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Hypogymnia papilliformis (*Parmeliaceae*), a new lichen from Far East Russia and China

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Abstract: *Hypogymnia papilliformis* McCune, Tchabanenko & X. L.Wei is described as a new species of lichenized fungus from the Primorsky region of Russia and Shaanxi Province in China. It is a relatively rare species from mixed conifer-broadleaved forests in suboceanic climates, in mountainous areas at elevations of 600–1500 m. Most similar to *H. delavayi*, the species are distinguished by branching pattern and chemistry. *Hypogymnia papilliformis* is predominantly isotomically branched while *H. delavayi* usually develops subpinnate branching. The ceiling of the lobe cavity is mid brown to dark brown in *H. papilliformis*, while the ceiling is often pale brownish or white in *H. delavayi*. Also, *H. papilliformis* lacks 3-hydroxyphysodic acid, and thus has a K– medulla, while *H. delavayi* always contains 3-hydroxyphysodic acid as a major substance and is thus K+ slowly reddish brown. We provide a key to the six esorediate *Hypogymnia* species known from the Russian Far East.

Key words: *Lecanorales*, lichenized ascomycetes, lichenized fungi, Primorsky, Shaanxi Province, Taibai Mountains

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Introduction

Although the centre of diversity of *Hypogymnia* in Asia appears to be in south-west China (McCune & Wang 2014), a number of endemic species have been found in central China (Wei & Wei 2005, 2012) and Far East Russia (Tchabanenko & McCune 2001; McCune & Tchabanenko 2002). The present paper continues that exploration by describing a new, relatively rare, esorediate species from Far East Russia and central China.

Materials and Methods

We applied standard microscopy and chemical spot test methods. Many specimens were subjected to thin-layer chromatography (TLC), using the standard methods of Culberson (1972) and reference tables of Chicita Culberson (1996, unpublished). Fragments of specimens were extracted in acetone at room temperature, spotted on aluminum-backed silica gel plates (Merck 5554/7 Silica gel 60 F_{254}), run in solvent systems A and C of Culberson (1972), lightly brushed or sprayed with 10% H_2SO_4, and charred in an oven at 100°C. No attempt was made to distinguish chloroatranorin from atranorin; nor was water applied to detect fatty acids.

Apothecial anatomy and measurements were studied with bright-field microscopy on hand-cut sections mounted in water with no staining. Ascospore and spermatia sizes were measured in sets of nine and expressed as the median and range. Spores were photographed, cut and pasted onto a single canvas, then measured with the line tool in PhotoShop with *View*|*Info* displayed. These raw values were converted to micrometres using a conversion factor calibrated from a stage micrometer.

The unusual morphology of lobes of the genus *Hypogymnia* has necessitated some terminology seldom used in other lichens. See McCune & Wang (2014) for further explanation of terminology for lobe cavities and perforations, and for further details on the methods.

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Hypogymnia papilliformis McCune, Tchabanenko & X. L.Wei sp. nov.

MycoBank No.: MB 809097

Similar to *H. delavayi* but differing in the more often isotomic dichotomous branching, upper surface becoming strongly verrucose or papillose, and absence of 3-hydroxyphysodic acid.

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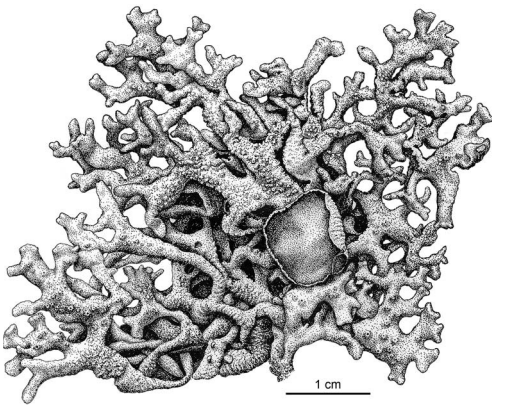

FIG. 1. *Hypogymnia papilliformis*, habit (part of holotype). Drawing by Alexander Mikulin.

