasolia amplissima*).

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