




Freshwater Sordariomycetes

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Abstract

Sordariomycetes is one of the largest classes of Ascomycota that comprises a highly diverse range of fungi mainly characterized by perithecial ascomata and inoperculate unitunicate asci. Freshwater Sordariomycetes play an important role in ecosystems and some of them have the potential to produce bioactive compounds. This study documents and reviews the freshwater Sordariomycetes, which is one of the largest and important groups of fungi in aquatic habitats. Based on evidence from DNA sequence data and morphology, we introduce a new order Distoseptisporales, two new families, viz. Ceratosphaeriaceae and Triadelphiaceae, three new genera, viz. *Aquafiliformis*, *Dematiosporium* and *Neospadicoides*, 47 new species, viz. *Acrodictys fluminicola*, *Aquafiliformis lignicola*, *Aquaopteridospora fusiformis*, *Arthriniium aquaticum*, *Ascocacculus fusiformis*, *Atractospora aquatica*, *Barbatosphaeria lignicola*, *Ceratosphaeria aquatica*, *C. lignicola*, *Chaetosphaeria aquatica*, *Ch. catenulata*, *Ch. guttulata*, *Ch. submersa*, *Codinaea yunnanensis*, *Conioscypha aquatica*, *C. submersa*, *Cordana aquatica*, *C. lignicola*, *Cosmospora aquatica*, *Cylindrotrichum submersum*, *Dematiosporium aquaticum*, *Dictyochoeta cangshanensis*, *D. ellipsoidea*, *D. lignicola*, *D. submersa*, *Distoseptispora appendiculata*, *D. lignicola*, *D. neurostrata*, *D. obclavata*, *Hypoxylon lignicola*, *Lepteutypa aquatica*, *Myrmecridium aquaticum*, *Neospadicoides aquatica*, *N. lignicola*, *N. yunnanensis*, *Ophioceras submersum*, *Peroneutypa lignicola*, *Phaeoisaria filiformis*, *Pseudostanjehughesia lignicola*, *Rhodoveronaea aquatica*, *Seiridium aquaticum*, *Sporidesmiella aquatica*, *Sporidesmium lageniforme*, *S. lignicola*, *Tainosphaeria lunata*, *T. obclavata*, *Wongia aquatica*, two new combinations, viz. *Acrodictys aquatica*, *Cylindrotrichum aquaticum*, and 9 new records, viz. *Chaetomium globosum*, *Chaetosphaeria cubensis*, *Ch. myriocarpa*, *Cordana abramovii*, *Co. terrestris*, *Cuspidatispora xiphiago*, *Sporidesmiella hyalosperma*, *Stachybotrys chartarum*, *S. chlorohalonata*. A comprehensive classification of the freshwater Sordariomycetes is presented based on updated literature. Phylogenetic inferences based on DNA sequence analyses of a combined LSU, SSU, RPB2 and TEF1 α dataset comprising species of freshwater Sordariomycetes are provided. Detailed information including their habitats distribution, diversity, holotype, specimens collected and classification are provided.

Keywords 47 new taxa · Asexual morphs · Phylogeny · Sexual morphs · Taxonomy

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Introduction

Shearer (1993) defined freshwater ascomycetes in a broad ecological sense as “all ascomycetes that occur on submerged or partially submerged substrates in aquatic habitats”. Freshwater fungi have also been defined as “fungi that the whole or part of their life cycle rely on freshwater” (Thomas 1996). The definition of Shearer (1993) has been regarded as the best current working definition for the freshwater ascomycetes (Cai et al. 2003a, 2014), and we follow the definition of Shearer (1993) in this study.

Lignicolous freshwater fungi are those that grow on submerged woody debris in freshwater streams, ponds,

lakes, tree hollows, peat swamps and dams (Ho et al. 2002a; Vijaykrishna et al. 2005; Hyde et al. 2016a). They play an important role in nutrient and carbon cycling, biological diversity and ecosystem functioning of freshwater ecosystems with their ability to decompose lignocellulose in woody litter, softening the wood and releasing nutrients (Hyde et al. 2016a). The lignicolous freshwater fungi are highly diverse in the classes Dothideomycetes and Sordariomycetes (Hyde et al. 2013; Maharachchikumbura et al. 2016; Liu et al. 2017; Lu et al. 2018a). There are a few freshwater taxa that belong to Eurotiomycetes (Liu et al. 2015a, b), Orbiliomycetes (Swe et al. 2009) and rarely Basidiomycetes (Hyde and Goh 1998a, 1999; Jones et al. 2014) collected from submerged wood in freshwater habitats.

Sordariomycetes is the second largest class of Ascomycota (Kirk et al. 2008; Hyde et al. 2013; Maharachchikumbura et al. 2015, 2016). Species of Sordariomycetes are mainly characterized by non-lichenized, perithecial ascomata and inoperculate unitunicate or non-fissitunicate asci (Zhang et al. 2006; Kirk et al. 2008). The class Sordariomycetes has a cosmopolitan distribution and accommodates mostly terrestrial taxa (Tang et al. 2007; Maharachchikumbura et al. 2015, 2016; Hongsanan et al. 2017), but there are several sordariomycetous species that have been reported from aquatic habitats (Hyde and Wong 2000; Cai and Hyde 2007; Raja et al. 2009a, b; Réblová et al. 2010, 2016a; Shearer et al. 2010; Hu et al. 2013; Cai et al. 2014; Jones et al. 2015; Lu et al. 2016; Su et al. 2016; Yang et al. 2017, 2018a, b; Luo et al. 2018a, b).

Freshwater Sordariomycetes play an important role in ecosystem functioning and many of them have shown potential application value (Cai et al. 2014). Annulatascaeous, distoseptisporaceous, pleurotheciaceous and halosphaeriaceous species are the most typical and common freshwater Sordariomycetes on submerged wood (Hyde et al. 1999a; Cai et al. 2014; Li et al. 2016a; Réblová et al. 2016a; Zhang et al. 2017a, b; Luo et al. 2018a; Yang et al. 2018a). The modern classification system of the overall Kingdom of Fungi, as well as Sordariomycetes, have been significantly improved with the utilization of molecular sequence data (Hibbett et al. 2007; Maharachchikumbura et al. 2015; Spatafora et al. 2017). Cai et al. (2014) provided a phylogenetic analysis of freshwater Sordariomycetes based on LSU sequence data. Their analysis showed that freshwater Sordariomycetes are scattered in three subclasses, Sordariomycetidae, Hypocreomycetidae and Xylariomycetidae including 13 orders. However, during the last four years, several Sordariomycetes species have been introduced comprising new genera, families, orders, subclasses and some of them were collected from freshwater habitats (Réblová et al. 2015a, b, 2016a, b; Maharachchikumbura et al. 2015, 2016;

Su et al. 2016; Hongsanan et al. 2017; Wijayawardene et al. 2017, 2018; Yang et al. 2017, 2018a, b; Zhang et al. 2017a, b; Song et al. 2018a, b; Wei et al. 2018).

In this study, 129 fresh isolates of sordariomycetous taxa were collected from freshwater habitats in China and Thailand. One new order, two new families, three new genera, 47 new species, two new combinations and 9 new records are introduced. A modified backbone tree based on phylogenetic analysis of combined LSU, SSU, RPB2 and TEF1 α sequence data of the freshwater Sordariomycetes is provided. Phylogenetic trees under genus or family level are also constructed in order to confirm the classification of the new isolates.

Materials and methods

Sample collection and specimen examination

Submerged decaying wood samples were collected from freshwater habitats in Yunnan Province (China) and Chiang Rai, Chiang Mai (Thailand) from 2013 to 2018. The process of morphological studies follows Luo et al. (2018a). Single spore isolates were obtained following the method of Chomnunti et al. (2014) and cultured according to Liu et al. (2010). Herbarium materials are deposited in the Herbarium of Mae Fah Luang University (Herb. MFLU), Chiang Rai, Thailand, Herbarium of Cryptogams Kunming Institute of Botany Academia Sinica (Herb. HKAS) and Dali University (Herb. DLU), Yunnan, China. Living cultures are deposited at Mae Fah Luang University Culture Collection (MFLUCC), Thailand, Kunming Institute of Botany culture collection (KUMCC) and culture collection at Dali University (DLUCC) China. Faces of fungi and Index Fungorum numbers are provided (Jayasiri et al. 2015; Index Fungorum 2019). New taxa are established based on guidelines outlined by Jeewon and Hyde (2016). Taxa deposited in HKU(M) mostly lack sequence data and were moved to IFRD in Kunming, China. These need to be recollected so that reference specimens (sensu Ariyawansa et al. 2014) can be designated.

DNA extraction, PCR amplification and sequencing

Genomic DNA was extracted from fungal mycelium grown on PDA or MEA at room temperature by using a EZ gene TM Fungal gDNA kit (GD2416) according to the manufacturer's instructions. The gene regions of the large subunit of the nuclear ribosomal DNA (LSU), the internal transcribed spacers (ITS), the small subunit of the nuclear ribosomal DNA (SSU), the translation elongation factor (TEF1 α) and RNA polymerase II subunit 2 (RPB2) were

amplified using the primer pairs LR0R/LR7 (Vilgalys and Hester 1990), ITS5/ITS4, NS1/NS4 (White et al. 1990), 983F/2218R (Rehner and Buckley 2005), fRPB2-5F/fRPB2-7cR (Liu et al. 1999) respectively. The ITS, LSU, SSU, RPB2 and TEF1 α amplification reactions were carried out using the method described by Luo et al. (2018a). DNA sequencing were performed with the primers mentioned above at Tsingke Biological Engineering Technology and Services Co., Ltd (Yunnan, P.R. China).

Phylogenetic analysis

Sequences generated from different primers were analyzed with other sequences obtained from GenBank. The sequences were deposited in GenBank and the accession numbers in the analyses were provided in Supplementary material 1. The sequence data were aligned using MAFFT v.7.110 online program (<http://mafft.cbrc.jp/alignment/server/>) (Katoh and Standley 2013) and manually adjusted via BioEdit v.7.2.3 (Hall 1999).

“ALTER” (Glez-Peña et al. 2010) was used to format the aligned fasta file for RAxML analysis. Maximum likelihood (ML) analysis was performed at the CIPRES Science Gateway v.3.3 (<http://www.phylo.org/portal2/>; Miller et al. 2010) using RAxML v.8.2.10 as part of the “RAxML-HPC2 on XSEDE” tool (Stamatakis et al. 2008; Stamatakis 2014). All free model parameters were estimated by RAxML with ML estimates of 25 per site rate categories. The final ML search was conducted using the GTRGAMMA + I model. The best scoring tree was selected with a final likelihood value of -194313.319877 . Phylogenetic tree was visualized using FigTree v1.4.0 (<http://tree.bio.ed.ac.uk/software/figtree/>, Rambaut 2012).

Results

Phylogenetic analysis of combined LSU, SSU, RPB2 and TEF1 α sequence data

The combined LSU, SSU, RPB2 and TEF1 α sequence dataset comprised 857 taxa with *Dothidea sambuci* (AFTOL ID 274), *Leotia lubrica* (AFTOL ID 1) and *Microglossum rufum* (AFTOL ID 1292) as the outgroup taxa. The combined aligned sequence matrix comprises LSU (768 bp), SSU (884 bp), RPB2 (850 bp) and TEF1 α (815 bp) sequence data for 857 taxa with a total of 3317 characters (including the gaps), of which 1046 characters were constant, 391 variable characters were parsimony-uninformative and 1880 characters were parsimony informative. The RAxML tree is shown in Fig. 1.

In the phylogenetic tree (Fig. 1), the 854 strains (including 129 fresh isolates) of Sordariomycetes included in

the analysis cluster into six subclasses: Sordariomycetidae, Hypocreomycetidae and Xylariomycetidae as in the previous treatments of Lumbsch and Huhndorf (2010), Diaporthomycetidae and Lulworthiomycetidae as suggested by Maharachchikumbura et al. (2015), as well as Savoryellomycetidae as suggested by Hongsanan et al. (2017). Of these included strains, 356 were isolated from freshwater habitats and distributed in 47 clades as follows:

Clade 1 represents the family Junewangiaceae with ten species which belong to three genera, viz. *Dictyospora*, *Junewangia* and *Sporidesmiella*. In this study, we provide sequence data for *Sporidesmiella novae-zelandiae* and *S. hyalosperma* for the first time, and introduce a new species *S. aquatica*.

Clade 2 represents the family Pseudoproboscisporaceae with four species from four genera, viz. *Aquaticola hyalomura*, *Cateractispora recepticuli*, *Diluvicola aquatica*, *Pseudoproboscispora thailandensis*.

Clade 3 represents the family Atractosporaceae. Presently, Atractosporales comprises the single family Atractosporaceae which includes two genera. All taxa of Atractosporales are collected from freshwater habitats (Réblová et al. 2016b; Zhang et al. 2017a, b). Two freshwater fungal strains obtained from this study cluster together with other *Atractospora* species and represent an independent lineage with strong support (100% ML). We therefore introduce a new species *Atractospora aquatica* sp. nov.

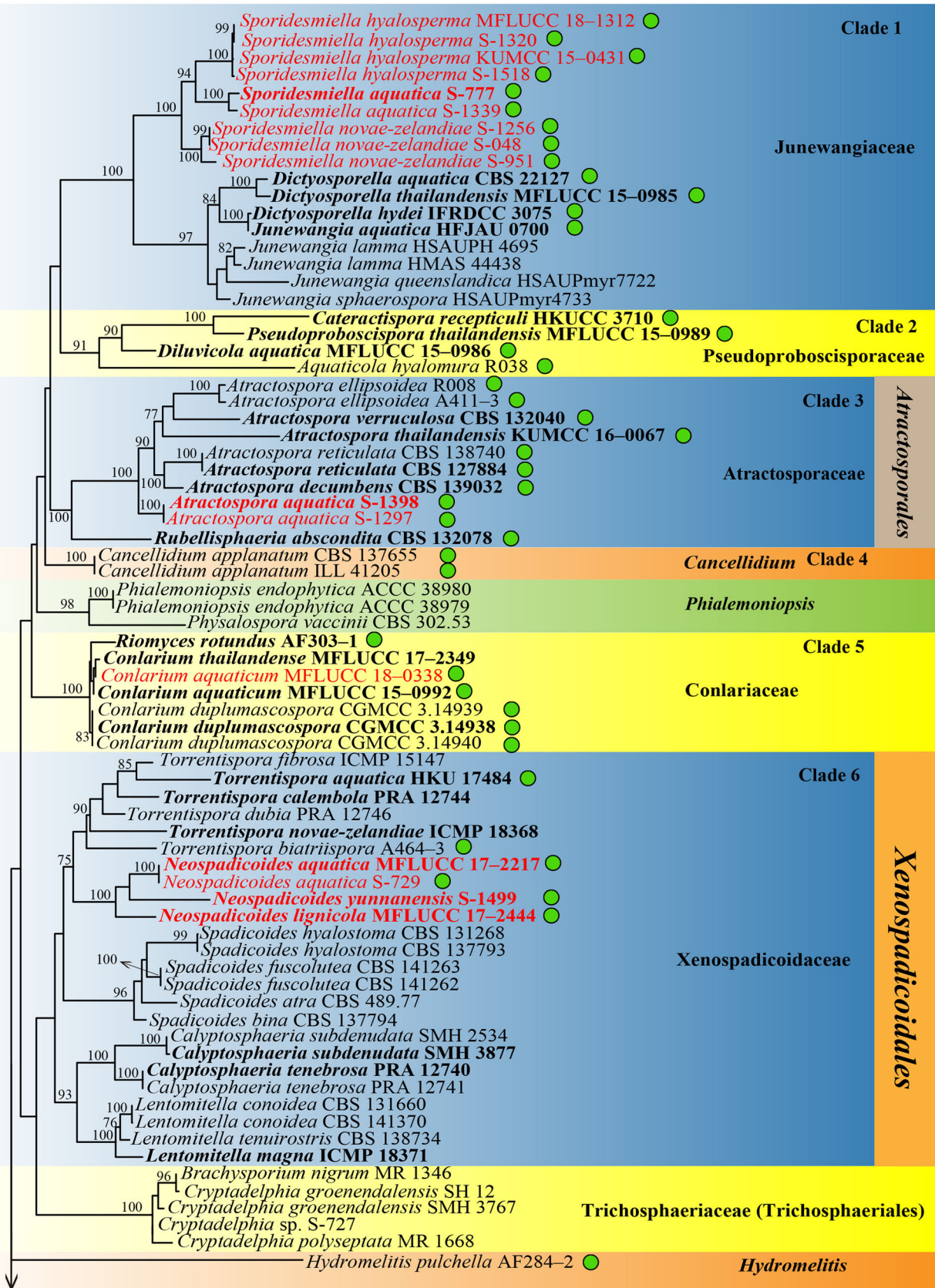
Clade 4 represents the genus *Cancellidium* with two strains of *Cancellidium applanatum*. These two strains were collected from freshwater habitats (Zelski et al. 2014).

Clade 5 represents the family Conlariaceae including three freshwater species of *Conlarium*, and one *Riomyces* species collected from freshwater.

Clade 6 represents the order Xenospadicoidales which was introduced by Réblová et al. (2018). Five freshwater fungal strains obtained in this study cluster together and represent an independent lineage with strong support (100% ML) within Xenospadicoidaceae. A new genus *Neospadicoides* is introduced herein based on phylogeny and morphology.

Clade 7 represents the order Sporidesmiales with a single family Sporidesmiaceae. Most of the species in Sporidesmiaceae are reported from freshwater habitats. For the first time, Zhang et al. (2017a, b) provided the sexual morph for the genus *Sporidesmium*. In this study, we introduce two new species, *Sporidesmium lageniforme* and *Sporidesmium lignicola*, based on both morphological characters and phylogenetic evidence, while *S. lignicola* is reported with both of asexual and sexual morphs.

Clade 8 represents the family Rhamphoriaceae established by Réblová and Štěpánek (2018) which includes four



◀**Fig. 1** Phylogram generated from maximum likelihood analysis based on combined LSU, SSU, RPB2 and TEF1 α sequence data for the species of Sordariomycetes. RAxML bootstrap support values equal to or greater than 75% are given above the nodes. Newly generated sequences are in red. Strains of known species collected from freshwater habitats are marked as “green circle” followed by strain number. Ex-type strains are in bold

genera. We introduce a new *Rhodoveronaea* species which is the first species described from freshwater in this family.

Clade 9 represents the family Acrodictyaceae established by Xia et al. (2017) with a single genus *Acrodictys*. A previously described species, *Barbatosphaeria aquatica* MFLUCC 18–0356 (Hyde et al. 2018), is synonymized under *Acrodictys aquatica*. We introduce a new species, *Acrodictys fluminicola*.

Clade 10 represents the monotypic genus *Pseudostanjehughesia* introduced by Yang et al. (2018a) with *P. aquitropica* as the type species and it was collected from freshwater habitats. We introduce the second species, *P. lignicola* sp. nov.

Clade 11 represents the family Papulosaceae established by Winka and Eriksson (2000). Papulosaceae is typified by the monotypic marine genus *Papulosa* (Winka and Eriksson 2000).

Clade 12 represents the species *Sporidesmium tropicale* (HKUCC 10838, MFLUCC 16–0185). The strain MFLUCC 16–0185 was obtained from the specimen collected from a freshwater habitat (Yang et al. 2018a).

Clade 13 represents the typical freshwater genus *Bulimyces* introduced by Ferrer et al. (2012).

Clade 14 represents the family Barbatosphaeriaceae which was introduced by Zhang et al. (2017a, b). We introduce a new species, *Barbatosphaeria lignicola* based on morphology and phylogeny.

Clade 15 represents the new order Distoseptisporales introduced herein. Su et al. (2016) introduced the family Distoseptisporaceae to accommodate *Sporidesmium*-like taxa based on morphology and phylogeny. Phylogenetic analysis based on combined LSU, SSU, RPB2 and TEF1 α sequence data show that the species of Distoseptisporales cluster together with strong support and form a distinct, strongly supported clade within Diaporthomycetidae.

Clade 16 represents two strains of the genus *Cyanoannulus*. Zhang et al. (2017a, b) established the family Woswasiaceae to accommodate *Woswasia*, *Xylochrysis* and *Cyanoannulus* in Diaporthomycetidae families *incertae sedis* with weak support. In our phylogenetic analysis, species of *Cyanoannulus* formed a distinct clade basal to the order Distoseptisporales and therefore we suggest to place *Cyanoannulus* in Diaporthomycetidae genera *incertae sedis*.

Clade 17 represents the order Annulatascales introduced by Maharachchikumbura et al. (2015). The family Annulatasceae is accepted in this order. Some species of Annulatasceae are lacking sequence data and therefore it is not possible to resolve their phylogenetic affinities.

Clade 18 represents the order Myrmecridiales established by Crous et al. (2015) with a single family, Myrmecridiaceae. We introduce a new species *Myrmecridium aquaticum*. Presently, three species (*M. aquaticum*, *M. fluviae*, *M. montsegurinum*) are collected from freshwater habitats.

Clade 19 represents the family Ophioceraceae, with eight species which were reported from freshwater habitats. We introduce a new species, *Ophioceras submersum*.

Clade 20 represents the new family Ceratosphaeriaceae introduced herein. The order Magnaporthales was introduced by Thongkantha et al. (2009) to accommodate Magnaporthaceae based on morphological characters of both asexual and sexual morphs together with phylogenetic analyses of combined LSU and SSU sequence data. There are four families accepted in Magnaporthales, viz. Magnaporthaceae, Ophioceraceae, Pseudohalonectriaceae, Pyriculariaceae. We introduce the new family Ceratosphaeriaceae to accommodate *Ceratosphaeria* species.

Clade 21 represents the family Pseudohalonectriaceae established by Hongsanan et al. (2017) based on the genus *Pseudohalonectria*. Five strains collected from freshwater habitats are included in our phylogenetic tree.

Clade 22 represents the family Magnaporthaceae introduced by Cannon (1994). We introduce a new monotypic genus *Aquafiliformis*.

Clade 23 represents the family Tirisporellaceae with a freshwater species, *Thailandiomyces bisetulosus* (BCC 00018, BCC 00200) which was introduced by Pinruan et al. (2008).

Clade 24 represents the family Jobellisiaceae with a freshwater species, *Jobellisia guangdongensis* (GD14–4) collected from southern China (Liu et al. 2011a, b).

Clade 25 represents the freshwater genus *Hyalorostratum* established by Raja et al. (2010) with *Hyalorostratum brunneisporum* as the type species.

Clade 26 represents the family Chaetosphaeriaceae established by Réblová et al. (1999) based on *Chaetosphaeria* (Tulasne and Tulasne 1863). We introduce 11 new species in this family, viz. *Chaetosphaeria aquatica*, *C. catenulata*, *C. guttulata*, *C. submersa*, *Codinaea yunnanensis*, *Dictyochaeta cangshanensis*, *D. ellipsoidea*, *D. lignicola*, *D. submersa*, *Tainosphaeria lunata* and *T. obclavata*. *Chloridium aseptatum* (MFLUCC 11–0216) (Wei et al. 2018) is synonymized under *Chloridium gonytrichii*.

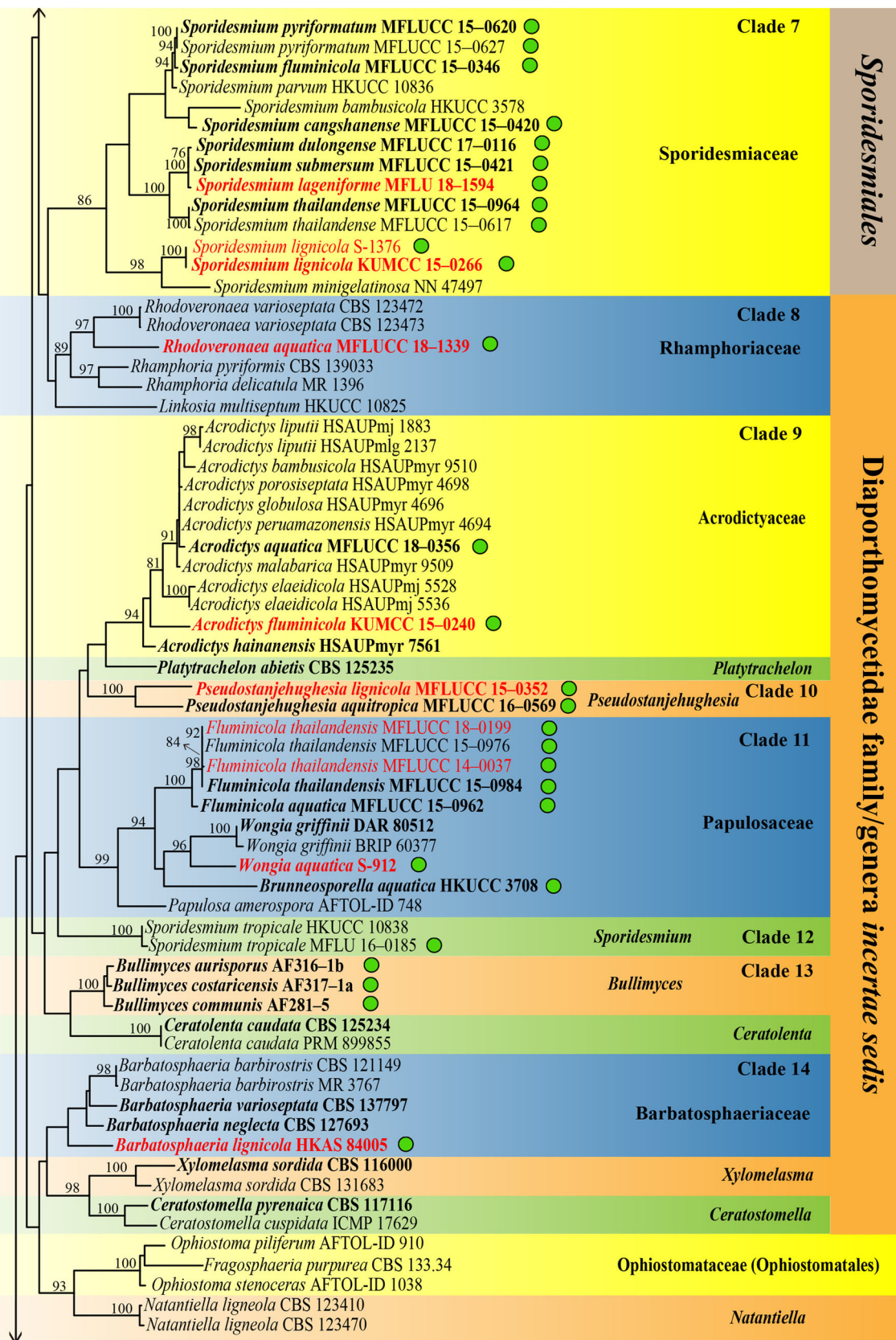


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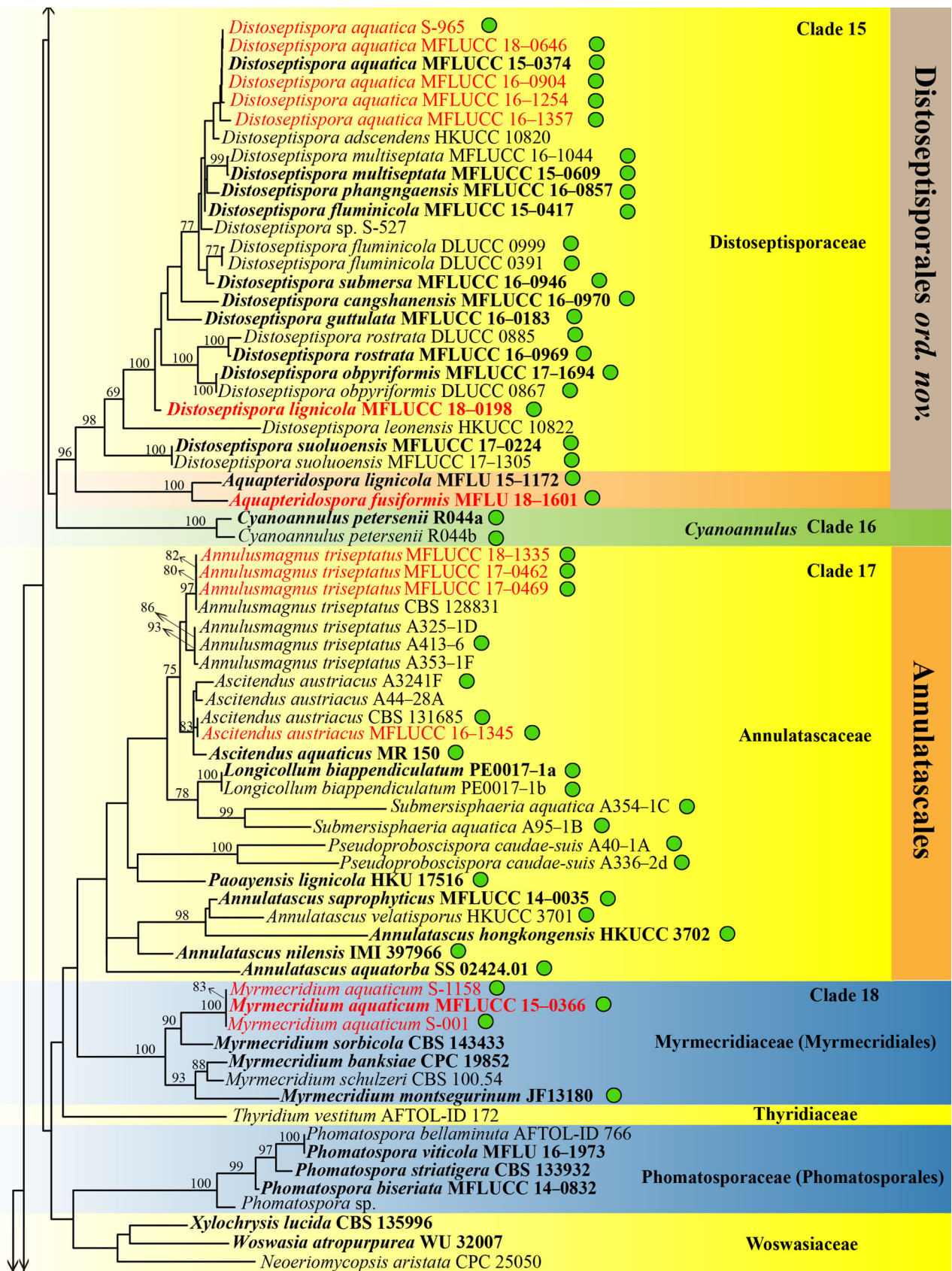


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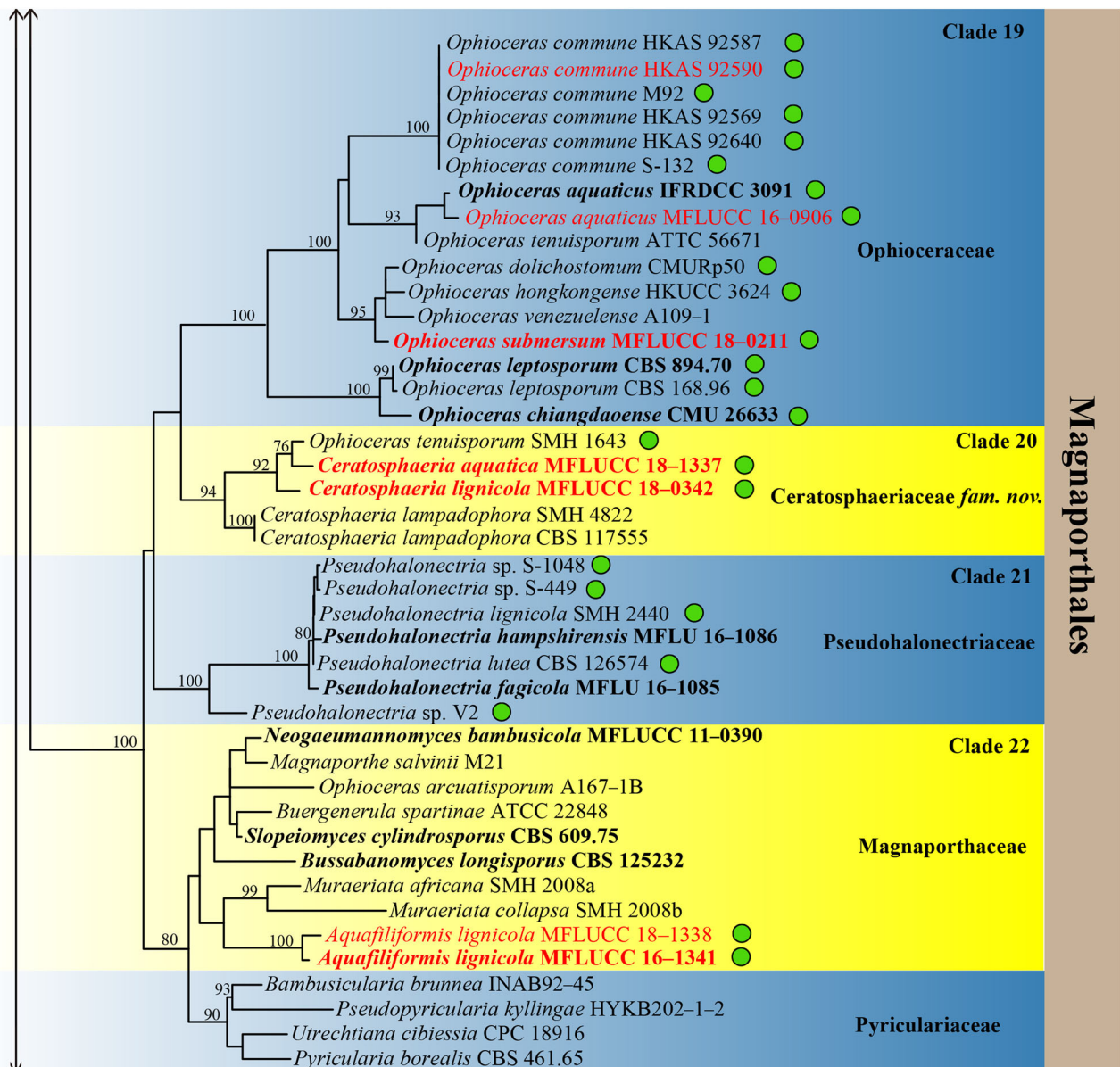


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Clade 27 represents the family Phyllachoraceae with five strains. *Phyllachora* sp. WF33A was collected from freshwater habitats.

Clade 28 represents the single isolate of *Clohiesia*. The species *Clohiesia corticola* (HKUCC 3712) which was collected from freshwater, clusters with species of Phyllachoraceae with weak support.

Clade 29 represents the order Sordariales established by Hawksworth and Eriksson (1986) and comprises three families, viz. Chaetomiaceae, Sordariaceae and Lasiosphaeriaceae sensu lato. Six freshwater species are represented in this clade and most of them are in Lasiosphaeriaceae.

Clade 30 represents the family Cordanaceae. We introduce two new species herein, *Cordana aquatica* and *C. lignicola*, based on morphology and phylogeny. We also provide descriptions, illustrations and molecular sequence data for *Cordana abramovii* and *C. terrestris*.

Clade 31 represents the family Coniochaetaceae with five *Coniochaeta* species and *Coniochaeta gigantospora* (ILLS 60816) which was originally collected from a freshwater habitat (Raja et al. 2012).

Clade 32 represents the family Sporocadaceae and we introduce a new species, *Seiridium aquaticum*.

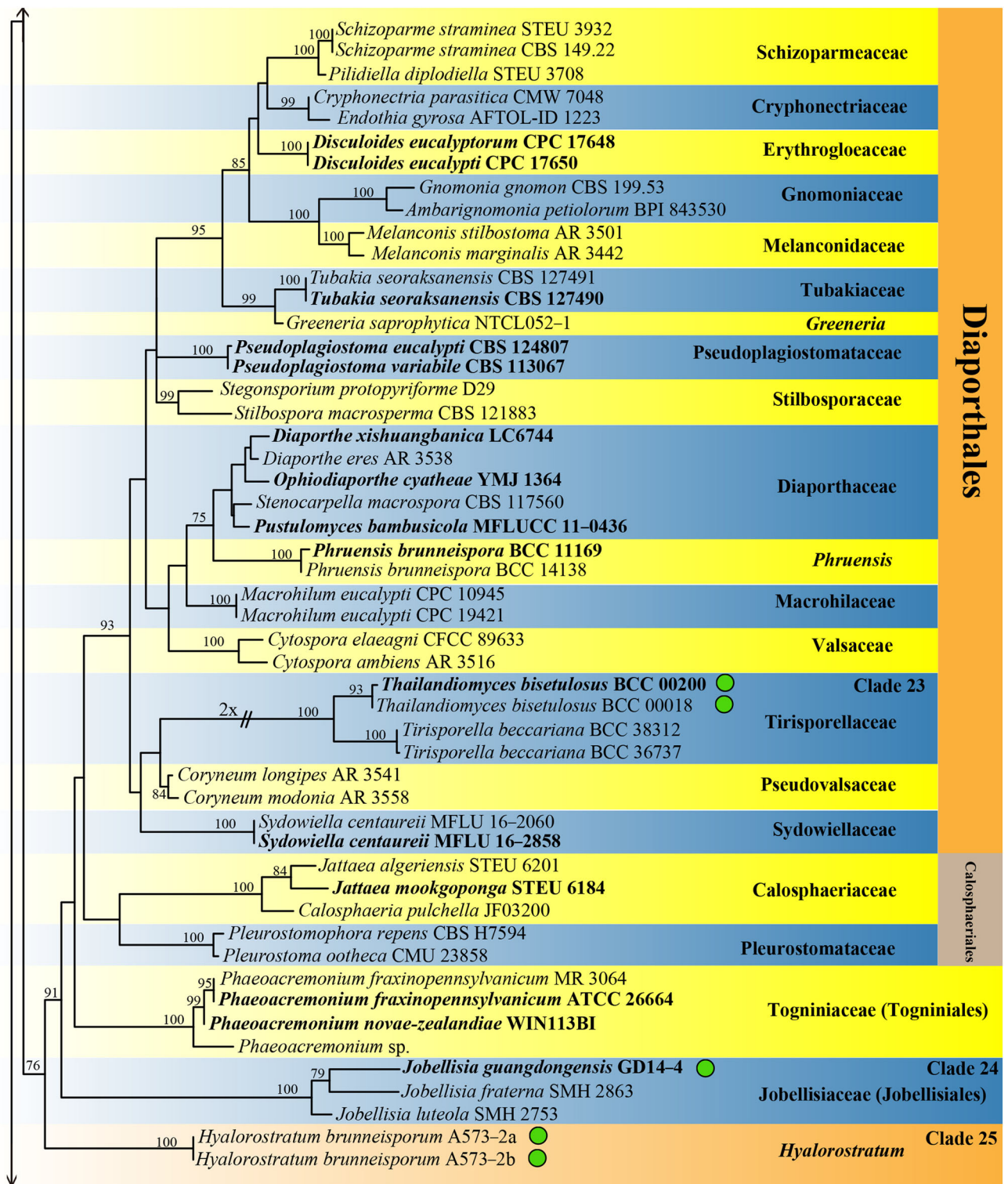


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Clade 33 represents the family Amphisphaeriaceae established by Winter (1885). We introduce a new species, *Lepteutypa aquatica*.

Clade 34 represents the family Apiosporaceae established by Hyde et al. (1998a). A new species, *Arthrinium aquaticum* is introduced.

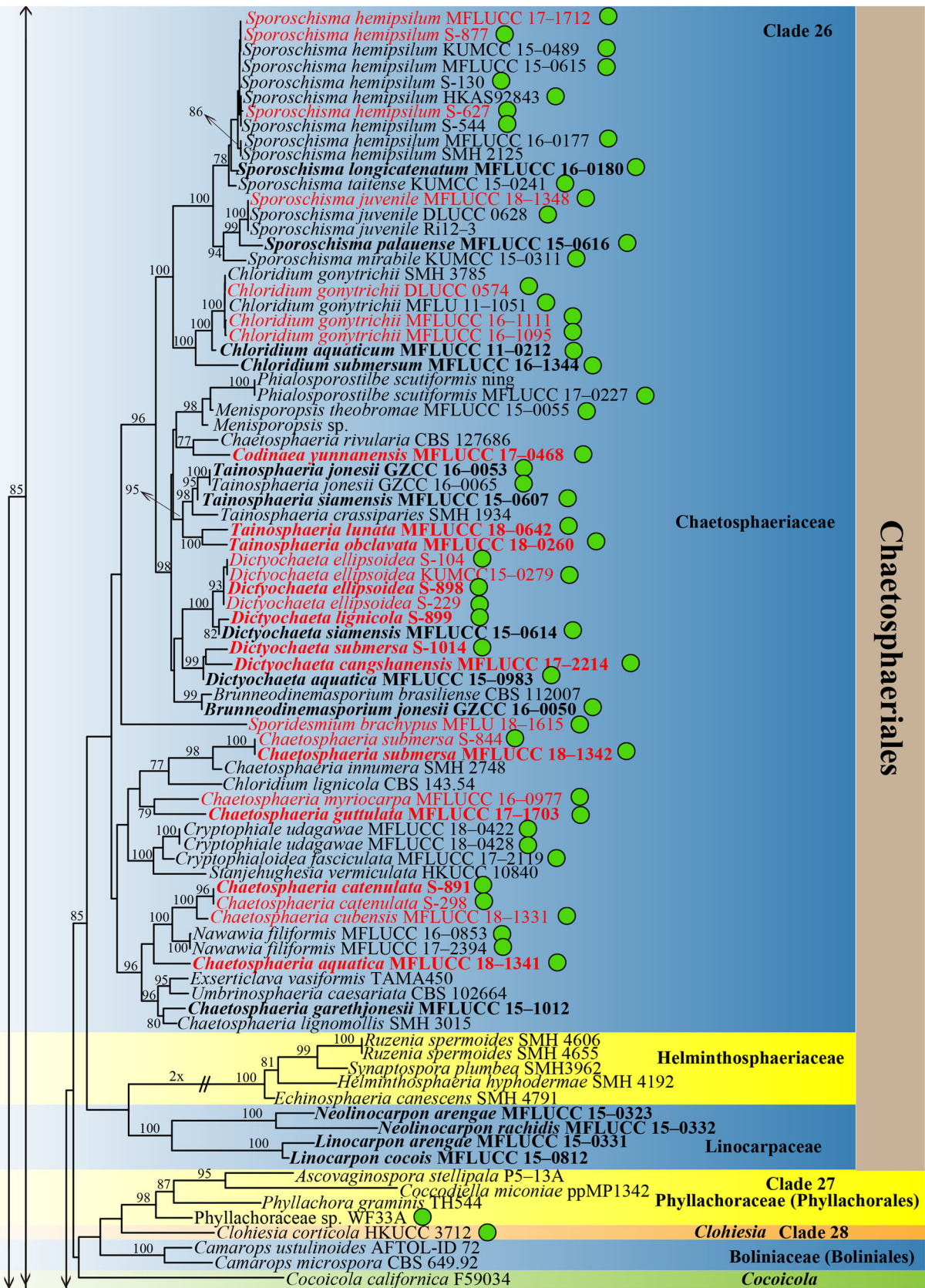


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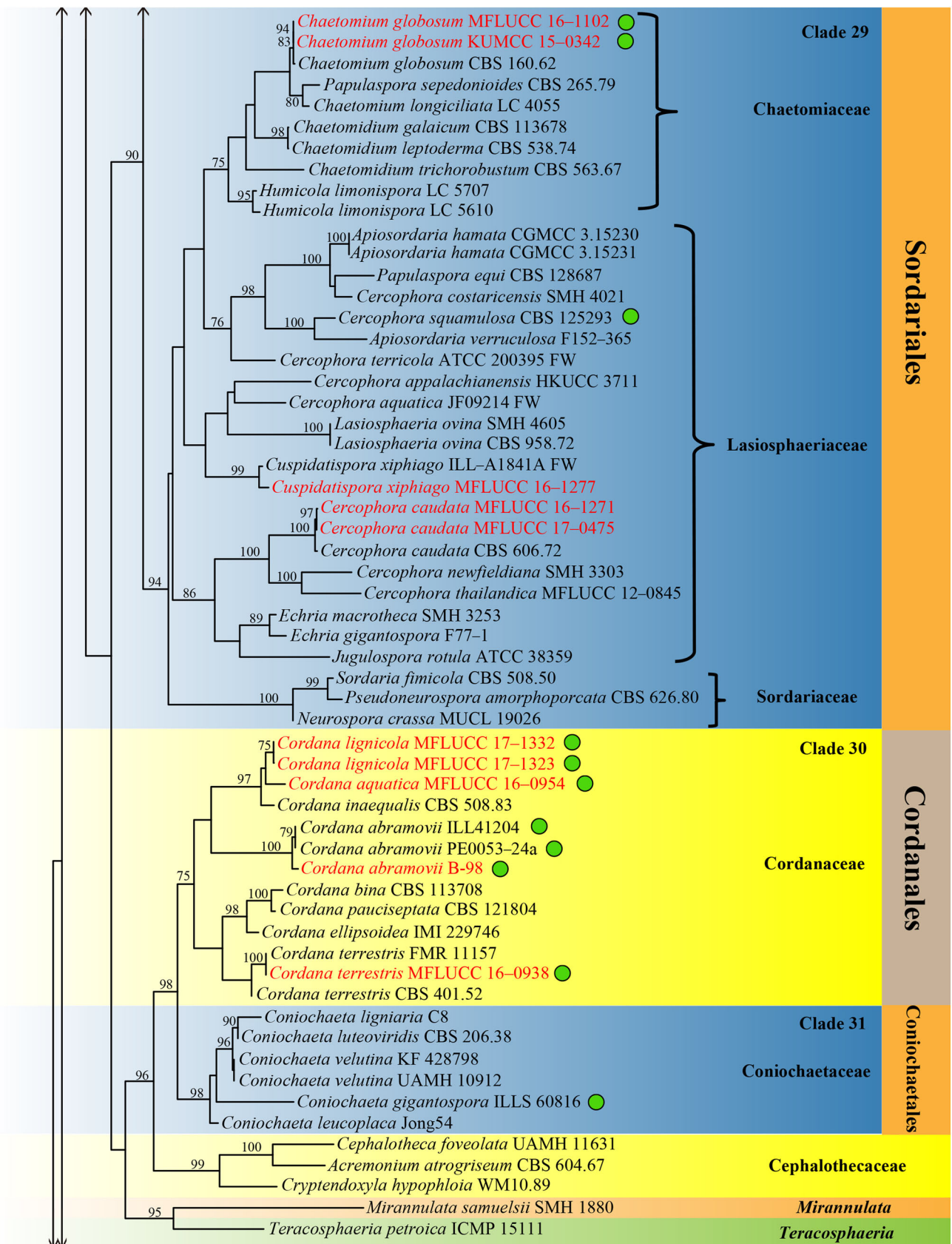


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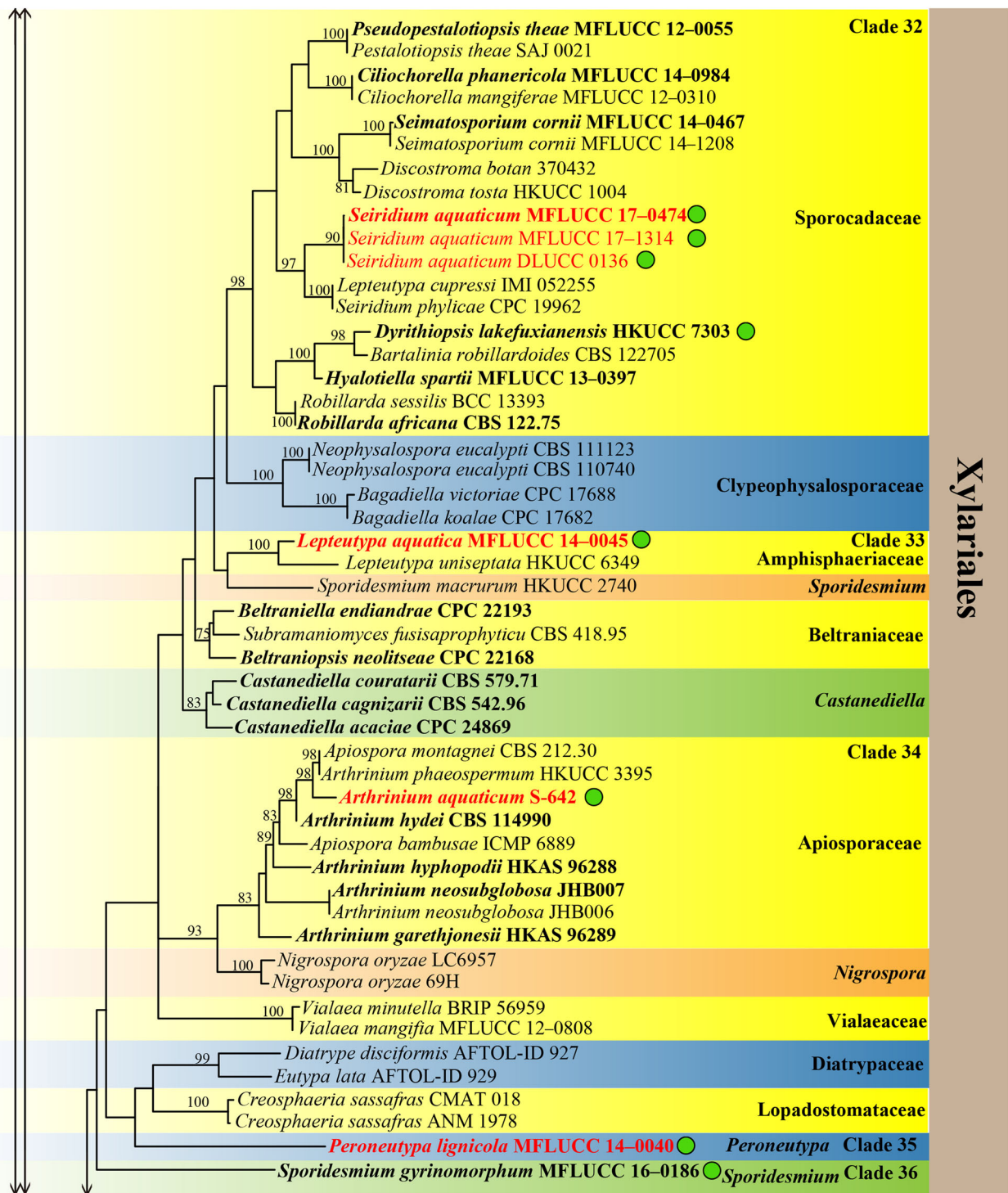


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Clade 35 represents a new species *Peroneutypa lignicola*. The genus *Peroneutypa* has been accommodated in Diatrypaceae (Shang et al. 2018). In our multi-gene phylogenetic analysis, the new species forms a distinct

subclade basal to Lopadostomataceae but close to Diatrypaceae, although this relationship is not supported.