Type: Russia, Primorsky Krai, Uglovaya Pad, Lazovsky Reserve, 43°0'N, 134°4'E, 600 m, mixed conifer–broadleaved forest, on *Pinus koraiensis*, 12 November 1981, *S. Tchabanenko* 13 (OSC —holotype; HMAS-L— isotype).

(Figs 1–4)

Thallus appressed to suberect, to 8 cm diam.; texture cartilaginous; branching variable, isotomic dichotomous or sometimes with adventitious side branches; *lobes* separate to centrally subcontiguous, commonly 1·5–4·0(–5·0) mm broad, short or elongate, hollow, even to somewhat nodulose in outline, lateral budding occasional; *upper surface* becoming distinctly rugose to verrucose or papillose, epruinose, pale greenish grey, dark mottling absent or very sparse, black border not visible; *lower surface* near lobe tips brown to dark brown, less often black, matt or semi-glossy; *lobe tips and axils* usually perforate, the holes lacking a differentiated rim; *ceiling of lobe cavity* off-white to dark (check 1 cm back from lobe tip); *floor of lobe cavity* dark brown; *soredia, isidia, and lobules* lacking.

Apothecia occasional, sessile to substipitate, the receptacle funnel-shaped; *disc* brown, to 8 mm diam.; *epihymenium* pale brown, POL−; *hymenium* 45–50 μm tall; *subhymenium c.* 15 μm tall, POL−; *hypothecium* POL−, 22–32 μm tall; *ascospores* 6·0–7·0 × 4·1–4·9 μm (median 6·5 × 4·5 μm).

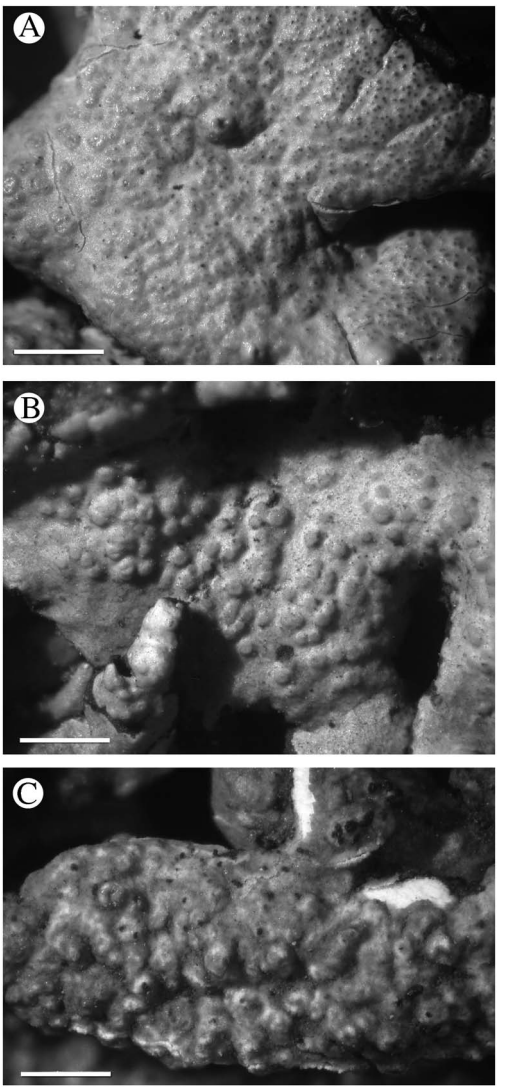

FIG. 2. *Hypogymnia papilliformis*, variation in upper surface. A, initial stages of development of papillae (*Skirina* 22711); B, well-developed papillae (*Skirina* 22711); C, mixed papillae and rugosity (*Xu & Yang* 1511). Scales: A–C = 1 mm.

