

The lichen flora of Gunib plateau, inner-mountain Dagestan (North-East Caucasus, Russia)

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Received: 02.05.2012 • Accepted: 15.03.2013 • Published Online: 02.07.2013 • Printed: 02.08.2013

Abstract: As a result of lichenological exploration of the Gunib plateau in the Republic of Dagestan (North-East Caucasus, Russia), we report 402 species of lichenised, 37 lichenicolous, and 7 nonlichenised fungi representing 151 genera. Nineteen species are recorded for the first time for Russia: *Abrothallus chrysanthus* J.Steiner, *Abrothallus microspermus* Tul., *Caloplaca albopruinosa* (Arnold) H.Olivier, *Candelariella plumbea* Poelt & Vězda, *Candelariella rhodax* Poelt & Vězda, *Cladonia firma* (Nyl.) Nyl., *Halospora diminuta* (Arnold) Tomas. & Cif., *Halospora discrepans* (J.Lahm ex Arnold) Hafellner, *Lichenostigma epipolina* Nav.-Ros., Calat. & Hafellner, *Milospium graphideorum* (Nyl.) D.Hawksw., *Mycomicrothelia atlantica* D.Hawksw. & Coppins, *Parabagliettoa cyanea* (A.Massal.) Gueidan & Cl.Roux, *Placynthium garovaglioii* (A.Massal.) Malme, *Polyblastia dermatodes* A.Massal., *Rusavskia digitata* (S.Y.Kondr.) S.Y.Kondr. & Kärnefelt, *Squamarina stella-petraea* Poelt, *Staurothele elenkinii* Oxner, *Toninia nordlandica* Th.Fr., and *Verrucaria endocarpoides* Servit. In addition, 71 taxa are new records for the Caucasus and 15 are new to Asia.

Key words: Lichens, lichenicolous fungi, biodiversity, Gunib plateau, limestone, Dagestan, Caucasus, Russia

1. Introduction

Dagestan is located in the Caucasus biodiversity hotspot. Nevertheless, in terms of lichenofloristic surveys, the Republic of Dagestan is one of the least-known parts of Russia and the Caucasus Mountains. Due to its diverse geomorphology and altitudinal range, it harbours a species-rich mosaic of vegetation ranging from xerophilous to alpine (e.g., mountainous dry pine forests, mesophytic deciduous forests, steppes, and semi-deserts). Vascular plants are rather well known and comprise approximately 3000 species, including 73 local endemics (Murtazaliev, 2008). However, only 63 lichen species (Barkhalov, 1983) were known before our investigations. In 2010 and 2011, an additional 81 species were reported from the Dagestan State Reserve and some areas of the Republic of Dagestan (Urbanavichus et al., 2010a, 2010b, 2010c, 2011). Due to the great diversity of habitat, a fairly high number of species can be expected to occur in Dagestan. The present paper adds further information to our knowledge of the lichen flora of Dagestan, the Caucasus Mountains, and Russia.

2. Study area

According to the Floristic Division of the World (Takhtajan, 1986), Dagestan is located on the border between the Caucasian (Circumboreal Region) and Turanian (Irano-

Turanian Region) floristic provinces, or, more broadly, the Boreal and Ancient Mediterranean floristic subkingdoms. The Caucasian province is more humid and the Turanian is more arid.

The study area, the Gunib plateau, lies in the central part of inner-mountain limestone Dagestan, which is located in the north-east of the Greater Caucasus (Figure). It is situated at 42°24'N, 46°55'E at altitudes ranging from 1400 to 2351 m and has an area of approximately 1470 ha. This relief consists of strongly inclined dolomite and limestone layers dating from the Jurassic up to the Cretaceous periods. Siliceous rocks are absent from the plateau. External slopes are very steep from all sides (50°–70°) with numerous cliffs. The Gunibka River, with a canyon in the middle flow, runs through the plateau. Continental climate prevails in inner-mountain limestone Dagestan. The mean rainfall per year is 680 mm, and the highest precipitation occurs in June and July. The mean annual relative humidity is 65%, and the mean annual temperature is 6.7 °C. The mean annual maximum temperature is 16.5 °C (August), while the mean minimum temperature is –5.2 °C (January).

Although the Gunib plateau is very small, it supports about 22% (approximately 660 species) of the Dagestani flora. Vegetation cover varies with altitude and exposure. Steep south-facing slopes ranging up to 1500–1600 m have petrophytic steppes with *Artemisia* spp., *Salvia canescens*

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Figure. Location of the study area.

C.A.Mey., *Thymus* spp., and *Prunus* spp., and in places there are thickets of *Juniperus oblonga* M.Bieb., *Rosa* spp., and spiny shrubs of *Astragalus denudatus* Stev. and *Onobrychis cornuta* (L.) Desv. At 1500–2000 m the forest occupies approximately 300 ha on northern slopes and consists of *Pinus kochiana* Klotzsch ex K.Koch, *Betula pendula* Roth, *B. litwinowii* Doluch., and *B. raddeana* Trautv., which provide suitable habitats for a rich lichen flora. Above 1800–1900 m meadows and pastures are dominant. The summit area (2200–2350 m) has a moderately gentle slope (mostly less than 10°) with meadow vegetation that has a number of subalpine elements (*Primula* spp., *Fritillaria* spp., *Muscari* spp., *Cerastium* spp., *Draba* spp., *Gagea* spp., *Iris* spp., *Trollius* spp., *Ranunculus* spp., *Gentiana* spp., and *Androsace* spp.) and is dominated by *Festuca woronowii* Hack., *Carex humilis* Leyss., etc. Cliffs and extensive rock outcroppings occur in many places. These have almost no vascular plant vegetation and are covered by different calcicolous lichen communities.

3. Materials and methods

The lichen and lichenicolous fungi specimens were collected in 52 different localities on the Gunib plateau from May 2009 to June 2011. For detailed information on the collecting localities, see the list below. The geographic coordinates (WGS84) and altitudes of each locality were measured by GPS. Air-dried samples were examined using a stereomicroscope and light microscope, and the usual spot tests were done with standard identification methods for lichenised and lichenicolous fungi (e.g., Mayrhofer, 1984; Clauzade & Roux, 1985; Clauzade et

al., 1989; Timdal, 1991; Wirth, 1995; Nimis & Martellos, 2004; Temina et al., 2005; Halıcı, 2008; Ihlen & Wedin, 2008; Smith et al., 2009; Prieto et al., 2010). Thin layer chromatography (TLC) analyses were carried out when needed (Orange et al., 2001). The nomenclature mainly follows that of Urbanavichus (2010) and Roux (2012). Abbreviations of author names are according to Kirk and Ansell (1992). The specimens are kept in the herbarium of the Mountain Botanical Garden, Dagestan Scientific Centre, Makhachkala (DAG) and in the private herbarium of G. Urbanavichus. In addition, some duplicates are held in the herbaria H, LE, and CBFS.

3.1. List of collection localities

For all localities: Caucasus, Russia, Republic of Dagestan, Gunib district, Gunib plateau.

1 – The central part of the plateau, mixed forest with calcareous boulders, ca. 1740 m a.s.l., 42°24'09.2"N, 46°55'17.9"E. 22.05.2009.

2 – Alpine meadows with calcareous outcrops near top of Mt. Gunib, 2300–2335 m a.s.l., 42°23'54.6"N, 46°52'40.6"E. 22.05.2009.

3 – Alpine meadows with calcareous outcrops, 2240–2250 m a.s.l., 42°23'54.1"N, 46°52'57.1"E. 22.05.2009.

4 – N-exposed slope, deciduous forest with calcareous cliff S-facing, 1700 m a.s.l., 42°23'51.0"N, 46°55'14.2"E. 23.05.2009.

5 – N-exposed slope, deciduous forest with mossy calcareous outcrops W-facing, 1725 m a.s.l., 42°23'48.2"N, 46°55'08.8"E. 23.05.2009.

6 – Ibid., 1780 m a.s.l., 42°23'46.0"N, 46°55'07.3"E. 23.05.2009.

