

Bryoscyphus hyalotectus (Helotiales), a new polytrichicolous ascomycete from North America

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Bryoscyphus hyalotectus (Helotiales, Ascomycota) is presented as a new species based on a single collection from Canada. It infects the moss *Polytrichum juniperinum*. Apothecia occupy a special microniche of the host plant. They develop between the leaf lamellae where the inflexed leaf margins meet. The parasite is distinguished by intracellular haustoria that arise directly from superficial hyphae without intervention of appressoria.

Key words: Bryophilous fungi, Canada, muscicolous, *Polytrichum juniperinum*

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Introduction

More than 70 parasitic fruit-body forming ascomycetes grow obligately on mosses of the family Polytrichaceae (Polytrichales). *Polytrichum* and related genera comprise a well defined group of approximately 200 species (Bell & Hyvönen 2010). The high number of parasites recorded may be partly explained by the frequency and wide geographical distribution of several host species and their structural complexity not found elsewhere in bryophytes which offers a considerable diversity of microniches for fungal colonization. In the following we describe a new discomycete on a common and widespread *Polytrichum* species from Northern North America, which indicates its intimate relation to the host plant by forming haustoria within leaf cells. The species belongs to the few parasitic ascomycetes recorded so far on bryophytes in North America.

Material and methods

The dried herbarium material was thoroughly wetted and investigated by standard methods. Measurements and drawings were made in lactophenol cotton-blue (CB), if not otherwise stated. Congo red (CR) was used in some cases. For iodine reactions asci were treated with Lugol's solution (LUG).

Bryoscyphus hyalotectus Huhtinen, W.R.Buck & Döbbeler, **sp. nova** – Fig. 1a–j

Mycobank no.: MB 823759

Diagnosis: Apothecia up to 220 µm in diam, pale brownish, glabrous; outer excipulum with *textura prismatica*, inner excipulum with *textura porrecta–textura oblita*; paraphyses filamentous; asci (sub)claviform, up to 71 × 10 µm, apical ring bluish in iodine; ascospores ellipsoidal, almost symmetrical, with 2 oil bodies, colourless,

