

Astrocystis revisited

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Astrocystis species (*Xylariaceae*) listed in *Index Fungorum* are revisited. A new species (*A. guyanae*) and eight new combinations from *Rosellinia* (*A. ambigena*, *A. dimidiata*, *A. formosa* var. *formosa*, *A. formosa* var. *flavozonata*, *A. hemisphaerica*, *A. marginatoclypeata*, *A. muroiana*, and *A. subverruculosa*) are proposed, described, and illustrated. A dichotomous key to *Astrocystis* species is provided, their hosts and distribution are listed, and species concepts are discussed.

Keywords: key; monocotyledons; morphology; alpha taxonomy; *Xylariaceae*. – 1 new species, 8 new combinations.

Berkeley & Broome (1875) introduced the genus *Astrocystis* Berk. & Broome for a specimen collected on bamboo, *A. mirabilis* Berk. & Broome, with single perithecia erumpent from a stromatic volva that forms stellate lobes when pushed sideways during the growth of the perithecium. Diehl (1925) accurately observed, described, and illustrated the development of the perithecia, which may form subhypodermally, subcuticularly, or subepidermally in the sclerenchymatous cells of the host hypodermis, the position very likely depending on the host species. During perithecial growth the overlaying host tissue is ruptured and the thickened subapical stromatic material exfoliates, forming an asteroid basal structure with host tissue tightly attached (Diehl 1925). *Astrocystis mirabilis* evoked similarities with *Rosellinia* De Not. (Penzig & Saccardo 1904) or *Anthostomella* Sacc. Section *Astrocystis* (von Höhnel 1909); however, its unique development pattern sets *Astrocystis* apart (Diehl 1925); consequently, *R. geasteroides* Ellis & Everh. and *R. bambusae* Henn. were synonymized with *A. mirabilis* (Diehl 1925).

Hughes (1953) transferred *Rosellinia sublimbata* (Durieu & Mont.) Pass. to *Astrocystis*. Ju & Rogers (1990) examined several specimens labelled as *A. mirabilis* and concluded that *R. bambusae* Henn. and *A. mirabilis* are two distinct species, but considered them to be better accommodated in *Rosellinia*. Læssøe & Spooner (1994) outlined the generic concept for *Astrocystis*, which differs from *Rosellinia* mainly by its erumpent stromata with ectostroma splitting into lobes giving a coronate or stellate appearance or being gradually shed off, api-

cal plug, and anamorph morphology; from *Collodiscula* I. Hino & Katum. by unicellular ascospores (Hino & Katumoto 1955); from *Cyanopulvis* J. Fröhl. & K.D. Hyde by the absence of a blue powder on stroma surface, ascospore and apical plug morphology (Fröhlich & Hyde 2000); from *Guestia* G.J.D. Sm. & K.D. Hyde by stroma texture containing host cells, ascospore and apical plug morphology (Smith & Hyde 2001) (Tab. 1). Læssøe & Spooner (1994) accepted *A. mirabilis* Berk. & Broome as the type species and recognized *A. bambusae* (Henn.) Læssøe & Spooner, *A. hughesii* Læssøe & Spooner, *A. sasae* Læssøe & Spooner, *A. madeirensis* (Henn.) Læssøe & Spooner, *A. sublimbata*, *A. smilacicola* (Schwein.) Læssøe & Spooner, *A. cocoës* (Henn.) Læssøe & Spooner, and *A. palmarum* Læssøe & Spooner, also mentioning two not formally described *Astrocystis* species (A, B), whereas they discussed *Hypoxyylon kurzianum* Currey ex Sacc., *H. culmorum* Cooke, and *Rosellinia rachidis* Pat. as belonging to *Astrocystis*. These species are distinguished based on their splitting (*A. mirabilis* and *A. bambusae*) and non-splitting (*A. hughesii*, *A. sasae*, *A. madeirensis*, *A. sublimbata*, *A. smilacicola*, *A. cocoës*, and *A. palmarum*) stromata in addition to host and spore size (Læssøe & Spooner 1994). Dulymamode et al. (1998) described three new species from *Pandanus*. Subsequently, additional species collected on *Cyathea dealbata* (Petrini 2003), palms (Daranagama et al. 2015, Li et al. 2016, Pinnoi et al. 2010, Smith & Hyde 2001, Taylor & Hyde 2003, Wu et al. 2021), and *Poaceae* (Daranagama et al. 2015) were included in *Astrocystis* or transferred to it, as *A. rachidis* (Fröhlich & Hyde 2000). Some *Rosellinia* species (*R. am-*

Tab. 1. Essential differentiating characters between genera closely resembling *Astrocystis*.

Characters	<i>Astrocystis</i>	^a <i>Collodiscula</i>	^b <i>Cyanopulvis</i>	^c <i>Guestia</i>	^d <i>Rosellinia</i>
Subiculum	absent	absent	absent	absent	present, persistent or evanescent
Stromata	uni-, pauciperitheciate	uniperitheciate	uni-, pluriperitheciate	uni-, pauciperitheciate	uniperitheciate
Ectostroma	splitting forming lobes or shedding off and reduced to discoid base or remaining as plates	shedding off and reduced to discoid base	splitting, discoid base absent, blue powdered	not splitting, contains host material	not splitting, discoid base absent
Ascospores	unicellular	bi-cellular	unicellular	unicellular	unicellular
Ratio length : width	<4	<4	<4	>4	<4, >4
Germslit	straight	absent	straight	straight or curved	straight, oblique, spiral
Asexual form	developing within ectostromal perithecia	developing within ectostromal perithecia	unknown	unknown	developing in the subiculum
Conidiophores	in sporodochia	in sporodochia			singly, scattered
Substrate	monocotyledons, wide host range	Bamboo	Palm	Palm	monocotyledons, dicotyledons, conifers

^a Hino & Katumoto (1955); Samuels et al. (1987); ^b Fröhlich & Hyde (2000); ^c Smith & Hyde (2001); ^d Petrini (2013).

bigenis, *R. amblystoma*, *R. dimidiata*, *R. formosa*, *A. hemisphaerica*, *R. marginatoclypeata*, *R. muroiana*, *R. smilacina*, and *R. subverruculosa*) show features typical for *Astrocystis*, and Petrini (2013) suggested that these taxa should be transferred to this genus.

Anamorphic characters of cultivated *A. bambusae* and *A. mirabilis* are reminiscent of those of *Collodiscula japonica* I. Hino & Katumoto (Ju & Rogers 1990, Samuels et al. 1987), and, in fact, stromal characters of *C. japonica* are also similar to those of *Astrocystis* (Hino & Katumoto 1955).

Molecular data are available only for *A. bambusae* (Daranagama et al. 2015, Hsieh et al. 2010, Pinnoi et al. 2010), *A. mirabilis* (Daranagama et al. 2015, Hsieh et al. 2010, Pinnoi et al. 2010), *A. sublimbata* (Daranagama et al. 2015, Hsieh et al. 2010), *A. eleiodoxae* Pinnoi, E.B.G. Jones & K.D. Hyde (Pinnoi et al. 2010), *A. concavispora* Daranagama, Camporesi & K.D. Hyde (Daranagama et al. 2015), *A. bambusicola* R.H. Perera & K.D. Hyde (Hyde et al. 2017, 2020; Wu et al. 2021), and *A. thailandica* Daranagama & K.D. Hyde (Li et al. 2016).

Currently, Index Fungorum (www.indexfungorum.org) lists 22 valid names for *Astrocystis* (cut-off 30.11.2021). The present paper is concerned to review these species and to introduce one new spe-

cies and eight new combinations from *Rosellinia*. It is limited to alpha taxonomy (Turrill 1935) as mainly herbarium material was studied.

Material and methods

Observations of macro- and microscopic characters are based on material on the host and were performed as described in Petrini (2013). For macroscopic descriptions of species with exfoliated ectostroma the terms perithecial stroma and conidiomal resp. ectostromal material (initial stages) (Ju & Rogers 1990) are used. Perithecial stroma corresponds to entostroma as defined by Læssøe & Spooner (1994). The term stroma is used for species with ectostroma not exfoliated. Stromal width was measured at mid height, width at base including ectostromal ring is indicated as such. For stroma of conical shape, the diameter was measured at the base. Measurements and descriptions for species not examined were taken from the respective protologues. Host names were verified according to IPNI (2021).

Only descriptive statistics [number of items measured (n), mean, standard deviation, range] were computed for all measured items and in the descriptions presented as range (mean ± standard

deviation) for ascospores or only as range depending on the number of items, and as range for stromata. No confirmatory statistics were computed, given the often too small sample size of the measurements.

The scale bar on each figure plate except Fig. 3 applies to all figure parts.

Taxonomy

Generic description

Astrocystis Berk. & Broome, J. Linn. Soc. Bot. 14: 123 (1875), emend. (Læssøe & Spooner 1994).

For genus description see Læssøe & Spooner (1994). Stroma development for species with splitting stromata is explained elsewhere (Diehl 1925, Ju & Rogers 1990). Hino & Katumoto (1958) illustrated a non-splitting stroma.

Description. – Ectostromal (conidiomal) material forms as black tar spots beneath or within host cuticle. The perithecial stroma (entostroma) develops centrally pushing upwards the ectostroma. The ectostroma exfoliates remaining either attached to the cuticle, thus forming stellate lobes in splitting stromata; or sheds off gradually in non-splitting stromata, exposing the perithecial stroma almost completely, to persist only at the base as a thickening and a ring around the base, often covered by cuticle. Sometimes it exfoliates only at the top, and a large part of the perithecial stroma remains covered. Remnants of the ectostroma give an opaque, dusty appearance to the perithecial stroma.

Perithecial stromata are semiglobose, mammaeform, conical. Asci are cylindrical with a short, often persistent stipe. Ascus apical plugs are at upper rim with a pronounced, sometimes sharp bulge, or flared, staining blue in Melzer's reagent. Ascospores are unicellular, asymmetrically ellipsoidal, brown to dark brown, sometimes with slimy sheath and caps or remnants of a cellular appendage. Conidiophores are simple, branched, hyaline to light brown, with small denticles left by detached conidia, on the host formed in conidiomata, conidia unicellular, hyaline to light brown (Ju & Rogers 1990, 1994) reminiscent to that of *Collodiscula japonica* I. Hino & Katum. (Samuels et al. 1987).

Species descriptions

Astrocystis ambigens (Sacc.) L.E. Petrini, comb. nov. – Fig. 1a, b.

Index Fungorum Registration Identifier: IF 559850

Basionym (IF 199812). – *Rosellinia ambigens* Sacc., *Bulletino dell'orto Botanico della R. Università di Napoli* 6: 43 (1921) [1918].

Holotypus. – ASIA. SINGAPORE. Botanic Gardens, on *Daemonorops*, October 1917, leg. C.E. Baker no. 5395 (PAD).

Description. – Stromata 375–525 µm diam., 250–375 µm high (n=5), erumpent from cuticle as crusts, then raising, remaining covered by the host epidermis that splits and exposes perithecial stromata, semiglobose, dark brown, black, solitary or 2 confluent, several stromata with common stromal base, with integrated to umbilicate ostioles, splitting outer layer 50 µm thick, wall of perithecial stroma 75–100 µm thick. – Perithecia attached.

Saccardo (1926): Stromal series up to 15 mm long. – Ascospores 9–10 × 4.5–5 µm, ovate-oblong, coffee bean shaped, brown.

Host plant. – *Arecaceae*: *Daemonorops*.

Distribution. – ASIA. Singapore.

Material examined. – *Rosellinia ambigens* Sacc: holotype.

Stromal features justify transferring *R. ambigens* to *Astrocystis*, as suggested already by Læssøe & Spooner (1994). The type material contains only stromata; ascospores and asci could not be examined.

Astrocystis ambigens has wider ascospores than *A. nypae* and smaller ascospores than *A. rudis*, *A. rarissima*, *A. formosa* var. *formosa*, *A. formosa* var. *flavozonata*, and *A. fimbriata*. *Astrocystis ambigens* has larger ascospores than *A. cepiformis* and *A. hemisphaerica*.

Astrocystis bambusae (Henn.) Læssøe & Spooner, *Kew Bull.* 49(1): 13 (1994) [1993]. – Fig. 1c–p.

Basionym. – *Rosellinia bambusae* Henn., *Hedwigia* 47(5): 256 (1908).

Description. – Perithecial stromata 550–675 µm diam. at mid height, at base 650–750 µm, 325–450 µm high (n=25), mainly 1, sometimes 2–4-peritheciate, developing centrally from ectostromal tar-like spots on cuticle, conidial stroma up to 200 µm diam; during growth ectostroma exfoliates and forms ca. 50 µm thick triangular lobes at stroma base, which is covered by the host cuticle or remains attached as denticles; semiglobose to cylindrical with cambered top, dark brown, opaque, dusty, shiny at top, with finely papillate ostioles. – Stromal wall 25–50 µm thick, black. – Perithecia detached. – Ascus apical plugs 2–3 µm high, upper width 2–3 µm, lower width 1–2.5 µm (n=18), staining blue in Melzer's reagent, with pronounced bulge at upper rim. – Ascospores 10–16.5 × 4–6 µm (12.8±1.1 × 4.9±0.4 µm) (n=130), asymmetrically ellipsoidal with broadly rounded ends and one flat side, dark brown, with

slimy sheath around flat side and both ends, immature ascospores with one cellular appendage, on flat side with straight germ slit as long as spore.

Host plants: *Poaceae*: bamboo, dead culm; Ju & Rogers (1990): *Dendrocalamus latiflorus*, *Phyllostachys makinoi*, *Schizostachyum*; Læssøe & Spooner (1994): *Bambusa* sp., *Bambusa vulgaris*, *Oxytenanthera*.

Distribution. – AFRICA. Ghana (Læssøe & Spooner 1994). ASIA. China, Hainan prov. (Ju & Rogers 1990); India (Læssøe & Spooner 1994); Philippines; Taiwan; Thailand. SOUTH AMERICA. Guyana (Ju & Rogers 1990).

Material examined. – *Astrocystis bambusae* (Henn.) Læssøe & Spooner: ASIA. PHILIPPINE ISLANDS. Luzon, Prov. of Pampanga, Mt. Arayat, on twig, February 1906, leg. E. D. Merrill no. 5030 (K 79231, BPI, isotypes); Luzon, Prov. Bataun, Mt. Mariveles, in *culmis bambusaceae scandentis*, 3–19 November 1912, leg. P. W. Graff (HBG, W, Sydow Fungi exotici exsiccati no. 126). THAILAND. Kanchanaburi prov., on monocot., January 1982, leg. L. Manoch & A.J.S. Whalley (ZT Myc 0066882). – *Astrocystis sublimbata* (Durieu & Mont.) G.C. Hughes: TAIWAN. Miao-I County, Tai-an Township, Gin-suei Village, Teng-lung, on bamboo culm, 8 July 2005, leg. Y.-M. Ju & H.-M. Hsieh no. 94070805 (HAST 145815).

In specimen HAST 145815 stromata grow next to those of *A. muroiana* (Fig. 1g).

Astrocystis bambusae has stellately splitting stromata as *A. mirabilis*. Diehl (1925) considered them as conspecific, however, Ju & Rogers (1990) showed that they represent two distinct species differing in ascospore morphology, especially spore width, conidial, and cultural characters. *Astrocystis bambusae* differs from other species with a similar ascospore size by stromal characters.

Astrocystis bambusicola R.H. Perera & K.D. Hyde, in Hyde et al. Fungal Diversity 87: 173 (2017).

Description. – Hyde et al. (2017, 2020): Ascomata 200–730 µm diam., 130–200 µm high, 1–3-peritheciate; asci 85–120 × 5–10 µm. – Ascus apical plugs 3–4.5 µm high, 1.5–2.5 µm diam., with pronounced upper rim. – Ascospores 12–16 × 6–8 µm, with germ slit slightly less than whole spore length, without a gelatinous sheath.

Host plant. – Bamboo.

Distribution. – ASIA. China, Yunnan; Thailand (Hyde et al. 2017, 2020).

Astrocystis bambusicola resembles *A. sasae* for spore and stroma size. In *A. bambusicola* only the stroma base is surrounded by the ectostromal material and most of the perithecial material is exposed and contains 1–3 perithecia, whereas in *A. sasae* perithecial stromata are 1–8-peritheciate (Læssøe & Spooner 1994), and almost completely encased in

the ectostromal material with only the tops exposed. *Astrocystis bambusicola* has smaller stromata than other species with the ascospores 10–18 µm long (< 17 µm long in average) as shown in part in part C of the key.

By means of a phylogenetic analysis Wu et al. (2021) identified an *Astrocystis* collected in China, Guizhou Province, as *A. bambusicola*, as this strain formed a clade with the type strain of *A. bambusicola* and also with *A. sublimbata* (strain 89032207, HAST 145813 as *A. muroiana*) with a high statistical support (ML bootstrap support value 99 %, 0.99 BYPP). However, the asci and ascospores sizes given for the Guizhou specimen (119–132 × 8–11.5 µm for asci, 18–26 × 6.5–11 µm for ascospores) are larger than those reported for the other specimens (85–120 × 5–10 / 12–16 × 6–8 µm) (Hyde et al. 2017, 2020). The ascospore size reported for the Guizhou specimen is actually similar to that of *A. multiloculata*, but the stromata differ.

