Folia Cryptog. Estonica, Fasc. 52: 101–107 (2015)
http://dx.doi.org/10.12697/fce.2015.52.13

Lichenicolous fungi from Russia, mainly from the Magadan Region

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Abstract: Twenty two species of lichenicolous fungi are reported, 19 of which are new to Magadan Region of Russia. *Spirographa fusisporella* is new to Asia. *Sphaerellothecium* cf. *parmeliae* growing on species of *Parmelia* s. str. and *"Sphaeropezia"* sp. on *Hypogymnia physodes* are briefly described, illustrated and discussed.

Keywords: lichen-inhabiting fungi, biogeography, taxonomy, ecology, Beringia, Northern Asia

INTRODUCTION

Despite the relatively well-studied lichenicolous mycobiota of Chukotka (Kristinsson et al., 2010), the Magadan Region next to it still remained virtually unexplored in this regard. So far just nine species of lichenicolous fungi have been reported from the region, viz. *Echinodiscus kozhevnikovii* Zhurb. (on *Cetraria laevigata*), *Endococcus nanellus* Ohlert (on *Stereocaulon alpinum*), *Lichenostigma maureri* Hafellner (on *Alectoria ochroleuca*), *Phaeospora arctica* Horáková & Alstrup (on *Cetraria islandica*), *Sphaerellothecium minutum* Hafellner (on *Sphaerophorus fragilis*), *S. reticulatum* (Zopf) Etayo [uncertain report on *Arctoparmelia separata* possibly referring to "*Lichenostigma arctoparmeliae*" R. Sant. (ined.)], *Stigmidium hafellneri* Zhurb. (on *Flavocetraria cucullata*), *Thamnogalla crombiei* (Mudd) D. Hawksw. (on *Thamnolia vermicularis*) and *Zwackhiomyces sipmanii* Diederich & Zhurb. (on *Phaeorrhiza sareptana* var. *sphaerocarpa*) (Zhurbenko, 2008, 2009a, b, 2010, 2012; Diederich & Zhurbenko, 2009; Zhurbenko & Vershinina, 2014). This paper presents results of a revision of a lichen collection mainly from Magadan Region of Russia, including 19 species new to the region and some other noteworthy findings.

MATERIAL AND METHODS

The material was identified by the first author using Zeiss microscopes Stemi 2000-CS and Axio Imager A1 equipped with Nomarski differential interference contrast (DIC) optics. Microscopical examination was done in water, 10% KOH (K), Lugol's iodine directly (I) or after a KOH pre-treatment (K/I) or brilliant cresyl blue (BCr). The ascomatal diameter and the length, breadth and length/breadth ratio (l/b) of asci and ascospores (when n >10) are given as: (min–) $\overline{X}$ –SD– $\overline{X}$ +SD(–max), where min and max are the extreme values, $\overline{X}$ the arithmetic mean, and SD the corresponding standard deviation. Measurements were taken from water mounts, unless otherwise indicated. The nomenclature of the host lichens follows Esslinger (2015). Examined specimens are deposited in the mycological herbarium of the V. L. Komarov Botanical Institute in St.-Petersburg, Russia (LE).

THE SPECIES

Species new to Magadan Region of Russia are denoted by an asterisk (*).

*Abrothallus parmeliarum (Sommerf.) Arnold – Magadan Region, Ola District, Taui River, ichthyological field station, 59°47'N, 148°16'E, alt. 35 m, mixed *Larix* forest, on *Parmelia sulcata* (lobes) growing on *Larix*, 18.06.2011, E. V. Zheludeva (LE 261202, LE 261281a); same district, Magadan Reserve, 7 km downstream by Yama River from Studenaya cabin, 59°44'N, 153°40'E, alt. 60 m, forested stone field, on *P. omphalodes* (thallus), 24.07.2010, E. V. Zheludeva (LE 264309a).

Note – Immature hyaline spores often have a distinct thick halo which is reduced at maturity.

