

New records of lichens and lichenicolous fungi from the Ural Mountains, Russia

Gennadii Urbanavichus¹ & Irina Urbanavichene^{2,3}

¹Laboratory of terrain ecosystems, Institute of the Industrial Ecology of the North, Kola Science Centre, Russian Academy of Sciences, Akademgorodok 14a, Apatity, 184209 Murmansk region, Russia. E-mail: g.urban@mail.ru

²Laboratory of Lichenology and Bryology, Komarov Botanical Institute, Professor Popov St. 2, 197376 St. Petersburg, Russia. E-mail: urbanavichene@gmail.com

³Baikalskii State Nature Biosphere Reserve, Tankhoi, 671120 Kabansk District, Buryatia Republic, Russia

Abstract: A total of 53 taxa of lichens and lichenicolous fungi are first reported from the Ural Mountains (Republic Bashkortostan, Russia). Nine lichen species, *Anema decipiens*, *Bagliettoa parmigera*, *Diplotomma hedinii*, *Heteroplacidium compactum*, *H. zamenhofianum*, *Lecania suavis*, *Placidiopsis cinerascens*, *Placynthium pulvinatum*, *Psorotichia montinii*, and six lichenicolous fungi, *Arthonia phaeophysciae*, *Buelliella poetschii*, *Karschia talcophila*, *Lichenopeltella hydrophila*, *Lichenostigma svandae*, *Phoma cladoniicola* are new to Russia.

Kokkuvõte: Samblike ja lihhenikoolsete seente uued leiud Uraali mägedest, Venemaal

Uraali mägedest (Baškiiria vabariigist) teatatakse 53 piirkonnale uue lihheniseerunud ja lihhenikoolse seeneliigi leidudest. Üheksa lihheniseerunud seene liiki (*Anema decipiens*, *Bagliettoa parmigera*, *Diplotomma hedinii*, *Heteroplacidium compactum*, *H. zamenhofianum*, *Lecania suavis*, *Placidiopsis cinerascens*, *Placynthium pulvinatum* ja *Psorotichia montinii*) ning kuus lihhenikoolset seent (*Arthonia phaeophysciae*, *Buelliella poetschii*, *Karschia talcophila*, *Lichenopeltella hydrophila*, *Lichenostigma svandae* ja *Phoma cladoniicola*) on uued Venemaale.

INTRODUCTION

Our research on lichens on the territory of Bashkiria National Park (Republic Bashkortostan, Russia) in 2007 resulted in discovering many interesting and new species for the lichen flora of the Ural Mountains. This is the first special study of lichens of this national park. Lichens have earlier been collected by geobotanists of the Biology Institute (Ufa Scientific Center, Russian Academy of Sciences). About 50 common epiphytic lichen species were recorded from the park (Zhuravleva, 2007). We identified 263 species of lichenized and lichenicolous fungi in total, from them about 210 species appear as new for the territory. In the present paper 53 species, 33 of them lichenized, and 20 lichenicolous fungi, are reported for the first time for the Ural Mountains.

The Bashkiria National Park is situated on the western slopes of the Southern Ural Mountains between the Nugush and Belaya rivers (Fig. 1). In the east, the park borders on the Shulgan-Tash State Reserve. The national park is located over the territory of three administrative districts, Burzyanski, Kugarchinski and Meleuzovski. The extent of the park territory from west to east is about 60 km, and its total

area is 92.006 ha (National parks of Russia, 1996). The main rocks, outcrops and cliffs in the park are formed of limestone and dolomite. The central, northern and eastern areas of the park constitute a raised mountain plateau which is cut by deep, steep gullies and river valleys. The highest points in the park reach 500–800 m. The rivers dividing the mountains have formed deep, narrow canyons with rocky protuberances of intriguing shapes (The Devil's Finger, The Sphinx, The Castle, The Duck's Nose etc.). The Nugush river is very convoluted in some parts and is a good example of entrenched meanders. For example, a place with five deeply entrenched meander loops is named "Pyatolistnik" (Five-leaves) (Fig. 2). Nugush Water Reservoir is situated in the north-western part of the park.

