

## New records of lichens from the Russian Far East. II. Species from forest habitats

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**ABSTRACT.** – *Micarea xanthonica* and *Trapelia elacista* are reported as new to Asia and Russia, *Lecania coreana* and *Lepraria pseudoarbuscula* are reported new to Russia, *Micarea globulosella* is reported for the first time for the Russian Far East, *Rinodina herreri* is reported for the second time for Asia and Russia from Khabarovsk Territory, and *Coenogonium isidiatum* is reported for the second time for Russia from Primorye Territory. A comparison of known isidiate *Coenogonium* species is made. *Lichenomphalia umbellifera* is reported as new to the Kuril Islands and Sakhalin Region. *Ramalina thrausta* is newly reported from Sakhalin Island. The characteristic features of the specimens from the Russian Far East and comparisons with similar species are given.

**KEYWORDS.** – Asia, basidiolichens, lichen biodiversity, Russia, Sikhote-Alin’.

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### INTRODUCTION

The Russian Far East is located in Northeast Asia and shares land borders with China and North Korea, and sea borders with Japan and U.S.A. (Figure 1). The region includes eight administrative provinces of Russia and is divided into three parts: the arctic Far East (northern Chukotka Autonomous Region), the northern part (Magadan Region, Kamchatka Region, southern Chukotka Autonomous Region,

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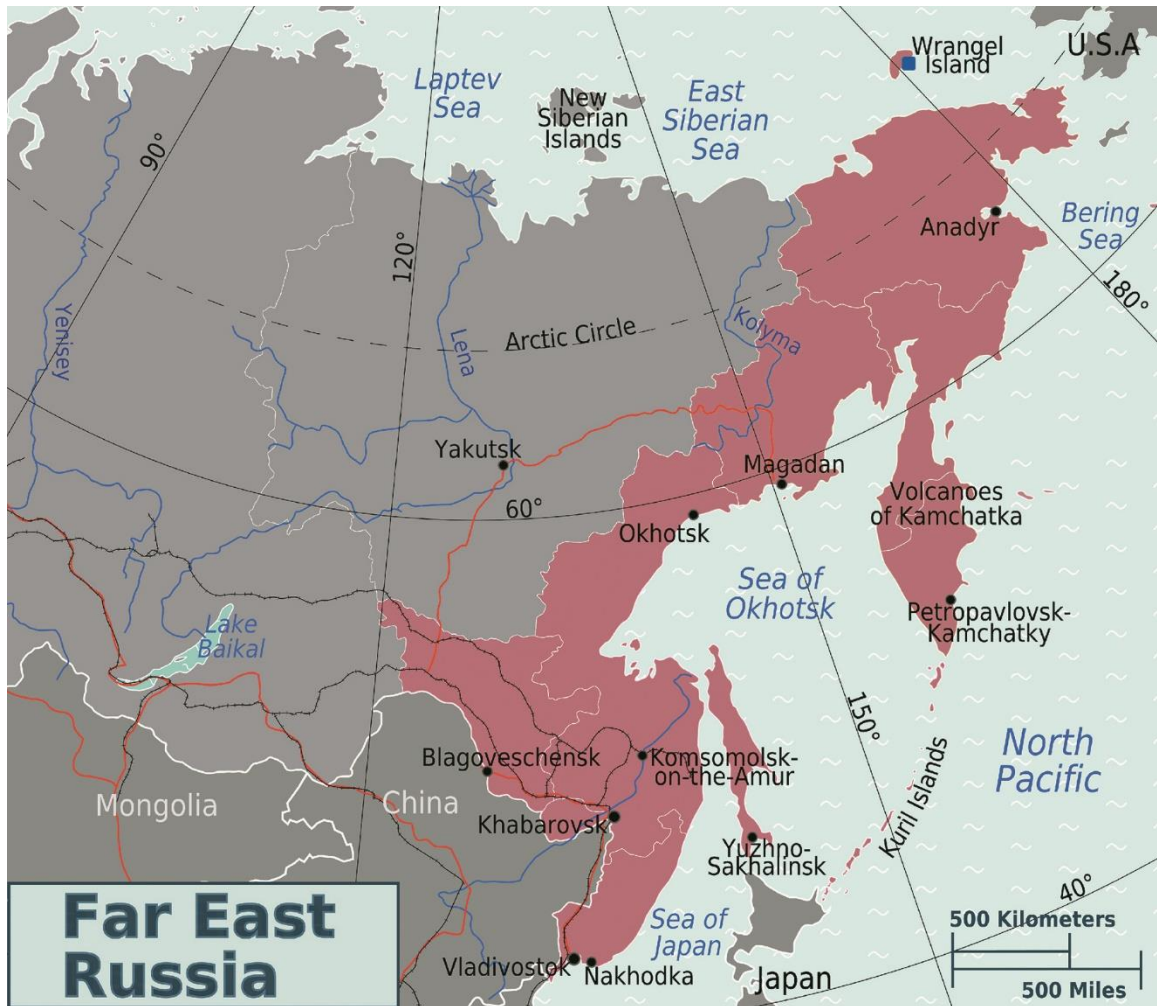
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**Figure 1.** Map illustrating the geographic position and delimitation of Far East Russia (shaded pink) in relation to northeastern Asia.

northern Khabarovsk Territory) and the southern part (Amur Region, Jewish Autonomous Region, Primorye Territory, Sakhalin Region, southern Khabarovsk Territory). The Far East is one of the largest provinces of Russia, its land area is 3,085,806 km<sup>2</sup>, or 18% of the whole territory of Russia, and it lies between latitudes 42°N and 71°N and between longitudes 119°E and 169°E. The highest elevation is 4750 meters at the summit of Klyuchevskaya Sopka volcano on the Kamchatka Peninsula. The largest mountain territory in the Russian Far East is the Sikhote-Alin' Range. It stretches for 1200 kilometers within the Khabarovsk and Primorye Territories. The highest mountain of the Sikhote-Alin' Range is Tordoki-Yani Mt., with a summit of 2090 m. The climate of the Russian Far East varies from Arctic to monsoon. Permafrost covers almost all the region except the southernmost part where relict broadleaf forest communities are extant. The vast area of the Russian Far East, as well as both latitudinal and elevation gradients, contribute to the richness of lichen biota of the region (Ganzei 2008).

Lichens and allied fungi have been poorly and unevenly studied in the Russian Far East. Currently, the most studied areas are the Kamchatka Region and Primorye Territory while the Khabarovsk Territory (especially its northern part) and the Amur Region remain insufficiently examined by lichenologists (Yakovchenko et al. 2013b). The first lichen studies in the Russian Far East date back to the middle of the 19th century and were summarized by Urbanavichus (2010). The most complete checklist of lichens of the southern part of the Russian Far East included 943 species and was published by Tchabanenko (2002). Since 2010 the results of many lichen collection efforts have been published, which included numerous new provincial and national records as well as description of new species. These include studies in Kamchatka (Davydov et al. 2011, Himelbrant et al. 2014, 2019, Kukwa et al. 2014, Stepanchikova et al.

