Contribution to the lichen flora of Erzi Nature Reserve, Republic of Ingushetia, North Caucasus, Russia

Authors: Urbanavichus, Gennadii P., and Urbanavichene, Irina N.

Source: Willdenowia, 47(3) : 227-236

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.47.47306
Contribution to the lichen flora of Erzi Nature Reserve, Republic of Ingushetia, North Caucasus, Russia

Version of record first published online on 9 November 2017 ahead of inclusion in December 2017 issue.

Abstract: As a result of lichenological exploration of the Erzi Nature Reserve in the Republic of Ingushetia, North Caucasus, Russia, we report 266 species of lichenized fungi, 13 of lichenicolous fungi and seven of non-lichenized saprophytic fungi, representing 115 genera. Twenty-three species are recorded for the first time for North Caucasus, of which 16 are new for the Caucasus and ten are new for Russia (Arthonia protoparmeliopseos, Aspicilia viridescens, Buellia abstracta, Lecidella viridans, Micarea soralifera, Rinodina straussii, R. tunicata, R. zwackhiana, Schizoxylon alboatrum and Verrucaria fuscoatraides). Of the 16 species new for the Caucasus, seven are recorded for the first time for Asia (Buellia abstracta, Micarea nigella, M. soralifera, Ramonia chrysophaea, Rinodina tunicata, Schizoxylon alboatrum and Verrucaria elevata). In addition, two taxa listed in the Red Data Book of Russia are recorded: Leptogium burnetiae and Usnea florida.

Key words: Caucasus, checklist, conservation, diversity, Erzi Nature Reserve, lichens, new records, Republic of Ingushetia, Russia

Article history: Received 31 May 2017; peer-review completed 9 October 2017; received in revised form 15 October 2017; accepted for publication 19 October 2017.

Citation: Urbanavichus G. P. & Urbanavichene I. N. 2017: Contribution to the lichen flora of Erzi Nature Reserve, Republic of Ingushetia, North Caucasus, Russia. – Willdenowia 47: 227–236. doi: https://doi.org/10.3372/wi.47.47306

Introduction

The Caucasus is one of the world’s biodiversity hotspots (Krever & al. 2001) and one of the most diverse regions of Russia (Geltman & al. 1998). In contrast to the relatively well-studied lichen flora of the W Caucasus, its C and E parts (including the Republic of Ingushetia) are still poorly explored. In North Caucasus, seven Nature Reserves include the most important natural ecosystems with great biological diversity and natural features of exceptional scientific interest. The lichen flora of six of these has been studied (Urbanavichus & Urbanavichene 2004, 2015, 2017; Urbanavichus & al. 2010); only the Erzi Nature Reserve remains to be studied. The present study aims at improving our knowledge of the Reserve’s lichen flora and, together with other recent contributions on Caucasian lichens, to serve as an official documentation of newly discovered/reported species for the region and for Russia.

Research area

The Erzi Nature Reserve (Kotiev & al. 2015) covers an area of 35,292 ha and is located on the N slope of the Greater Caucasus in the Sunzha and Dzeirakh districts of the Republic of Ingushetia, c. 35 km S of Magas city (Fig. 1). In Russia the Reserve is bordered by the Republic of Northern Ossetia (Severnaya Osetiya) and the Republic of Chechnya along the main Caucasian

1 Institute of the North Industrial Ecology Problems, Kola Science Centre, Russian Academy of Sciences, Akademgorodok 14, 184209 Apatity, Murmansk Region, Russia; *e-mail: g.urban@mail.ru (author for correspondence).
2 Komarov Botanical Institute, Professor Popov Str. 2, St. Petersburg 197376, Russia; e-mail: urbanavichene@gmail.com
ridge, with the Republic of Georgia to the south. The altitude ranges from 850 to 3031 m (the highest peak Mt Khakhalgi). The landscape features mountain range spurs over deep river valleys, steep S slopes and gently sloping N slopes. Rivers in the Reserve include the Assa and Armkhi, which feed into the Terek river. The outcropping rocks are predominantly of shales and sandstones of Miocene age; Jurassic calcareous rock formations are rare. About one-third of the Reserve is forested, mostly on the lower N slopes. The forests are mostly oak (*Quercus petraea* (Matt.) Liebl.) and birch-pine (*Betula pendula* Roth., *Pinus kochiana* Klotzsch ex K. Koch) communities. Underbrush at the mid-level includes sea buckthorn (*Hipophae rhamnoides* L.), willow (*Salix caprea* L.), grey alder (*Alnus incana* (L.) Moench) and in some places extensive hazel (*Corylus avellana* L.). Approaching the sub-alpine zone the brush features caucasian rhododendron (*Rhododendron caucasicum* Pall.). Above 2000 m, but below the alpine zone at 2500 m, is a belt of mountain forest-steppe: wheatgrass-wormwood-cereal xerophytic steppes on shallow meadow soils. Although the Reserve is rather small, it supports about 18% (c. 1100 species) of the Caucasian flora. The climate of Erzi is characterised by long, cold winters, and short, cool summers. The average number of days of precipitation per year is 113. The average temperature is −1.4 °C in January and 26.4 °C in July. The average annual precipitation ranges from 350–400 mm below 1200 m altitude to 500–600 mm above 2000 m. Over 160 historical and cultural sites (martial towers, temples, necropolis tracts, sacred groves, and structures from ancient, medieval and later periods) are also protected by the Reserve.