The climate of the region is continental. The annual mean precipitation is ca 400 mm in western and 580 mm in eastern part of the park. The average annual temperature is +4.5°C in the warmest part in the west and +0.1°C in the coldest part in the east. Average temperatures in July vary from +19.7°C in the lower altitudes to +13.6°C in higher elevations. The coldest month of the year is January when



Fig. 1. The position of the Bashkiria National Park in the Ural Mountains (Russia) and collection localities.

the average of temperatures is -16°C , but can decline to $-45(-48)^{\circ}\text{C}$.

Zonal vegetation in the study area includes broad-leaved forests and boreal-nemoral mixed forests, mainly with *Tilia cordata* Mill., *Acer platanoides* L., *Quercus robur* L., *Ulmus glabra* Huds., *U. laevis* Pall., *Fraxinus excelsior* L., *Populus tremula* L., *Betula pendula* Roth, *Pinus sylvestris* L., *Picea obovata* Ledeb. The central portion of the park which is difficult to access is rich in forests with numerous fallen trees and hollows in old trees giving shelter to many organisms and enriching the biodiversity of this area. Meadows, steppes and marshes do not contribute much to the the vegetation of the park.

Both epilithic lichen communities on limestone rocks [including species from the genera *Aspicilia* A. Massal., *Caloplaca* Th. Fr., *Collema* F. H. Wigg., *Diplotomma* Flot., *Lecania* A. Massal., *Lecanora* Ach., *Lobothallia* (Clauzade & Cl. Roux) Hafellner, *Physcia* (Schreb.) Michx., *Placidium* A. Massal., *Placocarpus* Trevis., *Placynthium* (Ach.) Gray, *Rinodina* (Ach.) Gray, *Toninia* A. Massal.,



Fig. 2. The First loop of “Pyatilistnik”. Foto P. Shirokikh.

Verrucaria Schrad.], and epiphytic communities [represented by the genera *Anaptychia* Körb., *Arthonia* Ach., *Bacidia* De Not., *Buellia* De Not., *Caloplaca* Th. Fr., *Candelariella* Müll. Arg., *Evernia* Ach. in Luyken, *Flavoparmelia* Hale, *Lecania* A. Massal., *Lecanora* Ach., *Melanelixia* O. Blanco et al., *Melanohalea* O. Blanco et al., *Parmelia* Ach., *Phaeophyscia* Moberg, *Physcia* (Schreb.) Michx., *Physconia* Poelt], are rich in species. Epigeic lichen communities under forest canopy in the studied parts of the park are, on the contrary, very poor; only two common genera, *Cladonia* P. Browne and *Peltigera* Willd., have been recorded.

MATERIAL AND METHODS

The primary purpose of our work on valley Nugush river was to collect lichens for inventory of lichen flora of the Bashkiria National Park. Field studies were carried out during June, 2007 in 11 localities (Fig. 1). The latitude-longitude and elevation range were measured with hand-held GPS-navigator (WGS 1984). Most species were identified using a stereomicroscope or compound microscope and with the help of chemical reactions from spot tests (para-phenylenediamine ethanol solution, sodium hypochlorite, 10% potassium hydroxide and Lugol’s iodine). The specimens were identified by using relevant literature (Clauzade & Roux, 1985; Clauzade et al., 1989; Ahti et al., 2007; Halıcı, 2008; Smith et al., 2009; etc.). Main part of the collected specimens is kept in personal herbarium of the authors, some specimens are preserved in LE.