- 7 – N-exposed slope, birch forest near edge of the plateau, ca. 1800 m a.s.l., 42°23'44.7"N, 46°55'06.4"E. 23.05.2009.
- 8 – The central part of the plateau, calcareous cliff E- and N-facing, ca. 1760–1770 m a.s.l., 42°24'26.1"N, 46°54'46.3"E. 23.05.2009.
- 9 – Subalpine meadows with calcareous outcrops, ca. 1900 m a.s.l., 42°25'10.0"N, 46°53'47.7"E. 24.05.2009.
- 10 – Subalpine meadows with calcareous cliff N-facing and with solitary trees, ca. 1980–1990 m a.s.l., 42°25'06.8"N, 46°53'42.1"E. 24.05.2009.
- 11 – Subalpine meadows with calcareous outcrops, ca. 1950 m a.s.l., 42°25'10.7"N, 46°54'11.1"E. 24.05.2009.
- 12 – The central part of the plateau, sparse pine forest and pasture at the roadside, ca. 1530 m a.s.l., 42°23'44.8"N, 46°55'58.9"E. 25.05.2009.
- 13 – N-exposed steep slope, deciduous forest, 1560 m a.s.l., 42°23'26.9"N, 46°56'22.1"E. 25.05.2009.
- 14 – Canyon of the Gunibka River, shady alder–elm forest with mossy calcareous outcrops, ca. 1450 m a.s.l., 42°23'46.3"N, 46°56'26.5"E. 25.05.2009.
- 15 – Ibid, ca. 1600 m a.s.l., 42°24'15.6"N, 46°55'33.5"E. 25.05.2009.
- 16 – N-exposed slope, shady birch forest, ca. 1760–1800 m a.s.l., 42°24'15.1"N, 46°54'55.6"E. 26.05.2009.
- 17 – The central part of the plateau, steppe hill in sparse woods, ca. 1725 m a.s.l., 42°24'16.8"N, 46°55'05.7"E. 28.05.2009.
- 18 – N-exposed slope, shady birch forest with mossy calcareous outcrops, ca. 1660–1690 m a.s.l., 42°24'23.0"N, 46°55'05.0"E. 28.05.2009.
- 19 – S-exposed slope, petrophytic steppes with calcareous outcrops, ca. 1820 m a.s.l., 42°24'52.7"N, 46°55'02.6"E. 29.05.2009.
- 20 – N-exposed slope, shady birch forest with mossy calcareous outcrops, ca. 1700–1750 m a.s.l., 42°24'51.8"N, 46°55'41.9"E. 29.05.2009.
- 21 – S-exposed slope, petrophytic steppes with scattered dwarf juniper shrubs and calcareous outcrops, ca. 1680 m a.s.l., 42°24'24.1"N, 46°55'39.6"E. 16.06.2010.
- 22 – Ibid., ca. 1710 m a.s.l., 42°24'22.8"N, 46°55'55.9"E. 16.06.2010.
- 23 – Ibid., ca. 1560–1570 m a.s.l., 42°23'58.4"N, 46°56'26.1"E. 16.06.2010.
- 24 – Subalpine meadows with calcareous cliffs near the edge of the plateau, ca. 2000 m a.s.l., 42°23'42.9"N, 46°54'10.9"E. 17.06.2010.
- 25 – The central part of the plateau, a deep dip in the stream with a waterfall and mossy calcareous outcrops, ca. 1900–1930 m a.s.l., 42°24'07.2"N, 46°54'10.1"E. 17.06.2010.
- 26 – The central part of the plateau, S- and E-facing limestone slope, ca. 1890 m a.s.l., 42°24'14.9"N, 46°54'20.2"E. 17.06.2010.
- 27 – Alpine meadows with calcareous cliffs, ca. 2200 m a.s.l., 42°23'55.1"N, 46°53'11.0"E. 18.06.2010.
- 28 – Ibid., ca. 2180 m a.s.l., 42°24'01.6"N, 46°53'21.5"E. 18.06.2010.
- 29 – The central part of the plateau, W-facing limestone cliff, ca. 1960 m a.s.l., 42°24'16.0"N, 46°53'52.1"E. 18.06.2010.
- 30 – Steppe cliff in birch forest, ca. 1830 m a.s.l., 42°24'43.7"N, 46°54'26.5"E. 19.06.2010.
- 31 – N-exposed steep slope, shady birch-pine forest, ca. 1900 m a.s.l., 42°24'37.7"N, 46°54'18.4"E. 19.06.2010.
- 32 – The central part of the plateau, pine forest, ca. 1940 m a.s.l., 42°24'35.8"N, 46°54'17.0"E. 19.06.2010.
- 33 – Ibid., old felled area in pine forest, ca. 1880 m a.s.l., 42°24'26.8"N, 46°54'23.0"E. 19.06.2010.
- 34 – N-exposed slope, shady birch-aspens forest with mossy calcareous outcrops, ca. 1650–1660 m a.s.l., 42°23'51.5"N, 46°55'20.5"E. 20.06.2010.
- 35 – Ibid., shady birch forest, ca. 1730–1760 m a.s.l., 42°23'46.3"N, 46°55'19.4"E. 20.06.2010.
- 36 – Alpine meadows with mossy calcareous outcrops and with ice in a deep fissure, ca. 2200 m a.s.l., 42°24'24.4"N, 46°52'56.3"E. 21.06.2010.
- 37 – Ibid, N-facing cliff, ca. 2220 m a.s.l., 42°24'26.1"N, 46°52'46.7"E. 21.06.2010.
- 38 – Alpine meadows with calcareous cliffs in the western part of the plateau, ca. 2270–2280 m a.s.l., 42°24'21.6"N, 46°52'33.9"E. 21.06.2010.
- 39 – Subalpine meadows with calcareous cliffs S-facing, ca. 2010 m a.s.l., 42°24'58.9"N, 46°52'53.1"E. 21.06.2010.
- 40 – Subalpine meadows with calcareous cliffs W-facing, ca. 1980 m a.s.l., 42°25'01.3"N, 46°53'30.5"E. 21.06.2010.
- 41 – N-exposed slope, pine forest, ca. 1940–1950 m a.s.l., 42°24'18.7"N, 46°54'13.7"E. 22.06.2010.
- 42 – N-exposed slope, birch forest, ca. 1900–1930 m a.s.l., 42°24'08.5"N, 46°54'34.1"E. 24.06.2010.
- 43 – Subalpine meadows with calcareous cliffs N-facing and solitary birch, ca. 2110 m a.s.l., 42°24'25.8"N, 46°53'07.8"E. 21.06.2011.
- 44 – Ibid., ca. 2160 m a.s.l., 42°24'28.8"N, 46°52'50.5"E. 21.06.2011.
- 45 – Subalpine meadows with calcareous cliffs E-facing, ca. 2075 m a.s.l., 42°24'18.2"N, 46°53'32.6"E. 21.06.2011.
- 46 – The central part of the plateau, calcareous boulders near edge of birch forest, ca. 1740 m a.s.l., 42°24'49.1"N, 46°54'25.8"E. 23.06.2011.
- 47 – W-exposed steep slope, shady birch–hornbeam forest with mossy calcareous outcrops, ca. 1840–1880 m a.s.l., 42°24'42.1"N, 46°54'07.3"E. 23.06.2011.
- 48 – S-exposed steep slope, petrophytic steppes with scattered dwarf juniper shrubs and calcareous outcrops, ca. 1500–1550 m a.s.l., 42°23'40.1"N, 46°57'07.1"E. 24.06.2011.

49 – Ibid., calcareous N-facing cliffs near edge of the plateau, ca. 1545–1550 m a.s.l., 42°23'46.2"N, 46°56'53.9"E. 24.06.2011.

50 – Birch forest with lime and oak trees near cliff above the Gunibka River, ca. 1495 m a.s.l., 42°23'44.8"N, 46°56'07.9"E. 24.06.2011.

51 – N-exposed slope, birch forest with fruit trees, ca. 1745 m a.s.l., 42°24'30.9"N, 46°54'55.5"E. 24.06.2011.

52 – The central part of the plateau, alder forest along the Gunibka River, ca. 1730 m a.s.l., 42°24'45.0"N, 46°54'34.5"E. 24.06.2011.

3.2. List of taxa and comments on some species

The taxa are listed in alphabetical order followed by the collection locality numbers and substrata. The taxa previously reported from the Gunib plateau are also listed here and references are given. Symbols used in the list of taxa: ■ - new record for Russia, · - new record for the Greater Caucasus, * - lichenicolous fungi, + - nonlichenised fungi.

■**Abrothallus chrysanthus* J.Steiner – 16: on *Usnea* sp. New to Asia.

This species differs from *A. usneae* Rabenh. ex Stein growing on *Usnea* sp. by smaller apothecia and yellowish hymenium without violet granules, and smaller spores of 8–10 × 3–4.5 µm instead of (11–)12–13(–14) × 4.5–6 µm in *A. usneae*. The species was formerly known from Europe, Macaronesia, and Central America (Etayo & van der Boom, 2006).

■**Abrothallus microspermus* Tul. – 20: on *Flavopunctelia soledica*. New to Asia.

This species differs from *A. parmeliarum* (Sommerf.) Arnold by epruinose, smaller apothecia, and smaller spores; from *A. parmotrematis* Diederich by distinctly smaller ascospores (mainly 9.5–14.5 × 3.5–5.5 µm, versus 13.1–16.4 × 5.3–6.1 µm) with a much larger length/breadth ratio, epruinose apothecia, abundance of pycnidia and rarity of ascomata, and different host selection (Diederich, 2011).

Abconditella lignicola Vězda & Pišut – 31: on lignum of *Pinus kochiana*.

Acarospora cervina A.Massal. – 1, 9, 45: on limestone.

Acarospora oligospora (Nyl.) Arnold – 3: on limestone.

·*Agonimia allobata* (Stizenb.) P.James – 15: on trunk of *Pyrus caucasica*. New to Asia.

Agonimia opuntiella (Buschardt & Poelt) Vězda – 6, 17, 21: on soil. First reported from Russia and the Caucasus by us (Urbanavichus et al., 2010c).

Agonimia tristicula (Nyl.) Zahlbr. – 1, 18, 48: on soil and trunk of *Betula* sp.

Alyxoria varia (Pers.) Ertz & Tehler – 14, 34, 50: on bark of *Populus tremula*, *Betula* sp., *Carpinus caucasica*, *Tilia* sp., and *Pyrus caucasica*.

Amandinea punctata (Hoffm.) Coppins & Scheid. – 4, 31, 50: corticolous on bark of *Pinus kochiana* and *Quercus macranthera*.

Anapytychia ciliaris (L.) Körb. – 9, 20, 42: very common, corticolous and terricolous.

Anapytychia desertorum (Rupr.) Poelt – 2, 28: on limestone.

·*Anisomeridium polypori* (Ellis & Everh.) M.E.Barr – 47: on bark of *Carpinus caucasica*.

Arthonia apatetica (Massal.) Th.Fr. – 47: on bark of *Carpinus caucasica*.

**Arthonia apotheciorum* (A.Massal.) Almq. – 24, 43, 44: on the apothecia of *Lecanora agardhiana* and *L. crenulata*. This record is the second for Asia. The nearest records to Dagestan are in Turkey (Karagöz & Aslan, 2012).

Arthonia atra (Pers.) A.Schneid. – 20: on bark of *Betula* sp.

Arthonia calcarea (Turner ex Sm.) Ertz & Diederich – 1: on limestone. Previously reported from the Caucasus by us (Urbanavichus et al., 2010a).

**Arthonia epiphyscia* Nyl. – 42: on *Physcia stellaris*.

Arthonia fusca (A.Massal.) Hepp – 1: on limestone. Previously reported from the Caucasus by us (Urbanavichus et al., 2010a).

**Arthonia hertelii* (Calat., Barreno & V.J.Rico) Hafellner & V.John – 2: on *Aspicilia desertorum*.

**Arthonia peltigerina* (Almq.) H.Olivier – 36: on *Solorina saccata*.

**Arthonia phaeophysciae* Grube & Matzer – 14: on *Phaeophyscia hirsuta*. This record is the second for Russia after our report from the southern Urals (Urbanavichus & Urbanavichene, 2011). New to Asia.

Arthonia radiata (Pers.) Ach. – 13, 34, 50: corticolous on bark of *Alnus incana*, *Betula* sp., *Carpinus caucasica*, and *Tilia* sp.

**Arthonia subfuscicola* (Linds.) Triebel – 42: on apothecium of *Lecanora carpinea*. New to Asia.

Arthopyrenia salicis A.Massal. – 42: on bark of *Betula* sp.

Arthrosporium populorum A.Massal. – 42: on bark of *Betula* sp. and *Quercus macranthera*.

Aspicilia candida (Anzi) Hue – 24, 43: on limestone.

Aspicilia desertorum (Kremp.) Mereschk. – 2, 7, 43: on limestone.

Bacidia bagliettoana (A.Massal. & DeNot.) Jatta – 22, 46: on soil.

Bacidia igniarrii (Nyl.) Oxner – 16, 30: on bark of *Salix* sp.

·*Bacidina chlorotricula* (Nyl.) Vězda & Poelt – 15: on bark of *Carpinus caucasica*.

Bacidina delicata (Larbal. ex Leight.) V.Wirth & Vězda – 14: on bark of *Alnus incana*.

·*Bagliettoa baldensis* (A.Massal.) Vězda – 46: on limestone.

