

New records of lichens and lichenicolous fungi for Russia and the Caucasus

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Received: 15.04.2010

Accepted: 24.01.2011

Abstract: Four species of lichens and 11 species of lichenicolous fungi are reported from the Republic of Daghestan for the first time for the Caucasus region. Of these, 7 taxa are new to Russia: *Caloplaca badioreagens* Tretiach & Muggia, *Caloplaca polycarpa* (A.Massal.) Zahlbr., *Lichenothelia renobalesiana* D.Hawksw. & V.Atienza, *Stigmidium rouxianum* Calat. & Triebel, *Toninia episema* (Nyl.) Timdal, *Toninia leptogii* Timdal, and *Verrucaria latericola* Erichsen. Comments on their geographic distribution, habitats, substrate, and comparisons with morphologically similar taxa are presented.

Key words: *Ascomycota*, lichens, lichenicolous fungi, new records, Caucasus, Daghestan, Russia

Rusya ve Kafkaslar için yeni liken ve likenikol fungus kayıtları

Özet: Bu çalışmada, Dağıstan Cumhuriyeti'nden Kafkas Bölgesi için dört yeni liken türü ve 11 likenikol fungus türü verilmiştir. Bunların yedisi Rusya için yeni kayıttır: *Caloplaca badioreagens* Tretiach & Muggia, *Caloplaca polycarpa* (A.Massal.) Zahlbr., *Lichenothelia renobalesiana* D.Hawksw. & V.Atienza, *Stigmidium rouxianum* Calat. & Triebel, *Toninia episema* (Nyl.) Timdal, *Toninia leptogii* Timdal, *Verrucaria latericola* Erichsen.

Anahtar sözcükler: *Ascomycota*, likenler, likenikol funguslar, yeni kayıtlar, Kafkas, Dağıstan, Rusya

Introduction

In spite of the increased studies on the lichen diversity of the Northern Caucasus Mountains in recent years, there is still no recent information on the lichen diversity of the eastern part of Northern Caucasus Mountains. Before our investigations the lichen flora of the Republic of Daghestan with only 63 species (Barkhalov, 1983) was poorly known. In

2010, 66 additional species have been reported from the Daghestan State Reserve and Gunib plateau (Urbanavichus et al., 2010a, 2010b, 2010c). With this study the number of lichenicolous fungi and lichen taxa has reached 144. Here we make a contribution to the knowledge of the lichen diversity of Daghestan and to the lichen flora of the Caucasus Mountains and Russia.

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Description of the study area

The Republic of Daghestan is situated in the North Caucasus Mountains (between coordinates 41°12' to 44°59'N and 45°05' to 48°30'E). It is the southernmost part of the Russian Federation (Figure). The area is 50,300 km². Its borders are: internal – Republic of Kalmykia (N), Chechen Republic (W), and Stavropol Krai (NW); international – Azerbaijan (S), Georgia (SW); water – Caspian Sea (E). Most of the Republic is mountainous, with the Greater Caucasus Mountains covering the south. The highest point is the Bazardyuzi peak at 4466 m. The climate is hot and dry in summer, but the winters are hard in the mountain areas. Average temperature is +2 °C in January and +30 °C in July. Average annual precipitation ranges from 200 (northern plains) to 800 mm (in the mountains). Calcareous rocks (upper Jurassic limestone) are predominantly seen in the study area of Inner mountain Daghestan (Milanovsky & Khain, 1963).

Due to its diverse geomorphology and altitudinal range, it harbours a species-rich mosaic of highland-xerophytic, alpine vegetation, mountains dry pine and mesophytic deciduous forests, steppe, and semi-desert of the plains. The vascular plants are comparatively well known (Murtazaliev, 2008) and

comprise about 3000 species, including 73 local endemics.

Materials and methods

The lichen and lichenicolous fungi specimens were collected from 4 localities at Gunib plateau in Gunib district of Inner-mountain Daghestan in 2009. For details of the collecting localities see the list below.