Clade 36 represents the species *Sporidesmium gyrinomorphy* (MFLUCC 16-0186) introduced by Yang et al. (2018a, b).

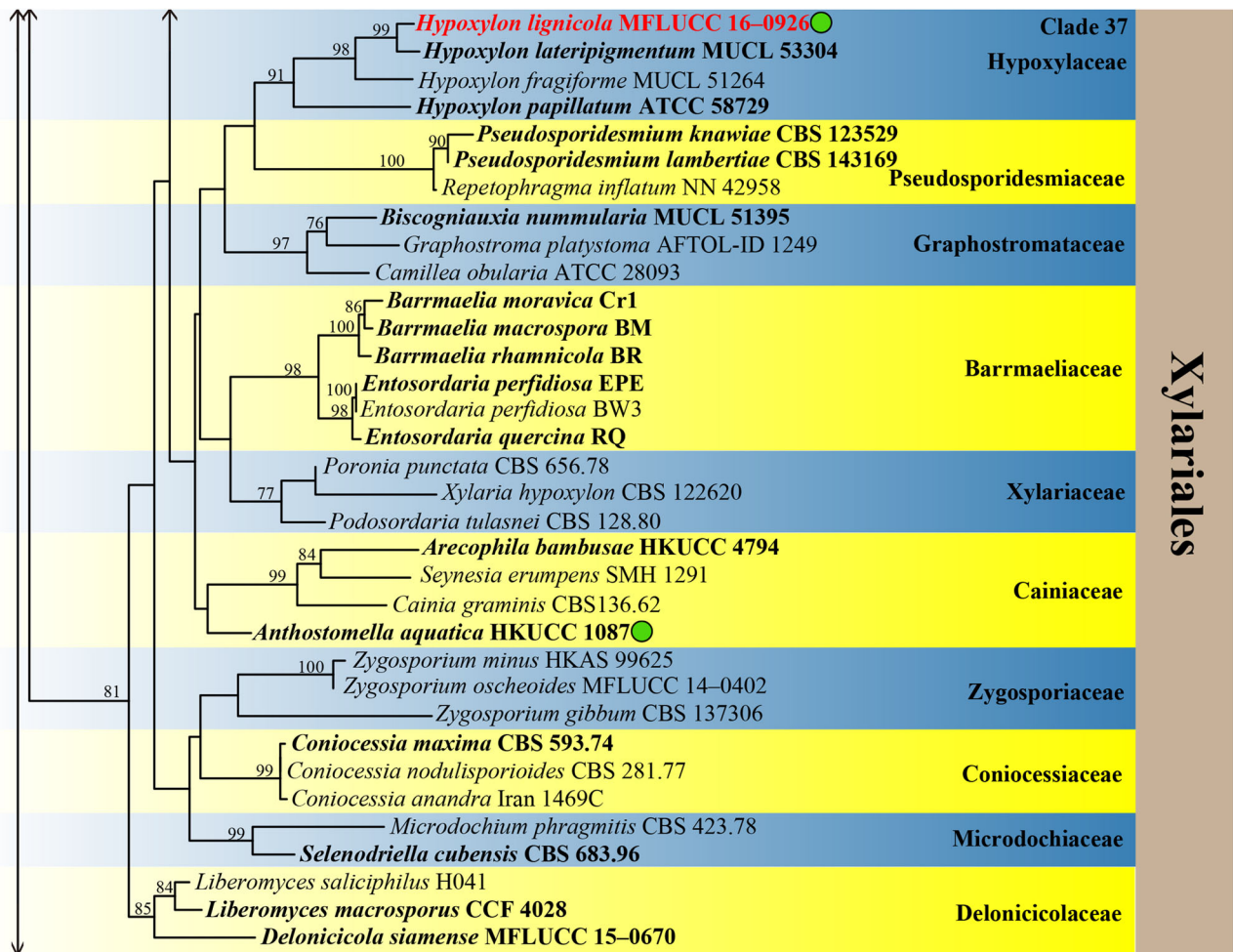


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Clade 37 represents the family Hypoxylaceae with four *Hypoxylon* strains. We introduce a new species *Hypoxylon lignicola* based on morphology and phylogeny. Wendt et al. (2018) emended Hypoxylaceae and accepted 14 genera in this family.

Clade 38 represents the family Nectriaceae including 66 strains. Lombard et al. (2015) accepted 47 genera in this family based on molecular sequence data. We introduce a new species *Cosmospora aquatica*, based on morphology and phylogeny. DNA sequence data for *Aquanectria jacinthicolor*, *A. penicillioides*, *Chaetopsina beijingensis*, *Mariannaea samuelsii*, *M. superimposita* and *Paracremonium binnewijzendii* are provided.

Clade 39 represents the family Stachybotriaceae established by Crous et al. (2014a) in the order Hypocreales to accommodate the genera *Myrothecium*, *Peethambara* and *Stachybotrys*. In this study, morphological characterization and DNA sequence data for *Stachybotrys chartarum* and *S. chlorohalonata* are provided.

Clade 40 represents the family Halosphaeriaceae. In this study, we introduce a new *Ascosacculus* species, *A. fusiformis*, based on morphology and phylogeny.

Clade 41 represents the new family Triadelphiaceae that we introduce herein based on its distinct morphology and molecular phylogeny.

Clade 42 represents the family Reticulascaceae. We introduced a new species herein, *Cylindrotrichum submersum* sp. nov. and synonymise *Blastophorum aquaticum* (Hyde et al. 2016) under *Cylindrotrichum aquaticum*.

Clade 43 represents one of most common and typical freshwater family Pleurotheciaceae established by Réblová et al. (2016a). We introduce a new species, *Phaeoisaria filiformis*.

Clade 44 represents another typical freshwater fungal family Savoryellaceae. We introduce a new genus *Dematiosporium* in this family.

Clade 45 represents the order Conioscyphales established by Réblová et al. (2016a) with a single family

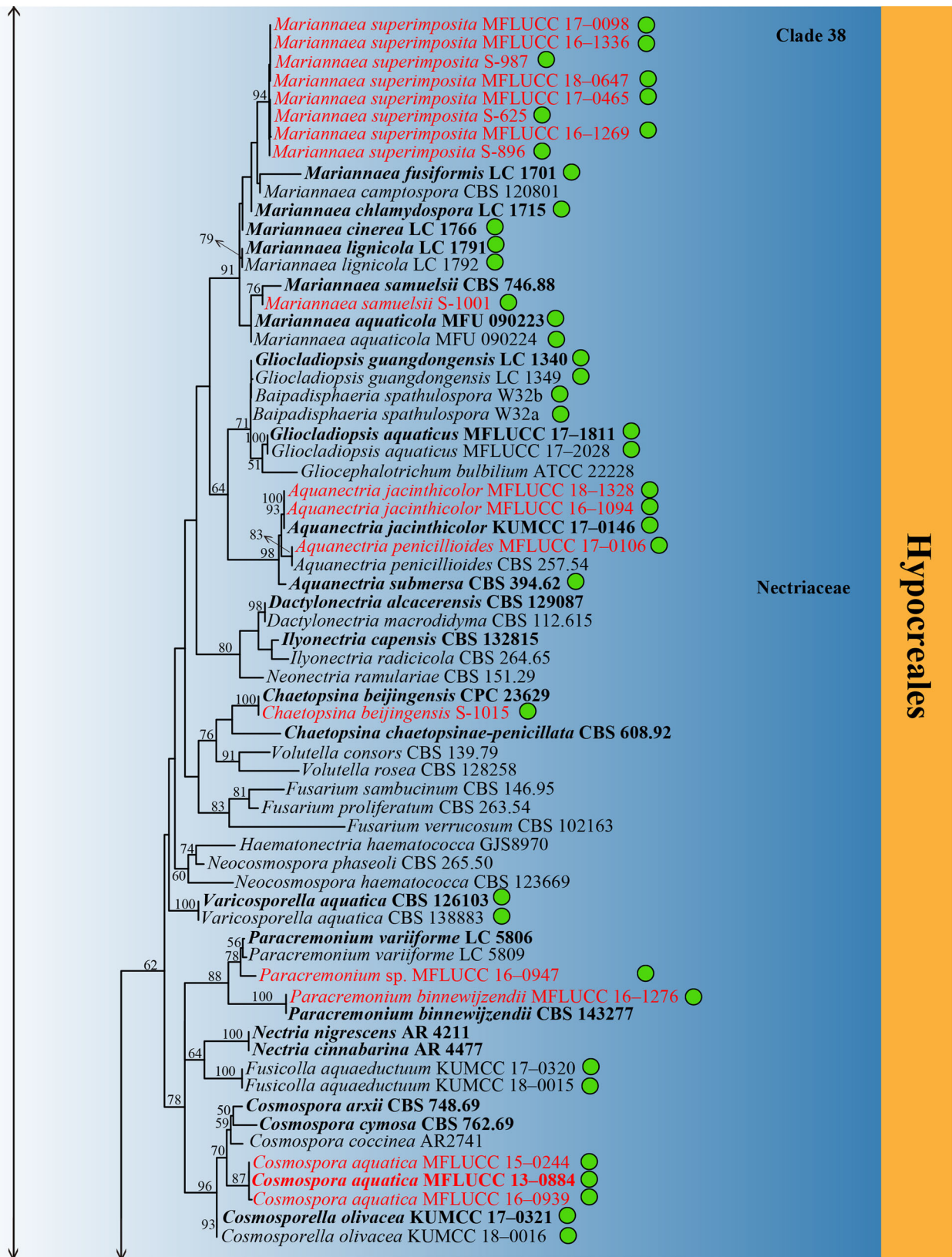


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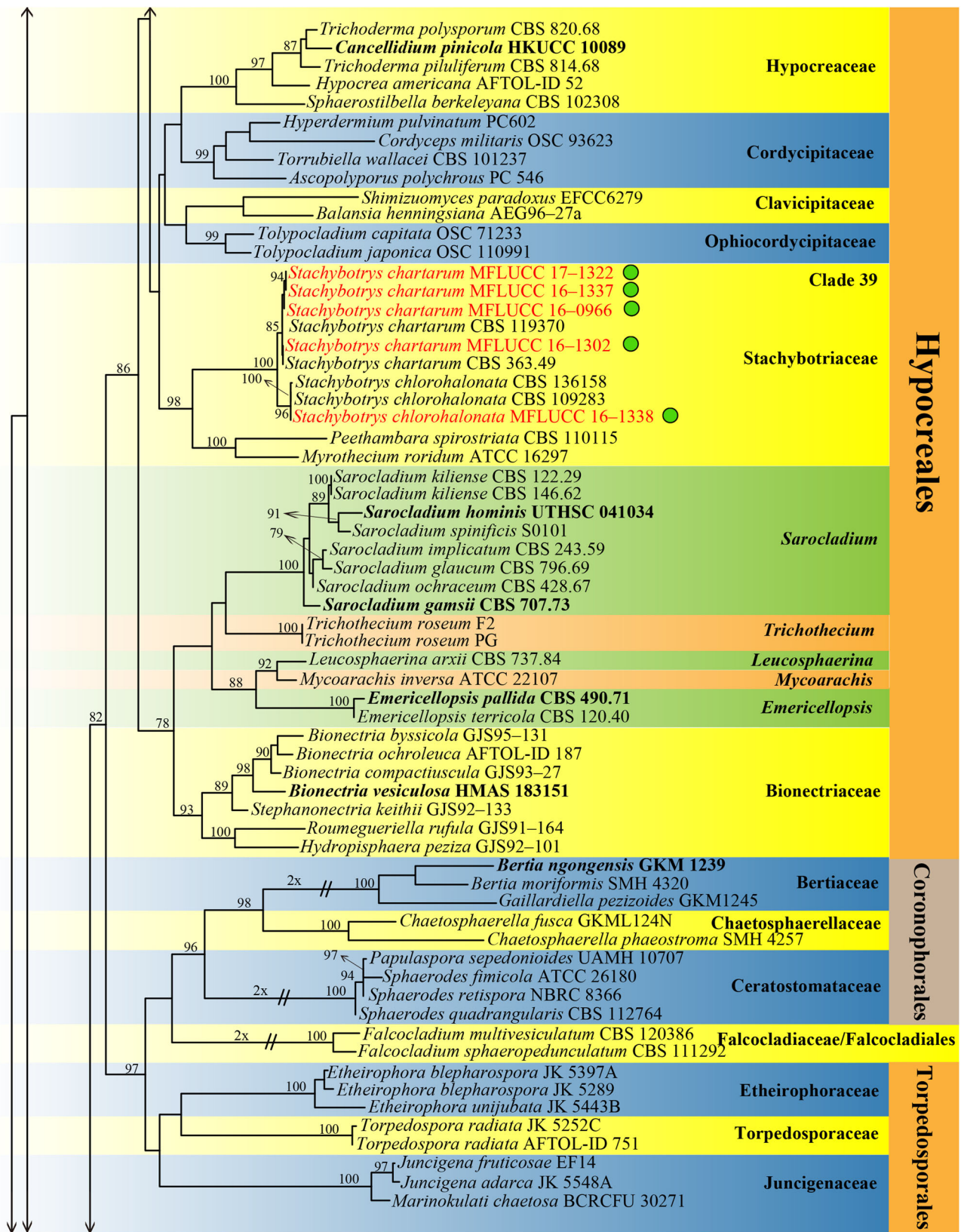


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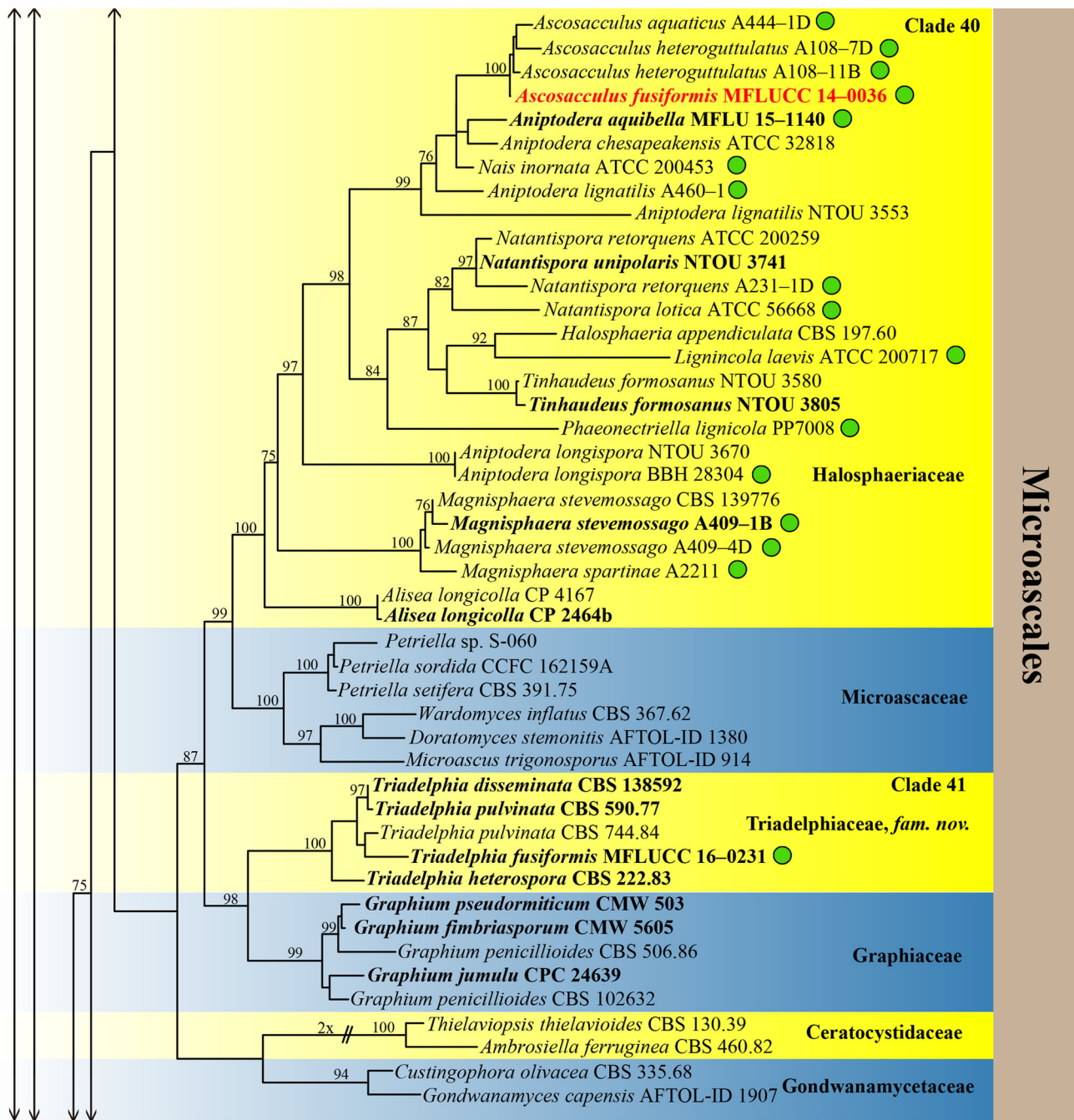


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Conioscyphaceae. We introduce two new species, *Conioscypha aquatica* and *C. submersa*.

Clade 46 represents the monotypic order Fuscosporellales established by Yang et al. (2016a) based on the family Fuscosporellaceae. Most of the species in this order are reported from freshwater habitats.

Clade 47 represents the genus *Flammispora* established by Pinruan et al. (2004a).

Taxonomy

Based on the outline and multigene phylogeny of freshwater Sordariomycetes provided in this study, freshwater Sordariomycetes are scattered in six sub-classes, viz. Diaporthomycetidae, Hypocreomycetidae, Lulworthiomycetidae, Savoryellomycetidae, Sordariomycetidae and Xylariomycetidae. In this section, we provide the notes for

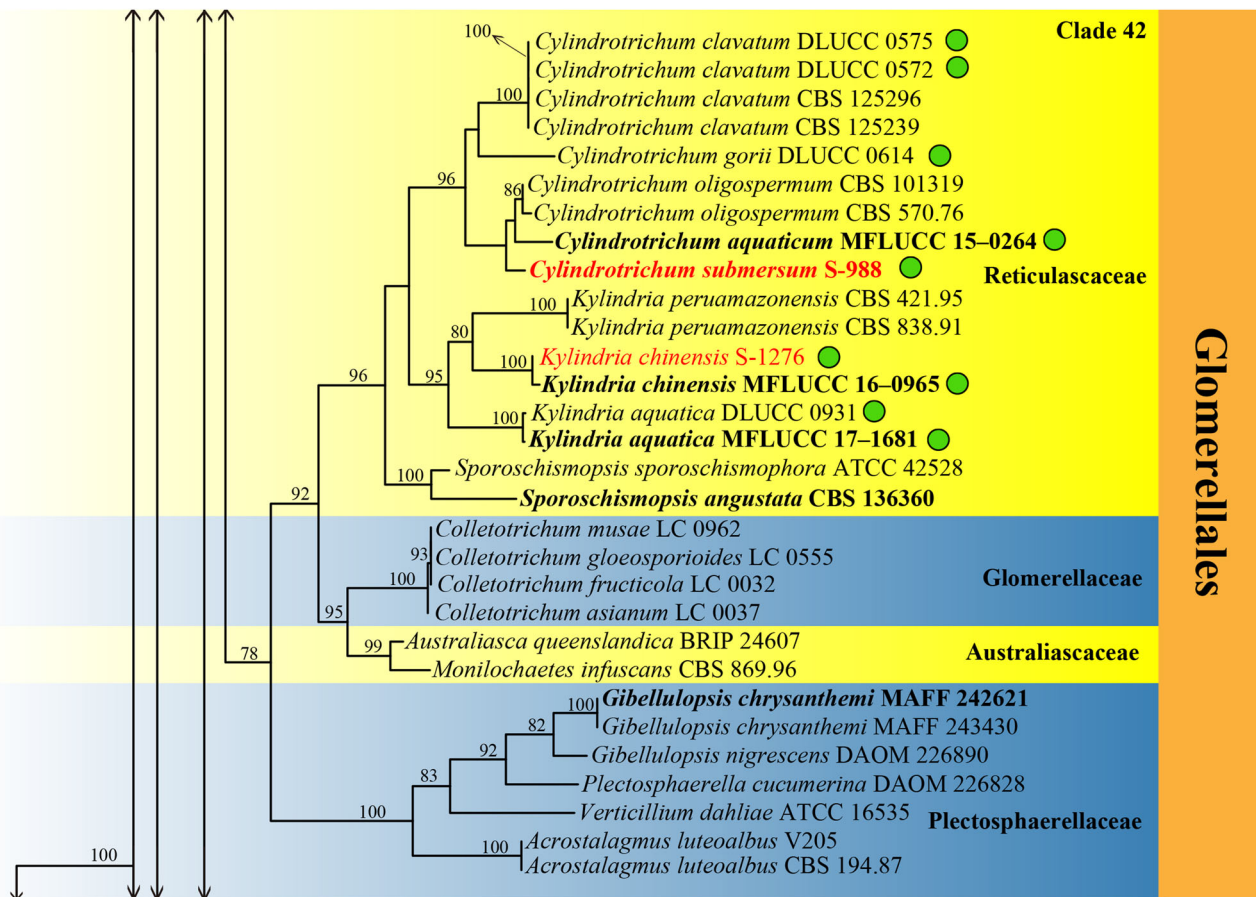


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each freshwater genera and species including information on known distribution, herbarium and sequence data. The outline of freshwater Sordariomycetes based on literature up to November 2018 was provided in Supplementary material 2. Descriptions, illustrations and sequence data for the fungi collected from freshwater habitats in China and Thailand from 2013 to 2018 are also provided.

Detailed information of freshwater Sordariomycetes are as follows:

Diaporthomycetidae Senan. et al.

Annulatascales D'souza et al.

Annulatasceae Wong et al.

Annulatascus K.D. Hyde, Aust. Syst. Bot. 5(1): 118 (1992)

Asexual morph Undetermined. **Sexual morph** Updated generic description and illustrations see Maharachchikumbura et al. (2016).

Type species: *Annulatascus velatisporus* K.D. Hyde, Aust. Syst. Bot. 5(1): 118 (1992)

Notes: Hyde (1992a) introduced the genus *Annulatascus* to accommodate two ascomycete species, *A. velatisporus* and *A. bipolaris*, with the former as the type species and both of them were collected from submerged decaying wood in Australia. There are 19 epithets of *Annulatascus* listed in Index Fungorum (December, 2018), however Hyde et al. (1999a, b) transferred *Annulatascus bipolaris* to the genus *Cataractispora* as *C. bipolaris* based on the morphological characters. Subsequently, Campbell and Shearer (2004) established a new genus *Annulismagnus* for *Annulatascus triseptatus* based on LSU sequence data, and Luo et al. (2015) combined *Annulatascus biatriisporus* as *Pseudoannulatascus biatriisporus*. Réblová et al. (2018) synonymised *Annulatascus biatriisporus* and *Pseudoannulatascus biatriisporus* under *Torrentispora biatriispora*, based on phylogenetic analysis. Currently, 16 species are accepted in *Annulatascus* and most of them are reported from freshwater habitats in tropical areas (Barbosa et al. 2008; Shearer et al. 2010; Boonyuen et al. 2012; Hu et al. 2012a) and only two species (*A. citrisporus* and *A.*

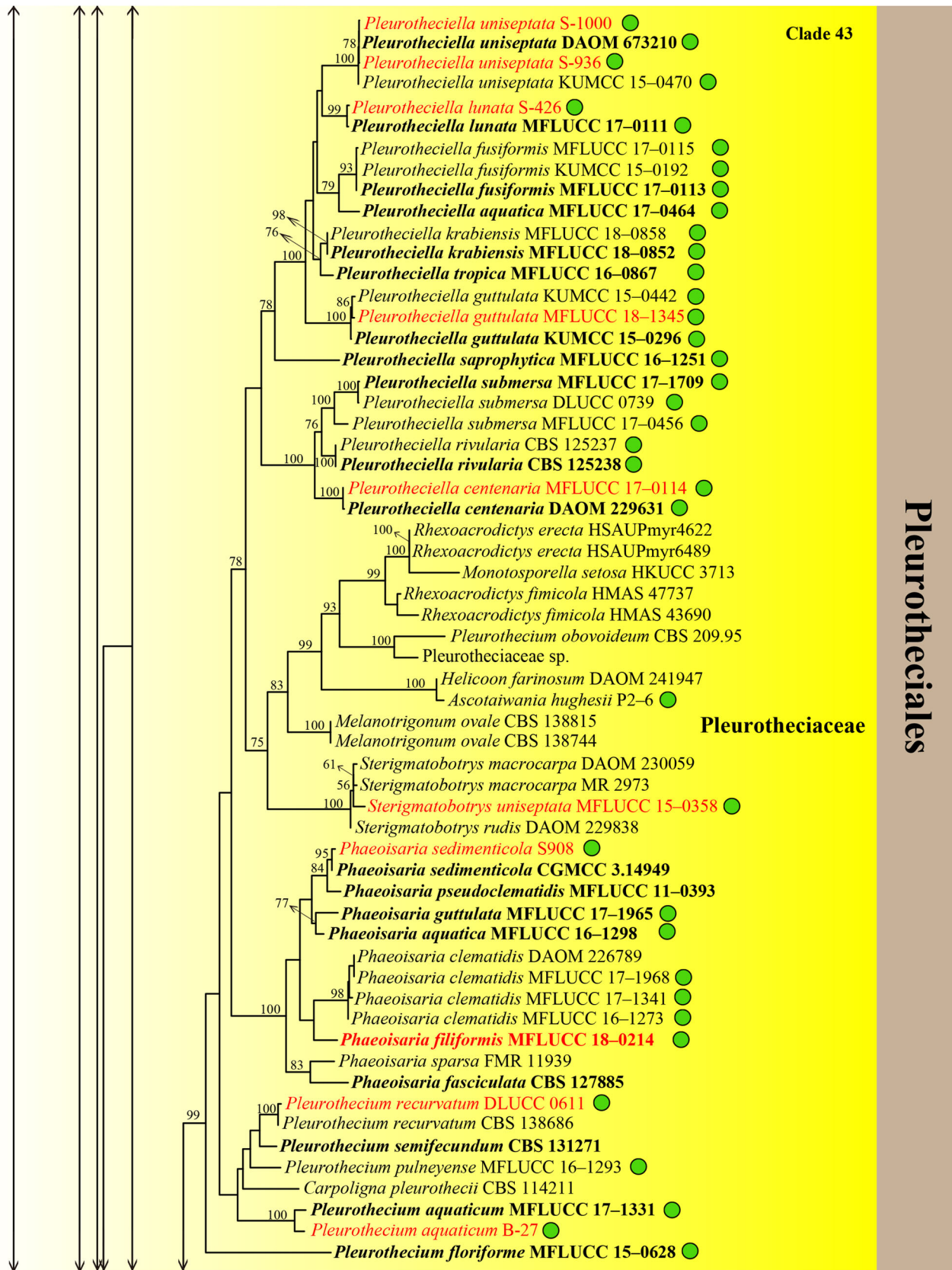


Fig. 1 continued

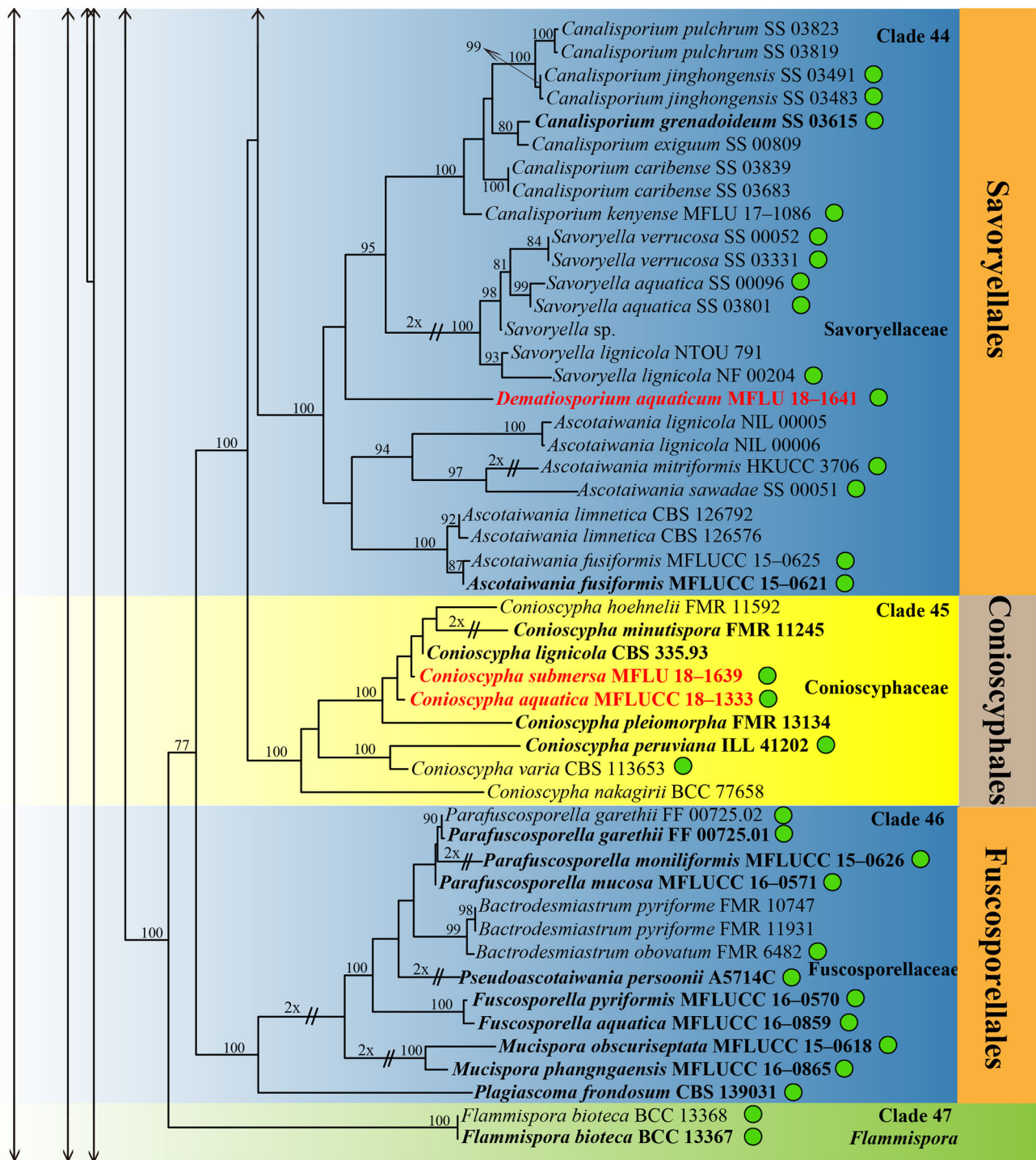


Fig. 1 continued

licualae) are known from terrestrial habitats on palm rachides (Fröhlich and Hyde 2000).

Annulatascus apiculatus F.R. Barbosa & Gusmão

Distribution: **Brazil**, on submerged decaying wood in a stream (Barbosa et al. 2008)

Asexual morph: Undetermined

Notes: Holotype HUEFS 134723. Sequence data is not available.

Annulatascus aquaticus Ho et al.

Distribution: **China**, Hong Kong, Tai Po Kau Forest stream, on submerged decaying wood (Ho et al. 1999a).

Asexual morph: Undetermined

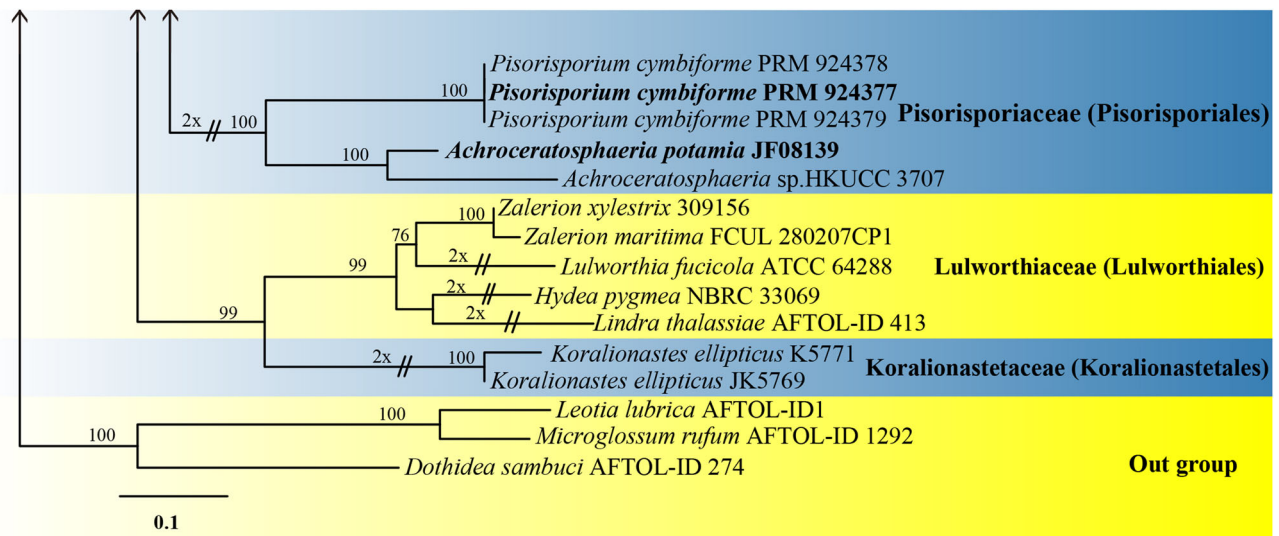


Fig. 1 continued

Notes: Holotype HKU (M) 4526 (now in IFRD). Sequence data is not available.

Annulatasacus aquatorba Boonyuen & Sri-indrasutdhi

Distribution: **Thailand**, Narathiwat Province, Sirindhorn Peat Swamp Forest, on submerged wood test block of *Erythrophleum teysmannii* (Boonyuen et al. 2012).

Asexual morph: Undetermined

Notes: Holotype BBH 29936. LSU and SSU sequence data are available.

Annulatasacus fusiformis K.D. Hyde & S.W. Wong

Distribution: **Australia**, Queensland, on submerged wood (Vijaykrishna and Hyde 2006); **China**, Yunnan Province, Yiliang county, Xiao Bai Long Mountain, on submerged culms of *Phyllostachys bambusoides* in a stream (Cai et al. 2006a); **Philippines**, Mindawao, Bukidnon, Impalutao, Natigbasan creek, on submerged wood (Hyde and Wong 2000).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 3102 (now in IFRD). Sequence data is not available.

Annulatasacus hongkongensis Ho et al.

Distribution: **China**, Hong Kong, Plover Cove Reservoir, on submerged wood (Ho et al. 1999b).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 4702 (now in IFRD). LSU sequence data is available.

Annulatasacus joannae Tsui et al.

Distribution: **China**, Hong Kong, Tai Po, Lam Tsuen River, on submerged wood (Tsui et al. 2002).

Asexual morph: Undetermined

Notes: Holotype IFRD 8648. Sequence data is not available.

Annulatasacus lacteus Tsui et al.

Distribution: **China**, Hong Kong, Tai Po, Lam Tsuen River, on submerged wood (Tsui et al. 2002).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 4623 (now in IFRD). Sequence data is not available.

Annulatasacus liputii L. Cai & K.D. Hyde

Distribution: **Philippines**, on submerged bamboo in Liput River (Cai et al. 2003b).

Asexual morph: Undetermined

Notes: Holotype PDD 75038. Sequence data is not available.

Annulatasacus menglensis Hu et al.

Distribution: **China**, Yunnan Province, Mengla, Wudaoban Stream, on submerged wood (Hu et al. 2012a).

Asexual morph: Undetermined

Notes: Holotype IFRDSC 002–017. Sequence data is not available.

Annulatasacus nilensis Abdel-Wahab & Abdel-Aziz

Distribution: **Egypt**, Sohag, Nile River, on decayed submerged stems of *Phragmites australis* (Abdel-Wahab et al. 2011).

Asexual morph: Undetermined

Notes: Holotype IMI 397966. LSU sequence data is available.

Annulatasacus palmietensis Goh et al.

Distribution: **Brunei**, Tutong River, on submerged wood (Fryar et al. 2004; Hyde and Sarma 2006); **South Africa**, Durban, Palmiet River, on submerged wood (Hyde et al. 1998b).

Asexual morph: Undetermined

Notes: Holotype IFRD 8649; Sequence data is not available.

Annulatascus saprophyticus Z.L. Luo & K.D. Hyde

Distribution: **Thailand**, Chiang Mai Province, on submerged wood in a stream (Luo et al. 2015).

Asexual morph: Undetermined

Notes: Holotype MFLU 15–0070, isotype HKAS 86445. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available and obtained from ex-type culture.

Annulatascus tropicalis Ranghoo & K.D. Hyde

Distribution: **China**, Hong Kong, Tai Po, Plover Cove Reservoir, on submerged wood (Tsui et al. 2002).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 5253 (now in IFRD). Sequence data is not available.

Annulatascus velatissporus K.D. Hyde

Distribution: **Australia**, Queensland, on submerged wood (Hyde 1992a; Dayarathne et al. 2016); **Brunei**, Temburong, Kuala Belalong Field Studies Centre, Sungai Anak, on submerged wood, **China**, Hong Kong, New Territories, Tai Po Kau Country Park, on twigs submerged in a stream; **Philippines**, Mindanao, Bukidnon, Impalutao, Natigbasan Creek, on submerged wood (Wong et al. 1999a); **Japan**, Koito River, on submerged wood (Tsui et al. 2001a); **India**, Western Ghats, Kali River, submerged woody litter (Sudheep and Sridhar 2011); **Malaysia**, Lipur Lentang Nature Reserve, on submerged wood in a stream (Ho et al. 2001); **South Africa**, Durban, Palmiet River, on submerged wood (Hyde et al. 1998b); **Thailand**, Chiang Mai Province, on submerged wood (Hu et al. 2012b).

Asexual morph: Undetermined

Notes: Holotype BRIP 17373, epitype MFLU 16–2204. LSU and SSU sequence data are available.

Annulusmagnus J. Campb. & Shearer, Mycologia 96(4): 826 (2004)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Campbell and Shearer (2004).

Type species: *Annulusmagnus triseptatus* (Wong et al.) J. Campb. & Shearer, Mycologia 96(4): 826 (2004)

Notes: Campbell and Shearer (2004) introduced the genus *Annulusmagnus* for *Annulatascus triseptatus* based on LSU sequence data. *Annulusmagnus triseptatus* was first collected from submerged wood in Brunei (Wong et al. 1999a) and subsequently reported from Australia, Canada and the USA, on submerged corticated or decorticated wood in both lotic and lentic habitats (Campbell and Shearer 2004). There is only one species reported in this genus (Campbell and Shearer 2004).

Annulusmagnus triseptatus (Wong et al.) J. Campb. & Shearer

≡ *Annulatascus triseptatus* Wong et al., Mycol. Res. 103(5): 563 (1999)

Distribution: **Australia**, Koah, Clohiesy River, on submerged wood (Campbell and Shearer 2004); **Brunei**, Temburong, Kuala Belalong Field Studies Centre, Sungai Anak, on submerged wood (Wong et al. 1999a); **Canada**, Ontario and Manitoba, on submerged wood; **USA**, on submerged wood; **Venezuela**, on submerged wood (Campbell and Shearer 2004).

Asexual morph: Undetermined

Notes: Holotype IFRD 8650. LSU, SSU and RPB2 sequence data are available.

Aqualignicola Ranghoo et al., Mycol. Res. 105(5): 628 (2001)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Ranghoo et al. (2001) and Hu et al. (2012a).

Type species: *Aqualignicola hyalina* Ranghoo et al., Mycol. Res. 105(5): 628 (2001)

Notes: *Aqualignicola* was introduced by Ranghoo et al. (2001) with *Aqualignicola hyalina* as type species. Currently, two species are accepted in this genus (Ranghoo et al. 2001; Hu et al. 2012a), and both species were collected from freshwater habitats in Asia (Ranghoo et al. 2001; Sudheep and Sridhar 2011; Hu et al. 2012a).

Aqualignicola hyalina Ranghoo et al.

Distribution: **China**, Hong Kong, New Territories, Tai Po, the Lam Tsuen River and Plover Cove Reservoir, on submerged wood (Ranghoo et al. 2001); **India**, Western Ghats, Kali River, submerged woody litter (Sudheep and Sridhar 2011).

Asexual morph: Undetermined

Notes: Holotype IFRD 8680. Sequence data is not available.

Aqualignicola vaginata Hu et al.

Distribution: **China**, Yunnan Province, Mengla, Wudaoban Stream, on submerged wood (Hu et al. 2012a).

Asexual morph: Undetermined

Notes: Holotype IFRDC 021–043. Sequence data is not available. *Aqualignicola vaginata* was introduced by Hu et al. (2012a) and it is so far only known from the type locality.

Ascitendus J. Campb. & Shearer, Mycologia 96(4): 829 (2004)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Campbell and Shearer (2004).

Type species: *Ascitendus austriacus* (Réblová et al.) J. Campb. & Shearer, Mycologia 96(4): 829 (2004)

Notes: Réblová and Winka (2001) introduced a new species, *Ascolacicola austriaca* from a stream in Australia. Campbell and Shearer (2004) examined 27 collections of *Ascolacicola austriaca* and found its morphology to be different from the type species of the genus. Based on the morphological differences between *Ascolacicola austriaca*

and *A. aquatica* and phylogenetic analysis, a new genus *Ascitendus* was proposed for *Ascolacicola austriaca* (Campbell and Shearer 2004). Hyde et al. (2018) introduced the second species for this genus. Currently, two species of *Ascitendus* are accepted and both were collected from freshwater habitats (Réblová and Winka 2001; Campbell and Shearer 2004; Hyde et al. 2018).

