

Sporodophoron primorskiense (Arthoniaceae, lichenized Ascomycota) New to Japan, as the Second Locality in the World

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Sporodophoron primorskiense is reported as new to Japan, as the second locality in the world. This species was previously only known from Primorsky territory in Russia. In Japan it was found on bark of *Fagus crenata* at ca. 1000 m elev. in an old-growth forest in Toyama Prefecture. This locality is situated at the Japanese side of the Sea of Japan opposite from Primorsky territory. The Japanese specimen agrees well with the type of *S. primorskiense* in terms of morphology and chemistry. Sequence data of mtSSU support conspecificity with the type. A key to Japanese *Arthoniaceae* with sporodochia or elevated, white pruinose pycnidia is also provided.

Key words: Conidia, distribution, mtSSU, pycnidia, sorediate crust, sporodochia.

The genus *Sporodophoron* Frisch, Y. Ohmura, Ertz & G. Thor (*Arthoniaceae*, lichenized *Ascomycota*) in the vegetative state is characterized by the crustose thallus with sporodochia which are whitish, convex, discrete or confluent in the thallus centre, sporodochial conidia formed in zigzag shaped and occasionally branched chains, and its distinctive thallus chemistry including 2'-*O*-methylperlatolic acid, the lepraric high unknown, and/or supposedly related trace compounds (Frisch et al. 2015). Four species are known in the genus: *S. americanum* (Lendemer, E. Trippe & R. C. Harris) Ertz & Frisch, *S. cretaceum* (Hue) Ertz & Frisch, *S. gossypinum* Frisch, Y. Ohmura & G. Thor, and *S. primorskiense* Frisch & Y. Ohmura. Among the species, *S. primorskiense* was only known from the type specimen and the



Fig. 1. Known distribution of *Sporodophoron primorskiense*. Type locality (●) and the locality of the Japanese collection in Toyama Prefecture (★) are shown.

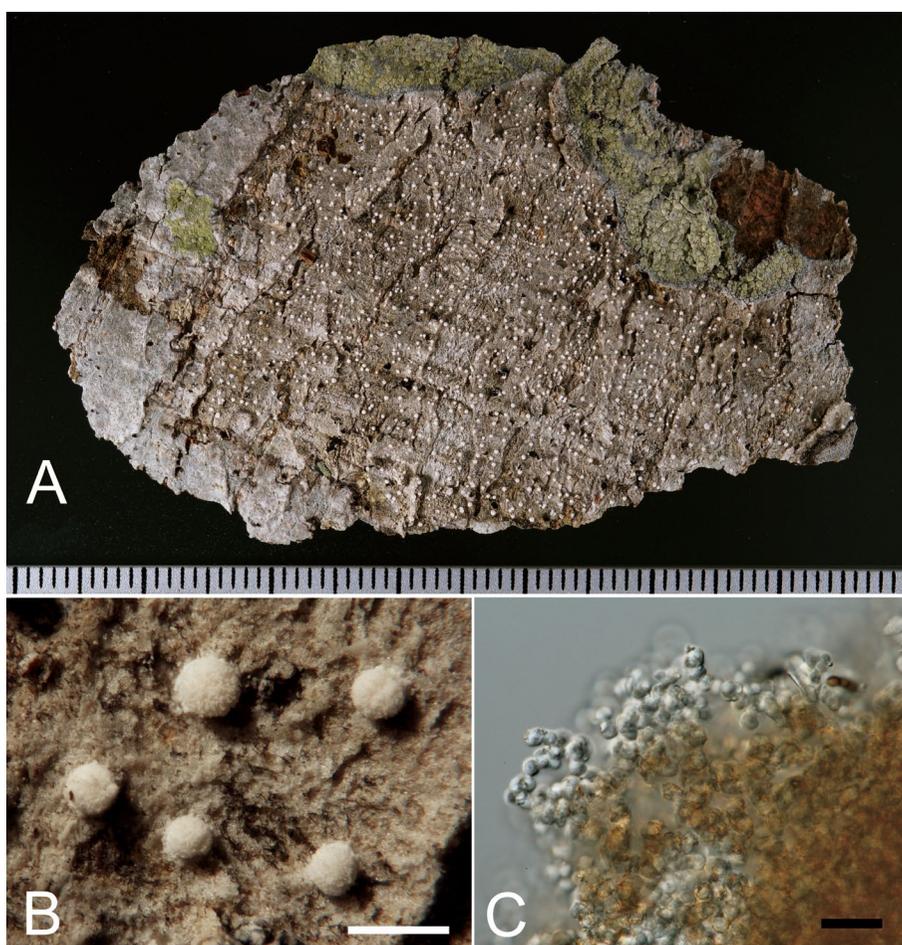


Fig. 2. *Sporodophoron primorskiense* collected from Toyama, Japan (Y. Ohmura 10607, TNS). A. Crustose thallus on bark of *Fagus crenata*. B. Sporodochia. C. Sporodochial conidia. Scales: 1 mm intervals (A), 0.5 mm (B) and 200 μm (C).

species delimitation and range of morphological variation was poorly understood. As part of our studies of Japanese lichens, *S. primorskiense* was collected in Toyama Prefecture, which is located opposite Primorsky territory at the Japanese side of the Sea of Japan (Fig. 1).