Morphological and microscopic investigations were performed under a binocular dissecting microscope, and supported with standard chemical spot tests. Specimens were examined in water, 10% KOH, and Lugol's iodine (MERCK 9261) solutions. Ascospore measurements were determined in water (Oxner, 1974). The specimens were identified with the aid of flora books and identification keys (Clauzade & Roux, 1985; Clauzade et al., 1989; Wirth, 1995; Halıcı, 2008a; Smith et al., 2009). The specimens are now kept at the herbarium of LE, H, Mountain Botanical Garden, Daghestan Science Centre, Makhachkala (Dagh.Sci.Cent.) and in the private herbarium of the first author (Urbanavichus). The geographic coordinates (WGS84) and elevations were recorded as well as the substrate types.



Figure. Location of the study area.

List of collection localities

1. Russian Federation, Daghestan Republic, Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, limestone, large boulder. 22.05.2009.

2. Russian Federation, Daghestan Republic, Gunib Plateau, the neighbourhood of Gunib Peak, alpine belt, 2335 m a.s.l., 42°23'54.6"N, 46°52'40.6"E, alpine meadow, limestone. 22.05.2009.

3. Russian Federation, Daghestan Republic, Gunib Plateau, c. 0.6 km S of Station of Mountain Botanical Garden, 1800 m a.s.l., 42°23'45"N, 46°55'06"E, edge of deciduous forest, limestone, exposed rocky wall. 23.05.2009.

4. Russian Federation, Daghestan Republic, Gunib Plateau, Canyon of the Gunibka River, c. 0.4 km NE of Station of Mountain Botanical Garden, 1600 m a.s.l., 42°24'15.6"N, 46°55'33.5"E, alder-elm forest, damp mossy rocks at the bottom of a canyon. 25.05.2009.

Species recorded

The taxa are listed in alphabetical order, followed by substrata, comparisons with morphologically similar taxa, geographic distribution, and specimens studied. Abbreviations of author names are according to Kirk and Ansell (1992). All the reported taxa are new to the Caucasus Mountains. The taxa new to Russia are indicated by (■). Lichenicolous fungi are marked with an asterisk (*).

■ *Caloplaca badioreagens* Tretiach & Muggia

On hard limestone rock in sunny exposed site.

The species has a peculiar combination of characters, not observed in other species of the subgenus *Pyrenodesmia*, namely simple, straight, slender paraphyses that are not constricted at the septa and non-capitate, a well-developed paraplectenchymatous hypothecium, as well as a reddish brown reaction of the epithecium to KOH (Muggia et al., 2008). This species is similar to *Caloplaca agardhiana* (A.Massal.) Clauzade & Cl.Roux, *C. alociza* (A.Massal.) Mig., and *C. erodens* Tretiach, Pinna & Grube, but it is readily distinguishable by the presence of an unknown lichen substance in the excipulum and the subhymenium, forming large, rectangular crystal plates.

This recently described crustose endolithic *Caloplaca* species previously known only from Italy (Tretiach & Muggia, 2006). New to Asia.

Specimen studied: Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, 22.05.2009, *G.P.Urbanavichus* (LE 0925134).

■ *Caloplaca polycarpa* (A.Massal.) Zahlbr.

This lichen species was observed as lichenicolous on *Bagliettoa* spp. on hard limestone rock.

This species belongs, according to Wirth (1995), to the *Caloplaca dolomiticola* group and is characterised by reduced areoles and inconspicuous marginal lobes. This species is similar to *Caloplaca oasis* (A.Massal.) Szatala (also occurs on the thallus of calcicolous species, *Bagliettoa* spp.), but differs in having a thicker, areolate, orange thallus with larger apothecia with thicker margins.

C. polycarpa is distributed in Europe, northern Africa, and south-western Asia. The nearest records to Daghestan are in Turkey (Candan & Türk, 2008).

Specimens studied: Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, 22.05.2009, *G.P.Urbanavichus* (LE 0925206); Gunib Plateau, the neighbourhood of Gunib Peak, alpine belt, 2335 m a.s.l., 42°23'54.6"N, 46°52'40.6"E, alpine meadow, 22.05.2009, *G.P.Urbanavichus* (Urbanavichus 0901136).