*Ameroconium cladoniae U. Braun & Zhurb. – Magadan Region, Ola District, Zavyalova Is-

land, Rassvet Bay, 59°04'N, 150°38'E, alt. 45 m, *Betula ermanii* forest, on *Cladonia coccifera* agg. (podetia, basal squamules), 29.06.2010, E. V. Zheludeva (LE 264269).

Note – This recently described species was formerly known only from Irkutsk Region and Trans-Baikal Territory in Russia from *Cladonia alaskana, C. arbuscula* and *C. rangiferina* (Zhurbenko & Braun, 2013; Zhurbenko & Yakovchenko, 2014). *Cladonia coccifera* agg. is a new host species.

*Epicladonia sandstedei (Zopf) D. Hawksw. – Magadan Region, North-Even District, mouth of Nayakhan River, 61°55'N, 159°00'E, alt. 5 m, on *Cladonia cornuta* (podetia), 14.06.2008, E. V. Zheludeva (LE 264349).

Note – Formerly known in Asian Russia from Karachaevo-Cherkesiya Republic, Krasnoyarsk Territory and Trans-Baikal Territory (Zhurbenko, 1998; Zhurbenko & Kobzeva, 2014; Zhurbenko & Yakovchenko, 2014).

*Everniicola flexispora D. Hawksw. – Magadan Region, Ola District, Taui River, ichthyological field station, 59°47'N, 148°16'E, alt. 40 m, *Pinus pumila* shrubs, on *Nephroma arcticum* (lobes), 23.06.2009, E. V. Zheludeva (LE 261323).

*Lichenoconium lecanorae (Jaap) D. Hawksw. – Magadan Region, North-Even District, Arestovo settlement at Gizhiga River, 61°58'N, 160°26'E, alt. 30 m, *Pinus-Betula nana* vegetation, on *Flavocetraria cucullata* (lobes), 9.07.2008, E. V. Zheludeva (LE 261313); same region, Ola District, Magadan Reserve, 7 km downstream by Yama River from Studenaya cabin, 59°45'N, 153°34'E, alt. 70 m, *Chosenia-Larix* forest, on *Melanohalea olivacea* (damaged hymenium of apothecia), 17.07.2010, E. V. Zheludeva (LE 261461b).

Note – *Flavocetraria* is a new host genus.

*Lichenoconium usneae (Anzi) D. Hawksw. – Magadan Region, Ola District, Taui River, ichthyological field station, 59°47'N, 148°16'E, alt. 35 m, *Larix-Betula* forest, on *Physcia aipolia* (destroyed apothecia) growing on *Betula*, 19.05.2009, E. V. Zheludeva (LE 264369b).

*Lichenopeltella cetrariicola (Nyl.) R. Sant. – Chukotka Autonomous Area, Anadyr District, Emeem Lagoon, Malyi Arinai Mountain, 62°40'53.90"N, 179°21'6.00"E, alt. 95 m, dwarf shrub-lichen tundra, on *Arctocetraria andrejevii* (lobe bases), 6.08.2012, D. S. Lysenko (LE 261433); Magadan Region, Tenkinskii District, bank of Omchak River, 61°33'N, 147°57'E, alt. 860 m, *Larix-Pinus pumila* vegetation, on *Cetraria islandica* (lobe bases), 30.06.2012, E. V. Zheludeva (LE 264469).

Notes – Asci 29–41(–48) × 10–12(–13) µm (n = 10, in K), 4(–6)-spored. Ascospores (11.0–)13.6–17.4(–19.1) × (2.8–)3.1–3.5(–3.8) µm, l/b = (3.2–)4.1–5.3(–6.1) (n = 32, in K), usually with 2 large guttules in each cell. Hawksworth (1980) gave sizes of asci as 25–35 × 8–12 µm and ascospores 14–16 × 2.5–4 µm. Formerly known in Russia from Irkutsk Region and Buryatia Republic (Zhurbenko & Vershinina, 2014). The species has mostly been collected on *Cetraria islandica*, but has also been reported from *Arctocetraria andrejevii* (Alstrup et al., 2009).