The localities in Bashkiria National Park

1. About 2 km from the former settlement Kashelya downstream Nugush river, mixed forest and cliff on left bank, 53°09'44"N, 56°48'06"E, alt. 290 m, 14.06.2007.
2. About 5.6 km from the former settlement Kashelya downstream Nugush river, broad-leaved forest on left of bank of the Nugush river, mossy rocks, 53°09'38.7"N, 56°45'57.6"E, alt. 280 m, 14.06.2007.
3. The First loop of "Pyatilistnik" (Fig. 2), limestone cliffs on the right bank of the Nugush river, fir-wood, pine and mixed forests (out of territory of the national park), 53°08'09"N, 56°44'59"E, alt. 275–325 m, 15.06.2007.
4. Between the Second and Third loops of "Pyatilistnik", broad-leaved forest on the left bank of the Nugush river, 53°07'16"N, 56°44'30"E, alt 270–280 m, 15–16.06.2007.
5. Ibid, limestone cliffs on the left bank of the Nugush river (closer to the Third loop), 53°07'00"N, 56°44'48"E, alt. 270–300 m, 16.06.2007.
6. Ibid, fragments of the petrophyte steppe on mountain top, pine and oak forests, exposed limestone, 53°07'18"N, 56°44'39"E, alt. 370–380 m, 16.06.2007.
7. The urochische "Savka" on the right bank of the Nugush river, broad-leaved forest, limestone cliffs, stone-fields, 53°09'18"N, 56°38'18"E, alt. 240 m, 17–18.06.2007.
8. The urochische "Kuperlya" on the right bank of the Nugush river, a natural sanctuary "Karst Bridge", limestone cliffs, broad-leaved forest, 53°08'43"N, 56°37'43"E, alt. 250–300 m, 18.06.2007.
9. The urochische on the right bank of the Nugush river, opposite to a mouth of the stream Yantas-Tarlagan, limestone cliffs and steppe vegetation on mountain top, 53°06'55"N, 56°38'02"E, alt. 330–350 m, 19.06.2007.
10. The left bank of the Nugush river, near the mouth of the stream Yantas-Tarlagan, broad-leaved forest on the slope of northern exposure, limestone cliffs with constant inflow waters, 53°06'41"N, 56°37'49"E, alt. 240–270 m, 19.06.2007.
11. The left bank of the Nugush river near the urochische "Kurgashly", broad-leaved forest on the slope and mountain top, limestone cliffs and rocks, 53°05'28"N, 56°36'27"E, alt. 330–380 m, 20.06.2007.

LIST OF SPECIES

Lichenicolous fungi are marked with #, and new taxa for Russia are in **bold**.

AGONIMIA OPUNTIELLA (Buschardt & Poelt) Vězda – 9: on plant debris and decaying mosses over limestone. This record is second for Russia after our report from Caucasus (Urbanavichus et al., 2010).

ANEMA DECIPIENS (A. Massal.) Forssell – 7: on limestone. The species is distributed in Europe, Asia and Northern Africa. The nearest record to Bashkortostan is in Iran (Seaward et al., 2008).

ARTHONIA APOTHECIORUM (A. Massal.) Almq. – 9: on apothecia of *Lecanora semipallida* H. Magn. growing on limestone.

ARTHONIA MOLENDOI (Heufl. ex Frauenf.) R. Sant. – 9: on thallus of *Caloplaca saxicola* (Hoffm.) Nordin and *Rusavskia soredata* (Vain.) S.Y. Kondr. & Kärnefelt growing on limestone.

ARTHONIA PHAEOPHYSCIAE Grube & Matzer – 8, 11: on thallus of *Phaeophyscia sciastra* (Ach.) Moberg growing on limestone. The species was previously known only from Western Europe and North America.

ARTHONIA RUANA A. Massal. – 2: on bark of *Tilia cordata*.

BAGLIETTOA PARMIGERA (J. Steiner) Vězda & Poelt – 6, 9: on limestone. This endolithic species is distributed in Europe, Asia and Northern Africa. The nearest records to Bashkortostan are in Turkey (Öztürk, 1990).

BUELLIELLA POETSCHII Hafellner – 7, 9: on thallus of *Endocarpon pusillum* Hedw. This species was described recently from Austria (Hafellner et al., 2008), known also from Switzerland and USA. All the characteristics of our specimen agree well with the original description.

CALOPLACA CORONATA (Kremp. ex Körb.) J. Steiner – 5: on limestone.

CALOPLACA PELLODELLA (Nyl.) Hasse – 9: on limestone.

CALOPLACA XANTHOLYTA (Nyl.) Jatta – 10: on limestone.

CANDELARIELLA REFLEXA (Nyl.) Lettau – 4, 6: on bark of *Ulmus* sp., *Quercus* sp., *Tilia cordata*.