Bagliettoa calciseda (DC.) Gueidan & Cl.Roux – 9, 43, 44: on limestone.

- Bilimbia lobulata* (Sommerf.) Hafellner & Coppins – 10, 23, 44: on soil.
- Bilimbia microcarpa* (Th.Fr.) Th.Fr. – 10: on soil. Previously reported from the Caucasus by us (Urbanavichus et al., 2010a).
- Botryolepraria lesdainii* (Hue) Canals, Hern.-Mar., Gómez-Bolea & Llimona – 3, 25: on soil in the crevices of limestone among moss.
- Bryoria furcellata* (Fr.) Brodo & D.Hawksw. – 15, 31, 47: on trunk of *Betula* sp., *Pinus kochiana*, and *Salix* sp.
- Bryoria fuscescens* (Gyeln.) Brodo & D.Hawksw. – 32, 33: on *Pinus kochiana*.
- Bryoria implexa* (Hoffm.) Brodo & D.Hawksw. – 32, 33: on *Pinus kochiana*.
- Bryoria kuemmerleana* (Gyeln.) Brodo & D.Hawksw. – 42: on *Betula* sp.
- Bryoria nadvornikiana* (Gyeln.) Brodo & D.Hawksw. – 32, 33: on *Pinus kochiana*.
- Bryoria subcana* (Nyl. ex Stizenb.) Brodo & D.Hawksw. – 34: on *Betula* sp.
- Buellia disciformis* (Fr.) Mudd – 13, 16, 47: on bark of *Betula* sp.
- Buellia elegans* Poelt – 26, 48: on soil.
- Buellia epigaea* (Pers.) Tuck. – 36, 37: on soil.
- Buellia griseovirens* (Turner & Borrer ex Sm.) Almb. – 31, 33, 51: on bark of *Pinus kochiana*.
- Calicium abietinum* Pers. – 33: on lignum of *Pinus kochiana*.
- Calicium glaucellum* Ach. – 41: on lignum of *Pinus kochiana*.
- Calicium salicinum* Pers. – 31, 42: on lignum of *Betula* sp. and *Pinus kochiana*.
- Calicium trabinellum* (Ach.) Ach. – 31, 33, 41: on lignum of *Pinus kochiana*.
- *Caloplaca albopruinosa* (Arnold) H.Olivier – 1, 43: on limestone.
- A detailed description is provided by Muggia et al. (2008). This species is very similar to *C. alociza*, from which it can be distinguished by the thickened, developed margin of apothecia. *C. badioreagens* differs by a brown reaction of the epithecium to KOH.
- Caloplaca alociza* (A.Massal.) Mig. – 5: on limestone.
- Caloplaca ammiospila* (Wahlenb.) H.Olivier – 36: on soil.
- Caloplaca aurantia* (Pers.) Hellb. – 1, 11, 51: very common, on limestone.
- Caloplaca badioreagens* Tretiach & Muggia – 7: on limestone. First reported in Russia and the Caucasus by us (Urbanavichus et al., 2011).
- Caloplaca biatorina* (A.Massal.) J.Steiner – 3, 11, 45: on limestone.
- Caloplaca cerina* (Hedw.) Th.Fr. – 1, 21, 50: very common, on bark of *Alnus incana*, *Malus orientalis*, *Populus tremula*, *Betula* sp., *Carpinus caucasica*, *Juniperus oblonga*, *Quercus macranthera*, and *Pyrus caucasica*.
- Caloplaca chalybaea* (Fr.) Müll.Arg. – 9, 24, 49: on limestone.
- Caloplaca chlorina* (Flot.) H.Olivier – 13, 47: on bark of *Betula* sp. and *Salix* sp.
- Caloplaca cirrochroa* (Ach.) Th.Fr. – 5, 29, 45: on limestone.
- Caloplaca crenulatella* (Nyl.) H.Olivier – 1: on limestone.
- Caloplaca decipiens* (Arnold) Blomb. & Forssell – 43, 44: on limestone.
- Caloplaca flavorubescens* (Huds.) J.R.Laundon – 42, 47, 52: on bark of *Alnus incana*, *Betula* sp., and *Prunus divaricata*.
- Caloplaca haematites* (Chaub. ex St.-Amans) Zwackh – 20: on bark of *Betula* sp.
- Caloplaca holocarpa* (Hoffm. ex Ach.) A.E.Wade – 1: on bark of *Pyrus caucasica*.
- Caloplaca hungarica* H.Magn. – 13, 31, 33: on bark of *Tilia* sp. and *Pinus kochiana*.
- Caloplaca inconnexa* (Nyl.) Zahlbr. – 1, 7: on limestone and lichenicolous on *Acarospora cervina*.
- *Caloplaca lenae* Søchting & Figueras – 7, 27, 47: on limestone.
- *Caloplaca marmorata* (Bagl.) Jatta – 3, 22, 46: on limestone.
- Caloplaca obscurella* (J.Lahm ex Körb.) Th.Fr. – 18: on bark of *Salix* sp.
- Caloplaca polycarpa* (A.Massal.) Zahlbr. – 1, 2: lichenicolous on *Bagliettoa* spp., on limestone. First reported in Russia and the Caucasus by us (Urbanavichus et al., 2011).
- Caloplaca pyracea* (Ach.) Th.Fr. – 22, 35, 50: on bark of *Populus tremula*, *Carpinus caucasica*, *Juniperus oblonga*, *Tilia* sp., *Quercus macranthera*, and *Pyrus caucasica*.
- *Caloplaca sinapisperma* (Lam. & DC.) Maheu & A.Gillet – 36: on soil.
- Caloplaca stillicidiorum* (Vahl) Lyngby – 7, 12, 21: very common, on soil.
- Caloplaca teicholyta* (Ach.) J.Steiner – 48: on limestone.
- Caloplaca tirolensis* Zahlbr. – 22: on soil.
- *Caloplaca trachyphylla* (Tuck.) Zahlbr. – 2: on limestone.
- Caloplaca variabilis* (Pers.) Müll.Arg. – 1, 11, 24: on limestone.
- Caloplaca xantholyta* (Nyl.) Jatta – 3, 5, 47: on limestone.
- Candelaria concolor* (Dicks.) Stein – 14, 33, 52: very common, corticolous.
- Candelariella aurella* (Hoffm.) Zahlbr. – 34: on bark of *Populus tremula*.
- *Candelariella efflorescens* R.C.Harris & W.R.Buck – 16, 30, 34, 42: common, on bark of *Betula* sp., *Carpinus caucasica*, *Pinus kochiana*, and *Salix* sp.

▪ *Candelariella plumbea* Poelt & Vězda – 4: on limestone.

This species is characterised by the grey to plumbeous grey thickly squamulose, finally isidiose-sorediose thallus and the inflexed thick, crenulate thalline margin of the apothecia. The other *Candelariella* species with grey thallus (*C. oleaginescens* Rondon) is distinguished from *C. plumbea* by the thinner areolate to squamulate thallus, smaller apothecia, and longer spores (Thor & Wirth, 1990).

Candelariella reflexa (Nyl.) Lettau – 47: on bark of *Carpinus caucasica*.

▪ *Candelariella rhodax* Poelt & Vězda – 29, 39, 45: on limestone.

C. rhodax has rosette-like bright yellow, sometimes to greenish grey thallus with distinctly effigurate marginal lobes. This species is similar to *C. medians* (Nyl.) A.L.Sm., which is readily distinguishable by blastidia.

Candelariella unilocularis auct., non (Elenkin) Nimis – 7: on mossy limestone.

Candelariella vitellina (Hoffm.) Müll.Arg. – 1, 20, 42: on bark of *Malus orientalis*, *Betula* sp., *Pyrus caucasica*, and *Salix* sp.

Candelariella xanthostigma (Ach.) Lettau – 4, 30, 47: common, on bark of *Betula* sp., *Tilia* sp., *Pinus kochiana*, and *Salix* sp.

Catapyrenium cinereum (Pers.) Körb. – 2: on soil.

· *Catillaria erysiboides* (Nyl.) Th.Fr. – 42: on bark of *Betula* sp.

Catillaria lenticularis (Ach.) Th.Fr. – 3, 5, 48: on limestone.

Catillaria nigroclavata (Nyl.) Schuler – 16, 30, 42: common, corticolous.

Cetraria aculeata (Schreb.) Fr. – 2, 23, 38: on soil.

Cetraria ericetorum Opiz – 12, 17, 49: on soil.

Cetraria islandica (L.) Ach. – 38, 4349: on soil.

Cetraria muricata (Ach.) Eckfeldt – 43: on soil.

Cetraria cf. *steppae* (Savicz) Kärnefelt – 13, 23: on soil.

Cetrelia cetrarioides (Delise & Duby) W.L.Culb. & C.F.Culb. – 16, 42, 47: on trunk of *Betula* sp., *Pinus kochiana*, and *Salix* sp.

Cetrelia olivetorum (Nyl.) W.L.Culb. & C.F.Culb. – 20, 32, 42: on trunk of *Betula* sp. and *Pinus kochiana*.

Chaenotheca brunneola (Ach.) Müll.Arg. – 41: on lignum of *Pinus kochiana*.

Chaenotheca furfuracea (L.) Tibell – 18: on soil and root of *Betula* sp.

Chaenotheca trichialis (Ach.) Th.Fr. – 31: on lignum of *Betula* sp.

· *Chaenotheca xyloxena* Nád. – 31, 33, 41: on lignum of *Pinus kochiana*.

+ *Chaenothecopsis debilis* (Turner & Borrer ex Sm.) Tibell – 34: on lignum of *Betula* sp.

+ *Chaenothecopsis pusilla* (Ach.) A.F.W.Schmidt – 41: on lignum of *Pinus kochiana*.

+ *Chaenothecopsis savonica* (Räsänen) Tibell – 20, 33: on bark and lignum of *Pinus kochiana* and *Juniperus oblonga*.

+ *Chaenothecopsis viridireagens* (Nád.) A.F.W.Schmidt – 41: on lignum of *Pinus kochiana*.

Chrysothrix candelaris (L.) J.R.Laundon – 20, 34, 47: on bark of *Betula* sp., *Pinus kochiana*, and *Salix* sp.

Chrysothrix flavovirens Tønsberg – 34: on bark of *Betula* sp.

Circinaria calcarea (L.) A.Nordin, S.Savić & Tibell – 1, 43, 51: very common, on limestone.

Circinaria contorta (Hoffm.) A.Nordin, S.Savić & Tibell subsp. *hoffmanniana* (S.Ekman & Fröberg ex R.Sant.) comb. ined. – 7: on limestone.

Circinaria hispida (Mereschk.) A.Nordin, S.Savić & Tibell – 22, 23, 49: on soil.