**Material and methods**

The lichen specimens were collected in the following seven localities:

1. Right-hand bank of Tetritskali river, 42°49’53”N, 44°55’19”E, 1280–1290 m, *Pinus kochiana* forest, 29 June 2016.
2. Targim tower complex on right-hand bank of Assa river, 42°50’00”N, 44°56’29”E, 1080 m, floodplain forest with *Alnus incana*, *Hipophae rhamnoides* and *Salix caprea*, 30 June 2016.
3. Between Leymi and Egikhal tower complexes, 42°50’02–07”N, 44°54’28–44”E, 1340–1450 m, *Pinus kochiana* forest and stony SE slope, 30 June 2016.
4. Right-hand bank of a nameless stream (right tributary of Tetritskali river), 42°49’43”N, 44°54’14”E, 1350–1360 m, *Alnus incana* and *Salix caprea* forest, 1 July 2016.
5. Around Ozdig tower complex, 42°49’30”N, 44°54’52”E, 1500–1600 m, *Pinus kochiana* and *Betula pendula* forest with *Populus tremula*, *Pyrus* sp. and *Tilia cordata* Mill. on N slope, 1 & 5 July 2016.
6. Left-hand bank of Assa river, 42°49’55”N, 44°56’18”E, 1090–1100 m, steppe meadow and grassland with calcareous and sandstones boulders, 2 & 6 July 2016.
7. Vovnushi tower complex on right-hand bank of Guloikh river, 42°48’01”N, 44°59’41”E, shale cliffs and single trees of *Alnus incana* with bushes of *Juniperus communis* L., 1220–1250 m, 4 July 2016.

Our results are based on investigations from the field trips made between 29 June and 6 July 2016. Air-dried samples were examined using a stereo microscope, a light microscope and the usual spot tests with standard identification methods for lichenized and lichenicolous fungi; thin layer chromatography (TLC) was undertaken where necessary (Orange & al. 2001). A bullet “●” marks the analysed specimens. Remarkable species and species difficult to identify in the field were collected. Common macrolichens and some crustose lichens were not collected in the field, only registered in each locality.
The specimens are kept in the herbarium of the Komarov Botanical Institute, St. Petersburg (LE), and in the private herbarium of G. Urbanavichus (“herb. Urbanav.”). All taxa listed here were collected by the authors. For nomenclatural aspects, mainly Hafellner & Türk (2016) and Lawrey & Diederich (2016) were followed, except for some of the Teloschistaceae taxa.

Results

Checklist of taxa

Symbols used before a species name are as follows: # = lichenicolous fungi; + = non-lichenized fungi; * = new for Russia; † = new for the Caucasus; ‡ = new for North Caucasus (i.e. not new for the whole Caucasus); ! = new for Asia; and after species name “•” = analysed specimens (see Material and methods).

Species names are cited with their authorship. They are followed by locality numbers (loc. 1—7, see Matey et al. 2015) and those of the second author by *†#.

Results

Substrates are indicated, with abbreviations as follows: Ai = Alnus incana, Bp = Betula pendula, Cb = Carpinus betulus, Ca = Corylus avellana, Jc = Juniperus communis,Pk = Pinus kochiana, Pt = Populus tremula, Pr = Prunus sp., Py = Pyrus sp., Qp = Quercus petreae, Sa = Sorbus aucuparia, Sc = Salix caprea, Sn = Sambucus nigra, Tc = Tilia cordata.

For certain species, additional comments are provided.

Amandinea punctata (Hoffm.) Coppins & Scheid. – loc. 1 (GU ER-16/1-011, LE), 5, 7 (in sample GU ER-16/7-511, herb. Urbanav.); on Jc, pine log, and rocks.

Anaptychia ciliaris (L.) Körb. – loc. 2, 4, 5; on Ai, Pt, Py.

Anemia tumidula Hennssen ex P. M. Jørg. & al. – loc. 3 (GU ER-16/3-130, herb. Urbanav.); on calcareous rocks.

Arthonia atra (Pers.) A. Schneid. – loc. 4 (IU ER-16/4-236, LE); on Sc.

Arthonia epiphytica Nyl. – loc. 2 (GU ER-16/2-050, herb. Urbanav.); on thallus of Physcia aipolia on Ai.

Arthonia fusca (A. Massal.) Hepp – loc. 3 (GU ER-16/3-131, herb. Urbanav.); on calcareous rocks.

Arthonia phaeophysciae Grube & Matzer – loc. 2 (GU ER-16/2-051, herb. Urbanav.); on thallus of a species from the Phaeophyscia hirsuta and Phaeophyscia orbicularis on Ai.

Arthonia protoparmeliopseos Etyao & Diederich – loc. 6 (GU ER-16/6-370, LE); on theopha of Protoparmeliopsis muralis on calcareous rocks. Described from Luxembourg and Spain (Etyao & Diederich 2009) and recently reported from Turkey (Yazici & Etyao 2014) and North America (Kocourková & Knudsen 2015).

Atriplex cl. desertorum (Kremp.) Merechk. nom. illeg. – loc. 6 (GU ER-16/6-372, herb. Urbanav.); on calcareous sandstones.

Bacidina viridescens (A. Massal.) Hue – loc. 7 (GU ER-16/7-450, herb. Urbanav.); on the. Also recorded from Armenia in Transcaucasia (Harutyunyan & al. 2011).

Bagliettoa calciseda (DC.) Gueidan & cl. Roux – loc. 6 (GU ER-16/6-373, herb. Urbanav.); on calcareous rocks.

Blastenia hungarica (H. Magn.) Arup & al. – loc. 1 (IU ER-16/1-016, LE); on Jc, Pk.

Blynothallia crispa (Huds.) Ótála & al. – loc. 7; on soil.

Bryoria capillaris (Ach.) Brodo & D. Hawksw. – loc. 5 (IU ER-16/5-263, LE); on Pk.
Bryoria fuscescens (Gyeln.) Brodo & D. Hawksw. – loc. 5 (IU ER-16/5-264, LE); on Pk, Tc.

*†*Buella abstracta (Nyl.) H. Olivier – loc. 6 (GU ER-16/6-374, LE); on sandstones. Also known from Europe and North and South America (Giralt & al. 2011; Knudsen & Kocourková 2012). Our specimens lack visible thallus; the spores are 4.5–5 × 10–12 µm.

Buella disciformis (Fr.) Mudd – loc. 4 (IU ER-16/4-215, LE); on Ai.

Buella erubescens Arnold – loc. 2 (GU ER-16/2-054, herb. Urbanav.); on Ai.

Buella griseovirens (Turner & Borrer ex Sm.) Almb. – loc. 1, 3; on Jc, Pk.

Calicium glaucellum (Turner & Borrer ex Sm.) Almb. – loc. 5 (GU ER-16/5-265, LE); on Pk.