CLIOSTOMUM GRIFFITHII (Sm.) Coppins – 4: on bark of *Populus tremula*.

CORTICIFRAGA FUECKELII (Rehm) D. Hawksw. & R. Sant. – 11: on thallus of *Peltigera canina* (L.) Willd.

- # DACTYLOSPORA PARASITICA (Flörke) Zopf – 1: on thallus of *Pertusaria* sp. (cf. *albescens*) overgrowing mossy limestone.
- # **DIPLOMMA HEDINII** (H. Magn.) P. Clerc & Cl. Roux – 9: on limestone. Like *D. alboatrum* (Hoffm.) Flot., but spores are (1–)3-septate, lacking longitudinal septa, and appear more frequently curved.
- DIPLOMMA NIVALIS (Bagl. & Carestia) Hafellner – 9: on thallus of *Rusavskia elegans* (Link) S.Y. Kondr. & Kärnefelt growing on limestone.
- # ENDOCOCCLUS RUGULOSUS Nyl. – 9: on thallus of *Heteropladidium compactum* (A. Massal.) Gueidan & Cl. Roux and *Verrucaria* cf. *nigrescens* Pers. growing on limestone.
- GYALECTA TRUNCIGENA (Ach.) Hepp – 8: on bark of *Ulmus* sp.
- # **HETEROPLACIDIUM COMPACTUM** (A. Massal.) Gueidan & Cl. Roux – 5, 6, 9: on limestone. Thallus areolate to subsquamulose, spores subglobose, 10–14 × 9–12 µm. The species has been previously reported from Europe, Asia, Northern Africa and Australia.
- # **HETEROPLACIDIUM ZAMENHOFFIANUM** (Clauzade & Cl. Roux) Cl. Roux – 5: on limestone. Distinguished from the closely related *H. compactum* by perithecia, which are located entirely within the algal layer, and broadly ellipsoid spores, 14–16 × 6–7 µm. The species was previously known only from Western Europe and North America.
- # INTRALICHEN CHRISTIANSENII (D. Hawksw.) D. Hawksw. & M.S. Cole – 5: on apothecia of *Candelariella* sp. growing on limestone.
- # INTRALICHEN LICHENICOLA (M.S. Christ. & D. Hawksw.) D. Hawksw. & M.S. Cole – 5: on apothecia of *Lecania turicensis* (Hepp) Müll. Arg. growing on limestone.
- # **KARSCHIA TALCOPHILA** (Flot.) Körb. – 9: on thallus of *Diploschistes muscorum* (Scop.) R. Sant. growing on mossy limestone. The spores of our specimens are 13–15 × 6–7 µm, with the posterior cell distinctly narrower. The species was previously known only from Western Europe, Northern Africa and North America.
- LECANIA RABENHORSTII (Hepp) Arnold – 6: on limestone.
- # **LECANIA SUAVIS** (Müll. Arg.) Mig. – 5, 9: on limestone. The commonest European *Lecania* with 3-septate spores; thallus typically of rounded warts, with apothecia varying from moderately convex with a distinct thalline margin, to strongly convex with an excluded margin (Smith et al., 2009).
- LEPTOGIUM PULVINATUM (Hoffm.) Otálora – 6, 8, 9, 11: on mossy limestone.
- LEPTOGIUM SCHRADERI (Bernh.) Nyl. – 7, 9: on calcium-rich soils and mossy limestone.
- # **LICHENOPELTELTA HYDROPHILA** R. Sant. – 5: on thallus and perithecium of *Thelidium papulare* (Fr.) Arnold growing on damp limestone (with constant inflow waters). This species has up to three pairs of setulae, attached near the spore septum. The spores of our specimens are 13–16 × 5–6 µm. The taxon was previously known only from Western Europe. *Thelidium papulare* is a new host species.
- # **LICHENOSTIGMA SVANDAE** Vondrák & Šoun – 9: on thallus of *Acarospora cervina* (Ach.) A. Massal. growing on limestone. This recently described lichenicolous ascomycete was previously known only from Europe and South-Western Asia.
- # LICHENOTHELIA RENOBALLESIANA D. Hawksw. & V. Aienza – 6: on limestone and on thallus of *Bagliettoa calciseda* (DC.) Gueidan & Cl. Roux. This record is second for Russia after our report from Caucasus (Urbanavichus et al., 2011).
- # MUELLERELLA LICHENICOLA (Sommerf. : Fr.) D. Hawksw. – 9: on apothecia of *Caloplaca flavovirescens* (Wulfen) Dalla Torre & Sarnth. and on thallus of *Physconia muscigena* (Ach.) Poelt
- # MYXOPHORA LEPTOGIOPHILA (Minks ex G. Winter) Nik. Hoffm. & Hafellner – 7: on thallus of *Collema fuscovirens* (With.) J.R. Laundon growing on limestone.
- PARMELIA BARRENOAE Divakar, M.C. Molina & A. Crespo – 1: on mossy limestone.
- PELTIGERA KRISTINSSONII Vitik. – 2, 5: on calcium-rich soils and mossy limestone.
- # PHOMA CALOPLACAE D. Hawksw. – 9: on apothecia of *Caloplaca cerina* (Ehrh. ex Hedw.) Th. Fr. var. *chloroleuca* (Sm.) Th. Fr. growing on mossy limestone.
- # **PHOMA CLADONICOLA** Diederich, Kocourk. & Etayo – 6: on thallus of *Cladonia pocillum* (Ach.) Grognot growing on mossy limestone. The conidia of our specimens are 5 × 2.2 µm. Infected parts of thalli are frequently bleached and often surrounded by a blackish necrotic line. This recently described species was previously known only from Europe and Greenland.