Cladonia arbuscula (Wallr.) Flot. subsp. *mitis* (Sandst.) Ruoss – 12, 38, 44: on soil.

Cladonia botrytes (K.G.Hagen) Willd. – 5, 16, 33: on lignum of *Pinus kochiana* stump.

Cladonia cenotea (Ach.) Schaer. – 33: on lignum of *Pinus kochiana* stump.

Cladonia chlorophaea (Flörke ex Sommerf.) Spreng. – 4, 12, 33: on soil and lignum of *Pinus kochiana* stump.

Cladonia coniocraea (Flörke) Spreng. – 8, 32, 33: on lignum of *Pinus kochiana* stump and base of *Salix* sp. trunk.

Cladonia convoluta (Lam.) Anders – 2, 17, 23: very common, on soil.

· *Cladonia farinacea* (Vain.) A.Evans – 9, 16: on base of *Pinus kochiana*.

Cladonia fimbriata (L.) Fr. – 16, 32, 33: on soil and lignum of *Pinus kochiana* stump.

▪ *Cladonia firma* (Nyl.) Nyl. – 23: on soil.

This species is distinguished by its large, thick squamules, which are green above, bluish violet below.

Cladonia floerkeana (Fr.) Flörke – 33: on lignum of *Pinus kochiana* stump.

Cladonia furcata (Huds.) Schrad. – 9, 12, 44: on soil.

Cladonia gracilis (L.) Willd. s.lat. – 9, 13, 36: on soil.

Cladonia macilenta Hoffm. var. *macilenta* – 33: on lignum of *Pinus kochiana* stump.

Cladonia macroceras (Delise) Hav. – 12, 23, 44: on soil.

· *Cladonia magyarica* Vain. – 7, 9: on soil.

· *Cladonia norvegica* Tønsberg & Holien – 16: on base of old *Betula* sp. stump.

Cladonia ochrochlora Flörke – 32, 33: on lignum and base of *Pinus kochiana* trunk.

Cladonia pocillum (Ach.) Grognot – 5, 12, 38: very common, on soil.

Cladonia pyxidata (L.) Hoffm. – 4, 13, 48: on soil.

Cladonia rangiformis Hoffm. – 6, 12, 49: on soil.

Cladonia rei Schaer. – 5, 16, 33: on lignum of *Pinus kochiana* and base of *Betula* sp. trunk.

- Cladonia squamosa* Hoffm. – 33, 47: on soil.
Cladonia subrangiformis Sandst. – 3, 9, 13: on soil.
Clauzadea monticola (Schaer.) Hafellner & Bellem. – 41, 43: on limestone.
Collema auriforme (With.) Coppins & J.R.Laundon – 3, 5, 36, 47: common, on mossy limestone and soil.
Collema crispum (Huds.) F.H.Wigg. var. *crispum* – 15: on soil.
Collema cristatum (L.) F.H.Wigg. (var. *cristatum* and var. *marginale* (Huds.) Degel.) – 8, 26, 45: common, on limestone.
Collema fasciculare (L.) F.H.Wigg. – 49, 51: on trunk of *Betula* sp. and *Pyrus caucasica*.
Collema flaccidum (Ach.) Ach. – 14, 42, 51: on trunk of *Alnus incana*, *Betula* sp., *Pyrus caucasica*, and *Salix* sp.
Collema fuscovirens (With.) J.R.Laundon – 11, 15, 44: on limestone.
Collema minor (Pakh.) Tomin – 7, 28, 36: on soil.
Collema multipartitum Sm. – 1, 8, 15: on limestone.
Collema polycarpon Hoffm. – 8, 45, 49: common, on limestone.
Collema subflaccidum Degel. – 5, 15, 18: on trunk of *Betula* sp.
Collema tenax (Sw.) Ach. em. Degel. s.lat. – 3, 17, 48: very common, on soil.
Collema undulatum Laurer ex Flot. var. *undulatum* – 3, 36: on limestone.
Cryptodiscus foveolaris (Rehm) Rehm – 31, 33, 41: on lignum of *Pinus kochiana*. New to Asia.
**Dacampia engeliana* (Saut.) A.Massal. – 36: on *Solorina saccata*.
Dermatocarpon miniatum (L.) W.Mann – 14, 20, 51: very common, on limestone.
Dimerella pineti (Schrud. ex Ach.) Vězda – 16, 34: on bark of *Betula* sp.
Diploschistes muscorum (Scop.) R.Sant. – 22, 36, 47: very common, on soil and base of trees above mosses and lichens.
Diploschistes ocellatus (Vill.) Norman – 7, 18, 52: on limestone.
Diplotomma hedinii (H.Magn.) P.Clerc & Cl.Roux – 2, 33, 48: very common, on limestone. This record is the second for Russia after our report from the southern Urals (Urbanavichus & Urbanavichene, 2011).
Dirina stenhammari (Fr. ex Stenh.) Poelt & Follmann – 6, 47: on limestone.
Elixia flexella (Ach.) Lumbsch – 33: on lignum of *Pinus kochiana*.
Endocarpon pusillum Hedw. – 1, 3, 6: on soil.
**Endococcus propinquus* (Körb.) D.Hawksw. – 43: on *Verrucaria endocarpoidea*.
Evernia divaricata (L.) Ach. – 31, 37, 42: on trunk of *Betula* sp. and *Pinus kochiana*, rarely on soil and mossy limestone.
Evernia mesomorpha Nyl. – 28, 38, 44: on trunk of *Pinus kochiana*, rarely on soil and mossy limestone.
Evernia prunastri (L.) Ach. – 16, 33, 42: on trunk of *Betula* sp., *Juniperus oblonga*, *Pinus kochiana*, and *Salix* sp.
Farnoldia jurana (Schaer.) Hertel subsp. *jurana* – 36: on limestone.
Flavocetraria cucullata (Bellardi) Kärnefelt & A.Thell – 9, 38, 44: on soil.
Flavocetraria nivalis (L.) Kärnefelt & A.Thell – 36, 38, 49: on soil.
Flavoparmelia caperata (L.) Hale – 16, 28, 38: very common, corticolous and rarely terricolous.
Flavopunctelia flaventior (Stirt.) Hale – 12, 18, 52: on trunk of *Betula* sp. and *Pinus kochiana*.
Flavopunctelia soledica (Nyl.) Hale – 1, 38, 50: very common, corticolous and rarely terricolous.
Fulgensia bracteata (Hoffm.) Räsänen – 2, 48, 49: on soil. Previously reported from the Caucasus by us (Urbanavichus et al., 2010a).
Fulgensia fulgens (Sw.) Elenkin – 10, 23, 38: common, on soil.
Fulgensia subbracteata (Nyl.) Poelt – 3, 22, 48: on soil. First reported from Russia and the Caucasus by us (Urbanavichus et al., 2010c).
Glypholecia scabra (Pers.) Müll.Arg. – 3, 9, 10, 45: on limestone. Previously reported from the northern Caucasus by us (Urbanavichus et al., 2010a).
Graphis scripta (L.) Ach. – 13, 50: on bark of *Betula* sp. and *Tilia* sp.
Gyalecta jenensis (Batsch) Zahlbr. – 1, 5, 36, 43: on limestone and soil.
 ■**Halospora deminuta* (Arnold) Tomas. & Cif. – 46: on undetermined endolithic lichen on limestone. New to Asia.
 A detailed description of the species was presented by Roux et al. (2002). Differs from *H. discrepans* by the larger spores with thick perispore, and different host.
 ■**Halospora discrepans* (J.Lahm ex Arnold) Hafellner – 36: on *Protoblastenia rupestris*. New to Asia.
Heppia adglutinata (Kremph.) A.Massal. – 2, 36, 37: on soil.
Heterodermia japonica (M.Satô) Swinscow & Krog – 20: on trunk of *Betula* sp.
Heterodermia speciosa (Wulfen) Trevis. – 18, 30, 47: on trunk of *Betula* sp. and *Salix* sp.
Heteroplacidium compactum (A.Massal.) Gueidan & Cl.Roux – 1: on limestone.
 **Homostegia piggotii* (Berk. & Broome) P.Karst. – 47: on *Parmelia sulcata*.
Hyperphyscia adglutinata (Flörke) H.Mayrhofer & Poelt – 4, 16, 47: common, corticolous.
Hypogymnia austerodes (Nyl.) Räsänen – 31, 32: on trunk of *Pinus kochiana*.

Hypogymnia bitteri (Lyngé) Ahti – 32, 35: on trunk of *Pinus kochiana*.

Hypogymnia farinacea Zopf – 34: on trunk of *Betula* sp.

Hypogymnia physodes (L.) Nyl. – 16, 31, 49: very common, corticolous.

Hypogymnia tubulosa (Schaer.) Hav. – 20, 33, 51: on trunk of *Betula* sp. and *Pinus kochiana*, on lignum of *Pinus kochiana*.

Hypogymnia vittata (Ach.) Parrique – 17: on mossy soil.

Hypotrachyna laevigata (Sm.) Hale – 16: on trunk of *Betula* sp.

Hypotrachyna revoluta (Flörke) Hale – 30, 33, 47: on trunk of *Betula* sp. and *Pinus kochiana*.

Lecania cyrtella (Ach.) Th.Fr. – 32, 35, 42: on bark of *Alnus incana*, *Populus tremula*, *Betula* sp., and *Pinus kochiana*.

Lecania erysibe (Ach.) Mudd – 43: on limestone.

Lecania naegelii (Hepp) Diederich & Van den Boom – 18, 34, 51: on bark of *Alnus incana*, *Betula* sp., and *Carpinus caucasica*.

Lecanora agardhiana Ach. – 1, 3, 24: on limestone.

Lecanora albellula (Nyl.) Th.Fr. – 31, 33, 41: on bark and lignum of *Pinus kochiana*.

Lecanora allophana Nyl. – 1, 14, 43, 52: common, corticolous.

Lecanora carpinea (L.) Vain. – 13, 42, 51: on bark of *Betula* sp., *Tilia* sp., and *Pyrus caucasica*.

Lecanora chlarotera Nyl. – 16, 30, 49, 51: very common, corticolous.

Lecanora crenulata Hook. – 2, 29, 48: on limestone.

Lecanora dispersa (Pers.) Sommerf. – 43, 44: on limestone.

Lecanora epibryon (Ach.) Ach. – 10, 28, 37: on mosses.

Lecanora hagenii (Ach.) Ach. – 30, 47, 52: on bark of *Alnus incana*, *Malus orientalis*, *Quercus macranthera*, *Pinus kochiana*, and *Salix* sp.

Lecanora perpruinosa Fröberg – 1: on limestone.

Lecanora persimilis (Th.Fr.) Nyl. – 42, 47: on bark of *Betula* sp.

Lecanora pruinosa Chaub. – 43: on limestone.

