

The genus *Rinodina* (Physciaceae, lichenized Ascomycota) in the Republic of Sakha (Yakutia) with a key to the species

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Abstract. The lichen genus *Rinodina* in the Republic of Sakha (Yakutia) is revised on the basis of extensive materials collected by the authors in 1974–2022. Twenty-four species of this genus have been recorded for the lichen biota of Yakutia. Eight species are recorded for the first time: *Rinodina cinereovirens*, *R. confragosa*, *R. conradii*, *R. intermedia*, *R. interpolata*, *R. metaboliza*, *R. oculata*, *R. trevisanii*. Five previously reported species were not found: *Rinodina archaea*, *R. exigua*, *R. exiguella*, *R. milvina*, *R. sophodes*. A key for identification of *Rinodina* known in Yakutia is given. For each species, characteristic features, differences from closely related species, and distribution in Russia and the world are discussed.

Keywords: Arctic, biodiversity, biogeography, lichens, new records, North-East Asia.

Род *Rinodina* (Physciaceae, лишенизированные Ascomycota) в Республике Саха (Якутия), с ключом для определения видов

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Резюме. Работа основана на изучении материала, собранного авторами в 1974–2022 гг. в Республике Саха (Якутия). В результате исследования новый список лишайников рода *Rinodina* для Якутии составил 24 вида, 8 из которых приводятся впервые для Якутии (*Rinodina cinereovirens*, *R. confragosa*, *R. conradii*, *R. intermedia*, *R. interpolata*, *R. metaboliza*, *R. orculata*, *R. trevisanii*). Пять видов из ранее опубликованных не найдены (*Rinodina archaea*, *R. exigua*, *R. exiguella*, *R. milvina*, *R. sophodes*). Представлен ключ для определения видов рода *Rinodina*, известных в Якутии. Для каждого вида обсуждаются характерные признаки, отличия от близких видов и распространение в России и мире.

Ключевые слова: Арктика, биоразнообразие, биогеография, лишайники, новые находки, Северо-Восточная Азия.

The genus *Rinodina* (Ach.) Gray belongs to the family Physciaceae Zahlbr. and comprises approximately 300 species worldwide (Sheard, 2010). *Rinodina* is polyphyletic, and its members are usually characterized with crustose thalli, lecanorine apothecia, 2-celled brown ascospores with inner wall thickenings and *Lecanora*-type asci (Nadyeina et al., 2010).

Rinodina species are generally difficult to identify due to the variety of spore types. However, a study of the genus *Rinodina* in North America (Sheard, 2010) was helpful to our understanding of this genus in Northeastern Asia (Sheard et al., 2017). In Russia, the genus *Rinodina* was actively studied in the last decade, but most of these investigations concern the south of the Far East (Galanina et al., 2011, 2018, 2021a, c; Galanina, 2013, 2016a, b, 2019; Sheard et al., 2017; Galanina, Ezkhin, 2019; Konoreva et al., 2018; Yakovchenko et al., 2018; Galanina, Yakovchenko, 2021; Galanina, Ohmura, 2022). In contrast, its northern part (Chukotka Peninsula, Magadan Region, and Yakutia) remains rather poorly studied and requires revision, although some *Rinodina* species were reported from this region as indicated below (Almquist, 1879, 1883; Savicz, Elenkin, 1950; Afonina et al., 1979, 1980; Korolev, Tolpysheva, 1980; Andreev, 1983, 1984; Makarova, Perfiljeva, 1984; Makarova, 1985, 1989, 1998; Makarova et al., 1988; Kotlov, 1991, 1993a, b, 1995, 2004; Samarskii et al., 1997; Poryadina, 1999a, b, 2001, 2008, 2010, 2020a, b; Zhurbenko et al., 2002, 2005; Vershinina et al., 2012, 2015; Chesnokov et al., 2016; Galanina et al., 2021b, 2022). The aim of this study is to summarise the knowledges on the genus *Rinodina* for the Republic of Sakha (Yakutia).

The first report of the genus *Rinodina* in Yakutia was found in the works of Almquist (Almquist, 1879, 1883, not seen, cited after Savicz, Elenkin, 1950) for the Preobrazhen'ya Island at the mouth of the Khatanga Bay (Anabarsky District): *R. exigua* (Ach.) Gray, *R. mniaroea* (Ach.) Körb., *R. turfacea* (Wahlenb.) Körb. Much later, new information appeared for the *Rinodina* species from the forest-steppe landscapes in the middle reaches of the Indigirka River (northeast of Yakutia), including *R. archaea* (Ach.) Arnold, *R. terrestris* Tomin, and *R. turfacea* (Afonina et al., 1979, 1980). Also, for the northeast of Yakutia, the species *R. sophodes* (Ach.) A. Massal. and *R. turfacea* were reported at the mouth of the Sukharnaya River on the coast of the East Siberian Sea (Andreev, 1984), and *Rinodina mniaroea*, *R. roscida* (Sommerf.) Arnold and *R. turfacea* were reported from Medvezh'i islands and mouth of the Kolyma River

(Andreev, 1983; Zhurbenko *et al.*, 2005). The species *R. archaea*, *R. bischoffii* (Hepp) A. Massal., *R. turfacea* were reported for the territory of the northwest of Yakutia (the vicinity of the village of Saskylakh and the coast of the Laptev Sea) (Makarova, Perfiljeva, 1984; Makarova, 1985).

For Arctic Yakutia (Novosibirskie Islands and the Lena River delta) the species *R. archaea*, *R. bischoffii*, *R. olivaceobrunnea* C. W. Dodge et G. E. Baker, *R. roscida*, *R. turfacea* were reported (Makarova *et al.*, 1988; Makarova, 1989, 1998; Samarskii *et al.*, 1997; Zhurbenko *et al.*, 2002). For central, southern and eastern Yakutia (Aldansky, Olekminsky, Tomponsky districts) the species *R. archaea*, *R. subpariata* (as *R. degeliana* Coppins), *R. demissa* (Körb.) Arnold, *R. excrescens* Vain., *R. exigua*, *R. freyi* H. Magn., *R. laevigata* (Ach.) Malme, *R. milvina* (Wahlenb.) Th. Fr., *R. mniaroea*, *R. oleae* Bagl., *R. olivaceobrunnea*, *R. pyrina* (Ach.) Arnold, *R. septentrionalis* Malme, *R. sophodes*, *R. terrestris*, and *R. turfacea* were reported (Poryadina, 1999a, b, 2001, 2008, 2010, 2020a, b; Verшинina *et al.*, 2012, 2015; Chesnokov *et al.*, 2016; Galanina, 2016a).

The Republic of Sakha (Yakutia) is the largest region of the Russian Federation and is located in the northwestern part of the Far East. Its total area is 3.103.200 square km. It measures 2000 km from north to south and 2500 km from west to east. About 40% of the territory is located inside the Arctic Circle. The climate is extremely continental, characterized by long winters and short summers. The temperature difference between the coldest month (January) and the warmest month (July) is 70–75 degrees. The absolute minimum temperature almost everywhere in the Republic is below -50°C . In Oymyakon there is a cold pole of the Northern Hemisphere of the planet, where a temperature of -71.2°C has been recorded (1924). The average air temperature in Yakutia is $+20^{\circ}\text{C}$ in July and -39°C in January. Annual precipitation for most of the territory is 200–250 mm, in the south and south-west — 350–500 mm. During the year, precipitation is unevenly distributed, in the cold period (from November to March) only 15–20% of the total falls, in the warm period (from April to October) — 75–80%, i. e. 4–5 times more. A particularly small amount of precipitation (from 150 to 250 mm per year) falls on the coast and islands, the Yansk and Oymyakon plateaus, the Verkhoyansk and Momo-Selennyakh basins, as well as the Central Yakut plain. In the foothills and mountainous areas, the amount of precipitation increases to 400 mm on the watersheds of the Olekma, Chara, and Aldan plateau and up to 500–700 mm on the western slopes of the Aldan-Uchursky and spurs of the Verkhoyansky ranges (Klimat..., 2001). Due to the small amount of precipitation falling in winter, the snow cover is thin over most of the territory. The number of days with snow cover ranges from 200–210 in the south of Yakutia to 250 in the tundra zone. Almost the entire territory of Yakutia lies in the zone of continuous permafrost (Troeva *et al.*, 2010; Raznoobrazie..., 2005).

More than two thirds of the territory are occupied by mountains and high plateaus (the highest point is Mount Pobeda up to 3003 m high). The North Siberian Lowland lies in the north and Central Yakutskaya Lowland in the east of the region.

Rivers drain into the Arctic Ocean. A large variety of natural conditions are found in Yakutia, from polar deserts on the islands, and tundra to forest-steppes with altitudinal zonation in the mountains. Most of the territory belongs to the middle taiga zone, with approximately 80% of the territory to be occupied by forests (Troeva *et al.*, 2010; Raznoobrazie..., 2005).

Material and Methods

During the study, herbarium material stored in the herbaria of Russia (LE, SASY, VLA) and the authors' collections from different districts of the Republic of Sakha (Yakutia) were studied. The collections of A. V. Galanin from midstream of the Vilyuy River in the region of the tukulans (sand dunes) were also studied. All of the localities are shown in Fig. 1. Materials were identified by the first author in the laboratory of Botany of the Federal Research Center for Biodiversity of the Far East Branch of Russian Academy of Sciences. The investigation of anatomical and morphological features of lichens was made using the microscopes Zeiss Axioplan 2 and Stemi 2000-C. The study of spore structures and measurements were made using immersion oil at 1000 \times magnification. Anatomical examination used hand-cut sections mounted in water, and the following reagents: 10% KOH (K) and C₆H₄(NH₂)₂ (P). The protocol of Meyer and Printzen (2000) was used to characterize the epihymenium pigments. Measurements of ascospores are presented as percentiles (5)25–75(95) μm length \times breadth, thus excluding outliers. Secondary products were analyzed by standard thin-layer chromatography techniques (Culberson, Kristinsson, 1970; Orange *et al.*, 2001) in solvent systems A (toluene: 1,4-dioxane: acetic acid, 180:45:5), B (hexane: diethyl ether: formic acid, 140:72:18), C (toluene: acetic acid, 170:30), and E (cyclohexane: ethyl acetate, 75:25). Recent publications of Sheard (Sheard, 2010, 2018; Sheard *et al.*, 2017) have been used for specimen identification. The study of secondary metabolites (TLC) was carried out by A. G. Paukov and L. A. Konoreva, and molecular genetic studies by E. A. Davydov and L. A. Konoreva.