Pycnidia (spermatogonia) common; *spermatia* rod-shaped to weakly bifusiform, 4·8–6·4 × 0·9–1·1 μm (median 5·6 × 0·9 μm).

Secondary chemistry. Atranorin, physodic acid (major), 2'-*O*-methylphysodic acid (minor), and vittatolic acid (minor accessory); medulla K−, C−, KC+ orange-red, P−.

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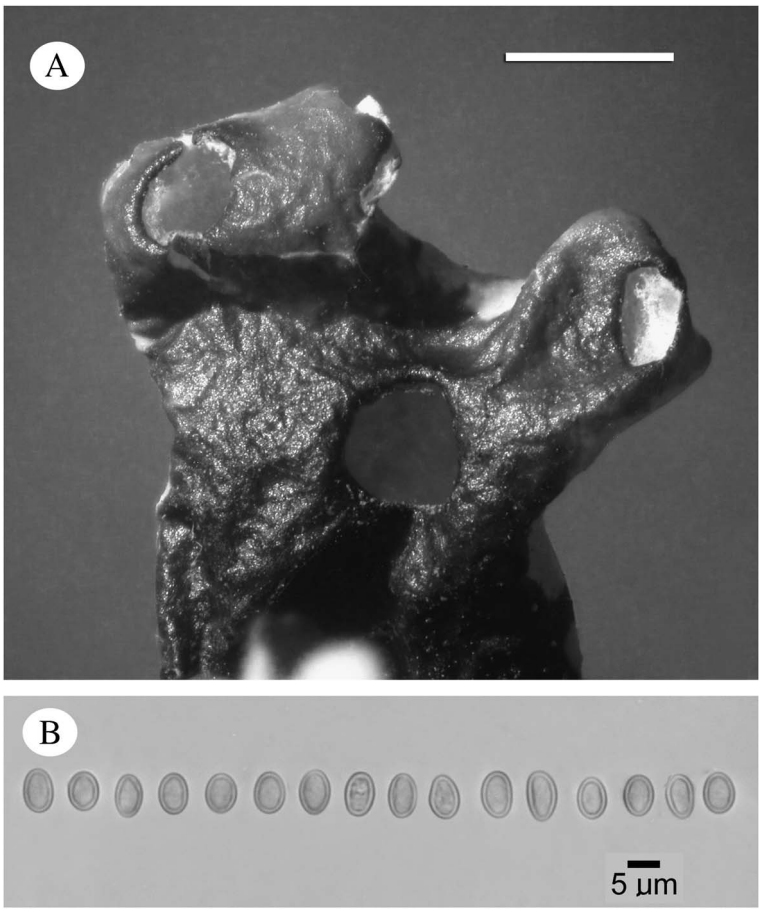

FIG. 3. *Hypogymnia papilliformis* details. A, perforations in lobes viewed from below (*Skirina* 22711); B, ascospores (holotype). Scale: A = 1 mm.

Etymology. The epithet '*papilliformis*' refers to the papillose texture that develops on the upper surface.

Ecology and substratum. *Hypogymnia papilliformis* is so far known from bark and wood of conifers in mixed conifer-broadleaved forests at elevations of 600–1500 m. The species occurs at temperate latitudes in the mountains of Shaanxi Province, China, and Far East Russia (southern Sikhote-Alin Range, Primorsky Krai).

Specimens examined. **China:** *Shaanxi Province*: Ningshan County, Taibai Mountain, 33°26'N, 108°27'E, 1500 m, on bark, 2005, *L. Xu & J. Yang* 1511 (HMAS-L 85008).—**Russia:** *Primorsky Krai*: Hasansky District, Kedrovaya pad Reserve, Kedrovaya River, conifer-broad-leaved forest, 43°5'41·15"N, 131°33'40·71"E, 600 m, on *Pinus koraiensis*, 1994, *Tchabanenko* 184 (SAKH); Anuchinsky District, Tigrovaya River, near village of Tigrovyi, on twigs of *Abies nephrolepis*, 2008, *Skirina* 22711 (SAKH); Lazovsky District, Lazovsky Pass, 43°30'7·3"N, 133°35'19·1"E, *c*. 900 m, 22 ix 2009, *Tchabanenko* s.n. (SAKH).