Lecanora rugosella Zahlbr. – 13, 50: on bark of *Euonymus* sp. and *Quercus macranthera*.

Lecanora saligna (Schr.) Zahlbr. – 18: on lignum of *Betula* sp.

Lecanora saxicola (Pollich) Ach. – 3, 11, 29, 52: very common, on limestone and rarely on mossy limestone.

Lecanora semipallida H.Magn. – 1, 2, 43: on limestone. Previously reported from the Caucasus by us (Urbanavichus et al., 2010a).

Lecanora strobilina (Spreng.) Kieff. – 4, 32, 41: on bark and lignum of *Pinus kochiana*.

Lecanora subcarpinea Szatala – 42: on bark of *Betula* sp. and *Salix* sp.

Lecanora symmicta (Ach.) Ach. – 16, 41, 47: on bark of *Betula* sp. and *Pinus kochiana*.

Lecidea tessellata Flörke var. *caesia* (Anzi) Arnold – 2, 39: on limestone.

Lecidella elaeochroma (Ach.) M.Choisy – 13, 34, 42: on bark of *Betula* sp., *Tilia* sp., and *Salix* sp.

Lecidella euphorea (Flörke) Hertel – 12, 20, 28, 34: common, corticolous.

Lecidella laureri (Hepp) Körb. – 4, 18, 43, 47: common, corticolous.

Lecidella patavina (A.Massal.) Knoph & Leuckert – 2, 24, 39: on limestone.

Lecidella stigmatea (Ach.) Hertel & Leuckert – 1, 44: on limestone.

Lecidella wulfenii (Hepp) Körb. – 37: on soil.

Lecidella xylophila (Th.Fr.) Knoph & Leuckert – 18: on lignum of *Betula* sp.

Lempholemma polyanthes (Bernh.) Malme – 46: on soil.

Leptogium gelatinosum (With.) J.R.Laundon – 37, 44, 47: on soil.

Leptogium lichenoides (L.) Zahlbr. – 7, 15, 25, 29: common, on soil.

Leptogium plicatile (Ach.) Leight. – 15: on mossy limestone. Previously reported from the northern Caucasus by us (Urbanavichus et al., 2010a).

Leptogium pulvinatum (Hoffm.) Otálora – 2, 25, 26, 48: on soil.

Leptogium saturninum (Dicks.) Nyl. – 4, 15, 42, 47, 52: common, corticolous.

Leptogium schraderi (Bernh.) Nyl. – 6, 30, 49: on soil. Previously reported from the Caucasus by us (Urbanavichus et al., 2010c).

Leptogium tenuissimum (Dicks.) Körb. – 47: on soil.

+ *Leptorhaphis epidermidis* (Ach.) Th.Fr. – 16: on bark of *Betula* sp.

Letharia vulpina (L.) Hue – 32: on trunk of *Pinus kochiana*.

**Lichenochora obscuroides* (Linds.) Triebel & Rambold – 14: on *Phaeophyscia hirsuta*.

**Lichenonium lecanorae* (Japp) D.Hawksw. – 2: on *Lecanora saxicola* Previously reported from the Caucasus by us (Urbanavichus et al., 2011).

**Lichenonium usneae* (Anzi) D.Hawksw. – 32: on apothecia of *Usnea* sp.

**Lichenostigma elongatum* Nav.-Ros. & Hafellner – 1, 7, 43: on *Aspicilia desertorum*. Previously reported from the Caucasus by us (Urbanavichus et al., 2011).

■**Lichenostigma epipolina* Nav.-Ros., Calat. & Hafellner – 39: on *Diplotomma hedinii*.

All the characteristics of the Dagestani specimens agree well with the description given by Calatayud et al. (2002). This species has subglobose ascomata and

vegetative strands formed mostly by a single row of cells. A similar species, *L. semiimmersum*, has ellipsoid ascospores and smaller, hyaline spores. With respect to *L. elongatum*, it differs in its shorter superficial hyphal strands, formed largely by a single row of cells, and mostly subglobose and not elongated ascospores.

**Lichenostigma semiimmersum* Hafellner – 48: on *Buellia elegans*.

**Lichenothelia renobalesiana* D.Hawksw. & V.Atiienza – 1: on limestone and endolithic *Bagliettoa* spp. and *Verrucaria* spp. First reported from Russia and the Caucasus by us (Urbanavichus et al., 2011).

Lobothallia praevalida (Nyl.) Hafellner – 24, 48: on limestone.

Lobothallia radiosa (Hoffm.) Hafellner – 9, 29, 44: on limestone.

Megaspora verrucosa (Ach.) Hafellner & V.Wirth – 36, 37, 38: on soil.

Melanelixia albertana (Ahti) O.Blanco & al. – 13, 42, 49: on trunk of *Alnus incana*, *Betula* sp., *Carpinus caucasica*, *Pyrus caucasica*, *Prunus divaricata*, and *Salix* sp. Previously reported from the Caucasus by us (Urbanavichus et al., 2010c).

Melanelixia glabra (Schaer.) O.Blanco & al. – 18, 34, 51: common, corticolous.

Melanelixia glabrata (Lamy) Sandler & Arup – 18, 20: on trunk of *Betula* sp. and *Pinus kochiana*.

Melanelixia subargentifera (Nyl.) O.Blanco & al. – 16, 47, 50: on trunk of *Betula* sp., *Carpinus caucasica*, *Quercus macranthera*, *Pyrus caucasica*, *Pinus kochiana*, *Prunus divaricata*, and *Salix* sp.

Melanelixia subaurifera (Nyl.) O.Blanco & al. – 18, 31, 42: on trunk of *Betula* sp. and *Pinus kochiana*.

Melanohalea exasperata (DeNot.) O.Blanco & al. – 1, 47, 52: on trunk of *Alnus incana*, *Malus orientalis*, *Betula* sp., *Pyrus caucasica*, and *Prunus divaricata*.

Melanohalea exasperatula (Nyl.) O.Blanco & al. – 1, 30, 43: very common, corticolous.

Melanohalea infumata (Nyl.) O.Blanco & al. – 9, 22, 47: on trunk of *Betula* sp., *Juniperus oblonga*, *Quercus macranthera*, and *Prunus divaricata*, rarely on limestone.

Micarea misella (Nyl.) Hedl. – 4, 33, 41: on bark and lignum of *Pinus kochiana*.

■**Milospium graphideorum* (Nyl.) D.Hawksw. – 6, 47: on *Dirina stenhammari*.

This lichenicolous hyphomycete is characterised by its lobate, brown to black conidia, with 2–6 mostly incomplete septa and unevenly thickened walls, 8–12 × 8–10 µm in size, which are often aggregated into black sporodochia on a host thallus.

**Muellerella erratica* (A.Massal.) Hafellner & V.John – 1: on *Acarospora cervina*, *Caloplaca variabilis*, *Circinaria calcarea*, *Lecanora agardhiana*, and *Protoblastenia*

rupestris. Previously reported from the Caucasus by us (Urbanavichus et al., 2011).

**Muellerella lichenicola* (Sommerf. ex Fr.) D.Hawksw. – 1: on *Aspicilia* spp., *Caloplaca* spp., and *Rinodina immersa*. Previously reported from the Caucasus by us (Urbanavichus et al., 2011).

**Muellerella pygmaea* (Körb.) D.Hawksw. – 1, 48: on *Aspicilia* spp., *Caloplaca teicholyta*, and *Verrucaria furfuracea*. Previously reported from the Caucasus by us (Urbanavichus et al., 2011).

Mycobilimbia tetramera (DeNot.) Hafellner & Türk – 15, 46: on mossy bark of *Pyrus caucasica* and mossy limestone.

+ *Mycocalicium subtile* (Pers.) Szatala – 42: on lignum of *Betula* sp.

■**Mycomicrothelia atlantica* D.Hawksw. & Coppins – 13, 42: on bark of *Betula* sp. and *Tilia* sp. New to Asia.

A detailed description of the species was presented by Smith et al. (2009). The similar species, *M. confusa* D.Hawksw., is distinguished by the larger and ±slipper-shaped ascospores, with an attenuated lower cell, and the absence of pycnidia.

**Nectriopsis lecanodes* (Ces.) Diederich & Schroers – 34, 42: on *Peltigera elisabethae* and *P. polydactylon*.

Neocatapyrenium rhizinosum (Müll.Arg.) Breuss – 2, 10, 36: on soil. Previously reported from the Caucasus by us (Urbanavichus et al., 2010c).

Ochrolechia arborea (Kreyer) Almb. – 18, 31, 42: on bark of *Betula* sp. and *Pinus kochiana*.

Ochrolechia pallescens (L.) A.Massal. – 1, 20, 47: on bark of *Betula* sp.

Opegrapha dolomitica (Arnold) Clauzade & Cl.Roux ex Torrente & Egea – 2, 10, 36: on limestone.

**Opegrapha pulvinata* Rehm – 4, 6: on *Endocarpon pusillum* and *Placidium* sp. Previously reported from the Caucasus by us (Urbanavichus et al., 2011).

Opegrapha rufescens Pers. – 35: on bark of *Carpinus caucasica*.

**Opegrapha rupestris* Pers. – 1, 10: on limestone and endolithic *Bagliettoa* spp. and *Verrucaria* spp.

Oxneria fallax (Hepp ex Arnold) S.Y.Kondr. & Kärnefelt – 14, 21, 49: common, corticolous, rarely on soil.

Oxneria ulophyllodes (Räsänen) S.Y.Kondr. & Kärnefelt – 16, 34, 51: common, corticolous.

Pannaria conoplea (Ach.) Bory – 20: on trunk of *Betula* sp.

■**Parabagliettoa cyanea* (A.Massal.) Gueidan & Cl.Roux – 10: on limestone. New to Asia.

Thallus thinly superficial, whitish, uncracked; the neighbouring thalli separated by sunken to slightly raised, more or less single or double brown-black lines. Perithecia immersed, with only the black apex visible; involucrellum confined to apex of exciple, or spreading sideways and

downwards; spores 14–16 × 6–7 µm. Differs from similar species *P. dufourii* (DC.) Gueidan & Cl.Roux in the smaller, less prominent perithecia, and the thalli typically in a mosaic with conspecific thalli, separated by dark lines.

Parmelia barroenoae Divakar, M.C.Molina & A.Crespo – 31, 42, 47: on trunk of *Betula* sp., *Pinus kochiana*, and *Salix* sp.

Parmelia serrana A.Crespo, M.C. Molina & D.Hawksw. – 32, 33, 41: on trunk of *Betula* sp. and *Pinus kochiana*.

Parmelia sulcata Taylor – 26, 33, 44: very common, corticolous, lignicolous, terricolous.

Parmeliella triptophylla (Ach.) Müll.Arg. – 20: on trunk of *Betula* sp.