2013, Zhurbenko et al. 2012), the Magadan Region (Makryi & Zheludeva 2012, 2018, Velikanov & Skirina 2012, Yakovchenko et al. 2013a, 2018, Zheludeva 2017, Zhurbenko & Zheludeva 2015), the Amur Region (Kochunova 2016, Kuznetsova & Dudov 2017, Pchelkin & Pchelkina 2013), the Jewish Autonomous Region (Skirina 2015a), Khabarovsk Territory (Galanina & Galanin 2014, Galanina et al. 2017, Gerasimova et al. 2018, Skirina 2012, Yakovchenko et al. 2013b), the Primorye Territory (Cherdantseva et al. 2013; Davydov et al. 2020, Kondratyuk et al. 2013b, 2014, Kuznetsova et al. 2013, McCune et al. 2015, Ohmura et al. 2017, Skirina 2015b, Skirina & Rodnikova 2014, Skirina & Skirin 2014, Yakovchenko et al. 2019, 2020a, b) and the Sakhalin Region (Ezhkin & Schumm 2018, Galanina & Ezhkin 2019, Galanina & Galanin 2014, Galanina et al. 2017, 2018, Gerasimova et al. 2018, Konoreva et al. 2018a, b, 2020, Skirina et al. 2016, Tchabanenko et al. 2018, Zhurbenko et al. 2017). It also included several monographs (Davydov 2017, Gagarina 2017, Vondrák et al. 2016, Tchabanenko 2018). New records from neighboring regions in other countries, including China, Japan and South Korea have also been published in a number of papers (e.g., Kondratyuk et al. 2013a, b, 2015, 2016a, b, McCune et al. 2015, Ohmura et al. 2014; Yakovchenko et al. 2016, 2018, Zhurbenko et al. 2015) that contributed to the understanding of the lichen flora of the Russian Far East and East Asia as a whole.

During our ongoing biogeographical and ecological studies of the lichen biota of the Russian Far East, we have compiled new provincial records that represent major range extensions. These records are presented here with detailed discussions.

## MATERIALS AND METHODS

This study was based on specimens collected by authors and deposited in the herbaria of the Altai State University (ALTB), Komarov Botanical Institute RAS (LE), Federal Scientific Center of the East Asia Terrestrial Biodiversity FEB RAS (VLA), Ural Federal University (UFU), and Institute of Marine Geology and Geophysics FEB RAS (SAK). Morphological observations were made using a stereomicroscope Zeiss Stemi 2000-C. Cross-sections of apothecia and thalli were made by hand with a razor blade and observed with a Zeiss Axio Lab.A1 compound microscope. after mounting in water. Measurements are presented as minimum–maximum observed with the extreme values in parentheses. Lichen substances of some species were studied by spot-tests using potassium hydroxide solution (K), sodium hypochlorite solution (C), 1,4-p-phenyldiamine (PD), and iodine (I), and by a thin-layer chromatography (TLC) in solvent systems A and B (Orange et al. 2001).

## RESULTS AND DISCUSSION

### *Coenogonium isidiatum* (G. Thor & Vězda) Lücking et al.

#### FIGURE 2.

NOTES. – *Coenogonium isidiatum* is newly reported here from the Primorye Territory, and for the second time from Russia. The nearest known locality is on Sakhalin Island; the species is also known from Kamchatka (Konoreva et al. 2018a). Worldwide *Coenogonium isidiatum* has been reported from Nepal (Thor & Vězda 1984), Costa Rica (Rivas Plata et al. 2006), U.S.A. (Seavey & Seavey 2014), South America (Ferraro & Michlig 2013), China and North Korea (Gagarina 2015) where it inhabits bark, plant debris, saxicolous mosses on siliceous rocks in shady and humid conditions. The species is characterized by having a crustose, thin, bluish-grey thallus without a hypothallus, and dense, up to 0.4 mm long, cylindrical to coralloid isidia, concolorous with the thallus, with obtuse apices and round, plain, sessile, basally constricted apothecia, up to 2 mm in diameter, with an orange disc and an indistinct, smooth proper margin that is paler than the disc, and ascospores that are ellipsoid and one-septate,  $9\text{--}14 \times 3\text{--}4 \mu\text{m}$  (Gagarina 2015). No lichen substances were detected by TLC in the specimens examined. The specimens cited below had large, up to 10 cm thalli densely covered by mostly branched isidia, 0.2–0.4 mm long and 0.05 mm thick, with numerous pale orange, biatorine apothecia, 0.5–1.4 mm in diameter with cream-colored smooth margins, ca. 0.1 mm wide; a hymenium 75–90  $\mu\text{m}$  tall, 8-spored cylindrical asci (I–) with colorless two-celled ellipsoid to fusiform ascospores,  $9\text{--}13 \times 3\text{--}3.5 \mu\text{m}$ . The material fully agrees with the detailed descriptions of the species published by Thor and Vězda (1984) and Gagarina (2015).

Apart from *Coenogonium isidiatum*, there are ten other isidiate *Coenogonium* species worldwide: *C. agonimioides* P. Halda et al., *C. coralloideum* Kalb, *C. disciforme* Pabon et al., *C. fruticosum* L. Ludw., *C. isidiiferum* (Lücking) Lücking, *C. isidiigerum* (Vězda & Osorio) Lücking et al., *C. isidiosum* (Breuss) Rivas Plata et al. and *C. upretianum* M. Cáceres & Aptroot (Aptroot & Cáceres 2018, Kalb 2007,



**Figure 2.** Thallus apothecia of *Coenogonium isidiatum* (L.S. Yakovchenko 1183 & E.A. Davydov, ALTB). Scale = 1.0 mm.

Kondratyuk et al. 2016b, Lüicking et al. 2001, Ludwig 2014, Papong et al. 2007, Rivas Plata et al. 2006) and two undescribed species from Brazil called “Spec. A” and “Spec. B” in Rivas Plata et al. (2006). Among these, *C. isidiatum* and *C. fruticosum* described from New Zealand (Ludwig 2014) are the species distributed in temperate regions. In subtropical regions two isidiate species: *C. agonimioides* described from Jeju Island (South Korea) (Kondratyuk et al. 2016b) and *C. isidiigerum* (Uruguay, Argentina) are known. Other *Coenogonium* species with isidia are restricted only to the tropics. All of these taxa can be clearly distinguished from *C. isidiatum*.

*Coenogonium agonimioides* differs from *C. isidiatum* in having a greenish-grey coralloid thallus, simple fusiform ascospores ( $12 \times 2 \mu\text{m}$ ) and in growing on rocks (Ludwig 2014). *Coenogonium upretianum*, recently described from Brazil (Aptroot & Cáceres 2018), is easily distinguished from *C. isidiatum* by the green shiny thallus, mostly unbranched, thicker isidia (0.1 mm thick) and longer ( $15\text{--}17 \times 3\text{--}4 \mu\text{m}$ ) ascospores that are fusiform with pointed ends. In contrast to *C. isidiatum*, *C. fruticosum* is characterized by the longer (up to 1 mm tall), densely coralloid, green to orange isidia as well as a partially crenulate proper margin of apothecia and slightly smaller ascospores,  $(6\text{--}7\text{--}10\text{--}11) \times 2\text{--}3 \mu\text{m}$  (Ludwig 2014). Compared to *C. isidiatum*, *C. isidiosum* has narrower ascospores,  $2.5\text{--}3 \mu\text{m}$  broad, smaller apothecia (up to 0.5 mm wide) with a lower hymenium ( $50\text{--}60 \mu\text{m}$  tall) and brownish-yellow apothecial discs. *Coenogonium isidiigerum* differs from *C. isidiatum* by the presence of a white hypothallus, much larger ascospores ( $20\text{--}24 \mu\text{m}$  long) and thicker (0.1 mm wide) isidia (Rivas Plata et al. 2006). As opposed to *C. isidiatum*, *C. disciforme* and *C. isidiferum* are characterized by the disc-shaped isidia, dissolving (evanescent) thallus and a foliicolous habit (Rivas Plata et al. 2006). The undescribed species from Brazil – *Coenogonium* spec. B, referring to “Kalb, pers. comm. 2000” in Rivas Plata et al. (2006) differs from *C. isidiatum* by the longer isidia (up to 0.7 mm long) aggregated into dense cushions and the orange-red apothecial disc. Another undescribed species, *Coenogonium* spec. A, differs from *C. isidiatum* by having longer ( $15\text{--}18 \mu\text{m}$ ) ascospores.

