



## *Rinodina riparia* (Physciaceae, lichenized Ascomycota) new to Eurasia from China and Russia

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### Abstract

*Rinodina riparia* was described from North America. It is here recorded for the first time in Eurasia from China and Russia. The species was collected on rough bark, plant debris and wood partly buried in sand. The paper provides data on morphology and anatomy, ecology, and comparisons with closely related species of *Rinodina riparia* based on the studied sample. The worldwide distribution of the species is discussed. A key for identification of *Rinodina riparia* and other species with *Dirinaria*-type spores in Buryatia is given.

**Key words:** biodiversity, biogeography, disjunctive species, lichens, new records, North-East Asia

### Introduction

*Rinodina* is a common and widespread genus occurring in most plant communities of Eurasia. Our study is part of a revision of the genus *Rinodina* in Russia and North-East Asia as a whole. We are discovering more and more connections between the lichen biota of North-East Asia and North America. This is manifested in the discovery of *Rinodina* species previously described for North America as endemic: *Rinodina albertana* Sheard (Galanina *et al.*, 2021a), *R. ascosciscana* (Tuck.) Tuck. (Sheard *et al.*, 2017; Galanina, Ezhkin, 2019; Galanina *et al.* 2021a), *R. endospora* Sheard (Sheard *et al.*, 2017; Galanina *et al.*, 2021a, b; Galanina, Ohmura, 2022), *R. herrei* H. Magn. (Galanina, Ezhkin, 2019), *R. macrospora* Sheard (Sheard *et al.*, 2017; Galanina, Ohmura, 2022), *R. megistospora* Sheard & Mayrhofer (Sheard *et al.*, 2017; Galanina *et al.*, 2018, Galanina, Ezhkin, 2019). Another such species is *Rinodina riparia* Sheard.

*Rinodina riparia* is reported as new to Eurasia from China and Russia. The species was described from Northern America (Colorado) (Sheard, 1998) where it was considered endemic having a north-south distribution, mainly east of the Rocky Mountains (Sheard, 2010).

*Rinodina riparia* is distributed in the temperate zone of the northern hemisphere, similar to *Rinodina jacutica* Galanina & Konoreva recently found in Northeast Asia (Galanina *et al.*, 2022).

### Materials and methods

The paper is based on the studies of collections stored in the following herbaria of Russia: LE, UUH, and SASY. The records are shown in Fig. 1. The locality of the sample from China is shown approximately on the map, since the sample label data is not complete; data on Potanin's expedition in 1885–1886 was used (Obruchev, 1962; Riegg, 2012) was used to find the locality. The map also shows the localities of *Rinodina riparia* specimens in North America, taken from the Consortium of Lichen Herbaria (2024). The materials were identified by J.W. Sheard (sample from China)

and I.A. Galanina (samples from Russia), Department of Biology, University of Saskatchewan and the laboratory of Botany of the Federal Research Center for Biodiversity of the Far East Branch of Russian Academy of Sciences, respectively. The studies of anatomical and morphological features have been made using the microscopes Zeiss Axioplan 2 and Stemi 2000-C. The studies of spore structures and measurements were accomplished using immersion oil at  $\times 1000$  magnification. Anatomical examination used hand-cut sections mounted in water, with the following reagents: 10% KOH (K) and  $C_6H_4(NH_2)_2$  (P). Measurements of ascospores are presented as percentiles (5)25–75(95)  $\mu m$  of length  $\times$  breadth, thus excluding outliers. Recent publications of J.W. Sheard (Sheard, 2010, 2018; Sheard *et al.*, 2017) have been used for specimen identification. The type specimens were not consulted because of mailing difficulties. Anatomical and morphological description of the species based on the studied specimens is provided below. Differences from closely related species and distribution of the species are discussed and also contrasted in the key.