Calicium lucidum (Th. Fr.) M. Pietro & Wedin – loc. 1, 3 (IU ER-16/3-154, LE); on Pk.

Calicium trabinellum (Ach.) Ach. – loc. 3, 5; on Pk.

Callome multipartita (Sm.) Otálora & al. – loc. 3, 6 (GU ER-16/6-396, herb. Urbanav.); on calcareous rocks.

Calogaya biatorina (Massal.) Arup & al. – loc. 7 (GU ER-16/6-397, herb. Urbanav.); on calcareous sandstones, shale.

Calogaya pusilla (Massal.) Arup & al. – loc. 5, 6, 7; on shale, calcareous rocks.

Calogaya saxicola (J. Lahm ex Körb.) Jatta – loc. 1, 5 (IU ER-16/5-267, LE); on Pk.

Calopogon pineti (Ach.) Lücking & Lumbsch – loc. 1, 3; on calcareous rocks.

Cladonia symphycarpa (Flörke) Fr. – loc. 3; on soil.

Cladonia macilenta (L.) J. r. Laundon – loc. 4, 5; on calcareous rocks.

Chaenotheca chrysocephala (Turner ex Ach.) Th. Fr. – loc. 1, 5; on Pk.

Chaenotheca furfuracea (L.) Tibell – loc. 5; on the roots of Bp.

Chaenotheca trichialis (Ach.) Th. Fr. – loc. 5; on pine wood.

Chaenotheca xylooxena Nádv. – loc. 5 (GU ER-16/5-278, LE); on pine wood.

†Chaenothecopsis pusiolata (Ach.) Vain. – loc. 5 (IU ER-16/5-279, LE); on pine wood.

†Chaenothecopsis savonica (Rášänen) Tibell – loc. 5 (IU ER-16/5-280, LE); on pine wood.

†Chaenothecopsis viridireagens (Nádv.) A. F. W. Schmidt – loc. 5 (IU ER-16/5-281, LE); on pine wood.

Chrysorthrix candelaris (L.) J. R. Laundon – loc. 4, 5; on Sc, Tc.

Circinaria calacrea (L.) A. Nordin & al. – loc. 6; on calcareous rocks.

Cladonia coniocraea (Flörke) Spreng. – loc. 1, 5; on Pk.

Cladonia foliacea (Huds.) Willd. – loc. 2, 3, 6, 7; on soil.

Cladonia fimbriata (Arnold) du Rietz – loc. 7; on plant debris on shale.

Circinaria calacrea (L.) A. Nordin & al. – loc. 6; on calcareous rocks.

Cladonia coniocraea (Flörke) Spreng. – loc. 1, 5; on Pk.

Cladonia foliacea (Huds.) Willd. – loc. 2, 3, 6, 7; on soil.

Cladonia fimbriata (Arnold) du Rietz – loc. 7; on plant debris on shale.

Collema flaccidum (Ach.) Ach. – loc. 5; on Pt, Tc.

Collema furfuraceum (Arnold) Du Rietz – loc. 7; on plant debris on shale.

Collema subflaccidum Degel. – loc. 7; on plant debris on shale.

Cryptodiscus foveolaris (Rehm) Rehm – loc. 5 (IU ER-16/5-287, LE); on pine wood.

Dermatocarpon minutatum (L.) W. Mann – loc. 1, 2, 3, 5, 6, 7; on shale, calcareous rocks.

Diploschistes muscorum (Scop.) R. Sant. – loc. 7; on soil.

Diplotomma hedini (H. Magn.) P. Clerc & Cl. Roux – loc. 6 (GU ER-16/6-401, herb. Urbanav.); on calcareous rocks.
Endocarpon pusillum (Sw.) Gray – loc. 3, 7; on calcareous soil.

Enchylium tenax (Hoffm.) Otálora & al. – loc. 6, 7; on calcareous rocks.

Enchylium polycarpon (Nylander) Otálora & al. – loc. 6; on calcareous rocks.

Endocarpon pusillum Hedw. – loc. 7 (GU ER-16/7-473, herb. Urbanav.); on soil.

*Endococcus pseudocarpus* Nyl. – loc. 6 (GU ER-16/6-402, herb. Urbanav.); on thallus of *Callome multipartita* on calcareous rocks.

*Evernia divaricata* (L.) Ach. – loc. 5; on Pr.

*Evernia prunastri* (L.) Ach. – loc. 1, 3, 5; on Bp, Pk, Pr, Py, Tc, snag.

*Flavoparmelia capita* (L.) Hale – loc. 1 (in sample IU ER-16/1-009, LE), 2, 3, 4, 5, 6, 7; on Ai, Ch, Jc, Pk, Pr, Py, Sc, Tc.

*Flavoparmelia coronata* (Kremp. ex Körb.) Arup & al. – loc. 1, 2, 3, 4, 5, 6, 7; on Ai, Jc, Pk, sh.

*Flavoparmelia soredica* (Hale) Hale – loc. 1, 2, 3, 4, 5, 6, 7; on Ai, Jc, Pk, Tc, shale.

*Graphis scripta* (L.) Ach. – loc. 2, 4, 5; on Ai, Bp, Tc.

*Gyalideopsis helvetica* van den Boom & Vezda – loc. 5 (GU ER-16/5-295, LE); on wood of pine log. Also recently reported from S Siberia (Urbanavichene 2015).

*Gyalolechia flavorubescens* (Huds.) Schönting & al. – loc. 2; on Ai.

*Gyalolechia flavivirescens* (Wulfen) Schönting & al. – loc. 3, 6 (in sample GU ER-16/6-370, LE); on calcareous sandstones, sandstones.

*Heteroderma speciosa* (Wulfen) Trevis. – loc. 4; on Ai.

*Heteroplaacidium compactum* (A. Massal.) Güéidan & Cl. Roux – loc. 6 (GU ER-16/6-406, herb. Urbanav.); on calcareous rocks.

*Hyperphyscia adglutinata* (Flörke) Mayrhofer & Poelt – loc. 2, 7; on Ai, Jc, shale.