**Lichenocodium lecanorae* (Japp) D.Hawksw.

Host lichen: *Lecanora muralis* (Schreb.) Rabenh. (apothecia) on hard limestone rock.

This species can easily be confused with *Lichenocodium usneae* (Anzi) D.Hawksw., species differing by distinctly longer conidiogenous cells and host selection. *L. lecanorae* often grows together with *L. erodens* M.S.Christ. & D.Hawksw., but can easily be distinguished by its larger pycnidia.

A common lichenicolous fungus, known from various localities in Russia. Almost cosmopolitan. The nearest location is known from north-eastern Turkey (Halıcı, 2008a).

Specimen studied: Gunib Plateau, the neighbourhood of Gunib Peak, alpine belt, 2335 m a.s.l., 42°23'54.6"N, 46°52'40.6"E, alpine meadow, 22.05.2009, *G.P.Urbanavichus* (Dagh.Sci.Cent. 0901226).

**Lichenostigma elongatum* Nav.-Ros. & Hafellner

Host lichen: *Aspicilia calcarea* (L.) Mudd (thallus) on hard limestone rock.

This species is most similar to *Lichenostigma rouxii* Nav.-Ros., Calat. & Hafellner, but differs by having shorter hyphal strands and lower number of ascomata per strand, and by occurring on different host species (*Squamarina* spp.). The size of the ascospores is almost identical in both taxa, but in *L. elongatum* the ascospores are always 1-septate, while in *L. rouxii* they may have up to 3 septa.

This species was recorded previously only from the Northern Ural Mountains (Komi Republic) and Taimyr peninsula in Russia (Hermansson et al., 2006; Zhurbenko, 2009). Almost cosmopolitan. The nearest location is known from eastern Turkey (Halıcı, 2008a).

Specimen studied: Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, 22.05.2009, *G.P.Urbanavichus* (LE 0925207).

■*Lichenothelia renobalesiana* D.Hawksw. & V.Atiensa

Host lichen: *Verrucaria* spp., *Bagliettoa* spp. (thallus) on hard limestone rock.

This species is similar to *Polycoccum opulentum* (Th.Fr. & Almq.) Arnold, but differs in having non-ostiolate broadly stipitate ascomata and narrow ascospores with a conspicuous gelatinous sheath. The true *P. opulentum* is known only from original collection on *Polyblastia hyperborea* Th.Fr. from Sweden.

L. renobalesiana, a species described very recently by Atienza and Hawksworth (2008) from Spain and Great Britain, known also from Belgium, France, Germany, Austria, Slovenia, and possibility from Africa (Morocco) and North America. All the characteristics of the Daghestani specimen agree well with the original description. New to Asia.

Specimens studied: Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, 22.05.2009, *G.P.Urbanavichus* (LE 0925208, Dagh.Sci.Cent. 0925225, Urbanavichus 0925213).

**Muellerella erratica* (A.Massal.) Hafellner & V.John

Host lichen: Common on a wide range of host spectra such as *Acarospora cervina* A.Massal., *Aspicilia calcarea*, *Caloplaca variabilis* (Pers.) Müll. Arg., *Lecanora agardhiana* Ach., *Protoblastenia rupestris* (Scop.) J.Steiner (thallus) on hard limestone rock.

It clearly differs from the closely related *Muellerella pygmaea* (Körb.) D.Hawksw. by having small smooth-walled ascospores.

This species was previously known from many regions of Russia. Widespread in cool temperate to temperate regions of both hemispheres. The nearest location is known from eastern Turkey (Halıcı, 2008a) and Iran (Seaward et al., 2008).

Specimens studied: Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, 22.05.2009, *G.P.Urbanavichus* (LE 0925209, 0925210).

**Muellerella lichenicola* (Sommerf.) D.Hawksw.

Host lichen: Common on a wide range of host spectra such as *Rinodina immersa*, *Aspicilia* spp., *Caloplaca* spp. (thallus) on hard limestone rock.

Distinguished from most other species *Muellerella* by having small ascomata and small ascospores, more than 64 per ascus.

This cosmopolitan species is widespread in Russia. The nearest reports to Daghestan are from Turkey (Halıcı, 2008a) and Iran (Seaward et al., 2008).