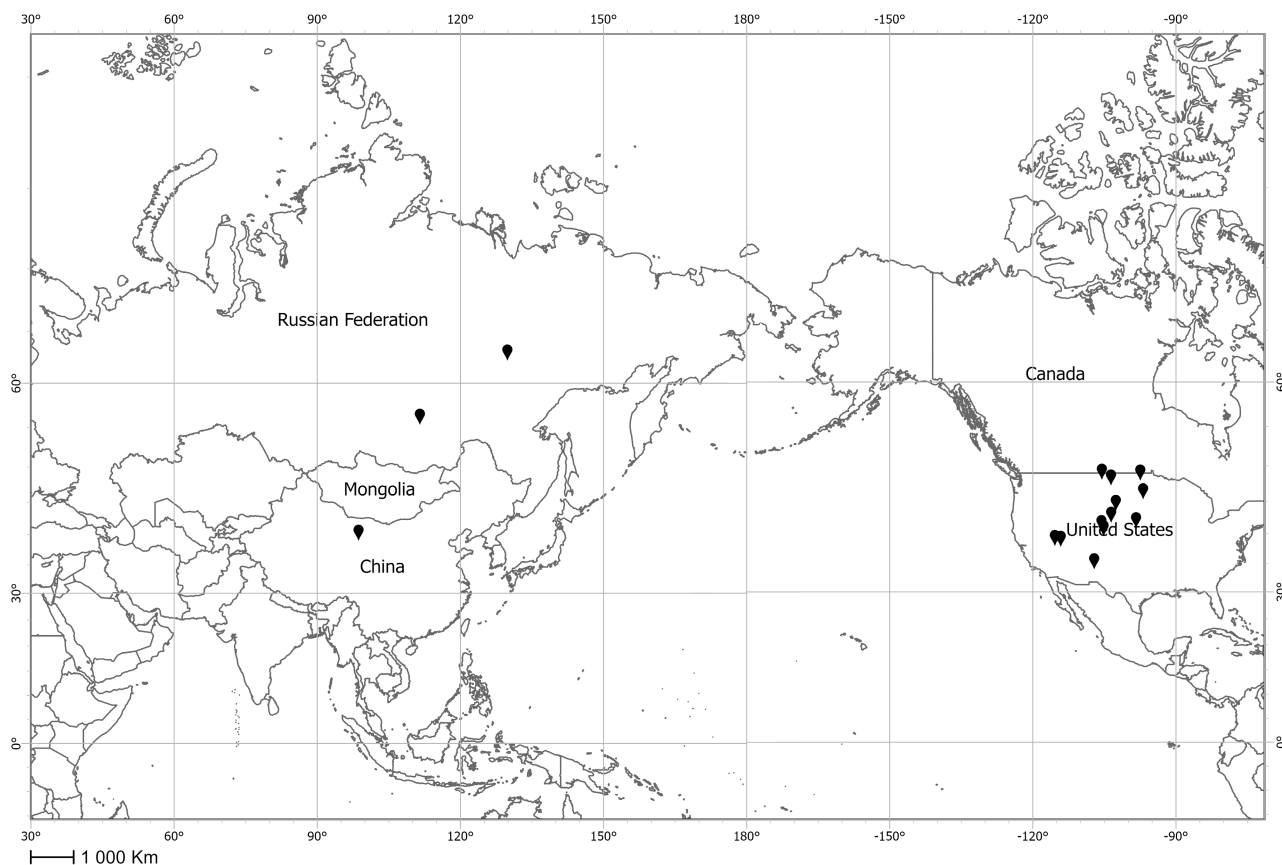


FIGURE 1. Distribution of *Rinodina riparia* in Eurasia and North America.

## Results

### *Rinodina riparia* Sheard (1988: 37)

Type:—U.S.A. Colorado. Jefferson Co., alongside Deer Creek, 4.7 km W of junction of Colo. 470 and Deer Creek Road. Growing at base of *Populus angustifolia*, 1650 m a.s.l., 5.V 1974, M.B. Carner 2525 (COLO—holotype, SASK—isotype, Sheard, 2010).