*Hyperphyscia granulata* (Poelt) Moberg – loc. 7 (GU ER-16/7-478, herb. Urbanav.); on shale. Also reported from S Siberia (Urbanavichene 2007).

*Hypocenomyce scalaris* (Ach.) M. Choisy – loc. 3; on Pk.

*Hypogymnia physodes* (L.) Nyl. – loc. 1, 3, 4, 5; on Pk, Sc.

*Hypogymnia tubulosa* (Schaer) Hav. – loc. 1, 3, 5; on Pk. 

*Lathagrium auriforme* (With.) Otálora & al. – loc. 7; on mossy calcareous rocks.

*Lathagrium cristatum* (L.) Otálora & al. – loc. 2, 3, 6, 7; on calcareous rocks, calcareous sandstones.

*Lathagrium fuscovirens* (With.) Otálora & al. – loc. 3, 7; on calcareous rocks, shale.

*Lathagrium undulatum* (Flot.) Otálora & al. – loc. 6; on calcareous rocks.

*Lecania croatica* (Zahlbr.) Kotlov – loc. 4 (IU ER-16/4-227, LE), 5; on Ai, Sc.

*Lecania naegeli* (Hepp) Diederich & van den Boom – loc. 2 (in sample GU ER-16/2-051, herb. Urbanav.); on Ai.

*Lecanora albella* (Pers.) Ach. – loc. 1, 5 (IU ER-16/1-029, LE, GU ER-16/5-299, herb. Urbanav.); on Pk, Tc.

*Lecanora albella* (Nyl.) Th. Fr. – loc. 3; on pine wood. Previously recorded from Georgia in Transcaucasia (Barkhalov 1983).

*Lecanora sulfurea* – loc. 7 (GU ER-16/7-479, herb. Urbanav.); on shale.

*Lecanora chlorostera* Nyl. – loc. 2; on Ai.

*Lecanora intumescens* (Rebent.) Rabenh. – loc. 5 (IU ER-16/5-301, LE); on Pr, Pt, Tc.

*Lecanora meridionalis* H. Magn. – loc. 2 (GU ER-16/2-077, herb. Urbanav.); on Ai.

*Lecanora populicola* (DC.) Duby – loc. 5; on Pt.

*Lecanora reagens* Norman – loc. 7 (GU ER-16/7-482, herb. Urbanav.); on shal. Previously recorded from Georgia in Transcaucasia (Barkhalov 1983).

*Lecanora subcarpinea* Szatala – loc. 2 (GU ER-16/2-081, herb. Urbanav.); on Ai.

*Lecanora symmicta* (Ach.) Ach. – loc. 2, 3; on Ai, Pk.

*Lecanora thysanophora* R. C. Harris – loc. 4 (IU ER-16/4-229, LE), 5; on Ai, Tc.

*Lecidea nylanderi* (Anzi) Th. Fr. – loc. 3 (GU ER-16/3-170, herb. Urbanav.); on Pk. Previously recorded from Azerbaijan in Transcaucasia (Barkhalov 1983).

*Lecidea achristera* (Nyl.) Hertel & Leuckert – loc. 2 (GU ER-16/2-083, herb. Urbanav.); on Ai.

*Lecidea flavosorediata* (Vezda) Hertel & Leuckert – loc. 2 (GU ER-16/2-084, herb. Urbanav.); 3 (GU ER-16/3-171, herb. Urbanav.); 5; on Ai, Pk.

*Lecidella patavina* (A. Massal.) Knoph & Leuckert – loc. 6 (GU ER-16/6-410, herb. Urbanav.); 7; on calcareous rocks and shale.

*Lecidella stigmataea* (Ach.) Hertel & Leuckert – loc. 3, 6 (GU ER-16/6-411, herb. Urbanav.); on calcareous rocks.

*Lecidella viridans* (Rebent.) Rabenh. – loc. 4 (IU ER-16/5-307, LE), 5; on Pr, Pt, Tc.

*Lepidopteris pyrenaea* (Pers.) J. Presl & C. W. Dicks. – loc. 4 (IU ER-16/6-230, LE), 5; (GU ER-16/7-486, herb. Urbanav.); on Sc, Tc, mossy shale.

*Leptogium burnetiae* (Flörke) Flörke – loc. 7 (IU ER-16/5-309, LE); on Tc.

*Leptogium saturninum* (Dicks.) Nyl. – loc. 4, 5, 7; on Ai, Sn, Tc, mossy shale.
†Lobothallia stipatula Nyl. – loc. 3, 6 (GU ER-16/6-413, herb. Urbanav.); on sandstone. Also known from S Ural mountains and S Siberia (Urbanavicich 2010).

Lobothallia aplophala (Wahlenb.) Hafellner – loc. 2; on sandstone. Lobothallia radiosa (Hoffm.) Hafellner – loc. 2, 3, 6; on calcareous rocks and sandstones.

Melanelixia albertana (Ahti) O. Blanco & al. – loc. 4 (IU ER-16/4-232, LE); 5; on Ai. Pr.

Melanelixia fuliginosa (Pr. ex Duby) O. Blanco & al. – loc. 1, 2 (GU ER-16/2-088, herb. Urbanav.); on Ai. Jc.

Melanelixia grabra (Schaer.) O. Blanco & al. sensu lato – loc. 2, 4, 5; on Ai, Pt, Tc. The recently resurrected taxon M. epilosa (J. Steiner) A. Crespo & al. (Leavitt & al. 2016) and the species M. grabra are not morphologically distinguishable. Probably our Ingushetian specimens refer to M. epilosa, but it is not certain without molecular sequence data. We treat our specimens in a broad sense as M. grabra sensu lato.

Melanelixia glabratula (Lamy) Sandler & Arup – loc. 5; on Bp, Tc.

Melanelixia subargentifera (Nyl.) O. Blanco & al. – loc. 4, 7; on Ai, shale.

Melanelixia subaurifera (Nyl.) O. Blanco & al. – loc. 1, 3, 4, 5; on Ai, Sc, Tc, pine wood.

Melanohalea exasperata (De Not.) O. Blanco & al. – loc. 5; on Ai, Bp, Qp.