*Specimens examined:* – **RUSSIA. PRIMORYE TERRITORY: LAZOVSKIY DISTRICT:** 19 km NE from Lazo Settlement, Lazovskiy State Reserve, Route to “Zuby Drakona” rock,  $43^{\circ}29'50.8''\text{N}$ ,



134°04'20.4"E, elev. 761 m, *Abies–Betula* forest, 20.v.2014, on mossy rocks, *L.S. Yakovchenko 1183 & E.A. Davydov* (ALTB). CHUGUEVSKIY DISTRICT: Sikhote-Alin' Range, 3 km to NE from the top of Sestra Mt., 43°33'39.1"N, 134°06'34.6"E, elev. 755 m, *Picea–Betula* forest, 7.viii.2014, on bark of *Picea* sp., *A.G. Paukov 3295* (UFU). **KHABAROVSK TERRITORY: KHABAROVSK DISTRICT:** Bolshekhkhtsyrsky Nature Reserve, Bykova River, neighborhood "Bychikha" cordon, 48°14'28.7"N 134°49'01.3"E, elev. 221 m, coniferous-deciduous forest, 29.ix.2018, on bark of *Picea* sp., *L.A. Konoreva 365* (LE); Bolshekhkhtsyrsky Nature Reserve, Bolshoy Khkhtsy Mountain, 48°13'24.2"N, 134°46'45.3"E, elev. 847 m, *Picea–Betula* forest, 2.x.2018, on bark of *Picea* sp., *S.V. Chesnokov 220* (LE).

***Lecania coreana* S. Y. Kondr. et al.**

**FIGURE 3.**

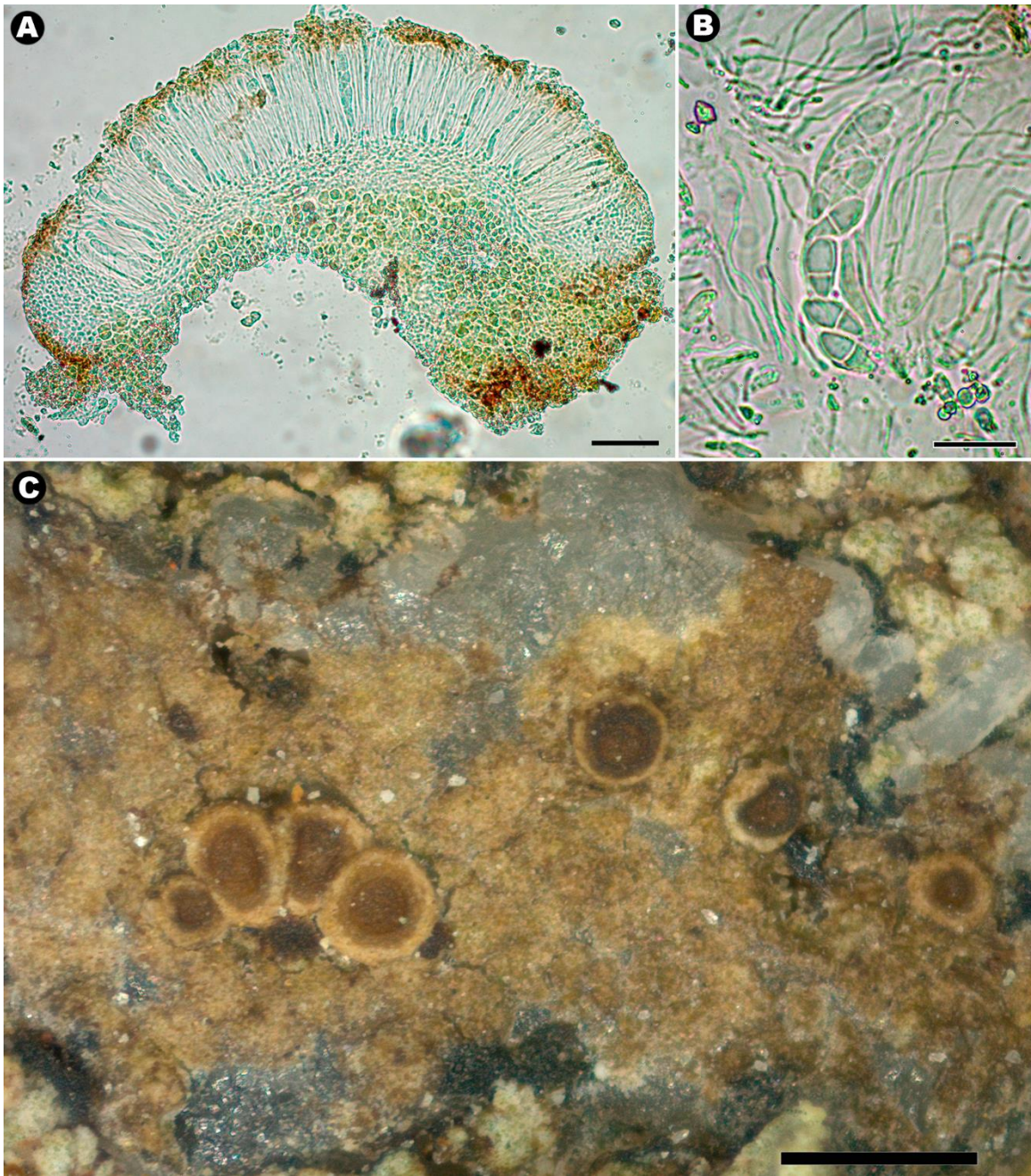
NOTES. – *Lecania coreana* is reported here for the first time from Russia and the second time from Asia. This species was described from South Korea (Kondratyuk et al. 2013a) and so far has not been reported from outside the western coastal part of that country. A brief characterization of our material is given below.

The thalli of the studied specimens are crustose, up to 8 cm in diameter, continuous-rimose, thin, film-like, repeating the shape of a rock surface and following the cracks in the rock, brownish in color and whitish on the margins, matt without a hypothallus. Numerous zeorine apothecia are dispersed across the thallus, scattered to crowded, rounded, 0.2–0.4 mm in diameter and up to 125 µm thick, sessile, widely attached to somewhat constricted at the base; with plane to concave, brown, epruinose, matt discs, and persistent proper margins. The latter is always seen as an elevated rim between the disc and the thalline margin, concolorous with the disc or more often darker (to dark brown), up to 0.05 mm wide. The thalline margins of apothecia are concolorous with the thallus, persistent or rarely remaining only at the base of apothecia. In section the thalline margin below the proper margin level is up to 50 µm wide, while the proper margin is up to 50 (–65) µm thick in the uppermost part, dark brown on the periphery and hyaline inside, scleroplectenchymatous, with cell lumina to 1.5 µm in diameter. The hymenium is up to 75 µm high, with paraphyses ca. 1 µm thick, anastomosed, and brown tips. The subhymenium is up to 30 µm thick and hyaline. Asci are 8-spored containing 1-septate, hyaline, not halonate, elongated, ellipsoid to cylindrical or somewhat clavate ascospores, with equal cells or one cell wider, straight or rarely curved, (12.5–)13–15(–16.5) × 4.5–6.5(–7) µm. No lichen substances were detected by TLC.