Ascitendus aquaticus Dayarathne et al.

Distribution: **Australia**, North Queensland, Mulgrave River, on decaying wood submerged in a River (Hyde et al. 2018).

Asexual morph: Undetermined

Notes: Holotype MFLU 18–0143. LSU and SSU sequence data are available.

Ascitendus austriacus (Réblová et al.) J. Campb. & Shearer

≡ *Ascolacicola austriaca* Réblová et al., Mycologia 93: 486 (2001)

Distribution: **Australia**, Wien 19, Herman-nskogel, on wood of *Fagus sylvatica* submerged in a stream (Réblová and Winka 2001), **Canada**, Ontario and Manitoba, on submerged wood; **USA**, on submerged wood; **Venezuela**, on submerged wood (Campbell and Shearer 2004).

Asexual morph: Undetermined

Notes: Holotype PRM 842991. LSU sequence data is available.

Ayria Fryar & K.D. Hyde, Cryptog. Mycol. 25(3): 248 (2004)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Fryar and Hyde (2004), Raja et al. (2009a).

Type species: *Ayria appendiculata* Fryar & K.D. Hyde, Cryptog. Mycol. 25(3): 248 (2004)

Notes: Fryar and Hyde (2004) established the genus *Ayria* with *A. appendiculata* as type species, the specimen was collected from rotting wood submerged in brackish and sea water, in Brunei. Raja et al. (2009a) introduced the second species *A. nubispora* in this genus.

Ayria appendiculata Fryar & K.D. Hyde

Distribution: **USA**, Florida, on submerged decaying wood (Raja et al. 2009b).

Asexual morph: Undetermined

Notes: Holotype IFRD 8706. The type specimen was collected from brackish, sea water. Raja et al. (2009b) reported this species from freshwater habitats but without description, illustration and information for specimens. Sequence data is not available.

Ayria nubispora Raja, Ferrer & Shearer

Distribution: **Costa Rica**, Heredia, La Selva stream, on submerged decorticated woody debris and Limon, Las Palmas Stream, on submerged decorticated wood; **USA**, Florida, Marion County, Ocala National Forest, Fore

Lake, on submerged decorticated woody debris (Raja et al. 2009a).

Asexual morph: Undetermined

Notes: Holotype ILL 40594. Sequence data is not available.

Cataractispora Hyde et al., Mycol. Res. 103(8): 1019 (1999)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Hyde (1992a) and Hyde et al. (1999).

Type species: *Cataractispora aquatica* Hyde et al., Mycol. Res. 103(8): 1020 (1999)

Notes: The genus *Cataractispora* was introduced by Hyde et al. (1999) with three new species and one new combination and all the species were collected from freshwater habitats. Ho et al. (2004) introduced one new species *C. receptaculorum* which was collected from freshwater habitats in Hong Kong, China. Five species are accepted in this genus and all species are reported from freshwater habitats around the world (Hyde 1992a; Hyde et al. 1999b; Ho et al. 2004; Raja et al. 2009b).

Cataractispora appendiculata Hyde et al.

Distribution: **Australia**, north Queensland, Cow Bay, freshwater stream, on submerged wood; **Brunei**, Temburong, Kuala Belalong Field Studies Centre, Sungai Esu, on submerged wood; **Seychelles**, Mahe, River St Marie Louise, on submerged wood (Hyde et al. 1999b).

Asexual morph: Undetermined

Notes: Holotype IFRD 8724. Sequence data is not available.

Cataractispora aquatica Hyde et al.

Distribution: **Australia**, north Queensland, Cow Bay, freshwater stream, on submerged wood; **Brunei**, Temburong, Kuala Belalong Field Studies Centre, Sungai Esu, on submerged wood; **Seychelles**, Mahe, River St Marie Louise, on submerged wood (Hyde et al. 1999b).

Asexual morph: Undetermined

Notes: Holotype IFRD 8725. Sequence data is not available.

Cataractispora bipolaris (K.D. Hyde) Hyde et al.

≡ *Annulatascus bipolaris* K.D. Hyde, Aust. Syst. Bot. 5(1): 120 (1992)

Distribution: **Australia**, north Queensland, Clohesy River, on submerged wood (Hyde 1992a); **USA**, Florida, on submerged decaying wood (Raja et al. 2009b).

Asexual morph: Undetermined

Notes: Holotype BRIP 17374. Sequence data is not available.

Cataractispora receptaculorum Ho et al.

Distribution: **China**, Hong Kong, Plover Cove Reservoir, on bamboo submerged in freshwater (Ho et al. 2004)

Asexual morph: Undetermined

Notes: Holotype HKU (M) 5239 (now in IFRD). Sequence data is not available.

Cataractispora viscosa Hyde et al.

Distribution: **Australia**, north Queensland, Cow Bay, freshwater stream, on submerged wood; **China**, Hong Kong, New Territories, Tai Po Kau Country Park, on twigs submerged in a stream; **Mauritius**, Black River National Park, Black River (Hyde et al. 1999b).

Asexual morph: Undetermined

Notes: Holotype IFRD 8726. Sequence data is not available.

Chaetorostrum Zelski et al., Mycosphere 2(5): 594 (2011)
Asexual morph *Taeniolella*-like. **Sexual morph** Description and illustrations see Zelski et al. (2011a)

Type species: *Chaetorostrum quincemilense* Zelski et al., Mycosphere 2(5): 595 (2011)

Notes: The genus *Chaetorostrum* was erected by Zelski et al. (2011) to accommodate a holomorph species collected from freshwater stream in Peru. There is only one species in this genus and known only from the type locality.

Chaetorostrum quincemilense Zelski et al.

Distribution: **Peru**, Camanti, Stream at Quincemil Trail 1, on submerged woody debris (Zelski et al. 2011).

Asexual morph: *Taeniolella*-like, see Zelski et al. (2011)

Notes: Holotype ILL 40822. Sequence data is not available.

Longicollum Zelski et al., Mycosphere 2(5): 540 (2011)
Asexual morph: Undetermined. **Sexual morph**: Description and illustrations see Zelski et al. (2011).

Type species: *Longicollum biappendiculatum* Zelski et al., Mycosphere 2(5): 540 (2011)

Notes: Zelski et al. (2011) introduced the genus *Longicollum* with single species *L. biappendiculatum*, which was collected from both lentic and lotic freshwater habitats in America.

Longicollum biappendiculatum Zelski et al.

Distribution: **Brazil**, Bahia, stream at Serra da Jibóia, on submerged bark debris; **Costa Rica**, Heredia, La Selva Biological Station, La Selva stream, on submerged bark debris; **Peru**, Camanti, stream at Quincemil Trail 1, on submerged woody debris; **USA**, Florida, Wildcat Lake, Ocala National Forest, on submerged woody debris (Zelski et al. 2011).

Asexual morph: Undetermined

Notes: Holotype ILL 40794. Sequence data is not available.

Submersisphaeria K.D. Hyde, Nova Hedwigia 62(1–2): 172 (1996)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Hyde (1996) and Campbell et al. (2003a, b)

Type species: *Submersisphaeria aquatica* K.D. Hyde, Nova Hedwigia 62(1–2): 172 (1996)

Notes: The genus *Submersisphaeria* was introduced by Hyde (1996) with *Submersisphaeria aquatica* as type species. Presently, five species were accepted in this genus and only one species has been reported from freshwater habitats. *Submersisphaeria aquatica* was originally described from Queensland, Australia (Hyde 1996), and Campbell et al. (2003a, b) reported it from six states in the USA. Fournier et al. (2016) found *S. aquatica* on submerged wood of *Pseudotsuga menziesii* in France.

Submersisphaeria aquatica K.D. Hyde

Distribution: **Australia**, Queensland, on submerged wood (Hyde 1996); **France**, Nièvre: Arleuf, Prépigny, on submerged wood of *Pseudotsuga menziesii* (Fournier et al. 2016); **USA**, Georgia, Louisiana, Mississippi, New Hampshire, North Carolina, Tennessee, Wisconsin, on submerged wood (Campbell et al. 2003a).

Asexual morph: Undetermined

Notes: Holotype BRIP 22743, other specimens collected from freshwater habitats: ILL 40186, ILL 40260. LSU sequence data is available.

Verticicola Hyde et al., Mycologia 92(5): 1019 (2000)
Asexual morph Undetermined. **Sexual morph** Description and illustrations see Ranghoo et al. (2000) and Barbosa et al. (2013).

Type species: *Verticicola caudatus* Hyde et al., Mycologia 92(5): 1020 (2000)

Notes: The genus *Verticicola* is characterized by asci with a refractive apical ring and a tail-like pedicel and distoseptate ascospores with relatively thick walls and lacking appendages or a sheath (Ranghoo et al. 2000). There are two species accepted in this genus and both were collected from freshwater habitats.

Verticicola ascoliberatus Shearer & F.R. Barbosa

Distribution: **Costa Rica**, Heredia, La Selva Biological Station, Salto 30, on submerged wood (Barbosa et al. 2013).

Asexual morph: Undetermined

Notes: Holotype ILL 40815. Sequence data is not available.

Verticicola caudatus Hyde et al.

Distribution: **China**, Hong Kong, Tai Po, Plover Cove Reservoir, submerged wood (Ranghoo et al. 2000).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 3108 (now in IFRD). Sequence data is not available.

Atractosporales Zhang et al.

Atractosporaceae Zhang et al.

Atractospora Réblová & J. Fourn., Mycol Prog 15: 8 (2016)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Réblová et al. (2016a).

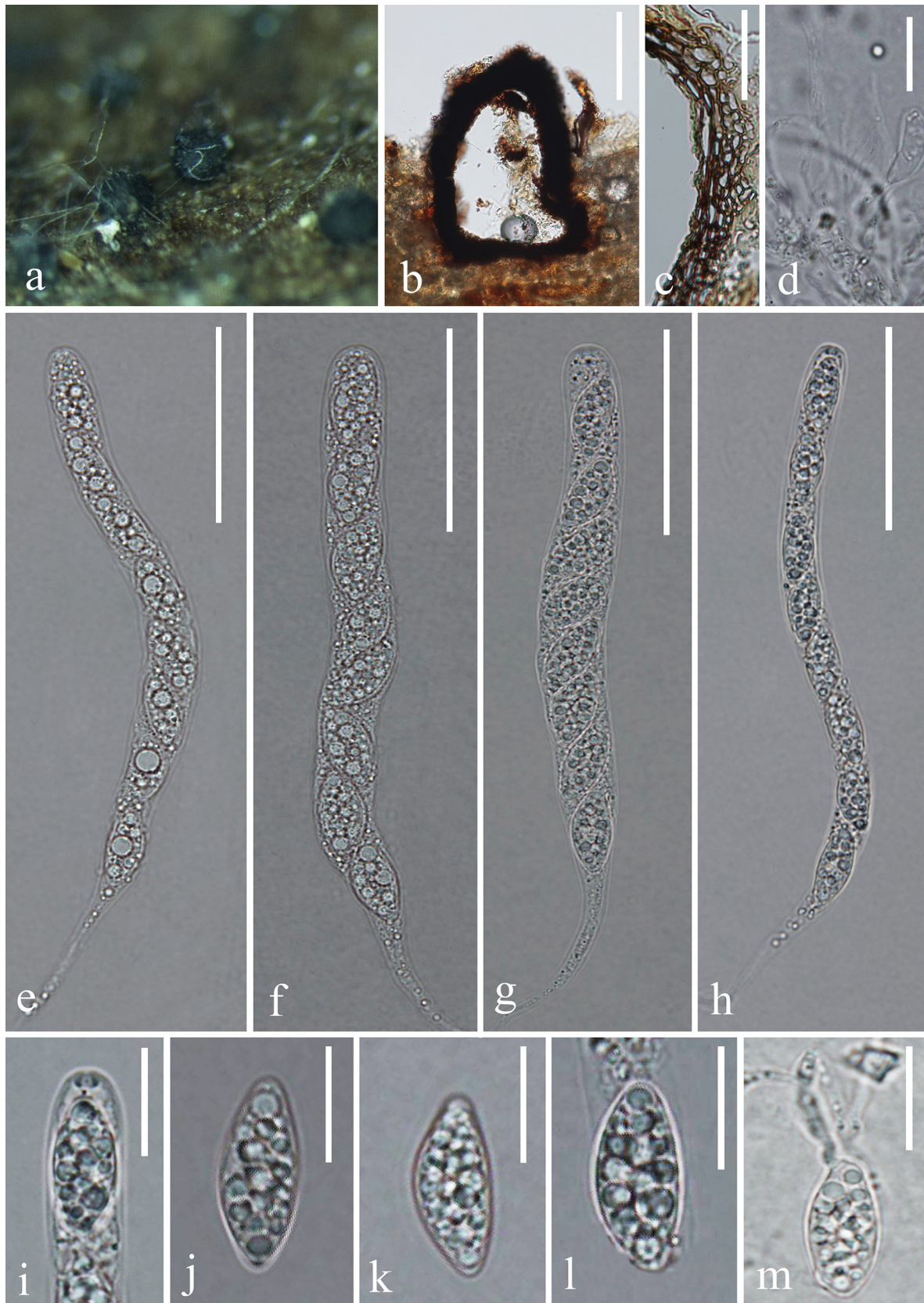


Fig. 2 *Atractospora aquatica* (MFLU 18–2322, holotype) **a** Ascomata on decaying wood. **b** Section of the ascoma. **c** Structure of peridium. **d** Paraphyses. **e–h** Asci. **i–l** Ascospores. **m** Germinating ascospore. Scale bars: **b** 100 μm , **c**, **d** 25 μm , **e–f** 50 μm , **i–m** 10 μm

Type species: *Atractospora reticulata* Réblová & J. Fourn., Mycol Prog 15(21): 10 (2016)

Notes: The genus *Atractospora* was described for perithecial ascomycetes occurring on decaying wood submerged in freshwater habitats (Réblová et al. 2016b). Five species are accepted in this genus, of which *Atractospora ellipsoidea* and *A. thailandensis* are reported from Asia and USA (Ho et al. 1999c; Campbell and Shearer 2004; Fryar et al. 2004), while other three species were collected from Europe (Réblová et al. 2016b).

Atractospora aquatica Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF555639, Facesoffungi number: FoF 05411, Fig. 2

Etymology: Referring to the aquatic habitat of this fungus.

Holotype: MFLU 18–2322

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Undetermined. **Sexual morph** *Ascomata* 157–251 µm high, 154–234 µm diam., dark brown to black, solitary, semi-immersed to superficial, globose to subglobose, unilocular. *Ostiole* periphysate. *Peridium* 20–34 µm thick, consisting two-layers, Outer layer consisting of thick-walled, mid brown cells of *textura prismatica*, towards the interior grading into several layers of thin-walled subhyaline, flattened cells. *Paraphyses* hyaline, unbranched, cylindrical. *Asci* 110–168 × 9–13 µm (\bar{x} = 139 × 11 µm, n = 20), 8-spored, unitunicate, cylindrical, with a slender, tapering stipe, apex broadly rounded, with a conspicuous, non-amyloid apical ring. *Ascospores* 15–19 × 7–9 µm (\bar{x} = 17 × 8 µm, n = 20), uniseriate or obliquely uniseriate, fusiform, guttulate, aseptate, hyaline, smooth-walled.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on decaying wood submerged in a freshwater stream, July 2017, H.W. Shen, S-1398 (MFLU 18–2322, holotype).

Notes: *Atractospora aquatica* resembles *A. thailandensis* in having globose to subglobose, unilocular, dark brown to black ascomata, hyaline, unbranched paraphyses, cylindrical asci with a slender, tapering stipe and conspicuous, non-amyloid, apical ring and fusiform, hyaline, aseptate, guttulate ascospores (Zhang et al. 2017a, b). However, *Atractospora aquatica* differs from *A. thailandensis* in having shorter asci (110–168 vs. 175–215 µm) and smaller ascospores (15–19 vs. 20–26 µm) with smaller guttules. *Atractospora aquatica* also resembles *A. decumbens* and *A. reticulata* in having solitary, dark brown ascomata, unitunicate, 8-spored, cylindrical asci and fusiform, hyaline ascospores uniseriate or obliquely uniseriate in the ascus (Réblová et al. 2016b). However, *Atractospora aquatica* differs from *A. decumbens* and *A. reticulata* in having shorter asci and aseptate ascospores, while *A.*

decumbens and *A. reticulata* have 3-septate ascospores. Phylogenetic results show that *Atractospora aquatica* is distinct from other species of *Atractospora* (Fig. 1, clade 3).

Atractospora decumbens Réblová & J. Fourn

Distribution: **France**, Midi-Pyrénées: Ariège, Rimont, L' Estanque brook, on submerged wood of *Sambucus nigra* in a stream (Réblová et al. 2016b).

Asexual morph: Undetermined

Notes: Holotype PRM 934676. ITS, LSU, SSU and RPB2 sequence data are available.

Atractospora ellipsoidea (Ho et al.) Réblová & J. Fourn
≡ *Aquaticola ellipsoidea* Ho et al., Fungal Divers 3: 90 (1999)

Distribution: **Brunei**, Tutong River, on submerged wood (Fryar et al. 2004); **China**, Hong Kong, Tai Po, Tai Po Kau Forest Stream, on submerged wood of *Machilus velutina* (Ho et al. 1999c); **USA**, North Carolina (Campbell and Shearer 2004).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 6033 (now in IFRD). LSU sequence data is available.

Atractospora reticulata Réblová & J. Fourn

Distribution: **France**, Midi-Pyrénées: Ariège, Rimont, Peyrau brook, on submerged wood of *Sambucus nigra* in a stream (Réblová et al. 2016b).

Asexual morph: Undetermined

Notes: Holotype PRM 934677. ITS, LSU and RPB2 sequence data are available.

Atractospora thailandensis Dong et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, on submerged wood in a small River (Zhang et al. 2017).

Asexual morph: Undetermined

Notes: Holotype HKAS 96226. ITS, LSU, SSU, RPB2 and TEF1α sequence data are available.

Atractospora verruculosa Réblová & J. Fourn

Distribution: **France**, Pyrénées-Atlantiques, Lescun, Borde Bayé, Lescun stream, on submerged wood of *Alnus glutinosa* (Réblová et al. 2016b).

Asexual morph: Undetermined

Notes: Holotype PRM 934679. ITS, LSU, SSU and RPB2 sequence data are available.

Rubellisphaeria Réblová & J. Fourn., Mycol Prog 15: 13 (2016)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Réblová et al. (2016a).

Type species: *Rubellisphaeria abscondita* Réblová & J.Fourn., Mycol Prog 15: 13 (2016)

Notes: Réblová et al. (2016a) introduced the genus *Rubellisphaeria* with single species *Rubellisphaeria abscondita*, collected from freshwater in France. This is a monotypic genus and known only from the type locality.

Rubellisphaeria abscondita Réblová & J. Fourn

Distribution: **France**, Loire: Saint Jean la Vêtre, Les Yverneaux, on submerged twigs of *Abies alba* in a peat bog (Réblová et al. 2016b).

Asexual morph: Undetermined

Notes: Holotype PRM 934681. ITS, LSU, SSU and RPB2 sequence data are available.

Jobellisiales M.J. D'souza & K.D. Hyde**Jobelliaceae** Réblová

Jobellisia M.E. Barr, Mycotaxon 46: 60 (1993)

Asexual morph Undetermined. **Sexual morph** *Ascomata* superficial or basally immersed, nonstromatic, globose to subglobose to obpyriform to lageniform, brown or externally with yellowish pigments, glabrous or slightly rugose, with short to long papilla or with long upright neck. *Peridium* comprising two or three layers. *Paraphyses* numerous, septate, hyaline. *Asci* 8-spored, unitunicate, cylindrical-clavate, with nonamyloid apex and distinct refractive apical annulus, with basally swollen stipe, stipe remnants attached to the ascogenous hyphae after dehiscence. *Ascospores* ellipsoidal to reniform to navicular, aseptate or transversely 1-septate with one or two polar germ pores, brown.

Type species: *Jobellisia luteola* (Ellis & Everh.) M.E. Barr, Mycotaxon 46: 61 (1993)

Notes: The genus *Jobellisia* currently comprises nine species and they are found in tropical and temperate zones of the northern hemisphere (Réblová 2008; Maharachchikumbura et al. 2016). Three species have been found in freshwater habitats.

Jobellisia guangdongensis F. Liu & L. Cai

Distribution: **China**, Guangdong Province, on submerged decaying wood (Liu et al. 2011).

Asexual morph: Undetermined

Notes: Holotype HMAS 251240. ITS and LSU sequence data are available.

Jobellisia luteola (Ellis & Everh.) M.E. Barr

≡ *Letendrea luteola* Ellis & Everh., Proc. Acad. nat. Sci. Philad. 47: 415 (1895)

Distribution: **USA**, on submerged decaying wood (Raja et al. 2009b).

Asexual morph: Undetermined

Notes: Holotype Morgan 1109. LSU sequence data is available. *Jobellisia luteola* was originally collected from decayed wood on terrestrial habitats. Raja et al. (2009b) reported this species from freshwater habitats during their studies on latitudinal, habitat and substrate distribution patterns of freshwater ascomycetes in Florida, USA.

Jobellisia viridifusca K.M. Tsui & K.D. Hyde

Distribution: **China**, Hong Kong, Lantau Island, Tung Chung River, on submerged decaying wood (Ranghoo et al. 2001)

Asexual morph: Undetermined

Notes: Holotype HKU (M) 80455 (now in IFRD). Sequence data is unavailable.

Diaporthales Nannf.**Diaporthaceae** Hohn. ex Wehm.

Diaporthe Nitschke, Pyrenomycetes Germanici 2: 240 (1870)

Asexual morph Coelomycetous, pycnidial, ostiolate, brown to black, scattered or aggregated, globose to subglobose. *Conidiophores* cylindrical, sometimes filiform, aseptate or septate, cylindrical, sometimes branched. *Conidiogenous cells* phialidic, cylindrical, terminal. *Conidia* dimorphic, hyaline, smooth, with usually fusiform and biguttulate alpha conidia and usually filiform, hamate, non-guttulate beta conidia. **Sexual morph** *Ascomata* globose to subglobose, coriaceous, immersed to semi-immersed, single to clustered, brown to black. *Neck* cylindrical, black. *Peridium* comprising compressed cells of *textura angularis*. *Paraphyses* cylindrical, longer than asci, septate. *Asci* 8-spored, unitunicate, thin-walled, apedicellate, broad cylindrical to obclavate, with a minute apical ring. *Ascospores* overlapping biseriate, ellipsoidal to fusiform, septate, hyaline, thin-walled, smooth-walled.

Type species: *Diaporthe eres* Nitschke, Pyrenomyc. Germ. 2: 245 (1870)

Notes: Species of *Diaporthe* have broad host ranges and are widely distributed (Udayanga et al. 2012). Currently, MycoBank (accessed December 2018) lists more than 900 names in the genus *Diaporthe*, but this was reduced to 171 species (Dissanayake et al. 2017). Hu et al. (2012c) introduced a new *Diaporthe* species *D. aquatica*, collected from submerged wood in stream in Yunnan Province, China.

Diaporthe aquatica Hu et al.

Distribution: **China**, Guizhou Province, Guiyang city, on submerged wood in a small ditch (Hu et al. 2012c)

Asexual morph: undetermined

Notes: Holotype IFRD 021–018; ITS sequence data are available, ex-type strain IFRDCC 3051. *D. aquatica* is the only *Diaporthe* species restricted to freshwater habitats (Hu et al. 2012c).

Gnomoniaceae G. Winter

Ambarignomonina Sogonov, Stud. Mycol. 62: 35 (2008)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations refer to Senanayake et al. (2018).

Type species: *Ambarignomonina petiolorum* (Schwein.) Sogonov, Stud Mycol 62: 36 (2008)

Notes: The genus *Ambarignomonina* was introduced by Sogonov et al. (2008) to accommodate *Sphaeria petiolorum*. Presently, there is only one species accepted in this genus. Sogonov et al. (2008) mentioned the monotypic *Ambarignomonina* with *A. petiolorum* and is restricted to one plant host, *Liquidambar styraciflua*, whereas other

genera of the Gnomoniaceae do not show such consistency in host associations.

Ambarignomonia petiolorum (Schwein.: Fr.) Sogonov
 ≡ *Sphaeria petiolorum* Schwein.: Fr., Schr. Naturf. Ges. Leipzig 1: 41. 1822; Syst. Mycol. 2: 517 (1823)
 ≡ *Gnomonia petiolorum* (Schwein.: Fr.) Cooke, Grevillea 7: 54 (1878)
 ≡ *Gnomoniella amoena* var. *petiolorum* (Schwein.: Fr.) Sacc., Syll. Fung. 1: 414 (1882)

Distribution: **USA**, Wisconsin, Trout lake/Big Muskelunge lake, on submerged partially decomposed *Acer rubrum* leaves (Fallah and Shearer 2001).

Asexual morph: Undetermined

Notes: Lectotype BPI 800519, Epitype BPI 844274, specimens collected from freshwater habitats: ILLS 54015, ILLS 54016. ITS, LSU, RPB2, TEF1 α and β -tubulin sequence data are available. Fallah and Shearer (2001) collected two specimens (ILLS 54015 and ILLS 54016) from freshwater habitats and provided descriptions and illustrations and identified the collections as *Gnomonia petiolorum*. Sogonov et al. (2008) combined this species as *Ambarignomonia petiolorum*.

Gnomonia Ces. & De Not., Comm. Soc. crittog. Ital. 1(4): 231 (1863)

Asexual morph see Sivanesan and Shaw (1977). **Sexual morph** Description see Maharachchikumbura et al. (2016).

Type species: *Gnomonia vulgaris* Ces. & De Not., Comm. Soc. crittog. Ital. 1(fasc. 4): 232 (1863)

Notes: The genus *Gnomonia* was introduced by Cesati and De Notaris (1863) and typified by *Gnomonia gnomon*. *Gnomonia* comprises 273 species and only one species has been reported from freshwater habitats (Sivanesan and Shaw 1977; Fallah and Shearer 2001; Senanayake et al. 2018).

Gnomonia papuana Sivan. & D.E. Shaw

Distribution: **Papua New Guinea**, on submerged leaves (Sivanesan and Shaw 1977).

Asexual morph: *Sesquicillium*-like, see Sivanesan and Shaw (1977)

Notes: Holotype IMI 197503. Sequence data is not available.

Gnomoniella Sacc., Michelia 2 (7): 312 (1881)

Asexual morph Undetermined. **Sexual morph** *Ascomata* globose to subglobose, immersed. *Paraphyses* deliquescent. *Asci* cylindrical, subsessile. *Ascospores* fusiform, ellipse, hyaline, septate.

Type species: *Gnomoniella tubaeformis* (Tode) Sacc., Syll. fung. (Abellini) 1: 413 (1882)

Notes: Kirk et al. (2008) accepted 13 species in the genus *Gnomoniella*. Two species have been found in freshwater habitats and both were collected from Asia (Ho et al. 2001).

Gnomoniella microspora M. Monod

Distribution: **Malaysia**, on submerged wood (Ho et al. 2001).

Asexual morph: Undetermined

Notes: ITS sequence data are available. *Gnomoniella microspora* was originally collected from terrestrial habitats (Monod 1983). Ho et al. (2001) reported *Gnomoniella microspora* from freshwater habitats and we consider this species as freshwater fungus.

Gnomoniella rubicola Pass.

Distribution: **Brunei**, on submerged wood (Ho et al. 2001).

Asexual morph: Undetermined

Notes: Sequence data is not available. Same as *Gnomoniella microspora*, the original collection of *G. rubicola* was not collected from freshwater habitats. However, we consider this species as freshwater fungus as Ho et al. (2001) found it on submerged wood in Brunei.

Diaporthales genera incertae sedis

Phruensis Pinruan, Mycologia 96 (5): 1165 (2004)

Asexual morph Hyphomycetous. *Colonies* on PDA effuse, brown mycelium partly immersed, nonstromatic. *Conidiophores* semimacronematous, mononematous, branched, straight or slightly flexuous, pale brown to brown, smooth. *Conidiogenous cells* monophialidic, determinate, with small collarettes. *Conidia* straight or curved, oblong, hyaline, smooth. **Sexual morph** *Ascomata* immersed, subglobose, black, coriaceous, ostiolate, with long central cylindrical neck. *Peridium* composed of 2 layers, with outer layer parenchymatous, intensely brown and merging with the host cells, with inner layer, cells elongate and hyaline. *Paraphyses* hyaline, broad, septate. *Asci* unitunicate, cylindrical to fusiform, apedicellate, apically rounded, J-, subapical ring. *Ascospores* cylindrical, straight or curved, versicolorous, transseptate, brown with hyaline or pale brown end cells.

Type species: *Phruensis brunneispora* Pinruan, Mycologia 96(5): 1165 (2004)

Notes: Pinruan et al. (2004b) introduced the genus *Phruensis* with a single species *P. brunneispora*, which was collected from a submerged palm in Sirindhorn Peat Swamp Forest in Thailand. No more species reported for this genus since it was introduced.

Phruensis brunneispora Pinruan

Distribution: **Thailand**, Narathiwat Province, Sirindhorn peat swamp forest, on submerged palm in freshwater stream (Pinruan et al. 2004b).

Asexual morph: *Phialophora*-like, see Pinruan et al. (2004b)

Notes: Holotype BBH, Pinruan Wah 113.1. SSU sequence data is available.

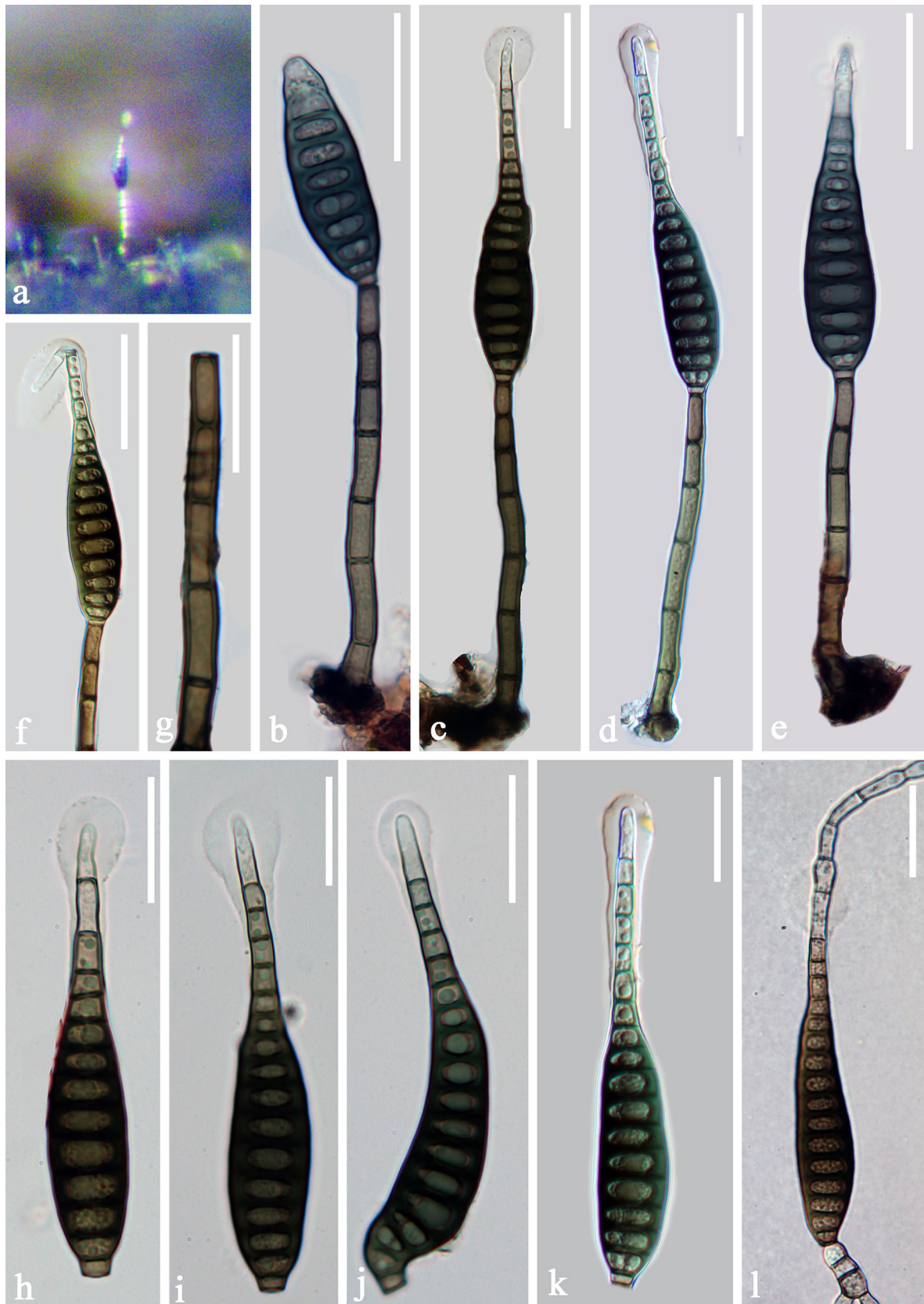


Fig. 3 *Distoseptispora appendiculata* (DLU B95, holotype) **a** Colonies on wood. **b–e** Conidiophores with conidia. **f** Conidiogenous cells with conidia. **g** Conidiogenous cells. **h–k** Conidia. **l** Germinating conidium. Scale bars: **b–f** 30 μ m, **g–l** 20 μ m



Fig. 4 *Distoseptispora guttulata* (B-43) **a** Colonies on wood. **b–d** Conidiophores with conidia. **e–g** Conidia. **h** Germinating conidium. Culture on PDA from above (**i**) and reverse (**j**). Scale bars: **b–h** 30 μ m

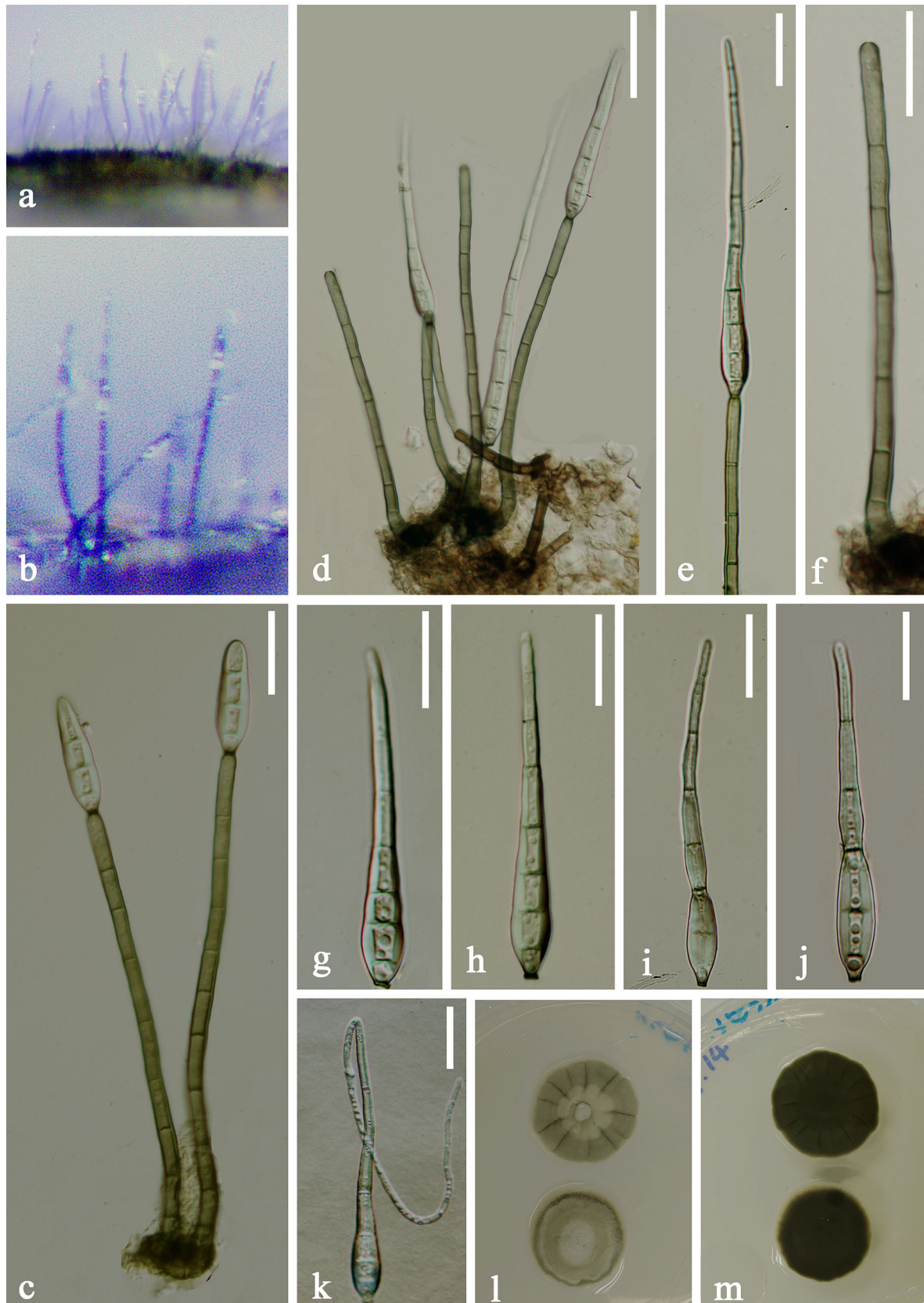


Fig. 5 *Distoseptispora lignicola* (MFLU 18–1458, holotype). **a, b** Colonies on wood. **c–d** Conidiophores with conidia. **e–f** Conidiogenous cells and conidia. **g–j** Conidia. **k** Germinating conidium. Culture on PDA from surface (**l**) and reverse (**m**). Scale bars: **d** 30 μ m, **c, e–k** 20 μ m



Fig. 6 *Distoseptispora multiseptata* (B-37) **a, b** Colonies on wood. **c–f** Conidiophores with conidia. **g–k** Conidia. **l** Conidiophores with conidiogenous cells. **m** Germinating conidium. Culture on PDA from above (**n**) and reverse (**o**). Scale bars: **c–k, m** 30 μ m, **l** 10 μ m

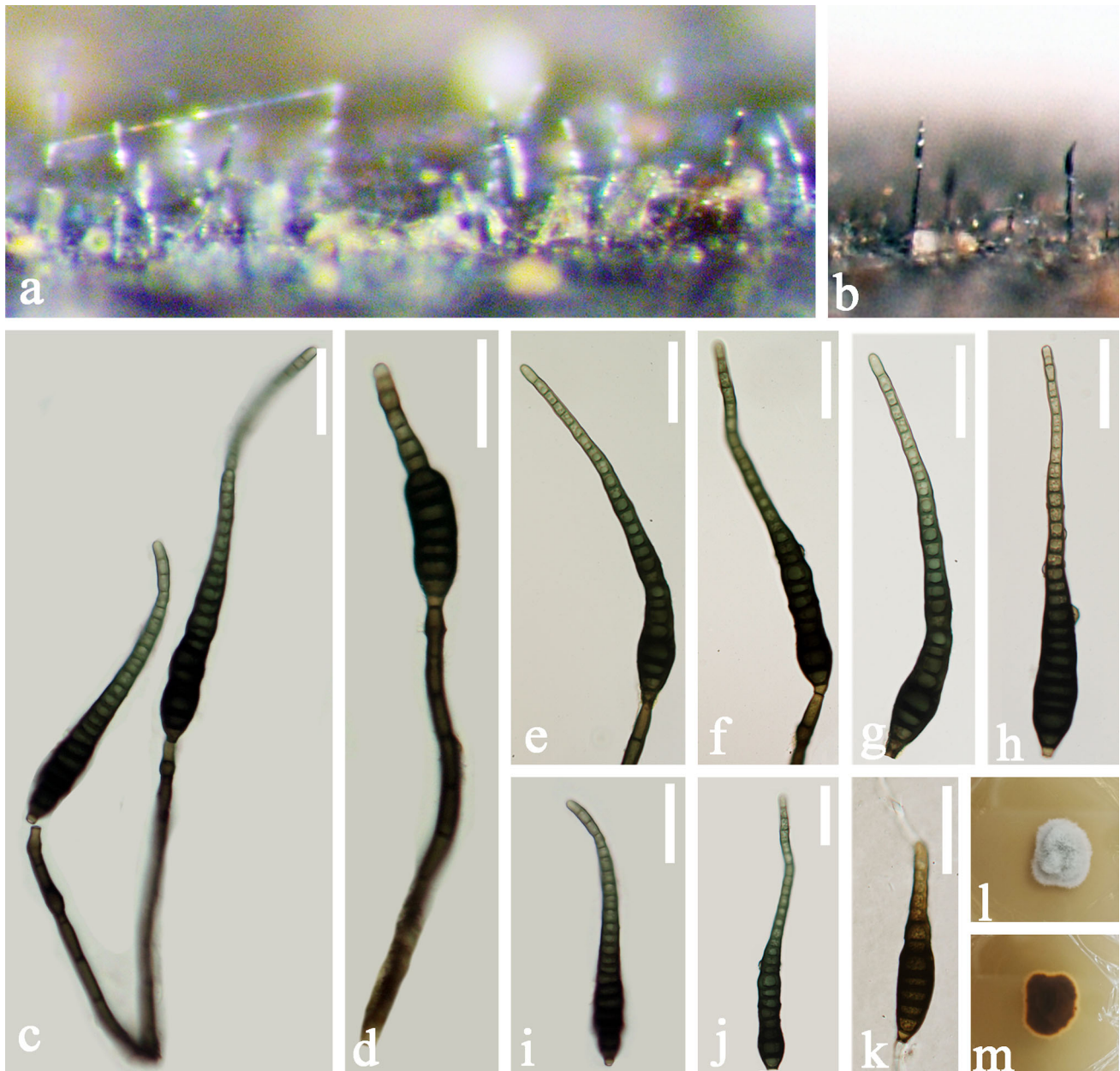


Fig. 7 *Distoseptispora neostrata* (DLU B103, holotype) **a, b** Colonies on wood. **c, d** Conidiophores with conidia. **e, f** Conidiogenous cells with conidia. **g–j** Conidia. **k** Germinating conidium. Culture on MEA from above (**l**) and reverse (**m**). Scale bars: **c–k** 30 μ m

Distoseptisporales Z.L. Luo, H.Y. Su & K.D. Hyde, *ord. nov*

Index Fungorum number: IF 555640, Facesoffungi number: FoF 05412

Asexual morph *Mycelium* mostly immersed, composed of branched, septate, smooth, pale brown hyphae. *Conidiophores* macronematous, mononematous, septate, unbranched, erect, straight or flexuous, smooth. *Conidiogenous cells* monoblastic, integrated, determinate, terminal, cylindrical. *Conidia* acrogenous, solitary, euseptate or

distoseptate, obclavate or cylindrical with rounded apex. *Conidial secession* schizolytic. **Sexual morph** Undetermined.

Type family: Distoseptisporaceae K.D. Hyde & McKenzie, Fungal Divers 80:402 (2016)

Notes: Distoseptisporaceae was established by Su et al. (2016) with a single genus *Distoseptispora* based on morphology and phylogeny. Phylogenetic analysis based on combined LSU, SSU, RPB2 and TEF1 α sequence data here shows that species of *Distoseptispora* and

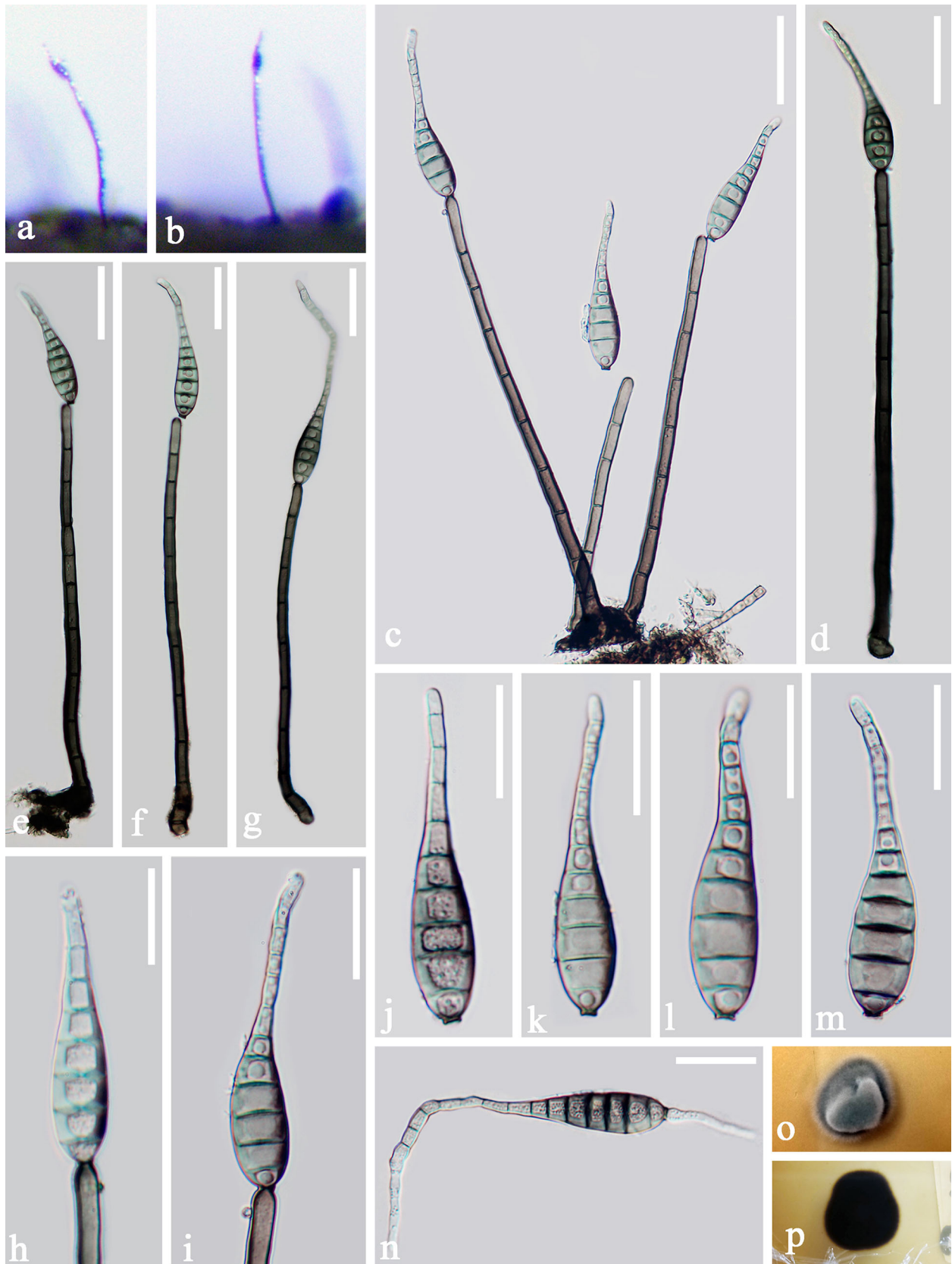


Fig. 8 *Distoseptispora obclavata* (DLU B71, holotype) **a, b** Colonies on wood. **c–g** Conidiophores with conidia. **h, i** Conidiogenous cells with conidia. **j–m** Conidia. **n** Germinating conidium. Culture on PDA from above (**o**) and reverse (**p**). Scale bars: **c–h** 30 μm , **i–n** 20 μm

Aquapteridospora cluster together with strong support and form a distinct clade within subclass Diaporthomycetidae. We therefore raise Distoseptisporaceae to order Distoseptisporales.