Specimen studied: Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, 22.05.2009, *G.P.Urbanavichus* (LE 0925208, file under *Lichenothelia renobalesiana*).

**Muellerella pygmaea* (Körb.) D.Hawksw.

Host lichen: Common on a wide range of host spectra such as *Aspicilia* spp., *Caloplaca* spp., *Verrucaria furfuracea* (B. de Lesd.) Breuss (thallus) on hard limestone rock.

This cosmopolitan species is widespread in Russia. The nearest reports to Daghestan are from Turkey (Halıcı, 2008a, 2008b) and Iran (Seaward et al., 2008).

Specimen studied: Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, 22.05.2009, *G.P.Urbanavichus* (Urbanavichus 0925211).

**Opegrapha pulvinata* Rehm

Host lichen: *Endocarpon pusillum* (thallus) on plant debris above limestone rock.

This species is parasitic on *Catapyrenium* spp., *Dermatocarpon* spp., *Endocarpon* spp., and *Staurothele* spp., and it clearly differs from *Opegrapha rupestris* Pers. (also occurring on saxicolous members of the *Verrucariaceae*) by its ascomata aggregated in dense and large cluster, an ascospore wall soon becoming light brown, and longer conidia. *Opegrapha physciaria* (Nyl.) D.Hawksw. & Coppins differs by shorter asci and ascospores, and a different host genus (*Xanthoria* spp.).

In Russia *O. pulvinata* was previously recorded from Karelia Republic in the northern European part of Russia (Räsänen, 1939). Known also from Europe, Asia, and North America. The nearest location to Daghestan is in Turkey (Halıcı, 2008a).

Specimen studied: Gunib Plateau, c. 0.6 km S of Station of Mountain Botanical Garden, 1800 m a.s.l., 42°23'45"N, 46°55'06"E, edge of deciduous forest, 23.05.2009, *G.P.Urbanavichus* (LE 0904190, filed under *Agonimia opuntiiella*).

**Sphaerellothecium cladoniae* (Alstrup & Zhurb.) Hafellner

Host lichen: *Cladonia pocillum* (Ach.) Grognot (thallus) on soil.

The species differs from the closely related *Sphaerellothecium araneosum* (Rehm) Zopf in its partly immersed ascomata and mycelium, the cell walls becoming coarsely granulose, bigger asci, narrower spores, and a different host (*Cladonia* spp.).

This species is common and widely distributed in Russia and in the northern hemisphere, also recently reported from the southern hemisphere (Flakus et al., 2008). The nearest record to Daghestan is in north-western Iran (Seaward et al., 2008).

Specimen studied: Gunib Plateau, the neighbourhood of Gunib Peak, alpine belt, 2335 m a.s.l., 42°23'54.6"N, 46°52'40.6"E, alpine meadow, 22.05.2009, *G.P.Urbanavichus* (H 0901145, filed under *Cladonia pocillum*).

■**Stigmidium rouxianum* Calat. & Triebel

Host lichen: *Acarospora cervina* (thallus) on hard limestone rock.

The infected squamules are slightly deformed and discoloured, so that it is possible that the fungus has a slightly damaging or adverse effect on the host. All the characteristics of the Daghestani specimen agree well with the description given in Calatayud and Triebel (2003).

Morphologically, *S. rouxianum* is similar to *S. squamarinicola* Calat. & Triebel and *S. psorae* (Anzi) Hafellner, but the former differs by its frequently 6-spored asci, shorter asci and ascospores, and by choice of host (*Squamarina* spp.), and the latter has larger asci and ascospores, and occurs on different host genus (*Psora* spp.).

Probably a rare lichenicolous fungus, was previously known only from Europe and south-western Asia. The nearest record to Daghestan is in Turkey (Halıcı & Aksoy, 2009).

Specimen studied: Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, 22.05.2009, *G.P.Urbanavichus* (LE 0925215).

Thelidium decipiens (Hepp) Kremp.

On hard limestone rocks.

Distinguished from the closely related *Thelidium incavatum* Nyl. ex Mudd (also with endolithic thallus, immersed perithecia without an involucrellum) by the smaller, always 1-septate ascospores.