The distribution of *Rinodina* species in the world is given using the following literature data: **Arctic** (Alstrup, 1986; Mayrhofer, Sheard, 1988; Andreev *et al.*, 1996; Zhurbenko *et al.*, 2005; Kristinsson *et al.*, 2010), **Europe** (Mayrhofer, Poelt, 1979; Mayrhofer, 1984; Tønsberg, 1992; Mayrhofer, Moberg, 2002; Giralt *et al.*, 1993, 1994; Giralt, Mayrhofer, 1995; Wirth, 1995; Giralt, van den Boom, 1996; Giralt, 2001, 2010; Mayrhofer *et al.*, 2001; Aragón *et al.*, 2004; Spribille *et al.*, 2006; Mayrhofer, Sheard, 2007; Giavarini *et al.*, 2009; Wirth *et al.*, 2013), **Asia** (Vězda, 1965; Schubert, Klement, 1971; Golubkova, 1981; Hauck, Javkhlan, 2006; Kurokawa, Kashiwadani, 2006; Hauck *et al.*, 2013a, b; Yakovchenko *et al.*, 2018; Galanina, Ohmura, 2022), **Russia**, general publications (Kotlov, 2008; Spisok..., 2010; Galanina *et al.*, 2021c), **Caucasus** (Urbanavichus *et al.*, 2010), **Siberia** (Almquist, 1879, 1883; Vainio, 1928; Magnusson, 1936, 1947; Makryi, 1986, 2008; Sedelnikova, 1990; Urbanavichene, Urbanavichus, 1998, 2008, 2009; Davydov, 2001; Urbanavichene, 2010; Davydov, Printzen, 2012; Kharpukhaeva, 2013; Chesnokov, Konoreva, 2015; Chesnokov, 2017; Kharpukhaeva,

Galanina, 2022), **Yakutia** (Andreev, 1983; Makarova, Perfiljeva, 1984, 1988; Makarova, 1985, 1989, 1998; Makarova *et al.*, 1988; Samarskii *et al.*, 1997; Poryadina, 1999a, b, 2001, 2003, 2005, 2006, 2008, 2010, 2020a, b; Zhurbenko *et al.*, 2002; Vershinina *et al.*, 2012, 2015; Chesnokov *et al.*, 2016; Galanina, 2016a; Galanina *et al.*, 2022), **Far East** (Afonina *et al.*, 1979; Korolev, Tolpysheva, 1980; Makarova, Katenin, 1983, 1992; Andreev, 1984; Insarov, Pchelkin, 1984; Kotlov, 1991, 1993a, b, 1995, 2004, 2008; Skirina, 1996, 2012, 2015; Tchabanenko, 2002; Himelbrant *et al.*, 2009, 2021; Himelbrant, Stepanchikova, 2011; Rodnikova, 2012; Velikanov, Skirina, 2012; Galanina, 2013, 2016b, 2019; Kondratyuk *et al.*, 2013; Yakovchenko *et al.*, 2013; Sheard *et al.*, 2017; Konoreva *et al.*, 2018; Galanina, Ezhkin, 2019; Galanina *et al.*, 2011, 2018, 2021a, b; Galanina, Yakovchenko, 2021; Chesnokov, Konoreva, 2022); **North America** (Sheard, 1995, 2010, 2018; Thomson, 1997; Sheard *et al.*, 2011); **South America** (Mayrhofer *et al.*, 2001); **Australia** (Kaschik, 2006).

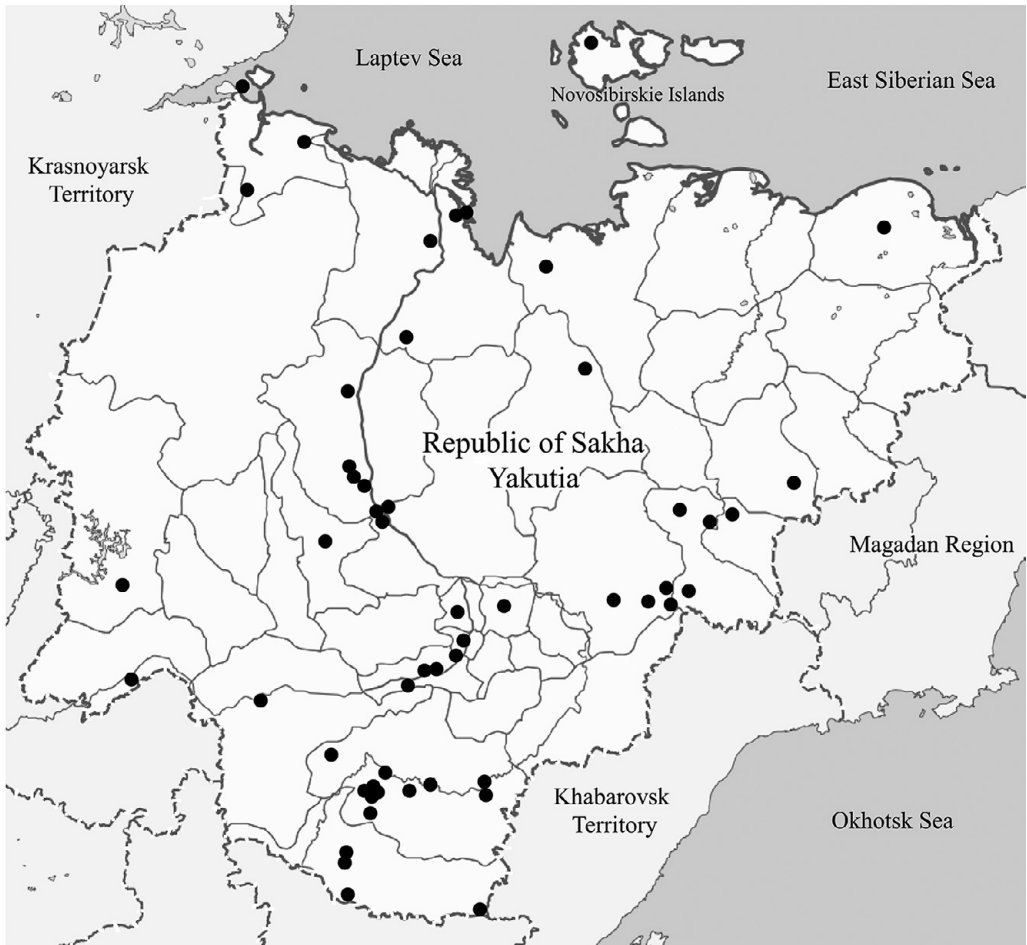


Fig. 1. Collection localities of *Rinodina* in the Republic of Sakha (Yakutia).

Results

In total, 19 species *Rinodina* were known for the Republic of Sakha (Yakutia) before the present study. As a result of our research, the list of *Rinodina* species of Yakutia includes 24 taxa, eight of which are new for the region (*R. cinereovirens*, *R. confragosa* (Ach.) Körb., *R. conradii* Körb., *R. intermedia* Bagl., *R. interpolata* (Stirt.) Sheard, *R. metaboliza* Vain., *R. orculata* Poelt et M. Steiner, *R. trevisanii* (Hepp) Körb.), and five species were not found or excluded because of misidentification (*R. archaea*, *R. exigua*, *R. exiguella*, *R. milvina*, *R. sophodes*).

Rinodina milvina (Poryadina, 2001), was identified as *Buellia* sp. (brown hypothecia, no thallus margin, *Buellia*-type spores) and therefore excluded. *Rinodina demissa* (Poryadina, 2001) was also excluded, the specimen belongs to *Dimelaena oreina* (Ach.) Norman. The material of *Rinodina pyrina* by Vershinina et al. (2012, 2015) requires verification, but these specimens are not available for revision. Other samples of *R. pyrina* from this region (Poryadina, 1999a, 2001, 2005) were reidentified by us as *R. laevigata*. However, *Rinodina pyrina* is known for Yakutia based on another specimen (see below).

Two samples of *Rinodina exigua* (Makarova, 1998; Poryadina, 2001) we identified as *R. turfacea* and *R. sibirica* H. Magn., respectively. We were unable to verify another record of *R. exigua* in the literature (Vershinina et al., 2012, 2015) as the samples were not available for study. *Rinodina exiguella* (Vainio) H. Magn. (Poryadina, 2005) was reidentified as *R. laevigata*.

Samples of *R. archaea* (Poryadina, 2001, 2008, 2020a, b) were identified as *R. cinereovirens* Vain., *R. laevigata*, *R. sibirica* and *R. turfacea*, respectively. The sample of *R. sophodes* (25 VII 1993 Poryadina 1993-07-25/11-3-4) was identified as *R. sibirica*.

The complete labels of examined specimens are in the [Supplementary file](#).

New species for the Republic of Sakha (Yakutia)

Rinodina cinereovirens (Vain.) Vain.

Rinodina cinereovirens is characterized by a thin light gray or brownish gray thallus without vegetative propagules. The apothecia quickly become narrowly attached, sometimes almost stipitate (to 0.6–1.0 mm in diam.) with a plane, black disc. The thalline margin is entire and typically persistent (80–120 µm wide), with a cortex expanded to 20–60 µm wide below. *Rinodina cinereovirens* has *Physcia*-type spores of Type A development, (21.5)23.0–25.5(27.5) × (10.0)11.5–13.5(14.0) µm and a well developed torus. Crystals absent in cortex and present in medulla (sphaerophorin). Spot tests all negative, the secondary metabolite sphaerophorin turns blue-white in longwave UV.

Rinodina cinereovirens is closely related to *R. turfacea* but differs by more broadly ellipsoid spores with more bluntly rounded apices. Furthermore, *R. cinereovirens* inhabits bark and wood, in contrast to *R. turfacea*, which typically grows on decaying ground vegetation, less often on wood in oroarctic environments in North America (Sheard et al., 2017).

Distribution. Eurasia [Scandinavia (Norway, Sweden, and Finland), Russia (from Leningrad Region to Kamchatka Territory and Magadan Region)], North America (USA: Alaska; Canada: northern Manitoba, northern Ontario, Newfoundland, New Brunswick).

Ecology. On bark of *Alnus* sp., *Larix gmelinii* (Rupr.) Kuzen. and *Pinus* sp. in mixed forests and on wood in mountain epilithic-lichen tundra.

Specimens examined: **Nizhnekolymsky District**, *Poryadina*, SASY L-2008-09-19/24-3; **Tomponsky District**, *Poryadina*, SASY L-1996-07-14/12-7-8 (det. as *Rinodina archaea*), *Poryadina*, SASY L-1996-07-04/6-1; **Olekminsky District**, 16 VII 2008, *Poryadina*, SASY; **Aldansky District**, 16 VII 2000, *Poryadina*, SASY; **Neryungrinsky District**, 30 VI 2015, *Konoreva SC-238*, LE L-25116; *Sofronova*, SASY L-2007-07-04/15-3.

***Rinodina confragosa* (Ach.) Körb.**

Rinodina confragosa is characterized by its thin, light-gray, areolate thallus and dark fimbriate prothallus. Its apothecia are narrowly attached, to 0.7–1.0 mm in diam., with a black and plane disc (Fig. 2 C). The thalline margin is entire and typically persistent, up to 100 μm wide, with a columnar cortex expanded to 30–50 μm wide below. *Rinodina confragosa* has *Physcia*-type spores of Type A development, (16.5)19.0–20.5(22.5) \times (8.0)9.0–10.0(11.0) μm and a pigmented torus (Fig. 2 D). Spot tests are K+ yellow, P+ faint yellow.

Rinodina confragosa is similar to *R. jacutica* Galanina et Konoreva in thallus morphology and spot tests, but the latter possesses *Dirinaria*-type spores (16.5)18.0–20.0(23.0) \times (7.5)8.5–10.0(11.5) (Galanina *et al.*, 2022). *Rinodina confragosa* is closely related to *R. brandii* Giralt et van den Boom (a rare European species) which differs in the presence of pannarin located only in the epihymenium (Giralt, van den Boom, 1996).

Distribution. Eurasia [from northern Europe to Turkey, Caucasus, Mongolia, Russian Far East (Primorye Territory and Southern Kuril Islands), and Japan], North America (widely distributed throughout the western United States and into Alberta, and rare in coastal Newfoundland in the east), South Africa, and Australia.

Ecology. On quartz pebbles in sparse pine forest on a river terrace.