Melanohalea exasperatula (Nyl.) O. Blanco & al. – loc. 2, 5; on Ai, Bp, Pk, Pr, Qp, Tc.

†Micarea nigella Coppins – loc. 5 (IU ER-16/5-317, LE); on pine wood. Also known from NW Russia (Urbanavicich 2010).

††Micarea soralifera B. Guzow-Krzemińska & al. – loc. 5 (IU ER-16/5-318, LE); on pine wood. A recently described species from the Czech Republic and Poland (Guzow-Krzemińska & al. 2016).

Montanelia tominii (Oxner) Divakar & al. – loc. 7; on shale.

#Muellerella lichenicola (Sommerf. ex Fr.) D. Hawksw. – loc. 3 (GU ER-16/3-176, herb. Urbanav.); 6 (in sample GU ER-16/6-370, LE); on thallus of Lecidella stigmatæa, and apothecia of Gymnolechia flavvoirescens and Xanthocarpia crenulatælla on calcareous rocks.

+Mycothecium subtile (Pers.) Szatala – loc. 5; on wood. Myriolecis crenulata (Hook.) Šliwa & al. – loc. 2, 6, 7; on calcareous sandstones, shale.

Myriolecis dispersa (Pers.) Šliwa & al. – loc. 3; on calcareous rocks.

Myriolecis persimilis (Th. Fr.) Šliwa & al. – loc. 2, 5; on Ai, Tc.

Myriolecis pruinosa (Chaub.) Šliwa & al. – loc. 3; on calcareous rocks.

Myriolecis semipallida (H. Magn.) Šliwa & al. – loc. 2, 3, 6, 7; on calcareous sandstones, shale.

Neocatapyrenium rhizinosum (Müll. Arg.) Breuss – loc. 3 (GU ER-16/3-177, herb. Urbanav.); on calcareous soil.

Neofuscelia pulla (Ach.) Essl. – loc. 7; on shale. Nephroma parle (Ach.) Ach. – loc. 5; on Sc, Tc.

#Nesolechia oxyspora (Tul.) A. Massal. – loc. 7 (GU ER-16/7-497, herb. Urbanav.); on thallus of Xanthoparmelia stenophyllæa on shale.

Ochrolechia arborea (Kreyer) Almb. – loc. 1, 3, 5; on Jc, Pk.

Opegrapha vulgata (Ach.) Ach. – loc. 5 (IU ER-16/5-322, LE); on Tc.

Parmelia barrenæae Divakar & al. – loc. 5 (GU ER-16/5-323, herb. Urbanav.); on Tc.

Parmelia sulcata Taylor – loc. 1, 2, 3, 4, 5, 6, 7; on Ai, Bp, Pk, Pr, Py, Sa, Sc, Tc.

Parmelinæa pastillifera (Harm.) Hale – loc. 5 (IU ER-16/5-325, LE); on Bp, Tc.

Parmelinæa tiliaææ (Hoffm.) Hale – loc. 1, 5 (IU ER-16/5-326, LE); on Bp, Pk, Pr, Tc.

Parmotrema perlatum (Huds.) M. Choisy – loc. 2, 4 (IU ER-16/4-239, LE); on Ai. (TLC – stictic acid).

Parmotrema stippeum (Taylor) Hale – loc. 5 (IU ER-16/5-327, LE); on Tc. (TLC – salazinic acid).

Peltigera canina (L.) Willd. – loc. 5; on soil.

Peltigera didactylæa (With.) J. R. Laundon – loc. 7; on mossy rocks.

Peltigera elisabethææ Geyln. – loc. 5; on mossy log.

Peltigera lepidophoræ (Nyl. ex Vain.) Bitter – loc. 7; on soil above shale.

Peltigera praetextata (Flörke ex Sommerf.) Zopf – loc. 5; on Pt, Tc, log.

Peltigera rufescens (Weiss) Humb. – loc. 3; on soil.

Peltula bolanderi (Tuck.) Wetmore – loc. 3, 7 (GU ER-16/7-495, herb. Urbanav.); on calcareous sandstones and shale.

Peltula euploca (Ach.) Poelt – loc. 6, 7 (GU ER-16/7-496, herb. Urbanav.); on shale.

+Peridiothelia fuligunctæa (Norman) D. Hawksw. – loc. 5 (GU ER-16/5-331, herb. Urbanav.); on Tc.

Phaeophysicia cernohorskyi (Nádv.) Essl. – loc. 6, 7 (GU ER-16/7-498, herb. Urbanav.); on plant debris above calcareous sandstones and shale.

Phaeophysicia ciliææ (Hoffm.) Moberg – loc. 2, 5; on Ai, Sn.

Phaeophysicia endophoënœæææ (Harm.) Moberg – loc. 2, 5; on Ai, Sn.
Phaeophyscia hirsuta (Mereschk.) Essl. – loc. 2, 5; on Ai, Je, Sc.
Phaeophyscia insignis (Mereschk.) Moberg – loc. 7 (GU ER-16/7-499) herb. Urbanav.); on shale.
Phaeophyscia kairamoi (Vain.) Moberg – loc. 2, 4, 5; on Ai, Pr, Sc, Sn.
Phaeophyscia nigricans (Flörke) Moberg – loc. 2, 7; on Phaeophyscia kairamoi (vain.) Moberg – loc. 2, 4, 5; on Mereschk.) Moberg – loc. 7 (Phaeophyscia insignis GU.

Phaeophyscia hirsuta

Physcia aipolia (ehrh. ex humb.) Fürnr. – loc. 2 (in sample GU ER-16/2-050, herb. Urbanav.), 4, 5; on Ai, Pr, Pt.

Physcia caesia (hoffm.) Fürnr. – loc. 2, 3, 5, 6, 7; on calcareous rocks, sandstones, shale.

Physcia dimidiata (Arnold) Nyl. – loc. 6, 7; on shale, sandstones.

Physcia dubia (Hoffm.) Lettau – loc. 7; on shale.

Physcia stellaris (L.) Nyl. – loc. 2, 5, 6; on Ai, Bp, Jc, Qp

Physcia subalbinea Nyl. – loc. 7; on shale.

Physcia tenella (Scop.) DC. – loc. 4, 5; on Ai, Pr.