This species was previously recorded from the Arctic, Ural Mountains, and Siberia in Russia (Andreev et al., 1996; Sedelnikova, 2001; Hermansson et al., 2006). The nearest record to Daghestan is in Turkey (Halıcı, 2008b).

Specimen studied: Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, 22.05.2009, *G.P.Urbanavichus* (LE 0925217).

■**Toninia episema* (Nyl.) Timdal

Host lichen: *Aspicilia calcarea* (thallus) on hard limestone rock.

A description of the species is presented by Timdal (1991). The species is very similar to *Toninia athallina* (Hepp) Timdal and *T. philippea* (Mont.) Timdal, but differs in being non-lichenised. This species can be confused with *T. subfuscae* (Arnold) Timdal, but differs in having exclusively 1-septate spores and in choice of host.

A rarely reported species was previously known from western and southern Europe, northern Africa, Asia. The nearest record to Daghestan is in Turkey (Halıcı, 2008a).

Specimen studied: Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, 22.05.2009, *G.P.Urbanavichus* (LE 0925218).

■**Toninia leptogii* Timdal

Host lichen: *Leptogium plicatile* (Ach.) Leight. (thallus) on wet mosses above limestone rock.

This species is probably a rare lichenicolous fungus occurring on cyanobiont lichens from genera *Collema* and *Leptogium* and resembles most closely *T. collematicola* Timdal, but differs in having shorter, 1-septate (not mainly 3-septate) spores and a reddish brown (not pale brown to colourless) inner part of the exciple and hypothecium.

The species was previously known only from southern Europe: France, Italy (Timdal, 1991), and Portugal (Silanez et al., 2009). The nearest locations are known from the Apennine Peninsula. New to Asia.

Specimen studied: Gunib Plateau, Canyon of the Gunibka River, c. 0.4 km NE of Station of Mountain Botanical Garden, 1600 m a.s.l., 42°24'15.6"N, 46°55'33.5"E, alder-elm forest at the bottom of a canyon, 25.05.2009, *G.P.Urbanavichus* (LE 0910219).

■*Verrucaria latericola* Erichsen

This lichen species was observed as lichenicolous on the thallus *Caloplaca* spp. and *Diplotomma venustum* Körb. on calcareous rocks. It is similar to *Verrucula pusillaria* Nav.-Ros. & Cl.Roux, but differs by its narrow ascospores, shorter asci, and more dark-coloured thallus.

A rarely reported lichenicolous lichen, was previously known only from Europe and south-western Asia. The nearest record to Daghestan is in Turkey (Halıcı & Aksoy, 2009).

Specimen studied: Gunib Plateau, the neighbourhood of Station of Mountain Botanical Garden, 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E, meadow with juniper and pine trees, 22.05.2009, *G.P.Urbanavichus* (LE 0925206, file under *Caloplaca polycarpa*).

The lichen flora of Daghestan is poorly known. The purpose of our research was to investigate the diversity of lichen and lichenicolous fungi in the interesting but yet poorly studied territory of the Republic of Daghestan. Fifteen species were determined from Gunib plateau (Inner mountain Daghestan, Eastern Caucasus, Russia). All taxa reported here are new to the Caucasus Mountains. Three of them (*Caloplaca badioreagens*, *Lichenothelia renobalesiana*, and *Toninia leptogii*) are new to Asia. Seven new species were added to the Russian lichen flora: *Caloplaca badioreagens*, *C. polycarpa*, *Lichenothelia renobalesiana*, *Stigmidium rouxianum*, *Toninia episema*, *T. leptogii*, and *Verrucaria latericola*. The preliminary analysis of the species' geographic distribution revealed that the lichen flora of Gunib plateau is connected to the floras of Central Anatolian and Armeno-Iranian floristic provinces (Takhtajan, 1986) of the Irano-Turanian region.

Acknowledgements

We thank the anonymous reviewers for their valuable suggestions and comments on the manuscript. The first author is grateful to the Director of the Mountain Botanical Garden, Daghestan Science Centre, Dr. S.M. Asadulaev, for financial support of field work.

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