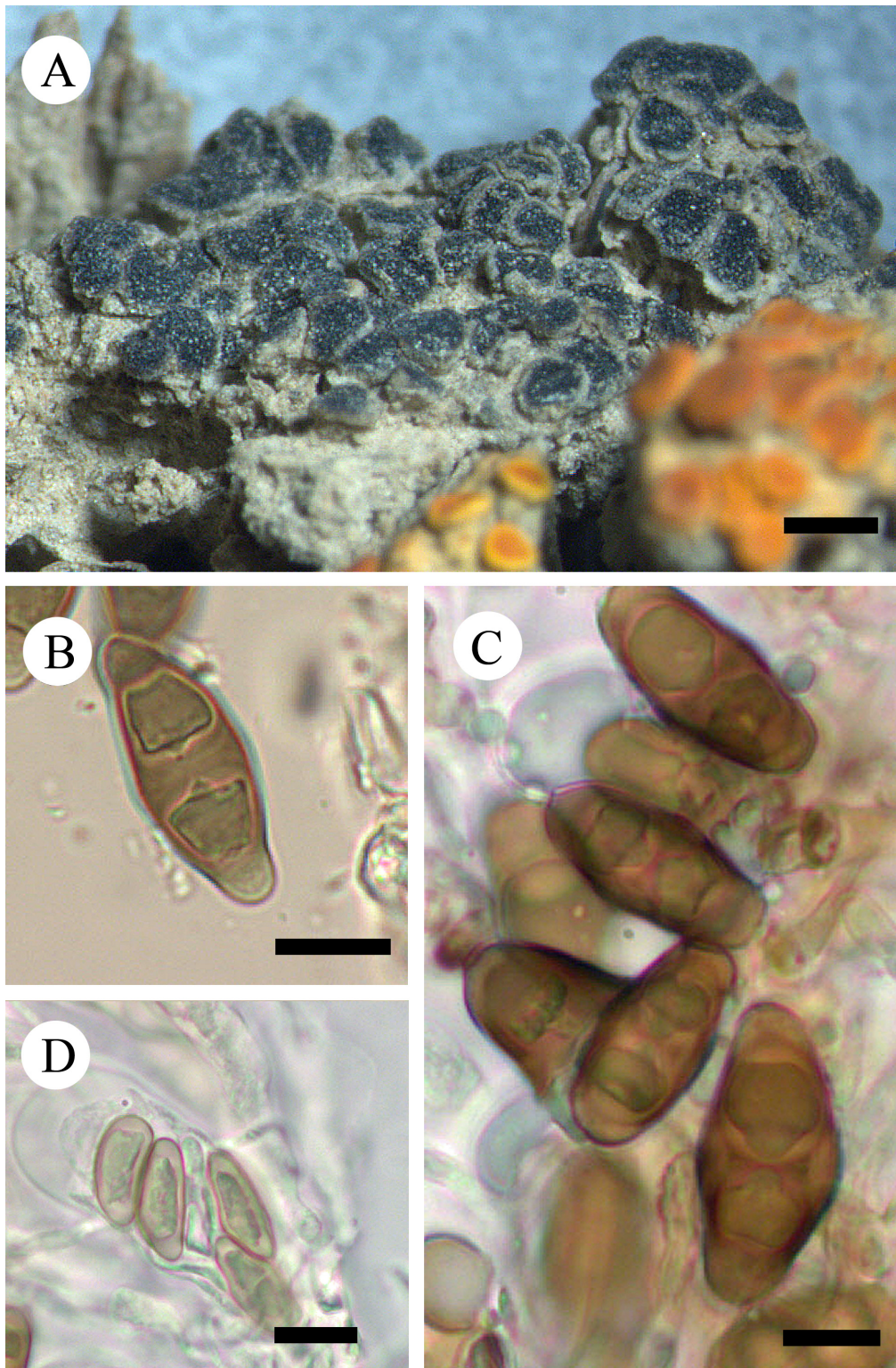
(Figs 2A–C)

*Thallus* thin, areoles at first discrete and slightly convex 0.2–0.5 mm wide, to 0.5–0.6 mm wide in older parts, light to dark gray sometimes with a brownish tinge. Prothallus and vegetative propagules absent.