*Lichenostigma alpinum (R. Sant., Alstrup & D. Hawksw.) Ertz & Diederich – Magadan Region, North-Even District, Arestovo settlement at Gizhiga River, 61°58'N, 160°26'E, alt. 15 m, on *Ochrolechia frigida* (thallus), 9.07.2008, E. V. Zheludeva (LE 264459).

*Lichenostigma cosmopolites Hafellner & Calat. – Magadan Region, Magadan, Nagaeva Bay, Morportovskaya Mountain, 59°34'N, 150°38'E, alt. 150 m, talus with *Betula ermanii*, on *Xanthoparmelia stenophylla* (disc of apothecia, thallus) growing on stone, 26.06.2007, E. V. Zheludeva (LE 264419).

Note – Formerly known in Asian Russia from Karachayevo-Circassian Republic, Trans-Baikal Territory and Jewish Autonomous Region (Zhurbenko, 2014; Zhurbenko & Kobzeva, 2014; Zhurbenko & Yakovchenko, 2014).

Lichenostigma maureri Hafellner (anamorph) – Magadan Region, Magadan, Nagaeva Bay, Morportovskaya Mountain, 59°34'N, 150°38'E, alt. 310 m, sparse *Larix-Pinus pumila* vegetation, on *Alectoria lata* (thallus) growing on *Larix*, 5.07.2005, E. V. Zheludeva (LE 261252).

Notes – Formerly reported in Magadan Region also from the vicinities of Magadan (Zhurbenko, 2009b). *Alectoria lata* is a new host species.

*Nesolechia oxyspora (Tul.) A. Massal. – Magadan Region, Ola District, Taui River, ichthyological field station, 59°47'N, 148°16'E, alt. 35 m, mixed *Larix* forest, on *Parmelia sulcata* (thallus), 18.06.2011, E. V. Zheludeva (LE 261281b); 20.05.2009, E. V. Zheludeva (LE 264499); same district, Magadan Reserve, 7 km downstream by Yama River from Studenaya cabin, 59°44'N, 153°40'E, alt. 60 m, forested stone field, on *P. omphalodes* (thallus), 24.07.2010, E. V. Zheludeva (LE 264309c).

*Plectocarpon linitae (R. Sant.) Wedin & Hafellner – Magadan Region, Ola District, Zavyalova Island, Rassvet Bay, 59°04'N, 150°38'E, alt. 80 m, *Betula ermanii-Alnus* forest, on *Lobaria linita* (thallus), 20.06.2010, E. V. Zheludeva (LE 261353).

*Roselliniella cladoniae (Anzi) Matzer & Hafellner – Magadan Region, North-Even District, Arestovo settlement at Gizhiga River, 61°58'N, 160°26'E, alt. 15 m, 9.07.2008, E. V. Zheludeva, on *Cladonia sulphurina* (dark basal parts of podetia) (LE 261443a), on *C. coccifera* agg. (dark basal parts of podetia) (LE 261443b).

*Sagediopsis campsteriana (Linds.) D. Hawksw. & R. Sant. – Magadan Region, Ola District, Zavyalova Island, near lighthouse at Rassvet Bay, 59°00'N, 150°29'E, alt. 390 m, stony lichen tundra, on *Ochrolechia frigida* (disc and margin of apothecia, thallus), 17.08.2009, E. V. Zheludeva (LE 264259).

Notes – Ascomata wall brown throughout or in young ascomata the outer layer reddish brown; pigmentation patchy in cross section. Formerly known in Asian Russia from Yamal-Nenets Autonomous Area, Krasnoyarsk Territory and Chukotka Autonomous Area (Zhurbenko, 2009c).

*Sphaerellothecium cladoniicola E.S. Hansen & Alstrup – Magadan Region, Tenkinskii District, Rodionovskii Creek (tribute of Nelkoba River), 61°22'N, 148°41'E, alt. 560 m, *Pinus pumila* vegetation, on *Cladonia arbuscula* (podetia), 4.07.2012, E. V. Zheludeva (LE 261212).