Astrocystis cepiformis Dulym., P.F. Cannon & Peerally, Mycol. Res. 102(11): 1328 (1998).

Description. – Dulymamode et al. (1998): Stromata 250–390 µm diam., 210–250 µm high. – Asci 52–68 × 4.5–6.5 µm, stipe 9.5–15 × 3.5–4 µm. – Ascus apical plugs 1 µm high, 2.5 µm diam., with flared upper rim. – Ascospores 6–8.5 × 3.5–4 µm, without a gelatinous sheath or caps, with straight germ slit as long as spore.

Host plant. – *Pandanaceae*: *Pandanus palustris*.

Distribution. – AFRICA. Mauritius (Dulymamode et al. 1998).

Astrocystis cepiformis has smaller stromata than *A. hemisphaerica* and smaller ascospores than the other seven taxa categorized on group D of the key.

Astrocystis concavisporea Daranag., Camporesi & K.D. Hyde, in Daranagama, Camporesi, Tian, Liu, Chamyuang, Stadler & Hyde, Fungal Diversity 73: 220 (2015).

Description. – Daranagama et al. (2015): Ascomata 320–350 × 300–350 µm. – Asci 80–135 × 5–7.5 µm. – Ascus apical plugs 5–7.8 µm high, 3–5.5 µm diam., with pronounced upper rim. – Ascospores 15–20 × 7–9 µm, reniform with inconspicuous gelatinous sheath and germ slit as long as spore.

Host plant. – *Poaceae* (Arundinoideae): *Arundo donax*.

Distribution. – EUROPE. Italy (Daranagama et al. 2015).

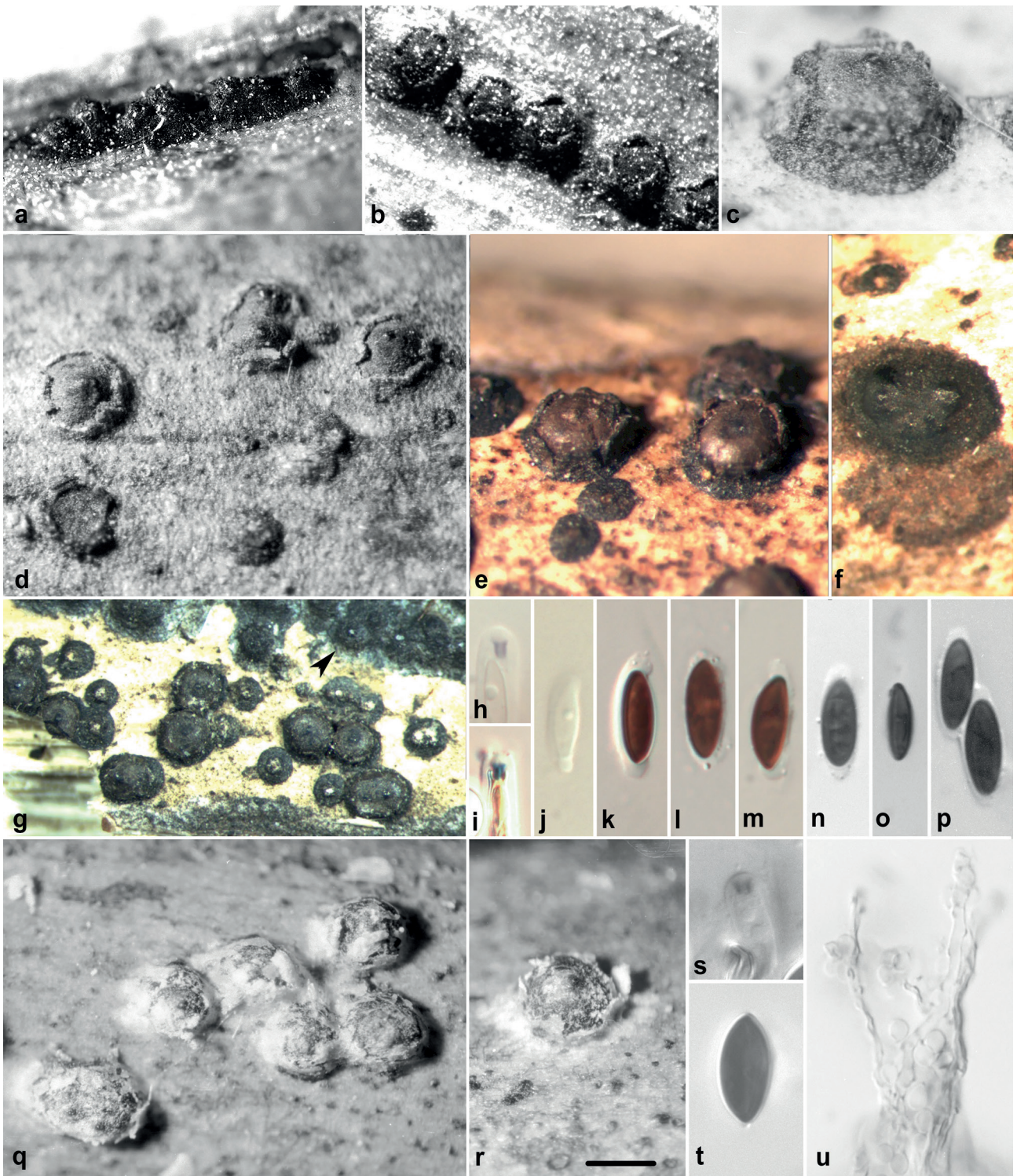


Fig. 1. *Astrocystis ambigens*; a, b. stromata. – *A. bambusae*. c–g. stromata; h, i. ascus apical plugs in Melzer's reagent; j. immature ascospore; k–p. ascospores. – *A. cyatheae*. q, r. stromata; s. ascus apical plug in Melzer's reagent; t. ascospore; u. conidiophores and conidia. (a, b. type, C.E. Baker no. 5395, PAD; c, m. P.W. Graff, Sydow Fungi exotici exsiccati no. 126, HBG; d, n. type, K 79231; e, f, i, k, l. ZT Myc 0066882; g, h, j. HAST: 145815; o. P.W. Graff, Sydow Fungi exotici exsiccati no. 126, W; p–s. holotype, PDD 49672; t. PDD: 42047). g. arrow points to stromata of *A. muroiana*. Scale bar: g = 1 mm; a, b, d, e, f, q, r = 500 μ m; c = 250 μ m; h–p, s–u = 10 μ m.

Astrocystis concavispora has smaller stromata than *A. sublimbata* and *A. subverruculosa*, both with similar spore sizes. Maximal ascospore lengths of the three species differ, being smallest in *A. sublimbata* and largest in *A. subverruculosa*. Ascospores of *A. concavispora* have a concave ventral side, absent in the other two species.

Astrocystis cyatheae L.E. Petrini, N.Z. J. Bot. 41(1): 77 (2003). – Fig. 1q–u.

Description. – Petrini (2003): Stromata 500–750 (657 ± 75) μm wide, 375–500 (438 ± 43) μm high, splitting host epidermis in a stellate manner, exposing the conidial state as white tufts, sometimes with host epidermis attached to its surface as white scales at an early stage. – Ascus apical plugs 2.4–2.8 μm high, upper width 2.8–4 μm , lower width 1.9–2.8 μm , with pronounced to flared upper rim. – Ascospores 13–17 (14.6 ± 0.8) μm long, 6.7–8.2 (7.5 ± 0.3) μm wide, inequilaterally ellipsoidal, dark brown, with straight germ slit, running over the whole spore length, some ascospores with a 1×1 μm large basal cellular appendage. – Conidiophores variable in length, 2.5–5 μm in width, hyaline to light brown at base, as white tufts on young stromata, arising from parenchymatous cell tissue. – Conidia $3\text{--}4 \times 3$ μm , globose, hyaline to light brown.

Host plant. – *Cyathea dealbata*, rachides.

Distribution. – OCEANIA. New Zealand, North Island, Auckland.

Astrocystis cyatheae differs from *A. smilacicola* by less wide and higher stromata, from *A. muroiana* by higher stromata, from *A. hughesii* by ascospores with a long germ slit, and from the remaining species in group C without splitting stromata by stroma size.

Astrocystis dimidiata (Starbäck) L.E. Petrini, **comb. nov.** – Figs. 2a–n, 3.

Index Fungorum Registration Identifier: IF 559851

Basionym (IF 223178). – *Rosellinia dimidiata* Starbäck, Bih. K. svenska VetenskAkad. Handl., Afd. 3 25(no. 1): 49 (1899)

Holotypus. – SOUTH AMERICA. BRAZIL. Rio Grande do Sul, Cascata de Hermenegilda prope Pelotas, ad *Smilacem*, 11 December 1892, leg. Gust. A.N. Malme (isotype, S, Ex Herb Brasil Regnell. Musei bot. Stockholm, no. 81).

Description. – Perithecial stromata 575–750 μm diam. at mid height, at base up to 825 μm , 450–550 μm high ($n=10$), semiglobose to conical, black, developing from ectostromal material below epidermis, with minutely papillate ostioles. – Stromal wall 50 μm , thick black. – Per-

ithecia detached. – Ascus apical plugs 4–6 μm high, upper width 4.5–6 μm , lower width 3–4 μm ($n=10$), staining blue in Melzer's reagent, sexangular in longitudinal section with pronounced square upper rim. – Ascospores 19.5–24 \times 8–11 μm ($21.8 \pm 1 \times 9.7 \pm 0.7$) ($n=60$), asymmetrically ellipsoidal with broadly rounded ends and one flat side, dark brown, with 2–4 \times 2–4 μm slimy caps at each end and thin sheath on flat side, some ascospores with a semiglobose cellular appendage, on flat side with straight germ slit as long as spore.

Host plants. – *Poaceae* (Bambusoideae): *Phyllostachys bambusoides*; *Smilacaceae*: *Smilax*.

Distribution. – SOUTH AMERICA. Brazil, Rio Grande do Sul. EUROPE. France, Pyrénées Atlantiques.

Material examined. – *Astrocystis dimidiata* (Starbäck) L.E. Petrini: EUROPE. FRANCE. Pyrénées Atlantiques, Sauveterre de Béarn, on *Phyllostachys bambusoides*, 20 March 1983, leg. F. Candoussau (ZT Myc 0066877). – *Rosellinia dimidiata* Starbäck: isotype.

A specimen collected in southern France, mentioned as *A. muroiana* in Petrini et al. (1989) had ascospore and stroma sizes matching those of the type material of *A. dimidiata* collected in Brazil. The range and average of the ascospore measurements ($19.5\text{--}24 \times 8\text{--}11$ μm / 21.8×9.7 μm) for *A. dimidiata* are larger than those for *A. subverruculosa* ($14\text{--}22 \times 6\text{--}11/18.3 \times 8.5$) and *A. sublimbata* ($14\text{--}22.5 \times 6\text{--}10/18 \times 8$ μm) allowing to keep these as separate species. *Astrocystis dimidiata* has also larger stromata than *A. subverruculosa*.

Astrocystis eleiodoxae Pinnoi, E.B.G. Jones & K.D. Hyde, in Pinnoi, Phongpaichit, Jeewon, Tang, Hyde & Jones, Mycosphere 1(1): 3 (2010).

Description. – Pinnoi et al. (2010): Stromata 825–1375 μm diam., 250–375 μm high, 1–3 peritheciate. – Ascii 107.5–155 \times 6.2–10 μm . – Ascus apical plugs 5×2.5 μm , wedge-shaped. – Ascospores 17.5–23 \times 4.5–6.2 μm , with a gelatinous sheath and germ slit nearly as long as spore.

Host plant. – *Arecaceae*: *Eleiodoxa conferta*, submerged petiole.

Distribution. – ASIA. Thailand (Pinnoi et al. 2010).

Astrocystis eleiodoxae has ascospores with length overlapping with that of *A. concavispora*, *A. dimidiata*, *A. multiloculata*, *A. sublimbata*, *A. subverruculosa*, and *A. thailandica*, but spore width is narrower than in these species. Stroma height and width distinguish *A. eleiodoxae* also from these species.

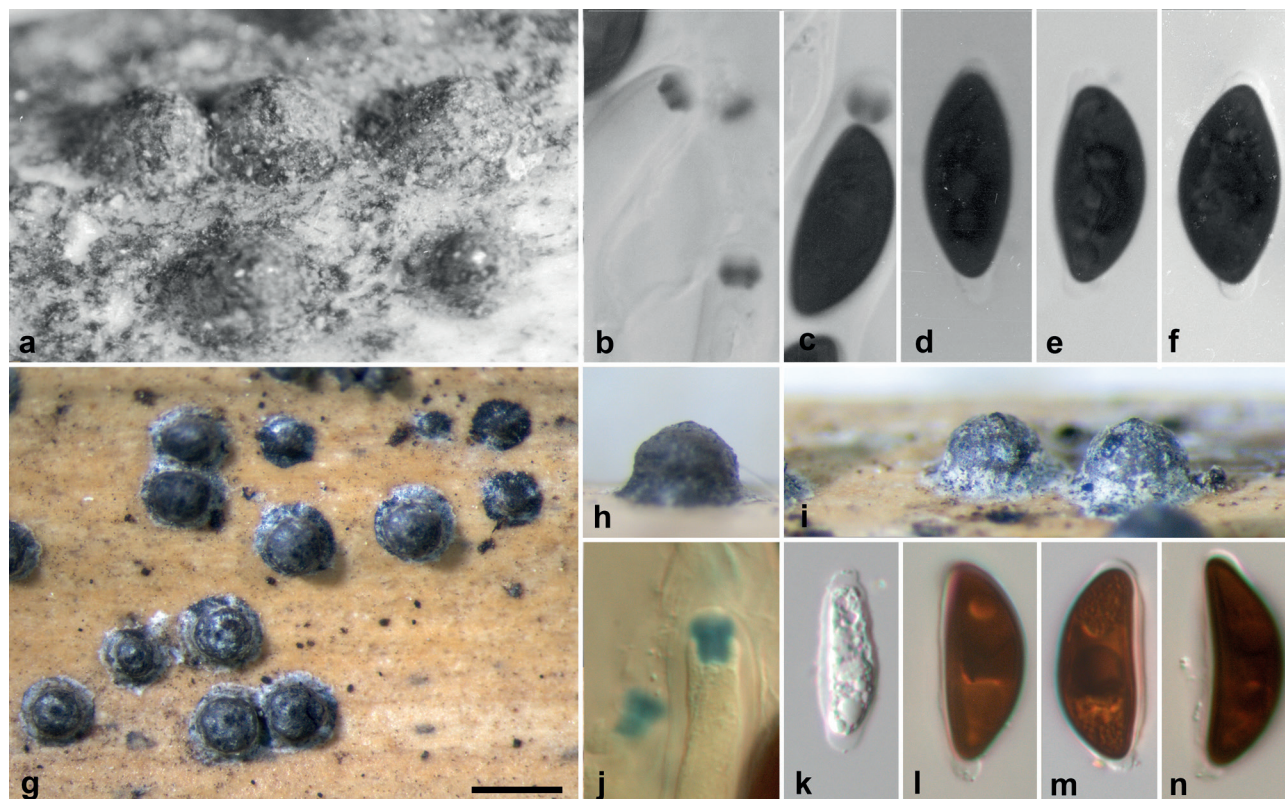


Fig. 2. *Astrocystis dimidiata*. **a, g, h, i.** stromata; **b, c, j.** ascus apical plugs in Melzer's reagent; **d-f, l-n.** ascospores with cellular appendage and slimy sheath; **k.** immature ascospore. (a-f. isotype, Gust. A.N. Malmé, S; g-n. ZT Myc 0066877). Scale bar: g = 1 mm; a, h, i = 500 μ m; b-f, j-n = 10 μ m.

Astrocystis fimbriata Dulym., P.F. Cannon & Peeraly, Mycol. Res. 102(11): 1326 (1998).

Description. – Dulymamode et al. (1998): Stromata 450–700 μ m diam., 300–600 μ m high. – Asci 72–130 \times 6–9 μ m. – Ascus apical plugs 1.5–2.5 μ m high, upper width 2.5 μ m, lower width 1.5 μ m, without pronounced upper rim. – Ascospores 8–12 \times 3.5–6 μ m, with germ slit as long as spore.

Host plant. – *Pandanaceae*: *Pandanus eydouxia* (Dulymamode et al. 1998).

Distribution. – AFRICA. Mauritius.

Astrocystis fimbriata has narrower ascospores and smaller minimum ascospore length than *A. rudis*, higher stromata than *A. ambigens*, *A. rarissima* and *A. formosa* var. *flavozonata*.

Astrocystis formosa (Penz. & Sacc.) L.E. Petrini var. ***formosa*, comb. nov.** – Fig. 4a–s.

Index Fungorum Registration Identifier: IF 559852

Basionym (IF 420652). *Rosellinia formosa* Penz. & Sacc. var. *formosa*, Malpighia 11(9–10): 393 (1897).

Holotypus. – INDONESIA. Java, Banten Province, Cibodas, on *Elettaria*, 01 February 1897, leg. O. Penzig (BO 3466).