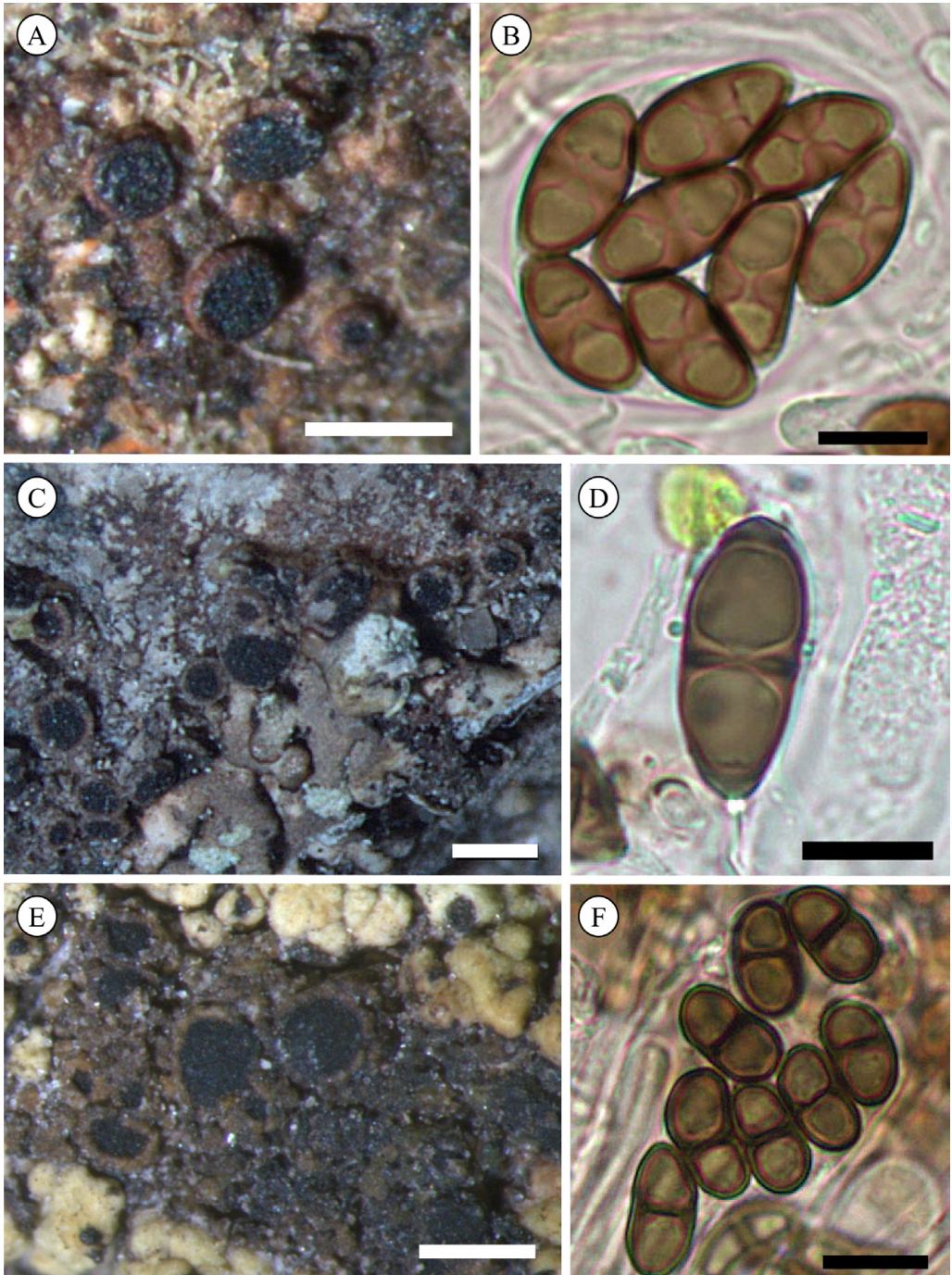
Specimen examined: **Zhigansky District**, *Galanina*, VLA L-3148.

***Rinodina conradii* Körb.**

Rinodina conradii is characterized by its 3-septate spores with Type B development. This species has a light to dark gray, brownish-gray continuous thallus with spot tests all negative.

Rinodina conradii can be mistaken for *R. intermedia* but the latter species differs in submuriform spores with Type A development. *Rinodina intermedia* can have rose-violet medullary reaction with KOH (Sheard, 2010).

Distribution. Widespread in the world in both hemispheres, with a cold temperate to oroarctic distribution, in Russia it is widespread from the Murmansk and Leningrad regions to the Primorye Territory in the Far East.



E c o l o g y . On bark in floodplain forests, mossy slope with birch trees at 807 m a. s. l. Specimens examined: **Tomponsky District**, 17 VII 2016, *Konoreva SC-302*, LE L-25121.

Rinodina intermedia Bagl.

Rinodina intermedia is characterized by its submuriform spores with Type A development. This species has a thin light gray-green to light brown continuous thallus and grows on soil or terricolous mosses.

Rinodina intermedia can be confused with *R. conradii* as discussed above.

D i s t r i b u t i o n . Widespread in the world: Europe (from the Iberian Peninsula in the south to the Channel Islands in the north), Africa (Kenya), Asia (Himalayas, Japan), North America (southwestern US states, Mexico), South America (Ecuador). In Russia the species is known from Kaliningrad Region, southern Siberia, Olkhon Island in Lake Baikal, Buryatia (Volcano valley), Trans-Baikal Territory (Sokhondinskiy Nature Reserve), Khabarovsk Territory (Kukanskii Ridge).

E c o l o g y . On bark of *Larix gmelinii* and on a dead tree in larch forests. More information about this species is in Galanina (2019).

Specimens examined: **Omyakonsky District**, 8 VII 2016, *Konoreva SC-291*, LE L-25117; 13 VII 2016, *Yatsyna SC-286*, LE L-25118.

Rinodina interpolata (Stirt.) Sheard

Rinodina interpolata is characterized by a *Physcia*-type to *Physconia*-type spores (14)15–17(20) × (6)7–8(9) μm of Type A development (Mayrhofer, Moberg, 2002). This species has a gray to dark brown rimose-areolate thallus and grows on siliceous rocks.

Rinodina interpolata might be confused with *R. parasitica* H. Mayrhofer et Poelt which also has *Physcia*-*Physconia*-type spores, but they have more rounded lumina and this species grows on the *Aspicilia*. *Rinodina interpolata* can also be confused with *R. tephraspis* (Tuck.) Herre, but it is distinguished by its larger *Teichophila*-type spores, (17)20–21(24) × (8)10.5–11.5(14) μm (Sheard, 2010).

D i s t r i b u t i o n . Europe (central part, British Isles, Scandinavia, and Iceland), Russia (Republic of Karelia, the Caucasus, the Urals and southern Siberia), North America.

E c o l o g y . On rocky outcrops in the river valley.

Specimen examined: **Tomponsky District**, *Poryadina*, SASY L-1996-07-08/9-5-6-7.

Fig. 2. A – apothecia of *Rinodina calcigena*; B – *Bischoffii*-type spores of *R. calcigena* with unusually narrow lumina canals during early development, *Physconia*-like lumina, lack of a torus, and a very poorly developed septal pigment band at maturity; C – apothecia of *Rinodina confragosa*; D – *Physcia*-type spores of *R. confragosa* with retaining septal and apical wall thickening and a pigmented torus; E – apothecia of *Rinodina pyrina*; F – mature spores of *R. pyrina* with *Physconia*-like lumina, torus lacking, and septal disk present.

Scale bars: A, C, E – 0.5 mm; B, D, F – 10 μm.

Rinodina metaboliza Vain.

Rinodina metaboliza is characterized by its *Dirinaria*-type spores (13.5)17.5–19.0(23.0) × (8.5)9.0–10.0(11.0) µm of Type B development that typically inflate at the septum in KOH. The species is very variable in thallus morphology, spore size, and apothecial convexity.

Rinodina metaboliza can be confused with *R. endospora* Sheard which also has *Dirinaria*-type spores, but they are larger size (20.5)22.0–24.0(27.5) × (8.5)9.0–10.0(11.0) µm (Sheard, 2010).

Distribution. Eurasia [Scandinavia (central Sweden and Norway), Russia (the republics of Karelia and Komi, South Siberia – Eastern Sayan Mountains, and the Far East – Magadan Region)], North America (from coastal Alaska to eastern Canada and the United States).

Ecology. On bark of *Alnus* sp., *Betula* sp., *Picea* sp., *Populus* sp., *Populus tremula* L., *Salix* sp., in floodplain and mixed forests at 130–295 m a. s. l.

Specimens examined: **Bulunsky District**, *Poryadina*, SASY L-2009-07-19/10-1; **Zhigansky District**, *Galanina*, VLA L-3152, L-3153; **Vilyuysky District**, *Galanina*, VLA L-2937, *Galanina*, VLA L-2963, *Galanina*, VLA L-2938, L-2956, L-2957, L-2958, L-2959, L-2970, L-2971, L-2977, L-2978, L-2980, L-3123, L-3127, L-3133, *Galanin*, VLA L-2950, L-2951, L-2966, L-2967, L-2969, L-2972, L-3121, L-3122, L-3124; **Kobyaysky District**, *Poryadina*, SASY L-2002-07-07/0-2; **Tomponsky District**, 21 VII 2016, *Konoreva SC-307*, LE L-25119; *Poryadina*, SASY L-2016-07-21/24-1, L-2011-07-07/3-4; **Khangalassky District**, *Ahti*, SASY L-2002-06-30/0-1; **Olekminsky District**, 16 VII 2008, *Poryadina*, SASY.

Rinodina orculata Poelt et M. Steiner

Rinodina orculata is characterized by a *Physcia-Physconia*-type spores (12.5)16.0–16.5(20.0) × (6.0)8.0–8.5(9.5) µm of Type A development. The species is very variable in thallus and apothecia morphology (Sheard, 2010).

Rinodina orculata can be confused with *R. trevisanii*, which has larger [(14.5)18.0–18.5(23.0) × (7.5)8.5–9.0(10.5) µm] *Physconia*-type spores. Unlike *R. trevisanii*, *R. orculata* has smaller spores on average and often shows persistent *Physcia*-type apical thickening (see Sheard, 2010).

Distribution. Eurasia [rarely and scattered in Germany, Scandinavia and often in the south (Iberian Peninsula, Portugal), Russia (Caucasus, Krasnoyarsk Territory, the Urals)], North America (widespread from the Gaspé Peninsula in eastern Canada to the west coast of North America, and often in the Rocky Mountains).

Ecology. On bark of *Pinus pumila* (Pall.) Regel in mixed forests at 836 m a. s. l.

Specimen examined: **Neryungrinsky District**, 30 VI 2015, *Konoreva SC-254*, LE L-25120.

Rinodina trevisanii (Hepp) Körb.

Rinodina trevisanii is characterized by a *Physconia*-type spores (14.5)18.0–18.5(23.0) × (7.5)8.5–9.0(10.5) µm of Type A development (Fig. 3 B, C). The species

possesses a thin continuous to rimose thallus and scattered apothecia with the discs frequently becoming convex, and the narrow thalline margins often becoming biatorine (Sheard, 2010). Young apothecia of *Rinodina trevisanii* are with plane discs and prominent apothecial margins (Fig. 3 A).

Rinodina trevisanii can be confused with *R. archaea* and *R. orculata*. See above for differences from *R. orculata*. *Rinodina archaea* is distinguished by a thick and areolate thallus, and apothecia quickly become contiguous, and angular by compression, with persistently plane discs and a well-developed thalline margin. Also, the spores of *R. archaea* have more prolonged *Physcia*-type stage of development. *Rinodina convexula* is synonymous with *R. trevisanii* (Mayrhofer, Sheard, 2007; Sheard, 2010).

Distribution. Europe [the Alps, rarely in Scandinavia (Finland and Sweden)], Asia (Mongolian part of Altai, Saur Range in Kazakhstan). *Rinodina trevisanii* is poorly studied in Russia and is rarely recorded [eastern Siberia (Krasnoyarsk Territory), Far East (Khabarovsk Territory, Bastak Nature Reserve)]. In North America, it is rarely found in Arizona, in the Cascade Mountains from Oregon to British Columbia.

Ecology. On bark in floodplain forests and on wood in thickets of dwarf birch at 807–1046 m a. s. l.

Specimens examined: **Tomponsky District**, 17 VII 2016, *Konoreva SC-302*, LE L-25121; **Oymyakonsky District**, *Poryadina*, SASY L-2016-07-13/13-2.

Species previously noted for the Republic of Sakha (Yakutia)

Rinodina bischoffii (Hepp) A. Massal.