In general, the material from the Russian Far East fits closely, but not completely, with the protologue (Kondratyuk et al. 2013a). In the protologue the thallus was described as consisting of small granules or areoles 0.1–0.2(–0.3) mm wide, scattered and distant to forming a lax network in peripheral portions of the thallus to more or less continuous in the center, with cracks, but not cracked-areolate. Our specimens had continuous thalli. Apothecia and thalli in our specimens were paler compared to the photographs in the protologue (Kondratyuk et al. 2013a: fig. 12). We attribute the paler coloration of our specimens with their different ecology: both were collected in a forest in shady conditions in contrast to the holotype specimen shown in the photo which was collected on the seaside. This ecological preference does not contradict with the original description of the species, because one paratype [KoLRI-011779 (100268), not seen] was also stated to have been found under a forest canopy.

*Lecania coreana* resembles small representatives of the genus *Rinodina* (Ach.) Gray but is easily distinguished by its hyaline ascospores. For differences between *L. coreana* from another saxicolous *Lecania* A. Massal., which however do not closely resemble it, see Kondratyuk et al. (2013a). Another saxicolous *Lecania* species with a continuous, film-like thallus described from a forest habitat in South Korea (Kondratyuk et al. 2015) is *L. chirisanensis* S.Y. Kondr. et al., which differs from *L. coreana* by its larger (0.3–1 mm in diam.), semi-convex, dark brown apothecia with the proper margin paler than the disc, and larger ascospores (15–25 × 6–11 µm).

The morphologically closest species to *L. coreana* is *L. rinodinoidea* S.Y. Kondr. et al., which was described in the same paper (Kondratyuk et al. 2013a). The differences between them are not clear: both species have more or less continuous thalli (wholly continuous-rimose, thicker in *L. rinodinoidea* and thinner, continuous with cracks in the central part in *L. coreana*) with numerous, tiny, brown to black apothecia, which are never convex, with a plane to concave disc and a thalline margin. The main size ranges of the characters in two species mostly overlap: apothecia (0.2–0.4 mm in diam. in *L. coreana* vs. 0.2–0.5 mm in diam. in *L. rinodinoidea*), ascospores (13–18 × 3–6 µm in *L. coreana* vs. 11–19 × 4.5–7 µm in *L. rinodinoidea*) and hymenium (up to 60 µm in *L. coreana* vs. up to 70 µm in *L. rinodinoidea*). The key difference between these species is the type of apothecia (lecanorine in *L. rinodinoidea* and zeorine in *L.*



**Figure 3.** Morphology and anatomy of *Lecania coreana*. (E.A. Davydov 18306 & I.A. Galanina, ALTB). **A**, cross-section of apothecium mounted in water. **B**, ascus with eight one-septate ascospores. **C**, gross morphology of thallus and apothecia. Scales = 50  $\mu\text{m}$  in A, 20  $\mu\text{m}$  in B, 0.5 mm in C.

*coreana*) although the proper margin is also present in apothecial sections in *L. rinodinoides* and is comparable with the previous species in the thickness of the uppermost part (30–40  $\mu\text{m}$  thick in *L. coreana* vs. 30–35  $\mu\text{m}$  thick in *L. rinodinoides*). In our opinion, in the photographs of two species in the protologues, the persistent proper margin is seen even better in *L. rinodinoides*. Other characters such as the color of the hypothecium (hyaline in *L. coreana* vs. straw to brownish in *L. rinodinoides*) and the structure of the proper margin (paraplectenchymatous in *L. rinodinoides* vs. scleroplectenchymatous in *L. coreana*) are variable characters. Further molecular studies are needed to substantiate difference or conspecificity of these taxa. Unfortunately, were unable to borrow the type material for study.





**Figure 4.** Morphology of *Lepraria pseudoarbuscula* (E.A. Davydov 17647 & L.S. Yakovchenko, ALTB). Scale = 0.5 mm.

*Specimen examined.* – **RUSSIA, PRIMORYE TERRITORY, KHASANSKY DISTRICT:** hills at 4.2 km NE of Sukhanovka, *Quercus mongolica* forest on NW slope, 42°45'08.0"N, 131°08'33.0"E, elev. 146 m, 16.viii.2017, on a boulder in the forest, E.A. Davydov 18306 & I.A. Galanina (hb. Davydov & Yakovchenko).

***Lepraria pseudoarbuscula* (Asahina) Lendemer & B.P. Hodk.**

**FIGURE 4.**

**NOTES.** – *Lepraria pseudoarbuscula* is reported here as new to Russia. Asahina (1943) described two species of *Stereocaulon* Hoffm. which he considered morphologically similar to *S. arbuscula* Nyl. (≡ *Lepraria arbuscula* (Nyl.) Lendemer & B.P. Hodk. in the modern sense) but differed in their secondary chemistry: *S. pseudoarbuscula* Asahina contained thamnolic acid, and *S. novoarbuscula* Asahina contained squamatic acid. Lamb and Ward (1974) placed the species in *Leprocaulon* and treated them as synonyms under the name *L. pseudoarbuscula* (Asahina) Lamb & Ward. According to those authors, the full chemical spectrum of *L. pseudoarbuscula* comprises squamatic, thamnolic, baeomycesic, and barbatic acids as well as four chemodeficient phases. The type specimen of *S. novoarbuscula* belongs to the “phase IV” with squamatic acid only. Lendemer and Hodkinson (2013) moved all known species of *Leprocaulon* Nyl. except the type into *Lepraria*. *Lepraria pseudoarbuscula* is distributed in East Asia (Japan and Eastern Himalaya), and Australasia (Jagadeesh Ram & Sinha 2010, Lamb & Ward 1974, Ohmura & Kashiwadani 2018). The new record from Russia is the northernmost known locality of the species. Squamatic acid was detected by TLC in the collection cited here.

*Specimen examined.* – **RUSSIA, PRIMORYE TERRITORY, KHASANSKY DISTRICT:** at the right bank of the Egerskaya River between Verkhniaya Breevka and Arkhipovka, Parshivaya Mt., *Quercus mongolica* forest on W slope, 43°46'05"N, 133°48'25.5"E, elev. 430 m, 5.ix.2017, on rocks, E.A. Davydov 17647 & L.S. Yakovchenko (hb. Davydov & Yakovchenko).