Description. – Stromata 775–1125 μ m diam., 400–750 μ m high (n=14), breaking through cuticle, semiglobose to conical, triangular in vertical section, not exfoliating or only on top and exposing the apex of perithecial stroma, black, with finely papillate ostioles, uniperitheciate, singly, gregarious. – Stromal wall 50 μ m thick, black, brittle. – Perithecia detached. – Ascus apical plugs 0.5–2 μ m high, 1.5–2 μ m wide (n=8), staining blue in Melzer's reagent, with flared upper rim. – Ascospores 8–11.5 \times 3–5 μ m ($9.2 \pm 0.9 \times 3.8 \pm 0.5 \mu$ m) (n=68), asymmetrically ellipsoidal with broadly rounded ends, brown to light brown, with straight germ slit almost as long as spore, terminating shortly before spore end.

Host plant. – *Zingiberaceae*: *Elettaria*; bamboo, dead grass culms.

Distribution. – ASIA. Indonesia, Java; China, Yunnan; NORTH AMERICA. USA, Florida.

Material examined. – *Rosellinia bambusae* Henn.: NORTH AMERICA. FLORIDA. Coconut Grove, on dead grass

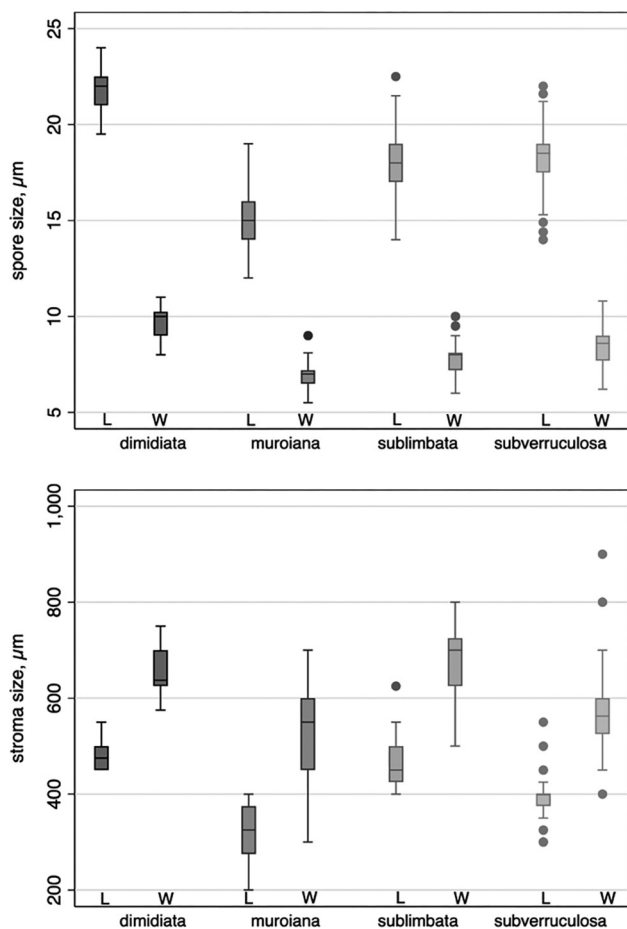


Fig. 3. Boxplots of spore and stroma size for *A. dimidiata*, *A. muroiana*, *A. sublimbata*, and *A. subverruculosa*. Middle line: median value; upper and lower lines of box: interquartile distance (represents 50% of the values; whiskers: minimum and maximum values measured); dots: outside values (outliers). L = length; W = width.

culms in pine wood, 1897–1898, *leg.* R. Thaxter (W, Farlow Herbarium). – *Rosellinia formosa* Penz. & Sacc.: holotype. – *Rosellinia rachidis* Pat.: ASIA. CHINA. Yunnan, Xishuangbanna District, Jinghong Co., Menglun, Xishuangbanna Tropical Bot. Garden, 580 m.a.s.l., on bamboo, 15 September 1987, *leg.* J.-Z. Yue & O.E. Eriksson no. 870915–5a (ZT Myc 52191).

Penzig & Saccardo (1904) indicate a smaller ascospore size (7–8.5 × 3.5–4.5 µm) than measured now in the type material. Læssøe & Spooner (1994) suggested that *Rosellinia formosa* might belong to *Astrocystis*. In fact, perithecial stromata are completely encased in ectostromal material, with only top exposed as in *A. marginatoclypeata*, *A. palmarum*, and *A. sasae*.

Astrocystis formosa var. *formosa* differs from *A. formosa* var. *flavozonata* by larger stromata and narrower ascospores. It differs from *A. rarissima* by ascospores with a germ slit almost as long as spore.

Two additional specimens resemble roughly *A. formosa* var. *formosa*. However, the Chinese specimen has ascospores often with a concave side and being lighter brown colored than in the other two specimens, whereas the Thaxter specimen has stromata with steeper slopes compared to the other material.

Astrocystis formosa* var. *flavozonata (Penz. & Sacc.) L.E. Petrini, **comb. nov.** – Fig. 4t–y.
Index Fungorum Registration Identifier: IF 559853

Basionym (IF 138626). – *Rosellinia formosa* var. *flavozonata* Penz. & Sacc., *Malpighia* 11(9–10): 393 (1897).

Holotypus. – ASIA. INDONESIA. Java, Banten Province, Cibodas, on culmis bambusae, 02 March 1897, *leg.* O. Penzig (BO).

Description. – Stromata 575–950 µm diam., 350–450 µm high (n=5), semiglobose to cupulate, black, gregarious, seated on a common stromal layer beneath epidermis, with base covered completely by epidermis, with finely papillate ostioles. – Stromal wall 25–50 µm thick, black. – Perithecia detached. – Ascus apical plugs 1 µm high, upper width 1.5–2 µm, lower width 1–1.5 µm (n=5), staining dark blue in Melzer’s reagent, with flared upper rim. – Ascospores 8.5–11 × 5–6 µm (9.6±0.7 × 5.7±0.4µm) (n=30), asymmetrically ellipsoidal with broadly rounded ends, brown, with straight germ slit as long as spore.

Host plant. – Bamboo, culms.

Distribution. – ASIA. Indonesia, Java.

Material examined. – *Rosellinia formosa* var. *flavozonata* Penz. & Sacc.: holotype.

According to stromal features, this species can be accommodated in *Astrocystis*. *Astrocystis formosa* var. *flavozonata* has wider ascospores than *A. formosa* var. *formosa* and *A. rarissima*, and stromata less high than those of *A. fimbriata* and *A. rudis*.

Astrocystis guyanae L.E. Petrini, **sp. nov.** – Fig. 5a–g.
Index Fungorum Registration Identifier: IF 559854

Diagnosis. – Ab *Astrocyste dimidiata* et *A. madeirensis* differt ascosporis crassioribus. Ab aliis speciebus *Astrocystis* differt ascosporis longissimis.

Holotypus. – SOUTH AMERICA. GUYANA. Mt. Wokomung, at base of exposed rockwall of main peak, 05° 05’ N, 59° 50’ W, elev. 1540–1570 m.a.s.l., on dead culm of bamboo, 11 July 1989, *leg.* G.J. Samuels & B.M. Boom no. 6556 (NY 04449001, Cryptogams of Guyana).

Description. – Perithecial stromata 575–700 µm diam. at mid height, at base 800–1000 µm, 400–500 µm high (n=5), developing from ectostromal spots beneath cuticle, emerging by cen-

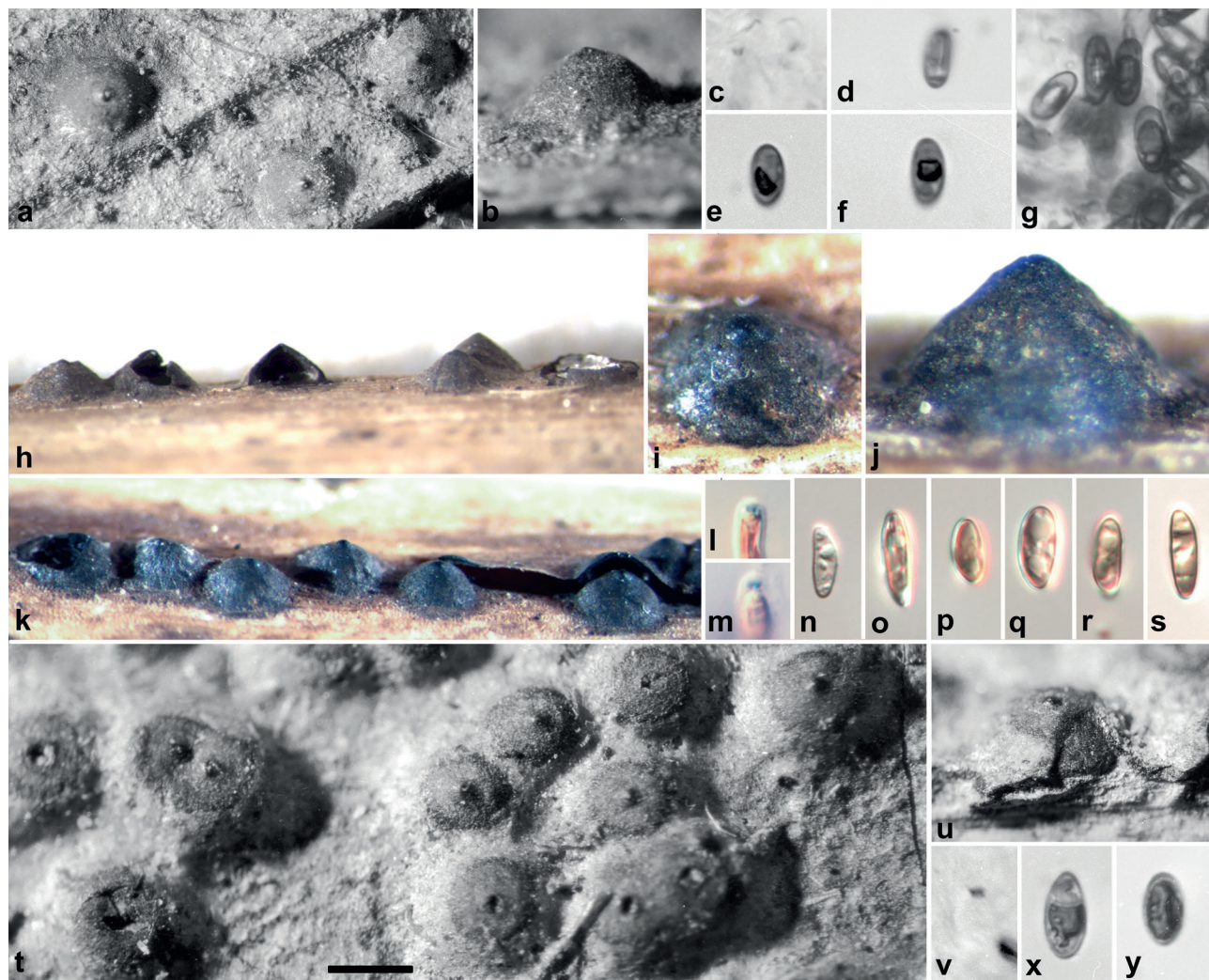


Fig. 4. *A. formosa* var. *formosa*. **a, b, h-k.** stromata; **c, l, m.** ascus apical plugs in Melzer's reagent; **d-g, n-s.** ascospores. – *A. formosa* var. *flavozonata*. **t, u.** stromata; **v.** ascus apical plug in Melzer's reagent; **x, y.** ascospores. (a–g. holotype, BO 3466; h–s. ZT Myc 52191; t–y. holotype, BO). Scale bar: a, h, k = 1 mm; b, i, t, u = 500 μ m; j = 250 μ m; c–g, l–s, v–y = 10 μ m.

trally pushing ectostromal material sideways, semi-globose to conical, black, surrounded by ectostromal margin, easily detachable from material. – Ostioles finely papillate to integrated – Stromal wall 50–75 μ m thick, black. – Ascus apical plugs 7–8 μ m high, upper width 6–7 μ m, lower width 3–4 μ m (n=5), staining blue in Melzer's reagent, with pronounced square upper rim. – Ascospores 23–28 \times 12–14 μ m (25.4 \pm 1.4 \times 13.3 \pm 0.6 μ m) (n=30), asymmetrically ellipsoidal with broadly rounded ends and one less curved side, dark brown, with one cellular appendage, with 2–4 \times 2–5 μ m slimy caps at each end and slimy sheath on flat side, on less curved side with germ slit as long as spore.

Etymology. – Species epithet refers to the country where the specimen was collected.

Host plant. – *Poaceae*: Bamboo, on ca 8 mm thick twig.

Distribution. – SOUTH AMERICA. Guyana, only known from the holotype.

Material examined: – *Astrocystis guyanae* L.E. Petrini: holotype.

Astrocystis guyanae differs from *A. dimidiata* and *A. madeirensis* by wider ascospores, from other *Astrocystis* species by bigger ascospores.

Astrocystis hemisphaerica (Sacc. & Paol.) L.E. Petrini, **comb. nov.** – Fig. 5h–j.

Index Fungorum Registration Identifier: IF 559861

Basionym (IF 217567). – *Rosellinia hemisphaerica* Sacc. & Paol., Atti Inst. Veneto Sci. lett., ed Arti, Sér. 6, 6: 387–428 (1888).

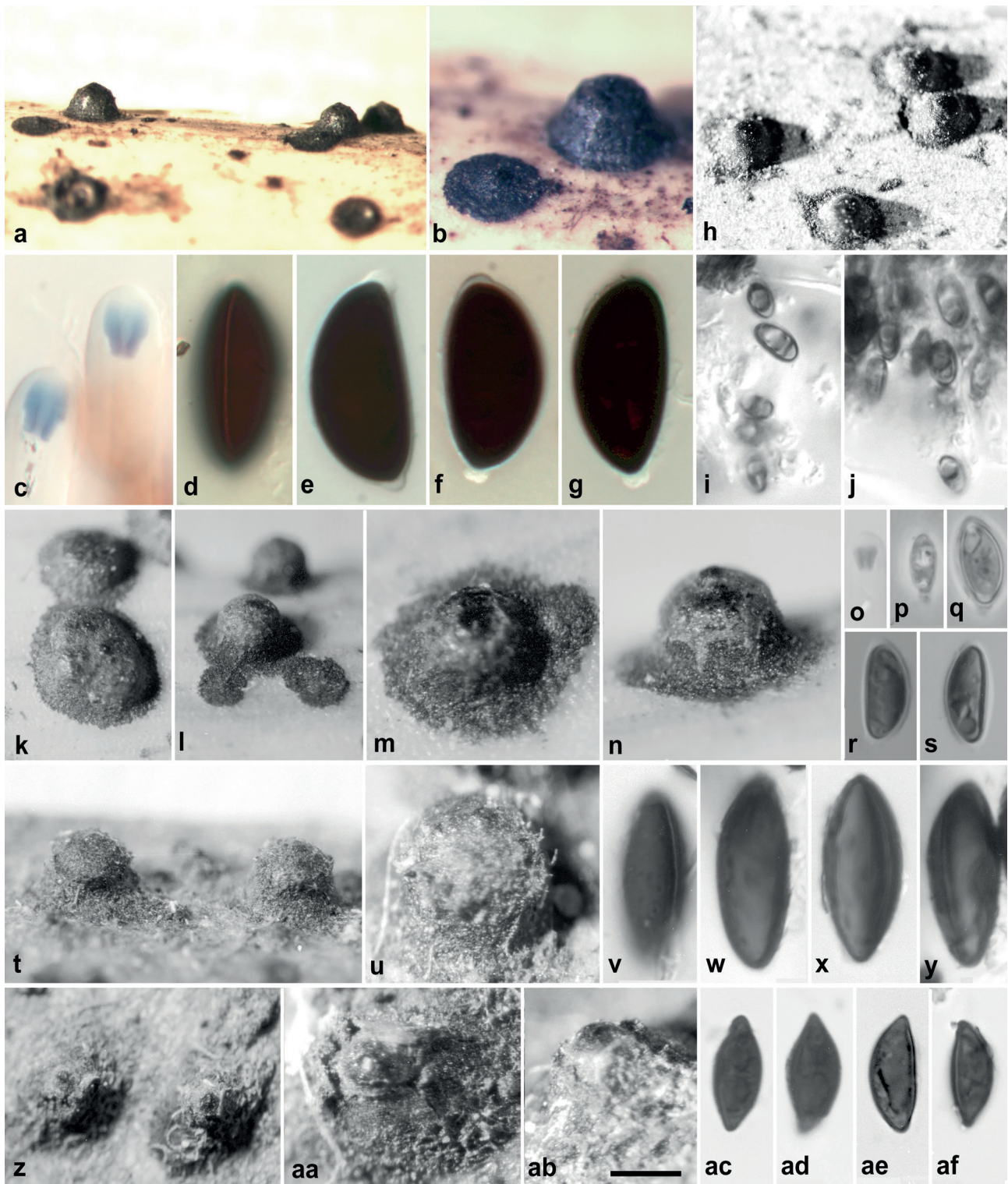


Fig. 5. *Astrocystis guyanae*. **a, b.** stromata; **c.** ascus apical plugs in Melzer's reagent; **d-g.** ascospores. *A. hemisphaerica*. **h.** stromata; **i, j.** ascospores. – *A. hughesii*. **k-n.** stromata; **o.** ascus apical plug in Melzer's reagent; **p, q.** immature ascospores; **r, s.** ascospores. – *A. madeirensis*. **t, u.** stromata; **v-y.** ascospores. – *A. marginatoclypeata*. **z-ab.** stromata; **ac-af.** ascospores. (a-g. holotype, NY 04449001; h-j. PAD, type; k-s. holotype, K-M 79229; t-y. isotype, E. Ule no. 2868, HBG; z-ab. type, BO 3468). Scale bar: a, h = 1 mm; b, k, l, t, z = 500 μ m; m, n, u, aa, ab = 250 μ m; c-g, i, j, o-s, v-y, ac-af = 10 μ m.