Rinodina bischoffii is variable in morphology. It is characterized by an inconspicuous, often endolithic thallus, but sometimes it can be well developed. Apothecia range from submerged in the thallus to narrowly attached, the disc quickly becomes convex to hemispherical, the thallus margin is concolorous with the thallus. *Rinodina bischoffii* has spores *Bischoffii*-type of Type A development, the torus is absent, the walls are not ornamented. The hymenium contains oil drops.

Rinodina bischoffii is highly polymorphic species and may or may not lack oil droplets in hymenium, J. Sheard (2010) considers *R. immersa* (Körb.) J. Steiner to be its synonym. *Rinodina bischoffii* is similar to *R. guzzinii*, but the latter has a more developed thallus and larger spores (21–22 μm length), and the spores of *R. bischoffii* (16–18 μm) have a more ellipsoidal shape, in contrast to *R. guzzinii*, in which the spores are broadly round at the ends. *Rinodina castanomelodes* H. Mayrhofer et Poelt is also a similar species, but it has a well-developed thallus which is almost lobate at the edges, larger apothecia (up to 0.9 mm in diam.) and the spores are also wide-rounded at the ends. Giralt (2010) considers *R. castanomelodes* to be a variety of *R. bischoffii*. In the Arctic, *R. calcigena* can be confused with *R. bischoffii*, but the former has larger, broadly ellipsoid spores (19–20 μm length), and a rapidly disappearing thin canal. A pigmented belt around the septum is visible only in mature spores (Sheard, 2010).

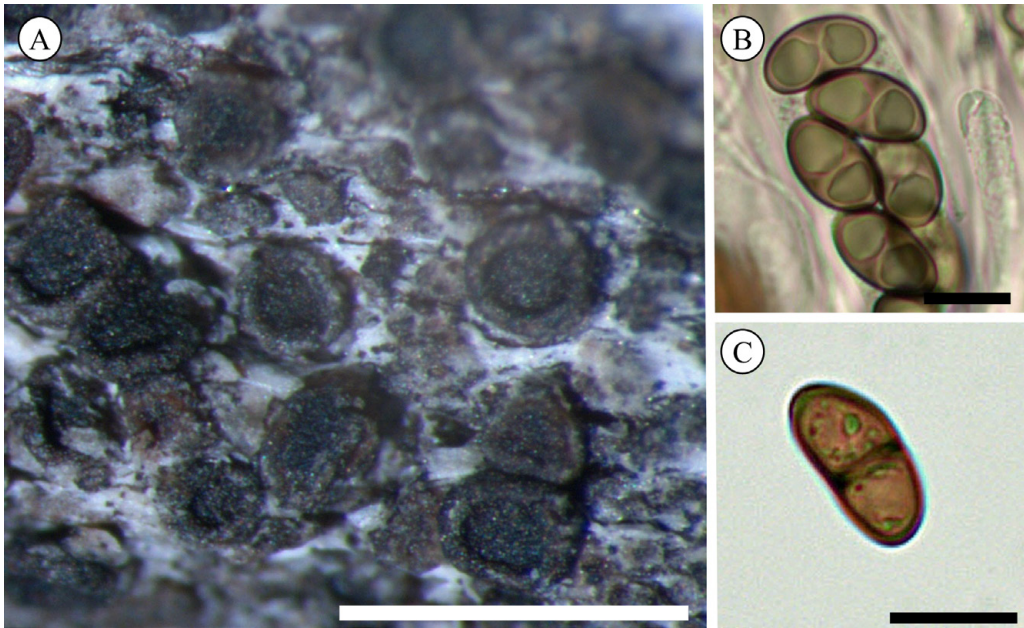


Fig. 3. A – young apothecia of *Rinodina trevisanii* with the plane discs and prominent apothecial margins; B – mature spores of *R. trevisanii* have *Physcia*- to *Physconia*-type lumina with relatively narrow canals when immature; C – overmature spore with inflated lumina, thin apical walls and narrow torus.

Scale bars: A – 0.5 mm; B, C – 10 μ m.

Distribution. Widespread in both hemispheres: Eurasia [Europe, Russia (from the Arctic to Southern Siberia and from the European part to the Far East), North and South Africa, Asia, and Australasia, North America (widespread in the temperate zone, excluding the northwestern Pacific and southeastern states). In Yakutia, *Rinodina bischoffii* was found on the New Siberian Islands (Zemlya Bunge Island) and in the Saskylakh village vicinity on lime-containing rocks (Makarova, 1985; Makarova et al., 1988).

Ecology. On lime-containing rocks at 507 m a. s. l.

Specimen examined: **Anabarsky District**, *Perfiljeva*, SASY L-1981-08-11/42-5.

***Rinodina calcigena* (Th. Fr.) Lyng**

Rinodina calcigena is characterized by a thin gray or ochraceous-brownish gray thallus present around the base of the apothecia or as scattered areoles on the substrate. Its apothecia are erumpent at first, broadly attached, to 0.5–0.9 mm in diam., the disc is black and plane (Fig. 2 A). The thalline margin is entire and narrow, typically persistent or rarely disappearing. *Rinodina calcigena* has *Bischoffii*-type spores of Type A development (Fig. 2 B), $(15.0)19.0\text{--}20.0(23.5) \times (9.0)11.5\text{--}11.5(13.0) \mu\text{m}$ and torus absent. The spores of *R. calcigena* have unusually narrow lumina canals during

development for the *Bischoffii*-type, never show apical thickening during development, a characteristic of the *Physconia*-type. A pigmented band is rarely evident around the septum at maturity but immature spores may possess very broad pigmented bands (Sheard, 2010). Spot tests are all negative.

Rinodina calcigena is closely related to *R. bischoffii* but differs in its longer spores with unusually narrow lumina canals during development. *Rinodina calcigena* is closely related to *R. guzzinii* but differs in its shorter spores with unusually narrow lumina canals during development, a poorly developed thallus and very symmetrical apothecia with a narrow or disappearing thallus margin (Mayrhofer, Sheard, 1988; Sheard, 2010).

Distribution. Eurasia [Europe (Scandinavia), Russia (Polar Urals, Novaya Zemlya, Southern Siberia, and Kamchatka)], North America (Arctic, Rocky Mountains, Greenland). In Yakutia (Mayrhofer, 1984; Kotlov, 2008).

Ecology. On rock in larch forests.

Specimen examined: **Tomponsky District**, *Poryadina*, SASY L-1996-07-02/0-1-2-3 (was previously determined as *R. gennarii* Bagl.).

Rinodina excrescens Vain.

Rinodina excrescens is characterized by its discrete, coarse, bullate areoles that often bear erumpent soredia or blastidia. It contains pannarin, resulting in a Pd+ orange spot test, and its often lightly pruinose apothecia (pannarin) include *Physcia*-type spores.

Rinodina granulans Vain. is similar but its blastidia are finer and meld to form a continuous leprose crust (Giralto *et al.*, 1994; Sheard, 2010; Galanina *et al.*, 2011).

Distribution. Eurasia [Europe (scattered and rare in Austrian province of Styria, Croatian island of Mljet, Spain, Greek island of Crete), Russia (West Siberia, Altay and Trans-Baikal Territories, and Far East (Primorye and Khabarovsk territories, Sakhalin and Shikotan Islands), Japan – on Hokkaido Island], North America (the Great Lakes region). Known from Yakutia (Chesnokov *et al.*, 2016).

Ecology. On bark of *Betula* sp. and *Larix gmelinii* also on wood and mosses in larch and mixed forest at 127–1108 m a. s. l.

Specimens examined: **Tomponsky District**, 19 VII 2016, *Konoreva SC-303, 305*, LE L-25122, L-25123; 17 VII 2016, *Konoreva SC-295, 297, 298, 299*, LE L-25124, L-25125, L-25137, L-25142; *Poryadina*, SASY L-2018-09-22/8-6, L-2018-09-22/8-9, L-2018-09-22/8-10, L-2018-09-22/8-11, L-2018-09-22/8-13, L-2018-09-22/8-14; **Oymyakonsky District**, 13 VII 2016, *Konoreva SC-292*, LE L-25126; **Namsky District**, *Poryadina*, SASY L-2019-06-01/1-9.

Rinodina freyi H. Magn.

Rinodina freyi is characterized by a gray-green continuous thallus, apothecia frequently becoming contiguous on small thalli, and relatively small, darkly pigmented *Physcia*-type spores (12.0)15.0–16.0(18.5) × (6.0)7.5–8.0(9.0) μm of Type A development, and a heavy torus.

Rinodina freyi can be confused with *R. septentrionalis*, but the latter species has copper-brown thallus consisting of small discrete verrucae (convex when moist), narrowly attached and scattered apothecia.

Distribution. European distribution of this species is poorly known although originally it was described from Europe (Switzerland) (Magnusson, 1947); the species is also published from Germany (Wirth *et al.*, 2013). In Russia, *R. freyi* was previously recorded from the Magadan Region, Kamchatka Territory, Sakhalin Region (Sakhalin Island), Khabarovsk and Primorye territories. It has also been reported from Japan and western Mongolia. *Rinodina freyi* is the most common species of the genus in North America, being frequent in both the East and West of the continent. In Yakutia, *Rinodina freyi* was found on the Tukuran Mahatta in the Vilyuysky District (Galanina, 2016a).

Ecology. On bark of *Alnus* sp., *Picea* sp., *Salix* sp. in different types of forest at 352 m a. s. l.

Specimens examined: **Vilyuysky District**, Galanina, VLA L-2952, L-2973, L-2974; **Olekminsky District**, 18 VII 2008, *Poryadina*, SASY; **Lensky District**, Egorova, SASY L-2002-06-24/0-2; **Neryunginsky District**, 12 VII 2015, *Poryadina*, SASY.

Rinodina jacutica Galanina et Konoreva

The species was recently described from Yakutia (Galanina *et al.*, 2022). The species was found in the Oymyakonsky District, on stones in coniferous moss-lichen forest in a river valley.

Rinodina jacutica is well distinguished by its *Dirinaria*-type spores, (16.5)18.0–20.0(23.0) × (7.5)8.5–10.0(11.5) μm (Fig. 4 B, C), type A development, light-gray thallus with a slight yellowish tinge and spot tests of thallus K+ yellow and P+ yellow (atranorin), as well as by growing on stony substrate (Fig. 4 A).

Rinodina jacutica can be confused externally with the saxicolous *R. santorinensis* J. Steiner from Southern Europe. *Rinodina santorinensis* also contains atranorin and has a similar habit but differs in its *Pachysporaria*-type spores (14.0)15.0–21.0(22.0) × 8.0–12.0(14.0) μm, type B development, well developed torus and the presence of pannarin (P+ orange) in the cortex and sometimes in the epihymenium (Giralt, 2001). It is a maritime Macaronesian-Mediterranean species unlikely to be found in Yakutia. *Rinodina gennarii* is similar to *R. jacutica* in its *Dirinaria*-type spores, but its spores are smaller (12.0)15.0–16.5(19.0) μm in length, and brown thallus has no reactions with K and P. *Rinodina confragosa* similar to *R. jacutica* by its thallus morphology and spot tests, but it has *Physcia*-type spores (16.5)19.0–20.5(22.5) × (8.0)9.0–10.0(11.0) μm (Sheard, 2010). *Rinodina brouardii* B. de Lesd. is a North American species that grows on calcium-containing rocks and has the *Dirinaria*-type spores (15.0)18.0–18.5(22.0) × (7.5)8.5–9.0(10.0) μm. It can be distinguished by dark gray to ochraceous, areolate thallus, lacking prothallus and negative spot test reactions (Sheard, 2010).

Distribution. Russia (Yakutia, Oymyakonsky District) (Galanina *et al.*, 2022).

Ecology. On stone in larch forest with mosses-lichen cover at 1179 m a. s. l.