Notes – Examined material fits the species protologue (Hansen & Alstrup, 1995), except that ascomata are smaller, 25–35(–45) μm (n = 25) vs. 30–60 μm diam. Wall of asci and ascospores BCr–. Formerly known in Asia and Russia only from Chukotka (Hansen & Alstrup, 1995).

Sphaerellothecium minutum Hafellner – Magadan Region, Ola District, Magadan Reserve, Yama River, 59°44'N, 153°40'E, alt. 60 m, forested stone field, on *Sphaerophorus globosus*, 24.07.2010, E. V. Zheludeva (LE 264449a).

Note – Formerly known in Magadan Region from the vicinities of Magadan (Zhurbenko, 2008).

*Sphaerellothecium cf. parmeliae Diederich & Etayo – Russia: Murmansk Region, near Alakurtti settlement, 66°58'N, 30°20'E, alt. 190 m, *Betula* forest, on *Parmelia saxatilis*, 5.07.1972, A. V. Dombrovskaya (LE 264409); Komi Republic, Northern Ural, headwaters of Pechora River, Yanypupuner Range, Mt. "981", 62°05'N, 59°06'E, alt. 800 m, mountain tundra, on *P. saxatilis*, 30.06.1997, M. P. Zhurbenko 97220 (LE 210213); Krasnoyarsk Territory, Taimyr Peninsula, Bikada River, 74°50'N, 106°30'E, tundra, 07.1989, E. B. Pospelova [LE 233398; published as *S. parmeliae* (Zhurbenko, 2009a)]; Republic of Tuva, Big Yenisey River valley, near Toora-Khem settlement, 52°26'N, 96°05'E, alt. 850 m, *Larix* forest, on *P. omphalodes*, 29.07.1995, T. N. Otnyukova (LE 207772); Trans-Baikal Territory, Sokhondinskii Reserve, Agutsa River at 1 km N of Buninda Cabin, 49°42'59" N, 111°22'50" E, alt. 1180 m, *Betula-Larix* forest, on *P. omphalodes*, 22.07.2008, L. S. Yakovchenko (LE 264479); Magadan Region, Ola District, Magadan Reserve, Yama River, 59°45'N, 153°35'E, alt. 70 m, mixed *Larix* forest, on *P. sulcata*, 23.07.2010, E. V. Zheludeva (LE 261363); same reserve, 7 km downstream by Yama River from Studenaya cabin, 59°44'N, 153°40'E, alt. 60 m, forested stone field, on *P. omphalodes*, 24.07.2010, E. V. Zheludeva (LE 264309b); Chukotka Autonomous Area, Rauchua River, near abandoned Baranikha settlement, 68°33'N, 168°12'E, stony tundra, on *P. omphalodes*, 20.06.1971, I. I. Makarova (LE 264299); same autonomous area, near confluence of Enmyvaam and Shustraya Rivers, 68°15'N, 166°03'E, *Pinus pumila* shrubs and scree tundra, on *P. omphalodes*, 30.06.1980, I. I. Makarova (LE 261373).

Specimen of an externally typical *Sphaerellothecium parmeliae* examined for comparison: Russia, Murmansk Region, Barents Sea coast, Shel'pino Bay, 69°05'N, 36°12'E, alt. 10 m, coastal cliffs among tundra, on *Parmelia omphalodes* (thallus), 4.09. 1997, M. P. Zhurbenko 97344 (LE 233170).