Holotypus. – ASIA. MALAYSIA. Malacca, *leg.* Scortechini no. 22 (PAD).

Description. – Young stromata covered by white-cream hyphal mat. Stromata 575–750 µm diam., 350–425 µm high (n=5), surrounded by ectostromal material, semiglobose, black, solitary or gregarious, sometimes 2 confluent, with finely but distinctly papillate ostioles. – Stromal wall 25–50 µm thick. – Perithecia detached. – Ascus apical plugs 1 µm high, upper width 1.5–2 µm, lower width 1–1.5 µm (n=2), staining pale blue in Melzer's reagent, with flared apical rim. – Ascospores 7–8.5 × 4–5 µm (7.7±0.5 × 4.3±0.3 µm) (n=30), asymmetrically ellipsoidal with broadly rounded ends, brown, with straight germ slit as long as spore.

Host plant. – *Agavaceae* or *Dracaenaceae*: *Yucca* or *Dracaena* (Saccardo 1891).

Distribution. – ASIA. Malaysia, Malacca.

Material examined. – *Rosellinia hemisphaerica* Sacc. & Paol.: holotype.

Stromal features warrant to transfer *Rosellinia hemisphaerica* to *Astrocystis*. The ascospore size overlaps with that of *A. cepiformis*. *Astrocystis hemisphaerica* can be distinguished from *A. cepiformis* by larger stromata; and from *A. nypae*, *A. ambigens*, *A. rudis*, *A. rarissima*, *A. formosa* var. *flavozonata*, and *A. fimbriata* by smaller ascospores.

Astrocystis hughesii Læssøe & Spooner, Kew Bull. 49(1): 16 (1994) [1993]. – Fig. 5k–s.

Description. – Perithecial stromata 450–550 µm diam., 225–350 µm high (n=5), singly or up to 4-peritheciate, developing centrally within ectostromal material 125–375 µm diam., initially covered by host cuticle, then emerging, semiglobose to cylindrical, black, remaining surrounded by conidiomatal material at base, with papillate to umbonate ostioles. – Stromal wall 50 µm thick. – Perithecia detached. – Ascus apical plugs 3–3.5 µm high, upper width 3–3.5 µm, lower width 2 µm (n=5), staining blue in Melzer's reagent, with pronounced upper rim. – Ascospores 11–15 × 5.5–7 µm (13.2±0.9 × 6.3±0.4 µm) (n=30), asymmetrically ellipsoidal with broadly rounded ends and one flat side, brown, surrounded by a slimy sheath, immature and sometimes mature ascospores with one cellular, semiglobose appendage, with a 7–10 µm long germ slit.

Host plant. – *Poaceae*, undetermined.

Distribution. – AFRICA. South Sudan, Western Equatoria.

Material examined. – *Astrocystis hughesii* Læssøe & Spooner: AFRICA. SOUTH SUDAN. Yambio, on stout grass, December 1948, *leg.* J. Tarr no. 605 (holotype, K-M 79229).

Astrocystis hughesii has ascospores with germ slits covering 0.5–0.75 of spore length, whereas the ascospores of the other species of this spore group have germ slits as long as spores. *Astrocystis hughesii* has smaller stromata than *A. palmarum*, *A. rachidis*, *A. sinensis*, *A. cyatheae*, *A. smilacicola*, and *A. muroiana*, and larger stromata than *A. bambusicola* and *A. sasae*.

Astrocystis madeirensis (Henn.) Læssøe & Spooner, Kew Bull. 49(1): 20 (1994) [1993]. – Fig. 5t–y.

Basionym. – *Rosellinia madeirensis* Henn., Hedwigia 43:242 (1904).

Description. – Perithecial stromata 400–625 µm diam. at mid height, 375–525 µm high (n=10), uniperitheciate, erumpent through cuticle, initially conical, then cylindrical with cambered top upon exfoliation of ectostroma at the top and exposure of perithecial stroma, dark brown to black, opaque, dusty due to residues from ectostroma, apex shiny, with finely papillate to umbonate ostioles, solitary or gregarious. – Stromal wall 25–50 µm thick, black. – Perithecia detached. – Ascus apical plugs not seen. – Ascospores 22–29 × 9.5–12 µm (25.2±1.8 × 11.1±0.7 µm) (n=50), asymmetrically ellipsoidal with broadly rounded ends and one less curved side, dark brown, with germ slit as long as spore.

Host plant. – *Poaceae*: monocotyledon, probably bamboo.

Distribution. – SOUTH AMERICA. Brazil, Estado de Amazonas, Río Madeira, pr. Cachoeiras do Marmellos.

Material examined. – *Rosellinia madeirensis* Henn.: SOUTH AMERICA. BRAZIL. Estado de Amazonas, Madeira, Marmellos, auf der Rinde eines Zweiges, März 1902, *leg.* E. Ule Herbarium Brasiliense no. 2868 (type, K-M 79222); Cachoeiras des Marmellos, auf Zweigrinde, März 1902, *leg.* E. Ule, ex Herbarium Brasiliense no. 2868 (isotype, HBG).

Astrocystis madeirensis has narrower ascospores than *A. guyanae* and longer ascospores than *A. dimidiata*. Stromata of *A. madeirensis* have a smaller diameter than those of *A. guyanae* and *A. dimidiata*. The material examined was rather old and in poor conditions covered with some debris, as also mentioned by Læssøe & Spooner (1994).

Astrocystis marginatoclypeata (Penz. & Sacc.) L.E. Petrini, **comb. nov.** – Fig. 5z–af.
Index Fungorum Registration Identifier: IF 559857

Basionym (IF 142434). – *Rosellinia marginatoclypeata* Penz. & Sacc. [as ‘*marginato-clypeata*’], *Malpighia* 11(9–10): 393 (1897).

Holotypus. – ASIA. INDONESIA. Java, on *culmis palmarum*, 11 December 1897, leg. O. Penzig (BO 3468).

Description. – Stromata 625–1250 µm diam. at base, 200–425 µm high (n=5), uniperitheciate, erumpent through epidermis, conical, black, solitary, ectostroma firmly attached to host epidermis, exfoliating on top and exposing the apex of perithecial stroma, with punctate to umbilicate ostioles. – Ascus apical plugs not seen. – Ascospores 13–17.5 × 7–9 µm (15.9±0.9 × 7.7±0.6 µm) (n=30), asymmetrically ellipsoidal with pinched ends to lemon shaped, dark brown, with germ slit on flat side almost as long as spore, terminating shortly before spore end.

Host plant. – *Arecaceae*: Palm, culms.

Distribution. – ASIA. Indonesia, Java.

Material examined. – *Rosellinia marginatoclypeata* Penz. & Sacc.: holotype.

Stromata of *A. marginatoclypeata* show features typical of *Astrocystis*. The ectostroma exfoliates only on top and remains attached to the perithecial stroma in large part. Penzig & Saccardo (1904) placed the species in the Section *Amphisphaerella* of *Rosellinia* and their illustration shows the lower portion of the fertile part immersed in the host tissue and the upper portion, but for the top, coated by stromal material forming a cone with gentle slopes. This could not be verified during this study due to scarcity of the type material. *Astrocystis formosa* var. *formosa*, *A. palmarum*, and *A. sasae* have also ectostroma exfoliating only at the top exposing solely the upper part of fertile stromata. The three species differ, however, by stroma size.

Astrocystis marginatoclypeata has ascospores with pinched ends, which distinguish it from *A. cyathaeae*, *A. muroiana*, *A. sinensis*, and *A. smilacicola*, which have ascospores of comparable sizes with long germ slits and stromata of different size and shape.

Astrocystis mirabilis Berk. & Broome, *J. Linn. Soc., Bot.* 14(no. 74): 123 (1873) [1875]. – Fig. 6a–j.

Synonyms. – = *Anthostomella mirabilis* (Sect. *Astrocystis*) (Berk. & Broome) Höhn., *Sitz. Akad. Wiss. Wien* 118: 328 (1909).

= *Rosellinia mirabilis* (Berk. & Broome) Y.M. Ju & J.D. Rogers, *Mycologia* 82(3): 343 (1990).

= *Rosellinia geasteroides* Ellis & Everh., *Proc. Acad. nat. Sci. Philad.* 47: 415 (1895).

= *Hypoxyylon geasteroides* (Ellis & Everh.) P.M.D. Martin, *Jl S. Afr. Bot.* 33: 322 (1967).

= *Hypoxyylon geasteroides* (Ellis & Everh.) P.M.D. Martin, *Jl S. Afr. Bot.* 42(1): 72 (1976).

Description. – Perithecial stromata 550–875 µm diam., 375–525 µm high (n=25), 1–3-peritheciate, developing from stromal spots beneath cuticle and assuming a conical form with gentle slopes; during development of fertile part emerging from cuticle, lower half remaining covered, cylindrical with cambered top, surface opaque, dark brown to black, with finely papillate ostioles, singly or gregarious, surrounded by ectostromal margin. – Stromal wall 25–50 µm thick, black. – Perithecia detached. – Ascus apical plugs 2–4 µm high, upper width 3–4 µm, lower width 2–2.5 µm (n=15), staining blue in Melzer’s reagent, with square upper rim. – Ascospores 10–14 × 5.5–8 µm (11.9±0.8 × 6.5±0.5 µm) (n=150), asymmetrically ellipsoidal with broadly rounded ends and one flat side, dark brown, occasionally with one semi-globose 0.5–1 µm wide and long cellular appendage, with germ slit as long as spore. – Conidiophores 20–30 µm long, as a creamy powder in core of young stroma; conidiogenous cells 5–17 × 3–4 µm (n=7) long. – Conidia 6.5–9.5 × 3–4 µm (n=6).

Host plants: *Poaceae* (Bambusoideae): *Arundinaria*, *Bambusa*; Ju & Rogers (1990): bamboo, *Dendrocalamus latiflorus*, *Phyllostachys pubescens* var. *pubescens*, *Schizostachyum*; Læssøe & Spooner (1994): *Bambusa multiplex*, *Bambusa vulgaris*.

Distribution. – ASIA. China; Indonesia (Ju & Rogers 1990; Læssøe & Spooner 1994); Japan (Læssøe & Spooner 1994); Philippines (Ju & Rogers 1990; Læssøe & Spooner 1994); Sri Lanka (Ju & Rogers 1990; Læssøe & Spooner 1994); Taiwan (Ju & Rogers 1990; Læssøe & Spooner 1994). CARIBBEAN. Guadeloupe. INDIAN OCEAN. Mauritius (Læssøe & Spooner 1994). NORTH AMERICA. USA, Louisiana; SOUTH AMERICA. Jamaica (Læssøe & Spooner 1994). SOUTH PACIFIC. New Caledonia (Læssøe & Spooner 1994).

Material examined. – *Astrocystis mirabilis* Berk. & Broome: ASIA. CHINA. Hainan: Li Mu Mt., near the farm, on bamboo, 12 January 1987, leg. J.-z. Yue, J.-x. Tian & O.E. Eriksson *Flora Sinica* 870112-3c (ZT Myc 0066881). SOUTH AMERICA. GUADELOUPE. Les Saintes, *Bambusa*, end of Oct 1993, leg. J. Vivant GUAD 06 (ZT Myc 0066879); Basse Terre, on bamboo, Bains Jaunes, 03 November 1993 leg. J. Vivant GUAD 656 (ZT Myc 0066880). – *Rosellinia geasteroides* Ellis & Everh.: NORTH AMERICA. USA. Louisiana, near St. Martinville, on dead canes of *Arundinaria*, Aug 1895, leg. A.B. Langlois (isotype, Ell. & Ev. Fungi Columbiani no. 820, HBG, ex herb Mag.); Louisiana, near St. Martinville, on the lower

parts of dead canes of *Arundinaria*, Aug 1895, *leg.* A.B. Lan-glois (isotype, Ell. & Ev. North American Fungi second series no. 3315, HBG, with conidial form).

Astrocystis mirabilis has splitting stromata, as *A. bambusae*. It differs from *A. bambusae* by wider ascospores and also anamorph characters (Ju & Rogers 1990), and from other species with similar spore size by stromal characters.

Astrocystis multiloculata Y.P. Wu & Q.R. Li, in Wu, et al. *Phytotaxa* 522(4): 276 (2021).

Description. – Wu et al. (2021): Stromata 600–3000 µm diam., 600–2400 µm high, containing more than 8 perithecia. – Ascii 120–142 × 7–12.5 µm. – Ascus apical plugs 3–5 µm high, 3–4.5 µm diam., staining blue in Melzer's reagent, with pronounced upper rim. – Ascospores 19–25 × 7–11 µm, without gelatinous sheath and germ slit slightly less than whole spore length.

Host plant. – *Poaceae*: Bamboo, culms.

Distribution. – ASIA: China (Wu et al. (2021)).

Astrocystis multiloculata has stromata among the largest in the genus *Astrocystis*, which contain numerous perithecia, thus evoking affinities with *Kretzschmariella* (Wu et al. 2021). Only *A. sasae* is reported to have stromata containing up to eight perithecia (Læssøe & Spooner 1994), and converging stromata of *A. muroiana* may reach also such an extent, but *A. multiloculata* has clearly larger ascospores. *Astrocystis multiloculata* has larger stromal dimensions than *A. concavispora*, *A. dimidiata*, *A. eleiodoxae*, *A. sublimbata*, *A. subverruculosa*, and *A. thailandica*, all species with overlapping spore size.

Astrocystis muroiana (I. Hino & Katum.) L.E. Petrini, **comb. nov.** – Figs. 3, 6k–ab.

Index Fungorum Registration Identifier: IF 559858

Basionym (IF 305333). – *Rosellinia muroiana* I. Hino & Katum., Bull. Faculty of Agriculture, Yamaguchi University 9: 893 (1958).

Holotypus. – ASIA. JAPAN. Prov. Settu, Urbs Kôbe, Mt. Rokkû, on *Sasa nipponica*, 14 September 1957, *leg.* H. Muroi, no. 21930 (YAM).

Description. – Perithecial stromata 300–700 µm diam. at mid height, at base including ectostromal margin 750–1000 µm, 1–3-peritheciate, if converging and forming multiperitheciate patches up to 3000 × 1625 µm wide, 200–400 µm high (n=35), developing from ectostromal spots beneath cuticle and assuming a conical form with gentle slopes, gradually emerging while ectostroma exfoliates but from the lowest part that remains covered by the host cuticle, cylindrical with cambered top,

opaque, grey to black, with finely papillate ostioles, singly or gregarious. – Stromal wall 25–50 µm thick. – Ascus apical plugs 3–5 µm high, upper width 3–4.5 µm, lower width 2–3 µm (n=21), staining blue in Melzer's reagent, with pronounced square upper rim. – Ascospores 12–19 × 5.5–9 µm (15±1.3 × 7±0.5 µm) (n=210), asymmetrically ellipsoidal with broadly rounded ends and one flat side, dark brown, with a slimy sheath surrounding the flat side and both ends covered by 2–4 × 2–4 µm slimy caps, occasionally with 1 semiglobose cellular appendage especially when immature, with straight germ slit as long as spore.

Host plants. – *Poaceae*: *Phyllostachys pubescens*, *Sasa nipponica* on 0.5 cm diam. twig, dead bamboo.

Distribution. – ASIA. Japan, Province Settu; Taiwan, Nantou County, Taitung County.

Material examined. – *Astrocystis sublimbata* (Durieu & Mont.) G.C. Hughes: ASIA. TAIWAN. Taitung County, Tientsi, culm of dead bamboo, 25 January 1988, *leg.* Y.-M. Ju no. JU 77012502 (HAST 145764). Taipei City, Nankang Mt. Hiking Trail, on bamboo culm, 22 March 2000, *leg.* Y.-M. Ju & H.-M. Hsieh no. 89032207 (HAST 145813). Nan-tou County, Lu-ku Township, Shi-tou, on bamboo culm, 22 Oct 2003, *leg.* Y.-M. Ju & H.-M. Hsieh no. 92102203 (HAST 145814); Miao-Ii County, Tai-an Township, Gin-suei Village, Teng-lung, on bamboo culm, 8 July 2005, *leg.* Y.-M. Ju & H.-M. Hsieh no. 94070805 (HAST 145815). – *Hypoxylon culmorum* Cooke: ASIA. TAIWAN. Nan-Tou, *Phyllostachys pubescens* var. *pubescens*, 22 Aug 1987, *leg.* Yu-Ming Ju no. NTB 7608 (HAST 145765). – *Rosellinia muroiana* I. Hino & Katum.: holotype. – *Rosellinia sublimbata* (Durieu & Mont.) Pass.: TAIWAN: Nantou County, Shitou, culm of *Phyllostachys pubescens*, 22 Aug 1987, *leg.* Y.-M. Ju no. JU 76082229 (HAST 145763).