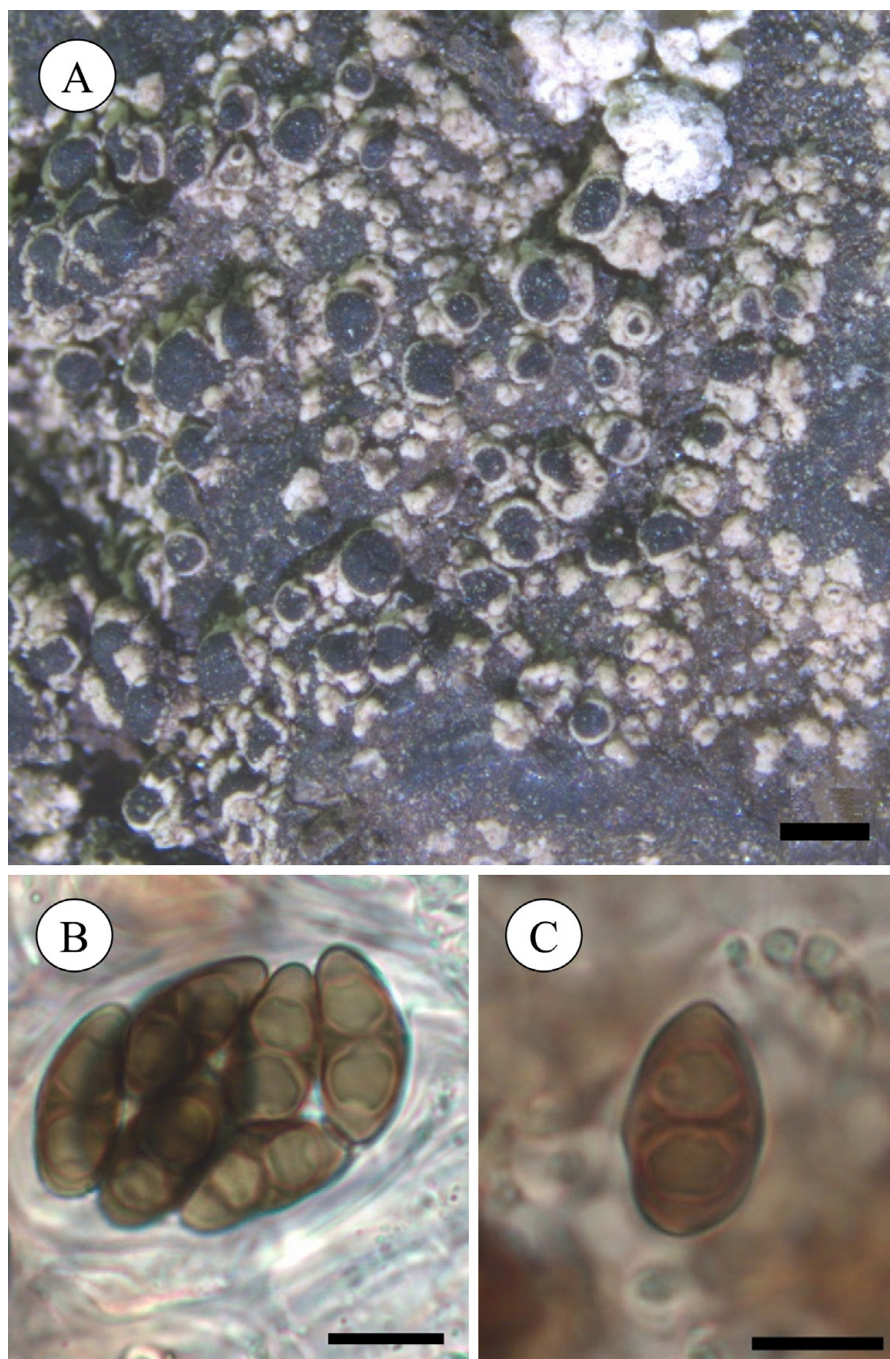


Fig. 4. *Rinodina jacutica*. A – habit; B, C – *Dirinaria*-type spores (B – note the *Physcia*-like lumina but lack of a torus, C – spore structure, note the septal swelling, the lack of a torus, and presence of a septal disc). Scale bars: A – 1 mm; B, C – 10 μ m. Photo from Galanina *et al.* (2022).

Specimens examined: **Oymyakonsky District**, 7 VII 2016, *Konoreva* 65, 75, LE L-15578, L-15579; doublet, VLA L-2928.

***Rinodina laevigata* (Ach.) Malme**

Rinodina laevigata is characterized by *Physcia-Physconia*-type spores (14.5)18.5–19.5(22.5) × (7.0)8.5–9.0(10.5) μm of Type A development, a thin poorly developed thallus, broadly attached apothecia with plane discs, and a usually thick lower apothecial cortex.

Rinodina laevigata can be confused with *R. sibirica* but differs by a less developed thallus, often its darker colour, smaller spores, and thick lower apothecial cortex. Often morphological and anatomical features of these two species have overlapping sizes, therefore genetic analysis is necessary for better understanding.

Distribution. Eurasia [Europe (Norway, Sweden, Finland, and Scotland), Asian Russia (from the North Caucasus to the Magadan Region)], North America (the western part, from Alaska to California and the Sierra Nevada). In Russia probably understudied. In Yakutia, *Rinodina laevigata* was found on the Tukuran Mahatta in the Vilyuysky District (Galanina, 2016a).

Ecology. On bark of *Alnus* sp., *Betula fruticosa* Pall., *Betula* sp., *Crataegus* sp., *Duschekia* sp., *Juniperus* sp., *Larix gmelinii*, *Larix* sp., *Picea* sp., *Pinus sylvestris*, *Populus tremula* in different types of forest. *Rinodina laevigata* is found very often in Yakutia at 70–861 m a. s. l.

Specimens examined: **Bulunsky District**, 20 VII 2009, *Poryadina*, SASY; **Ust-Yansky District**, *Perfiljeva*, SASY L-1995-07-29/46-1-2; **Nizhnekolymsky District**, 1977, *Andreev*, LE; **Zhigansky District**, *Galanina*, VLA L-3157, L-3158, L-3159, L-3160, L-3161, L-3162, L-3163, L-3164, L-3165, L-3166; **Mirninsky District**, *Poryadina*, SASY L-2006-08-12/8-2, L-2006-08-12/8-3, L-2006-08-12/8-1, L-2006-08-15/0-2, L-2006-08-17/18-1; **Vilyuysky District**, *Galanin*, VLA L-2098, L-2687, L-2688, L-2965, L-2979, L-2981, L-2982, L-3129, L-3135, L-3136, *Galanina*, VLA L-2973, L-2987, L-2988, L-2992, L-2998, L-3001, L-3002, L-3003, L-3004, L-3005, L-3006, L-3007, L-3008, L-3009, L-3010, L-3133; **Namsky District**, *Poryadina*, SASY L-2019-06-01/1-8; **Kobyaysky District**, *Poryadina*, SASY L-2002-07-04/2-3; **Tomponsky District**, 19 VII 2016, *Konoreva* SC-304, LE; *Poryadina*, SASY L-1993-09-03/1-1-2-3-4 (the two specimens together were determined as *Rinodina exiguella* and *R. exigua*); *Poryadina*, SASY L-1996-07-04/5-1-2, L-1996-07-05/7-1-2-3, L-1996-07-14/11-7-8-9 (det. as *R. archaea*); **Oymyakonsky District**, 8 VII 2016, *Konoreva* SC-291, LE L-25117; 5 VII 2016, *Konoreva* SC-287, LE L-25128; **Khangalassky District**, *Poryadina*, SASY L-2017-07-09/7-13; **Lensky District**, *Egorova*, SASY L-2002-06-29/0-5; *Poryadina*, SASY L-2014-06-01/0-1; **Olekminsky District**, *Chikidov*, SASY L-2006-07-13/0-1, L-2006-07-19/02-26; **Aldansky District**, 4 VII 2015, *Chesnokov* SC-208, LE L-25129; 10 VII 2015, *Chesnokov* SC-214, LE L-25130; 6 VII 2015, *Chesnokov* SC-210, LE L-25131; 16 VII 2000, *Poryadina*, SASY (two specimens).

***Rinodina mniaroea* (Ach.) Körb.**

Rinodina mniaroea is characterized by its apothecia becoming convex with thal-line margin becoming excluded, and large *Physcia*-type spores (20.5)24.5–25.5(30.0) × (9.5)11.5–12.5(14.5) μm of Type A development.

Rinodina mniaroea is similar to *R. turfacea*, which differs in producing sphaerophorin (UV+ blue-white) and its persistently plane apothecial discs with prominent thalline margins. Another species to be distinguished from *R. turfacea* is *R. olivaceobrunnea*, which differs in its smaller apothecia and spores.

Distribution. Eurasia [central European part, Iberian Peninsula, and Scandinavia, the Caucasus, Himalayas, Mongolia, China, Russia (widespread in the northern and mountain regions (Arctic, northern European part, North Caucasus, Siberia, Urals, Altai, Far East)], North America (common in the western Arctic, the Rocky Mountains and scattered in the eastern Arctic and Greenland). In Yakutia, *Rinodina mniaroea* was found in the mouth of the Kolyma River on the northeast of the region and on the Tukul Mahatta in the Vilyuysky District (Zhurbenko *et al.*, 2005; Galanina, 2016a).

Ecology. On mosses and plant debris in the birch and pine forests at 357–727 m a. s. l.

Specimens examined: **Vilyuysky District**, Galanina, VLA L-2939, L-2940, L-2941, L-2961, L-2953; **Aldansky District**, 4 VII 2015, Chesnokov SC-206, LE L-25132; 13 VII 2015, Konoreva SC-244, LE L-25133; 12 VII 2015, Konoreva SC-233, LE L-25134.

Rinodina oleae Bagl.

Rinodina oleae is characterized by its relatively small *Dirinaria*-type spores (12.0)15.0–16.5(19.0) × (6.5)7.5–8.0(9.5) μm of Type A or B development and innate to broadly attached apothecia (Sheard, 2010).

Rinodina oleae can be confused with *R. endospora* which also has *Dirinaria*-type spores, but they are a larger size (20.5)22.0–24.0(27.5) × (8.5)9.0–10.0(11.0) μm. *Rinodina oleae* is often regarded as being synonymous with *R. gennarii* but this species grows on rocks in seaside habitats, while *R. oleae* occurs on bark (Sheard, 2010). The close relationship of these species was discussed in several papers (Giralt, Mayrhofer, 1995; Trinkaus *et al.*, 1999; Giralt, 2001), also using molecular methods (Helms *et al.*, 2003; Kaschik, 2006). Currently, *R. gennarii* is treated as being separate by Sheard (2010), and therefore the distribution of the *R. oleae* should be studied in Russia.

Distribution. Eurasia [Southern Europe, Russia (Sakhalin and Kuril Islands, Khabarovsk and Primorye territories, reported from many regions as a synonym of *R. gennarii*), China, Korea, Japan], North America, where it has a scattered distribution. In Yakutia, *Rinodina oleae* was found on the Tukul Mahatta in the Vilyuysky District (Galanina, 2016a).

Ecology. On bark of *Salix* sp., twig of *Picea* sp. in the spruce forests at 62–81 m a. s. l.

Specimens examined: **Zhigansky Bistrict**, Galanina, VLA L-3165; **Vilyuysky District**, Galanina, VLA L-3145, L-3146.

Rinodina olivaceobrunnea Dodge et Baker

Rinodina olivaceobrunnea is characterized by *Physcia*-type spores (16.5)20.5–21.5(26.0) × (8.0)9.5–10.0(12.0) μm of Type A development. The species has abundant and small, narrowly attached apothecia.

Rinodina olivaceobrunnea might be confused with *R. turfacea*, but differs in its smaller spores and apothecia, absence of a massive columnar lower cortex, and the lack of sphaerophorin. *Rinodina olivaceobrunnea* can also be confused with *R. archaea*, but it is distinguished by its *Physcia*-type spores, and its typically muscicolous rather than lignicolous habitat (Sheard, 2010).