Discussion

Hypogymnia papilliformis appears to be a rare species. At this point, we have so few records and know so little about its habitat that it is difficult to describe with any

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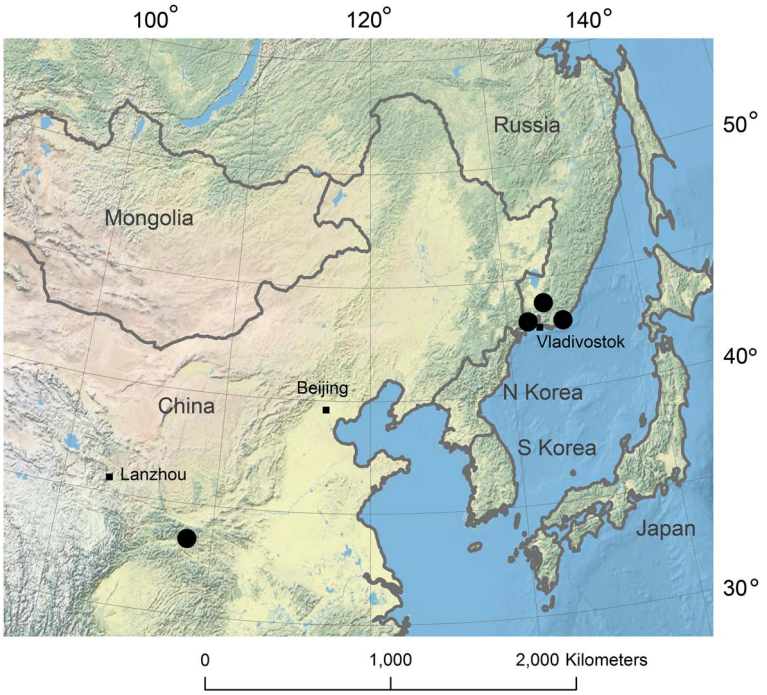

FIG. 4. Known world distribution of *Hypogymnia papilliformis* (solid dots). In colour online.

precision the ecological conditions necessary for its survival.

The only known reference to the species in the literature is Tchabanenko (2000) as *H. yunnanensis* Y. M. Jiang & J. C. Wei (synonym of *H. delavayi*; McCune 2012), before the distinctions between *H. delavayi* and the new species were understood. Although Rassadina (1971 and other papers) reported *H. delavayi* from the Russian Far East, the name was applied to various esorediate imperforate species, including what we now know as *H. arcuata* Tchabanenko & McCune and *H. sachalinensis* Tchabanenko & McCune.

The species most similar to *H. papilliformis* is the true *H. delavayi* from south-west China. *Hypogymnia papilliformis* is predominantly isotomically branched while *H. delavayi* usually develops subpinnate branching with numerous side lobes that are ± perpendicular to the main lobes. The ceiling of the lobe cavity is mid brown to dark brown in *H. papilliformis*, while the ceiling is often pale brownish or white in *H. delavayi*. Also, *H. papilliformis* lacks 3-hydroxyphysodic acid, and thus has a K– medulla, while *H. delavayi* always contains 3-hydroxyphysodic acid as a major substance and is thus K+ slowly reddish brown.

Hypogymnia sachalinensis is perhaps the species in the Russian Far East most likely to be confused with *H. papilliformis*. They are, however, readily distinguished by the narrower (mostly 0·5–1·5 mm broad), relatively smooth lobes of *H. sachalinensis*, in contrast to the broader (mostly 2–4 mm broad), verrucose or papillose lobes of *H. papilliformis*. Furthermore, *H. sachalinensis* always lacks 2'-*O*-methylphysodic acid, while all specimens of *H. papilliformis* tested so far contain this substance.