Parmelina carporrhizans (Taylor) Poelt & Vězda – 22: on trunk of *Betula* sp.

Parmelina pastillifera (Harm.) Hale – 16, 20, 47: on trunk of *Betula* sp.

Parmelina tiliacea (Hoffm.) Hale – 18, 44, 51: on trunk of *Betula* sp., *Carpinus caucasica*, *Pinus kochiana*, and *Salix* sp.

Parmotrema perlatum (Huds.) M.Choisy – 14, 18, 47: on trunk of *Betula* sp. and *Salix* sp.

Parmotrema stuppeum (Taylor) Hale – 16, 20, 33: on trunk of *Betula* sp. and *Pinus kochiana*.

Peltigera canina (L.) Willd. – 33, 42, 51: on soil.

Peltigera collina (Ach.) Schrad. – 47: on trunk of *Salix* sp.

Peltigera didactyla (With.) J.R.Laundon – 2, 10, 42: on soil.

Peltigera elisabethae Gyeln. – 10, 23, 37: on soil and mossy base of *Betula* sp. trunk.

Peltigera leucophlebia (Nyl.) Gyeln. – 44: on soil.

Peltigera malacea (Ach.) Funck – 2: on soil.

Peltigera monticola Vitik. – 3, 42: on soil.

Peltigera polydactylon (Neck.) Hoffm. – 42, 44: on soil and mossy base of *Betula* sp. trunk.

Peltigera praetextata (Flörke ex Sommerf.) Zopf – 13, 15, 49: on trunk of *Betula* sp. and *Pyrus caucasica* and soil.

Peltigera rufescens (Weiss) Humb. – 2, 9, 12, 21, 36: on soil.

Peltula bolanderi (Tuck.) Wetmore – 4: on limestone.

Peltula euploca (Ach.) Poelt – 4, 8, 39: on limestone.

Pertusaria albescens (Huds.) M.Choisy & Werner – 16, 20: on bark of *Betula* sp.

Pertusaria amara (Ach.) Nyl. – 16: on bark of *Betula* sp.

Pertusaria constricta Erichsen – 42: on bark of *Betula* sp.

Pertusaria glomerata (Ach.) Schaer. – 37: on dead mosses on soil.

Phaeophyscia cernohorskyi (Nádv.) Essl. – 1, 21, 22: on trunk of *Juniperus oblonga* and dead dwarf shrub. First reported from Russia and the Caucasus by us (Urbanavichus et al., 2010c).

Phaeophyscia ciliata (Hoffm.) Moberg – 14, 26, 47, 52: common, corticolous.

Phaeophyscia constipata (Norrl. & Nyl.) Moberg – 2, 7, 17, 21: on soil. Previously reported from the northern Caucasus by us (Urbanavichus et al., 2010c).

Phaeophyscia endophoenicea (Harm.) Moberg – 16, 30: on trunk of *Betula* sp. and *Salix* sp.

Phaeophyscia hirsuta (Mereschk.) Essl. – 4, 35, 50: very common, corticolous.

Phaeophyscia kairamoi (Vain.) Moberg – 15, 29, 47: common, corticolous and saxicolous.

Phaeophyscia nigricans (Flörke) Moberg – 1, 11, 35, 52: common, corticolous and saxicolous.

Phaeophyscia orbicularis (Neck.) Moberg – 15, 44, 52: very common, corticolous and saxicolous.

Phaeophyscia sciastra (Ach.) Moberg – 2, 8, 43, 46, 51: on limestone.

Phaeorrhiza nimbosea (Fr.) H.Mayrhofer & Poelt – 36: on soil.

Phaeorrhiza sareptana (Tomin) H.Mayrhofer & Poelt var. *sphaerocarpa* (Th.Fr.) H.Mayrhofer & Poelt – 36: on soil.

**Phaeosporobolus usneae* D.Hawksw. & Hafellner – 16, 43: on *Evernia mesomorpha* and *Usnea* sp.

Phlyctis argena (Spreng.) Flot. – 20: on trunk of *Juniperus oblonga*.

Physcia adscendens (Fr.) H.Olivier – 10, 22, 51: very common, corticolous, lignicolous, rarely saxicolous.

Physcia aipolia (Ehrh. ex Humb.) Fűrnr. – 1, 18, 26: very common, corticolous, lignicolous, rarely saxicolous.

Physcia aipolioides (Nádv.) Breuss & Türk – 22: on trunk of *Juniperus oblonga*. First reported from Russia and the Caucasus by us (Urbanavichus et al., 2010b).

Physcia caesia (Hoffm.) Fűrnr. – 2, 7, 9, 45: common, on limestone.

Physcia dimidiata (Arnold) Nyl. – 43, 45, 47: on trunk of *Carpinus caucasica* and on limestone.

Physcia leptalea (Ach.) DC. – 1: on twigs of *Juniperus oblonga*.

Physcia stellaris (L.) Nyl. – 4, 31, 49: very common, corticolous, lignicolous, rarely saxicolous.

Physcia subalbinea Nyl. – 43, 44: on limestone and plant debris.

Physcia tribacia (Ach.) Nyl. – 31: on trunk of *Pinus kochiana*.

Physcia vitii Nádv. – 1, 18, 42: common, corticolous. Previously reported from the northern Caucasus by us (Urbanavichus et al., 2010c).

Physciella chloantha (Ach.) Essl. – 4, 13, 35: common, corticolous and saxicolous.

Physconia distorta (With.) J.R.Laundon – 15, 35, 47: very common, corticolous.

Physconia muscigena (Ach.) Poelt – 7, 11, 27, 38, 49: common, terricolous.

Physconia perisidiosa (Erichsen) Moberg – 16, 30, 35: on trunk of *Betula* sp., *Carpinus caucasica*, and *Salix* sp.

Physconia rossica G.Urban. – 2, 6, 48: on soil, limestone, rarely on trunk of *Populus tremula*. Previously reported from the Caucasus by us (Urbanavichus et al., 2010c).

Ph. rossica is essentially a segregate of *Ph. perisidiosa* and had earlier been included in that species in herbaria (Lohtander et al., 2007). It differs from *Ph. perisidiosa* by having a white, partly corticate lower surface, and narrower and longer lobes. It differs from *Ph. grisea* (Lam.) Poelt by having finer and narrower lobes, a scleroplectenchymatous upper cortex, and absence of a distinct lower cortex (Urbanavichus, 2008).

Placidiosis cinerascens (Nyl.) Breuss – 46, 48: on soil. This record is the second for Russia after our report from the southern Urals (Urbanavichus & Urbanavichene, 2011).

Placidiosis pseudocinerea Breuss – 36: on soil.

Placidium squamulosum (Ach.) Breuss – 2, 4, 9, 22: on soil.

Placocarpus schaereri (Fr.) Breuss – 10, 24, 45: on limestone.

Placopyrenium fuscillum (Turner) Gueidan & Cl.Roux – 43: on *Verrucaria nigrescens*.

Placynthiella dasaea (Stirt.) Tønsberg – 18, 33, 41: on bark of *Pinus kochiana* and lignum of *Pinus kochiana* and *Betula* sp.

Placynthiella icmalea (Ach.) Coppins & P.James – 16: on decaying wood.

Placynthium filiforme (Garov.) Choisy – 8, 43: on limestone.

■ *Placynthium garovaglioii* (A.Massal.) Malme – 36: on limestone. New to Asia.

This species is distinguished from all other members of the genus by the small thallus, weakly effigurate, seldom exceeding 2 cm in diameter, with marginal (when present), appressed, slender lobes, and with dense, bluish white pruina, not papillate-coralloid, without prothallus. *P. hungaricum* differs by its clearly elongated margin lobes, not appressed, central parts of repeatedly branched lobules, appearing isidioid (thickly papillate to coralloid).

Placynthium hungaricum Gyeln. – 1: on limestone. New to Asia.

Placynthium nigrum (Huds.) Gray – 5, 8, 9: on limestone.

Placynthium subradiatum (Nyl.) Arnold – 8: on limestone.

Placynthium tremniacum (A.Massal.) Jatta – 1, 44, 48: on limestone.

Pleurosticta acetabulum (Neck.) Elix & Lumbsch – 16: on trunk of *Salix* sp.

Polyblastia albida Arnold – 10: on limestone. Previously reported from the Caucasus by us (Urbanavichus et al., 2010a).

■ *Polyblastia dermatodes* A.Massal. – 24: on limestone.

This species is characterised by the grey, immersed thallus; perithecia immersed in pits in limestone; absent involucrellum; pigmented exciple; colourless, submuriform (with 3–4 transverse septa and 1–2 longitudinal septa) spores, 25–50 × 12–25 µm.

Polyblastia sendtneri Kremp. – 7: on soil. Previously reported from the Caucasus by us (Urbanavichus et al., 2010c).

* *Polycoccum bryontheae* (Arnold) Vězda – 18: on *Lecanora saligna*.

Protoblastenia incrustans (DC.) J.Steiner – 10, 24, 47: on limestone.

Protoblastenia rupestris (Scop.) J.Steiner – 3, 5, 36, 41: on limestone.

Pseudevernia furfuracea (L.) Zopf – 16, 20, 42: common, on trunk of *Betula* sp. and *Pinus kochiana*.

Psora decipiens (Hedw.) Hoffm. – 8, 17, 36, 49: on soil.

Psora globifera (Ach.) A.Massal. – 6: on soil.

Psorotichia schaereri (A.Massal.) Arnold – 1: on limestone.

Punctelia borreri (Sm.) Krog – 3: on trunk of *Betula* sp.

Punctelia jeckeri (Roum.) Kalb – 18, 42: on trunk of *Betula* sp., *Pinus kochiana*, and *Salix* sp.

Punctelia subrudecta (Nyl.) Krog – 16, 30, 51: common, on trunk of *Betula* sp., *Pinus kochiana*, and *Salix* sp.

Pycnora praestabilis (Nyl.) Hafellner – 31: on lignum of *Pinus kochiana*.

Ramalina asahinana Zahlbr. – 4, 44, 51, 52: very common, corticolous.

Ramalina farinacea (L.) Ach. – 16, 34, 47: on trunk of *Betula* sp., *Pinus kochiana*, and *Salix* sp.

Ramalina fastigiata (Pers.) Ach. – 1, 44, 51: on trunk of *Malus orientalis*, *Carpinus caucasica*, and *Prunus divaricata*.

Ramalina fraxinea (L.) Ach. – 20, 32, 47: on trunk of *Betula* sp., *Pyrus caucasica*, *Pinus kochiana*, and *Salix* sp.

Ramalina pollinaria (Westr.) Ach. – 18, 37, 49: common, corticolous, rarely on mossy limestone and soil.