*Apothecia* numerous, broadly attached and densely contiguous in older parts of the thallus (Fig. 2: A), 0.4–0.6 (–1.0) mm diameter ( $n = 18$ ); disc black, persistently plane; thalline margin concolorous with thallus, entire and persistent; confluent excipular ring sometimes present. Cortex of apothecia to 20  $\mu m$  wide, not expanded below. Proper exciple hyaline, 15  $\mu m$  wide, expanding to 20  $\mu m$  at surface, pigmented the same colour as epihymenium; hypothecium hyaline, 30–40  $\mu m$  high; hymenium 70–100  $\mu m$  high, paraphyses 1.5–2.0  $\mu m$  wide, not conglutinate, apices to 5.5–6.8



$\mu\text{m}$  wide, forming a red-brown epihymenium. **Ascospores** 8 per ascus, type B development, *Dirinaria*-type (Fig. 2: B, C, D), (18.0–) 21.5–22.5 (–27.5)  $\times$  (9.0–) 10.0–11.0 (–12.0)  $\mu\text{m}$  ( $n = 49$ ), with *Physcia*-like lumina during development, torus lacking, septal disc sometimes present, walls rarely ornamented. Most mature spores inflated at septum, more so on application of KOH. Spores have lightly pigmented bulbous, apices at maturity (described as being “almost mucronate” by Sheard 1998).



**FIGURE 2.** *Rinodina riparia* (specimen from Yakutia, SASY L-2008-08-07/0-2). A. Habit of *Rinodina riparia*, apothecia broadly attached and contiguous, disc persistently plane, thalline margin concolorous with thallus, entire and persistent. B, C. *Dirinaria*-type spores with the *Physcia*-like lumina. B. Premature spore, note the septal swelling and lack of a torus. C. Mature spores showing bulbous apices and septal swelling in KOH. D. Immature spores indicate prior to septal division in Type B development in KOH. Scale: A = 0.5 mm, B, C, D = 10  $\mu\text{m}$ .

*Pycnidia* not seen.

*Chemistry*: Spot tests all negative.

*Distribution*: *Rinodina riparia* is reported as new to Eurasia from China and Russia (Fig. 1). In China, it was found in the Nanshan Highlands. In Russia, the species was found in Yakutia (Yakutsk vicinity) and Buryatia (Dzherginsky Reserve). The species was first described from Northern America (Colorado) by Sheard (1998). Its distribution in North America was supplemented by new location from North Dakota (Sheard, 2018). *R. riparia* was thought to be endemic to the continent, possessing a north-south distribution mainly east of the Rocky Mountains (Sheard, 2010).

**Specimens examined**: CHINA, Nanshan Highlands, on bark, 1885–1886 (collection date unknown), *G.N. Potanin*, LE 25792; RUSSIA, Republic of Buryatia, Kurumkansky District, Dzherginsky Reserve, Ikatsky Ridge, upper reaches of Barguzin River, Turakina stream valley, old fire-site, 55°20'26.6"N, 111°30'02"E, 1097 m a. s. l., on plant debris, 06 VII 2001, *T.M. Kharpukhayeva*, UUH L-02947; Republic of Sakha (Yakutia), Yakutsk vicinity, 33 km of highway P-503 to Kildemtsy, top of the slope, 62°16'19.2"N, 129°50'33"E, 95 m a. s. l., flat steppe area surrounded by larch forest, on wood partly buried in sand, *L.N. Poryadina*, SASY L-2008-08-07/0-2.