Distoseptisporaceae K.D. Hyde & McKenzie

Distoseptispora Hyde et al., Fungal Divers 80: 402 (2016)
Asexual morph Description and illustration see Su et al. (2016) and Yang et al. (2018). **Sexual morph** Undetermined.

Type species: *Distoseptispora aquatica* Luo et al., Fungal Divers 80: 402 (2016)

Notes: Su et al. (2016) introduced the genus *Distoseptispora* to accommodate two *Sporidesmium*-like species. Yang et al. (2017) emended the description of the genus *Distoseptispora*. Currently, there are 13 species in *Distoseptispora* with ten species collected from freshwater habitats (Su et al. 2016; Hyde et al. 2016b; Luo et al. 2018a; Yang et al. 2018a).

Distoseptispora appendiculata D.F. Bao, Z.L. Luo & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 556690, Facesoffungi number: FoF 06302, Fig. 3

Etymology: Referring to its gelatinous conidia appendage

Holotype: DLU B95

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, olivaceous or mid-brown, hairy, velvety. *Mycelium* mostly immersed, consisting of branched, septate, smooth, subhyaline to pale brown hyphae. *Conidiophores* 62–86 µm long, 4.5–5.5 µm wide ($\bar{x} = 74 \times 5$ µm, $n = 10$), macronematous, mononematous, solitary, erect, straight or flexuous, olivaceous or brown, 5–6-septate, smooth. *Conidiogenous cells* monoblastic, holoblastic, terminal, dark brown. *Conidia* 67–89 µm long, 10–16 µm wide ($\bar{x} = 78 \times 13$ µm, $n = 20$), acrogenous, solitary, obpyriform or obclavate, 13–17-distoseptate, thick-walled, olivaceous or dark brown below, hyaline towards apex, truncate at base, slender and rounded at apex, smooth, with a conspicuous, gelatinous, hyaline sheath around tip. **Sexual morph** Undetermined.

Material examined: **THAILAND**, Khwaeng Phra Khanong Nuea, Khet Watthana Krung Thep Maha Nakhon, saprobic on decaying wood submerged in a freshwater stream, 1st October 2017, Z.L. Luo, B-95 (DLU B95, holotype), ex-type living culture MFLUCC 18–0259.

Notes: *Distoseptispora appendiculata* resembles *D. obpyriformis* in having effuse, olivaceous or mid-brown, hairy, velvety colonies, macronematous, straight or flexuous, olivaceous or brown, septate conidiophores and obpyriform, distoseptate, olivaceous or dark brown conidia (Luo et al. 2018a). However, *Distoseptispora appendiculata* is easily distinguished from *D. obpyriformis* and other

Fig. 9 *Aquapteridospora fusiformis* (MFLU 18–1601, holotype). **a** Colonies on substrate. **b–d** Conidiophore with conidia. **e, f** Conidiogenous cells with conidia **g–j** Conidia, **k** Germinating conidium. Culture on PDA from surface (**l**) and reverse (**m**). Scale bars: **b–d** 50 µm, **e, f** 20 µm, **g–k** 10 µm

species in *Distoseptispora* by its conspicuous, gelatinous, hyaline appendage sheath. Phylogenetic results show that *Distoseptispora appendiculata* is distinct from other species of *Distoseptispora* (Fig. 10).

Distoseptispora aquatica Luo et al.

Distribution: **China**, Yunnan Province, Dali, Cangshan Mountain, on submerged wood in stream (Su et al. 2016).

Sexual morph: Undetermined

Notes: Holotype HKAS 83991. ITS and LSU sequence data are available.

Distoseptispora cangshanensis Luo et al.

Distribution: **China**, Yunnan Province, Dali, Cangshan Mountain, on submerged wood (Luo et al. 2018a).

Sexual morph: Undetermined

Notes: Holotype MFLU 18–0474. ITS, LSU and TEF1 α sequence data are available.

Distoseptispora fluminicola McKenzie et al.

Distribution: **China**, Yunnan Province, Dali, on submerged wood (Su et al. 2016).

Sexual morph: Undetermined

Notes: Holotype HKAS 84006. ITS, LSU and TEF1 α sequence data are available.

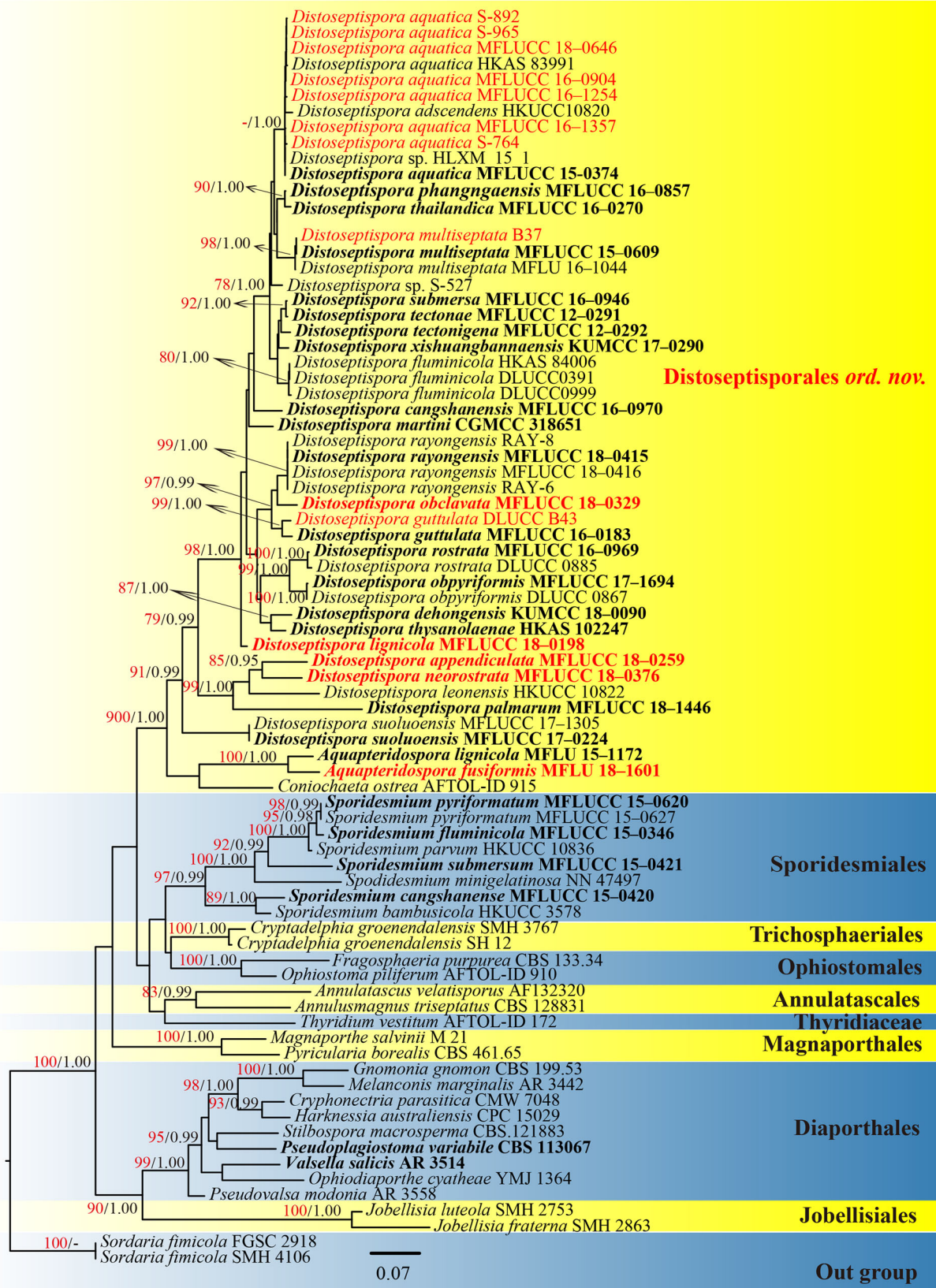
Distoseptispora guttulata J. Yang & K.D. Hyde

Facesoffungi number: FoF 03357, Fig. 4

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, brown to black, hairy or velvety. *Mycelium* partly superficial, partly immersed, consisting of branched, septate, smooth, subhyaline to pale brown hyphae. *Conidiophores* 28–84 µm long, 4–5 µm wide ($\bar{x} = 56 \times 4.5$ µm, $n = 20$), macronematous, mononematous, mid or dark brown, 3–4(–7)-septate, solitary or caespitose, smooth, straight or slightly flexuous, cylindrical, rounded at the apex. *Conidiogenous cells* monoblastic, integrated, terminal, determinate, mid to dark brown, cylindrical, sometimes proliferating percurrently. *Conidia* 70–190(–520) µm long, 8.5–10.5 µm wide ($\bar{x} = 130 \times 9.5$ µm, $n = 20$), acrogenous, solitary, holoblastic, obclavate or lanceolate, rostrate, curved, 9–14(–27)-euseptate, mid to dark brown, or olivaceous, smooth, truncate at the base, tapering to the apex. **Sexual morph** Undetermined.

Material examined: **THAILAND**, Khwaeng Phra Khanong Nuea, Khet Watthana Krung Thep Maha Nakhon, saprobic on decaying wood submerged in a freshwater stream, 1st October 2017, Z.L. Luo, B-43, living culture DLUCC B43.





◀**Fig. 10** Phylogram generated from maximum likelihood analysis based on ITS, LSU, RPB2 and TEF1 α sequence data for species of Distoseptisporales (with *Sordaria fimicola* as outgroup). The best scoring RAxML tree with a final likelihood value of -30852.86243 is presented. RAxML bootstrap support values equal to or greater than 75% are given before the forward slash (black). Bayesian posterior probability equal to or higher than 0.95 are given after the forward slash (red). Hyphen ('-') indicates a value lower than 75% for RAxML and Bayesian posterior probability lower than 0.95. Newly generated sequences are in red. Ex-type or ex-epitype strains are in bold

Distribution: **Thailand**, Prachuap Khiri Khan Province, on decaying wood submerged in a freshwater stream (Yang et al. 2018a)

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0852, isotype GZAAS 17–0005. ITS, LSU, SSU and TEF1 α sequence data are available. *Distoseptispora guttulata* was introduced by Yang et al. (2018a) based on a collection obtained from a freshwater stream in Thailand. Morphologically, our isolate fits well with the characters of *D. guttulata* (Yang et al. 2018a). Phylogenetic analysis also shows that our isolate clusters with ex-type of *D. guttulata* with good support (Fig. 10).

Distoseptispora lignicola D.F. Bao, Z.L. Luo, H.Y. Su & K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 555641, Facesoffungi number: FoF 05413, Fig. 5

Etymology: Referring to this taxon dwelling on wood

Holotype: MFLU 18–1458

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, scattered, hairy, pale brown to brown. *Mycelium* mostly immersed, composed of branched, septate, brown, smooth hyphae. *Conidiophores* 84–124 μm long, 4–5 μm wide ($\bar{x} = 104 \times 4.5 \mu\text{m}$, $n = 20$), macronematous, mononematous, solitary or in groups, erect, straight or slightly flexuous, 6–10-septate, unbranched, cylindrical, brown, smooth. *Conidiogenous cells* monoblastic, integrated, terminal, determinate, brown, cylindrical. *Conidia* 60–108 μm long, 7–9 μm wide ($\bar{x} = 84 \times 8 \mu\text{m}$, $n = 20$), acrogenous, solitary or catenate, obclavate, truncate at base, tapering towards the apex, straight or slightly curved, 5–9-euseptate, slightly constricted at septa, guttulate, brown, smooth. **Sexual morph** Undetermined.

Material examined: **THAILAND**, SaiKhu Waterfall, on submerged decaying wood, 28 August 2017, C.G. Lin, B-2 (MFLU 18–1458, holotype), ex-type living culture MFLUCC 18–0198.

Notes: *Distoseptispora lignicola* resembles *D. guttulata* in having macronematous, mononematous, unbranched, cylindrical, septate conidiophores, solitary or in groups on natural substrata, monoblastic, integrated, terminal, determinate conidiogenous cells and acrogenous, obclavate,

rostrate, euseptate, guttulate conidia (Yang et al. 2018a). However *D. lignicola* differs from *D. guttulata* in having longer conidiophores (84–124 vs. 55–90 (–145) μm) and 5–9-euseptate conidia, while *D. guttulata* has 11–14(–20)-euseptate conidia. Phylogenetically, *Distoseptispora guttulata* clusters in *Distoseptispora* and sister to *D. leonensis* (HKUCC 10822), but is distinct from other *Distoseptispora* species (Fig. 1, clade 15).

Distoseptispora multiseptata J. Yang & K.D. Hyde

Facesoffungi number: FoF 02244, Fig. 6

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, dark olive-green, hairy or velvety. *Mycelium* mostly immersed, comprised of branched, septate, smooth, hyaline to pale brown hyphae. *Conidiophores* 29–47 μm long, 4–6 μm wide ($\bar{x} = 38 \times 5 \mu\text{m}$, $n = 20$), macronematous, mononematous, solitary, brown, 2–3-septate, straight or slightly flexuous, erect, slightly tapering distally, truncate at the apex, olive-green to dark brown. *Conidiogenous cells* holoblastic, monoblastic, integrated, terminal, brown, determinate, cylindrical. *Conidia* 147–185 μm long, 12–14 μm wide ($\bar{x} = 16 \times 13 \mu\text{m}$, $n = 20$), acrogenous, solitary, obclavate, rostrate, multi-distoseptate, tapering towards the apex, dark olivaceous green. Conidial secession schizolytic. **Sexual morph** Undetermined.

Material examined: **THAILAND**, Sai khu waterfall, Prachuap khiri Khan., saprobic on decaying wood submerged in a freshwater stream, 1st September 2017, Vinit Kumar, B-37, living culture MFLUCC 18–0215.

Distribution: **Thailand**, Prachuap Khiri Khan Province, Hua Hin, on submerged wood in a stream (Hyde et al. 2016b).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1144, isotype HKAS 95045. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available. *Distoseptispora multiseptata* was introduced by Yang et al. (2018a) based on a collection obtained from a freshwater stream in Thailand. Morphologically, our isolate fits well with the characters of *D. multiseptata* (Yang et al. 2018a). Phylogenetic analysis also shows that our isolate clusters with ex-type of *D. multiseptata* (Fig. 10).

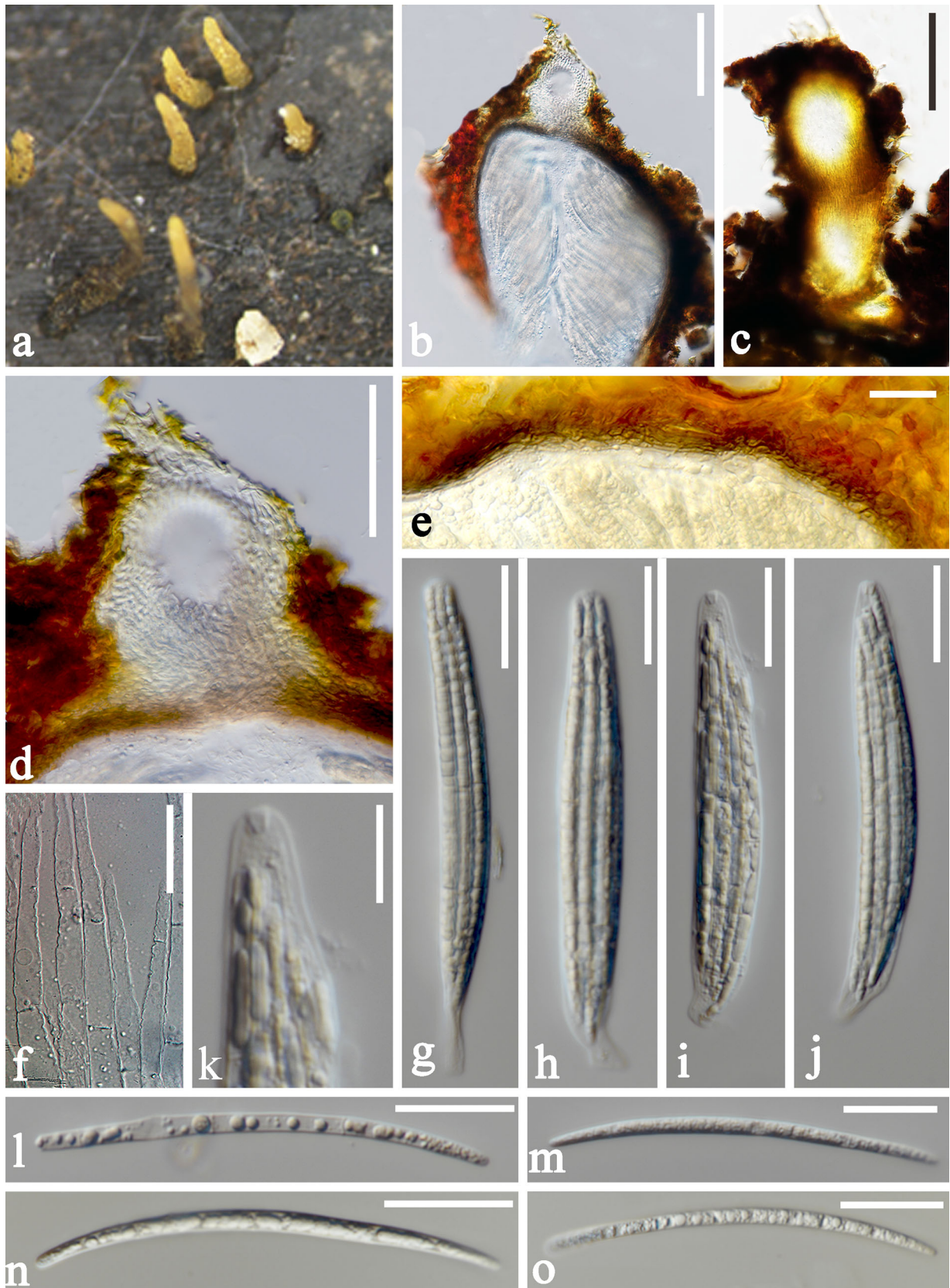
Distoseptispora neurostrata D.F. Bao, Z.L. Luo & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 556691, Facesoffungi number: FoF 06135, Fig. 7

Etymology: Referring to its morphological similarity to *D. rostrata*

Holotype: DLU B103

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, dark olivaceous, hairy. *Mycelium* partly superficial, partly immersed in the substrate, comprised of branched, septate, hyaline to pale



◀**Fig. 11** *Ceratosphaeria aquatica* (MFLU 18–2323, holotype) **a** Appearance of necks on substrate. **b** Section through ascumata. **c**, **d** Section through neck. **e** Structure of peridium. **f** Paraphyses. **g–j** Asci. **k** Apical ring. **l–o** Ascospores. Scale bars: **b**, **c** 100 μm , **d** 50 μm , **e–j**, **l–o** 20 μm , **k** 10 μm

brown hyphae. *Conidiophores* 93–117 μm long, 5.5–6.5 μm wide (\bar{x} = 105 \times 6 μm , n = 10), macronematous, mononematous, solitary, brown, 5–7-septate, straight or flexuous, tapering distally, truncate at the apex. *Conidiogenous cells* monoblastic, integrated, terminal, brown, determinate. *Conidia* 109–147 μm long, 13–15 μm wide (\bar{x} = 128 \times 14 μm , n = 20), acrogenous, solitary, elongate, obclavate, rostrate, multi-distoseptate, tapering towards the rounded apex, dark olivaceous to mid or dark brown, pale brown towards apex, truncate at the base, guttulate, smooth-walled. **Sexual morph** Undetermined.

Material examined: **THAILAND**, Khwaeng Phra Khanong Nuea, Khet Watthana Krung Thep Maha Nakhon, saprobic on decaying wood submerged in a freshwater stream, 1st October 2017, Z.L. Luo, B-103 (DLU B103, holotype), ex-type living culture MFLUCC 18–0376.

Notes: *Distoseptispora neurostrata* shares similar morphological characters with *D. rostrata* in the shape, colour and size of its conidiophores and conidia (Luo et al. 2018a). However, the multi-gene phylogenetic analyses showed that they are different species (Fig. 10).

Distoseptispora obclavata D.F. Bao, Z.L. Luo & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 556689, Facesoffungi number: FoF 06296, Fig. 8

Etymology: Referring to its obclavate conidia

Holotype: DLU B71

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, olivaceous or dark brown, hairy, velvety. *Mycelium* mostly immersed, consisting of branched, septate, smooth, subhyaline to pale brown hyphae. *Conidiophores* 117.5–162.5 μm long, 5–7 μm wide (\bar{x} = 140 \times 6 μm , n = 20), macronematous, mononematous, pale to dark brown, solitary, 5–10-septate, erect, straight or slightly flexuous, unbranched, smooth, cylindrical, rounded at the apex. *Conidiogenous cells* monoblastic, integrated, terminal, determinate, pale to dark brown, cylindrical. *Conidia* 46–66 μm long, 9–11 μm wide (\bar{x} = 56 \times 10 μm , n = 25), acrogenous, solitary, obclavate, 9–11-distoseptate, thick-walled, olivaceous to pale or dark brown, aperturing towards the rounded apex, slightly curved, truncate at the base, guttulate, smooth-walled. **Sexual morph** Undetermined.

Material examined: **THAILAND**, Khwaeng Phra Khanong Nuea, Khet Watthana Krung Thep Maha Nakhon, saprobic on decaying wood submerged in a freshwater

stream, 1st October 2017, Z.L. Luo, B-71 (DLU B71, holotype), ex-type living culture MFLUCC 18–0329.

Notes: *Distoseptispora obclavata* resembles *D. appendiculata* in having effuse, olivaceous or mid-brown, hairy, velvety colonies, macronematous, straight or flexuous, septate conidiophores and obclavate, distoseptate, olivaceous or dark brown conidia. However, *Distoseptispora obclavata* is easily distinguished from *D. appendiculata* by its shorter conidia (46–66 vs. 67–89 μm) without appendage sheath. Phylogenetic results show that *Distoseptispora appendiculata* is distinct from other species of *Distoseptispora* (Fig. 10).

Distoseptispora obpyriformis Z.L. Luo & H.Y. Su

Distribution: **China**, Yunnan Province, Nujiang River, on submerged wood (Luo et al. 2018).

Sexual morph: Undetermined

Notes: Holotype MFLU 18–0476, paratype MFLU 18–0477. ITS, LSU, RPB2 and TEF1 α sequence data are available.

Distoseptispora phangngaensis Yang et al.

Distribution: **Thailand**, Phang Nga Province, Bann Tom Thong Khang, on decaying wood submerged in a freshwater stream (Yang et al. 2018a).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0855, isotype GZAAS 17–0008. ITS, LSU and TEF1 α sequence data are available.

Distoseptispora rostrata Luo et al.

Distribution: **China**, Yunnan Province, Nujiang River, on submerged wood (Luo et al. 2018a).

Sexual morph: Undetermined

Notes: Holotype MFLU 18–0479, paratype MFLU 18–0475. ITS, LSU, RPB2 and TEF1 α sequence data are available.

Distoseptispora submersa Luo et al.

Distribution: **China**, Yunnan Province, Nujiang River, on submerged wood (Luo et al. 2018a).

Sexual morph: Undetermined

Notes: Holotype MFLU 18–0478, isotype HKAS 92806. ITS, LSU, RPB2 and TEF1 α sequence data are available.

Distoseptispora suoluensis Yang et al.

Distribution: **China**, Guizhou Province, Anshun city, Gaodang village, on decaying wood submerged in Suoluo River (Yang et al. 2018a).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0853, isotype GZAAS 17–0006, paratype MFLU 17–0854. ITS, LSU and TEF1 α sequence data are available.

Distoseptisporales genera *incertae sedis*

Aquapteridospora Yang et al., Cryptog. Mycol. 36(4): 474 (2015)

Asexual morph Descriptions and illustration see Yang et al. (2015). **Sexual morph** Undetermined.

Type species: *Aquapteridospora lignicola* J. Yang, K.D. Hyde & Maharachch, Cryptog Mycol 36: 474 (2015)

Notes: Yang et al. (2015) introduced the genus *Aquapteridospora* with single asexual species, *A. lignicola*, which was collected from freshwater stream in northern Thailand. In this study, we introduce the second species collected from freshwater. *Aquapteridospora* was placed as Diaporthomycetidae genera *incertae sedis* by Yang et al. (2015). In our phylogenetic analysis, *Aquapteridospora* species form a distinct clade within Distoseptisporales and basal to Distoseptisporaceae, and we therefore treat this genus as Distoseptisporales genera *incertae sedis*, and its familial placement needs further studies.

Aquapteridospora lignicola Yang et al.

Distribution: **Thailand**, Chiang Rai Province, stream flowing in Tham Luang Nang Non Cave, on submerged wood (Yang et al. 2015).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1172. LSU sequence data is available.

Aquapteridospora fusiformis Z.L. Luo, D.F. Bao, H.Y. Su & K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 555642, Facesoffungi number: FoF 05414, Fig. 9

Etymology: Referring to the fusiform conidia of this fungus.

Holotype: MFLU 18–1601

Saprobic on decaying wood submerged in freshwater. **Asexual morph** Colonies on the natural substrate effuse, hairy, pale brown to brown. *Mycelium* superficial or partly immersed, composed of branched, septate, pale brown to brown, smooth, thin-walled hyphae. *Conidiophores* (88–)134–188 μm long, 5–7 μm wide (\bar{x} = 161 \times 6 μm , n = 20), macronematous, mononematous, solitary, erect, straight or slightly flexuous, unbranched, cylindrical, septate, smooth, thick-walled, brown at the base, paler towards apex. *Conidiogenous cells* polyblastic, terminal, later becoming intercalary, pale brown, integrated, with several sympodial proliferations, bearing tiny, protuberant, circular scars. *Conidia* 14–18 μm long, 5–7 μm wide (\bar{x} = 16 \times 6 μm , n = 20), solitary, fusiform, obtuse at both ends, mostly 3-septate, sometimes 4-septate, slightly constricted at septa, brown to dark brown in central cells and subhyaline at end cells, smooth. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Jizu Mountain, saprobic on decaying wood submerged in a freshwater stream, July 2016, S.M. Tang, S-889 (MFLU 18–1601, holotype), ex-type living culture MFLUCC 18–1606.

Notes: *Aquapteridospora fusiformis* resembles *A. lignicola* in having macronematous, solitary, unbranched, septate conidiophores which are brown at the base and paler

towards apex, polyblastic, terminal conidiogenous cells and fusiform, septate conidia. Both of these species also share similar size of conidiophores and conidia (Yang et al. 2015). However, *A. fusiformis* differs from *A. lignicola* in having pale brown to brown colonies, smooth conidia without a sheath, while the conidia of *A. lignicola* has large guttules in the middle cells and a conspicuous sheath. Phylogenetic analysis also shows that *A. fusiformis* and *A. lignicola* are distinct from other species, but they cluster together with strong support (Fig. 1, clade 15). To further support *A. fusiformis* as a new species, we compared nucleotide differences with *A. lignicola* (MFLU 15–1172) following the guidelines of Jeewon and Hyde (2016). Comparison of the 789 nucleotides across the LSU region reveals 9 bp differences. Based on the differences of morphology and DNA nucleotide, we introduce our isolate as new species in *Aquapteridospora*.

Magnaporthales Thongk et al.

Ceratosphaeriaceae Z.L. Luo, H.Y. Su & K.D. Hyde, *fam. nov.*

Index Fungorum: IF 555643; Facesoffungi number: FoF 05415

Asexual morph *Harpophora*-like. *Phialides* or short *conidiophores* arising on aerial hyphae, with conidial heads slimy, inconspicuous, and transparent. *Conidiogenous cells* phialidic, ampulliform to lageniform, terminal or intercalary, cylindrical. *Conidia* cylindrical, hyaline, aseptate, smooth. Sexual morph *Stromata* absent. *Ascomata* globose to pyriform, deeply immersed to almost superficial, dark brown to black, carbonaceous, with a long cylindrical, black or yellow crystals neck. *Periphyses* well-developed. *Peridium* composed of a large number of layers of very thick-walled rather small cells in the neck region. Intercalary tissue of *paraphyses* thin-walled, probably evanescent at maturity. *Asci* 8-spored, unitunicate, cylindrical, fairly thin-walled, the apex truncate, with a conspicuous J-apical ring. *Ascospores* arranged biserially, narrowly cylindrical-fusiform, or filiform, the ends acute, thin-walled, hyaline, septate, guttulate, smooth-walled.

Type genus: *Ceratosphaeria* Niessl, Verh. nat. Ver. Brünn 14: 203 (1876)

Notes: Réblová (2006) accommodated *Ceratosphaeria* in Magnaporthaceae based on their phylogenetic analyses of combined LSU and SSU sequence data. Phylogenetically, our multi-gene analyses show that *Ceratosphaeria* species formed a distinct clade in Magnaporthales and shares close relationship with Pseudohalonectriaceae (Fig. 15). Morphologically, Pseudohalonectriaceae is characterized by erumpent to immersed ascomata with a protruding, greenish yellow, bright yellow to brown neck, cylindrical to clavate asci with a nonamyloid, thimble-shaped, refractive, apical apparatus and cylindrical or

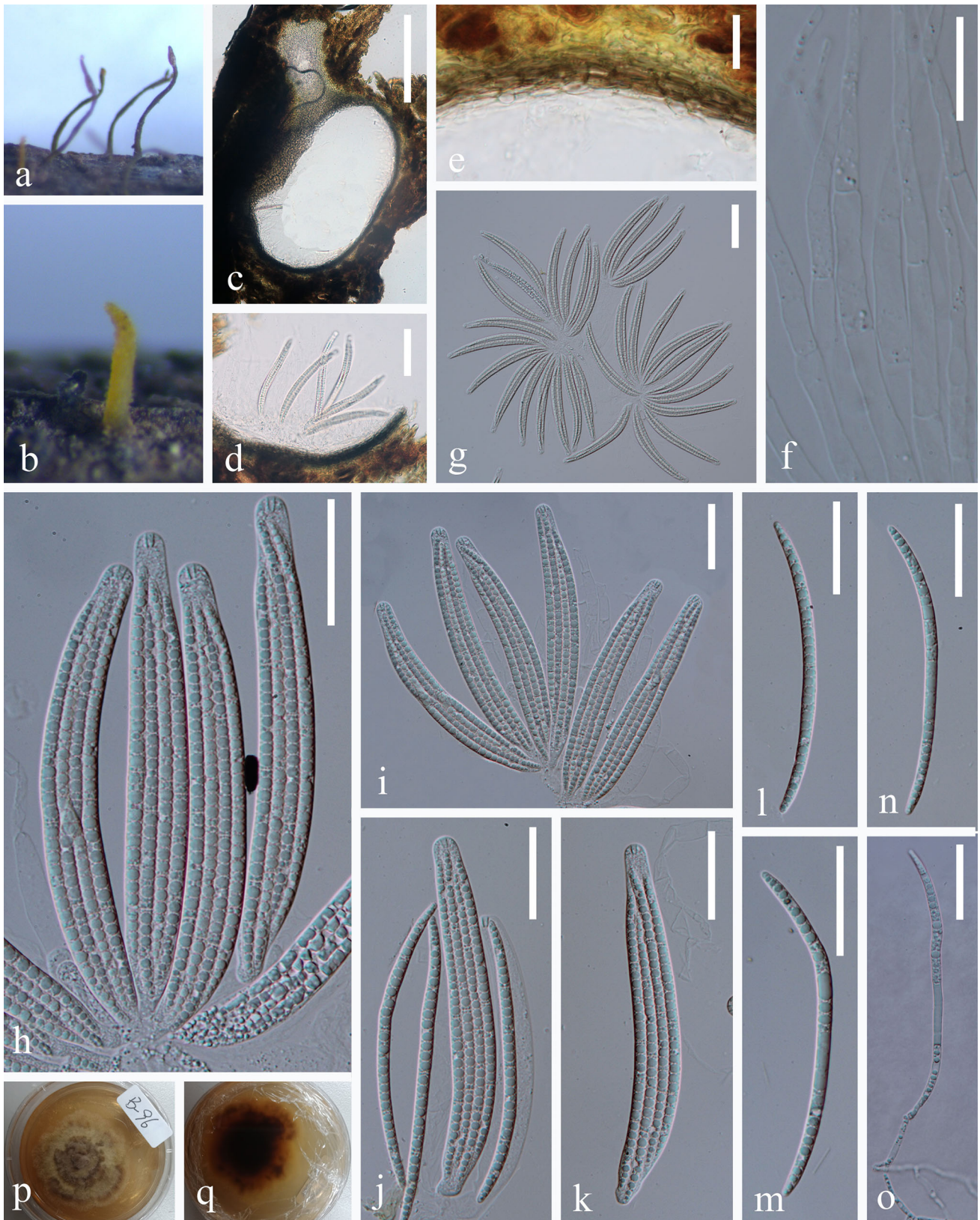
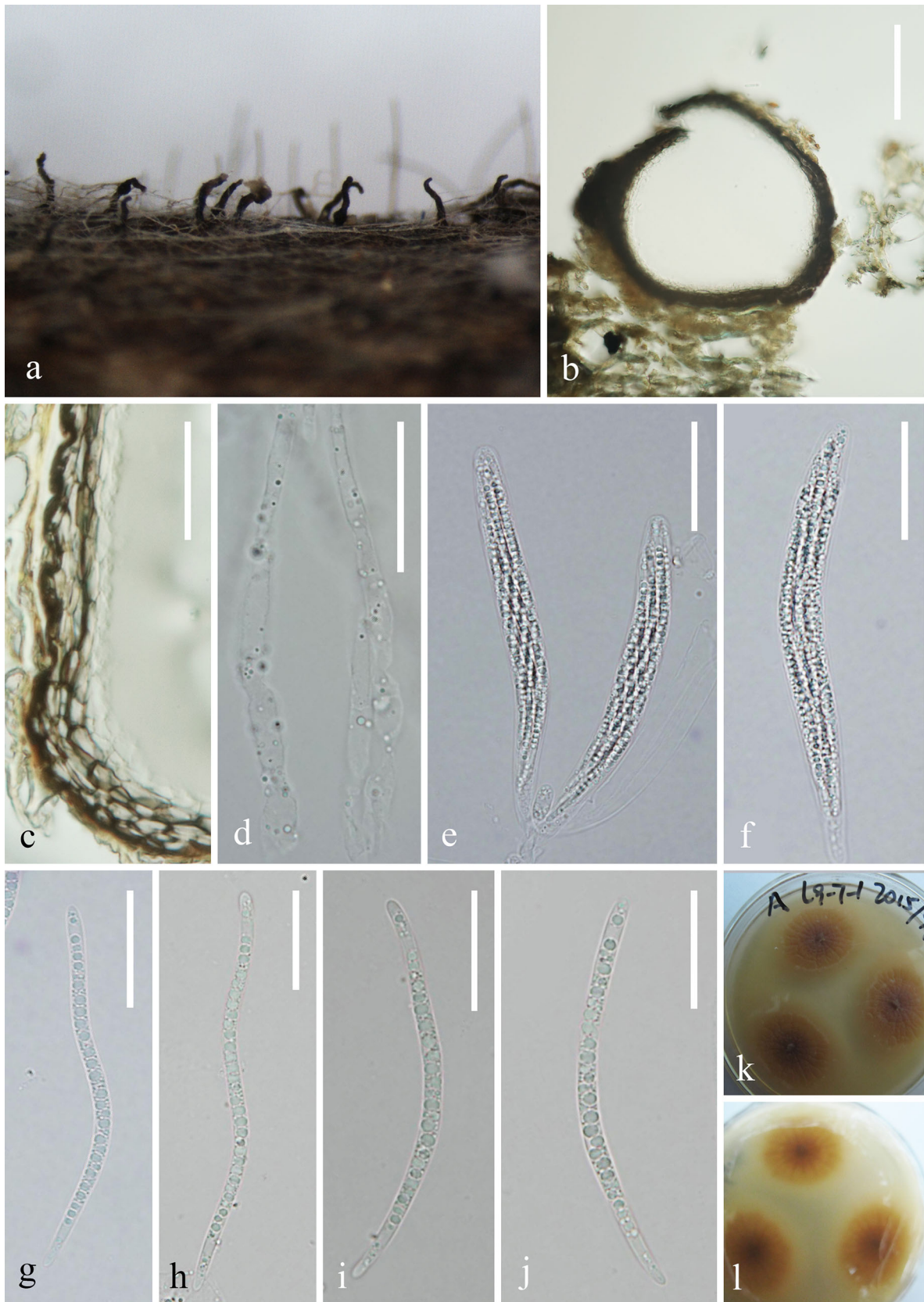


Fig. 12 *Ceratosphaeria lignicola* (MFLU 18-1457, holotype). **a**, **b** Appearance of neck on substrate. **c**, **d** Section of ascoma. **e** Structure of peridium. **f** Paraphyses. **g–k** Asci. **l–n** Ascospores. **o** Germinating

ascospore. culture on PDA from surface (**p**) and reverse (**q**). Scale bars: **c** 100 μm , **d**, **g** 50 μm , **h–o** 30 μm , **e**, **f** 20 μm



◀**Fig. 13** *Aquafiliformis lignicola* (MFLU 18–2325, holotype) **a** Appearance of necks on substrate. **b** Section through ascoma. **c** Structure of peridium. **d** Paraphyses. **e, f** Asci. **g–j** Ascospores. Culture on PDA from surface (**k**) and reverse (**l**). Scale bars: **b** 150 μm , **c** 50 μm , **d–f** 30 μm , **g–j** 20 μm

ellipsoidal, straight to curved, multi-septate ascospores (Hongsanan et al. 2017). Ceratosphaeriaceae is distinct from Pseudohalonectriaceae in having narrowly cylindrical-fusiform to filiform, longer ascospores. We therefore introduce a new family Ceratosphaeriaceae to accommodate *Ceratosphaeria*.

Ceratosphaeria Niessl, Verh. nat. Ver. Brünn 14: 203 (1876)

Asexual morph *Harpophora*-like. *Phialides* or short *conidiophores* arising on aerial hyphae, conidial heads slimy, inconspicuous, and transparent. *Conidiogenous cells* phialidic, ampulliform to lageniform, terminal or intercalary, hyaline to subhyaline, cylindrical. *Conidia* cylindrical with curvature, hyaline, narrowly rounded at both ends, aseptate, smooth. Sexual morph *Stromata* absent. *Ascomata* globose to pyriform, often irregular in shape due to compression, deeply immersed to almost superficial, dark brown to black, carbonaceous, with a long cylindrical black or yellow crystals, thick-walled neck which is easily detached, scattered to densely aggregated. *Peridium* composed of a large number of layers of very thick-walled rather small cells in the neck region. Interascal tissue of *paraphyses* thin-walled, probably evanescent at maturity, *periphyses* well-developed. *Asci* 8-spored, unitunicate, cylindrical, fairly thin-walled, the truncate apex, with a conspicuous, J-, apical ring. *Ascospores* arranged biserially, narrowly cylindrical-fusiform, filiform, the ends acute, often slightly curved, thin-walled, hyaline, guttulate, smooth-walled.

Type species: *Ceratosphaeria lampadophora* (Berk. & Broome) Niessl, Verh. nat. Ver. Brünn 14: 203 (1876)

Notes: The genus *Ceratosphaeria* was introduced by Niessl (1876) with *C. lampadophora* as the type species and it is morphologically characterized in having globose to pyriform, immersed to almost superficial, dark coloured stromatic ascomata, leathery to fragile perithecial walls, cylindrical-clavate, short-stipitate asci, truncate to broadly rounded at the apex, with an apical annulus and allantoid to suballantoid, pale brown, aseptate ascospores (Niessl 1876; Réblová 2006). In this study, we introduce two new species in *Ceratosphaeria*. Five species in this genus have been recorded from freshwater habitats.

Ceratosphaeria aquatica Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555644, Facesoffungi number: FoF 05416, Fig. 11

Etymology: Referring to the aquatic habitat of this fungus.

Holotype: MFLU 18–2323

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Undetermined. **Sexual morph** *Ascomata* 269–361 μm high, 196–284 μm diam., deeply immersed with neck erumpent through host surface, globose to subglobose, brown to yellow brown, occurring solitary. *Neck* long, surface smooth, at times with yellow crystals. *Peridium* 29–43 μm thick, composed of an inner layer of flattened hyaline cells, a middle layer of small, polygonal to irregular, pale brown cells, an outer layer of irregular, yellow brown, pseudoparenchymatic cells. *Paraphyses* 4–7 μm wide, longer than asci, long tapering above. *Asci* 86–124 \times 13–21 μm (\bar{x} = 105 \times 17 μm , n = 30), 8-spored, unitunicate, cylindrical to broadly fusiform, with a narrow apical ring. *Ascospores* 89–95 \times 4–7 μm (\bar{x} = 92 \times 5.5 μm , n = 30), filiform, mostly 3-septate, guttulate, hyaline, smooth-walled.

Material examined: **CHINA**, Yunnan Province, saprobic on decaying wood submerged in a freshwater river, April 2015, Z.L. Luo, S-639 (MFLU 18–2323, holotype; HKAS 92859, isotype), ex-type living culture MFLUCC 18–1337.

Notes: *Ceratosphaeria aquatica* resembles *C. phialidica* in having deeply immersed ascomata, and filiform, hyaline ascospores (Huhndorf et al. 2008). However, *Ceratosphaeria aquatica* differs from *C. phialidica* in having broader cylindrical asci (13–21 vs. 5.5–6.5 μm) and guttulate, septate, larger ascospores (89–95 \times 4–7 vs. 65–85 \times 1.3–1.7 μm). *Ceratosphaeria aquatica* also shares similar morphological characters with *C. lignicola* with filiform, guttulate, hyaline ascospores. However, *Ceratosphaeria aquatica* differs from *C. lignicola* in having 3-septate, wider ascospores (4–7 vs. 3.5–4.5 μm). Phylogenetic analysis also shows that *C. aquatica* is distinct from *C. lignicola* (Fig. 15).

Ceratosphaeria lampadophora (Berk. & Broome) Niessl \equiv *Sphaeria lampadophora* Berk. & Broome, Ann. Mag. nat. Hist., Ser. 3 3: 372 (1859)

Distribution: **Australia**, on submerged wood (Hyde et al. 1997)

Asexual morph: *Harpophora*-like. Detailed descriptions and illustrations refer to Réblová (2006).

Notes: LSU sequence data is available.

Ceratosphaeria phialidica (Shearer) Huhndorf et al.

\equiv *Pseudohalonectria phialidica* Shearer Can. J. Bot. 67(7): 1950 (1989)

Distribution: **USA**, submerged wood (Shearer 1989).

Asexual morph: *Harpophora*-like.

Notes: Holotype NY-01050492 and NY-01050493, other specimen collected from freshwater habitats: NY-03380687. Sequence data is not available.

