LICHENS — ЛИШАЙНИКИ

Lithographa tesserata (Trapeliaceae, lichenized Ascomycota) new to Japan

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Abstract. The genus *Lithographa* and the species *L. tesserata* are reported for the first time for Japan. The species was collected on siliceous rocks in mountain areas of Hokkaido. It is characterized by having crustose areolate thallus, black lirellate ascomata, simple hyaline ascospores and the presence of norstictic acid. Characteristic features of the species based on the Japanese material, distribution, comparison with other species of the genus are provided. In addition, a short description of a specimen of *L. tesserata* from Sakhalin Island and a comparison with the Japanese material are given.
Keywords: distribution, new records, taxonomy, East Asia, Hokkaido, Sakhalin.

Lithographa tesserata (Trapeliaceae, lichenized Ascomycota), новый для Японии вид лишайника

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Резюме. Род лишайников *Lithographa* и вид *L. tesserata* впервые приводятся для Японии. Вид был собран на силикатных породах в горных районах о. Хоккайдо. Он характеризуется накипным, ареолированным слоевищем, черными, лирелловидными апотециями, простыми, бесцветными аскоспорами и наличием норстиктовой кислоты. Приведены характерные особенности вида на основе изучения материала из Японии, а также распространение и сравнение

с другими видами рода. Кроме того, дано краткое описание экземпляра *L. tesserata* с о. Сахалин в сравнение с материалом из Японии.

Ключевые слова: новые находки, распространение, таксономия, Восточная Азия, Сахалин, Хоккайдо.

The genus *Lithographa* Nyl. (Trapeliaceae) comprises ten saxicolous species with chlorococcoid photobionts, crustose thalli, lirellate ascomata, branching and soon disappearing or sparse paraphyses, and simple or submuriform hyaline ascospores (Hertel, Rambold, 1990; Spribille *et al*., 2014; Wijayawardene *et al*., 2022).

The genus was monographed by Hertel and Rambold (1990) along with the genus *Rimularia* Nyl., and additional species have since been described: *L. graphidioides* (Cromb.) Imshaug ex Coppins et Fryday, *L. olivacea* Fryday, *L. opegraphoides* Coppins et Fryday, *L. serpentina* Coppins et Fryday, and *L. skottsbergii* (Zablbr.) Fryday and Coppins (Fryday, 2004; Coppins, Fryday, 2006; Fryday, Coppins, 2007). The representatives of the genus are distributed in Europe, Asia, North and South America, Tasmania and subantarctic islands (Flock, 1989; Hertel, Rambold, 1990; Lumbsch, 1997; Foucard, 2001; Fryday, 2004; Coppins, Fryday, 2006; Fryday, Coppins, 2007; Urbanavichus *et al*., 2008; Smith *et al*., 2009; Dietrich, Bürgi-Meyer, 2012; Wirth *et al*., 2013; Kristinsson *et al*., 2014; Joseph *et al*., 2016; McCune, 2017; Chesnokov *et al*., 2018; Ezhkin, Schumm, 2018; Westberg *et al*., 2021).

The molecular phylogenetic analysis (Spribille *et al*., 2014) showed that *Lithographa*, *Ptychographa* Nyl. and *Xylographa* (Fr.) Fr. are closely related. *Xylographa* is easily separated from *Lithographa* by its lignicolous habit and often exposed disk with a thin to moderately thickened proper exciple which is pale brown to hyaline in its inner part. *Ptychographa* shares the dark exciple with *Lithographa*, but is easily distinguished by its inconspicuous to minute granulate thallus, hymenium which is usually divided by a longitudinal ridge of a dark, sterile tissue, and occurrence on wood. *Ophegrapha* Ach. can also form lirellae on rock and has a very dark exciple, but the ascospores in this genus are transversely septate, and the photobiont is *Trentepohlia* Mart. *Lithographa* differs from *Rimularia* Nyl. by the shape of ascomata — elongated in *Lithographa* and orbicular in *Rimularia*.

During the revisionary studies of lichens of Hokkaido, we found two interesting specimens which were identified later as *Lithographa tesserata* (DC.) Nyl. The species has not been previously known from Japan and is reported here as a new generic and a species record. The investigation is conducted on the scope of the project of the inventory lichen flora of Japan (Paukov *et al*., 2021; Galanina, Ohmura, 2022; Yakovchenko *et al*., 2022).

Materials and Methods

All geographical coordinates are given in the coordinate system WGS 1984. Specimens collected in Hokkaido were examined morphologically using a dissecting stereomicroscope (Olympus SZX61) and a differential interference contrast microscope (Zeiss Axio Lab.A1). Anatomical investigation was undertaken using hand-cut

sections mounted in water. Measurements are given as the (extreme minimum–) minimum–maximum (–extreme maximum) observed. Lichen substances were studied using a thin layer chromatography (TLC) with solvent B' (hexane: methyl tetra-butyl ether: formic acid, 140 : 72 : 18) and a solvent C (toluene: acetic acid, 170 : 30) (Orange *et al.*, 2001).