Astrocystis muroiana differs from *A. cyatheae* and *A. smilacicola* by smaller stromata, from *A. dimidiata*, *A. sublimbata*, and *A. subverruculosa* by smaller ascospores and smaller stromata. Stromata of *A. muroiana* may form multiperitheciate complexes not observed for *A. dimidiata*, *A. sublimbata* and *A. subverruculosa*. *Astrocystis muroiana* has higher stromata than *A. bambusicola* and *A. sasae*.

Specimen HAST 145813 also contains stromata of *A. bambusae* on the same culm (Fig. 6w). Genomes of specimen HAST 145813 mentioned as *A. sublimbata* were repeatedly compared to those of other *Astrocystis* species. Size of stromata and ascospores of HAST 145813 match those of *A. muroiana*.

Astrocystis nypae G.J.D. Sm. & K.D. Hyde, *Fungal Diversity* 7: 93 (2001).

Description. – Smith & Hyde (2001): Stromata 400–600 µm diam., 300–400 µm high, mammoid with discoid base. – Ascii 100–120 × 5–7.2 µm.

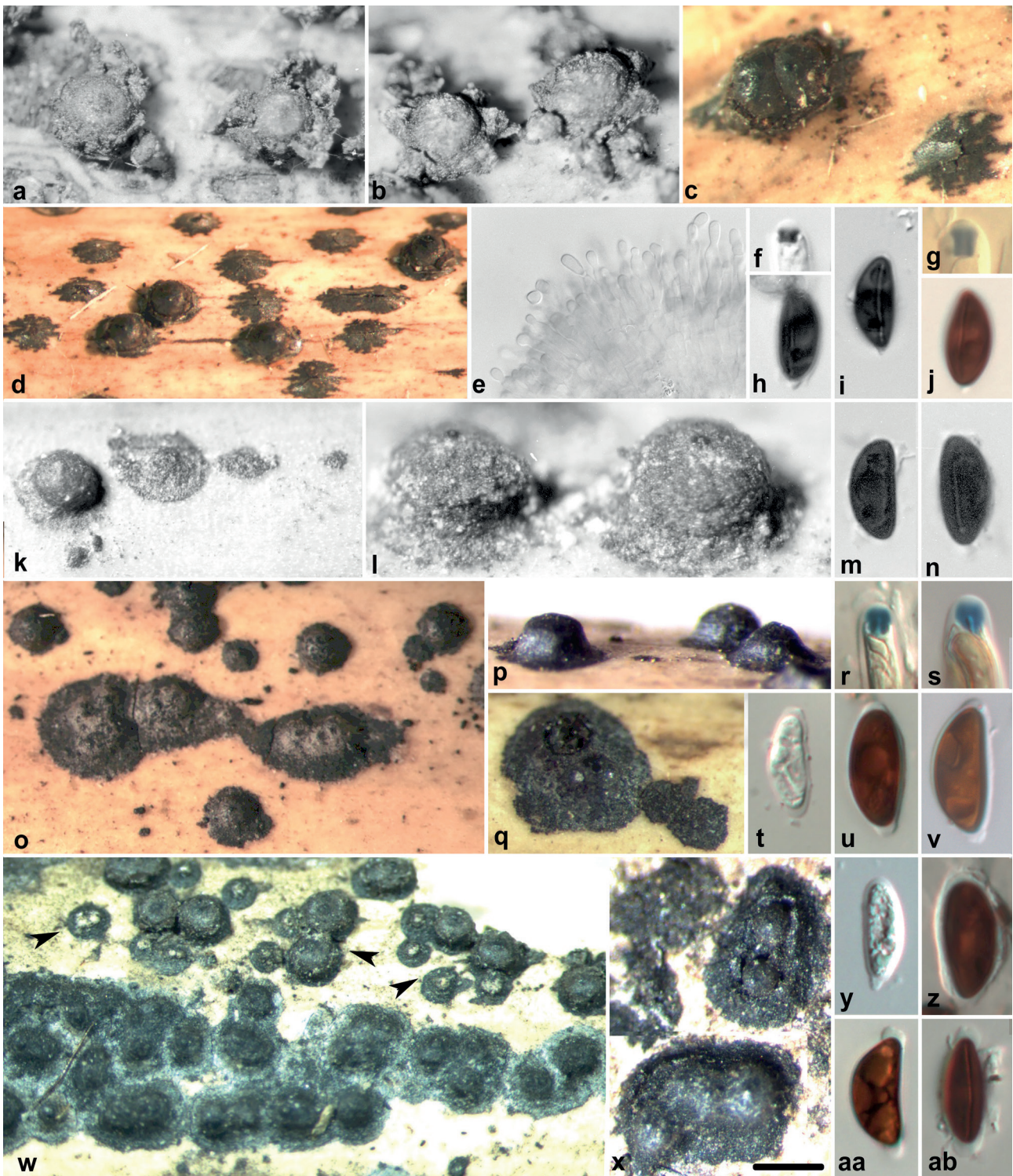


Fig. 6. *Astrocystis mirabilis*. **a–d.** stromata; **e.** conidiophores and conidia on host material; **f, g.** ascus apical plugs in Melzer's reagent; **h–j.** ascospores. – *A. muroiana*. **k, l, o–q, w, x.** stromata; **r, s.** ascus apical plugs in Melzer's reagent; **m, n, u, v, z–ab.** ascospores with slimy sheath; **t, y.** immature ascospores with cellular appendage. (a, b, e, f, h, i. isotype of *R. geasteroides*, Ell. & Ev. Fungi Columbiani no. 820, HBG; c, d, g, j. ZT Myc 0066881; k–n. holotype, H. Muroi, no. 21930, YAM; o. HAST 145765; p, q, r, t, u, z. HAST 145813; s, v. HAST 145764; w, y. HAST 145815; x, aa, ab. HAST 145814). w. arrows point to stroma group of *A. bambusae*. Scale bar: d, w = 1 mm; a–c, k, o–q, x = 500 µm; l = 250 µm; e = 20 µm; f–j, m, n, r–ab = 10 µm.

– Ascus apical plugs 0.8–1.2 μm high, 2.5–3.1 μm diam., with flared upper rim. – Ascospores 8.4–9.6 \times 3.3–4.5 μm , without a gelatinous sheath, germ slit ca. $\frac{4}{5}$ of whole spore length.

Host plant. – *Pandanaceae*: *Nypa*.

Distribution. – ASIA. Malaysia (Smith & Hyde (2001)).

Astrocystis nypae has less wide ascospores than *A. ambigens* and a different stromal shape. It has larger ascospores than *A. cepiformis* and *A. hemisphaerica*, smaller ascospores than *A. rarissima*, *A. formosa* var. *formosa*, *A. formosa* var. *flavozonata*, *A. fimbriata*, and *A. rudis*.

Astrocystis palmarum Læssøe & Spooner, Kew Bull. 49(1): 28 (1994) [1993]. – Fig. 7a–g.

Description. – Stromata 1000–1300 μm diam., 800–950 μm high (n=5), 1–2-peritheciate, erumpent, with ectostroma not exfoliating or exfoliating only at top, and remaining attached to a large part of the perithecial stroma, semiglobose to mammaeform, black, opaque, apex shiny, with umbilicate or coarsely papillate to integrated conical ostioles when covered by ectostroma; ectostroma at base covered by host epidermis, solitary or gregarious. – Stromal wall 75 μm thick. – Perithecia detached. – Ascus apical plugs 2–2.5 μm high, upper width 3 μm , lower width 2 μm (n=5), staining blue in Melzer's reagent, with flared upper rim. – Ascospores 12–15 \times 7–8.5 μm (13.4 \pm 0.9 \times 7.4 \pm 0.5 μm) (n=30), asymmetrically ellipsoidal with broadly rounded ends and one flat side, dark brown, with germ slit as long as spore.

Host plant. – *Arecaceae*: Palm, fallen petioles.

Distribution. – WESTERN NORTH ATLANTIC OCEAN. Bermuda.

Material examined. – *Astrocystis palmarum* Læssøe & Spooner: WESTERN NORTH ATLANTIC OCEAN. BERMUDA. Warwick, Fruitlands, on fallen petioles of palm, 1 Aug 1921, leg. H.H. Whetzel no. 106 (holotype, K-M 33779).

Astrocystis palmarum is characterized by large, coarse stromata with ectostroma exfoliating only at top. *Astrocystis palmarum* has the largest stromata, respectively the highest, among the species in spore group C of the key, setting it apart from the other species with large stromata as *A. marginatoclypeata*, *A. smilacicola*, and *A. muroiana*, whereas it has smaller ascospores and stromata than *A. multiloculata*.

Astrocystis rachidis (Pat.) K.D. Hyde & J. Fröhl., Fungal Diversity Res. Ser. 3: 306 (2000). – Fig. 7h–l.

Basionym. – *Rosellinia rachidis* Pat. [as '*rhachidis*'] Bull. Soc. mycol. Fr. 22: 57 (1906).

Description. – Stromata 675–750 μm diam., 400–625 μm high (n=5), ectostromal material confined to stroma base as a 200–250 μm wide disk, semiglobose, black, shiny on top, opaque on sides, with finely papillate ostioles, solitary or gregarious, 2–3 confluent. Base of young stromata covered with white particles, top with host fibers. – Stromal wall 50–75 μm thick, black, hard, brittle. – Perithecia detached. – Ascus apical plugs 1 μm high, upper width 1.5–2.5 μm wide (n=3), staining blue in Melzer's reagent, with flared upper rim. – Ascospores 11–14 \times 5–7 μm (11.8 \pm 0.8 \times 5.8 \pm 0.5 μm) (n=30), asymmetrically ellipsoidal with one flat side and broadly rounded ends, dark brown, with germ slit as long as spore.

Host plant. – *Arecaceae*: *Cocos nucifera*, rachides of leaves, heavily decomposed; Fröhlich & Hyde (2000): *Jessenia bataua*, *Mauritia flexuosa*; Smith & Hyde (2001): *Astrocaryum*, *Calamus*, *Elaeis guineensis*, *Korthalsia brassi*, *Phytelephas*, *Pinanga*.

Distribution. – SOUTH PACIFIC OCEAN. French Polynesia, Tahiti. SOUTH AMERICA. Ecuador (Fröhlich & Hyde (2000)). ASIA. Malaysia (Smith & Hyde (2001)); Australia (Smith & Hyde (2001)).

Material examined. – *Rosellinia rachidis* Pat.: SOUTH PACIFIC OCEAN. FRENCH POLYNESIA. Motu Pa-peetei, on rachis de la feuille de *Cocos nucifera*, 18 September 1904, leg. M. Seurat (holotype, FH).

Astrocystis rachidis has larger ascospores than *A. sinensis*, *A. ambigens*, *A. nypae* and *A. rudis*, and smaller stromata than *A. palmarum* and *A. marginatoclypeata*, and smaller ascospores than *A. eleiodoxae*, all species recorded from palms.

A specimen in a rather old condition from Gadeloupe, Basse Terre, Canal Le Pelletier, 600 m.a.s., March 1988, leg. J. Vivant (ZT: Myc 0066883) could be identified as *A. rachidis*. Its host was tentatively indicated as bamboo, but this is questionable. A few stromatic remnants are still attached to the fertile part of the stromata, indicating *Astrocystis* as a possible genus. The stromata measured 625–685 μm diam., 450–465 μm in height (n=5), ascospores 10–12.5 \times 5–7 μm (11.5 \pm 0.7 \times 6.3 \pm 0.5 μm) (n=30).

J.C. Krug annotated the type specimen as *Astrocystis rachidis* (Pat.) n. comb. in 1995, but the combination was formalized only later, with additional palm hosts and an extended distribution list (Fröhlich & Hyde 2000).

The type material was scant and not in good conditions. Therefore, it was difficult to judge whether the white material seen corresponds to the white mycelium mentioned by Fröhlich & Hyde (2000) and the thin white covering described by

Læssøe & Spooner (1994), or it was simply an artefact due to the preservation. Smith & Hyde (2001) have examined the holotype of *A. rachidis* and assigned several specimens examined to this species. The ascospore size given as $6.25\text{--}10 \times 2.5\text{--}4 \mu\text{m}$ is smaller than measured in this study. Taking their measurements, *A. rachidis* would be similar to *A. formosa* var. *formosa*, differing only by stroma shape.

Astrocystis rarissima Dulym., P.F. Cannon & Peerally, Mycol. Res. 102(11): 1327 (1998).

Description. – Dulymamode et al. (1998): Stromata $300\text{--}450 \mu\text{m}$ diam., $250\text{--}400 \mu\text{m}$ high. – Asci $88\text{--}108 \times 7\text{--}9 \mu\text{m}$, stipe $20\text{--}25 \mu\text{m}$ long. – Ascus apical plug $0.8 \mu\text{m}$ high, $1.5\text{--}2 \mu\text{m}$ diam., with flared upper rim. – Ascospores $8\text{--}11 \times 4.5\text{--}5 \mu\text{m}$, with $5\text{--}5.5 \mu\text{m}$ long germ slit.

Host plant. – Pandanaceae: *Pandanus palustris*, bark of prop roots.

Distribution. – INDIAN OCEAN. Mauritius (Dulymamode et al. (1998).

Astrocystis rarissima is distinct by ascospores with a short germ slit and stromata smaller in diameter than those of *A. fimbriata*, *A. formosa* var. *formosa*, *A. formosa* var. *flavozonata*, *A. nypa*, and *A. rudis*. *Astrocystis rarissima* has larger ascospores than *A. nypae* and *A. ambigens*.

Astrocystis rudis G.J.D. Sm. & K.D. Hyde, Fungal Diversity 7: 101 (2001).

Description. – Smith & Hyde (2001): Stromata $650\text{--}1000 \mu\text{m}$ diam., $500\text{--}750 \mu\text{m}$ high, ectostroma at base up to $1750 \mu\text{m}$ diam. – Asci $68\text{--}83 \times 7.5\text{--}10 \mu\text{m}$ at spore bearing part, $20\text{--}36 \mu\text{m}$ at stipe. – Ascus apical plug $1.2\text{--}1.9 \mu\text{m}$ high, $2.5\text{--}2.8 \mu\text{m}$ diam., with flared upper rim. – Ascospores $10\text{--}12.5 \times 5\text{--}6.7 \mu\text{m}$, with a thin mucilaginous sheath and germ slit as long as spore.

Host plant. – Areaceae: *Korthalsia brassi*.

Distribution. – ASIA. Papua New Guinea (Smith & Hyde (2001).

Astrocystis rudis differs from *A. rachidis* by smaller ascospores surrounded by a mucilaginous sheath. *A. rudis* has larger ascospores than *A. cepiformis*, *A. hemisphaerica*, *A. ambigens*, *A. formosa* var. *formosa*, *A. formosa* var. *flavozonata*, and *A. nypae* and larger stromata than *A. rarissima*, *A. formosa* var. *flavozonata*, and *A. fimbriata*.

Astrocystis sasae Læssøe & Spooner, Kew Bull. 49(1): 20 (1994) [1993]. – Fig. 7m–r.

Description. – Stromata $225\text{--}750 \mu\text{m}$ at mid height, at base up to $1375 \mu\text{m}$ diam., $175\text{--}200 \mu\text{m}$ high (n=3), ectostroma exfoliating on top, exposing apex of perithecial stroma and remaining mainly attached at sides, giving the surface a rough appearance; semiglobose to pulvinate, irregular in outline, with finely papillate ostioles. – Ascus apical plugs $4\text{--}4.5 \mu\text{m}$ high, upper width $4 \mu\text{m}$, lower width $2.5 \mu\text{m}$ (n=3), staining blue in Melzer's reagent, with pronounced square upper rim. – Ascospores $13\text{--}16 \times 6\text{--}9 \mu\text{m}$ ($14.4 \pm 1 \times 7.6 \pm 0.7 \mu\text{m}$) (n=30), asymmetrically ellipsoidal with broadly rounded ends and one less curved side, dark brown, with slimy caps at both ends, with germ slit as long as spore.

Host plant. – Poaceae: *Sasa* sp.

Distribution. – ASIA. Japan.

Material examined. – *Astrocystis sasae* Læssøe & Spooner: ASIA. JAPAN. Gumma Prefecture, Tone-gun, Katashiminura, Jujo Seishi Co. Forest, on *Sasa* sp., 25 Aug 1983, leg. P.F. Cannon (holotype, IMI 316492 (at K)).

Astrocystis sasae is distinguished from *A. bambusicola* by its stroma width and shape. Up to eight perithecial stromata may develop within the same ectostromal material (Læssøe & Spooner 1994), whereas only 1–3-peritheciate stromata are reported for *A. bambusicola* (Hyde et al. 2017, 2020). Low stromal height distinguishes *A. sasae* from *Astrocystis* species with similar spore size (*A. cyathea*, *A. hughesii*, *A. marginatoclypeata*, *A. muroiana*, *A. palmarum*, *A. rachidis*, *A. sinensis*, and *A. smilacicola*). *Astrocystis sasae* was also collected Japan and on the same host genus as *A. muroiana*. Both species have ascospores of the same size.