Physcia tribacia (Ach.) Nyl. – loc. 2 (GU ER-16/2-106, herp. Urbanav.); on Ai.

Physcia vitii Nádv. – loc. 1, 2, 4, 5; on Ai, Je, Pr, Sn.

Physciella choanta (Ach.) Essl. – loc. 2, 4, 5, 6, 7; on Ai, Bp, Sn, and all rock substrates.

Physconia distorta (With.) J. R. Laundon – loc. 2, 4, 5, 6; on Ai, Pr.

Physconia grisea (Lam.) Poelt – loc. 7; on plant debris, shale.

Physconia muscigena (Ach.) Poelt – loc. 7; on soil, plant debris above shale.

Physconia petraea (Poelt) Vězda & Poelt – loc. 7; on rocks.

Physconia rossica G. Urban. – loc. 3, 7 (GU ER-16/7-515, herb. Urbanav.); on rock substrates above shale.

Placidium rufescens (Ach.) A. Massal. – loc. 6 (GU ER-16/6-426, herb. Urbanav.); on calcareous rocks.

Placocarpos schaereri (Fr.) Breuss – loc. 3, 6; on calcareous rocks.

Placynthiella dasaea (Stirt.) Tönsberg – loc. 1, 3; on wood of pine log.

Placynthium nigrum (Huds.) Gray – loc. 3, 6; on calcareous rocks.

Placynthium posterulum (Nyl.) Henssen – loc. 6 (GU ER-16/6-429, herb. Urbanav.); on calcareous rocks.

Polycoccum clauzadei Nav.-Ros. & Cl. Roux – loc. 7 (GU ER-16/7-511, herb. Urbanav.); on thallus of Rusavskia sp. on rocks. Previously known only from the Republic of Buryatia, S Siberia (Urbanavichene & Urbanavichus 2009).

Protoparmeliopsis muralis (Schreb.) M. Choisy – loc. 1, 2, 3, 5, 6, 7; on all rock substrates.

Pseudevernia furfuracea (L.) Zopf – loc. 1, 3, 5; on Jc, Pr.

Pseudoschizommatum rupestris (Pers.) A. Ertz & Teherl – loc. 4 (IU ER-16/4-237, LE); on Ai.

Psora decipiens (Hedw.) Hoffm. – loc. 3; on calcareous soil.

Punctelia boreri (Sm.) Krog – loc. 4, 7; on Ai, shale.

Punctelia jeckera (Roum.) Kalb – loc. 1, 2, 3, 4, 5; on Ai, Je, Jc, Pr, shale.

Punctelia subradecta (Nyl.) Krog – loc. 5, 7; on Tc, shale.

Pychnora praestabilis (Nyl.) Hafellner – loc. 3; on Pk.

Pyrenodesmia chalybaea (Fr.) A. Massal. – loc. 6; on calcareous rocks.

Pyrenodesmia variabilis (Pers.) A. Massal. – loc. 3, 6; on calcareous rocks.

Ramalina asiachinana Zahlbr. – loc. 2, 4, 5; on Ai, Pt, Pr.

Ramalina farinacea (Pers.) M. Malme – loc. 1 (in sample GU ER-16/5-353, LE); on Sn. Previously reported from the S Ural mountains (Urbanavichene et al. 2013). A very rare or overlooked species, not reported outside of Europe.

Rhizocarpon disporum (Nägeli ex Hepp) Müll. Arg. – loc. 7 (GU ER-16/7-514, herb. Urbanav.); on shale.

Rhyzoeca chrysoleuca (Sm.) Zopf – loc. 6, 7; on small granite stones.

Rinodina bischoffii (Sm.) Zopf – loc. 6, 7; on trunks of pine, mainly Mediterranean species occurring on calcareous rocks at middle altitudes in the mountains of S Europe and N Africa (Giralt & Llimona 1997).

Rinodina clavaeformis (Pers.) IU ER-16/1-233 Willdenowia 47 – 2017

Rinodina exiguia (Ach.) Gray – loc. 2 (GU ER-16/2-115, herb. Urbanav.); on Ai.

Rinodina oleae Bagl. – loc. 2 (GU ER-16/2-116, herb. Urbanav.); on Ai.

Rinodina septentrionalis Malme – loc. 1 (IU ER-16/1-043, LE); on Pk.

Rinodina sophodes (Ach.) A. Massal. – loc. 2 (GU ER-16/2-117, herb. Urbanav.); on Ai.

Rinodina subgeniculata (Ach.) IU ER-16/4-237 Willdenowia 47 – 2017

Rinodina zwackhiana GU ER-16/7-518 Willdenowia 47 – 2017

Rusavskia papillifera (Vain.) S. Y. Kondr. & Kärnefelt – loc. 2, 3, 6, 7; on calcareous rocks.
Spilonema revertens Nyl. – loc. 7 (GU ER-16/6-520, herb. Urbanav.); on calcareous rocks.

Sarcogyne cinereovirens – loc. 6; on calcareous rocks.

Thyrea confusa (ach.) Flot. – loc. 6 (GU ER-16/6-334, LE); on calcareous rocks.

Thermutis velutina (ach.) ahti & d. hawksw. – loc. 7 (GU ER-16/3-204, herb. Urbanav.); on calcareous rocks.

Thallinocarpus nigrifellium (Lettau) P. M. Jørg. – loc. 3, 6; on calcareous rocks and sandstones.

Verrucaria macrostoma Dufour ex DC. – loc. 2 (GU ER-16/6-120, herb. Urbanav.); on calcareous sandstones.

Verrucaria nigrescens Pers. – loc. 7 (GU ER-16/6-525, herb. Urbanav.); on calcareous rocks.

Verrucaria phaeospora Anzi – loc. 3, 6 (GU ER-16/6-439, herb. Urbanav.); on calcareous rocks.

Verrucaria tristis (A. Massal.) Kremp. – loc. 3 (GU ER-16/3-204, herb. Urbanav.); on calcareous rocks.

Xanthocarpia crenulatella (Nyl.) Frödén & al. – loc. 3, 6; on calcareous rocks.