**Figure 5.** Morphology of *Lichenomphalia umbellifera* in the field (A.K. Ezhkin s.n., SAK 1773).

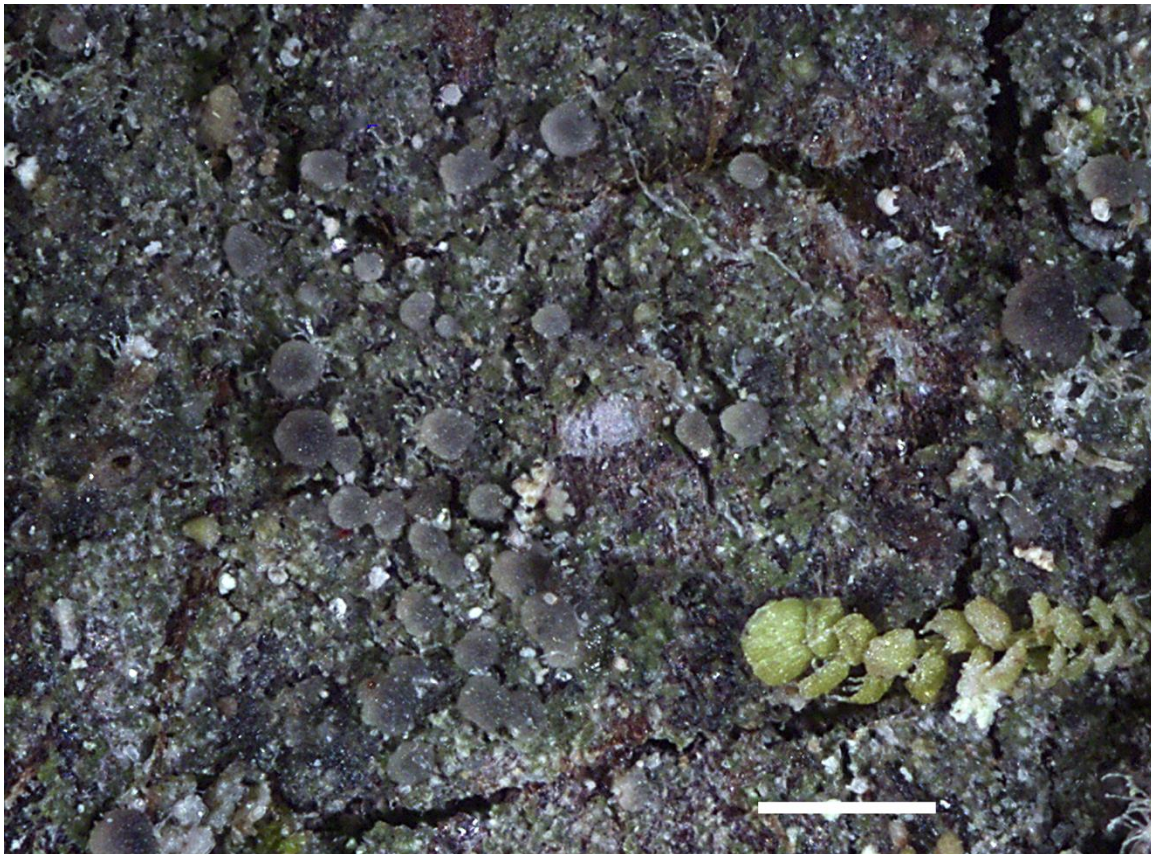
***Lichenomphalia umbellifera* (L.: Fr.) Redhead et al.**

**FIGURE 5.**

NOTES. – *Lichenomphalia umbellifera* is reported here for the first time to the Kuril Islands and Sakhalin Region. *Lichenomphalia umbellifera* is a widely distributed species known from Asia, Antarctica, Australia (Tasmania), Europe, and North America, and grows in wet conditions (lowlands, wet forests at the plain and in the mountains) where it overgrows mosses, especially *Sphagnum*, moist soil, mossy trunk bases and tussocks of grasses (McCune 2017, Watling & Woods 2009). It is widely distributed throughout all of Russia, occurring from tundra to temperate forests (Urbanavichus 2010). In the Russian Far East, it has been reported from the northern part in the Magadan Region (Sazanova 2009), Kamchatka Territory (Himmelbrant et al. 2014, 2019) and the southern part of the Amur Region (Kochunova 2016), Primorye Territory (Skirina 2017) and the Jewish Autonomous Region (Erofeeva et al. 2019). *Lichenomphalia umbellifera* is a lichenized agaricoid basidiomycete with a dark green, granular, *Botrydina*-type thallus having hyphae between granules that are 3–4(–6)  $\mu\text{m}$  in diameter with walls 0.5–1  $\mu\text{m}$  thick. The basidiomata are agaricoid, creamy white or light gray with convex to depressed, often funnel-shaped cap, 5–20 mm in diameter, that is brown to purplish-white when young but soon becomes yellowish-brown or almost white,. The stem is the same color as the cap but has a dark brown tint in its upper part, 10–25  $\times$  1–2 mm. Basidia are 1, 2 or 4-spored, containing hyaline, thin-walled basidiospores 7–10  $\times$  6–7  $\mu\text{m}$  (Elborne 2012; Urbanavichus & Urbanavichene 2008).

The specimens examined agree well with recently published descriptions (McCune 2017, Urbanavichus & Urbanavichene 2008, Watling & Woods 2009). The closely related *L. velutina* (Quél.) Redhead et al. is distinguished by its dark brown basidiomata becoming paler with age and when in the later state it can be confused with *L. umbellifera*. The most important distinguishing features of *L. umbellifera* are the hyphae between granules that are 3–4(–6)  $\mu\text{m}$  broad with walls 0.5–1  $\mu\text{m}$  thick (in contrast to 2–3  $\mu\text{m}$  broad hyphae without thick walls in *L. velutina*) and larger basidia (45–50  $\times$  6–7.5  $\mu\text{m}$  vs. 17–28  $\times$  4–7  $\mu\text{m}$  in *L. velutina*) (Urbanavichus & Urbanavichene 2008). The fruiting bodies of *L. umbellifera* are never bright yellow as in *L. alpina* (Britzelm.) Redhead et al. (Elborne 2012),





**Figure 6.** Morphology of *Micarea globulosella* (L.A. Konoreva 2, LE). Scale = 0.5 mm.

*Lichenomphalia umbellifera* is morphologically similar to *L. hudsoniana* (H.S. Jenn.) Redhead et al. which can be distinguished by its squamulose *Coriscium*-type thallus (Elborne 2012).

*Specimens examined.* – **RUSSIA. SAKHALIN REGION. SHIKOTAN ISLAND.** YUZHNO-KURILSKIY DISTRICT: creek valley between Tserkovnaya Bay and Notoro Mt., 43°45'18.8"N, 146°41'43.9"E, elev. 60 m, *Picea-Larix* forest with *Populus tremula* in the floodplain of the creek, 14.vi.2017, on a lignum of rotten stump, S.V. Chesnokov 176 (LE); neighborhood of Malaya Tserkovnaya Bay, 43°43'42"N, 146°40'28.4"E, elev. 66 m, *Larix kurilensis* forest with *Sasa kurilensis*, 13.vi.2017, on mosses, L.A. Konoreva 315 (LE); Tserkovnaya Bay, 43°43'31.2"N, 146°40'25.5"E, elev. 34 m, *Larix* forest, 13.vi.2017, on soil in mosses under the tree in shaded conditions, A.K. Ezhkin s.n. (SAK 1773). KUNASHIR ISLAND: Kuril Nature Reserve, neighborhood Saratovskiy cordon, left bank of Saratovskaya River, 44°15'58.3"N 146°06'20.3"E, elev. 21 m, *Betula-Abies-Picea* forest, 5.vi.2019, on rotten wood, S.V. Chesnokov 30 (LE).