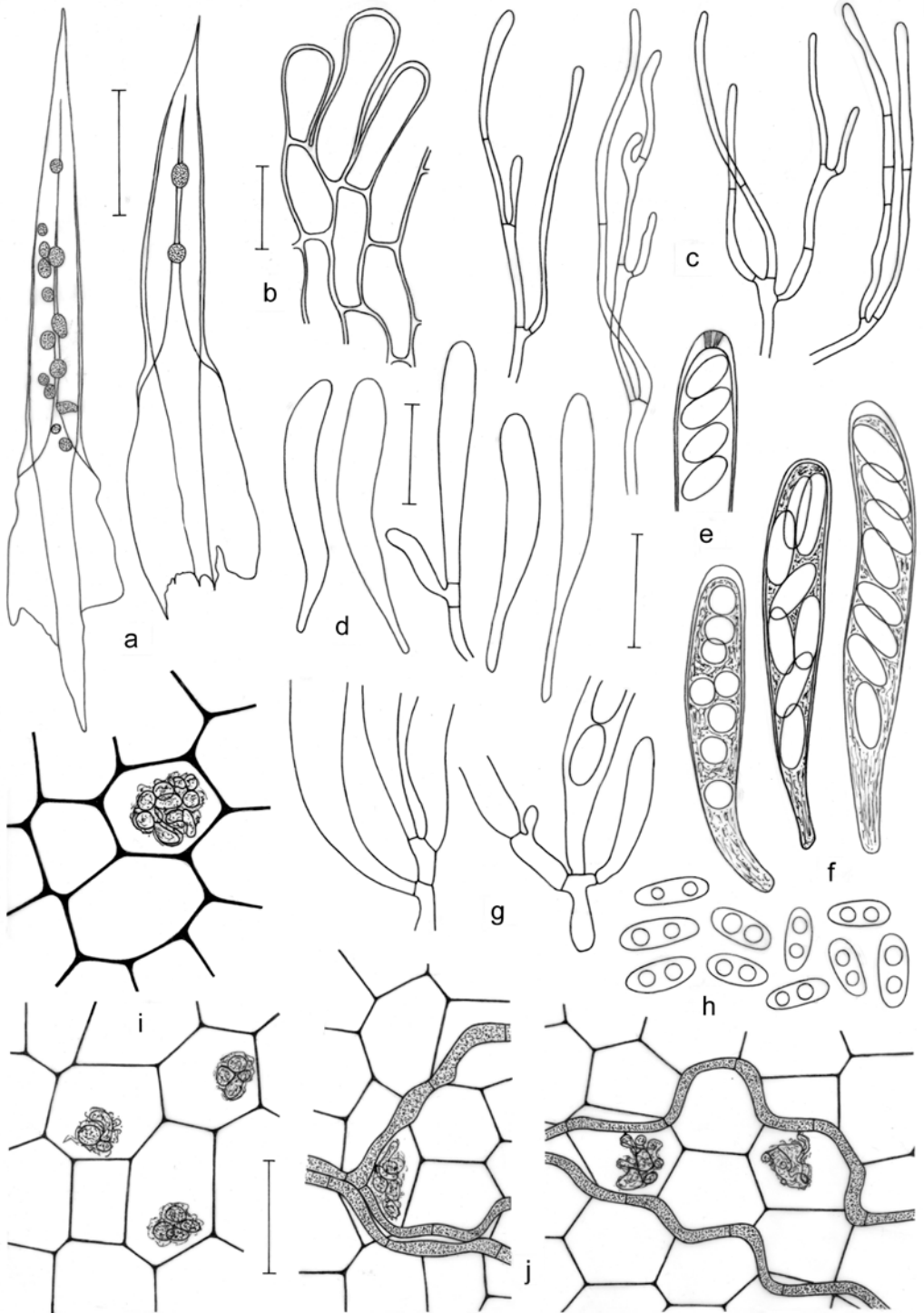


Fig. 1. *Bryoscyphus hyalotectus*. a) leaves of *Polytrichum juniperinum* with apothecia (adaxial view), b) apical border of outer excipulum in CR, c) paraphyses, d) asci in outline, e) ascus apex in iodine, f) mature asci, the left one with ascospores seen in an unusual position, g) basal parts of asci arising from ascogenous hyphae, h) ascospores, i) haustoria within leaf cells of lamellae in optical section, j) superficial hyphae with intracellular haustoria. – a scale = 1 mm, b scale = 10 μ m, c, e–h scale = 15 μ m, d scale = 20 μ m, i–j scale = 15 μ m.

8–10.5 × 4–4.5 μm; hyphae superficial, forming intracellular haustoria; parasitic on *Polytrichum juniperinum*.

Typus: CANADA. New Brunswick. Charlotte County, Campobello Island, Roosevelt Campobello International Park, Liberty Point, trail to Lower Duck Pond, 44°49'55"N, 66°55'45"W, ca. 40 m alt., coastal spruce forest, 24.IX.2016 Buck 64009 (NY–holotype, TUR–isotype).

Etymology: *Hyalos* (gr.) = glass, *tectus* (lat.) = covered; refers to the protected apothecia developing between the leaf lamellae and the transparent, inflexed leaf margins covering them.

Apothecia emerging from the interspaces between the longitudinal leaf lamellae of *Polytrichum juniperinum*, sometimes laterally compressed, shortly stipitate, almost colourless to light brown, glabrous, about 170 μm high, disc 70–220 μm in diam. *Excipulum* with *textura prismatica* in the outermost part, cells ca. 11–16 × 6–7 μm, thick-walled, marginal cells rounded, inner part with *textura porrecta* – *textura oblita*, hyphae ca. 2.5 μm wide. *Paraphyses* filamentous, septate, with few ramifications, end cells not or slightly claviform, 1–2(–2.5) μm thick. *Asci* unitunicate, cylindrical to slightly claviform, with an attenuated spore-free foot, 47–71 × 7.5–10 μm, 8-spored, arising from simple septa; in iodine (LUG) apically with a dirty bluish, often indistinct ring, after pretreatment with KOH ring not or somewhat more distinct. *Ascospores* ellipsoidal, almost symmetrical, colourless, with 2 large oil bodies, (7.5–)8–10.5(–11.5) × (3.5–)4–4.5(–5) μm, in CR 8–10.2 × 3.6–5.0 μm, mean 9.2 × 3.9 μm, Q = 2.1–2.6, mean Q = 2.4; epispore smooth, obliquely uniseriate or irregularly biseriate within the asci. *Hyphae* on the surfaces of the leaf lamellae, with ramifications and anastomoses, thick-walled, colourless, (1–)2–3(–4) μm in diam, preferring the anticlinal cell walls, intrahyphal hyphae present, surface of thicker hyphae cyanophilous. *Haustoria* individually within single host cells, consisting of intracellular, thin-walled, coiled and agglomerated hyphae, 5–15(–20) μm in diam, arising directly (without formation of morphologically recognizable appressoria) from the superficial hyphae and perforating the periclinal cell wall, insertion point hard to see, infected cell only partly filled by the haustorium.