Distribution. *Rinodina olivaceobrunnea* is distributed in both hemispheres being known in Europe, central Africa, Australasia, Antarctica, and North America. In Russia the species is widely distributed [Arctic (Novaya Zemlya, Taimyr, and Chukotka), Murmansk Region, Komi Republic, North Caucasus (Karachayevo-Circassian Republic), West and South-Eastern Siberia and Far East (Khabarovsk Territory)]. In Yakutia, *Rinodina olivaceobrunnea* was found on the New Siberian Islands and in the Vilyuysky District (Tukulan Mahatta) (Samarskii et al., 1997; Galanina, 2016a).

Ecology. On bark of *Salix* sp., wood, plant debris in the spruce forests and arctic lichen-moss rubble desert at 81–1280 m a. s. l.

Specimens examined: **Bulunsky District**, *Nikolin*, SASY L-1982-08-13/16-4, 12 VIII 1980, *Perfiljeva*, SASY, *Poryadina*, SASY L-1996-07-14/11-10-12 (det. as *Rinodina exigua*); **Vilyuysky District**, *Galanina*, VLA L-3147; **Namsky District**, *Poryadina*, SASY L-2019-06-01/1-7; **Tomponsky District**, 14 VII 2016, *Konoreva SC-293*, *SC-294*, LE L-25135, L-25136; 17 VII 2016, *Konoreva SC-297*, LE L-25137.

***Rinodina pyrina* (Ach.) Arnold**

Rinodina pyrina is characterized by its crowded apothecia, large algal cells and its small, *Dirinaria*-type spores with *Physconia*-like lumina that quickly becoming expanded to exclude the septal and apical wall thickenings (Fig. 2 E, F). The dark pigmented apices of the paraphyses form a dark brown rather than red-brown epihyemium (Mayrhofer, Moberg, 2002; Sheard, 2010, 2018; Sheard et al., 2011).

Distribution. The species is widespread worldwide: Europe, Asia, northern Africa, North America and Australasia. In Russia, the species is widely distributed according to the literature data, but it seems to be very rare based on studying samples from the Far East and Yakutia. *Rinodina pyrina* was reported from Yakutia (Poryadina, 1999a, 2005; Vershinina et al., 2012, 2015). The specimens (Vershinina et al., 2012, 2015) were not available for verification. One specimen (4 VII 1996, *Poryadina*, SASY L-1996-07-04/5-1-2) (Poryadina, 1999a) was reidentified as *R. laevigata* during this study. *Rinodina pyrina* was confirmed to occur in Yakutia during specimen revision from the Central Yakutia in the Namsky District.

Ecology. On wood on the steppe slope surrounded by larch forest.

Specimen examined: **Namsky District**, *Poryadina*, SASY L-2019-06-01/3-5-6 with *R. sibirica*.

***Rinodina roscida* (Sommerf.) Arnold**

Rinodina roscida is characterized by its very large *Physcia*-like spores (sometimes similar to *Dirinaria*-type), $(22.5)30.0\text{--}32.0(39.5) \times (10.5)12.5\text{--}13.5(16.0) \mu\text{m}$ of Type A or rarely B development, often with submucronate apices of spores and the lack of a torus.

Rinodina roscida can only be confused with *R. turfacea* and differings in its light gray thallus lacking sphaerophorin, pruinose apothecial discs. *Rinodina roscida* also has similar spore type and type of development to *R. terrestris* but *R. roscida* has much larger apothecia and spores (Sheard, 2010).

Distribution. *Rinodina roscida* is widespread in the northern and mountainous regions of Northern Hemisphere: Arctic (from Scandinavia to Chukotka and from Alaska to Greenland), Asia (Caucasus, Himalayas, Mongolia, China, Southern Siberia (Trans-Baikal Territory, Sayany), North America (Rocky Mountains and with an outlier population in Newfoundland). In Yakutia, *R. roscida* was found in the mouth of the Kolyma River, on the New Siberian Islands (Kotelnyi Island) (Makarova, Perfiljeva, 1988; Samarskii et al., 1997; Zhurbenko et al., 2005).

Ecology. On mosses and plant debris in pine forest, shrub-lichen-moss tundra and moss-ledum-blueberry flowing swamp at 81–410 m a. s. l.

Specimens examined: **Anabarsky District**, 4 VIII 1974, *Perfiljeva*, SASY, *Perfiljeva*, SASY L-1981-08-09/32-1-2; **Bulunsky District**, *Karpov*, SASY L-1980-08-12/12-2; **Vilyuysky District**, *Galanina*, VLA L-2997; **Aldansky District**, 16 VII 2015, *Konoreva*, LE L-13353; 13 VII 2015, *Konoreva SC-237*, LE L-25138; 13 VII 2015, *Chesnokov SC-215*, LE L-13333, L-25139.

Rinodina septentrionalis Malme

Rinodina septentrionalis is characterized by *Physcia*-type spores (13.5)16.0–17.0(19.5) × (6.5)7.5–8.5(9.5) μm with a well-developed torus and Type A development. *Rinodina septentrionalis* has copper-brown thallus consisting of small discrete verrucae (convex when moist), and narrowly attached and scattered apothecia.

The differences from the similar *R. freyi* see under that species.

Distribution. Eurasia (Arctic, boreal zones and mountainous regions from northern Scandinavia to Chukotka and Kamchatka, and southbound to Georgia, Kazakhstan, Altai Mts, Sikhote-Alin Mts, Japan); North America (Arctic, extending southwards in the Rocky Mountains to Colorado). In Yakutia, *Rinodina septentrionalis* was found in the Suntar-Khayata Ridge and Tukulun Mahatta (Poryadina, 2001; Galanina, 2016a).

Ecology. On the bark of *Alnus* sp., *Larix* sp., *Populus tremula*, *Salix* sp., twig of *Crataegus* sp. and *Picea* sp. in different forest and moss-ledum-blueberry flowing swamp at 31–579 m a. s. l.

Specimens examined: **Zhigansky Bistrict**, *Galanina*, VLA L-3153; **Vilyuysky District**, *Galanina*, VLA L-2963, L-2971, L-2989, L-2990, L-2991, L-3137, L-3138, *Galanin*, VLA L-1246, L-2974, L-2981, L-2983, L-2985; **Kobyaysky District**, *Poryadina*, SASY L-2002-07-07/0-1, L-2002-07-15/0-17; **Aldansky District**, 16 VII 2000, *Poryadina*, SASY. **Neryungrinsky District**, *Chikidov*, SASY L-2007-07-01/9-2-8.

Rinodina sibirica H. Magn.

Rinodina sibirica is characterized by *Physcia-Physconia*-type spores (17.0)20.0–21.5(25.5) × (8.5)10.0–11.5(13.0) μm with a well-developed torus, the darkly

pigmented walls, and Type A development. *Rinodina sibirica* has erumpent apothecia broadly attached at first, becoming narrow at the base, scattered, with the dark brown to black discs that may become convex or even hemispherical.

Rinodina sibirica might be confused with *R. archaea*, but the latter has *Physconia*-type spores and is mainly lignicolous (Sheard, 2010). The young apothecia of *R. sibirica* with plane discs can be confused with *R. cinereovirens*, which has large *Physcia*-type spores and crystals in medulla (sphaerophorin, UV+ blue-white). Specimens of *R. sibirica* have often been referred to *R. sophodes*, which differs in its small *Milvina*-type spores and European distribution (Sheard, 2010).

Distribution. This species has a wide Amphiberingian range, only slightly extending to Europe in the Ural Mountains (Galanina et al., 2021c). The species was described from the environs of Yeniseisk, Tomsk, and Tobolsk in Russia (Magnusson, 1936). Later, it was additionally reported from numerous places in Siberia along the rivers Yenisei, Ob, Irkut, Lena, and Aldan (Magnusson, 1947), as well as from Altai and Sayan (Kotlov, 2008), and from Mongolia (Golubkova, 1981). Recently *R. sibirica* was reported from the Trans-Baikal and Khabarovsk territories, the Magadan Region, Sakhalin Island, and the Kamchatka Peninsula (Sheard et al., 2017; Galanina et al., 2021a, b, c). The species is known from North America (Thomson, 1997, as *R. granulans*; Sheard, 2010). *Rinodina sibirica* was also reported from Yakutia (Kotlov, 2008).

Ecology. On the bark of coniferous and deciduous trees in different forest types and flowing swamp at 62–1640 m a. s. l. More information about this species is in Galanina et al. (2021).

Specimens examined: **Bulunsky District**, 2 VII 1998, *Makarova*, LE; *Poryadina*, SASY L-2009-07-22/15-1; **Zhigansky District**, 8 VI 1901, *Cajander*, H; 6 VIII 1901, *Cajander* (11 specimens s. n.), H; 7 VIII 1901, *Cajander* (3 specimens s. n.), H; 16 VIII 1901, *Cajander* (3 specimens s. n.), H; 17 VIII 1901, *Cajander*, H; *Cajander* (2 specimens s. n.), H; **Verkhoyansky District**, *Ahti*, *Efimova*, H 65400, 65400b; **Momsky District**, *Poryadina*, SASY L-1993-07-25/11-3-4 (det. as *Rinodina sophodes*); **Mirninsky District**, 15 VIII 2006, *Poryadina*, SASY (det. as *R. exigua* and as *R. archaea*); *Poryadina*, SASY L-2006-08-12/8-4; **Vilyuysky District**, 23 VII 2015, *Galanina*, VLA; 25 VII 2015, *Galanina*, VLA; 14 VII 2015, *Galanina*, VLA; 12 VII 2015, *Galanina* Ya-15-18, VLA; 11 VII 2015, *Galanina*, VLA; 4 VI 2012, *Galanina*, VLA L-2166, L-2167, L-2168, L-2169, L-2973, L-3128, L-3131, L-3132, L-3134; *Galanin*, VLA; 2 VI 2012, *Galanin*, VLA; *Galanin*, VLA L-2098, L-2158, L-2159, L-2160, L-2161, L-2162, L-2163, L-2164, L-2165, L-3126, L-3130; **Namsky District**, *Poryadina*, SASY L-2018-09-22/8-6 (det. as *R. archaea*), L-2019-06-01/3-5-6, L-2019-06-01/1-9; **Ust-Aldansky District**, *Zakharova*, SASY L-2011-08-23/0-3; **Kobyaysky District**, 9 VII 2002, *Poryadina*, SASY L-2002-07-09/0-6; 9 VII 2002, *Poryadina*, SASY; 13 VII 2002, *Poryadina*, SASY (det. as *R. exigua*); 25 VIII 1995, *Poryadina*, SASY L-1995-08-25/15-1, L-1995-08-25/15-2; 10 VII 2002, *Poryadina*, SASY; *Poryadina*, SASY L-2002-07-09/0-3, L-2002-07-09/0-5); 14 VII 2002, *Poryadina*, SASY; 14 VII 2002, *Poryadina*, SASY; 8 VII 2002, *Poryadina*, SASY; 18 VII 2002, *Poryadina*, SASY; *Poryadina*, SASY L-2002-07-15/0-16, L-2002-07-04/2-2; **Tomponsky District**, 17 VII 2016, *Konoreva* SC-301, LE L-25140, 17 VII 2016, *Konoreva* SC-296, 299, LE L-25141, L-25142; *Poryadina*, SASY 1996-07-05/7-1-2-3 (det. as *R. archaea*); *Poryadina*, SASY 1996-07-01/3-1-2-3 (det. as *R. archaea*); 14 VII 1996, *Poryadina*, SASY (det. as *R. archaea*); **Khangalassky District**, *Ahti*, H 61412, 61412d, duplet in SASY L-2002-06-30/0-1, *Ahti*, *Efimova*, H 42348, duplet in SASY; *Ahti*, *Timofeev*, H 64406d, *Ahti*, H 61800, *Poryadina*, SASY L-2007-09-15/0-2; 20 IX 2007, *Poryadina*,

SASY; **Olekminsky District**, 18 VII 2008, *Poryadina*, SASY; *Poryadina*, SASY L-2008-07-26/27-6; **Aldansky District**, *Poryadina*, SASY L-2015-07-16/41-1; 21 VII 2006, *Poryadina*, SASY (det. as *R. archaea*); 16 VII 2000, *Poryadina*, SASY; 4 VII 2015, *Chesnokov SC-209*, LE L-25143; 10 VII 2015; *Chesnokov SC-213*, LE L-25144; 6 VII 2015; *Chesnokov SC-211*, LE L-25145; 4 VII 2015, *Chesnokov SC-205*, LE L-25146; 6 VII 2015, *Chesnokov SC-212*, LE L-25147; **Neryungrinsky District**, 1 VII 2015, *Konoreva SC-253*, LE L-25148; *Fes'ko*, SASY L-1987-08-12/525; 11 VII 2015, *Poryadina*, SASY; 12 VII 2015, *Poryadina*, SASY.