Xanthoparmelia cantschadalis (Ach.) Hale – loc. 2, 3, 6; on soil.

Xanthoparmelia conspersa (Ehrh. ex Ach.) Hale – loc. 7; on shale.

Xanthoparmelia stenosphylla (Ach.) Ahti & D. Hawksw. – loc. 2, 7; on shale.

Xanthomendoza fallax Söchting & al. – loc. 3, 7; on calcareous rocks, shale.

Xanthomendoza fulva (Hoffm.) Söchting & al. – loc. 6; on calcareous rocks.

Xanthomendoza ulophylloides (Räisänen) Söchting & al. – loc. 2; on Ai.

Xanthoria aureola (Ach.) Erichsen – loc. 3, 7; on calcareous rocks, shale, mossy rocks.

Xanthoria calcicola Oxner – loc. 2, 6, 7; on sandstones, shale.

Xanthoria parietina (L.) Th. Fr. – loc. 1, 2, 3, 4, 5, 6, 7; on Ai, Cb, Jc, Pk, Pr, Py, Qp, Sc, Tc.

Xylographa parallela (Ach.) Fr. – loc. 3, 5; on pine wood.

Zwackhiomyces coepulonus (Norman) Grube & R. Sant. – loc. 7 (GU ER-16/6-532, herb. Urbanav.); on thallus of Calogaya biatorina on shale.

Conclusions

The inventory of lichenized and lichenicolous fungi taxa in Erzi Nature Reserve is essential for protecting the Caucasian lichen flora, and for future floristic, taxonomic, systematic and ecological studies, as well as for the monitoring of future changes in the composition of the flora. We currently recognize 286 species as occurring in the Erzi Nature Reserve (266 species of lichenized fungi, 13 of lichenicolous fungi and seven of non-lichenized saprophytic fungi), representing 115 genera. Twenty-three species are recorded for the first time for North Caucasus, of which 16 are new for the Caucasus and

reported from Abkhazia in Transcaucasia (Urbanavichus & Urbanavichene 2012). An apparently rather widespread but still poorly known species described from Germany; also reported from a few other European countries and North America (Breuss 2007; Breuss & Berger 2010). In her excellent revision of Verrucaria in Poland, Krzewicka (2012) suggested that V. fuscoatraoides may be a synonym of V. nigrobruma (A. Massal.) Servit.
ten are new for Russia (Arthonia protoparmeliopsis, Aspicilia viridescens, Buellia abstracta, Lecidella viridans, Micarea soralifera, Rinodina straussii, R. tunicata, R. zwackhiana, Schizothyron alboatrum and Verrucaria fuscoatroides). Of the 16 species new for the Caucasus, seven are recorded for the first time for Asia (Buellia abstracta, Micarea nigella, M. soralifera, Ramonia chrysophaea, Rinodina tunicata, Schizothyron alboatrum and Verrucaria elevata). In addition, two of the 42 taxa listed in the Red Book of Russia (Trutnev & al. 2008) are recorded, namely Leptogium burnetiae (Near Threatened category) and Usnea florida (Vulnerable category).

Acknowledgements

This work was supported by a grant of the Russian Foundation for Basic Research, No. 15-29-02396 “North Caucasian Lichen Flora: taxonomic structure, diversity, specificity, systematics of individual taxa and contribution to the diversity of the lichen flora of Russia”. We are grateful to Liza Khaykharoeva and staff of the Erzi Nature Reserve for supporting our research and to Prof. Mark Seaward who kindly corrected the English. We also thank Dr. Harrie J. M. Sipman (Botanic Garden and Botanical Museum Berlin) and an anonymous reviewer for their comments on an earlier version of this paper. Special thanks are also due to Igor Lavrinenko (Komarov Botanical Institute, St. Petersburg) for technical assistance with the map (Fig. 1).

References

Alstrup V., Zavarzin A. A., Kocourková J., Kravchenko A. V., Fadeeva M. A. & Shiefielbein U. 2005: Lichens and lichenicolous fungi found in northern Ladoga lake area (Republic of Karelia) during the international fieldtrip in August 2004, prior to the Fifth IAL Congress. – Trudy Karel’skogo Nauchnogo Tsentra.

Barkhalov S. O. 1983: Flora lishaynikov Kavkaza [The lichen flora of the Caucasus]. – Baku: El’m Press. [In Russian].

Breuss O. 2007: Verrucaria. – Pp. 335–377 in: Nash T. H. III, Gries C. & Bungartz F. (ed.), Lichen flora of the Greater Sonoran Desert region 3. – Tempe: Lichens Unlimited.

Breuss O. & Berger F. 2010: Die Verrucaria-Arten mit braunem Lager in den österreichischen Kalkalpen. Eine vorläufige Übersicht mit Bestimmungsschlüssel. – Biblioth. Lichenol. 104: 77–116.

Etayo J. & Diederich P. 2009: Arthonia protoparmeliopsis, a new lichenicolous fungus on Protoparmeliopsis muralis from Spain and Luxembourg. – Bull. Soc. Naturalistes Luxemb. 110: 93–94.

Gasparyan A., Aproot A., Burgaz A. R., Otte V., Zakeri Z., Rico V. J., Araujo E., Crespo A., Divakar P. K. & Lumbsch H. T. 2015: First inventory of lichens and lichenicolous fungi in the Khosrov Forest State Reserve, Armenia. – Fl. Medit. 25(2): 105–114.

Geil’tman D. V., Antonova N. N., Byalt V. V., Grabovskaya A. E., Dorofeev V. I., Zolkina L. A., Konechnaya G. Yu., Krasovskaya L. S., Krupkina L. I., Levichev I. G., Medvedeva N. A., Portenier N. N. & Sokolova I. V. 1998: Flora of the vascular plants of the Russian Federation. – Biol. Bull. (Moscow) 25(1): 78–82.

Giralt M., Bungartz F. & Elix J. A. 2011: The identity of Buellia sequax. – Mycol. Progr. 10: 115–119.

Giralt M. & Llimona X. 1997: The saxicolous species of the genera Rinodina and Rinodinella lacking spot test reactions in the Iberian peninsula. – Mycotaxon 62: 175–224.