Apothecia develop in the upper part of a shoot below the apical region. Leaves bearing fruit-bodies are usually somewhat yellowish or light brownish discoloured. Unaltered, green leaves may be found between them. Apparently, fungal infection does not cause the death of the whole plant. Fruit-bodies are even under favourable conditions hard to detect in the field. Known only from the type collection.

Discussion

The almost cosmopolitan *Polytrichum juniperinum* has a leaf anatomy that enables colonization of areas of low humidity. The greatly broadened transparent leaf margins are infolded and cover the adaxial photosynthetic leaf lamellae forming a miniature "greenhouse" (Smith 1971). Ascomycetes developing on or between the lamellae concentrate in the proximal unprotected part of the leaf and in the central linear region where both margins meet (microniche 4.4.3, Döbbeler 2002). Only these positions allow unhindered ascospore liberation into the open air. Apothecia not emerging in the appropriate leaf part bend to the small gap and tend to lift the leaf margin exposing their disc.

There are several discomycetes known to infect *Polytrichum juniperinum*. Three helotialean species occur on leaves. The necrotrophic *Fuscolachnum necator* Huhtinen & Döbbeler (Huhtinen et al. 2010) has apothecia that arise in the same manner as described for *Bryoscyphus hyalotectus*. The southern hemispheric *Potridiscus polymorphus* Döbbeler & Triebel with brown ascospores also occupies this microniche but occurs as well on unrelated Polytrichaceae with free-lying lamellae (Döbbeler & Triebel 2000). *Durella polytrichina* (P. Karst. & Starbäck) Racov. develops apothecia only within the antheridial cups of male plants of *Polytrichum commune*, *P. formosum*, and *P. juniperinum* (Racovitza 1940, 1946, Döbbeler 1978: 307). Apart from Helotiales, at least one species of bryophilous Pezizales, *Neottiella rutilans* (Fr.) Dennis, is obligately associated with *P. juniperinum* and further polytrichaceous hosts (Döbbeler 1980, Benkert 1995, 2009). The apothecia occur on soil among plants. However, living subterranean rhizoids or rhizome-like structures of the host are attacked by elaborate infection structures typical for octosporaceous fungi.

Bryoscyphus hyalotectus is clearly different from the mentioned discomycetes on *Polytrichum juniperinum* and other polytrichalean hosts by its diagnostic features. It also differs clearly from the seven known species of *Bryoscyphus* Spooner

Bryoscyphus was erected to accommodate four European species formerly assigned to *Helotium* and related genera (Spooner 1984). Meanwhile two additional bryophilous species have been added (Gamundí & Spinedi 1988, Verkley et al. 1997). Ecologically these fungi share parasitism on thallose liverworts and mosses, respectively. The seventh species *B. lichenicola* Alstrup & M.S. Cole is a lichenicolous fungus on *Cladonia* without a true excipulum and with one-septate ascospores (Alstrup & Cole 1998). *Bryoscyphus hyalotectus* fits the generic concept of *Bryoscyphus* with its type *B. conocephali* (Boyd) Spooner having similar apothecia and asci, a comparable excipular structure and a bryoparasitic ecology. The paraphyses of *B. hyalotectus* are ramified and not simple as in the other species. The ascospores slightly differ being constantly one-celled, ellipsoidal and biguttulate instead of (sub)fusoid to almost rhomboidal and aguttulate – characters not interpreted here to separate species at the generic level. Information regarding mycelial features is only available for *B. aestivalis* Gamundí & Spinedi from the Antarctic Peninsula. Its hyphae grow inter- and intracellularly within stems and leaves of *Bryum dichotomum* Hedw. (Gamundí & Spinedi 1988).

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