Ramalina sinensis Jatta – 1, 30, 47, 52: common, corticolous.

Rinodina bischoffii (Hepp) A.Massal. – 1, 9: on limestone.

Rinodina conradii Körb. – 18: on lignum of *Betula* sp.

Rinodina degeliana Coppins – 51: on bark of *Carpinus caucasica*.

Rinodina griseosoralifera Coppins – 30, 34, 42: on bark of *Betula* sp. and *Salix* sp.

Rinodina immersa (Körb.) Arnold – 1, 2, 48: on limestone.

Rinodina lecanorina (A.Massal.) A.Massal. – 39, 48: on limestone.

Rinodina oleae Bagl. – 1, 42, 50: on bark of *Betula* sp., *Quercus macranthera*, *Pyrus caucasica*, and *Prunus divaricata*.

·*Rinodina orculata* Poelt & M.Steiner – 42, 47: on bark of *Betula* sp. and *Carpinus caucasica*.

Rinodina pyrina (Ach.) Arnold – 16, 33: on bark of *Betula* sp.

Rinodina septentrionalis Malme – 4, 32, 42: on bark of *Betula* sp. and *Pinus kochiana*.

Rinodina terrestris Tomin – 3: on soil. Previously reported from the Caucasus by us (Urbanavichus et al., 2010a).

Romjularia lurida (Ach.) Timdal – 8, 25, 45, 48: on soil and limestone.

■*Rusavskia digitata* (S.Y.Kondr.) S.Y.Kondr. & Kärnefelt – 1: on limestone. New to Asia.

A detailed description of the species was presented by Khodosovtsev et al. (2004). This species has large coralloid, secondary outgrowths, which function as isidia, up to 2.5–5 mm tall/long, and abundantly pseudocyphellate and often almost entirely without the primary lobes. It differs mainly from the closely related *R. domogledensis* (Vězda) S.Y.Kondr. & Kärnefelt and *R. papillifera* in the generally longer isidioid outgrowths (cylindrical isidia 1–1.5 mm in *R. domogledensis* and finger-like to lobulate isidia up to 2 mm in *R. papillifera*). *R. digitata* was previously known from some isolated localities at relatively high altitudes (ca. 1500 m) in the Crimean Peninsula (Ukraine).

Rusavskia elegans (Link) S.Y.Kondr. & Kärnefelt – 3, 40, 52: very common, on limestone.

Rusavskia papillifera (Vain.) S.Y.Kondr. & Kärnefelt – 43: on limestone.

Rusavskia soredata (Vain.) S.Y.Kondr. & Kärnefelt – 40, 44, 51: on limestone.

·*Sagiolechia protuberans* (Ach.) A.Massal. – 36: on limestone.

Sarcogyne regularis Körb. – 2, 9: on limestone.

Scoliciosporum umbrinum (Ach.) Arnold – 18, 31, 47: on bark of *Betula* sp. and *Pinus kochiana*.

Seirophora contortuplicata (Ach.) Frödén – 2, 27: on limestone.

Solorina bispora Nyl. – 7, 43, 44: on soil.

Solorina saccata (L.) Ach. – 8, 12, 29, 46, 51: common, on soil.

Solorina spongiosa (Ach.) Anzi – 29: on soil.

**Sphaerellothecium cladoniae* (Alstrup & Zhurb.) Hafellner – 2: on *Cladonia pocillum*. Previously reported from the Caucasus by us (Urbanavichus et al., 2011).

Squamarina cartilaginea (With.) P.James – 7, 26, 44: on limestone and soil.

Squamarina conrescens (Müll.Arg.) Poelt – 12, 25, 48: limestone and soil. First reported from Russia and the Caucasus by us (Urbanavichus et al., 2010c).

■*Squamarina stella-petraea* Poelt – 48: on limestone.

Thallus rosette-forming, rather firmly attached; peripheral lobes 0.8–1 mm long and 1–2 mm wide,

contiguous, occasionally imbricated, flat to slightly convex, with somewhat inflated tips; central part more or less even and areolated; upper surface yellowish green, smooth, faintly pruinose. Medulla Pd + yellow.

·*Staurothele bacilligera* (Arnold) Arnold – 36: on limestone.

■*Staurothele elenkinii* Oxner – 48: on limestone.

Thallus crustose, at least partially endolithic; perithecial warts subspherical with the base constricted, to 0.7 mm broad; blackish, sometimes only a paling of the substrate is visible; prothallus absent. Perithecia single in the verrucule, up to 0.5 mm broad; involucrellum black carbonaceous and constricted below; asci 2-spored; spores ellipsoid, dark brown, muriform, up to 8-septate transversely and 3-septate longitudinally, 33–62 × 18–33 µm.

Staurothele frustulenta Vain. – 45: on limestone.

+ *Stenocybe pullatula* (Ach.) Stein – 14, 52: on bark of *Alnus incana*.

**Stigmidium congestum* (Körber) Triebel – 16, 42: on apothecia of *Lecanora chlarotera*.

**Stigmidium rouxianum* Calat. & Triebel – 1: on *Acarospora cervina*. First reported from Russia and the Caucasus by us (Urbanavichus et al., 2011).

·**Stigmidium tabacinae* (Arnold) Triebel – 48: on *Toninia cinereovirens*.

·*Strigula jamesii* (Swinscow) R.C.Harris – 14, 50: on bark of *Tilia* sp. and *Prunus divaricata*.

·*Synalissa ramulosa* (Hoffm. ex Bernh.) Fr. – 1, 8, 48: on limestone, often associated with *Romjularia lurida*.

·**Szygospora physciacearum* Diederich – 14: on *Physcia vitii*.

·*Thallinocarpon nigrillum* (Lettau) P.M.Jørg. – 8, 45, 48: on limestone.

Thamnolia vermicularis (Sw.) Schaer. – 36, 38, 44: on soil.

Thelenella modesta (Nyl.) Nyl. – 47: on bark of *Betula* sp.

Thelidium decipiens (Nyl.) Kremp. – 1: on limestone. Previously reported from the Caucasus by us (Urbanavichus et al., 2011).

Thelidium papulare (Fr.) Arnold – 3, 8, 43, 48: on limestone.

Thelidium pyrenophorum (Ach.) Mudd – 36: on limestone.

Thyrea confusa Henssen – 8, 44: on limestone.

Toninia alutacea (Anzi) Jatta – 2, 45, 48: on limestone.

Toninia athallina (Hepp) Timdal – 1, 44: on limestone.

Toninia candida (Weber) Th.Fr. – 8: on limestone.

Toninia cinereovirens (Schaer.) A.Massal. – 1, 8, 48, 49: on limestone.

Toninia diffracta (A.Massal.) Zahlbr. – 4, 8, 48: on soil and limestone. Previously reported from the Caucasus by us (Urbanavichus et al., 2010c).

**Toninia episema* (Nyl.) Timdal – 1: on *Circinaria calcarea*. First reported from Russia and the Caucasus by us (Urbanavichus et al., 2011).

**Toninia leptogii* Timdal – 15: on *Leptogium plicatile*. First reported from Russia and the Caucasus by us (Urbanavichus et al., 2011).

■ *Toninia nordlandica* Th.Fr. – 44: on limestone. New to Asia.

All the characteristics of the Dagestani specimen agree well with the description given by Timdal (1991). *T. nordlandica* is not a variable species. The upper side of the squamules may be more or less pruinose, with more or less well-developed fissures in the cortex. Except for the spore size, the apothecial anatomy of *T. nordlandica* is apparently indistinguishable from that of *T. pennina* (Schaer.) Gyeln. The species differ mainly in the shape and colour of the squamules: in *T. pennina* the squamules are plane to weakly convex, medium to dark brown, often shiny, and epruinose or weakly pruinose.

Toninia opuntiooides (Vill.) Timdal – 1, 7, 24, 48: on soil.

Toninia philippea (Mont.) Timdal – 1, 46: on limestone.

Toninia physaroides (Opiz) Zahlbr. – 2, 10, 48: on soil. Previously reported from the Caucasus by us (Urbanavichus et al., 2010c).

Toninia sedifolia (Scop.) Timdal – 2, 9, 21, 49: on soil.

Toninia toniniana (A.Massal.) Zahlbr. – 1: on limestone. First reported from Russia and the Caucasus by us (Urbanavichus et al., 2010c).

Toninia tristis (Th.Fr.) Th.Fr. – 4, 5, 49: on soil in fissures of limestone.

Toninia verrucarioides (Nyl.) Timdal – 1: on limestone. Previously reported from the Caucasus by us (Urbanavichus et al., 2010a).

Trapeliopsis flexuosa (Fr.) Coppins & P.James – 31, 33, 41: on decaying wood.

**Unguiculariopsis thallophila* (P.Karst.) W.Y.Zhuang – 42: on apothecia of *Lecanora chlarotera*.

Usnea articulata (L.) Hoffm. – 16, 49, 51: on trunk of *Betula* sp.

Usnea barabata (L.) F.H.Wigg. – 16, 47: on trunk of *Betula* sp.

Usnea cavernosa Tuck. – 18, 31, 32: on trunk of *Betula* sp. and *Pinus kochiana*.

Usnea dasypoga (Ach.) Röhl. – 16, 47, 51: on trunk of *Betula* sp. and *Pinus kochiana*.

Usnea florida (L.) F.H.Wigg. – 31, 47, 51: on trunk of *Betula* sp. and *Pinus kochiana*.

Usnea fulvovirens (Räsänen) Räsänen – 16: on trunk of *Betula* sp. and *Pinus kochiana*.

Usnea glabrata (Ach.) Vain. – 32, 42: on trunk of *Betula* sp. and *Pinus kochiana*.

Usnea glabrescens (Nyl. ex Vain.) Vain. – 42: on trunk of *Salix* sp.

Usnea hirta (L.) F.H.Wigg. – 1, 31, 47: on trunk of *Betula* sp., *Pinus kochiana*, and *Prunus divaricata*.

Usnea intermedia (A.Massal.) Jatta – 16: on trunk of *Betula* sp.

Usnea lapponica Vain. – 32: on trunk of *Pinus kochiana*.

Usnea subfloridana Stirt. – 32: on trunk of *Pinus kochiana*.

Usnea wasmuthii Räsänen – 16: on trunk of *Betula* sp.

Verrucaria caerulea DC. – 1, 44: on limestone. Previously reported from the northern Caucasus by us (Urbanavichus et al., 2010a).

■ *Verrucaria endocarpoides* Servit – 43: on limestone. New to Asia.

A detailed description was provided by Breuss and Berger (2010). Among the brown, thickly epilithic species, *V. endocarpoides* is characterised by immersed perithecia and stout periphyses. *V. nigrescens* is distinguished by the black prothallus and thallus anatomy. *V. nigrofusca* Servit may also bear some external similarities but has somewhat smaller spores, and is further distinguished by prominent perithecia and longer and thinner periphyses.