PHYSCONIA GRUMOSA Kashiw. & Poelt – 2: on bark of *Fraxinus excelsior*.

PHYSCONIA LEUCOLEIPTES (Tuck.) Essl. – 8: on mossy limestone.

PLACIDIOPSIS CINERASCENS (Nyl.) Breuss – 5: on thin, calcium-rich soil over limestone. The species is separated from the closely related, arctic-alpine *P. pseudocinerea* Breuss by hyaline rhizohyphae and pale perithecial walls. Widespread in Mediterranean Europe and Morocco, Central and Southern Asia, SW North America and Mexico in mediterranean climates.

PLACYNTHIUM PULVINATUM Øvstedal – 3: on thin, calcium-rich soil over limestone. The species was previously known only from Northern Europe – Norway (Svalbard, Tromsø) and Iceland. All the characteristics of our specimens agree well with the description (Ahti et al., 2007).

PLACYNTHIUM TREMNIACUM (A. Massal.) Jatta – 3, 5, 7, 9: on limestone.

PSOROTICHIA MONTINII (A. Massal.) Forssell – 7: on limestone. The species is characterized by the very small and very thin, granulose to almost powdery thallus and minute apothecia with punctiform discs and flat margin. It was previously known from Western Europe, Northern Africa and North America.

PSOROTICHIA SCHAEERERI (A. Massal.) Arnold – 3, 5, 6, 9: on limestone.

PYCNORA PRAESTABILIS (Nyl.) Hafellner – 6, 7: on lignum of *Pinus sylvestris*.

RINODINA ORCULATA Poelt & M. Steiner – 9: on dead twigs of dwarf shrubs.

ROSELLINIELLA CLADONIAE (Anzi) Matzer & Hafellner – Fourth loop of “Pyatilstnik” (outside the listed localities), on thallus of *Cladonia pocillum* (Ach.) Grognot growing on mossy limestone.

STIGMIDIUM ROUXIANUM Calat. & Triebel – 9: on thallus of *Acarospora cervina* (Ach.) A. Massal. growing on limestone.

TAENIOLELLA BESCHIANA Diederich – 11: on thallus of *Cladonia pyxidata* (L.) Hoffm. growing on soil.

THERMUTIS VELUTINA (Ach.) Flot. – 6: on limestone.

TONINIA PHYSAROIDES (Opiz) Zahlbr. – 5, 7, 9: on limestone.

TONINIA TONINIANA (A. Massal.) Zahlbr. – 9: on limestone. This record is second for Russia after our report from Caucasus (Urbanavichus et al., 2010).