Astrocystis sinensis Joanne E. Taylor, K.D. Hyde & E.B.G. Jones, Fungal Diversity Res. Ser. 12: 230 (2003).

Description. – Taylor & Hyde (2003): Stromata $700\text{--}1000 \mu\text{m}$ diam., $260\text{--}430 \mu\text{m}$ high, 1–2-peritheciate. – Asci $112\text{--}130 \times 10\text{--}12 \mu\text{m}$. – Ascus apical plugs $5\text{--}5.5 \mu\text{m}$ high, $4\text{--}4.5 \mu\text{m}$ diam., with pronounced upper rim. – Ascospores $12\text{--}16 \times 6\text{--}8 \mu\text{m}$, with a gelatinous sheath thicker at the ends and germ slit as long as spore.

Host plant. – Areaceae: *Trachycarpus fortunei*.

Distribution. – ASIA. China, Hubei Province (Taylor & Hyde (2003).

Astrocystis sinensis has smaller stromata and larger ascus apical plugs than *A. palmarum*, larger ascospores and larger ascus apical plugs than *A. rachidis*. Among the *Astrocystis* species on palms, *A. sinensis* has apical plugs with a pronounced upper rim.

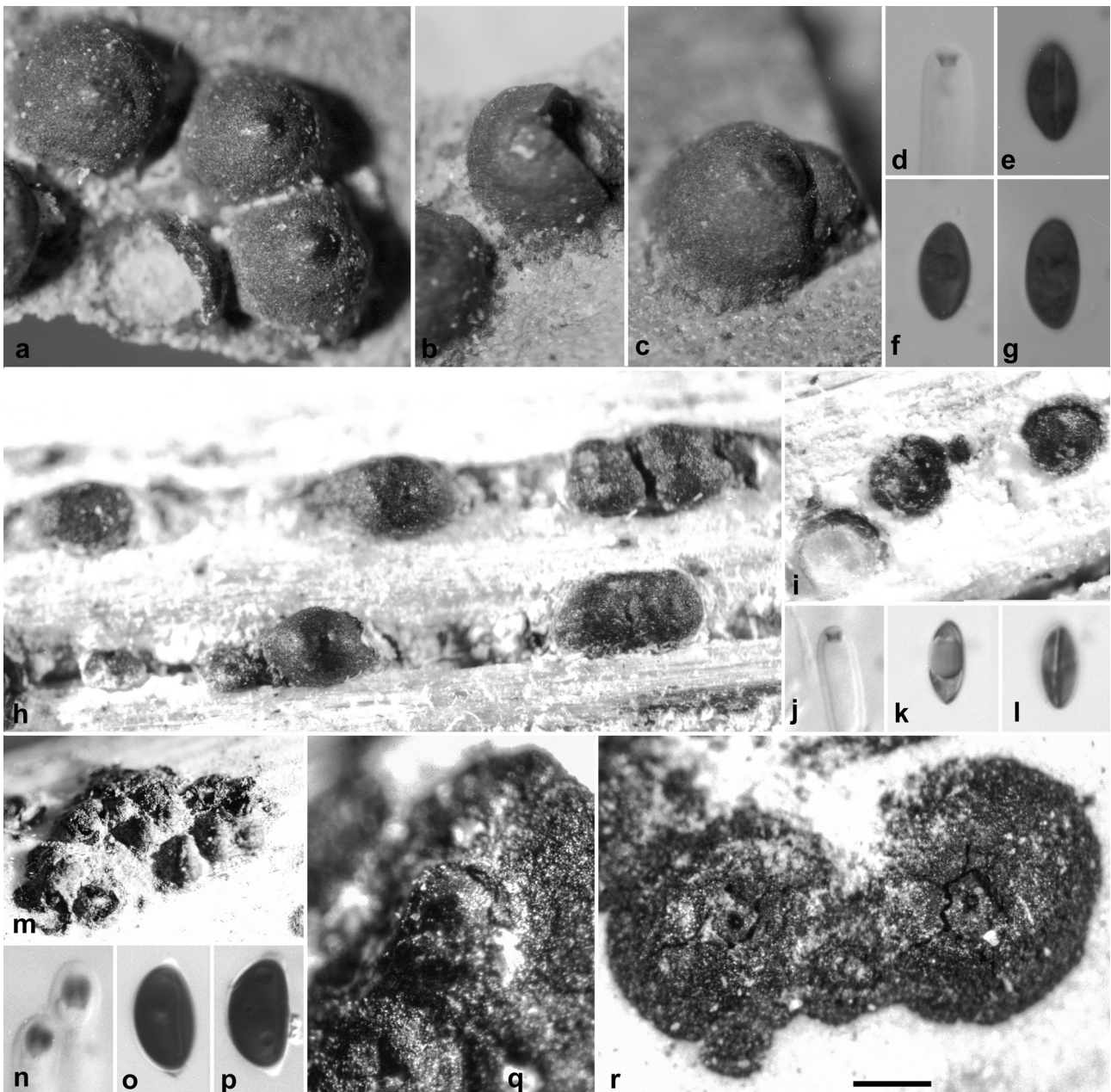


Fig. 7. *A. palmarum*. a–c. stromata; d. ascus apical plug in Melzer's reagent; e–g. ascospores. – *Astrocystis rachidis*. h, i. stromata; j. ascus apical plug in Melzer's reagent; k, l. ascospores. – *A. sasae*. m, q, r. stromata; n. ascus apical plugs in Melzer's reagent; o, p. ascospores. (a–g. holotype, K-M 33779; h–l. holotype, M. Seurat, FH; m–r. holotype, IMI 316492 (at K)). Scale bar: m = 1 mm; a–c, h = 500 μ m; i, q, r = 250 μ m; d–g, j–l, n–p = 10 μ m.

Astrocystis smilacicola (Schwein.) Læssøe & Spooner, Kew Bull. 49(1): 25 (1994) [1993].

Basionym. – *Sphaeria smilacicola* Schwein., in Fries, Elench. Fung 2: 71 (1828).

Synonyms. – \equiv *Diatrype smilacicola* (Schwein.: Fr.) Berk., Grevillea 4: 96 (1876).

= *Hypoxyylon smilacicola* Howe, Bull. Torrey bot. Club 6: 31 (1875).

Description. – Læssøe & Spooner (1994): Stromata 600–2000 \times 600–1600 μ m wide, 300–400 μ m high, 1–4-peritheciate. – Ascospores 13.5–17 (18.5) \times 6–7.5 μ m, with germ slit almost as long as spore.

Host plant. – *Smilacaceae*: *Smilax*.

Distribution. – NORTH AMERICA: Eastern USA (Læssøe & Spooner (1994)).

Astrocystis smilacicola has wider stromata than *A. muroiana* and *A. cyatheae*. Ju & Rogers (1994) have examined several specimens of *H. smilacicola*, including its type and that of *S. smilacicola* and concluded that the two species are synonyms. They illustrated the ascus apical plug as showing a pronounced upper rim.

Astrocystis sublimbata (Durieu & Mont.) G.C. Hughes, Mycol. Pap. 50: 9 (1953). – Figs. 3, 8a–j.

Basionym. – *Sphaeria sublimbata* Durieu & Mont., in Durieu, Exploration scientifique de l'Algérie, Flore d'Algérie, Cryptogamie: 498 (1846–1849).

Synonyms. – = *Rosellinia sublimbata* (Durieu & Mont.) Pass., in Thümen, Inst. Coimbra: no. 294 (1879).

= *Anthostomella sublimbata* (Durieu & Mont.) Speg., Revista Fac. Agron. Vet. Univ. nac. La Plata, Ser. 2 6(1): 38 (1910).

= *Hypoxyloa sublimbatum* (Durieu & Mont.) P.M.D. Martin, J. S. Afr. Bot. 33: 322 (1967), nom. inval., ICN Art. 41.1; J. South Afr. Bot. 42(1): 74 (1976).

= *Rosellinia amblystoma* Berl. & F. Sacc., Revue mycol., Toulouse 11(no. 43): 118 (1889).

Description. – Perithecial stromata 500–800 µm diam., at base including ectostromal ring up to 1125 µm diam., 400–625 µm high (n=25), 1–3-peritheciate, developing from ectostromal material beneath cuticle and assuming a conical form with gentle slopes, while growing perithecial stromata emerge through cuticle and ectostroma is shed off, cylindrical with cambered top, opaque, dark brown to black, with finely papillate ostioles, singly or gregarious, young stromata entirely covered by cuticle, older stromata only at base. – Stromal wall 25–50 µm thick, black. – Perithecia detached. – Ascospore bearing part 87–117 µm long, stipe 15–40 µm long, 6–11 µm wide (n=56). – Ascus apical plugs 2–5.5 µm high, upper width 3–4.5 µm, lower width 2–3 µm (n=18), staining blue in Melzer's reagent, with pronounced square upper rim. – Ascospores 14–22.5 × 6–10 µm (18±1.5 × 7.9±0.8 µm) (n=142), asymmetrically ellipsoidal with broadly rounded ends and one flat side, dark brown, with slimy sheath surrounding flat side and both ends forming 2–4 × 2–4 µm slimy caps, occasionally with 1 cellular appendage, with germ slit as long as spore. – Culture 3–3.5 cm diam. on 2% malt agar after 10 days, felted to cottony with scarce aerial mycelium, white, reverse light brown; after 49 days presence of stromatic patches with conidiophores aggregated in pustules, agar with light brown discolorations; after 77 days conidiophores 22–45 µm long, hyaline to light brown, with pronounced conidial scars of detached conidia arranged in a geniculate manner. – Conidia 6–8 × 3–3.5 µm, ovoid with truncate base, hyaline.

Hosts. – *Poaceae*: *Arundo donax*, *Stipa mauritanica* (= *Arundo mauritanica*), *Bambusa mitis*, *Phyllostachys* sp., *Sasa japonica*. Hughes (1953): *Bambusa vulgaris*. (Wu et al. 2021): bamboo, as *A. cocoës*).

Distribution. – AFRICA. Algeria; Ghana (Hughes (1953); Sudan (Læssøe & Spooner 1994). ASIA. China; Philippines; Taiwan (Ju & Rogers 1994); China (as *A. cocoës*) (Wu et al. 2021). EUROPE. France; Ireland (Læssøe & Spooner 1994); Portugal; Spain (Læssøe & Spooner 1994); U.K. (Læssøe & Spooner 1994). NORTH AMERICA. USA, Georgia (Læssøe & Spooner 1994). SOUTH AMERICA. Mexico (Ju & Rogers 1994; San Martín Gonzalez & Rogers 1995); Venezuela (Læssøe & Spooner 1994).

Material examined. – *Astrocystis sublimbata* (Durieu & Mont.) G.C. Hughes: EUROPE. France. Pyrénées Atlantiques, Peyrehorade, *Phyllostachys* sp., 29 November 1987, leg. F. Candoussau no. 3.159 (ZT Myc 0066876); Les Landes, Momuy, *Sasa japonica*, 28 June 1983, leg. F. Candoussau no. 376 (ZT Myc 0066878, cultured). – *Rosellinia amblystoma* Berl. & F. Sacc.: EUROPE. PORTUGAL. Coimbra, in Horto Botanico Coimbra Lusitaniae, in culmis exsiccatis *Bambusae mitis*, leg. De Roumeguère Exs no. 22 (isotype; G, Herbarium Boissier; FI). – *Rosellinia sublimbata* (Durieu & Mont.) Pass.: EUROPE. PORTUGAL. Coimbra, Chaumes morts du Roseau de Provence, Hiver, leg. A. Fr. Moller (G, 5139 C. Roumeguère Fungi selecti exsiccati); Coimbra, *Arundo donax*, January 1879, leg. Ad. Fr. Moller (G, GZU, ZT Myc 0066875, de Thümen, Mycotheca universalis no. 1743). – *Sphaeria sublimbata* Durieu & Mont.: NORTH AFRICA. ALGERIE. Alger, sur l'*Arundo mauritanica*, 7 mars 1840, leg. L. Durieu (isotypes, PC ex Herb Durieu de Maisonneuve, K-M 1434260 ex herb. Berkley).

Astrocystis sublimbata has smaller ascospores than *A. dimidiata* and larger ascospores and stromata than *A. subverruculosa* and *A. muroiana*. Ascospore range and average as well as stroma size obtained from the type specimen of *A. sublimbata* [18–20.5 × 7–9.5/19.4±0.6 × 8.1 ±0.6 µm (n=24), 400–625 µm high, 600–725 µm wide (n=10)] are similar to those of *Rosellinia amblystoma* [15–22 × 6.5–9/17.7±2.2 × 7.4±0.9 µm (n=17), 500 µm high, 700–800 µm wide (n=2)]. Therefore, these two names are considered synonyms.

Two specimens mentioned in Petrini et al. (1989) as *A. muroiana* from France could not be reexamined and belong probably to *R. sublimbata*.

***Astrocystis subverruculosa* (Rehm) L.E. Petrini, comb. nov.** – Figs. 3, 8k–x.

Index Fungorum Registration Identifier: IF 559859

Basionym (IF 154331). – *Rosellinia subverruculosa* Rehm, Anns mycol. 5(6): 526 (1907).

Lectotypus. – SOUTH AMERICA. BRAZIL. Rio Grande do Sul, São Leopoldo, in *Arundinaria*, 1905, leg. S.J. Rick (PACA 18977).

Synonym. – *Rosellinia smilacina* Speg., Anal. Mus. nac. B. Aires, Ser. 3 12: 339 (1909).

Holotypus. – SOUTH AMERICA. ARGENTINA. Tucumán, Parque Rocca, *Smilax campestris*, 15 April 1906, leg. C. Spegazzini (type, LPS 6569).

Description. – Perithecial stromata 400–900 µm diam., at base up to 1000 µm, 300–550 µm high (n=42), mainly uniperitheciate, developing from ectostromal material beneath cuticle, initially conical, becoming cylindrical with cambered top, opaque, dark brown, grey to black, with finely papillate ostioles, singly or gregarious, young stromata entirely covered by cuticle, older stromata only at base. – Stromal wall 25 µm thick, black. – Ascus apical plugs 2–5.5 µm high, upper width 2.5–5 µm, lower width 2–4 µm (n=36), staining blue in Melzer's reagent, with pronounced square upper rim. – Ascospores 14–22 × 6–11 µm (18.3±1.4 × 8.5±1 µm) (n=260), asymmetrically ellipsoidal with broadly rounded ends and one flat side, dark brown, with slimy sheath surrounding the flat side and both ends, forming 2–4 × 2–4 µm slimy caps, occasionally with 1 semiglobose cellular appendage especially when immature, with germ slit as long as spore.

Hosts: *Poaceae*: *Arthrotylidium*, *Arundinaria*, *Bambusa*, bamboo; *Smilacaceae*: *Smilax campestris*.

Distribution. – NORTH AMERICA. USA, Louisiana. SOUTH AMERICA. Argentina; Brazil; Costa Rica.

Material examined. – *Astrocystis subverruculosa* (Rehm) L.E. Petrini: NORTH AMERICA. USA. Louisiana, Avery Island, Iberia Parrish, *Bambusa* sp., 06 March 1985, leg. D.A. Glawe no. 85–33 (NY 04449002). – *Hypoxyton culmorum* Cooke: SOUTH AMERICA. COSTA RICA. Am Rio Poos zwischen Salanilla de Alajuela und San Pedro, *Arthrotylidium*, 10 January 1925, leg. H. Sydow (Z Myc 0012913 (at ZT), ex Herb. Dr. F. Petrak). – *Rosellinia amblystoma* Berl. & F.Sacc.: SOUTH AMERICA. COSTA RICA. La Capa pr. San José, in culmis *Arthrotylidii*, 21 December 1924, leg. H. Sydow (ZT Myc 0066871, ex Herb. Dr. F. Petrak). – *Rosellinia smilacina* Speg.: holotype. – *Rosellinia sublimbata* (Durieu & Mont.) Pass.: SOUTH AMERICA. BRAZIL. Sao Paulo, Oriente, Bambus, 06 May 1947, leg. H. Zogg no. 864 (ZT Myc 0066873; Sao Paulo, Oriente, Bambus, 29 April 1947, leg. H. Zogg no. 663 (ZT Myc 0066872); Sao Paulo, Oriente, Bambus, 06 May 1947, leg. H. Zogg no. 865 (ZT Myc 0066874). – *Rosellinia subverruculosa* Rehm: lectotype.; in culmis *Arundinaria*, 1929, leg. S.J. Rick (PACA 19052).

Astrocystis subverruculosa has ascospores of a similar size as, but smaller stromata than *A. sublimbata* and stromata of a similar size as *A. muroiana* but longer ascospores. It is debatable whether *A. subverruculosa* deserves its own species status or should be considered a synonym of *A. sublimbata*. The smaller stromata seen in specimens collected in South America and comparison of the features of

the respective type collections are the rationale to keep *A. subverruculosa* a separate species.