The purpose of this study is to provide new data on the variability of *S. primorskiense* in terms of morphology, chemistry, and genetic data. A key to Japanese *Arthoniaceae* with sporodochia or elevated, white pruinose pycnidia is also provided.

Material and Methods

A field survey was carried out in 2015. The voucher specimen is housed at the National Museum of Nature and Science (TNS), Tsukuba, Japan.

Morphological observations of lichen specimens were made using a dissecting microscope (Olympus SZX16) and a differential interference contrast microscope (Olympus BX51). Anatomical examination was undertaken using hand-cut sections mounted in GAW (glycerin : ethanol : water, 1:1:1).

Lichen substances were examined using thin

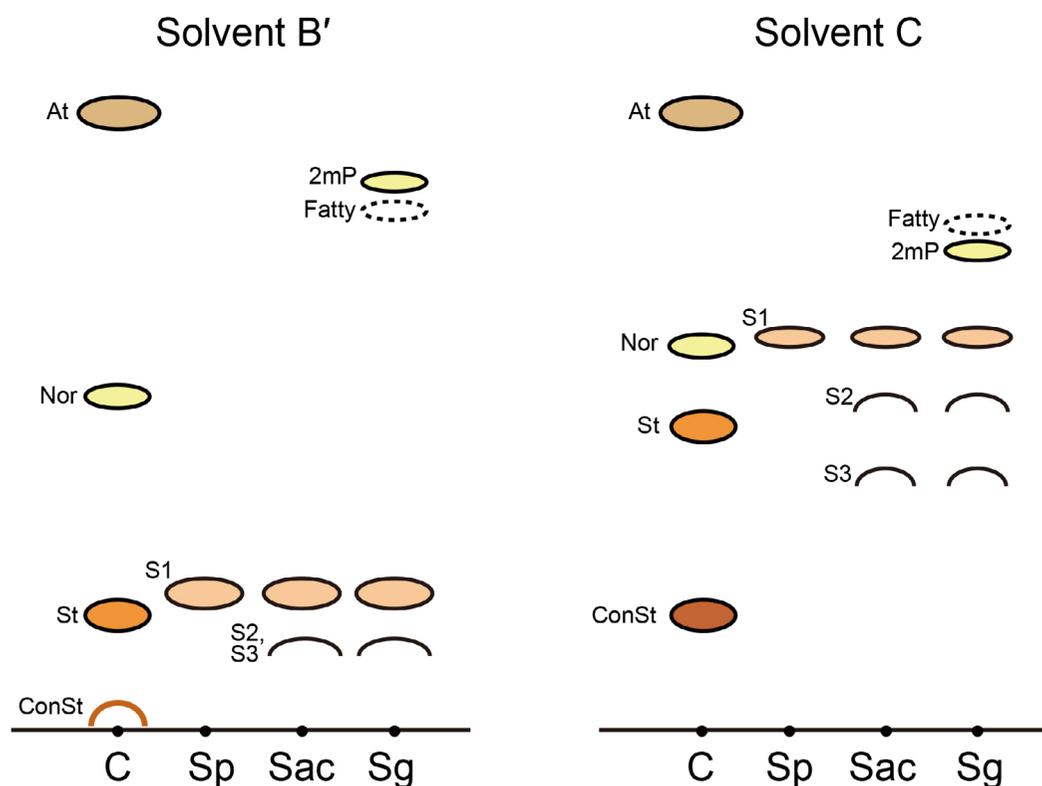


Fig. 3. Diagnostic TLC spots of lichen substances detected in the genus *Sporodophoron* in Solvent B' and Solvent C. Control (C) using *Stereocaulon japonicum* contains atranorin (At) for Rf class 7, norstictic acid (Nor) for Rf class 4, stictic acid (St) for Rf class 2, and constictic acid (ConSt) for Rf class 1. Sp = *S. primorskiense*; Sac = *S. americanum* and *S. cretaceum*; Sg = *S. gossypinum*; S1 = lepraric high unknown; S2 & S3 = unknown trace compounds; 2mP = 2'-O-methylperlatolic acid; Fatty = unidentified fatty acid.

layer chromatography (TLC) with solvent B' (hexane : methyl tert-butyl ether : formic acid, 140:72:18) and solvent C (toluene : acetic acid = 170:30) (Culberson and Kristinsson 1970, Culberson and Johnson 1982).

DNA extraction, PCR, sequencing and alignment followed Frisch et al. (2015).

Results and Discussion

Sporodophoron primorskiense Frisch & Y. Ohmura in *Lichenologist* 47: 251 (2015).