Ceratosphaeria pusilla (Fuckel) Sacc

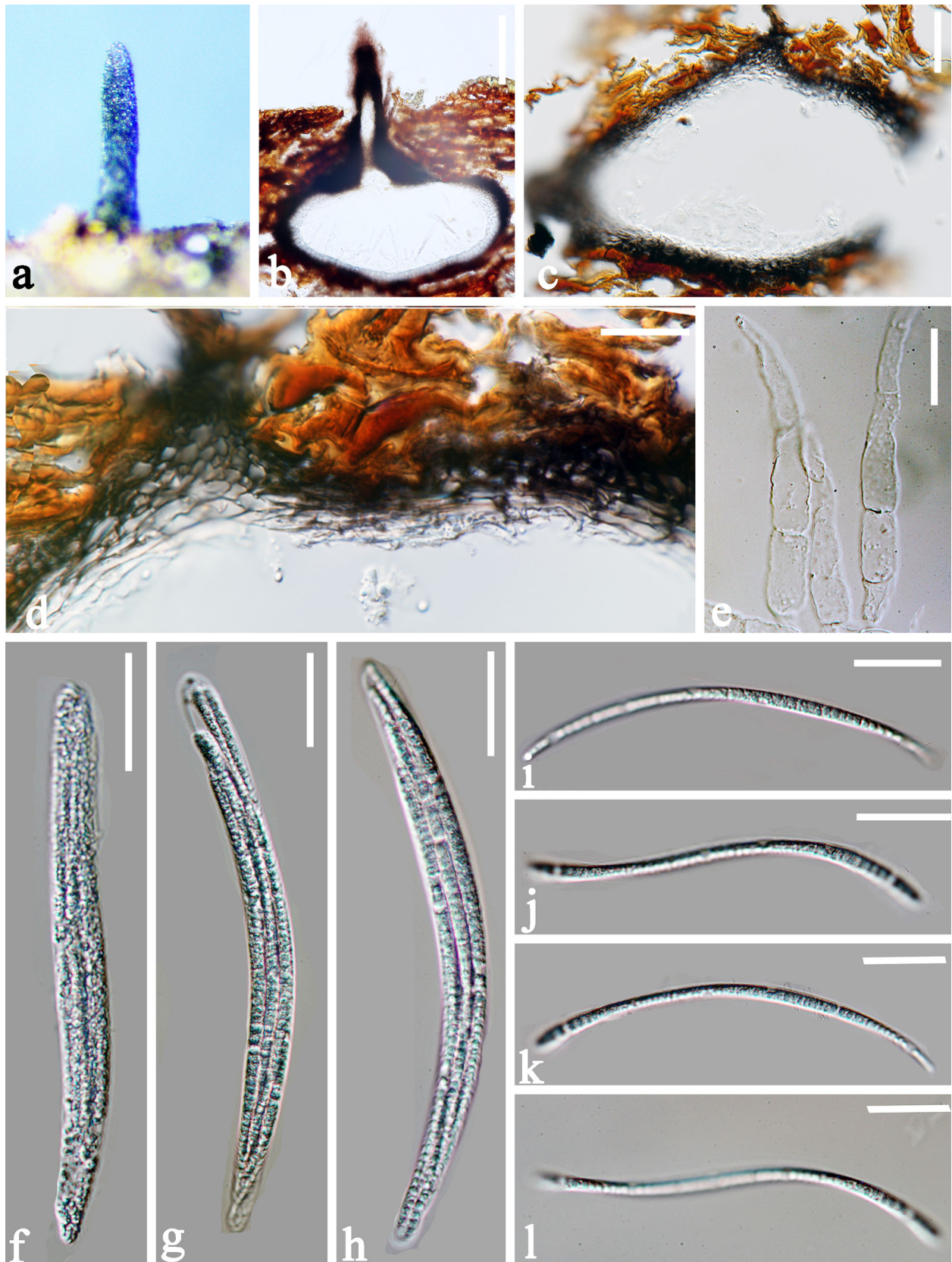
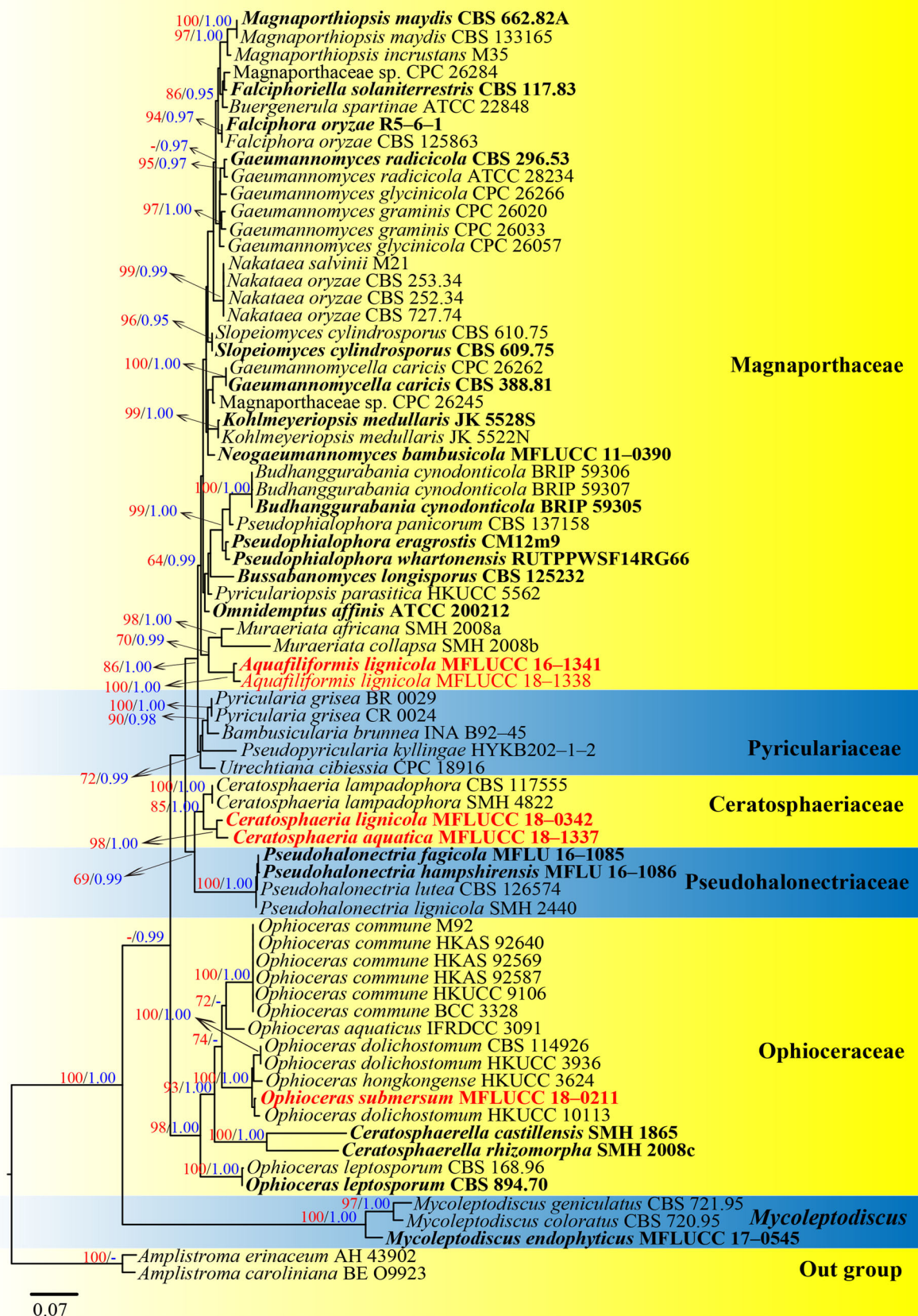


Fig. 14 *Ophioceras submersum* (MFLU 18–1459, holotype). **a** Appearance of neck on substrate. **b–c** Section of ascoma. **d** Structure of peridium. **e** Paraphyses. **f–h** Asci. **i–l** Ascospores. Scale bars: **b** 150 μ m, **c** 50 μ m, **d–l** 20 μ m



◀ **Fig. 15** Phylogram generated from maximum likelihood analysis based on LSU and TEF1 α sequence data for species of Magnaporthales (with *Amplistrroma erinaceum* and *A. caroliniana* as outgroup). The best scoring RAxML tree with a final likelihood value of -10365.588175 is presented. RAxML bootstrap support values equal to or greater than 60% are given before the forward slash (black). Bayesian posterior probability equal to or higher than 0.95 are given after the forward slash (red). Hyphen ('-') indicates a value lower than 60% for RAxML and Bayesian posterior probability lower than 0.95. Newly generated sequences are in red. Ex-type or ex-type strains are in bold

≡ *Ceratostoma pusillum* Fuckel Jb. nassau. Ver. Naturk. 23-24: 128 (1870) [1869-70]

Distribution: **USA**, submerged wood in southern Illinois swamps (Shearer and Crane 1986).

Asexual morph: Undetermined

Notes: Sequence data is not available.

Ceratosphaeria lignicola D.F. Bao, Z.L. Luo, H.Y. Su & K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 555645, Facesoffungi number: FoF 05417, Fig. 12

Etymology: Referring to this fungus dwelling on wood.

Holotype: MFLU 18-1457

Saprobic on decaying wood, submerged wood in freshwater. **Asexual morph** Undetermined. **Sexual morph** *Ascomata* 390–470 μm diam., 500–600 μm high, solitary or aggregated, deeply immersed, subglobose, dark brown to black, with a yellow, cylindrical, periphysate neck. *Peridium* 13.5–17.5 μm wide, composed of an inner layer of flattened hyaline cells, a middle layer of small, polygonal to irregular, brown cells, an outer layer of irregular, yellow brown, pseudoparenchymatic cells. *Paraphyses* 4.5–6.5 μm wide, numerous, septate, hyaline, tapering distally, smooth. *Asci* 106–116 \times 11–13 μm (\bar{x} = 111 \times 12 μm , n = 20), 8-spored, unitunicate, broadly cylindrical, thin-walled, with a refractive apical apparatus. *Ascospores* 94–102 \times 3.5–4.5 μm (\bar{x} = 98 \times 4 μm , n = 30), hyaline, filiform, tapering at both ends, guttulate, smooth-walled.

Material examined: **THAILAND**, Khwaeng Hua Mak, Khet Bang Kapi Krung Thep Maha Nakhon, saprobic on decaying wood submerged in a freshwater stream, October 2017, Z.L. Luo, B-96, (MFLU 18-1457, holotype), ex-type living culture, MFLUCC 18-0342.

Notes: *Ceratosphaeria lignicola* resembles *C. phialidica* in having deeply immersed ascomata in the substrate (Huhndorf et al. 2008). *Ceratosphaeria lignicola* differs from *C. phialidica* in having broader cylindrical asci (11–13 vs. 5.5–6.5 μm) and larger, guttulate, ascospores (94–102 \times 3.5–4.5 vs. 65–85 \times 1.3–1.7 μm). *Ceratosphaeria lignicola* also shares similar morphological characters with *C. lampadophora* (Huhndorf et al. 2008).

However, *Ceratosphaeria lignicola* differs from *C. lampadophora* in having longer, filiform, aseptate ascospores (94–102 vs. 52–72 μm), while *C. lampadophora* have fusiform, 5–7-septate ascospores. Phylogenetic analysis also shows that *Ceratosphaeria lignicola* is distinct from *C. lampadophora* (Fig. 15).

Magnaporthaceae P.F. Cannon

Aquafiliformis Z.L. Luo, K.D. Hyde & H.Y. Su, *gen. nov.*

Index Fungorum number: IF 555646, Facesoffungi number: FoF 05418

Etymology: “Aqua” referring to the aquatic habitats, “filiformis” referring to the filiform ascospores.

Saprobic on decaying wood. **Asexual morph** Undetermined. **Sexual morph** *Ascomata* immersed with neck erumpent through host surface, globose to subglobose, dark brown to black, solitary. *Peridium* composed of an inner layer of flattened hyaline cells and an outer layer of irregular, heavily pigmented, thick-walled, pale brown to dark brown cells of *textura angularis*. *Paraphyses* hyaline, septate, unbranched. *Asci* 8-spored, unitunicate, cylindrical to clavate, hyaline. *Ascospores* filiform, aseptate, guttulate, hyaline, smooth-walled.

Type species: *Aquafiliformis lignicola* Z.L. Luo, K.D. Hyde & H.Y. Su

Notes: *Aquafiliformis* morphologically resembles *Ceratosphaeria* in having globose to subglobose, dark brown to black ascomata, cylindrical, 8-spored, unitunicate asci and filiform, hyaline, guttulate ascospores (Huhndorf et al. 2008). However, the phylogenetic analysis of combined LSU, SSU, RPB2 and TEF1 α sequence data show that our newly obtained strains (MFLUCC 16-1341, MFLUCC 18-1338) clusters in Magnaporthaceae, while *Ceratosphaeria* belongs to the newly introduced Ceratosphaeriaceae (Fig. 1, clade 20, 22). Wijayawardene et al. (2018) accepted 23 genera in the family Magnaporthaceae. Twenty genera with available molecular sequence data are included in our phylogenetic analysis and 17 of them clusters together, while the newly obtained strains MFLUCC 16-1341 and MFLUCC 18-1338 form a separate clade in Magnaporthaceae and close to *Muraeriata* (SMH 2008a, SMH 2008b) (Fig. 15). However, our strain differs from *Muraeriata* species in having globose to subglobose ascomata, a peridium composed of an inner layer of flattened hyaline cells and an outer layer of irregular, heavily pigmented, thick-walled, pale brown to dark brown cells of *textura angularis* and filiform, aseptate ascospores, while *Muraeriata* species have lageniform to globose ascomata, a peridium with a middle layer of large, polygonal to irregular, hyaline cells that collapse or rupture creating large empty pockets, with an external brown crust and narrowly fusiform, septate ascospores (Huhndorf et al. 2008). The genera *Clavatisporella* and *Herbampulla* were

also placed in Magnaporthaceae, but the sequence data for these two genera are unavailable, and morphology of our fungus are different from those of *Clavatisporella* and *Herbampulla* by its filiform ascospores (Scheuer and Nogrask 1993; Hyde 1995a). Therefore, we introduce a new genus *Aquafiliformis* to accommodate our collections. *Aquafiliformis lignicola* Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555647, Facesoffungi number: FoF 05419, Fig. 13

Etymology: Referring to this fungus dwelling on wood.

Holotype: MFLU 18–2325

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Undetermined. **Sexual morph** *Ascomata* 275–335 μm high, 300–356 μm diam., immersed with erumpent neck through host surface, globose to subglobose, dark brown to black, solitary. *Peridium* 24–34 μm thick, composed of an inner layer of flattened hyaline cells and an outer layer of irregular, heavily pigmented, thick-walled, pale brown to dark brown cells of *textura angularis*. *Paraphyses* 4.5–7.5 μm wide, hyaline, septate, unbranched. *Asci* 76–86 \times 8–12 μm (\bar{x} = 81 \times 10 μm , n = 25), 8-spored, unitunicate, cylindrical to clavate, hyaline. *Ascospores* 57–69 \times 2.5–3.5 μm (\bar{x} = 63 \times 3 μm , n = 20), filiform, guttulate, aseptate, hyaline, smooth-walled.

Material examined: **CHINA**, Yunnan Province, saprobic on decaying wood submerged in a freshwater River, April 2015, X.C. Tao, S-478 (MFLU 18–2325, holotype; HKAS 92814, isotype), ex-type living culture MFLUCC 16–1341; *Ibid.*, saprobic on decaying wood submerged in a freshwater stream in Cangshan Mountain, August 2016, H.W. Shen, S-717 (MFLU 18–2324, paratype), living culture MFLUCC 18–1338.

Notes: *Aquafiliformis lignicola* resembles *Neogaemannomyces bambusicola* in having immersed, globose to subglobose, solitary ascomata, unitunicate, cylindrical, hyaline asci and filiform, hyaline, guttulate ascospores (Liu et al. 2015a, b). However, *Aquafiliformis lignicola* differs from *Neogaemannomyces bambusicola* in having different sizes of ascomata, asci and ascospores. *Aquafiliformis lignicola* has aseptate ascospores, while *Neogaemannomyces bambusicola* has 2–3-septate ascospores. Phylogenetic analysis also support that they belong to different genera (Fig. 15).

Ophioceraeae Klaubauf et al.

Ophioceras Sacc., Syll. fung. (Abellini) 2: 358 (1883)

Asexual morph Undetermined. **Sexual morph** *Ascomata* globose to elongate-globose, superficial to immersed, black, with a long neck. *Peridium* thick, blackened. *Paraphyses* hypha-like, hyaline, septate, numerous. *Asci* 8-spored, cylindrical, with small, refractive, apical rings.

Ascospores filiform, narrowly fusoid to cylindrical, septate, hyaline.

Type species: *Ophioceras dolichostomum* (Berk. & M.A. Curtis) Sacc., Syll. fung. (Abellini) 2: 358 (1883)

Notes: Saccardo (1883) introduced *Ophioceras* based on *O. dolichostomum* (Berk. & M.A. Curtis) Sacc. *Ophioceras* species are commonly encountered on decaying woody substrates in freshwater habitats worldwide (Hyde 1992b; Hyde and Goh 1998a; Shearer et al. 1999; Tsui et al. 2001a,b; Thongkantha et al. 2009).

Ophioceras aquaticus Hu et al.

Distribution: **China**, Yunnan Province, on submerged wood (Hu et al. 2012c).

Asexual morph: Undetermined

Notes: Holotype IFRD 021–055. ITS, LSU and SSU sequence data obtained from ex-type culture are available.

Ophioceras arcuatisporum Shearer et al.

Distribution: **Canada**, Manitoba, Lake Rosabella, on submerged grasses; **USA**, Minnesota, Lake Itasca State Park, Elk lake, on *Typha* sp., Shagawa lake, on submerged herbaceous debris (Shearer et al. 1999).

Asexual morph: Undetermined

Notes: Holotype ILLS, Crane A-167–1. Sequence data is not available.

Ophioceras commune Shearer et al.

Distribution: **China**, Hong Kong, Lam Tsuen River, on submerged wood (Tsui et al. 2001b); **Egypt**, River Nile, on submerged wood (Abdel-Aziz 2016); **Japan**, Koito River, on submerged wood (Tsui et al. 2001a); **Panama**, Barro Colorado Island, on twig submerged in Allee Creek (Shearer et al. 1999); **USA**, Illinois, Louisiana, Minnesota, on submerged wood (Shearer et al. 1999), Florida, on submerged decaying wood (Raja et al. 2009b).

Asexual morph: Undetermined

Notes: Holotype ILLS, Shearer 408–2, other specimens collected from freshwater habitats: HKAS 92587, HKAS 92640, HKAS 92569. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

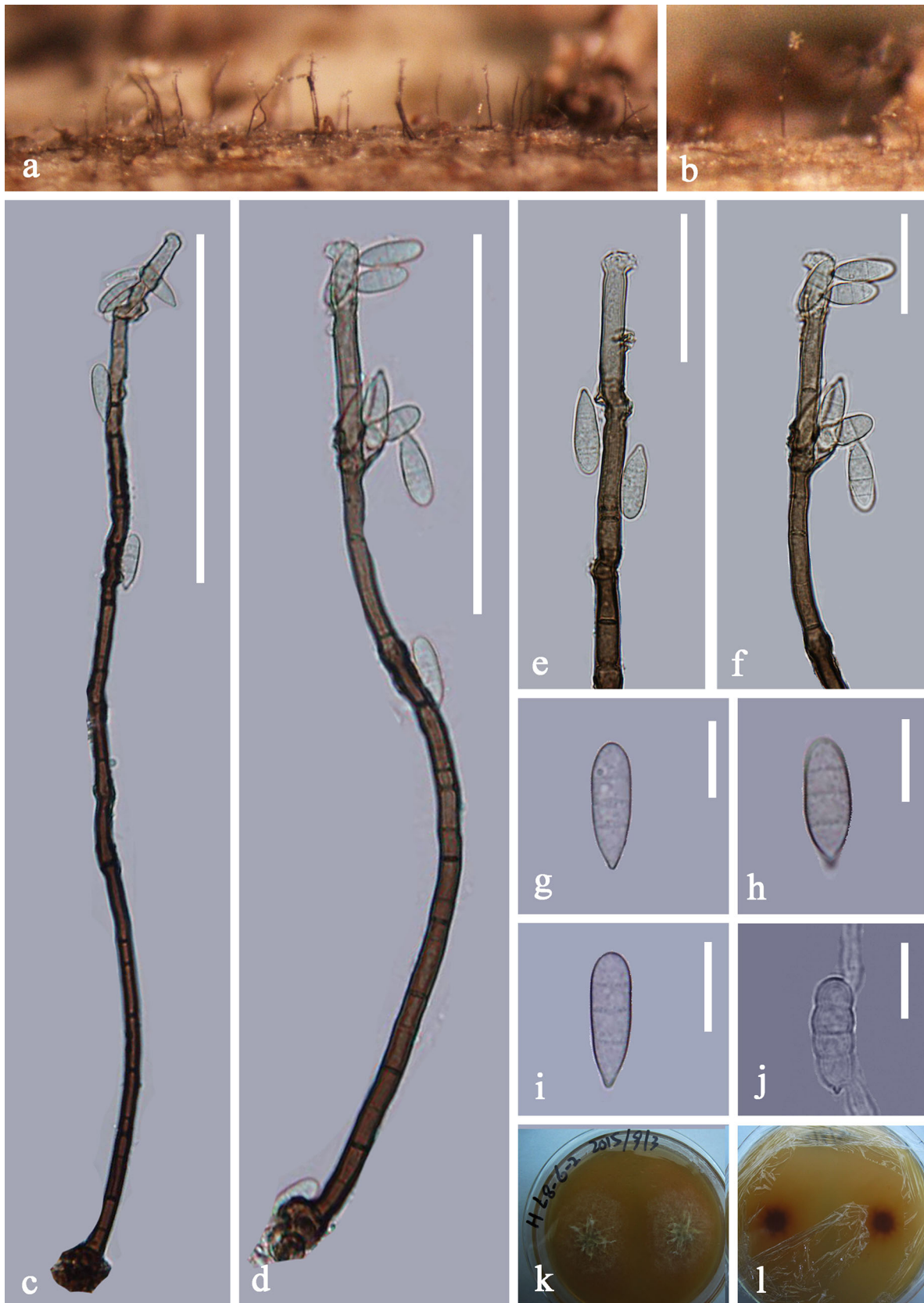
Ophioceras dolichostomum (Berk. & M.A. Curtis) Sacc \equiv *Sphaeria dolichostoma* Berk. & M.A. Curtis, Soc., Bot. 10(no. 46): 388 (1868) [1869]

Distribution: **Australia**, north Queensland, submerged wood (Hyde 1992b); **Japan**, Koito River, on submerged wood (Tsui et al. 2001a); **USA**, Florida, on submerged wood (Conway and Barr 1977); **Seychelles**, Riviere St Marie-Louis, on submerged wood (Hyde and Goh 1998a).

Asexual morph: Undetermined

Notes: Holotype anon. 51 (anon. 580), other specimen collected from freshwater habitats: BRIP 19330. ITS, LSU, SSU, TEF1 α and MCM7 sequence data are available.

Ophioceras fusiforme Shearer et al.



◀**Fig. 16** *Myrmecridium aquaticum* (MFLU 18–1595, holotype) **a**, **b** Colony on natural substrate. **c**, **d** Conidiophore with conidia. **e**, **f** Conidiogenous cells with conidia. **g–i** Conidia. **j** Germinating conidium. Culture on PDA from above (**k**) and reverse (**l**). Scale bars: **c**, **d** 100 μm , **e**, **f** 30 μm , **g–j** 10 μm

Distribution: **USA**, Indiana, Shades State Park, small stream, on submerged decorticated woody debris (Shearer et al. 1999).

Asexual morph: Undetermined

Notes: Holotype ILLS, Shearer 837–1. SSU sequence data obtained from ex-type culture is available.

Ophioceras guttulatum Tsui et al.

Distribution: **China**, Hong Kong, Tai Po. Lain Tsuen River, on submerged wood (Tsui et al. 2001c); **China**, Yunnan Province, on submerged bamboo (Cai et al. 2006a).

Asexual morph: Undetermined

Notes: Holotype IFRD 8819. Sequence data is not available.

Ophioceras hongkongense Tsui et al.

Distribution: **China**, Hong Kong, Tai Po. Lain Tsuen River, on submerged wood (Tsui et al. 2001c)

Asexual morph: Undetermined

Notes: Holotype IFRD 8820. LSU and SSU sequence data are available.

Ophioceras leptosporum (S.H. Iqbal) J. Walker

Synonym: *Gaeumannomyces leptosporus* S.H. Iqbal, Trans. Br. mycol. Soc. 58(2): 346 (1972)

Distribution: **UK**, submerged plant stalks (Iqbal 1972).

Asexual morph: Undetermined

Notes: Holotype K(M) 35072. ITS, LSU, SSU, RPB1, TEF1 α and MCM7 sequence data are available.

Ophioceras submersum D.F. Bao, Z.L. Luo, H.Y. Su & K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 555648, Facesoffungi number: FoF 05420, Fig. 14

Etymology: Referring to the submerged habitats of the fungus

Holotype: MFLU 18–1459

Saprobic on decaying wood, submerged wood in freshwater. **Asexual morph** Undetermined. **Sexual morph** *Ascomata* 500–600 μm diam., 300–400 μm high, scattered, solitary, deeply immersed, subglobose or ellipsoidal, coriaceous, black, with a long black neck. *Ostiole* central, with straight upright neck at one end, black, periphysate. *Peridium* 25–31 μm , thick-walled, composed two layers, inner layer of hyaline, small pseudoparenchyma cells, outer layer of pseudoparenchyma cells occluded with brown amorphous material, dark brown cells of *textura angularis*. *Paraphyses* 7–10 μm wide, hyaline, septate, constricted at septa, broader at base, tapering to the end, longer than asci,

smooth. *Asci* 115–137 \times 10–11 μm (\bar{x} = 126 \times 10.5 μm , n = 15), 8-spored, unitunicate, cylindrical, subhyaline, apically rounded. *Ascospores* 87–109 \times 3–4 μm (\bar{x} = 98 \times 3.5 μm , n = 20), overlapping in ascus, filiform, slightly curved, thin-walled, multi-septate, rounded at both ends, hyaline, smooth-walled.

Material examined: **THAILAND**, Sai Khu Waterfall, on submerged decaying wood, 1 September 2017, C.G. Lin, B-25 (MFLU 18–1459, holotype), ex-type living culture, MFLUCC 18–0211.

Notes: *Ophioceras submersum* clusters in *Ophioceras* based on multi-gene phylogenetic analyses and is related to *O. dolichostomum*, *O. hongkongense* and *O. venezuelense* (Fig. 15). *Ophioceras submersum* resembles *O. hongkongense* in having subglobose, black ascomata with a long black neck, hyaline, septate paraphyses, unitunicate, cylindrical, subhyaline asci and filiform, hyaline, septate, smooth ascospores (Tsui et al. 2001c). However, *Ophioceras submersum* differs from *O. hongkongense* by its smaller ascomata and longer asci (Tsui et al. 2001c). Phylogenetic analysis also shows that they are distinct species (Fig. 1, clade 19).

Ophioceras tenuisporum Shearer et al.

Distribution: **Panama**, Barro Colorado Islanda, on twig submerged in Allee Creek (Shearer et al. 1999);

Asexual morph: Undetermined

Notes: Holotype ILLS, Shearer 652–1. LSU, SSU and β -tubulin sequence data are available.

Ophioceras venezuelense Shearer et al.

Distribution: **Venezuela**, on submerged decorticated wood (Shearer et al. 1999).

Asexual morph: Undetermined

Notes: Holotype ILLS, Crane A-109–1. SSU sequence data is available.

Pseudohalonectriaceae Hongsanan & K.D. Hyde

Pseudohalonectria Minoura & T. Muroi, Trans. Mycol. Soc. Japan 19(2): 132 (1978)

Asexual morph Hyphomycetous, phialidic. *Phialides* hyaline, micronematous, flask-shaped. *Conidia* allantoid, hyaline, aseptate. **Sexual morph** *Ascomata* immersed or partially immersed, with a long neck, globose to subglobose. *Peridium* membranous. *Paraphyses* numerous, septate, hyaline. *Asci* unitunicate, cylindrical, straight or curved, with J-, thimble-shaped apical ring. *Ascospores* overlapping uniseriate to biseriate, multi-seriate, filiformes, septate.

Type species: *Pseudohalonectria lignicola* Minoura & T. Muroi, Trans. Mycol. Soc. Japan 19(2): 132 (1978)

Notes: The genus *Pseudohalonectria* was introduced to accommodate *P. lignicola* (Minoura and Muroi 1978). Hongsanan et al. (2017) introduced Pseudohalonectriaceae as a new family within Magnaporthales to accommodate

Pseudohalonestria. Sixteen species are accepted in this genus, of which six species have been reported from freshwater habitats worldwide (Minoura and Muroi 1978; Shearer 1989a, b; Hyde et al. 1998b; Cai et al. 2002a).

Pseudohalonestria adversaria Shearer

Distribution: **South Africa**, Durban, Palmiet River, on submerged wood (Hyde et al. 1998b); **USA**, Illinois, on

submerged woody debris from Deer Pond (Shearer 1989a, b).

Asexual morph: Undetermined

Notes: Holotype ILLS, CS-603–1. Sequence data is not available.

Pseudohalonestria falcata Shearer

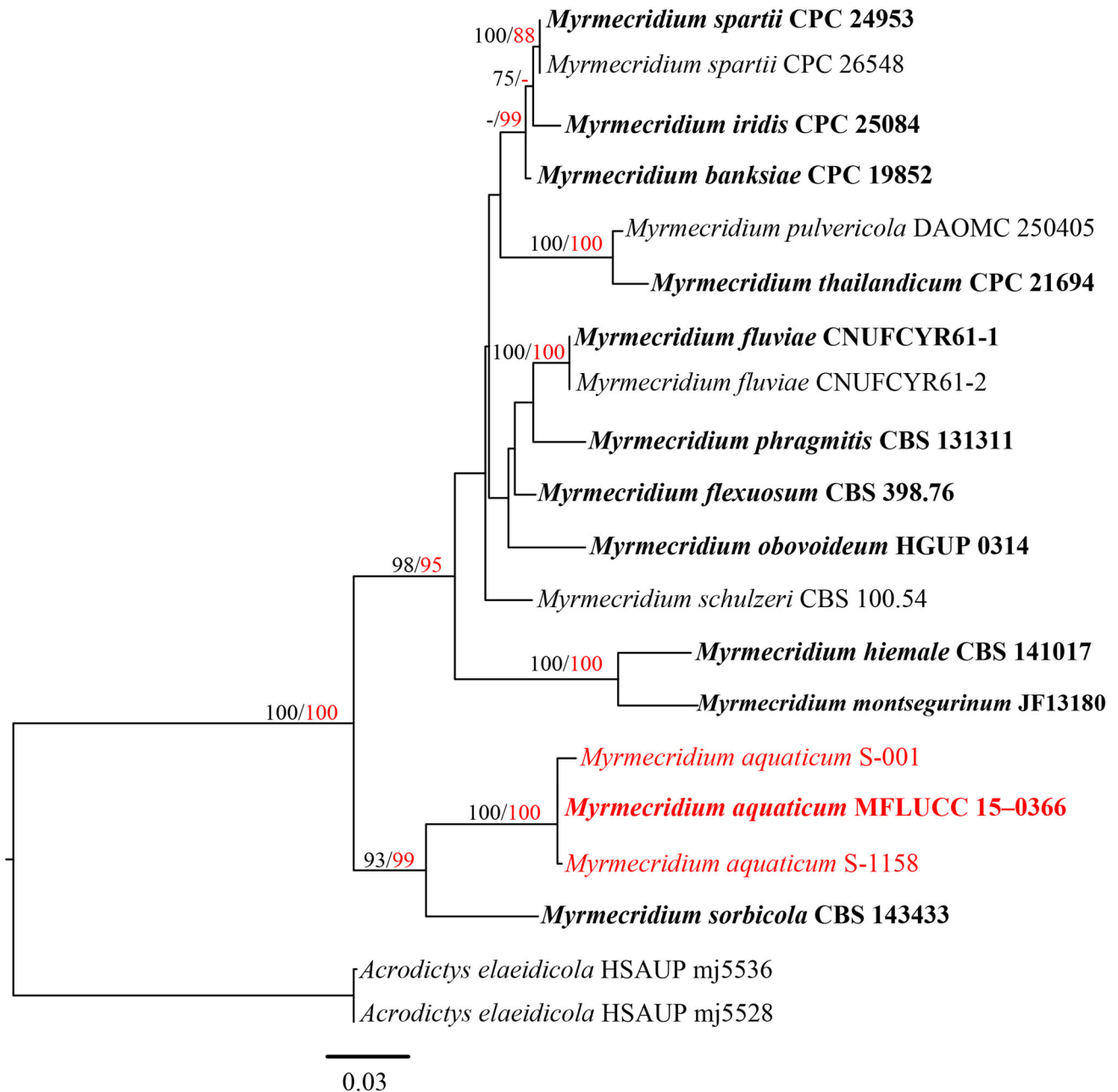


Fig. 17 Phylogram generated from maximum likelihood analysis based on combined ITS and LSU sequence data for species of *Myrmecridium* (with *Acrodictys elaeidicola* as outgroup). The best scoring RAxML tree with a final likelihood value of -4631.789675 is presented. RAxML bootstrap support values equal to or greater than

75% are given before the forward slash (black). Maximum parsimony bootstrap support values equal to or greater than 75% are given after the forward slash (red). Hyphen ('-') indicates a value lower than 75% for RAxML and Maximum parsimony. Newly generated sequences are in red. Ex-type strains are in bold

Distribution: **USA**, Illinois, on submerged twig collected from Quiver Creek (Shearer 1989).

Asexual morph: Undetermined

Notes: Holotype NY-01050484, paratype NY-01050483, other specimens collected from freshwater habitats NY-03380667, NY-03380668. LSU, SSU and TEF1 α sequence data are available.

Pseudohalonectria fuxianii Cai et al.

Distribution: **China**, Yunnan Province, Lake Fuxian, on submerged wood (Cai et al. 2002a).

Asexual morph: Undetermined

Notes: Holotype IFRD 8838. Sequence data is not available.

Pseudohalonectria lignicola Minoura & T. Muroi

Distribution: **China**, Yunnan Province, Lake Fuxian, on submerged wood (Cai et al. 2002a); **Japan**, Koito River, on submerged wood (Tsui et al. 2001a), Lake Biwa, on submerged wood (Minoura and Muroi 1978); **USA**, Illinois, Indiana, on submerged wood in streams or Rivers (Shearer 1989a, b).

Asexual morph: Undetermined

Notes: Holotype HUT 40005. ITS, LSU, SSU, RPB1, TEF1 α , MCM7 and β -tubulin sequence data are available.

Pseudohalonectria longirostrum Shearer

Distribution: **Panama**, a twig submerged in Shannon Creek (Shearer 1989).

Asexual morph: Undetermined

Notes: Holotype CS-656-1, NY. Sequence data is not available.

Pseudohalonectria lutea Shearer

Distribution: **China**, Yunnan Province, Lake Fuxian, on submerged wood (Cai et al. 2002a); **Chile**, submerged wood collected from a small stream (Shearer 1989a).

Asexual morph: Undetermined

Notes: Holotype NY-01050490, NY-01050491. LSU sequence data is available.

Myrmecridiales Crous

Myrmecridiaceae Crous

Myrmecridium Arzanlou et al., Stud. Mycol. 58: 84 (2007)

Asexual morph Colonies flat, with immersed mycelium. *Conidiophores* arising vertically and clearly distinct from creeping hyphae, unbranched, straight or flexuose, septate, thick-walled. *Conidiogenous cells* polyblastic, integrated, terminally, cylindrical. *Conidia* solitary, subhyaline, smooth or finely verrucose, obovoidal or fusiform, conidial secession schizolytic. **Sexual morph** *Ascomata* solitary or aggregated in small groups, immersed, hyaline to pale brown. *Papilla* or *short necks* centrally located, opening flush with the wood surface or slightly projecting. *Ostiole* periphysate. *Clypeus* positioned slightly beneath the wood surface. *Ascomatal wall* two layered. *Paraphyses* hyaline, septate, slightly constricted at the septa, cylindrical. *Asci*

cylindrical, with a slender, long stipe. *Ascospores* ellipsoidal, delicately verruculose, septate, hyaline.

Type species: *Myrmecridium schulzeri* (Sacc.) Arzanlou, W. Gams & Crous, Stud. Mycol. 58: 84 (2007)

Notes: The genus *Myrmecridium* was introduced by Arzanlou et al. (2007) to accommodate *Ramichloridium*-like taxa with hyaline mycelium, and pale to unpigmented conidiophores with pimple-like conidiogenous denticles at their apices. Twelve species are accepted in this genus (Peintner et al. 2016; Réblová et al. 2016b; Tibpromma et al. 2017) and two of them were collected from freshwater habitats (Réblová et al. 2016b; Tibpromma et al. 2017).

Myrmecridium aquaticum Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555649, Facesoffungi number: FoF 05421, Fig. 16

Etymology: Referring to the aquatic habitat of this fungus

Holotype: MFLU 18–1595

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on natural substrate superficial, effuse, hairy, brown. *Mycelium* immersed, composed of septate, branched, smooth, hyaline hyphae. *Conidiophores* 211–308 μm long, 5–7 μm wide (\bar{x} = 258 \times 6 μm , n = 20), macronematous, mononematous, erect, unbranched, multi-septate, straight or flexuose, cylindrical, percurrently proliferating, brown, paler towards the apex, smooth, nodose at the tip. *Conidiogenous cells* holoblastic, polyblastic, integrated, terminal, later becoming intercalary, subhyaline to pale brown. *Conidia* 14–16 μm long, 4–6 μm wide (\bar{x} = 15 \times 5 μm , n = 20), acropleurogenous, dry, obovoid, rounded at the apex, pointed at the base, 3-septate, subhyaline, smooth-walled. **Sexual morph** Undetermined

Material examined: **CHINA**, Yunnan Province, Lancang River, saprobic on submerged decaying wood, April 2015, X.C. Tao, S-448 (MFLU 18–1595, holotype; HKAS 92833, isotype), ex-type living culture MFLUCC 15–0366, KUMCC 15–0340; Jizu Mountain, saprobic on decaying wood submerged in a freshwater stream, April 2017, N Zhao, S-1158, living culture MFLUCC 18–1489; Cangshan Mountain, saprobic on decaying wood submerged in a freshwater stream, March 2014, X.Y. Liu, S-001.

Notes: *Myrmecridium aquaticum* resembles *M. sorbicola* in having solitary, erect, unbranched, multi-septate, brown conidiophores, integrated, terminal and intercalary conidiogenous cells and obovoid, smooth conidia rounded at the apex (Crous et al. 2018). However, *Myrmecridium aquaticum* differs from *M. sorbicola* in having larger conidiophores (211–308 vs. 50–200 μm), 3-septate and longer conidia (14–16 vs. 8–10 μm), while *M. sorbicola* has almost 1-septate conidia with mucoid sheath



Fig. 18 *Sporidesmium lageniforme* (MFLU 18–1594, holotype) **a, b** Colonies on substrate. **c, d** Conidiophore with conidia. **e** Conidiophores. **f** Conidiogenous cells **g–i** Conidia **j** Germinating conidium. Culture on PDA from above (**k**) and reverse (**l**). Scale bars: **c–e** 50 μ m, **f–l** 20 μ m

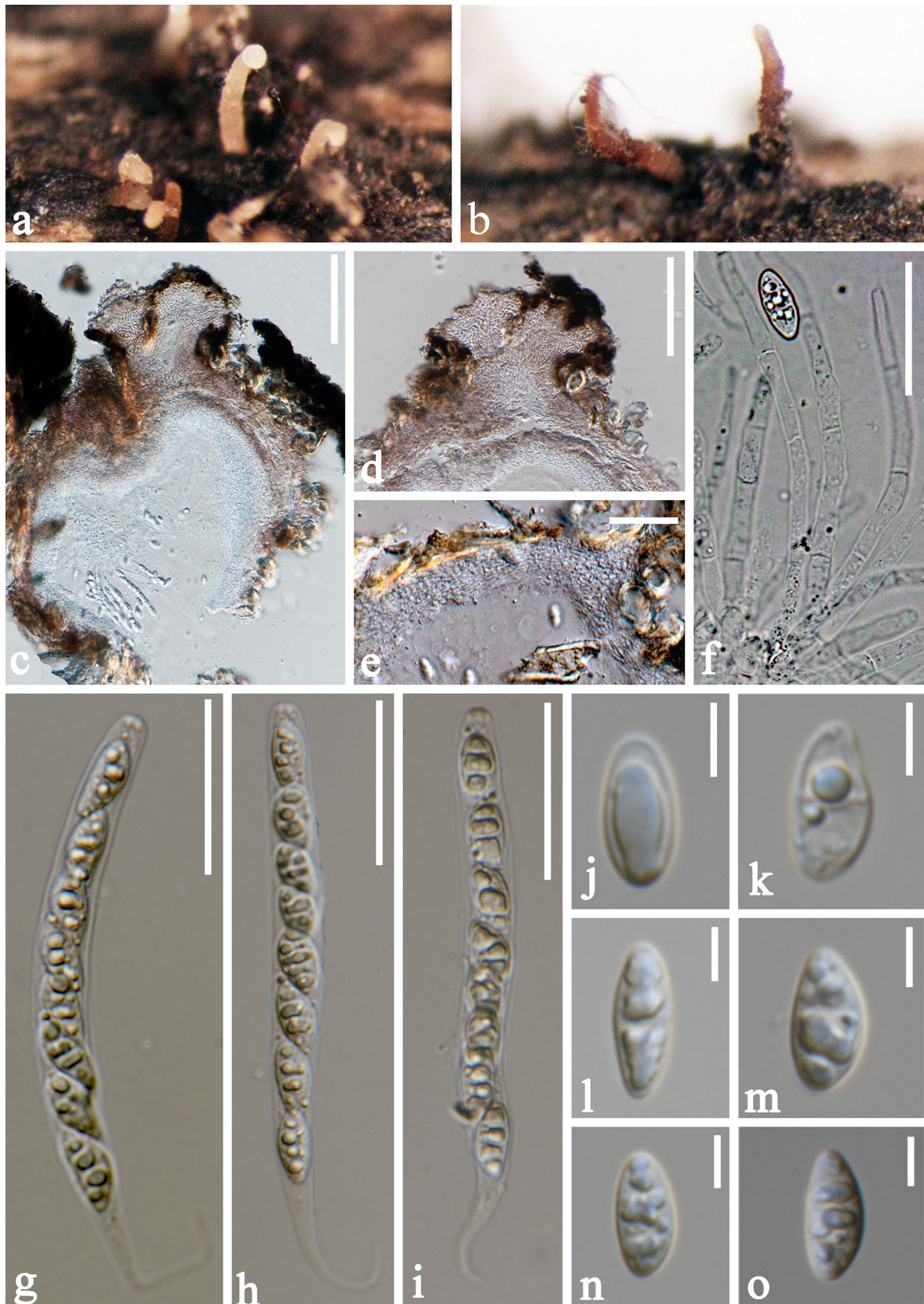


Fig. 19 Sexual morph of *Sporidesmium lignicola* (MFLU 18–2326, holotype) **a, b** Appearance of necks on substrate. **c** Section through ascoma. **d, e** Structure of peridium. **f** Paraphyses. **g–i** Asci. **j–o** Ascospores. Scale bars: **c** 100 μm , **d** 50 μm , **f–i** 30 μm , **j–o** 5 μm

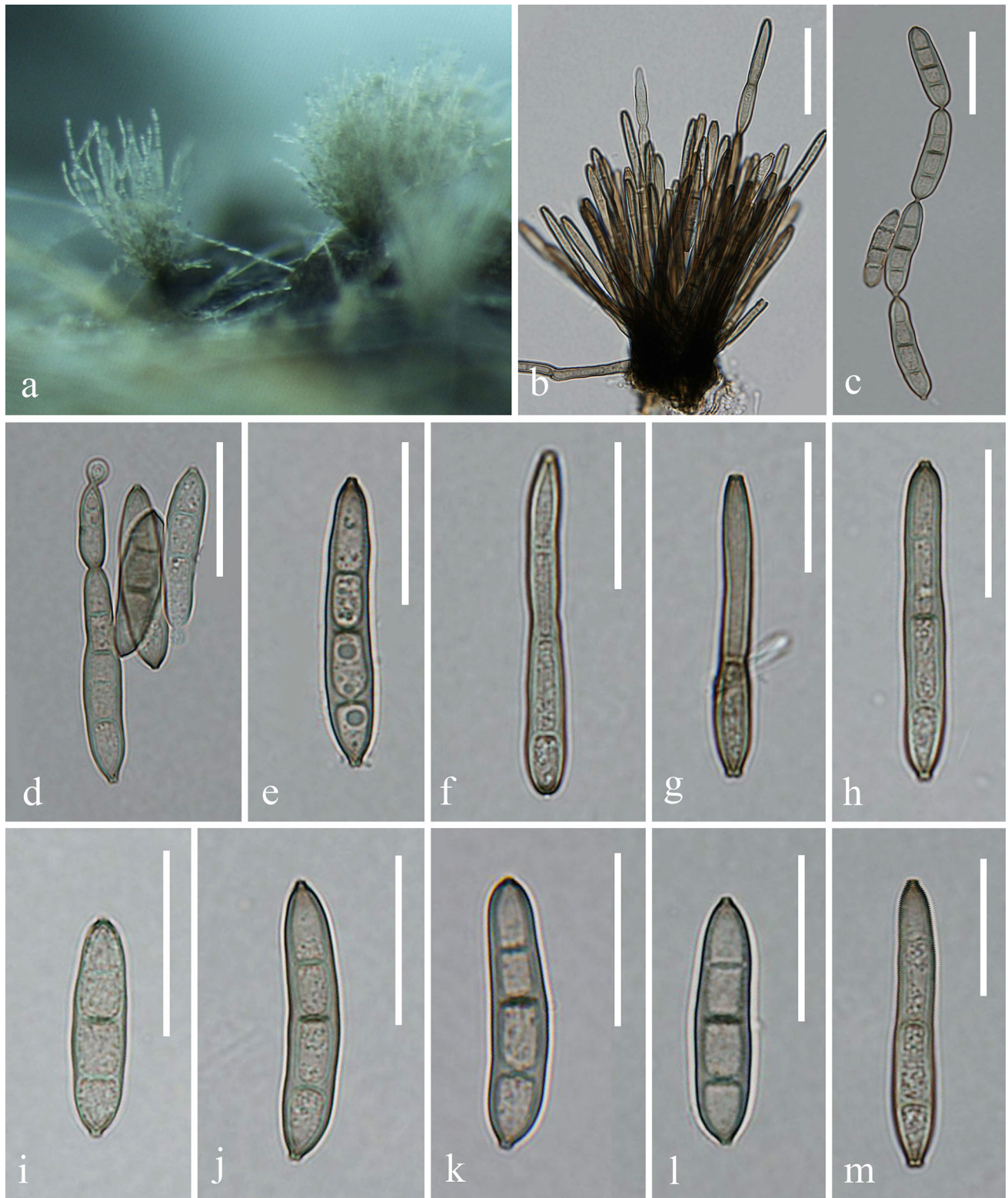


Fig. 20 Asexual morph of *Sporidesmium lignicola* (DLU 1376) **a** Colonies on natural substrate. **b** Conidiophore with conidia. **c–m** Conidia. Scale bars: **b–m** 20 μm

surrounding conidium in median region. Phylogenetic analysis shows that *Myrmecridium aquaticum* is distinct from other *Myrmecridium* species (Fig. 17).

Myrmecridium fluviae Hyang B. Lee & T.T.T. Nguyen

Distribution: **Korea**, Jeonnam Province, Yeongsan River located in Gwangju, from a freshwater sample (Tibpromma et al. 2017).

Sexual morph: Undetermined

Notes: Holotype CNUFC YR61–1; ITS and LSU sequence data are available.

Myrmecridium montsegurinum Réblová & J. Fourn

Distribution: **France**, Midi-Pyrénées: Ariège, Montségur, Le Lasset stream along D9 road, on submerged wood of *Fraxinus excelsior*, *Fagus sylvatica*, *Hedera helix* and *Alnus glutinosa* (Réblová et al. 2016b)

Asexual morph: Undetermined

Notes: Holotype PRM 934684, other specimens collected from freshwater habitats: PRM 934685, PRM 934686. ITS, LSU, SSU and RPB2 sequence data are available.