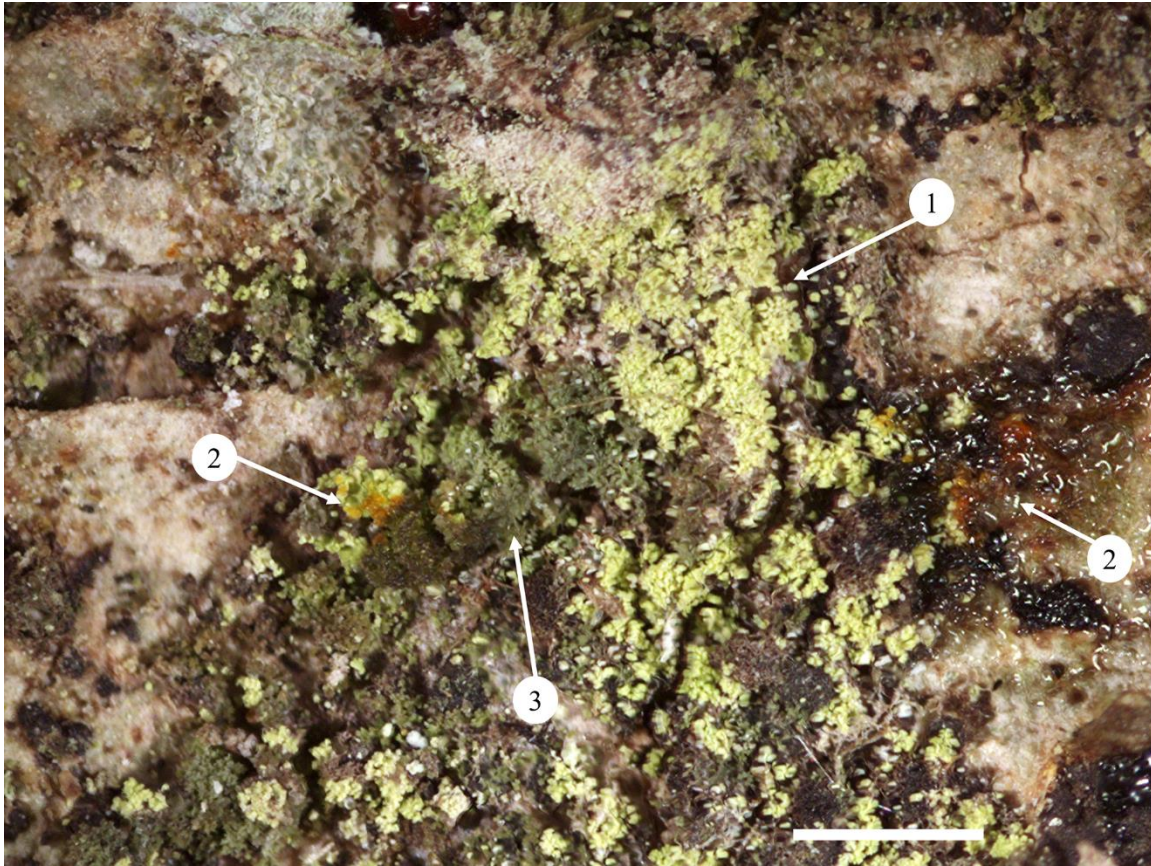
***Micarea globulosella* (Nyl.) Coppins**

**FIGURE 6.**

NOTES. – *Micarea globulosella* is reported here as new to the Russian Far East. The species has previously been reported from Asia, Europe, and North America, where it grows mainly in boreal, oceanic and mountainous territories with high precipitation and inhabits bark of both deciduous and coniferous, often old growth trees (Czarnota 2007, Esslinger 2018, Ohmura & Kashiwadani 2018). In Russia it has previously been reported from the Arkhangelsk Region (Tarasova et al. 2019), Komi Republic (Hermansson et al. 2006, Pystina 2001), Krasnodar Region (Himmelbrant & Kuznetsova 2002) and Republic of Tatarstan (Evstigneeva 2007). A brief characterization of our material is presented below.

Our specimens have effuse to areolae thalli, reacting C+ red (gyrophoric acid), K–, PD– with convex, whitish to grey areoles, 40–150 µm in diameter, micareoid photobiont with cells 4–7 µm in diameter, immarginate, convex and adnate to subglobose apothecia which are greyish or brownish-black, sometimes pale grey or pallid (in shade), 0.1–0.25 mm in diameter. Apothecial sections have C+ red





**Figure 7.** Morphology and chemical spot test reaction of *Micarea xanthonica* (S.V. Chesnokov 1, LE) wherein *M. xanthonica* is denoted by “1”, the persistent C+ orange reaction of the thallus is denoted by “2” and an adjacent sterile olive-green thallus of *M. prasina* s. str. is denoted by “3”. Scale = 1.0 mm.

(gyrophoric acid), with hymenium up to 50  $\mu\text{m}$  tall, in the upper part dilute olivaceous or olive-brown, K+ violet, C+ violet (Sedifolia–gray pigment), colourless hypothecium, up to 75–100  $\mu\text{m}$  tall. POL+ crystals are present in the hymenium, but absent in the thallus. Ascospores are fusiform–acicular to rod-shaped, slightly curved, 3(6)–septate, 22–25  $\times$  2–2.5  $\mu\text{m}$ , paraphyses are numerous, branched and anastomosing, up to 1  $\mu\text{m}$  wide. Pycnidia of two types are present, one type is immersed in large areoles, sometimes emergent, 60–100  $\mu\text{m}$  diam. and the others are similar but smaller, approximately 30–40  $\mu\text{m}$  diam.

In comparison with the description published by Coppins (1983) our specimens have higher hymenia (up to 50  $\mu\text{m}$  vs. 35–40  $\mu\text{m}$  tall), hypothecia (75–100  $\mu\text{m}$  vs. 50–70  $\mu\text{m}$  tall) and ascospores that fall within the upper part of the size range (22–25  $\times$  2–2.5  $\mu\text{m}$  vs. 13–26  $\times$  (1.5–)2–2.5(–3)  $\mu\text{m}$ ). *Micarea globulosella* is closely related to *M. denigrata* (Fr.) Hedl. and *M. nitschkeana* (J. Lahm ex Rabenh.) Harm. but can be distinguished by its longer, almost acicular, or rod-shaped ascospores (Coppins 1983). *Micarea synotheoides* (Nyl.) Coppins differs by the dark green granular areoles ( $\pm$  gelatinous when wet), often longer ascospores and a lack of substances detected by TLC (Coppins 2009). *Bacidia beckhausii* Körb., which is similar in morphology and anatomy is distinguished by the non-micareoid photobiont with larger cells.

*Specimen examined.* – **RUSSIA. SAKHALIN REGION. KUNASHIR ISLAND:** vicinity of Yuzno-Kurilsk Settlement, neighborhood of Serebryanoe Lake, 44°03'07.3"N, 145°51'16.5"E, elev. 10 m, *Picea glehnii* forest with *Sasa kurilensis*, 3.vi.2019, on bark of rotten *Picea*, L.A. Konoreva 2 (LE).

#### *Micarea xanthonica* Coppins & Tønsberg

#### FIGURE 7.

NOTES. – *Micarea xanthonica* is reported here for the first time from Asia and Russia. The species was described from Europe and North America, mainly in the Pacific Northwest, and grows in coastal



lowlands, old-growth forests in cool temperate areas and inhabits old stumps of coniferous trees, bark of mature trees (coniferous and deciduous), and moribund bryophytes (Coppins & Tønsberg 2001). The thalli in the material from the Russian Far East agree completely with the original description (Coppins & Tønsberg 2001), however the collections were sterile and apothecia were not observed. The specimens have a pale yellow-green, C+ persistent orange thallus (xanthones), which is composed of gonocysts 17–27 µm in diameter (16–28 µm *fide* Coppins & Tønsberg 2001) that sometimes adhere to form larger, composite granules up to approximately 50 µm in diameter. POL+ crystals are present in the thallus and the photobiont is micareoid with cells 4–7 µm in diameter.