XANTHOMENDOZA FULVA (Hoffm.) Søchting, Kärnefelt & S.Y. Kondr. – 8: on bark of *Ulmus* sp.

DISCUSSION

Before our study, about 50 species of epiphytic macrolichens were known from the Bashkiria National Park. The number of recorded taxa has grown to 275 now. From 53 species reported here, 15 species, *Anema decipiens*, *Arthonia phaeophysciae*, *Bagliettoa parmigera*, *Buelliella poetschii*, *Diplotomma hedinii*, *Heteroplacidium compactum*, *H. zamenhofianum*, *Karschia talco-phila*, *Lecania suavis*, *Lichenopeltella hydrophila*, *Lichenostigma svandae*, *Phoma cladoniicola*, *Placidiosis cinerascens*, *Placynthium pulvinatum*, *Psorotichia montinii*, are new for Russia. Majority of recorded species are calciphilous and they were collected from limestone, calcium-rich soil or mosses over limestone. The discovery of numerous lichen species previously unreported from the Ural Mountains and Russia demonstrates the need for more thorough research on lichens in the Southern Ural Mountains and Republic Bashkortostan.

ACKNOWLEDGEMENTS

We thank the administration of the Bashkiria National Park, and especially Deputy Director of Scientific work Liliya Sultangareeva, and also Vasili Martynenko and Pavel Shirokikh (Biology Institute of Ufa Science Centre, Russian Academy of Sciences) for organizing the field trips. Our visit to the Bashkiria National Park was financially supported by Russian Foundation for Basic Research (grant 06–04–49467). We thank the anonymous reviewers for their valuable suggestions and comments on the manuscript.

REFERENCES

- Ahti, T., Jørgensen, P. M., Kristinsson, H., Moberg, R., Søchting, U. & Thor, G. (eds). 2007. *Nordic Lichen Flora Vol. 3. Cyanolichens*. Nordic Lichen Society, Uddevalla. 219 pp.
- Clauzade, G. & Roux, C. 1985. Likenoj de Okcidenta Europo. Ilustrita determinlibro. *Bulletin de la Société Botanique du Centre-Ouest, Nouvelle série, Numéro Spécial 7*: 1–893.
- Clauzade, G., Diederich, P. & Roux, C. 1989. Nelikenigintaj fungoj likenloĝaj. Ilustrita deter-

- minilibro. *Bulletin de la Société Linneenne de Provence, Numéro Spécial 1*: 1–142.
- Halıci, M. G. 2008. A key to the lichenicolous *Ascomycota* (including mitosporic fungi) of Turkey. *Mycotaxon* 104: 253–286.
- National Parks of Russia. Guide*. 1996. Biodiversity Conservation Center, Moscow. 198 pp. (In Russian).
- Öztürk, S. 1990. New records of lichens for Turkey. *Turk. J. Bot.* 14: 87–96.
- Seaward, M. R. D., Sipman, H. J. M. & Sohrabi, M. 2008. A revised checklist of lichenized, lichenicolous and allied fungi for Iran. *Sauteria* 15: 459–520.
- Smith, C. W., Aptroot, A., Coppins, B. J., Fletcher, A., Gilbert, O. L., James, P. W. & Wolseley, P. A. (eds). 2009. *The Lichens of Great Britain and Ireland*. British Lichen Society. 1046 pp.
- Urbanavichus, G. P., Ismailov, A. B. & Gabibova, A. R. 2010. New species to the lichen flora of Russia from Daghestan. *Botanicheskii Zhurnal* 95(7): 983–988. (In Russian).
- Urbanavichus, G., Gabibova, A. & Ismailov, A. 2011. New records of lichens and lichenicolous fungi for Russia and the Caucasus. *Turk. J. Bot.* 3: 291–297.
- Zhuravleva, S. E. 2007. Epiphitic macrolichens of the National Park “Bashkiria”. – In: Mirkin, B. M., Safiullina, N. M., Sultangareeva, L. A. & Yakupov, I. I. (eds). *Ecological aspects of biodiversity conservation of the National Park “Bashkiria” and other territories*. Infokloma, Ufa, pp. 69–71. (In Russian).