Notes – Vegetative hyphae branched, forming a dense superficial reticulum, medium brown, 2.5–4(–5) µm thick, with scaly fissured surface. Ascomata black, glossy, subglobose, (25–)40–60(–65) µm diam. (n = 25), with ostiole ca. 5–8 µm, semi-immersed to superficial, dispersed. Asci saccate, ovoid or pyriform, 21–30(–37) × (11–)12–14(–17) µm (n = 16), 8-spored, wall BCr–. Ascospores narrowly ellipsoid with wider upper cell (obskittle-shaped), hyaline, (8.4–)9.3–11.1(–12.5) × (3.0–)3.2–4.0(–4.5) µm, l/b = (2.1–)2.5–3.1(–3.4) (n = 54), 1-septate, sometimes slightly constricted at the septum, smooth-walled, non-halonate, wall BCr–. Infections usually dispersed over healthy-looking host lobes, but occasionally also growing on bleached or darkened areas of the lobes (Fig. 1A, B).

In the protologue of *Sphaerellothecium parmeliae* (Etayo & Diederich, 1998) its vegetative hyphae were reported being smooth-walled, ascomata somewhat smaller, viz. 25–40(–60) µm diam., asci smaller, 19–23 × 9–12.5 µm, ascospores oval and smaller, 8.5–10 × 3–4 µm. The fungus was also characterized by its infections arising from black necrotic areas of the host lobes. However, examined material of an externally typical *S. parmeliae*, strictly associated with well delimited black areas of the host thalli (Fig. 1C), has ascomata [(30–)40–50(–70) µm diam. (n = 62)] and ascospores [(9.7–)10.3–11.9(–13.0) × (4.0–)4.2–4.8(–5.3) µm l/b = (2.1–)2.3–2.7(–2.9) (n = 43, in BCr or water)] similar in size to those of *S.* cf. *parmeliae*. It is could be hypothesized that the species is not obligately associated with black necrotic areas of the host thallus, which might have an independent origin.

Sphaerellothecium parmeliae was formerly reported in Russia from Murmansk Region and Krasnoyarsk Territory (Zhurbenko & Otnyukova, 2001; Zhurbenko, 2009a). The species is so far known in Asia only from Russia and Turkey (Hafellner & John, 2006).

*Sphaerellothecium sp. – Magadan Region, Magadan, Nagaeva Bay, Morportovskaya Mountain, 59°34'N, 150°38'E, alt. 310 m, sparse *Larix-Pinus pumila* vegetation, on *Arctoparmelia centrifuga* (thallus), 5.07.2005, E. V. Zheludeva (LE 261262); same region, Ola District, Zavyalova Island, Rassvet Bay, 59°04'N, 150°38'E, alt. 25 m, talus, on *A. centrifuga* (thallus), 13.08.2009, E. V. Zheludeva (LE 261233).