Type: RUSSIA. Primorsky Kray, Chandolaz, ca. 13 km W of Novitskoye, 43°03'02"N, 133°01'04"E, on bark of broadleaf deciduous tree, 220 m, 20 September 2013, Y. Ohmura 10509 (TNS!–holotype). [Fig. 2]

Morphological and chemical characters of the Japanese material (Fig. 2) agree with the type specimen except for the slightly taller sporodochia (up to 0.25 mm tall vs. 0.20 mm tall in the type) and wider conidia (4.5–6.0 μm wide vs. 3.0–4.5 μm wide). The width of the sporodochial conidia in the Japanese material of *S. primorskiense* is somewhat overlapping with the range known from *S. americanum* (4.0–9.0 μm wide) distributed in eastern North America. The latter species, however, can be distinguished by its pattern of unknown trace compounds below the lepraric high unknown (Fig. 3). Gross morphology of *S. primorskiense* resembles *S. gossypinum* which also occurs in Japan. However, *S. primorskiense* is a corticolous

species and lacks 2'-*O*-methylperlatolic acid in the thallus while *S. gossypinum* is a saxicolous species and contains 2'-*O*-methylperlatolic acid. The mitochondrial small subunit rDNA (mtSSU) sequences also support the conspecificity between the Japanese material (GenBank accession no. LC086299) and the holotype of *S. primorskiense* (GenBank accession no. KP870157). The mtSSU is rather conserved within *Sporodophoron*, and only five and eight nucleotides are exchanged in *S. primorskiense* compared to *S. gossypinum* and *S. cretaceum*, respectively. We tried to amplify and sequence other gene regions (i.e., ITS rDNA, RPB2 and nrLSU), but they could not be obtained in this study.

The Japanese material was collected on bark of *Fagus crenata* at ca. 1000 m elev. in a mixed old-growth forest with broad-leaved deciduous trees (e.g., *Acer* spp., *Aesculus turbinata*, *Fagus crenata*, *Quercus crispula*, and *Magnolia obovata*) and coniferous trees (e.g., *Cryptomeria japonica* and *Tsuga diversifolia*). In contrast, the vegetation of the type locality (220 m elev.) was dominated by broad-leaved deciduous trees (e.g., *Betula* and *Quercus*) with scattered coniferous trees (e.g., *Abies* and *Picea*). Thus, *Sporodophoron primoskiense* has been found in deciduous broad-leaved tree dominated forest mixed with coniferous trees in the temperate region of eastern Asia, where this species is reported as new to Japan and the second locality in the world. Further careful search in this habitat is expected to expand its distribution.

Specimen examined: **JAPAN**. Honshu: Prov. Etchu (Pref. Toyama): Bijyodaira, Tateyama-machi, Nakaniikawagun (N36°34'52", E137°27'39"), on bark of *Fagus crenata*, ca. 1000 m elev., 4 June 2015, Y. Ohmura 10607 (TNS).

A key to Japanese *Arthoniaceae* with sporodochia or elevated, white pruinose pycnidia

1. Sporodochia present; elevated white pruinose pycnidia absent 2
1. Sporodochia absent; elevated white pruinose pycnidia present 3
2. Saxicolous (semi-shaded sheltered rock faces); 2'-*O*-methylperlatolic acid present in thallus (but sometimes faint trace)
..... *Sporodophoron gossypinum*
2. Corticolous; 2'-*O*-methylperlatolic acid absent in thallus *Sporodophoron primorskiense*
3. Thallus and pycnidia K-; lepranic acid absent...
..... *Inoderma byssaceum* (Weigel) Gray
3. Thallus and pycnidia K+ yellow; lepranic acid present *Inoderma nipponicum*
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大村嘉人^a, A. Frisch^b: 世界二番目の産地としての日本
新産のビジョノコナユキゴケ(ホシゴケ科, 地衣化子嚢菌)

地衣類ホシゴケ科の *Sporodophoron* コナユキゴケ属(新称)に所属する *S. primorskiense* ビジョノコナユキゴケ(新称)が日本で初めて富山県美女平のブナ樹皮上で発見された。本種はロシア・プリモルスキー地方から採集されたタイプ標本1点のみが知られていただけであり、本報告は世界で二番目の産地である。それらの標本に基づく本種の特徴は以下の通りである。地衣体は樹皮に固着し、白色で突出し独立した分生子座 sporodochia (幅 0.25–0.50 mm × 高さ 0.25 mm まで)を有する。その分生子 (= 粉子) は 0–2 個の横隔壁があり、幅 3.0–6.0 μm, 各分生子がややジグザグ状に連なる。地衣成分として未同定物質 (lepranic high unknown) を含む。タイプ標本との同一性は mtSSU 塩基配列が一致す

ることからも確かめられた。本種に関連する分生子座または粉霜で被われる粉子器を有するホシゴケ科の日本産種として *Sporodophoron gossypinum* コナユキゴケ(新称) (岩上生, 地衣体に 2'-O-メチルペルラトリン酸を含む), 分生子座を欠き粉霜に被われた粉子器を有する *Inoderma* コナユキゴケモドキ属(新称)の *Inoderma byssaceum* コナユキゴケモドキ(新称) (地衣体および粉子器は K-, レプラル酸を欠く) および *Inoderma nipponicum* ヤマトコナユキゴケモドキ(新称) (地衣体および粉子器は K+ レモン色, レプラル酸を含む) があり, それらの検索表も併せて示した。

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