Verrucaria furfuracea (B. de Lesd.) Breuss – 1, 39: on limestone.

Verrucaria hochstetteri Fr. – 1, 36: on limestone.

Verrucaria muralis Ach. – 48: on limestone.

Verrucaria nigrescens Pers. – 3, 36, 46: on limestone.

Verrucaria sphaerospora Anzi – 29: on limestone.

Verrucula latericola (Erichsen) Nav.-Ros. & Cl.Roux – 1: lichenicolous on *Caloplaca* sp., and *Diplotomma* sp. on limestone. First reported from Russia and the Caucasus by us (Urbanavichus et al., 2011).

Verruculopsis lecideoides (A.Massal.) Gueidan & Cl.Roux – 39: on limestone. The nearest records to Dagestan are in Turkey (Karagöz & Aslan, 2012).

Vulpicida pinastri (Scop.) J.-E.Mattsson & M.J.Lai – 31, 33, 44: on lignum and bark of *Pinus kochiana*.

Xanthomendoza fulva (Hoffm.) Söchting, Kärnefelt & S.Y.Kondr. – 6, 47, 52: common, corticolous, rarely saxicolous.

Xanthoparmelia camtschadalis (Ach.) Hale – 9, 11, 30, 38: on soil.

Xanthoparmelia pulvinaris (Gyeln.) Ahti & D.Hawksw. – 2, 9: on soil.

Xanthoparmelia stenophylla (Ach.) Ahti & D.Hawksw. – 20, 30, 32: on trunk base of *Betula* sp. and *Pinus kochiana*.

Xanthoria parietina (L.) Th.Fr. – 1, 35, 52: very common, corticolous.

Xylographa parallela (Ach.) Fr. – 41: on wood of *Pinus kochiana*.

4. Results and discussion

Before our research began, there were only 2 species known from the Gunib plateau: *Cladonia fimbriata*

and *Cladonia convoluta* (Barkhalov, 1983; LE). As a result of the lichenological exploration of the Gunib plateau, we are able to report 151 genera and 446 species, corresponding to more than one-third of the known North Caucasian lichen flora (Urbanavichus, 2010). Of the species encountered, 19 are reported here for the first time from Russia: *Abrothallus chrysanthus*, *Abrothallus microspermus*, *Caloplaca albopruinosa*, *Candelariella plumbea*, *Candelariella rhodax*, *Cladonia firma*, *Halospora deminuta*, *Halospora discrepans*, *Lichenostigma epipolina*, *Milospium graphideorum*, *Mycomicrothelia atlantica*, *Parabagliettoa cyanea*, *Placynthium garovaglioii*, *Polyblastia dermatodes*, *Rusavskia digitata*, *Squamarina stella-petraea*, *Staurothele elenkinii*, *Toninia nordlandica*, and *Verrucaria endocarpoides*; 71 taxa are new records for the Caucasus. In addition, 15 are new to Asia. From the Gunib plateau we previously reported 13 species for the first time from Russia, 36 new records for the Caucasus, and 4 new records for Asia (Urbanavichus et al., 2010a, 2010c, 2011). The majority of the species newly reported for Russia and the Caucasus were previously known from Turkey and other countries of South-West Asia (John, 1996; Yazıcı, 1999; Temina et al., 2005; Seaward et al., 2008; Halıcı & Aksoy, 2009; Kocakaya et al., 2009; Kinalioğlu, 2010; Karagöz et al., 2011; Yazıcı et al., 2011) and the Mediterranean region (Sipman & Raus, 2002; Calatayud & Triebel, 2003; Vondrák et al., 2008; Etayo, 2010; Garofalo et al., 2010; Oran & Öztürk, 2012).

In addition to lichenicolous (37 taxa) and nonlichenised fungi (7 taxa), among the 402 lichen taxa, 184 are crustose, colonising a wide variety of substrata in the study area. *Caloplaca*, *Lecanora*, *Rinodina*, and *Arthonia* are the more common crustose genera. Among these, *Caloplaca* is the most diverse (represented by 29 species, mostly on rocks). Among the macrolichens, 122 taxa are foliose, 63 fruticose, and 33 squamulose. *Cladonia*, *Toninia*, *Usnea*, *Collema*, *Peltigera*, *Physcia*, and *Phaeophyscia* are the more common genera. Twenty-three species of the genus *Cladonia* were found on the Gunib plateau, mostly on soil in forests.

Almost 80% of the species (355) were present in 2 vegetation types: (1) pine forest with *Pinus kochiana* and (2) birch forest. On trees we found 224 taxa (including corticolous and lignicolous, and nonlichenised and lichenicolous fungi growing on epiphytic lichens); among these, 192 were exclusively epiphytic. The highest species diversity (137 taxa) was recorded from *Betula* sp., the phorophyte that was present at most of the forest localities. With respect to species diversity the next best host tree species after *Betula* sp. is *Pinus kochiana*, with 81 taxa. The proportion of foliose lichens is very high on these trees.

Saxicolous and terricolous species grow in a wide altitudinal range; however, the greatest diversity occurs in more humid conditions over 1650 m a.s.l. On

limestone substrata 148 taxa were found, whereas 130 were exclusively epilithic. *Caloplaca*, *Toninia*, *Lecanora*, *Verrucaria*, *Collema*, *Physcia*, and *Placynthium* are the more common genera among the epilithic taxa. More specifically, 79 species were identified growing on 1 limestone boulder 1.5 m in height (locality 1). Terricolous species (including those growing on plant debris and among terricolous bryophytes) were represented by 112 species, and among these 67 were exclusively terricolous. *Cladonia* and *Peltigera* are the most common terricolous genera. In addition, the majority of the members of the genera *Collema*, *Leptogium*, and *Toninia* were found on calciferous soil. Several lichens that usually dwell on bark occasionally become terricolous in subalpine meadows (e.g., *Anaptychia ciliaris*, *Evernia divaricata*, *Evernia mesomorpha*, *Flavoparmelia caperata*, *Flavopunctelia soledica*, and *Ramalina pollinaria*).

In all, 37 species of lichenicolous fungi were identified. The greatest diversity of lichenicolous fungi is seen in mature lichen communities in natural undisturbed habitats (Lawrey & Diederich, 2003). Thus, the rich biodiversity of lichenicolous fungi on the Gunib plateau indicates that it is a natural undisturbed habitat. The lichen genera *Aspicilia*, *Caloplaca*, *Lecanora*, and *Usnea* harbour most of the lichenicolous species.

The lichen flora of the Gunib plateau is of great phytogeographic interest because it includes various lichen complexes: (1) temperate oceanic/suboceanic (e.g., *Cetrelia cetrarioides*, *C. olivetorum*, *Collema fasciculare*, *Heterodermia japonica*, *H. speciosa*, *Hypotrachyna laevigata*, *H. revoluta*, *Pannaria conoplea*, *Parmotrema perlatum*, *P. stuppeum*, *Peltigera collina*, *Usnea articulata*, and *U. florida*), (2) boreal (e.g., the majority of the genera *Bryoria* spp., *Cladonia* spp., and *Peltigera* spp.), (3) arctic-alpine (e.g., *Bacidia bagliettoana*, *Caloplaca ammiospila*, *C. sinapisperma*, *C. tirolensis*, *Catapyrenium cinereum*, *Flavocetraria cucullata*, *F. nivalis*, *Lecanora epibryon*, *Solorina* spp., and *Thamnolia vermicularis*), and (4) Mediterranean species (e.g., *Caloplaca albopruinosa*, *Caloplaca alociza*, *C. badioreagens*, *C. biatorina*, *Candelariella unilocularis*, *Cladonia firma*, *Fulgensia fulgens*, *F. subbracteata*, *Lecanora pruinosa*, *Placocarpus schaeferi*, *Squamarina concrescens*, *S. stella-petraea*, *Toninia leptogii*, and *T. toniniana*). It also contains very rare species that are disappearing from large areas of Europe (e.g., *Agonimia allobata*, *A. opuntiella*, *Bryoria kuemmerleana*, *Bacidia igniarii*, *Candelariella plumbea*, *Chrysothrix flavovirens*, *Cladonia magyrica*, *Cryptodiscus foveolaris*, *Elixia flexella*, *Leptogium schraderi*, *Mycomicrothelia atlantica*, *Strigula jamesii*, and *Thelenella modesta*) or Asia (e.g., *Anaptychia desertorum*, *Caloplaca lenae*, *Collema minor*, *Glypholecia scabra*, *Melanelixia albertana*, and *Neocatapyrenium rhizinosum*). Many of the epiphytic

species are indicators of air purity and the long ecological continuity of the woods (e.g., *Cetrelia* spp., *Collema* spp., *Flavopunctelia* spp., *Heterodermia* spp., *Hypotrachyna* spp., *Letharia vulpina*, *Pannaria conoplea*, *Parmotrema* spp., and *Usnea* spp.) (e.g., Coppins & Coppins, 2002, 2006; Fernández-Salegui et al., 2007; Nascimbene et al., 2008; Bradtka et al., 2010).

Most species with temperate oceanic/suboceanic and boreal distributional ranges occur at altitudes between 1600 and 1900 m. They grow in dense forest stands where moisture remains for a long time. Most species with an arctic-alpine distributional range grow on exposed cliffs, rocks, and soils over 1900–2000 m a.s.l. The Mediterranean species occur mainly at lower altitudes (1400–1600 m a.s.l.).

Thus, in 3 years (2009–2011), 446 species of lichens and lichenicolous fungi have been recorded within 15 km² on the Gunib plateau in inner-mountain Dagestan. It has higher lichen biodiversity in a relatively small area than anywhere else in Russia. The Russia lichen checklist currently comprises almost 3400 species (Urbanavichus,

2010), which means that the Gunib plateau supports more than 13% of the lichen species richness reported for all of Russia, although it is only a fraction of its size (0.000088%). Never before have 408 species been found in the Republic of Dagestan. More than 100 recorded species were previously unknown from the Caucasus, and 33 species are new to Russia. With the current study the number of known lichens and lichenicolous fungi reported from Dagestan has reached 482. The enormous number of species newly reported for Dagestan and the Caucasus shows that knowledge of lichen distribution in the Caucasus is still very incomplete.

Acknowledgements

We are grateful to the reviewers for their valuable comments on the manuscript, and we thank Prof Teuvo Ahti, Dr Irina Urbanavichene, Dr Orvo Vitikainen, and Dr Jan Vondrák for confirming some species of *Caloplaca*, *Cladonia*, and *Peltigera*. The first author is grateful to Dr SM Asadulaev, Director of the Mountain Botanical Garden, Dagestan Scientific Centre, for financial support of the field work.

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