The phylogenetic affinities of *H. papilliformis* are obscure, although we presume a close relationship with *H. delavayi* on morphological grounds. Unfortunately, we lack specimens collected recently enough to be useful in DNA sequencing, based on our

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current poor results with specimens even a few years old. Both species share a tendency to open branching, a verrucose or less commonly rugose upper surface, perforations in the lobe tips and axils, and ascospores broadly overlapping in size and shape. Spermatia are also essentially the same size and shape in the two species. No species similar to *H. papilliformis* are known from other continents.

Rassadina (1971) included 20 species of *Hypogymnia* in the Russian Far East, seven of which lack soredia and corticate granules. Most of our species concepts have been refined since then, so we offer below a key to the esorediate species in the Russian Far East. We defer a treatment of the sorediate species because certain problematic species (especially *H. pseudophysodes*, *H. bullata*, and *H. submundata*) require further study.

Key to esorediate species of *Hypogymnia* in Far East Russia

1 True isidia present; medulla P+ orange-red (containing physodalic and protocetraric acids) or P−; lobes contiguous to imbricate; thallus appressed; lobe margins often fimbriate; on bark, wood, and most frequently mossy rock. China, Russia, Japan . . . . . **H. duplicatoides** (Oxner) Rassad. [=*H. subcrustacea* (Flot.) Kurok. *sensu* Asahina. The P− chemotype of *H. duplicatoides* is the rare species, *H. hokkaidensis* Kurok.; otherwise, *H. duplicatoides* is P+ orange-red.]

Thallus lacking isidia, but upper surface sometimes verrucose or papillose; medulla P− (lacking physodalic and protocetraric acids); lobes various 2

2(1) Lobes suberect to drooping, arcuate-tipped; branching mainly isotomic dichotomous. 3

Lobes appressed to drooping, not arcuate-tipped; branching various 4

3(2) Lower surface heavily perforate with large holes, the holes occupying more area than the intact lower surface and fusing to form a continuous gap; lobes slender, arcuate, mostly 0·6–1·2 mm broad; thallus with accessory 2'-*O*-methylphysodic acid but lacking 3-hydroxyphysodic acid. Russia, Japan . . . . . **H. fragillima** (Hillmann) Rassad.

Lower surface heavily to moderately perforate; lobes similar to *H. fragillima* but tending to be slightly shorter and broader; thallus containing 2'-*O*-methylphysodic and 3-hydroxyphysodic acids. Primorsky, Russia, China . . . . . **H. arcuata** Tchabanenko & McCune

4(2) Lobes isotomic dichotomous branched, forming a lattice with polygonal spaces, appressed to somewhat imbricate; lobes slender, 0·5–1·2 mm broad; thallus usually <3 cm broad; medullary cavity white to light brown above, dark below; thallus containing 3-hydroxyphysodic acid. Russia, China, Japan. . . . . **H. nikkoensis** (Zahlbr.) Rassad.

Lobes variously branched but not forming an appressed lattice, or thallus lobes too short and contiguous to evaluate branching; lobes narrow or broad; thallus often >3 cm broad; medullary cavity dark, light-coloured only near the lobe tips; thallus lacking 3-hydroxyphysodic acid 5

5(4) Upper surface becoming verrucose to warty papillate; lobes mostly 2–4(–5) mm broad; thallus containing 2'-*O*-methylphysodic acid. China, Russia. . . . . **H. papilliformis** McCune *et al.*

Upper surface smooth to weakly rugose; lobes 0·5–1·5(–2·5) mm broad; thallus lacking 2'-*O*-methylphysodic acid. Russia, Japan. . . . . **H. sachalinensis** Tchabanenko & McCune

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