*Micarea xanthonica* belongs to the *M. prasina* group and differs from other similar species in the combination of pallid, completely pigment-deficient apothecia and a pale, yellowish-green thallus that contains xanthones (Coppins & Tønsberg 2001). The closely related *M. viridileprosa* van den Boom & Coppins has a C+ fleetingly red thallus and contains gyrophoric acid (van den Boom & Coppins 2001). *Micarea isabellina* Coppins & Kantvilas and *M. lignaria* var. *endoleuca* (Leight.) Coppins contain xanthones but both these species have areolate thalli, black apothecia, and ascospores with more transverse septa (mostly 1-septate in *M. xanthonica* vs. 3-septate in *M. isabellina* and 3–7-septate in *M. lignaria* var. *endoleuca*; Coppins & Tønsberg 2001).

*Specimen examined.* – **RUSSIA. SAKHALIN REGION. KUNASHIR ISLAND:** vicinity of Yuzno-Kurilsk Settlement, neighborhood of Serebryanoe Lake, 44°03'07.3"N, 145°51'16.5"E, elev. 10 m, *Picea glehnii* forest with *Sasa kurilensis*, 3.vi.2019, on bark of rotten *Picea*, S.V. Chesnokov 1 (LE).

### ***Ramalina thrausta* (Ach.) Nyl.**

**NOTES.** – *Ramalina thrausta* is reported here for the first time to the Sakhalin Island. It is a circumpolar boreal corticolous lichen reported from Asia, Europe and North America, and is common in coniferous forests where it grows on branches and a bark of coniferous trees and rarely amongst mosses on rocks along saltwater beaches (Davydov & Konoreva 2017, Elix & Tønsberg 2005, Geiser et al. 1998, Kataeva & Makarova 2008, McCune & Geiser 1997). In the Russian Far East, it has been reported both from its northern (Kataeva & Makarova 2008, Vyatkin et al. 2017) and the southern part (Yakovchenko et al. 2013b). The material from Sakhalin Island is characterized by the fruticose, pendulous thallus, up to 30 cm long, pale green filamentous branches with tips that are often hooked and have minute whitish soralia. All spot tests were negative and the material was sterile. Morphologically, *R. thrausta* resembles species of *Alectoria* Ach. with grey thalli by its long greyish branches but is easily distinguished by the lack of prominent elongate pseudocyphellae (McCune & Geiser 1997).

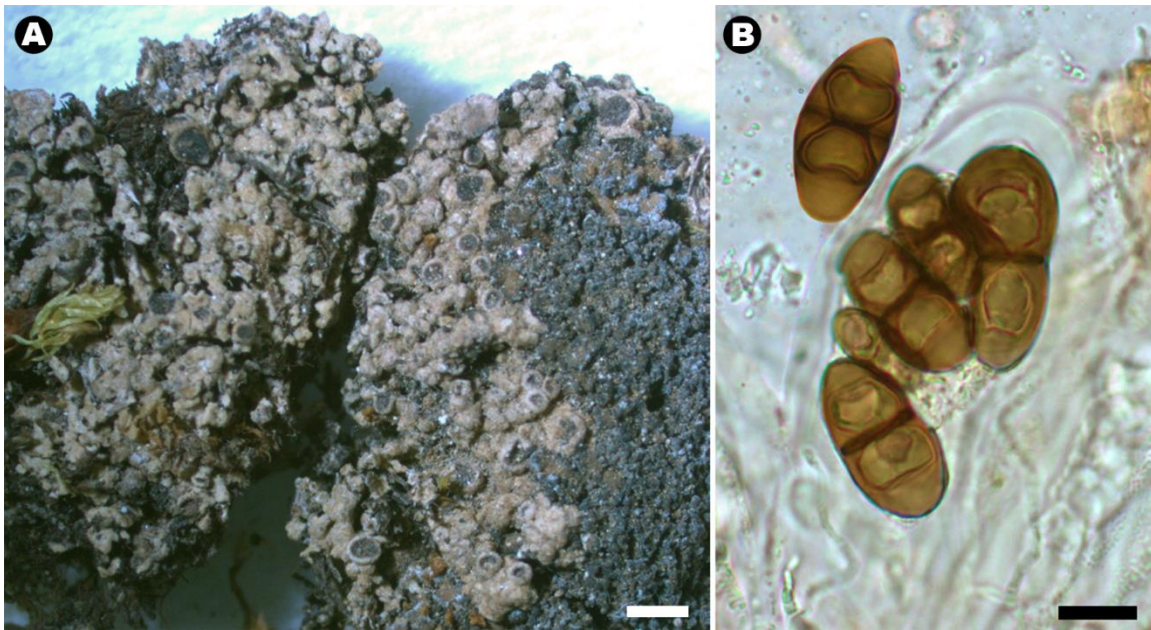
*Specimens examined.* – **RUSSIA. SAKHALIN REGION. SAKHALIN ISLAND. TYMOVSKIY DISTRICT:** surroundings of Argi-Pagi village, 51°21'04.7"N, 142°43'53.1"E, elev. 64 m, coniferous forest, 13.viii.2018, on twigs of *Picea jezoensis*, A.K. Ezhkin s.n. (SAK 1774). **KORSAKOVSKIY DISTRICT:** surroundings of Prigorodnoye village, 46°39'27.79"N, 142°55'16.70"E, elev. 47 m, coniferous forest, 6.xi.2014, on bark of *Abies sakhalinensis*, A.K. Ezhkin s.n. (SAK 1205, SAK 1206); surroundings of Prigorodnoye village, 46°38'36.50"N, 142°54'10.27"E, elev. 13 m, coniferous forest, 7.vii.2014, on bark of *A. sakhalinensis*, A.K. Ezhkin s.n. (SAK 1207).

### ***Rinodina herrei* H. Magn.**

#### **FIGURE 8.**

**NOTES.** – *Rinodina herrei* is newly reported here from the Khabarovsk Territory, and for the second time from both Asia and Russia. In the study area it was found only once on mosses and plant debris. The species was previously considered endemic to North America, where it is common along the Pacific Coast from Baja California, Mexico, north to British Columbia, Canada (Sheard 2010). It grows commonly on dusty bark, especially of oaks (*Quercus*), and less often inhabits wood and soil (Sheard 2010). The species was recently reported as new to Russia and nNortheast Asia from Iturup Island where it was found on the bark of *Q. crispula* in an oak grove (Galanina & Ezhkin 2019). *Rinodina herrei* differs from similar species by its plane, rimose-areolate thallus with the margins of the areoles sometimes developing blastidia, erumpent apothecia with a black, finally convex disc, and ascospores of *Teichophila*-type with A-type development (Sheard 2010).