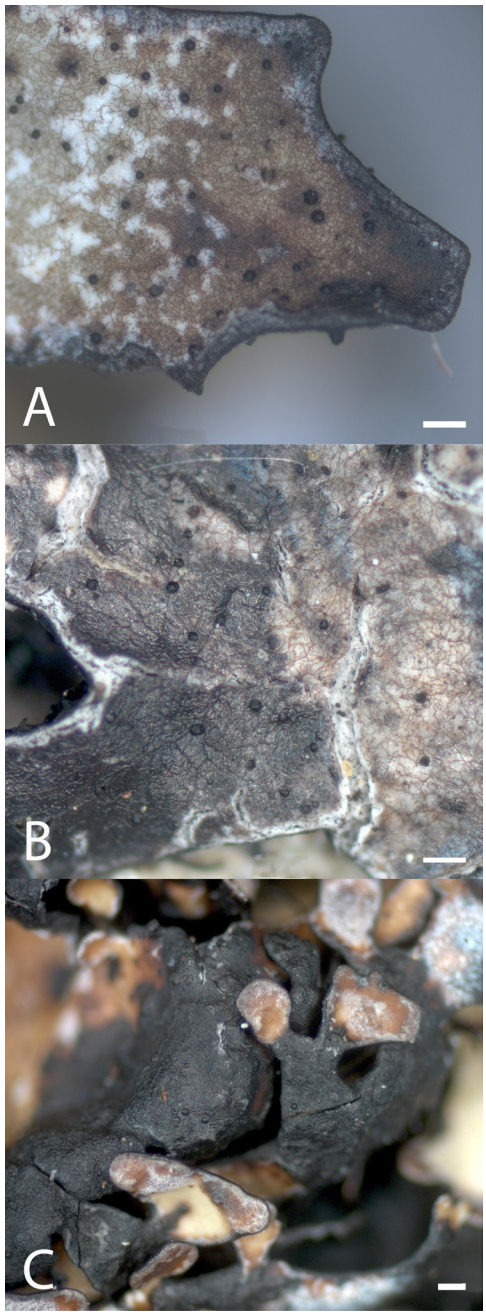

Fig. 1. A: *Sphaerellothecium* cf. *parmeliae* growing on healthy-looking lobes of *Parmelia omphalodes* (LE 264309b). B: *S.* cf. *parmeliae* growing on blackened or bleached parts of *Parmelia sulcata* lobes (LE 261363). C: *S. parmeliae* growing on black areas of *Parmelia omphalodes* lobes (233170). Scale bars = 200 µm.

Notes – Vegetative hyphae form a superficial dark reticulum, medium brown, 4–10 µm diam., granulate and scaly-areolate. Ascomata black, subglobose, 25–35(–45) µm diam. (n = 28), sessile; wall medium brown, granulate. Santesson et al. (2004: 194) introduced the new name "*Lichenostigma arctoparmeliae*" R. Sant. (ined.), which has never been validly published, but may refer to this fungus.

"Sphaeropezia" sp. – Magadan Region, Ola District, Talan Island, 59°18'N, 149°04'E, alt. 170 m, mountain tundra, on *Hypogymnia physodes* (thallus) growing on stone, 10.07.2012, E. V. Zheludeva (LE 264289).

Notes – Ascomata cleistohymenial, subglobose to slightly flattened, dark brown or blackish, 200–250 µm diam., opening by a wide pore, surrounded by radially fissured exciple margins, immersed to finally slightly protruding (Fig. 2). Exciple without hairs, dark brown above, medium to pale brown below, pigmentation granulose and patchy, K+ acquires olivaceous tinge. Ascomatal center I+ orange and partly blue. Paraphyses filiform, apically not swollen, 1–2 µm thick, not or occasionally branched. Mature asci and ascospores not observed. Infection causes distinct bleaching of host thallus. According to the observed characters this probably undescribed lichenicolous ascomycete on *Hypogymnia* resembles a species of *Sphaeropezia* Sacc. (Diederich et al., 2002; Baloch et al., 2013). So far no species of cleistohymenial ascomycetes has been reported from *Hypogymnia* (Lawrey & Diederich, 2015).

*Spirographa fusisporella (Nyl.) Zahlbr. – Magadan Region, Ola District, Magadan Reserve, Studenaya cabin at Yama River, 59°45'N, 153°34'E, alt. 70 m, *Chosenia-Larix* forest, on