Results and Discussion

Lithographa tesserata is a species characteristic by its distinct areolate, whitish to pale gray-brownish thallus of plane to convex areoles up to 0.4(1.5) mm wide, black, shortly lirellate apothecia, 0.2–1.5 × 0.2–0.4 mm, with margins of a proper exciple arranged close to each other like thick black lips, and a slit-like, not opening disk. Paraphyses slender, up to 1 μm wide, branched, soon disappearing or sparse. Asci 8-spored, *Rimularia*-type, ascospores hyaline, broadly ellipsoid to ovate, thin-walled, 9–15 × 5–8 μm. Medulla C–, K+ yellow-red (crystals), KC+ red, Pd+ orange, UV– (TLC: norstictic acid). The specimens from Japan (Fig. 1, 2) agree well with available descriptions of the species (Smith *et al.*, 2009; Foucard, 2001; Wirth *et al.*, 2013; McCune, 2017) differing by somewhat larger size of areoles, apothecia, and ascospores as well as the presence of a black-greenish tint on the inner edge of the exciple. Thus, the diagnostic characters are continuous crustose thallus with whitish, areolate, mostly plane

Fig. 1. Morphology of *Lithographa tesserata* from Japan (Ohmura 3587, TNS): thallus and apothecia. Scale bar: 0.5 mm.

Fig. 2. *Lithographa tesserata* (Ohmura 3587, TNS): asci with eight non-septate ascospores. Scale bar: 10 μm.

areoles, up to 1.4(1.8) mm wide with uneven surface, black, poorly developed hypothallus, only occasionally visible between the areoles; black lirellate, adnate, numerous, solitary or crowded, straight or curved apothecia, 0.3–1.6 × 0.2–0.4 with a slit-like disc. Exciple dark brown, sometimes colored greenish-black on the inner edge, pol–. Hymenium hyaline with a dark-brown epihymenium, pol–. Paraphyses thin, ca. 1 μm wide, branched. Ascospores hyaline, broadly ellipsoid, 10.0–15.0(16.5) × × 6.0–8.0(9.0) μm. Both medulla and the upper cortex are yellow with P and red with K (norstictic acid).

In Japan the species was found on siliceous rocks, partly overgrowing saxicolous mosses at the elevation ca. 2000 m a. s. l. Worldwide the species is recorded on moist siliceous or basic rocks, especially basalt, but also on granite in exposed sites. It is a widespread but rarely collected arctic-alpine species known from North America (Flock, 1989, McCune, 2017), Europe (Foucard, 2001; Urbanavichus *et al*., 2008; Smith *et al*., 2009; Dietrich, Bürgi-Meyer, 2012; Wirth *et al*., 2013; Kristinsson *et al*., 2014; Westberg *et al*., 2021), and Asia where it is reported from South Siberia (Urbanavichus, Urbanavichene, 2004, Chesnokov *et al*., 2018) and Sakhalin Island (Ezhkin, Schumm, 2018).

A specimen of *Lithographa tesserata* collected in Sakhalin Island differs from the Japanese material by its darker (brownish grey) thallus composed of larger, up to 1.5(2.0) mm wide, moderately convex areoles with a smooth upper surface, distinct hypothallus on the thallus periphery, smaller apothecia 0.20–1.00 × 0.20–0.35 mm and ascospores 9.0–13.0(15.0) × 5.0–7.5 μm, narrowly to broadly-ellipsoid, with rounded to pointed one or two ends.

Among *Lithographa* species, *L. tesserata* is unique in containing norstictic acid. Other four *Lithographa* species with simple ascospores are separated from *L. tesserata* morphologically: *L. graphidioides* has ± orbicular ascomata with more open discs; *L. opegraphoides* possesses initially slit-like discs that usually expand later; *L. olivacea* has dark, olive-brown thallus and slit-like discs but apothecia are smaller, up to 0.6 × 0.2 mm; *L. marionensis* Hertel et Rambold has gray rimose-areolate thallus reacting C+ red (gyrophoric acid). The two remaining species of the genus differ mainly by their submuriform ascospores.

Specimens examined: **Japan**, Hokkaido, Prov. Tokachi: along the trail between Minami-numa Campsite and Kita-numa, Mt. Tomuraushi, Daisetsu Mts, Shintoku-cho, Kamikawa-gun, rocks and stonefield on N slope, 43°31′43″N, 142°50′45″E, 2000 m a. s. l., on rocks, 28 VIII 2019, *Davydov 18314*, (hb. Davydov et Yakovchenko); *ibid*., rocks and stonefield on NE slope, 43°31′49″N, 142°50′59.5″E, 2030 m a. s. l., on N exposed rocks, 28 VIII 2019, *Davydov 18315* (hb. Davydov et Yakovchenko, TNS). Prov. Ishikari: around the summit of Mt. Tomuraushi, Disetsu Mts, Biei-cho, Kamikawa-gun, 43°31′38.0″N, 142°50′54.5″E, 2130 m a. s. l., on rock, 24 VII 1997, *Ohmura 3587* (TNS).

Additional specimens examined: **Russia**, Sakhalin, Korsakovsky District: Pik Chekhova Mt, ca. 6 km E of Yuzhno-Sakhalinsk, rock "Borodavka", N and W sides, 46°59′27″N, 142°50′18″E, 910 m a. s. l., on rocks, 8 VIII 2019, *Davydov 19308* (hb. Davydov et Yakovchenko).

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