Rinodina subpariata (Nyl.) Zahlbr.

Rinodina subpariata is characterized by its light gray thallus, whitish labriform soralia in early development, abundant presence of atranorin, and *Physcia*-type spores (Sheard, 2010) in early development and *Physconia*-type spores in well developed esorediate morphs (Resl *et al.*, 2016).

Rinodina subpariata might be confused with light gray forms of *R. efflorescens* Malme, but the latter species has pannarin and its soralia do not contrast with the thallus in colour (Sheard, 2010). *Rinodina griseosoralifera* Coppins is also characterized by the presence of atranorin and zeorin but is distinguished by its bluish- or greenish-gray soralia over large areas of the thallus and by its *Pachysporaria*-type spores (Sheard, 2010). *Rinodina subpariata* is similar to *R. willeyii* Sheard et Giralt, but the latter has *Pachysporaria*-type spores, and an areolate thallus producing pannarin (P+ cinnabar).

Distribution. Eurasia [Scotland, Scandinavia, and Austria (as *R. degeliana* Coppins)], Mongolia, (Khentey Mountans), Russia (from the Caucasus to the Far East), Japan, and Korea], North America (a Pacific and North Atlantic disjunct distribution). *Rinodina subpariata* was reported in Yakutia as *R. degeliana* (Vershina *et al.*, 2012, 2015; Chesnokov *et al.*, 2016).

Ecology. On bark of *Picea obovata* Ledeb., *Salix* sp. in different forests at 110–582 m a. s. l.

Specimens examined: **Zhigansky District**, *Galanina*, VLA L-3154; **Aldansky District**, 19 VII 2015, *Chesnokov SC-216*, LE L-25148; 11 VII 2015, *Chesnokov SC-232*, LE L-25150; **Neryungrinsky District**, 11 VII 2015, *Poryadina*, SASY; *Chikidov*, SASY L-2007-07-01/9-1.

Rinodina terrestris Tomin

Rinodina terrestris is characterized by a thin brownish-gray thallus, small apothecia with a persistently plane or rarely convex black disc, thalline margin concolorous with thallus, *Physcia-Physconia*-type spores $(17.5)22.5\text{--}24.0(29.0) \times (8.0)10.0\text{--}10.5(12.5) \mu\text{m}$ of Type A or B development, without torus and often mucronate.

Rinodina terrestris can be confused with *R. roscida*; for the differences see the description of *R. roscida*.

Distribution. *Rinodina terrestris* is scattered throughout the temperate and Arctic Northern Hemisphere, North America (from western intermontane dry areas of British Columbia and USA, occurring southwards into Colorado and New Mexico). Despite *R. terrestris* has been several times reported for Yakutia (Afonina, 1980, 1979; Poryadina, 2020a, b) it was only once found in the studied collections (27 VI 1976,

Makarova, LE). One specimen (Poryadina, 2020b) was reidentified as *R. sibirica*. It had atypical “bloated” thick thallus growing on wood along with *R. pyrina* (1 VI 2019, Poryadina, SASY L-2019-06-01/3-5-6). We have already studied samples of *R. sibirica* with a similar non-typical thallus from Yakutia and they were also seen by John Sheard (Galanina et al., 2021c). Three specimens (not published) (16 VII 2015, Konoreva, LE L-13353; 13 VII 2015, Chesnokov, LE L-13333; 13 VII 2015, Konoreva SC-237, LE) were reidentified as *R. roscida*.

Ecology. On soil near the mouth of river in meadow-steppe. The species is characteristic for dry steppes and desert-like sites.

Specimen examined: **Oymyakonsky District**, 27 VI 1976, *Makarova*, LE.

***Rinodina turfacea* (Wahlenb.) Körb.**

Rinodina turfacea is characterized by a brownish-gray thallus, large apothecia with concave or plane discs, persistent thalline margin containing crystals of sphaerophorin, *Physcia*-type spores $(22.0)27.5-29.5(35.0) \times (10.5)12.5-13.5(15.5) \mu\text{m}$ of Type A development.

Rinodina turfacea can be confused with *R. cinereovirens*; for the differences see the description of the latter species.

Distribution. It is mainly northern circumpolar species restricted to the Arctic and Subarctic territories. Eurasia (from Scandinavia to the Kamchatka Peninsula with southernmost locations in the Mongolian and Chinese parts of the Altai), North America (Arctic, southwards to the Rocky Mountains in Montana and Wyoming, and Colorado). *Rinodina turfacea* was previously reported from the Yakutia (Afonina et al., 1979, 1980; Andreev, 1983, 1984; Makarova, Perfiljeva, 1984; Makarova et al., 1988; Makarova, 1989; Samarskii et al., 1997; Poryadina, 2001, 2020a; Zhurbenko et al., 2002, 2005).

Ecology. On mosses and plant debris in different forests and tundras, flowing swamp at 81–1092 m a. s. l.

Specimens examined: **Anabarsky District**, 1981, Anonymous, SASY; 8 VII 1981, *Stepanova*, SASY; **Bulunsky District**, 12 VIII 1982, *Nikolin*, SASY; *Nikolin*, SASY L-1982-08-14/20-1; 12 VIII 1982, *Nikolin*, SASY; 12 VIII 1982, *Perfiljeva*, SASY; 18 VIII 1982, *Perfiljeva*, SASY; *Poryadina*, SASY L-2009-07-24/19-1; 2 VII 1988, *Makarova*, LE (2 specimens, det. as *Rinodina exigua*); *Nikolin*, SASY L-1982-08-13/16-4; **Momsky District**, 25 VII 1993, *Poryadina*, SASY; **Vilyuysky District**, *Galanina*, VLA L-2997; **Tomponsky District**, 14 VII 1996, *Poryadina*, SASY (det. as *R. archaea*), *Poryadina*, SASY L-2016-07-17/19-5; **Oymyakonsky District**, *Yatsyna* SC-286, LE L-25151.

Doubtful and excluded species

***Rinodina archaea* (Ach.) Arnold**

Rinodina archaea is characterized by its broadly attached and contiguous apothecia with disc rather persistently plane, and by its relatively large *Physconia*-type spores (Sheard, 2010, 2018).

Distribution. Europe and western North America with some outliers in the eastern part, Russia (European part, the Urals, Siberia, and the Far East). Before our study, the species was several times reported for Yakutia (Poryadina, 2001, 2003, 2006, 2020a; Vershinina *et al.*, 2015). We assume that *Rinodina archaea* can be found in Yakutia, but the available specimens identified as *R. archaea* (Poryadina, 2001, 2003, 2006, 2020a) were reidentified as *R. sibirica* (21 VII 2006, *Poryadina*, SASY; 14 VII 1996, *Poryadina*, SASY; 5 VII 1996, *Poryadina*, SASY L-1996-07-05/7-1-2-3; 1 VII 1996, *Poryadina*, SASY L-1996-07-01/3-1-2-3; 22 IX 2018, *Poryadina*, SASY L-2018-09-22/8-6), *R. turfacea* (14 VII 1996, *Poryadina*, SASY), *R. laevigata* (14 VII 1996, *Poryadina*, SASY L-1996-07-14/11-7-8-9), and *R. cinereovirens* (14 VII 1996, *Poryadina*, SASY L-1996-07-14/12-7-8). The samples published by Vershinina *et al.* (2015) were not available for revision. No specimens of I. I. Makarova (Makarova, Perfiljeva, 1984; Makarova, 1998) were found in LE. Among the studied specimens from Yakutia, *R. archaea* was not found. We also did not find *R. archaea* in the Far East of Russia (Sheard *et al.*, 2017; Galanina, Ezhkin, 2019; Galanina *et al.*, 2021a, b).

Ecology. *Rinodina archaea* is typically lignicolous but also occurs rarely on rough bark of deciduous and coniferous trees, and even more rarely on siliceous rocks in southern Europe (Mayrhofer, Sheard, 2007; Sheard, 2010).

***Rinodina exigua* (Ach.) Gray**

Rinodina exigua is characterized by its *Physcia*-type spores, cortical atranorin, indistinct cortex, large areoles, and rugose thallus (Mayrhofer, Moberg, 2002).

Distribution. Europe (the species is common in western and central, scattered in southern areas), North Africa, Australasia, North America (California and the Sierra Nevada), and Russia (temperate zone). Our research has shown that it was misidentified in Russia. We think that this species is absent on the territory of Yakutia, as well as on the territory of the Far East (Sheard *et al.*, 2017; Galanina, Ezhkin, 2019; Galanina *et al.*, 2021a, b). Most of the specimens previously identified as *Rinodina exigua* and published for Yakutia (Makarova, 1998; Poryadina, 2001, 2003, 2006; Vershinina *et al.*, 2015) have been revised and reidentified by us: two specimens as *R. sibirica* [15 VIII 2006, *Poryadina*, SASY; 13 VII 2002, *Poryadina*, SASY) with *R. exiguella* (Vainio) H. Magn., one specimen as *R. laevigata* (3 IX 1993, *Poryadina*, SASY L-1993-09-03/1-1-2-3-4), two specimens as *R. turfacea* (2 VII 1988, *Makarova*, LE), and one as *R. olivaceobrunnea* (14 VII 1996, *Poryadina*, SASY L-1996-07-14/11-10-12). The material published by Vershinina *et al.* (2015) was not available for this study. *Rinodina exigua* was found neither among the collections from Yakutia nor from the Far East (Sheard *et al.*, 2017; Galanina, Ezhkin, 2019; Galanina *et al.*, 2021a, b).

Ecology. *Rinodina exigua* is typically corticolous growing on bark of deciduous and coniferous trees, rarely lignicolous (Mayrhofer, Moberg, 2002; Sheard, 2010).

***Rinodina exiguella* (Vainio) H. Magn.**

Rinodina exiguella is characterized by its gray, thin thallus, dense, small, black apothecia, cellular cortex, I-, and the spores *Physcia*-type (Magnusson, 1947) and it is cited as a synonym of *R. septentrionalis* by Sheard (2010).

Distribution. *Rinodina exiguella* was previously recorded for Yakutia from Yano-Indigirsky Region (Poryadina, 2005). But this specimen (3 IX 1996, *Poryadina*, whith *R. exigua*, SASY L-1993-09-03/1-1-2-3-4) (Poryadina, 2005) appeared to belong to *R. laevigata*. As there are no other references stating this species as growing in Yakutia, we exclude it from the list of the area.

Ecology. *Rinodina exiguella* is a lignicolous species known from the bank of the Irtys River (Magnusson, 1947).

***Rinodina milvina* (Wahlenb.) Th. Fr.**

Rinodina milvina is characterized by thick dark brown thallus and *Milvina*-type spores (15.5)18.0–19.0(22.0) × (7.5)9.5–10.5(12.0) μm of Type A development. Young thalli of *R. milvina* can be confused with *R. parasitica*, which is well distinguished by its smaller *Physcia*-*Physconia*-type spores.