Guzow-Krzemińska B., Czarnota P., Lubea A. & Kukwa M. 2016: Micarea soralifera sp. nov., a new sorediate species in the M. prasina group. – Lichenologist 48: 161–169.

Hafellner J. & Türk R. 2016: Die lichenisierten Pilze Österrech’s – eine neue Checkliste der bisher nachgewiesenen Taxa mit Angaben zu Verbreitung und Substratökologie [The lichenized fungi of Austria – a new checklist of the taxa so far recorded, with data to distribution and substrate ecology]. – Sapia 104(1): 1–214.

Harutyunyan S., Wiesnair B. & Mayrhofer H. 2011: Catalogue of the lichenized fungi in Armenia. – Herzogia 24: 265–296.

Knoph J.-G. & Leuckert C. 2004: Lecidella. – Pp. 309–320 in: Nash T. H. III, Ryan B. D., Diederich P., Gries C. & Bungartz F. (ed.), Lichen flora of the Greater Sonoran Desert region 2. – Tempe: Lichens Unlimited.

Knudson K. & Kocourková J. 2012: Buellia abstracta in the Joshua Tree National Park (California, U.S.A.). – Published at http://zip.czu.cz/zyxv/kon/maps/kocek/koc-0005.pdf [accessed 27 May 2017].

Kocourková J. & Knudsen K. 2015: Notes on the lichen flora of the Khosrov Forest state reserve, Armenia. – Published at http://www.erziri.ru/ [accessed 10 Oct 2017].

Krever V., Zazanashvili N., Jungius H., Williams L. & Petelin D. 2001: Biodiversity of the Caucasus: an analysis of biodiversity and current threats and initial investment portfolio. – Moscow: World Wide Fund for Nature.

Krzewicka B. 2012: A revision of Verrucaria s.l. (Verrucariaceae) in Poland. – Polish Bot. Stud. 27: 3–142.

Lawrey J. D. & Diederich P. 2016: Lichenicolous fungi – worldwide checklist, including isolated cultures and sequences available. – Published at http://www.lichenicolous.net [accessed 1 Mar 2017].
Leavitt S. D., Esslinger T. L., Divakar P. K., Crespo A. & Lumbsch H. T. 2016: Hidden diversity before our eyes: delimiting and describing cryptic lichen-forming fungal species in camouflage lichens (Parmeliaceae, Ascomycota). – Fungal Biol. 120: 1374–1397

Merkulova O. S. & Urbanavichus G. P. 2006: Addition to the lichen flora of the Ural region. – Pp. 148–152 in: Andreev M. P., Himelbrant D. E., Golubkova N. S., Titov A. N. & Urbanavichus G. P. (ed.), Lichen flora of Russia: state and perspective of exploration. Proceedings of the international conference dedicated to the 120-th anniversary of V. P. Savicz. – St. Petersburg: LETI Press. [In Russian].

Orange A., James P. W. & White F. J. 2001: Microchemical methods for the identification of lichens. – London: British Lichen Society.

Pykälä J., Stepanchikova I. S., Himelbrant D. E., Kuznetsova E. S. & Alexeeva N. M. 2012: The lichen genera Thelidium and Verrucaria in the Leningrad region (Russia). – Folia Cryptog. Estonica 49: 45–57.

Sheard J. W. 2010: The lichen genus Rinodina (Ach.) Gray (Lecanoromycetidae, Physciaceae) in North America, north of Mexico. – Ottawa: NRC Research Press.

Sherwood M. A. 1977: The Ostropalean fungi. – Mycologist 5: 1–277.

Trutnev Yu. P., Gizatulin R. R., Mitvol O. L., Amirkhanov A. M., Kamelin R. V., Bardunov L. V. & Novikov V. S. (ed.) 2008: Red Data Book of the Russian Federation (Plant and Fungi). – Moscow: KMK Scientific Press Ltd.

Urbanavichene I. N. 2015: The first record of Gyalideopsis helvetica (Graphidiaceae, lichenized Ascomycota) for Russia from the southern part of Lake Baikal region. – Novosti Sist. Nizsh. Rast. 49: 282–288 [In Russian].

Urbanavichene I. N. & Urbanavichus G. P. 2009: To the lichen flora of Oka plateau (eastern Sayan, Republic of Buryatia). – Novosti Sist. Nizsh. Rast. 43: 229–243. [In Russian].

Urbanavichus G. P. 2010: A checklist of the lichen flora of Russia. – St. Petersburg: Nauka.

Urbanavichus G. P. & Urbanavichene I. N. 2004: Lichens. – Pp. 5–235 in: Korneeva T. M., Afonina O. M., Golubkova N. S. & Blagovidov A. K. (ed.), The present-day state of biological diversity within protected areas in Russia. Issue 3, Lichens and bryophytes. – Moscow: World Conservation Union; Ministry of Natural Resources of the Russian Federation; Commission on Biodiversity Conservation of the Russian Academy of Sciences.

Urbanavichus G. P. & Urbanavichene I. N. 2007: The distribution and ecology of genera Hyperphyscia and Pyxine (Physciaceae, lichenized Ascomycota) in Russia. – P. 154 in: Abstracts. XV Congress of European Mycologists. Saint Petersburg, Russia, September 16–21, 2007. – St. Petersburg: TREEART LLC.

Urbanavichus G. P. & Urbanavichene I. N. 2012: Addition to the lichen flora of Abkhazia and Caucasus. – Vestn. Tversk. Gosud. Univ., Ser. Biol. Ecol. 27(23): 109–116. [In Russian].

Urbanavichus G. P. & Urbanavichene I. N. 2015: A contribution to the lichen flora of Utrish Nature Reserve. – Furezaninowia 18: 86–93. [In Russian].

Urbanavichus G. P. & Urbanavichene I. N. 2017: New and noteworthy records of lichen-forming and lichenicolous fungi from Abrau peninsula (NW Caucasus, Russia). – Fl. Medit. 27: 175–184.

Yazici K. & Etayo J. 2014: Lichenicolous fungi in Iğdır province, Turkey. – Acta Bot. Brasil. 28: 1–3.