Specimen ZT Myc 0066871 has wider stromata than the other specimens but fits better in this species than in *A. sublimbata* because of its stroma height and collection site. Specimen NY 04449002, collected in Louisiana, has narrower ascospores than the other specimens and stromata showing ectostroma material still attached like plates, not observed in the other specimens of *A. subverruculosa*, *A. dimidiata*, *A. muroiana*, or *A. sublimbata*. However, the available material does not allow erecting a new species and this specimen is thus accommodated in *A. subverruculosa*, mainly because of stroma size and ascospore length.

Ascospore and stroma height of the type specimens of *A. subverruculosa* [16–20 × 8–10 (18.6±0.9 × 9.5 ±0.5 (n=30), 300–400 µm high, 500–550 µm wide (n=5)] and *A. smilacina* [16–19.5 × 7–9.5 (17.9±0.9 × 8.5±0.5 (n=20), 300–500 µm high, 550–900 µm wide (n=5)] are similar, thus justifying to synonymize the two names.

Astrocystis thailandica Daranag. & K.D. Hyde, in Li et al., Fungal Diversity 78: 110 (2016).

Description. – Li et al. (2016): Stromata 650–1075 µm diam., 250–375 µm high, 2–3-peritheciate; asci 88–125 × 8.2–12.2 µm. – Ascus apical plugs 4.5–5 µm high, 2.5–3 µm diam., with pronounced, flared upper rim. – Ascospores 17–24 × 6.2–7.5 µm, with a gelatinous sheath forming slimy caps at each end and germ slit as long as spore length or 3/4 of spore length.

Host plant. – *Poaceae*: Bamboo.

Distribution. – ASIA. Thailand.

Astrocystis thailandica has smaller stromata than *A. eleiodoxae* and *A. multiloculata*, and wider ascospores than *A. eleiodoxae*. Moreover, its ascospores are surrounded by a conspicuous gelatinous sheath absent in the other two species (Li et al. 2016). Larger stromata distinguish *A. thailandica* from species with overlapping spore sizes like *A. dimidiata*, *A. concavisporea*, *A. sublimbata*, and *A. subverruculosa*.

Doubtful species

Astrocystis cocoës (Henn.) Læssøe & Spooner, Kew Bulletin 49: 27. 1994.

Basionym. – *Rosellinia cocoës* Henn., Hedwigia 47: 256. 1908.

Petrini (2004) and Petrini & Ju (2021) consider *A. cocoës* conspecific with *Stilbohypoxyton elaeidi-*

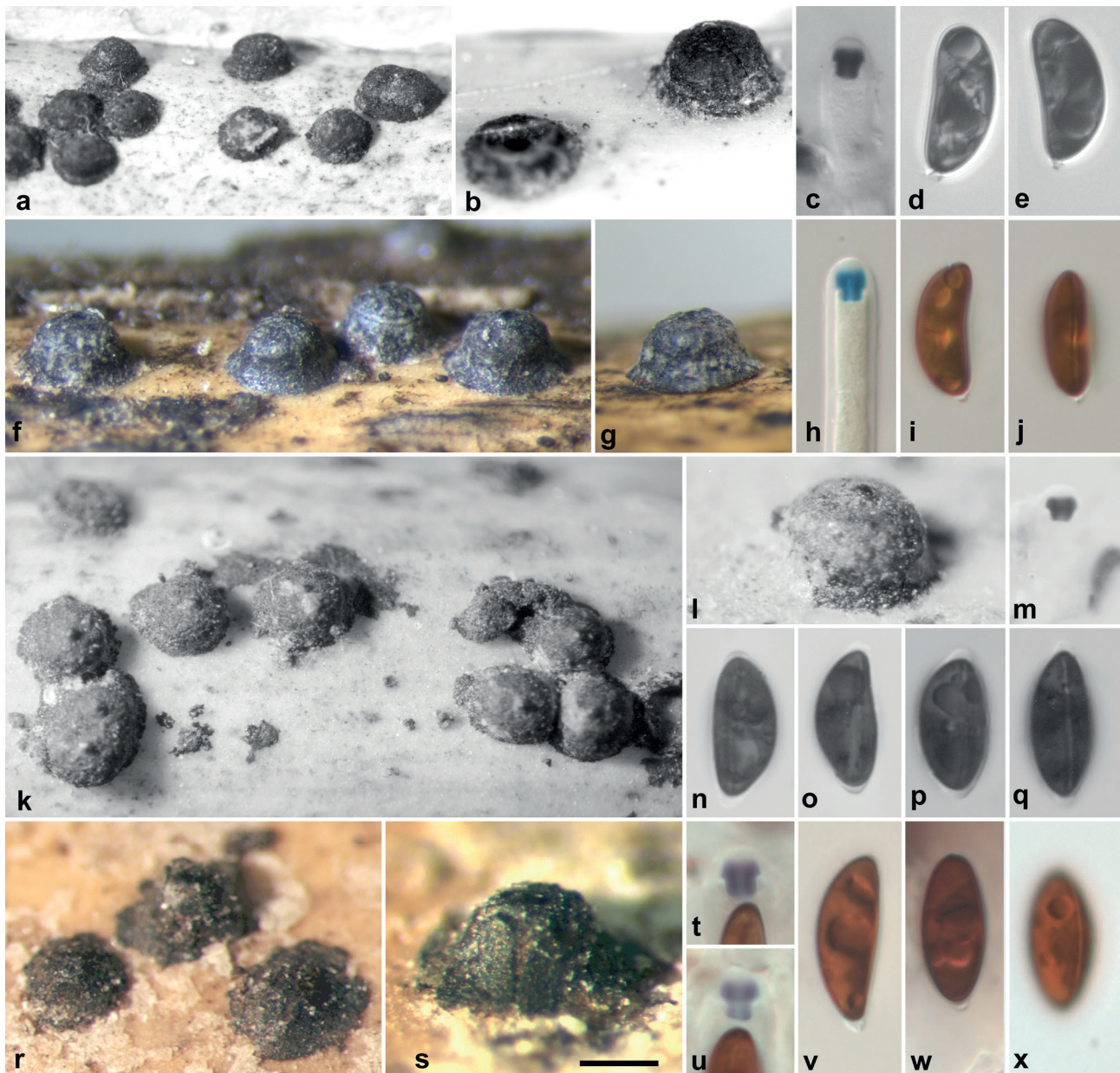


Fig. 8. *Astrocystis sublimbata*. **a, b, f, g.** stromata; **c, h.** ascus apical plug in Melzer's reagent; **d, e, i, j.** ascospores. – *A. subverruculosa*. **k, l, r, s.** stromata; **m, t, u.** ascus apical plugs in Melzer's reagent; **n–q, v–x.** ascospores. (a–e. PC, type of *Sphaeria sublimbata*; f–j. ZT Myc 0066878; k–p. type, PACA 18977; q. PACA 19052; r–x. NY 04449002). Scale bar: a = 1 mm; b, f, g, k, r = 500 µm; l, s = 250 µm; c–e, h–j, m–q, t–x = 10 µm.

cola (Henn.) L. E. Petrini based on observation of stromata with synnemata on the type material [PHILIPPINES: Mindanao, Davao, March 1904, *E. B. Copeland no. 456* (K, W)], a feature typical for *Stilbohypoxylon*. Læssøe & Spooner (1994) differentiate *A. cocoës* from *A. sublimbata*, a decision based on host considerations. They mention peg-like protuberances in an Indian and the Philippine specimens also examined by Petrini (2004) as indic-

ative of synnemata. Pinnoi et al. (2010), on the other hand, retain *A. cocoës* in *Astrocystis*. Their molecular analyses show *A. cocoës* in the same cluster as some *Rosellinia* and *Nemania* species, whereas *A. eleiodoxae* clusters with *Stilbohypoxylon elaeidicola*. Wu et al. (2021) differentiate *A. cocoës* from *A. sublimbata* based on ascospore size and the presence of a mucilaginous sheath in spores of *A. cocoës*. The specimen of *A. cocoës* cited was collected

on dead bamboo and the illustration and measurements provided suggest conspecificity with *A. sublimbata*. Ascospores of *A. sublimbata* have a mucilaginous sheath when in good condition.

Astrocystis selangorensis G.J.D. Sm. & K.D. Hyde, Fungal Diversity 7: 104 (2001).

Description. – Smith & Hyde (2001): **Stromata** 560–700 µm diam., 400–560 µm high, without discoid base, soft-walled; spore bearing part of asci 100–120 × 10–13 µm. – **Ascus** apical plug 3.5–4 µm high, 4–4.5 µm diam., with flared upper rim. – **Ascospores** 15–19 × 7.5–9 µm, with a minute germ pore at one end and germ slit slightly less than whole spore length.

Host plant. – *Areaceae*: *Nypa*.

Distribution. – ASIA. Malaysia.

Stromata of *A. selangorensis* are soft-walled and lack the discoid base.

Excluded species

There are no other species to exclude presently from *Astrocystis* than those mentioned by Ju & Rogers (1990) and Læssøe & Spooner (1994), i.e. *Astrocystis amazonensis* Bat. & H. Maia, *Astrocystis capparis* A.K. Kar & Maity, and *Astrocystis mycophila* (Fr.: Fr.) Teng.

Key to *Astrocystis* species

Text in bold in couplets emphasizes the morphological differences useful for species differentiation. Species in bold have been recorded from *Poaceae*.

Ascospores

- 20–29 µm long.....A
- 14–25 µm long, on average ≥17 µm long.....B
- 10–18 µm long, on average <17 µm long.....C
- 6–12 µm long.....D

A Ascospores 20–29 µm long

- 1. Ascospores **12–14 µm wide**, 23–28 µm long, stromata 400–500 µm high, **575–700 µm wide** ...
.....*A. guyanae*
- 1*. Ascospores **9.5–12 µm wide**, 22–29 µm long, stromata 375–525 µm high, **400–625 µm wide** ...
.....*A. madeirensis*

B Ascospores 14–25 µm long, on average ≥17 µm long

- 1. Ascospores **<6 µm wide**, 17.5–23 µm long, 4.5–6.2 µm wide, stromata 250–375 µm high, 825–1375 µm wide.....*A. eleiodoxae*

- 1*. Ascospores **>6 µm wide**.....2
- 2. Ascospores 17–25 µm long.....3
- 2*. Ascospores 14–22.5 µm long.....5
- 3. Ascospores **≤7.5 µm wide**, 17–24 µm long, 6.2–7.5 µm wide, stromata 250–375 µm high, 650–1075 µm wide.....*A. thailandica*
- 3*. Ascospores **≤11 µm wide**.....4
- 4. Ascospores 19–25 µm long, 7–11 µm wide, **stromata 600–2400 µm high, 600–3000 µm wide**
.....*A. multiloculata*
- 4*. Ascospores 19.5–24 µm long, 8–11 µm wide, **stromata 450–550 µm high, 575–750 µm wide** ...
.....*A. dimidiata*
- 5. Ascospores with **concave ventral side, stromata up to 350 µm high**, up to 350 µm wide
.....*A. concavispora*
- 5*. Ascospores with **flat ventral side, stromata up to 625 µm high, >400 µm wide**6
- 6 **Stromata 300–550 µm high, 400–900 µm wide** ..
.....*A. subverruculosa*
- 6*. **Stromata 400–625 µm high, 500–800 µm wide**, at base up to 1125 µm.....*A. sublimbata*

C Ascospores 10–18 µm long, on average <17 µm long

- 1. Stromata splitting, perithecial stromata with denticles around top or surrounded by stromal lobes2
- 1*. Stromata not splitting, perithecial stromata lacking denticles or stromal lobes3
- 2. Ascospores 5.5–8 µm wide.....*A. mirabilis*
- 2*. Ascospores 4–6 µm wide.....*A. bambusae*
- 3. Ascospores **with pinched ends**, stromata 200–425 µm high, 625–1250 µm wide.....
.....*A. marginatoclypeata*
- 3*. Ascospores **with rounded ends**4
- 4. Stromata ≤200 µm high5
- 4*. Stromata >200 µm high6
- 5. Stromata 130–200 µm high, 200–730 µm wide, 1–3-peritheciate, **surrounded at base by ectostromal material***A. bambusicola*
- 5*. Stromata 175–200 µm high, 225–750 µm wide, at base up to 1375 µm in diam., 1–8-peritheciate, **encased in ectostromal material** and only top of perithecial stroma exposed*A. sasae*
- 6. Stromata >800 µm high, 1000–1300 µm wide....
.....*A. palmarum*
- 6*. Stromata smaller.....7
- 7. On palms.....8
- 7*. On other hosts9
- 8. **Maximal ascospore length 14 µm**, stromata 400–625 µm high, 675–750 µm wide
.....*A. rachidis*

- 8*. Maximal ascospore length >14 µm, stromata 260–430 µm high, 700–1000 µm wide *A. sinensis*
9. Ascospores with short, 7–10 µm long germ slit, stromata 225–350 µm high, 450–550 µm wide... *A. hughesii*
- 9*. Ascospores with germ slit almost or as long as spore 10
10. Stromata 1–2-peritheciate, stromata 375–500 µm high, 500–750 µm wide, on tree ferns.... *A. cyatheae*
- 10*. Stromata 1–2-peritheciate and pluriperitheciate, on *Smilax* or bamboo 11
11. Stromata 300–400 µm high, up to 2000 µm wide, on *Smilax* *A. smilacicola*
- 11*. Stromata 200–400 µm high, 300–700 µm wide if 1–3-peritheciate, up to 3000 x 1625 µm wide if pluriperitheciate, on bamboo *A. muroiana*

D Ascospores 6–12 µm long

1. Maximal ascospore length ≤8.5 µm 2
- 1*. Maximal ascospore length 8.5–11 µm 3
2. Stromata 210–250 µm high, 250–390 µm wide, ascospores 6–8.5 µm long, 3.5–4.5 µm wide *A. cepiformis*
- 2*. Stromata 350–425 µm high, 575–750 µm wide, ascospores 7–8.5 µm long, 4–5 µm wide, stromata *A. hemisphaerica*
3. Maximal ascospore width ≤5 µm 4
- 3*. Maximal ascospore width >5 µm 7
4. Ascospores with short, 5–5.5 µm long germ slit, 8–11 µm long, 4.5–5 µm wide, stromata 250–400 µm high, 300–450 µm wide *A. rarissima*
- 4*. Ascospores with germ slit as long as spore or nearly so 5
5. Stromata 450–750 µm high, 775–1125 µm wide, conical, ascospores 8–11 long, 3–5 µm wide..... *A. formosa* var. *formosa*
- 5*. Stromata ≤600 µm wide 6
6. Ascospores 8.4–9.6 µm long, 3.3–4.5 µm wide, stromata 300–400 µm high, 400–600 µm wide, mammoid with discoid base *A. nypae*
- 6*. Ascospores 9–10 µm long, 4.5–5 µm wide, stromata 250–375 µm high, 375–525 µm wide, semiglobose *A. ambigens*
7. Stromata up to 700 µm wide, 300–600 µm high, subglobose, oblate, ascospores 8–12 µm long, 3.5–6 µm wide *A. fimbriata*
- 7*. Stromata wider 8
8. Stromata 350–450 µm high, 575–950 µm wide, semiglobose to cupulate, ascospores 8.5–11 µm long, 5–6 µm wide... *A. formosa* var. *flavozonata*

- 8*. Stromata 500–750 µm high, 650–1000 µm wide, semiglobose, ascospores 10–12.5 µm long, 5–6.7 µm wide *A. rudis*

Discussion

Morphology

Spore and stroma size, and additionally length of germ slit, shape of ascospores or number of perithecia in a stroma allow distinguishing 29 taxa of *Astrocystis*, including one new species and eight new combinations. Most species (>80 %), unfortunately, are known only from the type material or a limited number of additional specimens, often from the same or nearby localities. Only *A. bambusae*, *A. mirabilis*, *A. muroiana*, *A. sublimbata*, and *A. subverruculosa*, all from bamboo, are documented by several specimens and thus allow evaluating their variability. From palm hosts only *Astrocystis rachidis* is represented by numerous specimens.

Stromata: Læssøe & Spooner (1994) distinguish two groups of species, those with splitting (i.e., *A. bambusae*, *A. mirabilis*) and others with non-splitting stromata. In species with splitting stromata the ectostromal material (conidiomal material) splits into lobes with host cuticle tightly attached surrounding the now exposed entostroma (perithecial stroma) in a stellate manner (e.g., Figs. 1e, 6a, b). In species with non-splitting stromata the ectostroma is shed off, leaving sometimes dust particles attached (e.g., Fig. 6o) and eventually is reduced to a stromal thickening at the base of the entostroma or to a ring as first illustrated for *A. muroiana* (Hino & Katumoto 1958) (e.g., Figs. 6k, o–q, w, x, 8a, f, k, r) or material remains attached as plates (e.g., Figs. 5m, n, 8s).