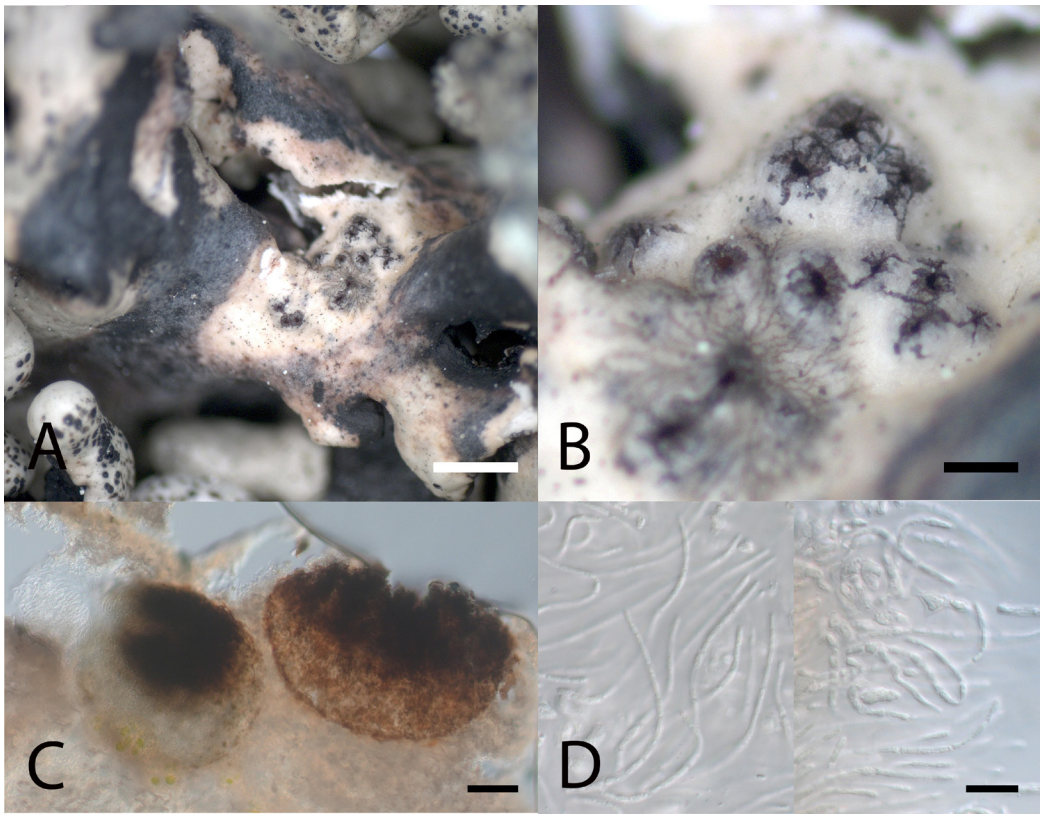

Fig. 2. *"Sphaeropezia"* sp. on thallus of *Hypogymnia physodes* (LE 264289). A, B: infection and ascomata habitus. C: squashed young and old ascomata in water. D: paraphyses in water. Scale bars: A = 1 mm, B = 200 µm, C = 50 µm, D = 10 µm.

Melanohalea olivacea (damaged hymenium of apothecia), 17.07.2010, E. V. Zheludeva (LE 261461a).

Notes – Formerly known in Russia from Murmansk Region and Komi Republic (Zhurbenko, 2009a; Zhurbenko et al., 2012). The species is widely distributed in the world, but still new to Asia.

*Syzygospora bachmannii Diederich & M.S. Christ. – Magadan Region, Ola District, Ola River valley, 59°35'N, 151°15'E, alt. 15 m, *Larix* forest, on *Cladonia ecmocyna* (podetia), 31.07.2009, E. V. Zheludeva (LE 264279).

Notes – Formerly known in Asian Russia from Karachaevo-Cherkesiya Republic, Sverdlovsk Region and Trans-Baikal Territory (Shiryaev et al., 2010; Zhurbenko & Kobzeva, 2014; Zhurbenko & Yakovchenko, 2014). So far known in Asia only from Russia.

*Syzygospora physciacearum Diederich – Magadan Region, Ola District, Taui River, ichthyological field station, 59°47'N, 148°16'E, alt. 35 m, *Larix-Betula* forest, on *Physcia aipolia* (thallus) growing on *Betula*, 19.05.2009, E. V. Zheludeva (LE 264369a).

Note – Formerly known in Asian Russia from Republic of Daghestan, Republic of Adygeya and Sverdlovsk Region (Shiryaev et al., 2010; Urbanavichus & Ismailov, 2013; Urbanavichus & Urbanavichene, 2014).

ACKNOWLEDGEMENTS

Paul Diederich, Javier Etayo and Wolfgang von Brackel are thanked for valuable discussions on *Sphaerellothecium parmeliae*; furthermore, Paul Diederich reviewed the manuscript and made helpful comments. The study of M. P. Zhurbenko was carried out within the framework of the research project of the Komarov Botanical Institute Russian Academy of Sciences no. 01201255602.

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