Ophiostomatales Benny & Kimbr.

Ophiostomataceae Nannf.

Subbaromyces Hesselt., Bull. Torrey bot. Club 80: 511 (1953)

Asexual morph *Conidiophores* branched, septate. *Conidia* hyaline, smooth-walled, aseptate, exogenously formed, ellipsoid. **Sexual morph** *Ascomata* partially submerged, later superficial, membranous, syringe-shaped, beak divided into two portions by a large pronounced collar, with upper portion tapering to a small ostiole, surrounded by a fringe of hyphae. *Paraphyses* absent. *Asci* 8-spored, unitunicate, clavate, with autodigestible wall. *Ascospores* 2-celled, with cells of equal size, hyaline, surrounded by a gelatinous envelope, released as a mucus-like droplet at tip of perithecium.

Type species: *Subbaromyces splendens* Hesselt., Bull. Torrey bot. Club 80: 511 (1953)

Notes: The genus was established by Hesseltine (1953) for a taxon collected from trickling filter rocks in New York, USA. Two species were accepted within this genus (Hesseltine 1953; Chary and Ramarao 1974). The other accepted species, *S. aquaticus*, was introduced by Chary and Ramarao (1974) for a species isolated from water samples collected in India. A phylogenetic analysis based on SSU sequence data of *S. splendens* was provided by Jones et al. (1999), and it showed that *S. splendens* is closely related to *Curvularia brachyspora*. In updated classifications, *Subbaromyces* was placed in the family Ophiostomataceae (Ophiostomatales, Sordariomycetes) (Maharachchikumbura et al. 2015, 2016; Wijayawardene et al. 2017, 2018).

Subbaromyces aquaticus Manohar. & P. R. Rao

Distribution: **India**, on submerged wood in freshwater (Chary and Ramarao 1974).

Asexual morph: Undetermined

Notes: Sequence data is not available.

Phomatosporales Senan. et al.

Phomatosporaceae Senan. & K.D. Hyde

Phomatospora Sacc., Nuovo G. bot. ital. 7: 306 (1875)

Asexual morph *Sporothrix*-like, reported from culture (Rappaz 1992). **Sexual morph** *Ascomata* solitary to rarely gregarious, immersed or becoming erumpent with age, globose or subglobose, light brown, dark brown to black, coriaceous, sometimes developing under a small blackened clypeus, ostiolate, papillate. *Papilla* short or rarely somewhat long, central or eccentric, cylindrical, sometimes covered with black, amorphous material around the upper region, periphyses hyaline, short, filiform. *Peridium* comprising small, brown pseudoparenchymatous cells forming a *textura angularis* to *textura prismatica* or inner, hyaline, thick-walled cells of *textura angularis* and outer, brown, cells of *textura angularis*. *Paraphyses* comprising hypha-like, filamentous, septate or aseptate, slightly constricted at the septa, distally tapering, hyaline. *Asci* 8-spored, unitunicate, cylindrical or oblong-fusiform, thin-walled, short stalked or sessile, apex oblong with J-, apical apparatus. *Ascospores* uniseriate, rarely biseriate, overlapping uniseriate to biseriate, ellipsoidal to fusiform, 0–3-septate, not constricted at the septum, sometimes bi-guttulate, guttules located at the ends of the cell, or longitudinally striate, sometimes with filamentous appendages at both ends, hyaline.

Type species: *Phomatospora berkeleyi* Sacc., Nuovo G. bot. ital. 7(4): 306 (1875)

Notes: *Phomatospora* was placed in Ascomycota genera *incertae sedis* based on phylogenetic analysis (Vijaykrishna et al. 2006). Senanayake et al. (2016) established the family Phomatosporaceae (Phomatosporales) to accommodate the genera *Phomatospora*, *Lanspora* and *Tenuimurus*. Members of the genus *Phomatospora* are widely distributed in freshwater, marine and terrestrial habitats. Seven species of *Phomatospora* are known from freshwater habitats (Shearer and Raja http://fungi.life.uiuc.edu/world_records; Nordén et al. 2015).

Phomatospora aquatica Minoura & T. Muroi

Distribution: **Australia**, Queensland, submerged wood in stream (Vijaykrishna and Hyde 2006); **Japan**, on basal wood submerged in Pond Nanatsuike (Minoura and Muroi 1978).

Asexual morph: Undetermined

Notes: Holotype HUT 40004. Sequence data is not available.

Phomatospora berkeleyi Sacc

Distribution: **Australia**, Queensland, submerged wood in stream (Vijaykrishna and Hyde 2006); **USA**, Illinois, Tinley Park Forest Preserve, Typha pond, on submerged stems of *Typha latifolia*; Wisconsin, Trout lake, on submerged stems of *Carex comosa*, Big Muskellunge lake, on submerged stems of *Scirpus brevicaudatus*, Allequash lake, on submerged stems of *Typha latifolia* (Fallah and Shearer 1998).

Asexual morph: Undetermined

Notes: Holotype K(M) 49573, other specimens were collected from freshwater: ILLS 53088, ILLS 53089, ILLS 53091. Sequence data is not available. *Phomatospora berkeleyi* was originally collected from dead stalks of *Solanum* on terrestrial habitats (Saccardo 1875). Fallah and Shearer (1998) collected this species from freshwater habitats and provided descriptions and illustrations.

Phomatospora helvetica H. Wegelin

Distribution: **Norway**, Aust-Agder, Arendal, Langevoll, Nedenes, on submerged wood in small stream in temperate deciduous forest (Nordén et al. 2015).

Asexual morph: Undetermined

Notes: Sequence data is not available.

Phomatospora luteotagensis J. Fourn. & Lechat

Distribution: **France**, Ariège: Caussou, Caussou Brook, on submerged branch of *Fraxinus excelsior*, Hautes Pyrénées: Asque, La Gourgue, Arros stream, on submerged twig of *Alnus glutinosa*; **Spain**, Asturias: road to La Endriga, on submerged wood of *Alnus glutinosa* (Fournier and Lechat 2010)

Asexual morph: Undetermined

Notes: Holotype LIP, Fournier 09145. Sequence data is not available.

Phomatospora muskellungensis Fallah & Shearer

Distribution: **USA**, Wisconsin, Big Muskellunge lake, submerged wood of *Typha latifolia*, Allequash lake, on submerged stems of *Typha latifolia* (Fallah and Shearer 1998).

Asexual morph: Undetermined

Notes: Holotype ILLS 53011. Sequence data is not available.

Phomatospora striatigera Scheuer

Distribution: **Australia**, on submerged *Carex gracili* in freshwater (Scheuer 1988)

Asexual morph: Undetermined

Notes: Holotype GZU, Scheuer, 18 Jun. 1981, Epitype CBS 133932. ITS and LSU sequence data are available.

Phomatospora triseptata Raja & Shearer

Distribution: **USA**, Florida, Big Cypress National Preserve, on submerged soft, decorticated woody debris (Raja and Shearer 2008).

Asexual morph: Undetermined

Notes: Holotype ILL 40114. Sequence data is not available.

Sporidesmiales Crous

Sporidesmiaceae Fr.

Sporidesmium Link, Mag. Gesell. naturf. Freunde, Berlin 3(1–2): 41 (1809)

Asexual morph Descriptions and illustrations refer to Su et al. (2016). **Sexual morph** Descriptions and illustrations refer to Zhang et al. (2017a, b).

Type species: *Sporidesmium atrum* Link, Mag. Gesell. naturf. Freunde, Berlin 3(1–2): 41 (1809)

Notes: The genus *Sporidesmium* was established by Link (1809) with *S. atrum* Link as the type. *Sporidesmium* is a large and heterogeneous genus with 483 epithets referred to the genus in Index Fungorum (December 2018). However, many previously described species were revised and transferred to over 30 genera (Iturriaga et al. 2008). Studies based on phylogenetic analyses have been carried out to further re-examine the classification of *Sporidesmium*-like taxa, given that the generic delimitations based on morphological characters appear to be questionable, and it has been found that *Sporidesmium* and its morphology similar genera are clearly not monophyletic, and even they are distributed among different families and orders within Dothideomycetes and Sordariomycetes (Shenoy et al. 2006; Su et al. 2016; Yang et al. 2018a). *Sporidesmium* was only found as an asexual morph genus until Zhang et al. (2017a, b) introduced the first sexual morph *Sporidesmium thailandense* which was collected from freshwater habitats in Thailand.

Sporidesmium aquaticivaginatum J. Yang & K.D. Hyde

Distribution: **Thailand**, Prachuap Khiri Khan Province, Hua Hin, stream flowing outside Kaeng Krachan National Park, on submerged wood (Hyde et al. 2016b).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1159, isotype HKAS 95046. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

Sporidesmium cangshanense Z.L. Luo & K.D. Hyde, **nom. nov.**

Facesoffungi number: FoF 05422

\equiv *Sporidesmium aquaticum* H.Y. Su, Z.L. Luo & K.D. Hyde, Fungal Divers 80:398 (2016)

Distribution: **China**, Yunnan Province, Dali city, on submerged wood in a freshwater stream in Cangshan Mountain (Su et al. 2016).

Sexual morph: Undetermined

Notes: Holotype HKAS 84029. LSU sequence data is available. *Sporidesmium aquaticum* was introduced by Arambarri et al. (1989). Su et al. (2016) introduced a new *Sporidesmium* species also called *Sporidesmium aquaticum* which is a homonym and thus invalid. We replace the latter invalid name, *Sporidesmium aquaticum*, as *Sporidesmium cangshanense*.

Sporidesmium dulongense Luo et al.

Distribution: **China**, Yunnan Province, saprobic on decaying wood submerged in Dulong River (Hyde et al. 2019).

Sexual morph: Undetermined

Notes: Holotype HKAS 92659. ITS, LSU, RPB2 and TEF1 α sequence data are available.

Sporidesmium fluminicola H.Y. Su & K.D. Hyde

Distribution: **China**, Yunnan Province, Dali, Cangshan Mountain, saprobic on decaying wood submerged in stream (Su et al. 2016).

Sexual morph: Undetermined

Notes: Holotype HKAS 84003. ITS, LSU and SSU sequence data are available.

Sporidesmium gyrimorphum Yang et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, on decaying wood submerged in a freshwater stream (Yang et al. 2018a).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0851, isotype GZAAS 17–0004. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

Sporidesmium lageniforme Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555650, Facesoffungi number: FoF 05423, Fig. 18

Etymology: Referring to the lageniform conidia of the fungus

Holotype: MFLU 18–1594

Saprobic on decaying wood submerged in freshwater. **Asexual morph** Colonies on the substratum superficial, effuse, scattered, hairy, black. *Mycelium* mostly immersed, comprising of branched, septate, smooth-walled, brown hyphae. *Conidiophores* 105–141 μm long, 4–6 μm wide (\bar{x} = 123 \times 5 μm , n = 20), macronematous, mononematous, erect, straight or flexuous, unbranched, 4–6-septate, greyish brown to dark brown, smooth. *Conidiogenous cells* monoblastic, integrated, terminal, determinate, cylindrical, dark brown. *Conidia* 38–48 μm long, 13–17 μm wide (\bar{x} = 43 \times 15 μm , n = 20), acrogenous, solitary, lageniform, truncate at base, tapering at apex, 5–7-septate, subhyaline to greyish at immature, dark olivaceous-brown at maturity, hyaline towards the apex, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Nujiang River, saprobic on decaying submerged wood, October 2016, Z.L. Luo, S-880 (MFLU 18–1594, holotype), ex-type living culture DLUCC 0880.

Notes: *Sporidesmium lageniforme* resembles *S. dulongense* in having unbranched, dark brown, septate conidiophores, monoblastic, terminal, determinate conidiogenous cells and acrogenous, solitary, septate conidia truncate at base, tapering at apex. *Sporidesmium lageniforme* differs from *S. dulongense* in having shorter conidia (38–48 vs.

50–58 μm) and conidia of *S. dulongense* have spherical guttules in each cell while conidia of *S. lageniforme* mostly have no guttules. Phylogenetic analysis also shows that *Sporidesmium lageniforme* and *S. dulongense* are distinct species (Fig. 1, clade 7).

Sporidesmium lignicola Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555651, Facesoffungi number: FoF 05424, Figs. 19, 20

Etymology: Referring to the fungus dwelling on wood.

Holotype: MFLU 18–2326

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse on natural substrate, scattered, pale brown to brown. *Mycelium* immersed, composed of septate, branched, brown, smooth hyphae. *Conidiophores* 50–70 μm long, 3–4 μm wide (\bar{x} = 60 \times 3.5 μm , n = 20), macronematous, mononematous, unbranched, erect, straight or flexuous, brown to dark brown, septate, smooth. *Conidiogenous cells* holoblastic, monoblastic, terminal, determinate, dark brown, cylindrical. *Conidia* 21–27 μm long, 4.5–6.5 μm wide (\bar{x} = 24 \times 5.5 μm , n = 20), acrogenous, solitary, dry, clavate or cylindrical, straight or slight curved, truncate at base, brown, mostly 3-septate, formed in chains, smooth. **Sexual morph** *Ascomata* 190–330 μm high, 160–340 μm diam., immersed with neck erumpent through host surface, subglobose to ellipsoid, scattered, 2–4 locules, pale brown to brown. *Ostiole* 185–365 μm long, 78–122 μm wide, cylindrical, central or lateral, brown at the base, becoming hyaline towards the apex. *Peridium* 30–44 μm thick, two-layered, outer layer comprising pale brown to brown, oblong and rounded cells, inner layer comprising several layers of hyaline, large cells of *textura angularis* or irregular cells. *Paraphyses* 2.5–4.5 μm wide, hyaline, unbranched, septate, slightly constricted at the septum. *Asci* 87–115 \times 8–10 μm (\bar{x} = 101 \times 9 μm , n = 35), 8-spored, unitunicate, cylindrical, with a tapering pedicel, apically rounded, with a distinct, relatively small, refractive, wedge-shaped apical ring. *Ascospores* 13–15 \times 6–8 μm (\bar{x} = 14 \times 7 μm , n = 35), uni-seriate, fusiform, aseptate or uniseptate, guttulate, hyaline, smooth-walled.

Material examined: **CHINA**, Yunnan Province, saprobic on decaying wood submerged in a freshwater river, April 2015, X.C. Tao, S-429 (MFLU 18–2326, holotype), ex-type living culture KUMCC 15–0266; Cangshan Mountain, saprobic on decaying wood submerged in a freshwater stream, July 2017, H.W. Shen, S-1376 (DLU 1376, paratype), living culture DLUCC 1376.

Notes: The sexual morph of *Sporidesmium lignicola* resembles *Sporidesmium thailandense* in having subglobose to ellipsoid, scattered, immersed ascomata with necks erumpent through the host surface, hyaline, unbranched,

septate paraphyses, cylindrical asci apically rounded with an apical ring and fusiform, hyaline ascospores (Zhang et al. 2017). However, *Sporidesmium lignicola* differs from *S. thailandense* in having ascomata with 2–4 locules, a two-layered peridium, smaller asci ($87\text{--}115 \times 8\text{--}10$ vs. $160\text{--}220 \times 11\text{--}14 \mu\text{m}$), and aseptate or uniseptate, smaller ascospores ($13\text{--}15 \times 6\text{--}8$ vs. $23\text{--}28 \times 8\text{--}10 \mu\text{m}$) with small guttules, while *S. thailandense* has 3-septate

ascospores with 2–5 prominent guttules. The asexual morph of *Sporidesmium lignicola* can be easily distinguished from other *Sporidesmium* asexual morph species in having clavate or cylindrical conidia formed in chains. Phylogenetically, our two newly obtained strains cluster together with high support (100% ML) and is distinct from other *Sporidesmium* species (Fig. 1, clade 7). We therefore



Fig. 21 *Neosporidicoides aquatica* (MFLU 18–1605, holotype) **a–c** Conidiophores with conidia. **d, e** Conidiogenous cells with percurrent proliferations. **f–k** Conidium. Scale bars: **a–c** 40 μm , **d, e** 25 μm , **f–k** 10 μm

introduce a new species *Sporidesmium lignicola* with both asexual and sexual morphs.

Sporidesmium olivaceoconidium J. Yang & K.D. Hyde

Distribution: **Thailand**, Chiang Rai Province, stream flowing in Tham Luang Nang Non Cave, on submerged wood (Hyde et al. 2016b).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1175. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

Sporidesmium pyriformatum J. Yang & K.D. Hyde

Distribution: **Thailand**, Khiri Khan Province, Hua Hin, stream flowing outside Kaeng Krachan National Park, on submerged wood (Hyde et al. 2016b).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1155. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

Sporidesmium submersum H.Y. Su & K.D. Hyde

Distribution: **China**, Yunnan Province, Dali, Cangshan Mountain, saprobic on decaying wood submerged in stream (Su et al. 2016).

Sexual morph: Undetermined

Notes: Holotype HKAS 84004. ITS, LSU and SSU sequence data are available.

Sporidesmium thailandense Dong et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, on submerged wood in a small River (Zhang et al. 2017a, b; Yang et al. 2018a).

Asexual morph: Undetermined

Notes: Holotype MFLU 15–2709, other specimen collected from freshwater habitats MFLU 15–1152. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

Sporidesmium tropicale M.B. Ellis

Distribution: **Thailand**, Prachuap Khiri Khan Province, on decaying wood submerged in a freshwater stream (Yang et al. 2018a).

Sexual morph: Undetermined

Notes: Holotype IMI 37498, other specimen collected from freshwater MFLU 17–0850. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available. *Sporidesmium tropicale* was found on dead branches of woody plants and is widely distributed in tropical areas (Ellis 1958; Wu and Zhuang 2005). Yang et al. (2018a, b) collected this species from freshwater habitats in Thailand and provided the illustrations and descriptions.

Tirisporellales Suetrong et al.

Tirisporellaceae Suetrong et al.

Thailandiomyces Pinruan, Sakayaroj, Hyde & Jones, Fungal Diversity 29: 91 (2008)

Asexual morph Colonies on natural substrate effuse, black. *Mycelium* superficial. *Conidiophores* macronematous, mononematous, erect, brown, paler towards the apex, straight or flexuous, branched or unbranched.

Conidiogenous cells enteroblastic, monophialidic, integrated, terminal, with a large and distinct collarette; collarette funnel-shaped. *Conidia* cylindrical, ellipsoid or obovoid, thick-walled, brown, aseptate. **Sexual morph** *Ascomata* scattered to gregarious, semi-immersed to superficial, globose, black, coriaceous, ostiolate, with long cylindrical necks, periphysate with short hyaline cells. *Peridium* composed of compressed cells of *textura angularis*, black outside, becoming brown inwardly. *Paraphyses* present but deliquescent, irregular in width, rarely septate, tapering towards the apices, embedded in a mucilaginous matrix. *Asci* 8-spored, unitunicate, cylindrical to clavate, apedicellate, free-floating, apically truncate, with a J-subapical ring. *Ascospores* uniseptate, obliquely overlapping 2-seriate, fusoid, straight or broadly curved, with bipolar appendages, hyaline, smooth-walled.

Type species: *Thailandiomyces bisetulosus* Pinruan et al., Fungal Divers 29: 91 (2008)

Notes: The genus *Thailandiomyces* was introduced by Pinruan et al. (2008) to accommodate one ascomycete species collected from submerged trunk of *Licuala longicalycata* in Thailand. This species was apparently linked with a *Craspedodidymum* asexual morph in culture. This genus remains monotypic. Based on phylogenetic analyses, Suetrong et al. (2015) introduced a new family Tirisporellaceae, typified by a new genus *Tirisporella* E.B.G. Jones, K.D. Hyde & Alias. The genus *Thailandiomyces* phylogenetically resides in this family.

Thailandiomyces bisetulosus Pinruan et al.

Distribution: **Thailand**, on submerged trunk of *Licuala longicalycata* (Pinruan et al. 2008).

Asexual morph: *Craspedodidymum licualae* Pinruan

Notes: Holotype BBH, Pinruan, Wah 110. LSU and SSU sequence data are available.

Togniniales Senan. et al.

Togniniaceae R  blov   et al.

Phaeoacremonium Gams et al., Mycologia 88: 789 (1996)

Asexual morph *Mycelium* consisting of branched, septate hyphae, single or bundled. *Conidiophores* branched in the basal region or unbranched, arising from aerial or submerged hyphae, erect, nearly cylindrical when unbranched, slightly tapering, straight or flexuous, variable in length, up to 7-septate, mostly pale brown, paler towards the tip. *Conidiogenous cells* mostly monophialidic, discrete or integrated, terminal or intercalary, sometimes polyphialidic, sparsely warted, pale brown to hyaline, verruculose or smooth. *Conidia* aggregated into round, slimy heads at the apices of phialides, aseptate, hyaline, smooth-walled; oblong-ellipsoidal to obovate, cylindrical, allantoid or reniform, uncommonly fusiform-ellipsoidal or globose, becoming guttulate with age. **Sexual morph** *Ascomata* aggregated or solitary, superficial to immersed,

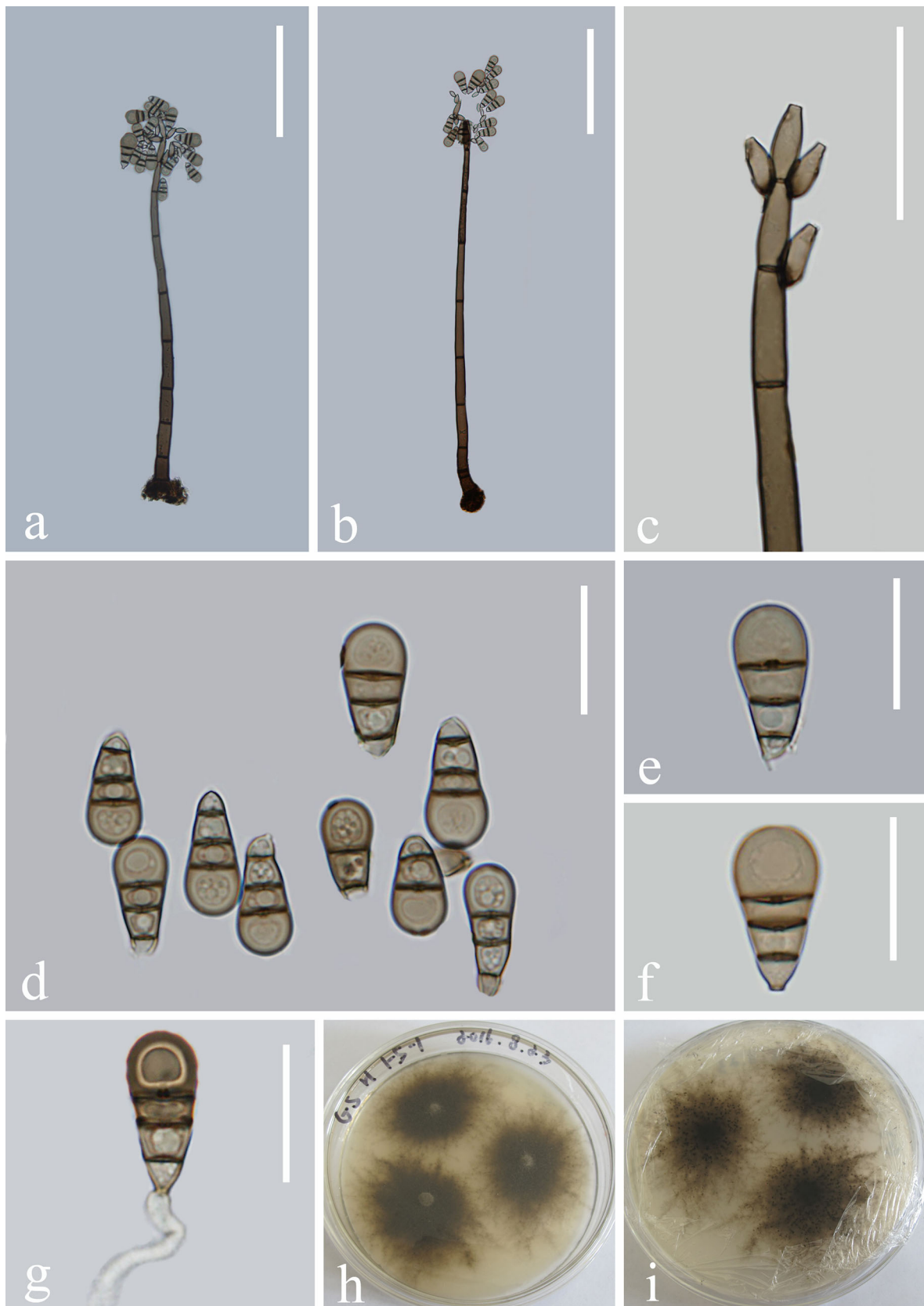


Fig. 22 *Neospadicoides lignicola* (MFLU 18–1606, holotype) **a, b** Conidiophores with conidia. **c** Conidiophore apex with discrete conidiogenous cells. **d–f** Conidia. **g** Germinating conidium. Culture on PDA from above (**h**) and reverse (**i**). Scale bars: **a, b** 50 μm , **c** 30 μm , **d–g** 20 μm

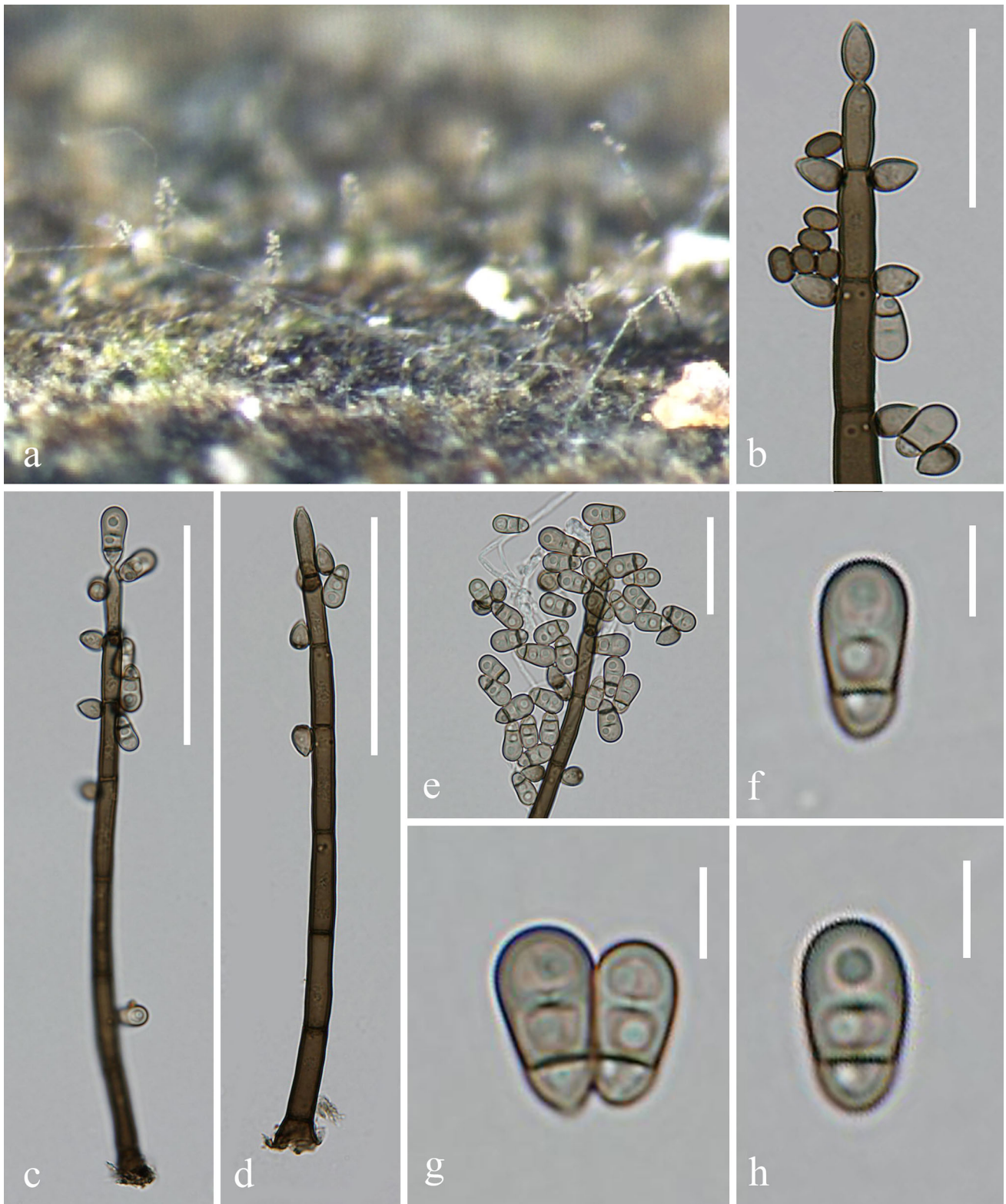


Fig. 23 *Neospadicoides yunnanensis* (MFLU 18–2329, holotype) **a** Colonies on substrate. **b** Conidiophore with conidiogenous cells. **c**, **d** Conidiophore with conidia. **e–h** Conidia. Scale bars: **c**, **d** 50 μm , **b**, **e** 20 μm , **f–h** 5 μm

nonstromatic, globose to subglobose, dark, opaque, long-necked. *Paraphyses* abundant, broadly cellular, slightly constricted at the septa, branching, hyaline, slightly tapering apically or thread-like towards the apex. *Asci* 8-spored, unitunicate, arising in acropetal succession, appearing spicate when mature, ascus apex thickened without a discharge mechanism, basally bluntly obtuse, sessile. *Ascospores* mostly biseriata or in a single row, allantoid, reniform, cylindrical or oblong-ellipsoidal, aseptate, hyaline.

Type species: *Phaeoacremonium parasiticum* (Ajello, Georg & C.J.K. Wang) Gams et al., *Mycologia* 88(5): 794 (1996)

Notes: *Phaeoacremonium* has recently been monographed, and comprises 46 species (Gramaje et al. 2015; Maharachchikumbura et al. 2016). *Phaeoacremonium* species are saprobic on plants, or pathogenic on human and animals or soil fungi (Mostert et al. 2006; Maharachchikumbura et al. 2016). Hu et al. (2012c) introduced a new species, *Togninia aquatica*, collected from freshwater habitats. Gramaje et al. (2015) combined this species as *Phaeoacremonium aquaticum*.

Phaeoacremonium aquaticum (Hu et al.) Gramaje et al.

≡ *Togninia aquatica* Hu et al. *Mycologia* 104(6): 1482 (2012)

Distribution: **China**, Yunnan Province, Jinghong City, Mengla County, on submerged wood in a small stream (Hu et al. 2012c).

Asexual morph: Undetermined

Notes: Holotype IFRD 023–047. ITS sequence data is available.

Phaeoacremonium ovale Huang et al.

Distribution: **China**, Yunnan Province, Baoshan City, on submerged decayed wood in a stream along the roadside (Huang et al. 2018a).

Sexual morph: Undetermined

Notes: Holotype HKAS 99550, isotype MFLU 18–1076. ITS, actin and β -tubulin sequence data are available.

Trichosphaeriales M.E. Barr

Trichosphaeriaceae G. Winter

Brachysporium Sacc., *Syll. fung.* (Abellini) 4: 423 (1886)

Asexual morph Colonies effuse, brown, velvety. *Mycelium* mostly immersed, composed of branched, septate, subhyaline to brown hyphae. *Conidiophores* mononematous, macronematous, erect, straight or slightly flexuous, smooth, thick-walled, septate, unbranched, cylindrical, brown in the bottom, paler and tapering toward the apex. *Conidiogenous cells* holoblastic, terminal, integrated, hyaline, denticulate, proliferating sympodially. *Conidia* acropleurogenous, septate, smooth, thick-walled, fusoid to limoniform, polar cells subhyaline, narrowing at the apex, median cells brown. **Sexual morph** *Ascomata* partly

immersed to superficial, solitary, globose to subglobose, conical around the ostiole, papillate, dark brown to black, glabrous. *Peridium* leathery to fragile, consisting of two regions; outer region of carbonaceous, dark brown, angular to rectangular cells; inner region of hyaline, thin-walled, elongated, compressed cells. *Ostiolar canal* periphysate. *Paraphyses* persistent, branched, hyaline, septate, irregular in width. *Asci* 8-spored, unitunicate, cylindrical-clavate, with long, slender stipe, broadly rounded to truncate at the apex, with distinct refractive apical annulus. *Ascospores* biseriata, ellipsoidal to fusiform to oblong-lemon-shaped, at first aseptate, followed by formation of a median septum, hyaline, smooth-walled.

Type species: *Brachysporium obovatum* (Berk.) Sacc., *Syll. fung.* (Abellini) 4: 427 (1886)

Notes: The asexual morph genus *Brachysporium* was established by Saccardo in 1880. Réblová and Seifert (2004a) introduced a new genus *Cryptadelphina*, with type species *C. groenendalensis* (Sacc., E. Bomm. & M. Rouss.) Réblová & Seifert to accommodate six sexual morphs of *Brachysporium*. Many *Brachysporium* species were reported saprobic on decaying wood of different substrates (Réblová and Seifert 2004a; Markovskaja and Treigien 2007). Some species were also described from marine habitats, e.g. *B. belgolandicum* Schaumann and *B. helgolandicum* Schaumann. Among the accepted *Brachysporium* species, only two are known from freshwater habitats (Lamore and Goos 1978; Raja et al. 2009b).

Brachysporium obovatum (Berk.) Sacc.

≡ *Helminthosporium obovatum* Berk., *Annals and Magazine of Natural History* 6: 434 (1841)

Distribution: **USA**, Florida, on submerged substrate in lentic habitat in Ocala National Forest (Raja et al. 2009b).

Sexual morph: see Réblová and Seifert (2004a)

Notes: Sequence data is not available.

Brachysporium nigrum (Link) S. Hughes

Distribution: **USA**, Rhode Island, on wood in the Sau-gatucket River (Lamore and Goos 1978).

Sexual morph: see Réblová and Seifert (2004a).

Notes: LSU, SSU and RPB2 sequence data are available.

Unisetosphaeria Pinnoi et al., *Mycoscience* 44: 377 (2003)

Asexual morph Undetermined. **Sexual morph** *Ascomata* immersed to superficial, scattered, pyriform, hyaline to light brown, dark brown near the apex, coriaceous, ostiolate, papillate. *Papilla* periphysate, surrounded by short dark hairs. *Seta* single, composed of several rows of brown cells, arising from the ostiolar region. *Peridium* composed of angular brown-walled cells. *Paraphyses* sparse, obscure, comprising short rows of ovoid to oblong cells. *Asci* 8-spored, unitunicate, clavate, short pedicellate, apically

truncate, with a refractive, J-, apical ring. *Ascospores* 2-seriate, septate, hyaline.

Type species: *Unisetosphaeria penguinoides* Pinnoi et al., Mycoscience 44(5): 378 (2003)

Notes: This monotypic genus was introduced by Pinnoi et al. (2003). Its taxonomic placement was between Chaetosphaeriaceae and Trichosphaeriaceae. However, *Unisetosphaeria penguinoides* has several incompatible characters of ascomata, paraphyses and asci which are against the Chaetosphaeriaceae. The characters of ascomata, paraphyses, asci and ascospores are more congruent for Trichosphaeriaceae (Pinnoi et al. 2003). Thus, it was suggested to assign this genus in Trichosphaeriaceae based on morphology. This suggestion was followed by Maharachchikumbura et al. (2015, 2016).

Unisetosphaeria penguinoides Pinnoi et al.

Distribution: **Thailand**, Narathiwat Province, on submerged petiole of *Eleiodoxa conferta* (Pinnoi et al. 2003).

Asexual morph: Undetermined

Notes: Holotype BBH Aom 103. Sequence data is not available.

Xenospadicoidales Hern.-Restr. et al.

Xenospadicoidaceae Hern.-Restr. et al.

Neospadicoides Z.L. Luo, K.D. Hyde & H.Y. Su, *gen. nov.*

Index Fungorum number: IF 555652, Facesoffungi number: FoF 05425

Etymology: Referring to the genus similar to *Spadicoides*.

Saprobic on decaying wood. **Asexual morph** Colonies effuse, hairy, brown to dark brown. *Mycelium* partly superficial, partly immersed, composed of septate, branched, smooth, pale brown hyphae. *Conidiophores* macronematous, mononematous, solitary or in groups, erect, unbranched, septate, straight or flexuous, cylindrical, brown, paler towards the apex, smooth. *Conidiogenous cells* holoblastic, enteroblastic, percurrent, polytretic, integrated, terminal. *Conidia* acrogenous or acropleurogenous, fusiform, obovoid, septate, smooth-walled. **Sexual morph** Undetermined.

Type species: *Neospadicoides lignicola* Z.L. Luo, K.D. Hyde & H.Y. Su

Notes: *Neospadicoides* is morphologically similar to *Spadicoides* in having effuse, hairy colonies on natural substrate, mycelium composed of septate, branched, smooth hyphae, conidiophores macronematous, mononematous, erect, straight or flexuous, cylindrical, smooth, conidiogenous cells integrated, terminal and smooth conidia (Hughes 1958; Seifert et al. 2011). However, *Neospadicoides* differs from *Spadicoides* in having unbranched conidiophores and acrogenous or acropleurogenous, septate conidia while *Spadicoides* have branched or unbranched conidiophores, tretic conidiogenous cells

and acropleurogenous, aseptate or septate conidia (Hughes 1958; Goh and Hyde 1996a; Seifert et al. 2011). The phylogenetic analysis show that our *Neospadicoides* species cluster together with good support value and form a distinct subclade from *Spadicoides* within Xenospadicoidaceae (Xenospadicoidales) (Fig. 1, clade 6).

Neospadicoides aquatica Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555654, Facesoffungi number: FoF 05426, Fig. 21

Etymology: Referring to the aquatic habitat of this fungus.

Holotype: MFLU 18–1605

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, brown to dark brown. *Mycelium* partly superficial, partly immersed, composed of septate, branched, smooth, pale brown hyphae. *Conidiophores* (80–)126–194(–218) μm long, 5–7 μm wide (\bar{x} = 160 \times 6 μm , n = 20), macronematous, mononematous, solitary or in groups, erect, unbranched, septate, straight or flexuous, cylindrical, brown, paler towards the apex, smooth, percurrently proliferating. *Conidiogenous cells* holoblastic, integrated, terminal, subhyaline, percurrently proliferating. *Conidia* 18–22 μm long, 7–9 μm wide (\bar{x} = 20 \times 8 μm , n = 20), acrogenous or acropleurogenous, subhyaline to pale brown when young, brown to dark brown when matured, fusiform to cylindrical, rounded at the apex, truncate at the base, 2-septate, with thick and dark band at septa, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Gaoligong Mountain, saprobic on decaying wood submerged in a freshwater stream, July 2015, X.J. Su, S-701 (MFLU 18–1605, holotype), ex-type living culture MFLUCC 17–2217.

Notes: *Neospadicoides aquatica* resembles *Spadicoides americana* in having macronematous, mononematous, erect, unbranched, septate, solitary or in groups conidiophores paler towards the apex, integrated, terminal conidiogenous cells and 2-septate, smooth conidia (Wongsawas et al. 2008). However, *Neospadicoides aquatica* differs from *Spadicoides americana* in having larger conidia (18–22 \times 7–9 vs. 10–14.5 \times 4–6.5 μm) which are rounded at the apex, truncate at the base.

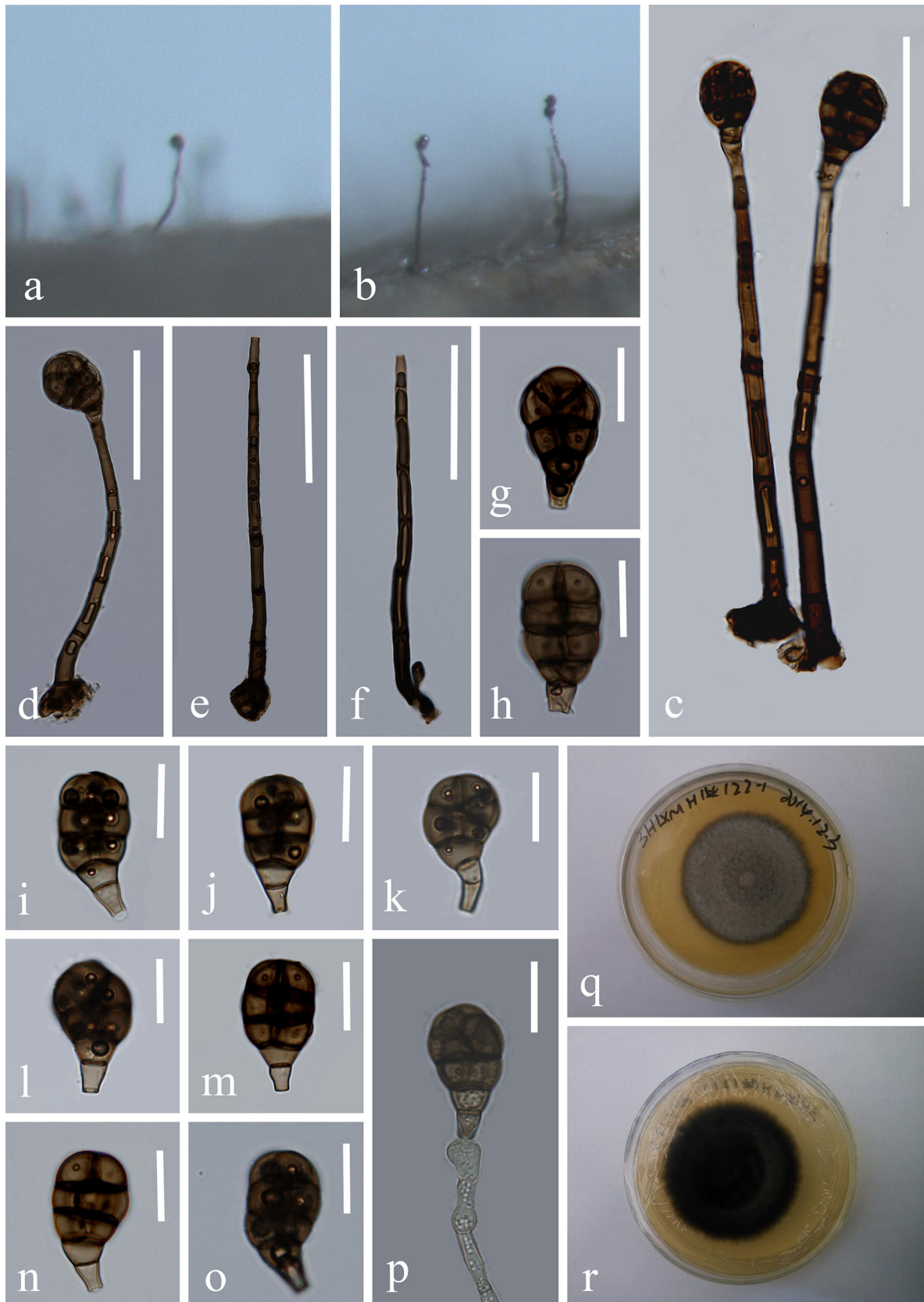
Neospadicoides lignicola Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555653, Facesoffungi number: FoF 05427, Fig. 22

Etymology: Referring to this fungus dwelling on wood.

Holotype: MFLU 18–1606

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, brown to dark brown. *Mycelium* partly superficial, partly immersed, composed of septate, branched, smooth, pale brown



◀ **Fig. 24** *Acrodictys fluminicola* (DLU 0274, holotype) **a, b** Colonies on natural substrate. **c, d** Conidiophores with conidia. **e, f** Conidiophores with conidiogenous cells. **g–o** Conidia. **p** Germinating conidium. Culture on MEA, **q** from above, **r** from reverse. Scale bars: **c–f** 50 μm , **g–p** 15 μm

hyphae. *Conidiophores* (70–)134–276(–303) μm long, 5–7 μm wide ($\bar{x} = 205 \times 6 \mu\text{m}$, $n = 20$), macronematous, mononematous, solitary or in groups, erect, unbranched, septate, straight or flexuous, cylindrical, brown, paler towards the apex, smooth. *Conidiogenous cells* holoblastic, discrete, terminal and intercalary, subhyaline to pale brown. *Conidia* 20–24 μm long, 9–13 μm wide ($\bar{x} = 22 \times 11 \mu\text{m}$, $n = 20$), acrogenous or acropleurogenous, pale brown to brown, obovoid, rounded at the apex, truncate at the base, almost 2–3-septate, with dark band at septa, guttulate, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Gaoligong Mountain, saprobic on decaying wood submerged in a freshwater stream, July 2015, X.J. Su, S-735 (MFLU 18–1606, holotype), ex-type living culture MFLUCC 17–2444.

Notes: *Neospadicoides lignicola* resembles *N. yunnanensis* in having macronematous, mononematous, solitary or in groups, erect, unbranched, septate, straight or flexuous, cylindrical, brown conidiophores paler towards the apex, integrated, terminal conidiogenous cells and obovoid, septate, guttulate conidia (this study). However, *Neospadicoides lignicola* differs from *N. yunnanensis* in having larger conidia (20–24 \times 9–13 vs. 7.5–10.5 \times 4–6 μm), and conidiogenous cells of *N. yunnanensis* are with pale-colored pores at the conidiogenous loci. Phylogenetic analysis also shows that *N. lignicola* and *N. yunnanensis* are different species (Fig. 1, clade 6). To further support *Neospadicoides lignicola* as a new species, we compared nucleotide differences with *N. yunnanensis* following the guidelines of Jeewon and Hyde (2016). Comparison of the 521 nucleotides across the ITS region reveals 40 bp differences (7.67%) including 3 gaps.

Neospadicoides yunnanensis Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555655, Facesoffungi number: FoF 05428, Fig. 23

Etymology: Referring to the location where this fungus was collected, Yunnan Province, China.