The specimens examined agree with previously published descriptions (Galanina & Ezhkin 2019, McCune 2017, Sheard 2010) except in that they have larger spores, (16.0–)18–25 × 11.0–12.5 µm (vs. (16–)19.5–20(–23.5) × (8–)10–11(13) µm), and moderately convex apothecial discs. *Rinodina herrei* resembles *R. juniperina* Sheard but the latter species has smaller *Physcia*-type ascospores (Sheard 2010). Another



**Figure 8.** Morphology of *Rinodina herrei* (L.S. Yakovchenko 1884, VLA). **A**, gross morphology of the thallus and apothecia. **B**, ascospores mounted in water. Scales = 1.0 mm in A, 10  $\mu$ m in B.

similar species, *R. hallii* Tuck. is distinguished by its pruinose apothecia and larger *Physcia*-type spores (Sheard 2010). *Rinodina intermedia* Bagl. grows on soil but may be confused with *R. herrei*, nonetheless it is easily separated by its 3–septate to muriform ascospores (Sheard 2010). Among the latter three species only *R. intermedia* has been reported from Russia (Galanina 2019, Sheard et al. 2017).

*Specimen examined.* – **RUSSIA. KHABAROVSK TERRITORY. VERKHNEBUREINSKY DISTRICT:** Bureinsky Reserve, upstream of the Pravaya Bureya River, “Tsarskaya Road”, 25 km by air SE village Sofiyisk 2.5 km NE upstream station “Novaya Medvezhka”, 500 m from the station “Staraya Medvezhka”, *Larix Vaccinium*-moss forest in the area of the old bridge, 52°08.947'N, 134°18.993'E, elev. 885 m, 9.viii.2009, on mosses and plant debris, L.S. Yakovchenko 1884 (VLA).

### *Trapelia elacista* (Ach.) Orange

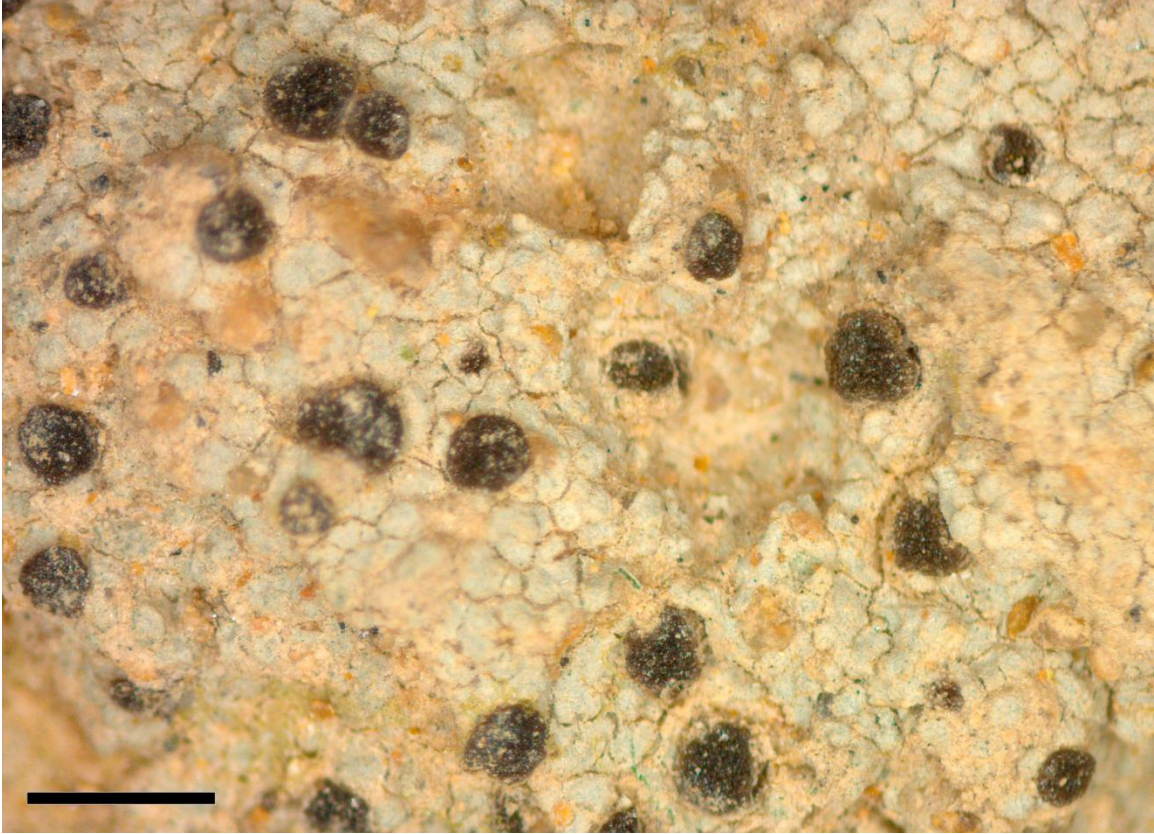
### FIGURE 9.

**NOTES.** – *Trapelia elacista* is reported here as new to Asia and Russia. In the study area it was found as a primary colonizer of barren soils on spoil heaps. In other regions it has been reported mostly on siliceous rocks and bricks, on stones lying on the ground, along tracks, on spoil heaps, often as a pioneer species in moist microhabitats (Orange 2018). The species was recently resurrected by Orange (2018) and had been known with certainty only from Europe, although it seems to be more widespread as it was confused with *T. involuta* (Taylor) Hertel or *T. glebulosa* (Sm.) J. R. Laundon in the past. *Trapelia elacista* can be recognized by its areolate to rimose, pale grey, matt thallus often thinning at the margin, brown-black apothecia, up to 0.6 mm in diameter, sometimes separated from adjacent thallus by a crack, 8-spored, *Trapelia*-type asci containing simple, hyaline ascospores, 14.0–24.5  $\times$  8.0–12.5  $\mu$ m, and by thalline spot tests that are K–, C+ red, KC+ red and PD– (gyrophoric acid).

The specimen from the Far East agrees well with the recent description by Orange (2018) in having a whitish, areolate thallus composed of continuous to scattered, moderately convex, non-effigurate areoles up to 0.4(–0.5) mm wide, without a hypothallus and with brown-black apothecia (brown then wet), 0.2–0.6 mm in diameter, with a plane disc and a proper margin somewhat paler than the disc and sometimes with a thin, whitish, uneven, pseudothalline margin. The material has *Trapelia*-type asci with eight hyaline, ellipsoid to ovate ascospores (15.0–)17.0–22.0(–26.0)  $\times$  7.5–10.0(–12.5)  $\mu$ m.

A similar species, *T. coarctata* (Sm.) M. Choisy usually possesses a very thin, pale greenish grey, weakly cracked, continuous thallus and apothecia not separated from the thallus by a crack. Another similar species, *T. glebulosa*, differs by its thallus margin that has prominent, convex to effigurate areoles. *Trapelia*





**Figure 9.** Morphology of *Trapelia elacista* (E.A. Davydov 18336 & I.A. Galanina, ALTB). Scale = 1.0 mm.

*involuta* differs by its larger, up to 0.7(–1.2) mm wide, subsquamulose, crenate to lobate, sometimes glossy areoles (Orange 2018).

*Specimen examined.* – **RUSSIA. PRIMORYE TERRITORY. KHASANSKY DISTRICT:** hills at the W coast of Ptichie Lake at 1.5 km to W of Mayachnoye Settlement, 42°38'24.0"N, 130°40'30.1"E, elev. 55 m, burned *Quercus dentata* forest, 10.viii.2018, on soil, E.A. Davydov 18336 & I.A. Galanina (ALTB).

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