### Key to the *Rinodina* species with *Dirinaria*-type spores in Buryatia

1.	On rock .....	2
-	On bark, wood and plant debris.....	3
2.	K+ yellow, P+ yellow, atranorin present in cortex .....	<i>R. jacutica</i>
-	K-, P- .....	<i>R. gennarii</i>
3.	Spores averaging 12.0–21.0 µm .....	4
-	Spores averaging 21.0–26.0 µm .....	5
4.	Spores averaging 12.0–18.0 µm .....	6
-	Spores averaging 17.5–21.0 µm .....	7
5.	Spores have lightly pigmented and more bulbous apices at maturity, thallus is usually gray apothecia broadly attached and densely contiguous to 1.00 mm diameter .....	<i>R. riparia</i>
-	Spores do not have lightly pigmented and more bulbous apices at maturity, thallus is usually being a shade of brown and narrowly attached apothecia to 0.70 mm diameter .....	<i>R. endospora</i>
6.	Spores with lumina <i>Physcia</i> -like at maturity, apothecia erumpent .....	8
-	Spores with lumina <i>Physconia</i> -like at maturity, apothecia not erumpent .....	9
7.	Spores averaging 19.0–21.0 µm, blastidia and (or) consoredia often present.....	<i>R. albertana</i>
-	Spores averaging 17.5–19.0 µm, blastidia and consoredia absent .....	<i>R. metaboliza</i>
8.	Spores averaging 15.5–16.5 µm .....	<i>R. oleae</i>
-	Spores averaging 16.5–18.0 µm .....	<i>R. manshurica</i>
9.	Spores averaging 12.5–13.5 µm .....	<i>R. pyrina</i>
-	Spores averaging 15.0–18.0 µm .....	<i>R. mongolica</i>

### Discussion

*Rinodina riparia* is the tenth species to be recorded from North-East Asia with *Dirinaria*-type spores, although its distribution is poorly understood. The detailed description was given by Sheard (1989, 2010). Based on the description presented, there are no significant differences in character between the newly discovered material from Asia and the original specimens described from North America.

*Rinodina riparia* might be confused with *R. endospora* Sheard, as their spores with similar structure and size. But spores of *R. riparia* have lightly pigmented and more bulbous apices at maturity. Thallus and apothecia of *R. endospora* differ from *R. riparia* in usually being a shade of brown and often possessing usually distinctive flaking scales on the thalline margins of the narrowly attached apothecia (Sheard, 2010). *Rinodina riparia* has a gray thallus with numerous, broadly attached and densely contiguous apothecia to 1.00 mm diameter. *Rinodina riparia* may also be confused with *R. albertana* Sheard, which also has *Dirinaria*-type spores, but they are of smaller size (15.0)19.0–20.0(24.0) × (6.5)9.0–10.0(13.0) µm and thallus with blastidia and (or) consoredia (Sheard, 2010). Spores of *Rinodina riparia* may be confused with spores of *R. terrestris* Tomin due to their lightly pigmented submucronate apices. But *R. riparia* has *Dirinaria*-type spores which are mostly bulbous at apices at maturity and *R. terrestris* has *Physcia*-*Physconia*-type spores and they are larger (17.5–) 22.5–24.0 (–29.0) × (8.0–) 10.0–10.5 (–12.5) µm (Sheard, 2010).

*Rinodina riparia* was collected on rough bark presumably of *Ulmus* sp. in China during Potanin's expedition in 1885–1886 and on plant debris and wood partly buried in sand in Buryatia (Dzherginsky Reserve) and Yakutia (Yakutsk vicinity) in Russia.



Taking into account new data, we should consider the species distribution range as the East-Asia-North American, which provokes interest and raises questions. Asian part of the distribution range is distinguished by significant disjunctions. But if localities in Yakutia and Buryatia are conjoined by Verkhoyansky and Stanovoi mountain ranges, the locality in Nanshan is situated in relative isolation. According to the Consortium of Lichen Herbaria (2024) and herbaria specimens, the center of species distribution is situated mainly east of the Rocky Mountains region in North America a north-south. This is consistent with Sheard (2010).

Most of localities are found compactly in the temperate zone of the Boreal Subzone. Localities from New Mexico, Nevada and Colorado are located at altitude (1880–2250 m a. s. l.) in the alpine meadow and forest belts. Asian localities are located in mountain terrainous or in the permafrost zone.

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