Holotype: MFLU 18–2329

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on decaying wood effuse, pale brown, hairy. *Mycelium* partly immersed in the substrata, composed of pale brown, septate, smooth, branched hyphae. *Conidiophores* 113–153 μm long, 4–

6 μm wide ($\bar{x} = 133 \times 5 \mu\text{m}$, $n = 20$), macronematous, mononematous, erect, unbranched, dark brown, paler towards the apex, straight or slightly flexuous, cylindrical, septate, smooth, thick-walled, occasionally swollen at the apex. *Conidiogenous cells* polytretic, integrated, terminal and intercalary, with pale colored pores remaining at the conidiogenous loci. *Conidia* 7.5–10.5 μm long, 4–6 μm wide ($\bar{x} = 9 \times 5 \mu\text{m}$, $n = 20$), acropleurogenous, solitary, pale brown, obovoid, guttulate, mostly 2-septate, comprising a proximal euseptum and a distal distoseptum, with dark band at basal septa, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Lancang River, saprobic on decaying wood submerged, December 2017, X.J. Su, S-1499 (MFLU 18–2329, holotype), ex-type living culture DLUCC 1499.

Notes: *Neospadicoides yunnanensis* resembles *Spadicoides hodgkissa* in having macronematous, mononematous, erect, solitary, unbranched, dark brown, paler towards the apex, straight or slightly flexuous, cylindrical, septate, smooth conidiophores occasionally swollen at the apex, polytretic, integrated, terminal and intercalary conidiogenous cells with pale colored pores remaining at the conidiogenous loci and solitary, obovoid, guttulate conidia comprising a proximal euseptum and a distal distoseptum (Ho et al. 2002b). However, *Neospadicoides yunnanensis* differs from *Spadicoides hodgkissa* in having pale brown conidia with dark band at basal euseptum while *Spadicoides hodgkissa* has versicolored conidia comprising a proximal euseptum and a distal distoseptum and the distal distoseptum possesses a conspicuous central pore which is surrounded by a pigmented ring, appearing as dolipores in side view.

Spadicoides S. Hughes, Can. J. Bot. 36: 805 (1958)

Asexual morph Descriptions and illustrations refer to Réblová et al. (2018). **Sexual morph** Undetermined.

Type species: *Spadicoides bina* (Corda) S. Hughes, Can. J. Bot. 36: 806 (1958)

Notes: The genus *Spadicoides* was introduced by Hughes (1958) with *S. bina* as the type species. Goh and Hyde (1996a) briefly discussed the generic concept of *Spadicoides*. Thirty-one *Spadicoides* species were revised, of which 21 species were accepted. Presently, 55 epithets are listed in Index Fungorum (December 2018), and most of the species are reported from terrestrial habitats (Subramanian and Vittal 1974; Kuthubutheen and Nawawi 1991a; Wong et al. 2002; Li 2010; Xia et al. 2014; Ma et al. 2016). Seven species are known from freshwater habitats (Goh and Hyde 1996a; Ho et al. 2002b; Cai et al. 2004a, 2006a, b, c; Zhuang 2001).

Spadicoides americana C.J.K. Wang

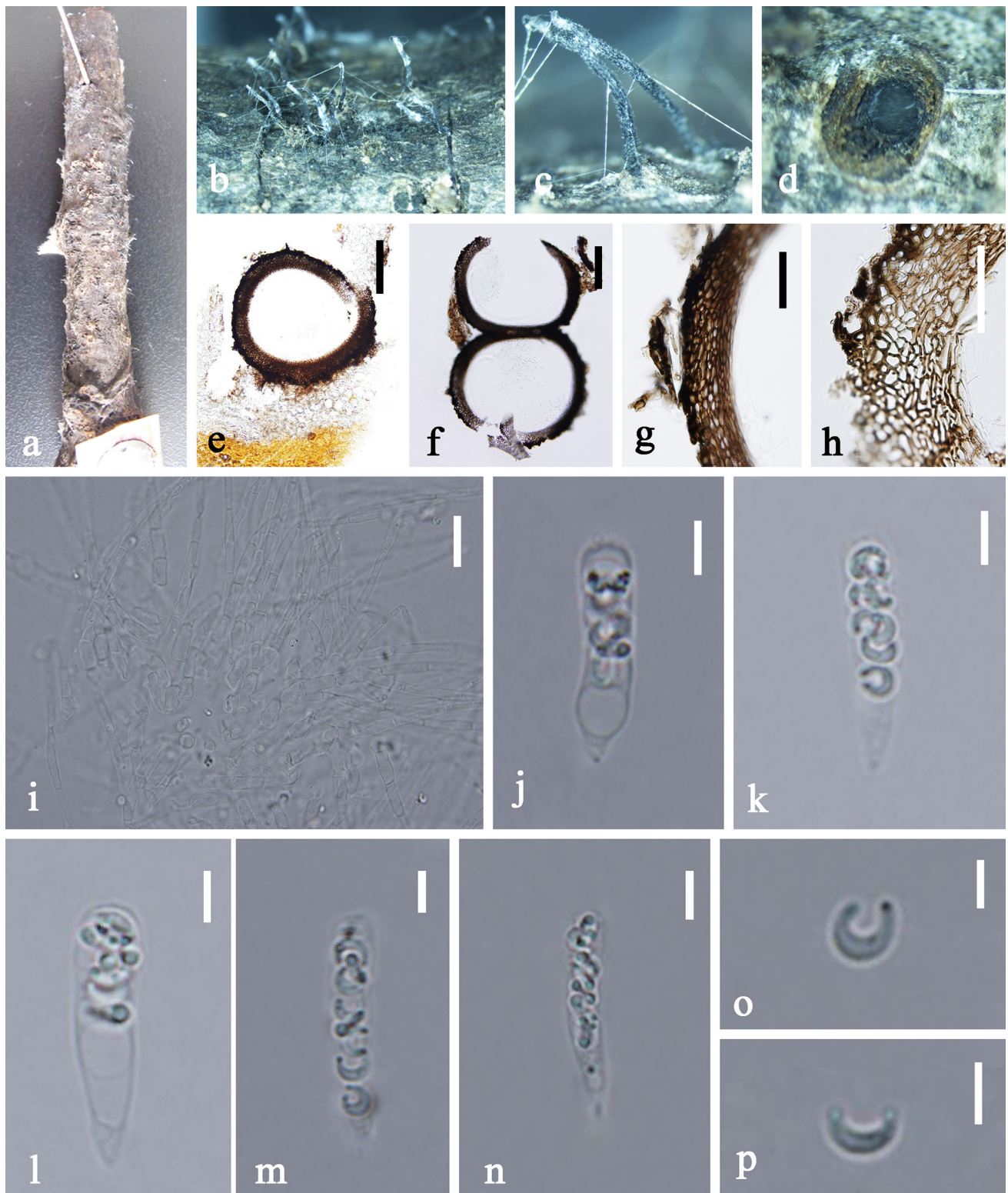


Fig. 25 *Barbatosphaeria lignicola* (HKAS 84005, holotype) **a** Specimen. **b, c** Appearance of necks on substrate. **d** Horizontal section through ascomata. **e, f** Section through ascomata. **g, h** Structure of peridium. **i** Paraphyses. **j–n** Ascus. **o–p** Ascospore. Scale bars: **e, f** 150 μm , **g–i** 30 μm , **j–p** 5 μm

Distribution: **China**, Zhejiang Province, Hangzhou city, on submerged wood in a stream at Nine Creeks (Wong-sawas et al. 2008).

Sexual morph: Undetermined

Notes: Specimen collected from freshwater habitats HMZFW 00002. Sequence data is not available.

Spadicoides atra (Corda) S. Hughes

≡ *Chloridium atrum* Corda, Icones fungorum hucusque cognitorum 1: 17, t. 4:235 (1837)

≡ *Psilonia atra* (Corda) Corda, Icones fungorum hucusque cognitorum 4: 27, t. 6:84 (1840)

≡ *Catenularia atra* (Corda) Sacc., Sylloge Fungorum 4: 304 (1886)

Distribution: **China**, Hong Kong, on submerged wood (Zhuang 2001).

Sexual morph: Undetermined

Notes: LSU, SSU and RPB2 sequence data are available.

Spadicoides bambusicola Zhou et al.

Distribution: **China**, Yunnan Province, on submerged wood (Cai et al. 2006a).

Sexual morph: Undetermined

Notes: Holotype HKU (M) 8333 (now in IFRD). Sequence data is unavailable.

Spadicoides cordanoides Goh & K.D. Hyde

Distribution: **Australia**, Queensland, on submerged wood (Goh and Hyde 1996a).

Sexual morph: Undetermined

Notes: Holotype BRIP 23201. Sequence data is not available. This species is known only from Australia on submerged wood in freshwater habitats (Goh and Hyde 1996a).

Spadicoides hodgkissa Ho et al.

Distribution: **China**, Hong Kong, Tai Po Kau Forest Stream (Ho et al. 2002b)

Sexual morph: Undetermined

Notes: Holotype HKU(M) 6155 (now in IFRD). Sequence data is unavailable.

Spadicoides minuta Cai et al.

Distribution: **China**, Yunnan Province, on *Phyllostachys bambusoides* submerged in a small stream (Cai et al. 2004a).

Sexual morph: Undetermined

Notes: Holotype IFRD 8850. Sequence data is unavailable.

Spadicoides obovata (Cooke & Ellis) S. Hughes

≡ *Acrothecium obovatum* Cooke & Ellis, Grevillea 5 (34): 50 (1876)

≡ *Spondylocladium obovatum* (Cooke & Ellis) S. Hughes, Can. J. Bot. 31 (5): 634 (1953)

Distribution: **China**, Hong Kong, on submerged wood (Zhuang 2001).

Sexual morph: Undetermined

Notes: Sequence data is unavailable.

Torrentispora Hyde et al., Mycol. Res. 104(11): 1399 (2000)

Asexual morph Undetermined. **Sexual morph** Updated description refer to Réblová et al. (2018).

Type species: *Torrentispora fibrosa* Hyde et al., Mycol. Res. 104(11): 1399 (2000)

Notes: Hyde et al. (2000) introduced the genus *Torrentispora* with single species, *T. fibrosa*. Réblová et al. (2018) revisited *Torrentispora* with nine species in this genus and assigned it to the new family Xenospadicoidaceae within the new order Xenospadicoidales based on morphology and DNA sequence data. *Torrentispora* comprises seven species from freshwater habitats.

Torrentispora aquatica (Vijaykr. et al.) Réblová & A.N. Mill

≡ *Fusoidispora aquatica* Vijaykr. et al., Sydowia 57:272 (2005)

Distribution: **China**, Hong Kong, New Territories, Tai Po Kau Country Park, Tai Po Kau Forest Stream, on submerged wood (Vijaykrishna et al. 2005).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 17484 (now in IFRD), isotype PDD 78746. LSU sequence data is available.

Torrentispora biatriispora (K.D. Hyde) Réblová & A.N. Mill.

≡ *Annulatascus biatriisporus* K.D. Hyde, Nova Hedwigia 61: 120 (1995)

≡ *Pseudoannulatascus biatriisporus* (K.D. Hyde) Z.L. Luo et al., Phytotaxa 239:179 (2015)

Distribution: **Australia**, on submerged wood (Hyde 1995b); **China**, Hong Kong, Tsuen Wan, Shing Mun Reservoir, on submerged wood (Tsui et al. 2002); **Costa Rica**, on submerged wood (Barbosa et al. 2013); **Seychelles**, on submerged wood (Hyde and Goh 1998a).

Asexual morph: Undetermined

Notes: Holotype BRIP 21481, other specimen collected from freshwater habitats: ILL 40816. ITS, LSU, SSU and RPB2 sequence data are available.

Torrentispora calembola Réblová & A.N. Mill.

Distribution: **France**, on submerged wood of *Fraxinus excelsior* (Réblová et al. 2018).

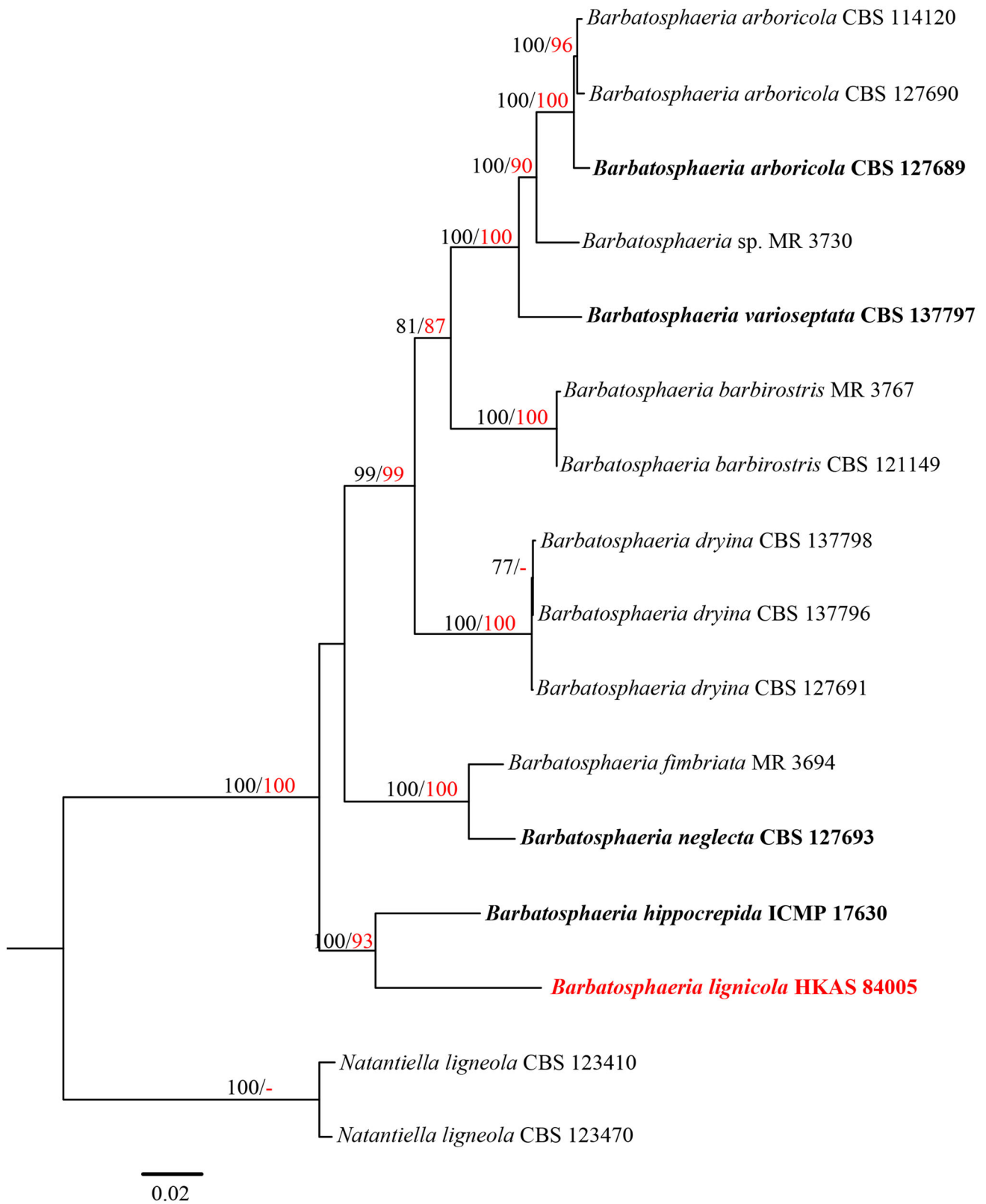
Asexual morph: Undetermined

Notes: Holotype PRA-12744 (M.R. 3726), isotype PRA-12745. ITS, LSU and SSU sequence data are available.

Torrentispora crassiparietis Fryar & K.D. Hyde

Distribution: **Brazil**, on submerged bark (Barbosa et al. 2013); **Brunei**, on submerged wood (Fryar and Hyde 2004; Fryar et al. 2004); **Costa Rica**, on submerged wood (Barbosa et al. 2013).

Asexual morph: Undetermined



◀**Fig. 26** Phylogram generated from maximum likelihood analysis based on combined ITS, LSU and RPB2 sequence data for species of *Barbatosphaeria* (with *Natantiella ligneola* as outgroup). The best scoring RAxML tree with a final likelihood value of -9327.825160 is presented. RAxML bootstrap support values equal to or greater than 75% are given before the forward slash (black). Maximum parsimony bootstrap support values equal to or greater than 75% are given after the forward slash (red). Hyphen ('-') indicates a value lower than 75% for RAxML and maximum parsimony. Newly generated sequences are in red. Ex-type strains are in bold

Notes: Holotype IFRD 8863, other specimens collected from freshwater habitats: HUEFS 158094, ILL 40817, ILL 40818, ILL 40819, ILL 40820. Sequence data is unavailable.

Torrentispora fibrosa Hyde et al.

Distribution: **China**, Hong Kong, New Territories, Tai Po, Lam Tsuen River and Tai Po Kau Forest Reserve, Tai Po Kau Forest Stream, on submerged decaying wood (Hyde et al. 2000); **New Zealand**, Lake Christabel track, on decaying wood of *Nothofagus* sp. (Réblová et al. 2018).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 4519 (now in IFRD), other specimen collected from freshwater habitats PDD 110879. LSU, SSU and RPB2 sequence data are available.

Torrentispora fusiformis Fryar & K.D. Hyde

Distribution: **Brunei**, on submerged wood (Fryar and Hyde 2004).

Asexual morph: Undetermined

Notes: Holotype IFRD 8864. Sequence data is not available. This species is known only from Brunei on submerged wood in brackish and freshwater habitats (Fryar and Hyde 2004).

Torrentispora pilosa Shearer & F.R. Barbosa

Distribution: **Costa Rica**, on submerged wood (Barbosa et al. 2013).

Asexual morph: Undetermined

Notes: Holotype ILL 40814. Sequence data is not available. This species is known only from Costa Rica, on submerged wood (Barbosa et al. 2013).

Diaporthomycetidae family *incertae sedis*

Acrodictyaceae J.W. Xia & X.G. Zhang

Acrodictys M.B. Ellis, Mycol. Pap. 79: 6 (1961)

Asexual morph Descriptions and illustrations refer to Xia et al. (2017). **Sexual morph** Undetermined.

Type species. *Acrodictys bambusicola* M.B. Ellis, Mycol. Pap. 79: 6 (1961)

Notes: *Acrodictys* was introduced by Ellis (1961), with *A. bambusicola* M.B. Ellis as the type species. There are 45 epithets listed in Index Fungorum (December 2018). Until 2016, identification of *Acrodictys*-like species was based on morphology. Xia et al. (2017) provided ITS, LSU, SSU

and β -tubulin sequence data, detailed descriptions and illustrations for eight *Acrodictys* species, including a new species. In this study, we introduce a new species and a new combination for this genus. Three *Acrodictys* species have been reported from freshwater habitats.

Acrodictys aquatica (N.G. Liu & K.D. Hyde) Z.L. Luo & K.D. Hyde, *comb. nov.*

\equiv *Barbatosphaeria aquatica* N.G. Liu & K.D. Hyde, in Hyde et al., Mycosphere 9(2): 384 (2018)

Index Fungorum: IF 655656; Facesoffungi number: FoF 05438

Descriptions and illustrations refer to Hyde et al. (2018).

Distribution: **Thailand**, Chiang Rai Province, Muang, Ban Nang Lae Nai, on decaying wood submerged in a freshwater stream (Hyde et al. 2018).

Sexual morph: Undetermined

Notes: Holotype MFLU 18-0040. ITS and LSU sequence data are available. Hyde et al. (2018) introduced the species *Barbatosphaeria aquatica* based on a collection obtained from freshwater habitat in Thailand. Our phylogenetic analysis based on multi-genes shows that the strain from ex-type culture of *Barbatosphaeria aquatica* clusters in the genus *Acrodictys* (Fig. 1, clade 9). Morphology of *Barbatosphaeria aquatica* also fits well with *Acrodictys* species in having mononematous, erect, unbranched conidiophores; monoblastic, terminal, integrated conidiogenous cells; solitary, dry, clavate, green to brown conidia, with transverse septa, deeply constricted at the septa, distinctly verruculose (Hyde et al. 2018). Based on morphology and phylogenetic analyses, we synonymize *Barbatosphaeria aquatica* under *Acrodictys aquatica*.

Acrodictys fluminicola Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555657, Facesoffungi number: FoF 05429, Fig. 24

Etymology: Referring to this fungus dwelling in a stream.

Holotype: DLU 0274

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, dark brown to black. *Conidiophores* 98–142 μm long, 4–6 μm wide ($\bar{x} = 120 \times 5 \mu\text{m}$, $n = 20$), macronematous, mononematous, erect, unbranched, straight or flexuous, septate, dark brown at the base, narrower and paler toward the apex, smooth, thick-walled. *Conidiogenous cells* monoblastic, integrated, terminal, cylindrical, lageniform to doliiform, subhyaline to pale brown, smooth. *Conidia* 24–30 μm long, 13–17 μm wide ($\bar{x} = 27 \times 15 \mu\text{m}$, $n = 20$), acrogenous, solitary, muriform, broadly clavate, obovoid to pyriform, usually with 2–3 transverse septa and a few longitudinal septa, with conspicuous pores in each cells, slightly constricted at the septa, pale brown at the basal

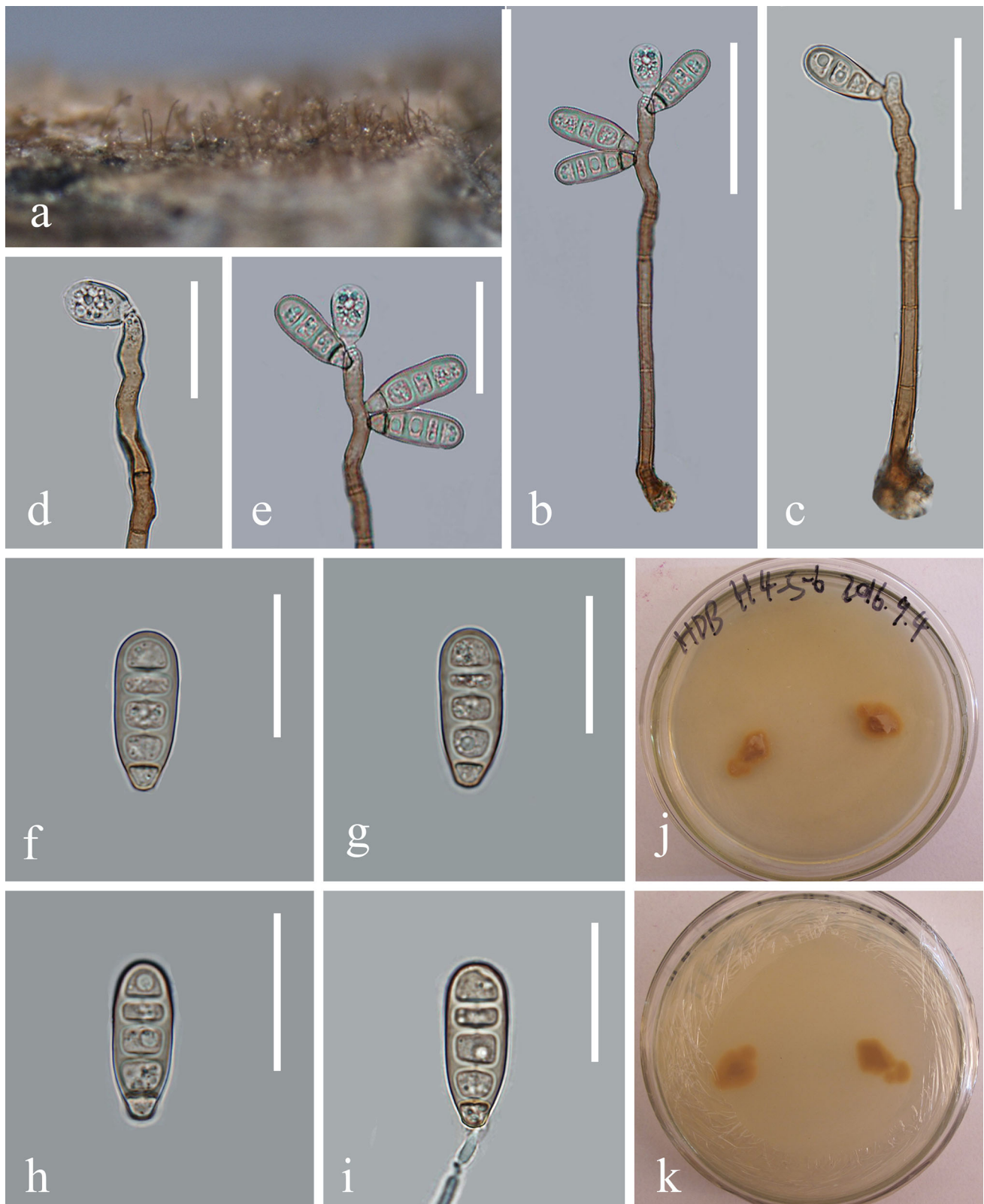


Fig. 27 *Sporidesmiella aquatica* (MFLU 18–1602, holotype) **a** Colony on natural substrate. **b, c** Conidiophore with conidia. **d, e** Conidiogenous cells with conidia. **f–h** Conidia. **i** Germinating conidium. Culture on PDA from above (**j**) and reverse (**k**). Scale bars: **b, c** 100 μ m, **d–i** 50 μ m

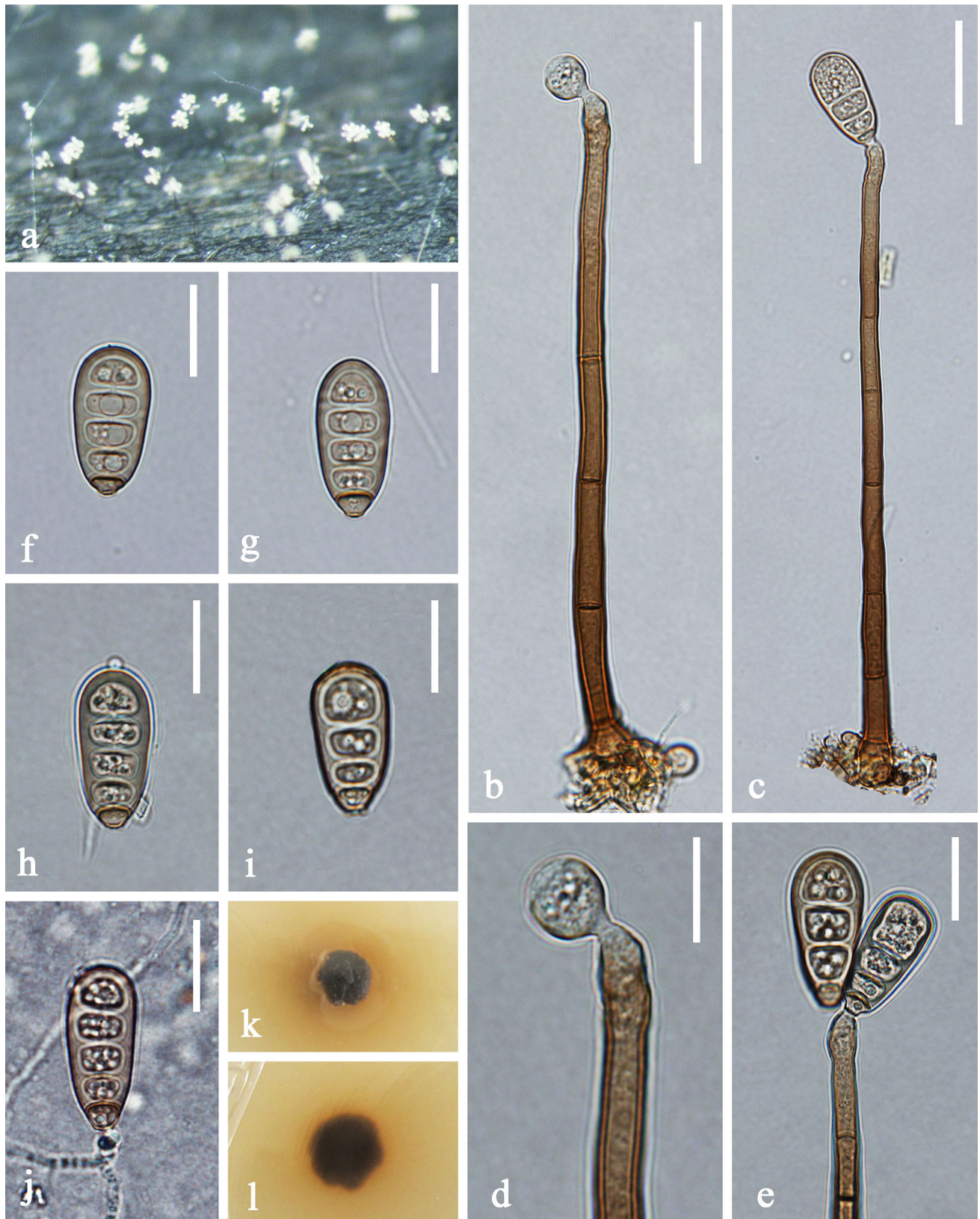


Fig. 28 *Sporidesmiella novae-zelandiae* (MFLU 18–1604) **a** Colony on natural substrate. **b, c** Conidiophore with conidia. **d, e** Conidiogenous cells with conidia. **f–i** Conidia. **j** Germinating conidium. Culture on PDA from surface (**k**) and reverse (**l**). Scale bars: **b, c** 30 μm , **d–i** 15 μm

cells and brown at the other part, basal cell obconical, truncate at base. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on decaying wood submerged in a freshwater stream, October 2014, L.W. Wang, S-274 (DLU 0274, holotype), ex-type living culture KUMCC 15–0240.

Notes: *Acrodictys fluminicola* resembles the generic type *A. bambusicola* in having macronematous, unbranched and septate conidiophores dark brown at the base, narrower and paler toward the apex, solitary, muriform, obovoid to pyriform conidia slightly constricted at the septa, with obconical basal cell and the size of conidiophores and conidia of these two species are almost similar (Xia et al. 2017). However, *A. fluminicola* differs from *A. bambusicola* in has 2–3 transverse septa conidia with conspicuous guttulae in each cell, while *A. bambusicola* have 3–4 transverse septa. Phylogenetic analysis also shows that *Acrodictys fluminicola* and *A. bambusicola* are distinct species (Fig. 1, clade 9). Phylogenetically, *A. aquatica* clusters with *A. hainnensis* (Fig. 1, clade 9), however, *Acrodictys fluminicola* morphologically differs from *A. hainnensis* in having longer conidiophores (98–142 vs. up to 35 μm) and larger conidia (24–30 \times 13–17 vs. 15–22 \times 7–13 μm).

Acrodictys liputii Cai et al.

Distribution: **Philippines**, Negros Occidental, Barrio Alegria, Liput River, on submerged bamboo culm (Cai et al. 2002b).

Sexual morph: Undetermined

Notes: Holotype PDD 74789, isotype IFRD 8640. ITS, LSU and SSU sequence data are available.

Barbatosphaeriaceae Zhang et al.

Barbatosphaeria Réblová, Mycologia 99(5): 727 (2008) [2007]

Asexual morph Undetermined. **Sexual morph** Description and illustrations refer to Réblová et al. (2015a).

Type species: *Barbatosphaeria barbirostris* (Dufour) Réblová, Mycologia 99(5): 727 (2008)

Notes: *Barbatosphaeria* is a non-stromatic perithecial ascomycete introduced for a single species *Barbatosphaeria barbirostris* and placed in the Sordariomycetes genera *incertae sedis* based on nuc28S rDNA sequences (Réblová 2007). Réblová et al. (2015a) revisited *Barbatosphaeria* and introduced seven species for this genus. In this study, we introduce one new species and this is the only known *Barbatosphaeria* species collected from freshwater habitats.

Barbatosphaeria lignicola Z.L. Luo, H.Y. Su & K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 555658, Facesoffungi number: FoF 05430, Fig. 25

Etymology: Referring to this fungus dwelling on wood

Holotype: HKAS 84005

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Undetermined. **Sexual morph** *Ascomata* immersed, globose to subglobose, dark brown to black, 380–400 μm high, 270–320 μm diam., aggregated in circular groups, occasionally solitary. *Neck* black, cylindrical, straight to slightly flexuous, converging radially. *Peridium* 25–40 μm thick, leathery to fragile, 2-layered. Outer layer consisting of thick-walled, brown, polyhedral to elongate cells of *textura prismatica* to *textura angularis*, towards the interior grading into several layers of thin-walled pale brown to subhyaline flattened cells. *Paraphyses* septate, slightly constricted at the septa, wider near the base, tapering toward the tip, longer than asci. *Asci* 19–31 \times 4–6 μm (\bar{x} = 25 \times 5 μm , n = 30), 8-spored, unitunicate, clavate in sporiferous part, tapering toward the stipe, ascus apex broadly rounded to obtuse. *Ascospores* 5–7 \times 1–2 μm (\bar{x} = 6 \times 1.5 μm , n = 20), arranged obliquely 1–2-seriately in the sporiferous part of the ascus, allantoid, U- to horseshoe shaped, narrow to pitted at both ends, aseptate, non-constricted, hyaline.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on decaying wood submerged in Heilong stream, 15 March 2014, Z.L. Luo, S-105, (HKAS 84005, holotype).

Notes: *Barbatosphaeria lignicola* mostly resembles *B. hippocrepida* in having globose to subglobose, dark brown to black ascomata, black, cylindrical neck, septate paraphyses wider near the base, tapering toward the tip, longer than asci and slightly constricted at the septa, unitunicate, 8-spored asci and allantoid, U- to horseshoe shaped, hyaline, aseptate, non-constricted, similar size of ascospores (Réblová and Štěpánek 2009). However, *B. lignicola* differs from *B. hippocrepida* in having smaller ascomata (380–400 \times 270–320 vs. 350–500 \times 400–650 μm), ascospores tending to group in the apex of the sporiferous part while ascospores of *B. hippocrepida* tend to group in the middle of the sporiferous part, leaving the apex empty. Phylogenetic analyses show that *Barbatosphaeria lignicola* is distinct from other *Barbatosphaeria* species (Fig. 26).

Conlariaceae Zhang et al.

Conlarium F. Liu & L. Cai, Mycologia 104(5): 1180 (2012)

Asexual morph Hyphomycetous, for description and illustration refer to Zhang et al. (2017a, b). **Sexual morph** Description and illustration refer to Liu et al. (2012).

Type species: *Conlarium dupliciascospora* F. Liu & L. Cai, Mycologia 104(5): 1180 (2012)

Notes: Currently, two species are accepted in the genus *Conlarium*, and both *C. aquaticum* and *C. dupliciascospora* are reported from freshwater habitats in China and Thailand respectively (Liu et al. 2012; Zhang et al. 2017a, b).



Fig. 29 *Sporidesmiella hyalosperma* (MFLU 18–1603) **a** Colony on natural substrate. **b** Conidiophores with conidia. **c** Conidiogenous cells. **d, e** Conidia. **f, g** Germinating conidia. Culture on PDA from above (**h**) and reverse (**i**). Scale bars: **b** 50 μ m, **c–g** 20 μ m

Conlarium aquaticum Dong et al.

Distribution: **Thailand**, Prachuap Khiri Khan, on submerged wood in a small River (Zhang et al. 2017).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–2703. ITS, LSU, SSU and TEF1 α sequence data obtained from ex-type culture are available.

Conlarium dupliciascosporum F. Liu & L. Cai

Distribution: **China**, Guangdong Province, Zhaoqing, Dinghu Mountain, on submerged wood in a stream (Liu et al. 2012).

Asexual morph: See Liu et al. (2012)

Notes: Holotype HMAS 243129. ITS, LSU and SSU sequence data are available, ex-type strain CGMCC3.14938.

Riomyces Ferrer et al., Mycologia 104(4): 876 (2012)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustration refer to Ferrer et al. (2012).

Type species: *Riomyces rotundus* A. Ferrer, A.N. Mill., Sarmiento & Shearer, Mycologia 104(4): 876 (2012)

Notes: There is only one species was accepted in the genus *Riomyces* and was only known from the type locality.

Riomyces rotundus Ferrer et al.

Distribution: **Costa Rica**, Alajuela and Heredia, on submerged wood (Ferrer et al. 2012).

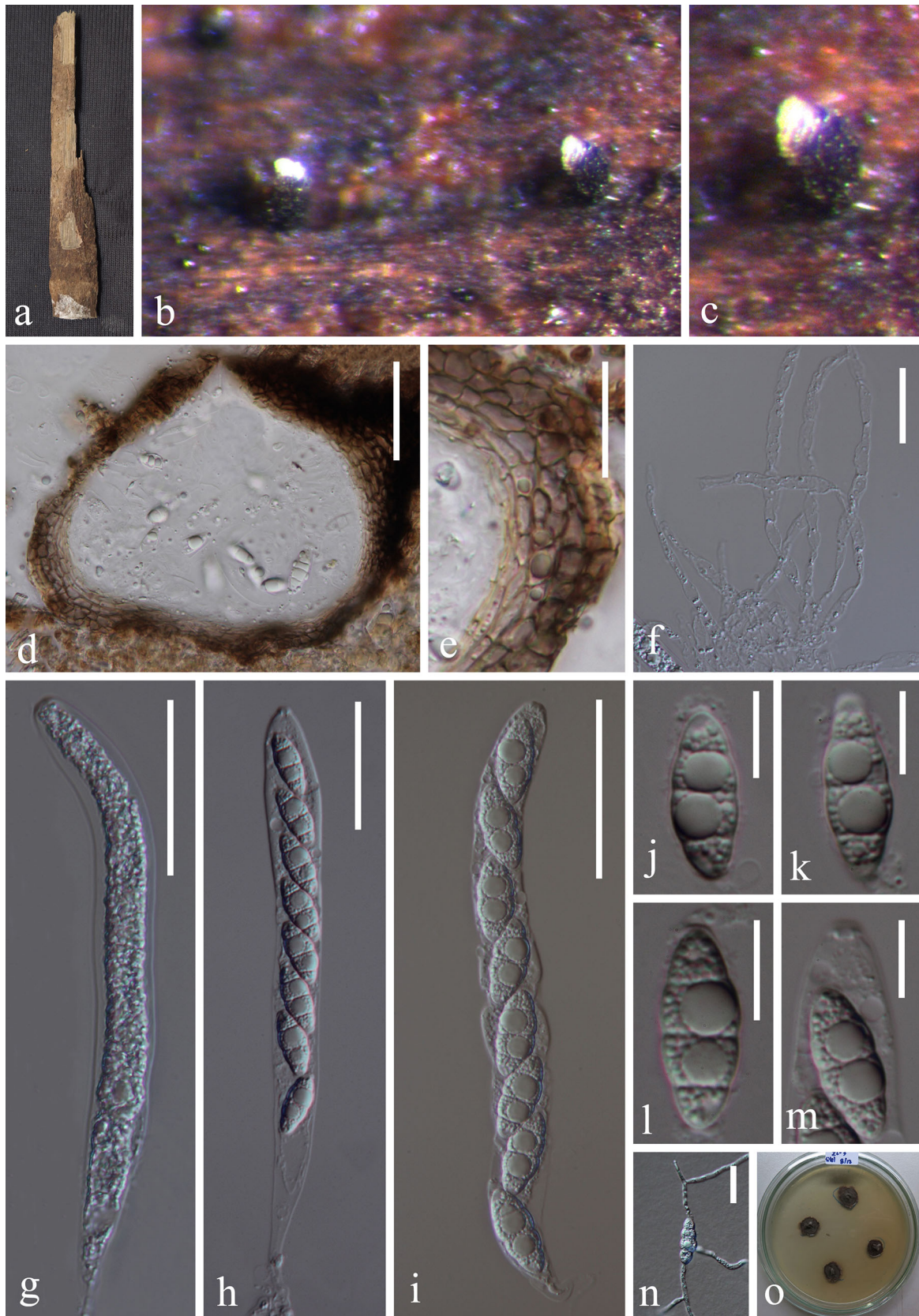
Asexual morph: Undetermined

Notes: Holotype ILL AF303–1, other specimen collected from freshwater habitats: ILL AF303–3. LSU and SSU sequence data are available.

Junewangiaceae J.W. Xia & X.G. Zhang

Dictyosporella Abdel-Aziz, Fungal Divers 75: 144 (2015)

Asexual morph Description and illustrations see Ariyawansa et al. (2015). **Sexual morph** Description and illustrations see Zhang et al. (2017a, b).



◀**Fig. 30** *Fluminicola thailandensis* (MFLU 15–0085) **a** Specimen. **b**, **c** Appearance of necks on substrate. **d** Vertical section of ascomata. **e** Structure of peridium. **f** Paraphyses. **g–i** Ascus. **j–m** Ascospores. **n** Germinating ascospore. **o** Colony on PDA. Scale bars: **d**, **g–i** 40 μm , **e**, **f**, **n** 20 μm , **j–m** 10 μm

Type species: *Dictyosporella aquatica* Abdel-Aziz, Fungal Divers 75: 145 (2015)

Notes: Ariyawansa et al. (2015) introduced the genus *Dictyosporella* to accommodate the asexual morph species *D. aquatica* Abdel-Aziz, collected on submerged decaying stems of *Phragmites australis* in Nile River, Egypt, and accommodated it in family Annulatascaceae. Zhang et al. (2017a, b) introduced a sexual morph species *Dictyosporella thailandensis* W. Dong, H. Zhang & K.D. Hyde for this genus which was collected from freshwater, and they moved this genus from Annulatascaceae to Diaporthomycetidae genera *incertae sedis*. Song et al. (2018a) introduced the third species *Dictyosporella hydei* H.Y. Song & D.M. Hu based on morphology and phylogenetic analyses, but the placement of this genus was not mentioned in their study. Our phylogenetic analysis based on multi-gene shows that the genus *Dictyosporella* clusters in Junewangiaceae with strong support (Fig. 1, clade 1). According to our phylogenetic result, *Dictyosporella* is transferred from Diaporthomycetidae genera *incertae sedis* to Junewangiaceae. Three species were accepted in this genus and all were collected from freshwater habitats.

Dictyosporella aquatica Abdel-Aziz

Distribution: **Egypt**, Sohag, River Nile, on submerged decayed stem of *Phragmites australis* (Ariyawansa et al. 2015).

Sexual morph: Undetermined

Notes: Holotype CBS H-22127, isotype MFLU 15–1510. LSU and SSU sequence data are available.

Dictyosporella hydei H.Y. Song & D.M. Hu

Distribution: **China**, Yunnan Province, Mengla, on submerged wood in a small stream (Song et al. 2018a).

Sexual morph: Undetermined

Notes: Holotype IFRD 021–044. LSU sequence data is available. This species is only known from the type locality.

Dictyosporella thailandensis Dong et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, on submerged bamboo in a small River (Zhang et al. 2017a, b).

Asexual morph: Undetermined

Notes: Holotype MFLU 15–2706. ITS, LSU, SSU and RPB2 sequence data are available.

Junewangia W.A. Baker & Morgan-Jones, Mycotaxon 81: 307 (2002)

Asexual morph Description and illustrations see Xia et al. (2018). **Sexual morph** Undetermined.

Type species: *Junewangia sphaerospora* W.A. Baker & Morgan-Jones, Mycotaxon 81: 312 (2002)

Notes: *Junewangia* was established by Baker et al. (2002) to accommodate four species of *Acrodictys* M.B. Ellis. The species of *Junewangia* are characterized by slightly flared conidiophores with annellidic, percurrent proliferation, cylindrical or narrowly cuneate conidigenous cells, subglobose to globose conidia with a prominent, protruding basal cell, uniformly pigmented, and a series of largely angular or oblique septa, with schizolytic secession. Seven species are accepted in the genus *Junewangia* and only one of them was collected from freshwater habitats in China (Song et al. 2018b).

Junewangia aquatica H.Y. Song & D.M. Hu

Distribution: **China**, Yunnan Province, Mengla, stream in rubber trees field, on submerged wood (Song et al. 2018b).

Sexual morph: Undetermined

Notes: Holotype HFJAU 0700; ITS, LSU, SSU sequence data are available. This species is only known from the type locality.

Sporidesmiella P.M. Kirk

Asexual morph Descriptions and illustrations see Wu and Zhuang (2005); **Sexual morph** Undetermined.

Type species: *Sporidesmiella claviformis* P.M. Kirk, Trans. Br. Mycol. Soc. 79: 479 (1982)

Notes: Kirk (1982) introduced the genus *Sporidesmiella* P.M. Kirk to accommodate the species previously described in the genera *Sporidesmium* and *Endophragma*. *Sporidesmiella* resembles *Repetophragma* but differs in its distoseptate conidia (Kirk 1982; Subramanian 1992). In our phylogenetic analysis, *Sporidesmiella* clusters in Junewangiaceae while *Repetophragma* belongs in Pseudosporidesmiaceae (Fig. 1, clade 1, 37). In this study, we report three *Sporidesmiella* species which were collected from freshwater habitats with one new taxon.