Distribution. *Rinodina milvina* has scattered distribution in Europe (Mayrhofer, Moberg, 2002) and also occurs in Asia (Turkey, Iraq, Georgia, Armenia, Azerbaijan, Kazakhstan, Mongolia, and Japan) (Wagner, Spribille, 2005; Kotlov, 2008; Byazrov, 2013; Ohmura, Kashiwadani, 2018), North Africa (Kotlov, 2008), and North America (Greenland, Rocky Mountains, Sierra Nevada, Cascades and costal range) (Sheard, 2010). In Russia, the species is widespread from the European part to the Far East, and from the Southern Siberia to the Arctic (Novaya Zemlya) (Kotlov, 2008).

The specimen of *Rinodina milvina* (07 VII 1996, *Poryadina*, SASY) (Poryadina, 2001), was identified as *Buellia* sp. (brown hypothecia, no thallus margin, *Buellia*-type spores). *Rinodina milvina* was not found among the studied specimens from Yakutia.

Ecology. *Rinodina milvina* inhabits siliceous rocks, sometimes parasitizing crustose lichens (Mayrhofer, Moberg, 2002; Kotlov, 2008). In North America, the species was found on granites, quartzites and other acidic rocks, on sandstone, volcanic rocks, from 900 to 3660 m a. s. l. (Sheard, 2010).

***Rinodina sophodes* (Ach.) A. Massal.**

Rinodina sophodes is characterized by *Milvina*-type spores 13.0–18.0 × 7.0–9.0 μm with the well-developed torus, and Type A development. *Rinodina sophodes* has immersed to subimmersed apothecia, often confluent with plane dark brown disc and reddish-brown thallus on a black prothallus (Mayrhofer, Moberg, 2002).

Rinodina sophodes can be often confused with *R. archaea*, but the latter has *Physconia*-type spores and mainly lignicolous (Sheard, 2010). Specimens of *R. sophodes* may also be confused with *R. sibirica*, which differs by *Physcia*-*Physconia*-type spores and erumpent apothecia broadly attached at first and then becoming narrow at the base,

scattered, numerous with the dark brown to black disc becoming convex, sometimes hemispherical (Sheard, 2010; Galanina *et al.*, 2021c).

Distribution. *Rinodina sophodes* is common in Europe, scattered in southern and central Scandinavia, rare in Denmark, widespread in the British Isles, less common in Germany, common in southern Europe and Macaronesia. *Rinodina sophodes* is widely distributed throughout Russia (Arctic, European part, Urals, Siberia, Far East). However, it was previously excluded from the list of species of the Far East (Sheard *et al.*, 2017). As well as in Yakutia, the specimens previously identified as *R. sophodes* from the Far East appeared to be a mixture of other species. The species was recently excluded from the lichen list of North America (Sheard, 2010) as an old, misapplied name. *R. sophodes* was reported in Yakutia for the Verkhoyansk Range (Poryadina, 1999b) and for the Sukharnaya River mouth on the East Siberian Sea coast (Andreev, 1984). The specimen (25 VII 1993, Poryadina, SASY L-1993-07-25/11-3-4) was reidentified as *R. sibirica*. *R. sophodes* was not found among the studied collection of specimens from Yakutia.

Ecology. *Rinodina sophodes* is corticolous, on smooth bark, especially on twigs of deciduous trees (Mayrhofer, Moberg, 2002).

Key to the species of *Rinodina* from the Republic of Sakha (Yakutia)

1. On rock 2
 - On other substrate 6
2. Ascospores *Physcia*-type 3
 - Ascospores different 4
3. Ascospores averaging 19.0–20.0 µm, *Physcia*-type, thallus K+ yellow, P+ yellow, atranorin present in cortex..... *R. confragosa*
 - Ascospores averaging 15.0–17.0 µm, *Physcia-Physconia*-type, thallus K–, P–, atranorin absent
..... *R. interpolata*
4. Ascospores *Bischoffii*-type 5
 - Ascospores *Dirinaria*-type *R. jacutica*
5. Ascospores averaging 16.0–18.0 µm, with unusually broad lumina canals during spore development, which sometimes become excluded *R. bischoffii*
 - Ascospores averaging 19.0–20.0 µm, with unusually narrow lumina canals during spore development *R. calcigena*
6. On bark or wood, ascospores of various types 11
 - On decaying plant debris, bryophytes, or soil, ascospores *Physcia*- or *Physcia-Physconia*-type 7
7. Ascospores averaging 20.5–21.5 µm, *Physcia*-type *R. olivaceobrunnea*
 - Ascospores averaging >21.5 µm, of various types 8
8. On soil, ascospores averaging 22.5–24.0 µm, *Physcia-Physconia*-type *R. terrestris*
 - On decaying plant debris or bryophytes, ascospores averaging >24.0 µm, *Physcia*-type or *Physcia*-like 9
9. Ascospores averaging 24.5–25.5 µm, apothecia becoming convex, thalline margin becoming excluded *R. mniaroea*

– Ascospores averaging >27.0 µm, apothecia not becoming convex, thalline margin not becoming excluded	10
10. Ascospores averaging 27.5–29.5 µm, <i>Physcia</i> -type, sphaerophorin present	<i>R. turfacea</i>
– Ascospores averaging 30.0–32.0 µm, <i>Physcia</i> -like (sometimes similar to <i>Dirinaria</i> -type), sphaerophorin absent	<i>R. roscida</i>
11. Vegetative propagules present	12
– Vegetative propagules absent	13
12. Areolae plane, light gray with labriform soralia, P+ yellow	<i>R. subpariata</i>
– Areolae convex to bullate, dark gray to brown, blastidia often present, P+ orange	<i>R. excrescens</i>
13. Ascospores <i>Milvina</i> -type	<i>R. sophodes</i>
– Ascospores different	14
14. Ascospores <i>Dirinaria</i> -type	15
– Ascospores different	17
15. Ascospores averaging <16.5 µm, of Type A or B development, slightly inflated at septum, thickening is hardly noticeable in water and is better visible in KOH	16
– Ascospores averaging 17.5–19.0 µm, of Type B development, inflated at septum, thickening is clearly visible in water, more so in KOH	<i>R. metaboliza</i>
16. Ascospores averaging 12.0–14.0 µm, of Type B development, with <i>Physconia</i> -like lumina and thin walls, apothecia broadly attached, often contiguous with convex disc	<i>R. pyrina</i>
– Ascospores averaging 15.0–16.5 µm, of Type A and B development, with <i>Physcia</i> -like lumina, apothecia erumpent, becoming broadly attached, often scattered with plane or slightly convex disc	<i>R. oleae</i>
17. Ascospores 3-septate or submuriform at maturity	18
– Ascospores 1-septate at maturity	19
18. Ascospores 3-septate, of Type B development	<i>R. conradii</i>
– Ascospores submuriform, of Type A development	<i>R. intrmedia</i>
19. Ascospores <i>Physcia</i> -type	20
– Ascospores <i>Physconia</i> - or <i>Physcia-Physconia</i> -type	25
20. Thallus K+ yellow, atranorin present in cortex	<i>R. exigua</i>
– Thallus K–, atranorin absent	21
21. Ascospores averaging 23.0–25.5 µm	<i>R. cinereovirens</i>
– Ascospores averaging <21.5 µm	22
22. Ascospores averaging 20.5–21.5 µm, apothecia with disc becoming convex to half-globose	<i>R. sibirica</i>
– Ascospores averaging <19.5 µm, disc of apothecia plane to convex	23
23. Ascospores averaging 18.5–19.5 µm, apothecia with disc plane, sometimes becoming convex	<i>R. laevigata</i>
– Ascospores averaging <17.0 µm	24
24. Ascospores averaging 15.0–16.0 µm, thallus gray-green, continuous, apothecia frequently becoming contiguous on small thalli	<i>R. freyi</i>
– Ascospores averaging 16.0–17.0 µm, thallus copper-brown, consisting of small discrete verrucae (convex when moist), apothecia narrowly attached and scattered	<i>R. septentrionalis</i>

25. Ascospores *Physcia-Physconia* type, averaging 16.0–16.5 μm *R. orculata*
 – Ascospores *Physconia*-type, averaging >18.0 μm 26
26. Ascospores averaging 18.0–18.5 μm , apothecia scattered, with the disc frequently becoming convex, and the narrow thalline margin often becoming biatorine or excluded, typically corticolous *R. trevisanii*
 – Ascospores averaging 19.0–20.0 μm , apothecia broadly attached and contiguous, with the disc rather persistently plane, with thalline margin to 0.10 mm wide, typically lignicolous
 *R. archaea*

Discussion

As a result of the study, the list of *Rinodina* species known from the Republic of Sakha (Yakutia) consists of 24 species, eight of which are reported for the first time for the region (*Rinodina cinereo-virens*, *R. confragosa*, *R. conradii*, *R. intermedia*, *R. interpolata*, *R. metaboliza*, *R. orculata*, *R. trevisanii*). One more interesting record is *Rinodina jacutica* which has only recently been described from Northeast Asia (Galanina *et al.*, 2022).

In Yakutia, *Rinodina* is mainly represented by species typically occurring in the or-arctic (*R. mniaroea*, *R. roscida* and *R. turfacea*) and north temperate regions (*R. cinereo-virens*, *R. metaboliza*, *R. olivaceobrunnea*, *R. septentrionalis*, and *R. sibirica*). Other noteworthy species are *R. bischoffii*, *R. calcigena*, *R. confragosa*, *R. conradii*, *R. intermedia*, *R. interpolata*, *R. jacutica*, *R. orculata*, *R. pyrina*, and *R. trevisanii* which, as yet, have been found only once. Some species are apparently rare because saxicolous species are poorly collected and therefore poorly represented in herbaria. Other species which require further attention are *R. laevigata* and *R. sibirica*, both being widespread in Russia. The distribution of *R. sibirica* was recently presented by Galanina *et al.* (2022), and it is clear that both species are close to each other in morphology and ecology. They often occur together and have often been confused because of their overlapping in size *Physcia-Physconia*-type spores, numerous scattered apothecia often with a convex dark brown to black disc, and thallus consisting of scattered grayish brown areoles. The distribution of *R. laevigata* and its differences from *R. sibirica* deserve further study using molecular methods.

One more species that needs to be mentioned is *Rinodina excrescens*. We previously reported the rediscovery of this species in Russia from new records in the Russian Far East from Sakhalin Island to the Mongolian border (Galanina *et al.*, 2011). *R. excrescens* was described from western Siberia by Vainio (1928) but since then has been reported as frequent from eastern North America (Great Lakes region), and from south-central and southern Europe, where it is rare (Giralt *et al.*, 1993, 1994; Aragón *et al.* 2004; Spribille *et al.* 2006; Giralt 2010; Sheard, 2010). We reported a major extension to the species' range in northeastern Asia and an apparent second centre of its distribution that had previously been overlooked (Galanina *et al.*, 2011). In Yakutia and Siberia as a whole, we found confirmation of this, because *R. excrescens* is very often encountered here, as well as *R. laevigata* and *R. sibirica*. These species are abundant on the territory of Yakutia.

Four species were not found by us in Yakutia, but were previously reported for the region. These are *Rinodina archaea*, *R. exigua*, *R. exiguella* and *R. sophodes*. Based on

studies of *Rinodina* in Northeast Asia (Sheard *et al.*, 2017; Galanina, Ezhkin, 2019; Galanina *et al.*, 2021a, b), we believe that the specimens stored under these names in Russian herbaria need to be verified. *Rinodina pyrina* was also often incorrectly identified in Yakutia. We reidentified all samples of *R. pyrina* from Yakutia, with one exception from the central part of the region.

Despite the presented data, the genus *Rinodina* in the Republic of Sakha (Yakutia) requires further study.

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