Ascospores: Species can be accommodated in four arbitrary categories according to their spore length as shown in the identification key herein, and within these categories, stroma size is the discriminating factor for species delimitation. *Astrocystis guyanae* and *A. madeirensis* are characterized by their large spore size, ranging 20–29 µm. Six species, i.e., *A. concavispora*, *A. dimidiata*, *A. eleiodoxae*, *A. multiloculata*, *A. sublimbata*, *A. subverruculosa*, and *A. thailandica*, have ascospores of 14–25 µm in length, on average ≥17 µm long. Twelve species have ascospores of 10–18 µm, on average <17 µm long: *A. bambusicola*, *A. bambusae*, *A. cyatheae*, *A. hughesii*, *A. marginatoclypeata*, *A. mirabilis*, *A. muroiana*, *A. palmarum*, *A. rachidis*, *A. sasae*, *A. sinensis*, and *A. smilacicola*. Eight species and one variety, i.e., *A. ambigens*, *A. cepiformis*, *A. formosa* var. *formosa*, *A. formosa* var. *flavozonata*,

A. fimbriata, *A. hemisphaerica*, *A. nypae*, *A. rarissima*, and *A. rudis*, are small spored (6–12 µm in length). Ascospores with a slimy sheath and caps were seen in specimens of *A. bambusae*, *A. dimidiata*, *A. guyanae*, *A. mirabilis* (Ju & Rogers 1990), *A. muroiana*, *A. sasae*, *A. sublimbata*, and *A. subverruculosa*. In some species (*A. bambusae*, *A. cyatheae*, *A. dimidiata*, *A. guyanae*, *A. hughesii*, *A. muroiana*, *A. sasae*, *A. sublimbata*, and *A. subverruculosa*), young ascospores and some mature ones bear a cellular appendage. Detection of the presence of slimy sheaths and caps, however, often depends on the age and quality of the material.

Ascus apical plugs: Three types of ascus apical plugs were observed. One is reminiscent of that in *Dematophora* R. Hartig, comprising the species of *Rosellinia* De Not. with synnemateous anamorphs, with a pronounced, often square upper rim, the plug being higher than wide (e.g., Fig. 8c, h, m, t, u) and occurring in most species on *Poaceae*, like *A. bambusae*, *A. bambusicola*, *A. concavisporea*, *A. guyanae*, *A. hughesii*, very likely *A. madeirensis*, *A. mirabilis*, *A. multiloculata*, *A. muroiana*, *A. sasae*, *A. sublimbata*, *A. subverruculosa*, and *A. thailandica*; in *A. dimidiata* and *A. smilacicola* on *Smilacaceae* (Ju & Rogers 1994); in *A. cyatheae* on *Cyatheaceae*; and in *A. sinensis* on *Areaceae*. The second type, similar as in *Nemania*, is as high as wide with flared upper rim (e.g., Fig. 7d, j) and is present in species on *Areaceae* like *A. eleiodoxae*, *A. nypae*, *A. palmarum*, and *A. rachidis*. The third type is wider than high (e.g., Fig. 4c, l, m, v) occurring in small spored species such as *A. cepiformis*, *A. fimbriata*, *A. rarissima* (on *Pandanaceae*), *A. hemisphaerica* (on *Agavaceae*), *A. rudis* (on *Areaceae*), *A. formosa* var. *formosa*, and *A. formosa* var. *flavozonata* (on *Poaceae*). Ascus apical plugs could not be studied in *A. madeirensis*, *A. marginatoclypeata*, and *A. ambigens*.

Anamorphs: The conidial form was observed in cultures from *A. bambusae* (Ju & Rogers 1990), *A. cyatheae* (Petrini 2003), *A. mirabilis* (Ju & Rogers 1990), and *A. sublimbata* including a specimen of *A. muroiana* (Ju & Rogers 1994), as well as on young stromata on the host in one specimen of *A. mirabilis*. The conidial form of all these species is morphologically similar to that of *Collodiscula japonica* I. Hino & Katum. described as *Acanthodochium collodisculae* Samuels, J.D. Rogers & Nagas. (Samuels et al. 1987).

Molecular analyses

Molecular analyses have shown *A. bambusae*, *A. mirabilis*, and *A. cocoës* (Bahl et al. 2005) and *A. bambusae*, *A. mirabilis*, and *A. muroiana* (as *A. sub-*

limbata) to be separate species (Hsieh et al. 2010). In some analyses, *A. bambusae* and *A. mirabilis* cluster together probably reflecting common morphological characters such as splitting stromata (Bahl et al. 2005, Hsieh et al. 2010, Li et al. 2016, Pinnoi et al. 2010). Molecular analyses of recently described species (*A. bambusicola*, *A. concavisporea*, *A. eleiodoxae*, *A. multiloculata*, and *A. thailandica*) compared to those of *A. bambusae*, *A. mirabilis*, and *A. muroiana* (as *A. sublimbata*), allowed further differentiation, confirmed also by the evaluation of morphological characters (Daranagama et al. 2015; Hyde et al. 2017, 2020; Li et al. 2016; Pinnoi et al. 2010; Wu et al. 2021). Intraspecific variation at the molecular level, however, is unknown, as sequences of only one or two specimens were available for comparison and were used in multiple analyses (Daranagama et al. 2015; Hyde et al. 2017, 2020; Li et al. 2016; Pinnoi et al. 2010; Wu et al. 2021). The paucity of available genomes of more species prevents firm conclusions about species concepts.

Taxonomic position

The diversity of ascus apical plugs suggests that the species presently treated as *Astrocystis* might be accommodated in different genera upon additional consideration of other features derived from studies of freshly collected material, including exhaustive molecular and perhaps metabolite analyses. Species such as *A. mirabilis*, developing ascus apical plugs with a pronounced upper rim and occurring preferably on bambusoid, as well as some on arundinoid, smilacaceous, and cyatheaceous hosts may be best accommodated in *Astrocystis* s. str., while species with other ascus apical morphology and other host preferences (all species fruiting on palms, except *A. sinensis*, and those fruiting on other families than *Poaceae* and *Smilacaceae*) could probably be placed in distinct new or already existing genera. Exhaustive future phylogenetic analyses will tell.

Host plants and distribution

Astrocystis has been so far recorded only from monocots in tropical, subtropical, and neotropical climatic areas and appears to share these habitats with *Stilbohypoxyton elaeidicola* (Henn.) L.E. Petrini, *S. elaeidis* Konta & Hyde, *S. samoënsis* (Henn.) L.E. Petrini & Y.-M. Ju, or *S. novae-zelandiae* L.E. Petrini, as well as tropical *Rosellinia* from monocotyledonous hosts or tree ferns (Petrini 2013, Petrini & Ju 2021). Of 29 taxa (28 species, 1 variety)

presently assigned to *Astrocystis*, one was collected on *Agavaceae* (or *Dracaenaceae*), nine on *Arecaceae*, one on *Cyatheaceae*, three on *Pandanaceae*, 14 on *Poaceae* subfamily *Bambusoideae*, two on *Poaceae* subfamily *Arundinoideae*, three on grasses not

further identified, three on *Smilacaceae*, and one on *Zingiberaceae* (Tab. 2).

Species on palms do not occur on hosts from other host families and vice versa. *Astrocystis rachidis* accounts for most records from various palm

Tab. 2. Hosts and collection countries of *Astrocystis* species.

Host family	Host species	<i>Astrocystis</i> species	Number of specimens	Collection countries
<i>Agavaceae</i> or <i>Dracaenaceae</i>	<i>Yucca</i> or <i>Dracaena</i>	<i>A. hemisphaerica</i>	1, type	Malaysia
<i>Arecaceae</i>	^a <i>Astrocaryum</i>	<i>A. rachidis</i>	1	Ecuador
	^a <i>Calamus</i>	<i>A. rachidis</i>	1	Australia
	<i>Cocos nucifera</i>	<i>A. rachidis</i>	1, type	French Polynesia
	<i>Daemonorops</i>	<i>A. ambigens</i>	1, type	Singapore
	^a <i>Elaeis guineensis</i>	<i>A. rachidis</i>	1	Malaysia
	^b <i>Eleiodoxa conferta</i>	<i>A. eleiodoxae</i>	2, type, same site	Thailand
	^c <i>Jessenia bataua</i>	<i>A. rachidis</i>	1	Ecuador
	^a <i>Korthalsia brassi</i>	<i>A. rachidis</i>	1	Papua New Guinea
	^a <i>Korthalsia brassi</i>	<i>A. rudis</i>	1, type	Papua New Guinea
	^c <i>Mauritia flexuosa</i>	<i>A. rachidis</i>	2, same site	Ecuador
	^a <i>Nypa</i>	<i>A. nypae</i>	1, type	Malaysia
	^a <i>Pinanga</i>	<i>A. rachidis</i>	1	Malaysia
	^a <i>Phytelephas</i>	<i>A. rachidis</i>	1	Ecuador
	^d <i>Trachycarpus fortunei</i>	<i>A. sinensis</i>	4, type, same site	China
	palm	<i>A. marginatoclypeata</i>	1, type	Indonesia
palm	<i>A. palmarum</i>	1, type	Bermuda	
^a palm	<i>A. rachidis</i>	2	Malaysia, Philippines	
<i>Cyatheaceae</i>	^c <i>Cyathea dealbata</i>	<i>A. cyathea</i>	4, incl. type	New Zealand, North Island
<i>Pandanaceae</i>	ⁱ <i>Pandanus eydouxia</i>	<i>A. fimbriata</i>	1, type	Mauritius
	ⁱ <i>Pandanus palustris</i>	<i>A. cepiformis</i>	2, type	Mauritius
	ⁱ <i>Pandanus palustris</i>	<i>A. rarissima</i>	2, type, same site	Mauritius
<i>Poaceae</i> , <i>Bambusoideae</i>	<i>Arthrostylidium</i>	<i>A. subverruculosa</i>	2	Costa Rica
	<i>Arundinaria</i>	<i>A. mirabilis</i>	2, type of <i>R. geasteroides</i> , same site	Louisiana
	<i>Arundinaria</i>	<i>A. subverruculosa</i>	2, type, same site	Brazil
	<i>Bambusa mitis</i> (= <i>Arundo mitis</i>)	<i>A. sublimbata</i>	1, type of <i>R. amblystoma</i>	Portugal
	^g <i>Bambusa multiplex</i>	<i>A. mirabilis</i>	1	Japan
	^g <i>Bambusa vulgaris</i>	<i>A. mirabilis</i>	1, 1	Jamaica, Philippines
	^g <i>Bambusa vulgaris</i>	<i>A. bambusae</i>	1	Ghana
	^h <i>Bambusa vulgaris</i>	<i>A. sublimbata</i>	1	Ghana
	^g <i>Bambusa</i> spp.	<i>A. bambusae</i>	3	India
	^g <i>Bambusa</i> spp.	<i>A. mirabilis</i>	>10	China, Guadeloupe, Indonesia, Mauritius, New Caledonia, Sri Lanka (type), Taiwan

Table 8 cont.

Host family	Host species	<i>Astrocystis</i> species	Number of specimens	Collection countries
	<i>Bambusa</i> spp.	<i>A. suverruculosa</i>	4	Brazil 3, Louisiana
	¹ <i>Dendrocalamus latiflorus</i>	<i>A. bambusae</i>	3	Taiwan
	¹ <i>Dendrocalamus latiflorus</i>	<i>A. mirabilis</i>	1	Taiwan
	⁸ <i>Oxytenanthera</i>	<i>A. bambusae</i>	1	India
	<i>Phyllostachys bambusoides</i>	<i>A. dimidiata</i>	1	France
	¹ <i>Phyllostachys makinoi</i>	<i>A. bambusae</i>	1	Taiwan
	¹ <i>Phyllostachys pubescens</i>	<i>A. mirabilis</i>	1	Taiwan
	<i>Phyllostachys pubescens</i>	<i>A. muroiana</i>	2	Taiwan
	<i>Phyllostachys pubescens</i>	<i>A. sublimbata</i>	1	France
	<i>Phyllostachys</i> sp.	<i>A. sublimbata</i>	1	France
	<i>Sasa japonica</i>	<i>A. sublimbata</i>	1	France
	<i>Sasa nipponica</i>	<i>A. muroiana</i>	1, type	Japan
	<i>Sasa</i> sp.	<i>A. sasae</i>	1, type	Japan
	^{8,1} <i>Schizostachyum</i> sp.	<i>A. bambusae</i>	1	Philippines
	¹ <i>Schizostachyum</i> sp.	<i>A. mirabilis</i>	1	Philippines
	^m <i>Yushania niitakayamensis</i>	<i>A. sublimbata</i>	1	Taiwan
	^{8,1} bamboo	<i>A. bambusae</i>	>10	Guyana, Philippines (type), Taiwan, Thailand
	^{1,k} bamboo	<i>A. bambusicola</i>	3	China, Thailand
	bamboo	<i>A. formosa</i> var. <i>formosa</i>	1	China
	bamboo	<i>A. formosa</i> var. <i>flavozonata</i>	1, type	Indonesia
	bamboo	<i>A. guyanae</i>	1, type	Guyana
	^{8,1} bamboo	<i>A. mirabilis</i>	>10	China, Guadeloupe, Indonesia, Mauritius, New Caledonia, Philippines, Sri Lanka (type)
	bamboo	<i>A. madeirensis</i>	2, type, isotype, same site	Brazil
	^k bamboo	<i>A. multiloculata</i>	1, type	China
	bamboo	<i>A. muroiana</i>	4	Taiwan
	^{8,m} bamboo	<i>A. sublimbata</i>	4	China, Eire, Georgia, Mexico, Philippines, Spain, Taiwan, U.K., Venezuela
	¹ bamboo	<i>A. thailandica</i>	1, type	Thailand
<i>Poaceae</i> , Arundinoideae	ⁿ <i>Arundo donax</i>	<i>A. concavispora</i>	2, type, same site	Italy
	<i>Arundo donax</i>	<i>A. sublimbata</i>	2	Portugal
	<i>Stipa mauritanica</i> (= <i>Arundo mauritanica</i>)	<i>A. sublimbata</i>	1, type	Algeria
	grass culms in pine wood	<i>A. formosa</i> var. <i>formosa</i>	1	Florida
	stout grass	<i>A. hughesi</i>	1, type	Sudan
	⁸ stout grass	<i>A. sublimbata</i>	1	Sudan

Host family	Host species	<i>Astrocystis</i> species	Number of specimens	Collection countries
Smilacaceae	<i>Smilax campestris</i>	<i>A. subverruculosa</i>	1, type of <i>R. smilacina</i>	Argentina
	<i>Smilax</i> sp.	<i>A. dimidiata</i>	1, type and isotype	Brazil
	^g <i>Smilax</i> sp.	<i>A. smilacicola</i>	1, type	Eastern North America
Zingiberaceae	<i>Elettaria</i>	<i>A. formosa</i> var. <i>formosa</i>	1, type	Indonesia

^aSmith & Hyde (2001); ^bPinnoi et al. (2010); ^cFröhlich & Hyde (2000); ^dTaylor & Hyde (2003); ^ePetrini (2003); ^fDulymamode et al. (1998); ^gLæssøe & Spooner (1994); ^hHughes (1953); ⁱJu & Rogers (1990); ^jHyde et al. (2017); ^kWu et al. (2021); ^lLi et al. (2016); ^mJu & Rogers (1994); ⁿDaranagama et al. (2015).

genera distributed in different geographical locations, whereas eight species described also from palms are known only from the type collection or 1–3 additional records from the same locality.

Species from other hosts than *Poaceae* are known only from the type collection or 1–3 additional specimens from nearby areas. *Smilax* is the host for the type specimens of *A. dimidiata* and *A. smilacina* (synonym of *A. subverruculosa*) described respectively from Brazil and Argentina. A specimen on *Phyllostachys* from France had a similar ascospore size as *A. dimidiata*.

Arundo donax and *Stipa mauritanica* of the *Poaceae* subfamily Arundinoideae are hosts for *A. concavispora* and the type specimen of *A. sublimbata*, collected in Southern Europe and Northern Africa. Eight species and the variety represent single records on hosts from the subfamily Bambusoideae, whereas *A. bambusae*, *A. mirabilis*, *A. muroiana*, *A. sublimbata*, and *A. subverruculosa* were repeatedly collected on various bambusoid hosts.

Astrocystis bambusae is reported from Africa, Asia, and South America, *A. mirabilis* from Asia, North and South America, and South Pacific, *A. muroiana* presently from Japan and Taiwan, *A. sublimbata* from North Africa and Southern Europe, whereas *A. subverruculosa* from South America and southern North America. According to the literature, the geographic distribution of *A. sublimbata* seems more widespread, however, the authors had a different species concept probably including *A. muroiana* or *A. subverruculosa* as well (Ju & Rogers 1994, Læssøe & Spooner 1994, San Martín Gonzalez & Rogers 1995).

Conclusion

Future studies adopting a polyphasic approach including host preferences, and perhaps geographical distribution among others, must confirm or refute the species concepts presented here. For instance, ascospore and stroma size of the type speci-

mens of *A. dimidiata*, *A. muroiana*, *A. sublimbata*, and *A. subverruculosa* are clearly different, but species delimitation gets blurred when additional specimens are available. A pragmatic approach would suggest synonymizing them and perhaps merge also other species if in practice they cannot be keyed out unequivocally. It remains to be seen whether the narrow species concept resulting from recent descriptions of new *Astrocystis* species distinguished mainly by molecular methods is justified, considering that the morphological differences observed are small.

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