Sporidesmiella aquatica Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555659, Facesoffungi number: FoF 05431, Fig. 27

Etymology: Referring to the aquatic habitat of this fungus

Holotype: MFLU 18–1602

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, hairy, yellow brown to brown. *Mycelium* partly superficial, partly immersed, composed of septate, branched, smooth, pale brown hyphae. *Conidiophores* 178–228 μm long, 8–10 μm wide (\bar{x} = 203 \times 9 μm , n = 20), macronematous, mononematous, erect, unbranched, septate, straight or

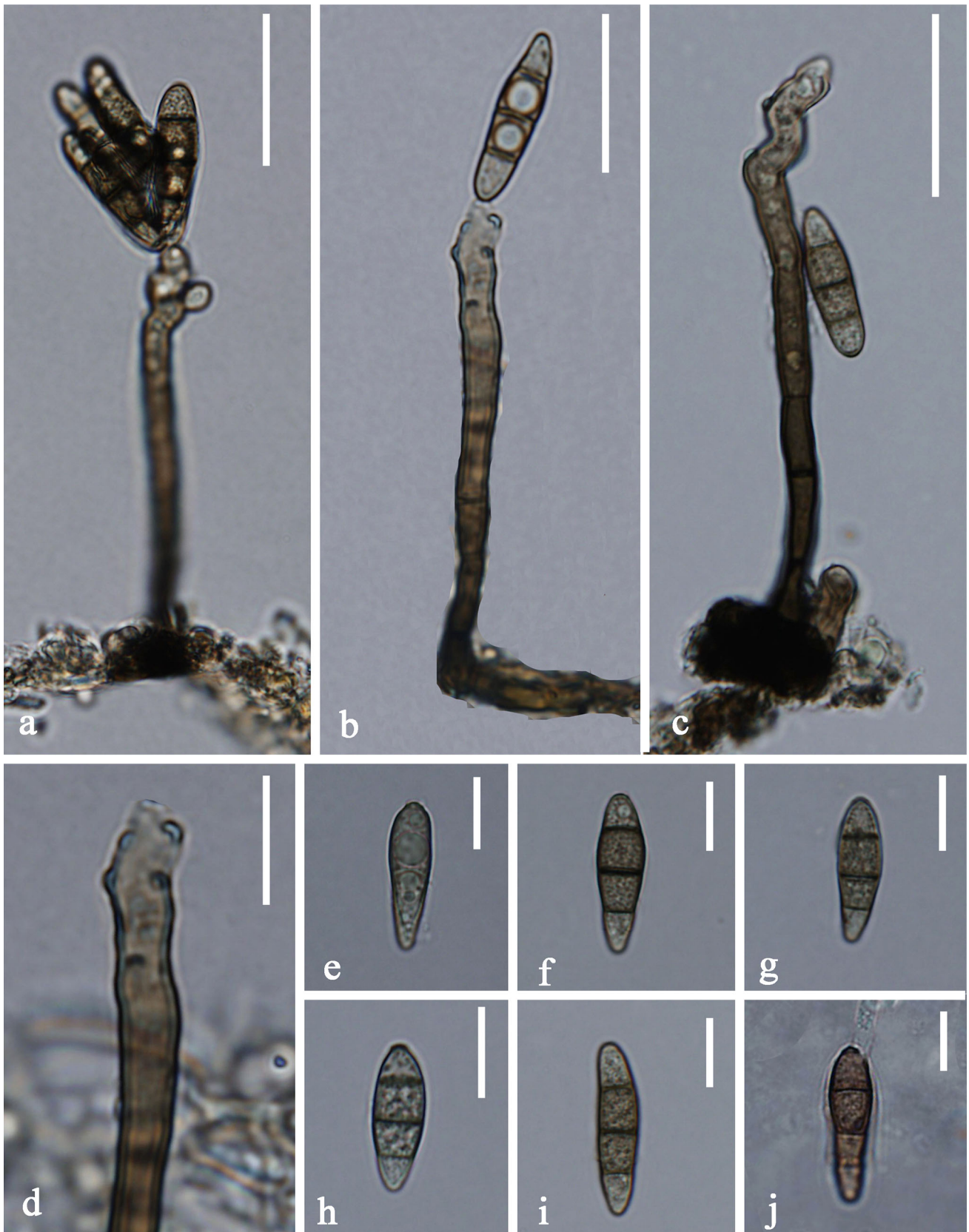


Fig. 31 *Wongia aquatica* (MFLU 18–1596, holotype) **a–c** Conidiophore with conidia. **d** Conidiogenous cells. **e–i** Conidia. **j** Germinating conidium. Scale bars: **a–c** 45 μm , **d–j** 20 μm

flexuous, cylindrical, yellow–brown, paler towards the apex, smooth. *Conidiogenous cells* holoblastic, polyblastic, sympodial, integrated, terminal, subterminal, subhyaline to pale brown, with percurrent or sympodial proliferations. *Conidia* 51–59 μm long, 18–22 μm wide ($\bar{x} = 55 \times 20 \mu\text{m}$, $n = 20$), acropleurogenous, dry, clavate or obovoid, rounded at the apex, truncate at the base, 3–4-distoseptate, pale brown, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on decaying wood submerged in a freshwater stream, October 2016, Z.L. Luo, S-777 (MFLU 18–1602, holotype), ex-type living culture DLUCC 0777; Laojunshan Mountain, saprobic on decaying wood submerged in a freshwater stream, August 2017, H.W. Shen, S-1339 (MFLU 18–2331, paratype), living culture DLUCC 1339.

Notes: *Sporidesmiella aquatica* resembles *S. hyalosperma* in having macronematous, mononematous, erect, unbranched, septate, cylindrical conidiophores, integrated, terminal conidiogenous cells with percurrent or sympodial proliferations and acrogenous, dry, clavate or obovoid conidia (Kirk 1982; Wu and Zhuang 2005). However, *S. aquatica* differs from *S. hyalosperma* in having polyblastic conidiogenous cells and larger conidia (51–59 \times 18–22 vs. 22–25 \times 9–12 μm).

Sporidesmiella novae-zelandiae (S. Hughes) Madrid et al.
 \equiv *Sporidesmium hyalospermum* var. *novae-zelandiae* S. Hughes, N.Z. J. Bot. 16(3): 349 (1978)

\equiv *Sporidesmiella hyalosperma* var. *novae-zelandiae* (S. Hughes) P.M. Kirk, Trans. Brit. Mycol. Soc. 79: 479 (1982)

\equiv *Exserohilum novae-zelandiae* (S. Hughes) H.P. Upadhyay & Mankau, Mycologia 83: 373 (1991)

Facesoffungi number: FoF 05432, Fig. 28

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, hairy, yellow brown to brown. *Mycelium* partly superficial, partly immersed, composed of septate, branched, smooth, pale brown hyphae. *Conidiophores* 132–186 μm long, 5–7 μm wide ($\bar{x} = 159 \times 6 \mu\text{m}$, $n = 20$), macronematous, mononematous, erect, unbranched, septate, straight or flexuous, cylindrical, yellow–brown, paler towards the apex, smooth. *Conidiogenous cells* holoblastic, polyblastic, sympodial, integrated, terminal, subhyaline to pale brown. *Conidia* 25–29 μm long, 12–14 μm wide ($\bar{x} = 27 \times 13 \mu\text{m}$, $n = 20$), acrogenous, dry, pale brown, clavate or obovoid, rounded at the apex, truncate at the base, 2–4-distoseptate, basal cell cut off by a dark brown septum, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Dulong River, saprobic on decaying wood submerged, October 2016, Z.L. Luo, S-951 (MFLU 18–1604), living culture

DLUCC 0951; Laojunshan Mountain, saprobic on decaying wood submerged in a freshwater stream, August 2017, H.W. Shen, S-1256 (MFLU 18–2332), living culture DLUCC 1256.

Notes: Holotype PDD 30420, isotype DAOM 159962, other specimen collected from freshwater habitats: MFLU 18–1604. We provide the ITS, LSU, SSU, RPB2 and TEF1 α sequence data for this species. The species *Sporidesmiella novae-zelandiae* was originally described as *Sporidesmium hyalospermum* var. *novae-zelandiae* by Hughes (1978). This species and the type variety were reallocated to *Sporidesmiella* by Kirk (1982) and *Sporidesmium hyalospermum* var. *novae-zelandiae* was later transferred to *Exserohilum* as *E. novae-zelandiae* by Upadhyay and Mankau (1991). Hernández-Restrepo et al. (2018) considered that *Exserohilum novae-zelandiae* should be retained in *Sporidesmiella* and combined it as *S. novae-zelandiae*. During an investigation on lignicolous freshwater fungi in China, a *Sporidesmiella*-like fungus was collected from Yunnan Province and the morphological characters of our new collection fits well with *S. novae-zelandiae* (Hughes 1978; Kirk 1982; Wu and Zhuang 2005; Hernández-Restrepo et al. 2018). Phylogenetic analysis shows that our isolates cluster with other *Sporidesmiella* species with good bootstrap support value and form in a distinct clade (Fig. 1, clade 1). Based on the morphology and phylogeny, we identify our isolates as *Sporidesmiella novae-zelandiae*.

Sporidesmiella hyalosperma (Corda) P.M. Kirk

\equiv *Helminthosporium hyalospermum* Corda, Icon. fung. (Prague) 1: 13 (1837)

Facesoffungi number: FoF 05433, Fig. 29

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, hairy, yellow brown to brown. *Mycelium* partly superficial, partly immersed, composed of septate, branched, smooth, pale brown hyphae. *Conidiophores* 116–144 μm long, 5–7 μm wide ($\bar{x} = 130 \times 6 \mu\text{m}$, $n = 20$), macronematous, mononematous, erect, unbranched, septate, straight or flexuous, cylindrical, brown, paler towards the apex, smooth. *Conidiogenous cells* holoblastic, polyblastic, sympodial, integrated, terminal, later becoming subterminal, subhyaline to pale brown, with percurrent or sympodial proliferations. *Conidia* 17–21 μm long, 8–10 μm wide ($\bar{x} = 19 \times 9 \mu\text{m}$, $n = 20$), acropleurogenous, dry, clavate or obovoid, rounded at the apex, truncate at the base, 3–4-distoseptate, pale brown, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Jinsha River, saprobic on decaying wood submerged, April 2015, Z.L. Luo, S-563 (MFLU 18–1603, HKAS 92987), living

culture KUMCC 15–0431; Cangshan Mountain, saprobic on decaying wood submerged in a freshwater stream, August 2017, H.W. Shen, S-1400, living culture MFLUCC 18–1312; *Ibid.*, saprobic on decaying wood submerged in a freshwater stream, August 2017, H.W. Shen, S-1518 (MFLU 18–2330), living culture DLUCC 1518.

Notes: Holotype PDD 30420, specimen collected from freshwater habitats: MFLU 18–1603. We provide the ITS, LSU, SSU, RPB2 and TEF1 α sequence data for this species in this study. *Sporidesmiella hyalosperma* is the most common species in the genus *Sporidesmiella*. Morphologically, our isolates fit well with the *Sporidesmiella hyalosperma* in having macronematous, mononematous, solitary, erect, unbranched, septate, straight or flexuous, cylindrical, brown, smooth conidiophores paler towards the apex, holoblastic, integrated, terminal, subhyaline to pale brown conidiogenous cells with percurrent or sympodial proliferations and acrogenous, dry, clavate or obovoid, distoseptate conidia rounded at the apex, truncate at the base and even the size of conidiophores and conidia are also similar (Kirk 1982; Wu and Zhuang 2005). Therefore, we identify our collections as *Sporidesmiella hyalosperma*, and it is the first time to report this species from freshwater.

Papulosaceae Winka & O.E. Erikss.

Brunneosporella Ranghoo & K.D. Hyde, Mycol. Res. 105(5): 625 (2001)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations refer to Ranghoo et al. (2001).

Type species: *Brunneosporella aquatica* Ranghoo & K.D. Hyde, Mycol. Res. 105(5): 625 (2001)

Notes: Ranghoo et al. (2001) introduced the genus *Brunneosporella* with single species *B. aquatica* which was collected from freshwater habitats. This species is only known from the type locality.

Brunneosporella aquatica Ranghoo & K.D. Hyde

Distribution: **China**, Hong Kong, New Territories, Plover Cove Reservoir, on submerged wood (Ranghoo et al. 2001).

Asexual morph: Undetermined

Notes: Holotype IFRD 8717. ITS and LSU sequence data are available.

Fluminicola Wong et al., Fungal Diversity Res. Ser. 2: 190 (1999)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations refer to Wong et al. (1999b) and Zhang et al. (2017a, b).

Type species: *Fluminicola bipolaris* Wong et al., Fungal Divers 2: 190 (1999)

Notes: Wong et al. (1999b) established the genus *Fluminicola* with *F. bipolaris* as type species. Zhang et al. (2017a, b) introduced three species which were collected from a freshwater River in southern Thailand.

Fluminicola aquatica Dong et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, on submerged wood in a small River (Zhang et al. 2017a, b).

Asexual morph: Undetermined

Notes: Holotype MFLU 15–2710. ITS, LSU and SSU sequence data are available.

Fluminicola bipolaris Wong et al.

Distribution: **Philippines**, Mindanao, Bukidnon, Impalutao, Natigbasan Creek, on submerged wood (Wong et al. 1999b).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 3127 (now in IFRD). Sequence data is not available.

Fluminicola saprophytica Dong et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, on submerged bamboo in a small River (Zhang et al. 2017a, b).

Asexual morph: Undetermined

Notes: Holotype MFLU 15–2694. ITS, LSU, SSU and RPB2 sequence data are available.

Fluminicola thailandensis Dong et al.

Facesoffungi number: FoF 03346, Fig. 30

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Undetermined. **Sexual morph** *Ascomata* 138–156 μm high, 100–120 μm diam., immersed with neck erumpent through host surface, subglobose to ellipsoid, solitary, dark brown to black. *Ostiole* central, with straight upright, black neck. *Peridium* 12–18 μm thick, consisting two-layers, outer layer comprising 3–4 layers of dark brown, thick-walled cells of *textura angularis*, inner layer comprising 2–3 layers of pale brown to hyaline, thin-walled cells of *textura angularis*. *Paraphyses* 4–6 μm wide, hyaline, unbranched, septate, slightly constricted at the septum. *Asci* 135–181 \times 11–15 μm (\bar{x} = 158 \times 13 μm , n = 20), 8-spored, unitunicate, cylindrical, pedicellate, tapering to a point, apically rounded or slightly obtuse, with an indistinct, refractive, small, discoid apical ring. *Ascospores* 19–21 \times 7–9 μm (\bar{x} = 20 \times 8 μm , n = 20), uniseriate, fusiform, 3-septate, slightly constricted at the septa, with 2 prominent guttules, with a thin mucilaginous sheath, hyaline, smooth-walled.

Material examined: **THAILAND**, Chiang Rai Province, saprobic on decaying wood submerged in a freshwater stream, November 2013, Z.L. Luo, ZL-10 (MFLU 15–0085), living culture MFLUCC 14–0037.

Distribution: **Thailand**, Prachuap Khiri Khan Province, on submerged wood in a small River (Zhang et al. 2017a, b), Chiang Rai Province, saprobic on decaying wood submerged in a freshwater stream (This study).

Asexual morph: Undetermined

Notes: Holotype MFLU 15–2704, other specimen collected from freshwater MFLU 15–0085. ITS, LSU, SSU

and TEF1 α sequence data are available. *Fluminicola thailandensis* was introduced by Zhang et al. (2017a, b) based on an isolate collected from southern Thailand. During our investigation of lignicolous freshwater fungi in northern Thailand, an *Annulatascaceae*-like fungus was collected from Chiang Rai Province. Morphologically, the new isolate resembles *Fluminicola* species in having immersed ascomata with black neck, cylindrical asci with apical ring and fusiform, septate, guttulate ascospores with a thin mucilaginous sheath. Phylogenetic analysis based on LSU, SSU, RPB2 and TEF1 α sequence data shows that the new strain (MFLUCC 14–0037) clusters with *Fluminicola* species with good support, and close to *F. thailandensis* and *F. saprotrophitica*. We compared the ITS sequences and noted that there are 3 nucleotide differences (including 2 gaps) between the ex-type strain of *Fluminicola thailandensis* (MFLUCC 15–0984) and our strain (MFLUCC 14–0037). Based on morphology and phylogeny, we identify our species as *Fluminicola thailandensis*.

Wongia Khemmuk et al., IMA Fungus 7(2): 249 (2016)

Asexual morph Colonies effuse, scattered, hairy, dark brown. Mycelium partly immersed, composed of branched, septate, brown, smooth hyphae. Conidiophores macrone-matous, mononematous, solitary, erect, straight or flexuous, unbranched, septate, dark brown, smooth. Conidiogenous cells polyblastic, denticulate, integrated, terminal, subhyaline. Conidia acrogenous, clavate to fusiform, 3-septate, guttulate, dark brown at central two cells, paler at end cells, rounded and narrow at apex, truncate at base. **Sexual morph** Descriptions refer to Khemmuk et al. (2016).

Type species: *Wongia garrettii* (P. Wong & M.L. Dickinson) Khemmuk et al., IMA Fungus 7(2): 250 (2016)

Notes: Khemmuk et al. (2016) re-examined *Magnaporthe garrettii* and *M. griffinii* that are pathogenic on roots of couch and hybrid couch (Wong et al. 2012) and established the genus *Wongia*. *Wongia* is the fourth genus to be placed in Papulosaceae, along with *Brunneosporella* (Ranghoo et al. 2001), *Fluminicola* (Wong et al. 1999a, b) and *Papulosa* (Kohlmeyer and Volkmann-Kohlmeyer 1993). In this study, we introduce an asexual *Wongia* species which was collected from freshwater habitats in northwestern Yunnan Province, China.

Wongia aquatica Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555660, Facesoffungi number: FoF 05434, Fig. 31

Etymology: Referring to the aquatic habitat of this fungus

Holotype: MFLU 18–1596

Saprobic on submerged decaying wood. **Asexual morph** Colonies effuse, scattered, hairy, dark brown. Mycelium partly immersed, composed of branched, septate,

brown, smooth hyphae. Conidiophores 54–90 μm long, 3–6 μm wide (\bar{x} = 72 \times 4 μm , n = 20), macrone-matous, mononematous, solitary, erect, straight or flexuous, unbranched, septate, dark brown, smooth. Conidiogenous cells polyblastic, sympodial, denticulate, integrated, terminal, subhyaline, with pale brown scar. Conidia 17–21 μm long, 5–7 μm wide (\bar{x} = 19 \times 6 μm , n = 20), acropleurogenous, fusiform, guttulate, 3-septate, dark brown at central two cells, paler at end cells, rounded and narrow at apex, truncate at base, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Dulong River, saprobic on decaying wood submerged, October 2016, Z.L. Luo, S-912 (MFLU 18–1596, holotype), ex-type living culture MFLUCC 18–1607.

Notes: There are no asexual morphs reported for *Wongia garrettii* and *W. griffinii*. *Wongia aquatica* is the first asexual morph species in the genus *Wongia*. Phylogenetically, *W. aquatica* shares a sister relationship to *W. griffinii* with high bootstrap support (96% ML) (Fig. 1, clade 11).

Pseudoproboscisporaceae Zhang et al.

Diluviicola Hyde et al., Fungal Diversity Res. Ser. 1: 141 (1998)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Hyde et al. (1998b).

Type species: *Diluviicola capensis* K.D. Hyde, S.W. Wong & E.B.G. Jones, Fungal Divers 1: 134 (1998)

Notes: Hyde et al. (1998b) introduced the genus *Diluviicola* based on a collection from Brunei. Zhang et al. (2017a, b) introduced the second species in this genus, *Diluviicola aquatica* W. Dong, H. Zhang & K.D. Hyde, based on a collection made from submerged bamboo in a river in Thailand.

Diluviicola aquatica Dong et al.

Distribution: **Thailand**, Prachuap Khiri Khan, on submerged bamboo in a small River (Zhang et al. 2017a, b).

Asexual morph: Undetermined

Notes: Holotype MFLU 15–2701. ITS, LSU, SSU and RPB2 sequence data obtained from ex-type culture are available.

Diluviicola capensis Hyde et al.

Distribution: **Brunei**, Temburong, Kuala Belalong Field Studies Centre, Sungai Esu, on submerged wood (Hyde et al. 1998c).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 3125 (now in IFRD). Sequence data is unavailable.

Pseudoproboscispora Punith., Kew Bull. 54(1): 234 (1999)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Wong and Hyde (1999a, b).

Type species: *Pseudoproboscispora aquatica* (S.W. Wong & K.D. Hyde) Punith., Kew Bull. 54(1): 234 (1999)

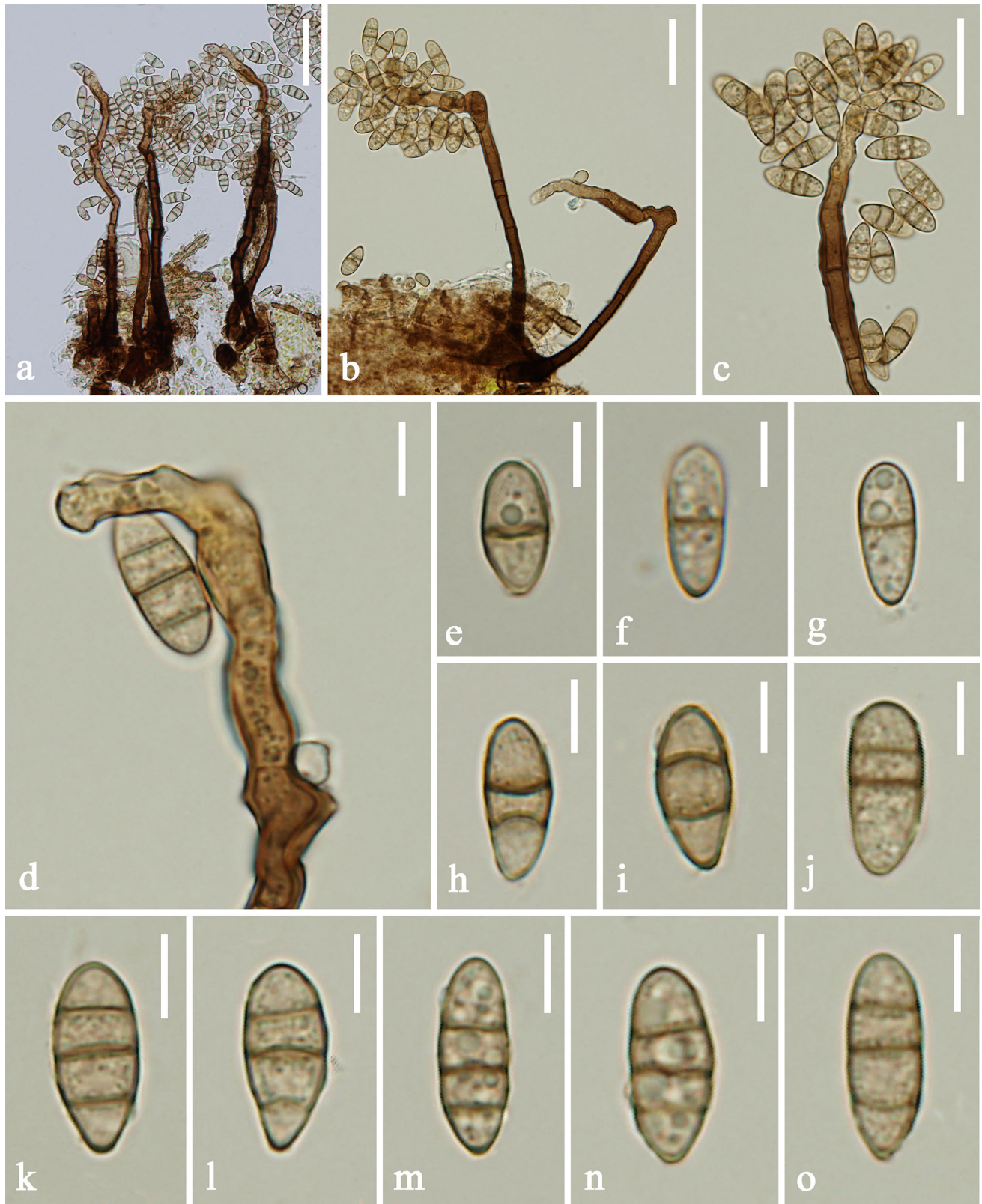


Fig. 32 *Rhodoveronaea aquatica* (MFLU 18–1593, holotype). **a, b** Conidiophores with conidia. **c, d** Conidiogenous cells with conidia. **e–o** Conidia. Scale bars: **a–c** 50 μ m, **d–o** 10 μ m

Notes: Index Fungorum (2018) lists three species in the genus *Pseudoproboscispora*. Previous studies showed that the species of *Pseudoproboscispora* are distributed worldwide and all of them were reported from freshwater habitats (Wong and Hyde 1999a, b; Campbell et al. 2003a; Zhang et al. 2017a, b).

Pseudoproboscispora aquatica (S.W. Wong & K.D. Hyde) Punith.

≡ *Proboscispora aquatica* S.W. Wong & K.D. Hyde, Mycol. Res. 103: 82 (1999)

Distribution: **Australia**, North Queensland, near Cairns, Crystal Cascades, on submerged wood; **Philippines**, Negros Occidental, Bacolod, Kaliban River, on submerged wood (Wong and Hyde 1999a, b). **Japan**, Koito River, on submerged wood (Tsui et al. 2001a)

Asexual morph: Undetermined

Notes: Holotype HKU (M) 2792 (now in IFRD). Sequence data is not available.

Pseudoproboscispora caudae-suis (Ingold) J. Campb. et al.
≡ *Ceriospora caudae-suis* Ingold, Trans. Br. Mycol. Soc. 34: 210 (1951)

Distribution: **UK**, Westmorland, Lake Windermere, on submerged, decorticated twigs of *Fraxinus*; **USA**, Arkansas, Lee County, Florida, Hamilton County, Illinois, Johnson County, Louisiana, Caldwell Parish, Mississippi, Franklin County, New York, Adirondack Park, North Carolina, Cheoah River, Oregon, Florence County, Pennsylvania, Columbia County, Tennessee, Great Smoky Mountains National Park, West Virginia, Pocahontas County, Wisconsin, Adams County, on submerged wood in lentic or lotic habitats (Campbell et al. 2003a).

Asexual morph: Undetermined

Notes: Holotype K(M) 109308; Sequence data is not available.

Pseudoproboscispora thailandensis Dong et al.

Distribution: **Thailand**, Prachuap Khiri Khan, on submerged bamboo in a small River (Zhang et al. 2017a, b).

Asexual morph: Undetermined

Notes: Holotype MFLU 15–2705. ITS, LSU and SSU sequence data are available.

Rhamphoriaceae Réblová

Rhamphoria Niessl, Verh. nat. Ver. Brünn 14: 204 (1876)

Asexual morph Hyphomycetous (*Phaeoisaria*-like). **Sexual morph** *Ascomata* partly immersed in the wood, black, single or sometimes in pairs, flask-shaped with an ostiolar neck or depressed cup shape with the neck arising sideways. *Peridium* composed of thick-walled, dark brown polygonal cells which become thin-walled and hyaline towards interior. *Paraphyses* filiform, hyaline and numerous. *Asci* 8-spored, unitunicate, cylindrical, long-stalked. *Ascospores* monostichous in the ascus, ovoid to oblong, hyaline to subhyaline, smooth-walled.

Type species: *Rhamphoria delicatula* Niessl, Verh. nat. Ver. Brünn 14: 206 (1876)

Notes: 15 *Rhamphoria* epithets are listed in Index Fungorum (December 2018) and only one species was reported from freshwater habitats (Ho et al. 2001).

Rhamphoria pyriformis (Pers.) Höhn

≡ *Sphaeria pyriformis* Pers., Syn. meth. fung. (Göttingen) 1: 64 (1801)

Distribution: **China**, Hong Kong, Tai Po Kau Forest, on submerged wood in a stream (Ho et al. 2001)

Asexual morph: Undetermined

Notes: Herbarium records CBS H-115, CBS H-17785. ITS, LSU and RPB2 sequence data are available. Ho et al. (2001) reported that *Rhamphoria pyriformis* was found from freshwater habitats in China, but they did not provide illustrations and descriptions for this species.

Rhodoveronaea Arzanlou et al., Stud. Mycol. 58: 89 (2007)

Asexual morph Colonies velvety, floccose; surface olivaceous-grey to dark olivaceous-green, reverse olivaceous-black. *Hyphae* pale olivaceous, smooth, thin-walled. *Conidiophores* arising vertically from creeping hyphae, straight or flexuose, simple, thick-walled, red-brown, with inflated basal cell. *Conidiogenous cells* polyblastic, terminally integrated, sympodial, smooth, thick-walled, pale brown, rachis straight, occasionally geniculate, with crowded, slightly prominent conidium-bearing denticles, denticles flat-tipped, slightly pigmented. *Conidia* solitary, ellipsoidal to obovoidal, aseptate to multiseptate, with a protruding base and a marginal basal frill, pale brown, thinner or slightly thick-walled, smooth. *Conidial secession* schizolytic (Arzanlou et al. 2007). **Sexual morph** *Ascomata* nonstromatic, gregarious or solitary, dark brown to black, venter subglobose to conical, immersed; neck conical, emerging above the substratum, straight or slightly curved, ostiolum periphysate. *Peridium* leathery, two-layered. *Paraphyses* septate, hyaline, tapering towards the tip, longer than the asci. *Asci* 8-spored, unitunicate, cylindrical, broadly rounded at the apex, long-stipitate. *Ascospores* fusiform, aseptate to multiseptate, hyaline (Réblová 2009).

Type species: *Rhodoveronaea varioseptata* Arzanlou, W. Gams & Crous, Stud. Mycol. 58: 91 (2007)

Notes: Arzanlou et al. (2007) introduced the genus *Rhodoveronaea* with single asexual species *R. varioseptata*. Réblová (2009) provided the sexual morph for this species. In this study, we introduce the second species *R. aquatica*, which was collected from freshwater habitats in northwestern Yunnan, China.

Rhodoveronaea aquatica Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555661, Facesoffungi number: FoF 05435, Fig. 32

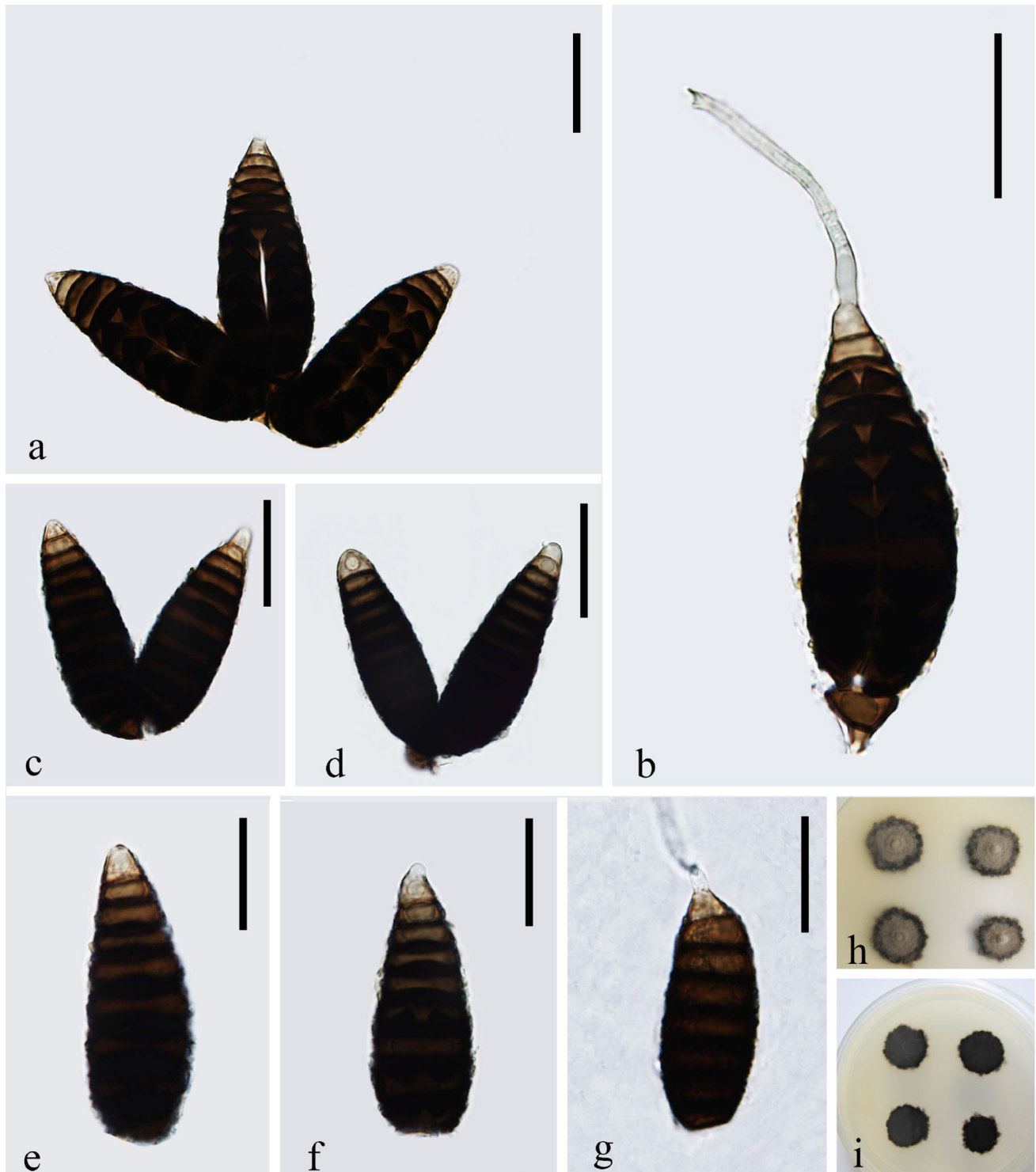


Fig. 33 *Pseudostanjehughesia lignicola* (DLU 078, holotype) **a, c–f** Conidia. **b, g** Germinating conidium. **h, i** Culture on PDA after 20 days (**i** from below). Scale bars: **a–g** 20 μm

Etymology: Referring to the aquatic habitat of this fungus

Holotype: MFLU 18–1593

Saprobic on decaying, submerged wood in freshwater habitats. **Asexual morph** Hyphomycetous. **Colonies** effuse, inconspicuous, brown, hairy. **Conidiophores** 182–310 μm long, 9–13 μm wide ($\bar{x} = 246 \times 11 \mu\text{m}$, $n = 20$),

macronematous, mononematous, cylindrical, arising vertically from creeping hyphae, straight or flexuose, simple, thick-walled, septate, red-brown, paler at apex. *Conidiogenous cells* polyblastic, terminally integrated, sympodial, smooth, thick-walled, pale brown at the base, paler towards the apex. *Conidia* 23–27 μm long, 9–11 μm wide ($\bar{x} = 25 \times 10 \mu\text{m}$, $n = 20$), acropleurogenous, ellipsoid to obovoid, apically rounded, with a flat basal scar, 1–3-septate, pale brown, smooth-walled. *Conidial secession* schizolytic. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Gaoligong Mountain, saprobic on submerged decaying wood in a freshwater stream, 10 July 2015, X.J. Su, S-718 (MFLU 18–1593, holotype), ex-type living culture MFLUCC 18–1339.

Notes: *Rhodoveronaea aquatica* resembles *R. varioseptata* in having macronematous, mononematous, cylindrical, straight or flexuose, septate, red-brown conidiophores, terminally integrated, polyblastic, sympodial, smooth conidiogenous cells, ellipsoid to obovoid, pale brown, septate conidia (Arzanlou et al. 2007; Réblová 2009). However, *R. aquatica* differs from *R. varioseptata* in having longer conidiophores (182–310 vs. 80–125 μm) and larger conidia (23–27 \times 9–11 μm vs. 8–15 \times 3–4 μm). Phylogenetic analysis also shows that *Rhodoveronaea aquatica* and *R. varioseptata* are distinct species (Fig. 1, clade 8).

Woswasiaceae Zhang et al.

Cyanoannulus Raja et al., Mycotaxon 88: 8 (2003)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations see Raja et al. (2003).

Type species: *Cyanoannulus petersenii* Raja, J. Campb. & Shearer

Notes: The genus *Cyanoannulus* was introduced by Raja et al. (2003) with single species *Cyanoannulus petersenii* Raja, J. Campb. & Shearer which was collected from freshwater habitats. And this species is known only from the type locality.

Cyanoannulus petersenii Raja et al.

Distribution: **USA**, North Carolina and Tennessee, Great smoky Moubtains National Park, on submerged wood (Raja et al. 2003).

Asexual morph: Undetermined

Notes: Holotype ILL, Raja & Hamburger R044-1. ITS and LSU sequence data are available.

Diaporthomycetidae genera *incertae sedis*

Aquaticola Ho et al., Fungal Diversity Res. Ser. 3: 88 (1999)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustration see Ho et al. (1999c).

Type species: *Aquaticola hyalomura* W.H. Ho, C.K.M. Tsui, Hodgkiss & K.D. Hyde, Fungal Divers 3: 88 (1999)

Notes: The genus *Aquaticola* was introduced for tropical freshwater fungi occurring on submerged wood in Asia with two species and was placed in the family Annulatasaceae (Ho et al. 1999c). Subsequently, Tsui et al. (2003) described three additional *Aquaticola* species from tropical freshwater environments in Asia and Australia. Réblová et al. (2016a) transferred *Aquaticola ellipsoidea* to the genus *Atractospora* as *At. ellipsoidea*. Four freshwater species are accepted in *Aquaticola*.

Aquaticola hyalomura Ho et al.

Distribution: **China**, Hong Kong, Tai Po Kau Forest Stream, on submerged decaying wood (Ho et al. 1999c).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 2969 (now in IFRD). LSU sequence data is available.

Aquaticola longicolla Tsui et al.

Distribution: **Australia**, north Queensland, near Ravenshoe, submerged in creek (Tsui et al. 2003); **Brunei**, Tutong River, on submerged wood (Fryar et al. 2004)

Asexual morph: Undetermined

Notes: Holotype IFRD 8682. Sequence data is not available.

Aquaticola minutiguttulata Tsui et al.

Distribution: **China**, Hong Kong, Sai Kung, Hang Cho Shui, on submerged wood (Tsui et al. 2003).

Asexual morph: Undetermined

Notes: Holotype IFRD 8683. Sequence data is not available.

Aquaticola triseptata Tsui et al.

Distribution: **China**, Hong Kong, Tai Po, Lam Tsuen River, on submerged wood (Tsui et al. 2003).

Asexual morph: Undetermined

Notes: Holotype IFRD 8684. Sequence data is not available.

Bullimyces Ferrer et al., Mycologia 104(4): 868 (2012)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations see Ferrer et al. (2012).

Type species: *Bullimyces communis* Ferrer et al., Mycologia 104(4): 868 (2012)

Notes: Ferrer et al. (2012) introduced the genus *Bullimyces* with three freshwater species. All these species are known only from their respective type localities.

Bullimyces aurisporus Ferrer et al.

Distribution: **Costa Rica**, Alajuela, on submerged wood (Ferrer et al. 2012).

Asexual morph: Undetermined

Notes: Holotype ILL AF316–1. LSU and SSU sequence data are available.

Bullimyces communis Ferrer et al.

Distribution: **Costa Rica**, Alajuela and Heredia, on submerged wood (Ferrer et al. 2012).

Asexual morph: Undetermined

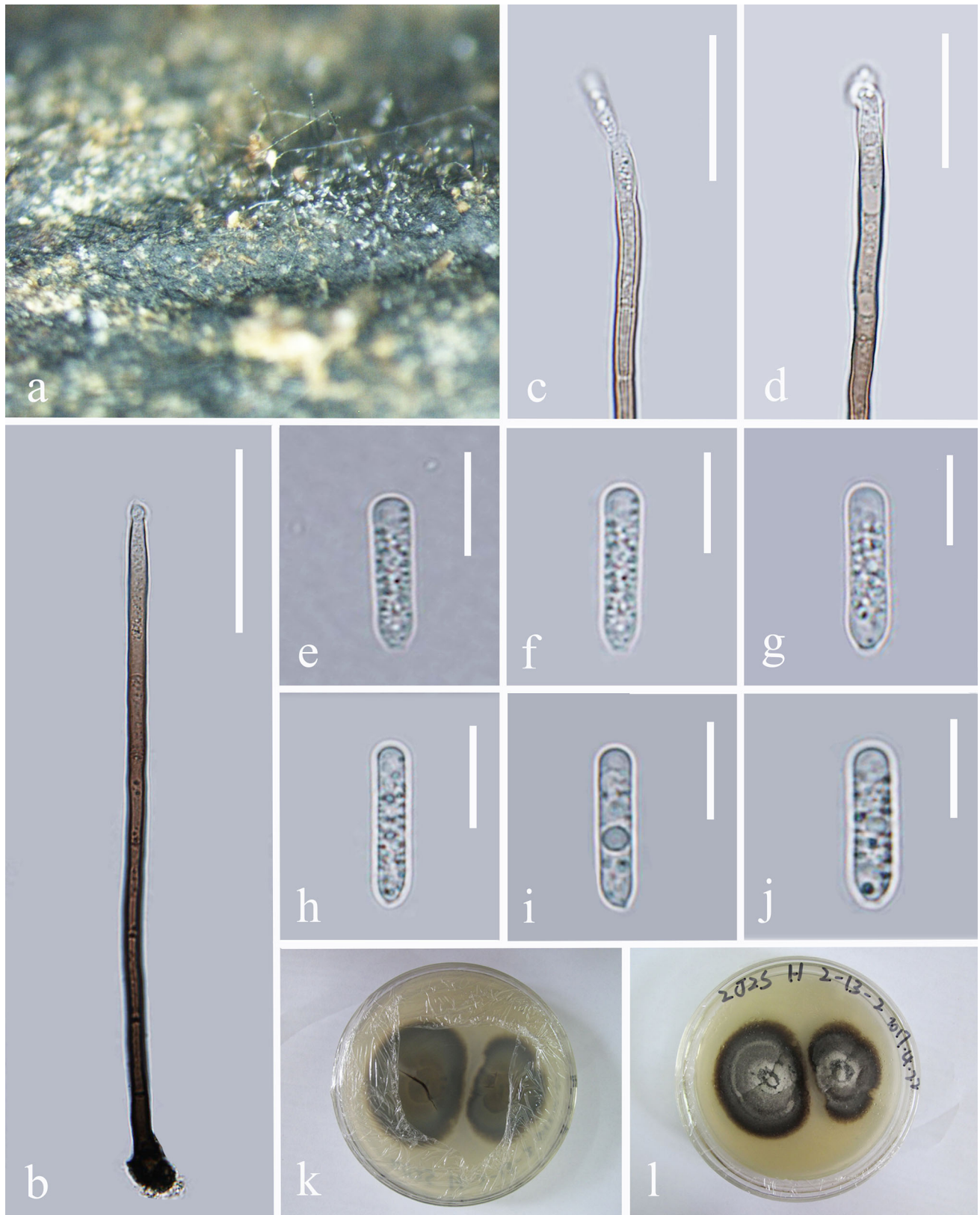


Fig. 34 *Cylindrotrichum submersum* (MFLU 18–2320, holotype) **a** Colonies on wood. **b** Conidiophore. **c**, **d** Conidiogenous cells. **e–j** Conidium. Colonies on PDA from above (**l**) and reverse (**k**). Scale bars: **b** 40 μ m, **c**, **d** 20 μ m, **e–j** 10 μ m

Notes: Holotype ILL AF281–1, other specimens collected from freshwater habitats: ILL AF281–4, ILL AF281–7, ILL AF281–3. LSU, SSU sequence data are available.

Bullimyces costaricensis Ferrer et al.

Distribution: **Costa Rica**, Limón, on submerged wood (Ferrer et al. 2012).

Asexual morph: Undetermined

Notes: Holotype ILL AF317–1. LSU and SSU sequence data are available.

Cancellidium Tubaki, Trans. Mycol. Soc. Japan 16(4): 357 (1975)

Asexual morph Colonies on natural substrate effuse, black, shiny. *Mycelium* immersed or superficial, composed of septate, subhyaline to hyaline, smooth-walled hyphae. *Conidiophores* micronematous, short. *Conidiogenous cells* integrated, terminal, determinate, cylindrical, subhyaline. *Conidia* acrogenous, solitary, muriform, dictyosporous, strongly flattened, fan-shaped, obovate to obcordate, brown to almost black, shiny. **Sexual morph** Undetermined.

Type species: *Cancellidium applanatum* Tubaki, Trans. Mycol. Soc. Japan 16(4): 358 (1975)

Notes: The genus *Cancellidium* is typified by *C. applanatum* which was collected from wood blocks of *Ochroma pyramidale* (Cav. ex Lam.) Urb. in Kobe, Japan. The genus includes two species (Tubaki 1975; Yeung et al. 2006).

Cancellidium applanatum Tubaki

Distribution: **Perú**, Cusco, on submerged, decomposing woody and herbaceous debris in freshwater habitats (Zelski et al. 2014).

Sexual morph: Undetermined

Notes: Specimens collected from freshwater: ILL 41205, ILL 41206. LSU sequence data is available.

Ceratostomella Sacc., *Michelia* 1(no. 4): 370 (1878)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations see Inderbitzin (2000) and Réblová (2006).

Type species: *Ceratostomella vestita* Sacc., *Michelia* 1(no. 4): 370 (1878)

Notes: Index fungorum (2018) lists 112 epithets for the genus *Ceratostomella* and only one species was collected from freshwater habitats (Inderbitzin 2000).

Ceratostomella hyalocoronata Inderb

Distribution: **China**, Guangdong Province, on submerged wood in a stream (Inderbitzin 2000).

Asexual morph: Undetermined

Notes: Holotype UBC F13874. Sequence data is not available.

Clohiesia K.D. Hyde, *Nova Hedwigia* 61(1-2): 125 (1995)

Asexual morph: Undetermined. **Sexual morph**: Descriptions and illustrations see Hyde (1995), Cai & Hyde (2007).

Type species: *Clohiesia corticola* K.D. Hyde, *Nova Hedwigia* 61(1–2): 126 (1995)

Notes: *Clohiesia* K.D. Hyde was established by Hyde (1995) to accommodate the freshwater taxon *C. corticola* from tropical Australia. Subsequently, another two species *Clohiesia curvispora* and *C. lignicola* were introduced by Tsui et al. (1998) and Cai and Hyde (2007) respectively. All these species were collected from freshwater habitats. Presently, *Clohiesia* is placed in the family Annulatasaceae (Maharachchikumbura et al. 2015, 2016; Wijayawardene et al. 2017). However, Zhang et al. (2016) showed that *Clohiesia corticola* (HKUCC 3712) is close to Chaetosphaeriales based on phylogenetic analyses. In this study, *Clohiesia corticola* (HKUCC 3712) is basal to Phyllachoraceae based on phylogenetic analysis, therefore we assign this genus to Diaporthomycetidae genera *incertae sedis*.

Clohiesia corticola K.D. Hyde

Distribution: **Australia**, Queensland, on submerged wood (Hyde 1995b); **Japan**, Koito River, on submerged wood (Tsui et al. 2001a).

Asexual morph: Undetermined

Notes: Holotype BRIP 21485. LSU sequence data is available.

Clohiesia curvispora L. Cai & K.D. Hyde

Distribution: **China**, Yunnan Province, Jinghong city, on submerged wood in a small forest stream (Cai and Hyde 2007).

Asexual morph: Undetermined

Notes: Holotype HKU(M) 10854 (now in IFRD). Sequence data is not available.

Clohiesia lignicola Tsui et al.

Distribution: **China**, Hong Kong, on submerged wood (Tsui et al. 1998a)

Asexual morph: Undetermined

Notes: Holotype HKU(M) 5533 (now in IFRD). Sequence data is not available.

Hyalorostratum Raja & Shearer, *Mycosphere* 1(4): 281 (2010)

Asexual morph Undetermined. **Sexual morph** Description and illustrations refer to Raja et al. (2010).

Type species: *Hyalorostratum brunneisporum* Raja & Shearer, *Mycosphere* 1(4): 281 (2010)

Notes: *Hyalorostratum* was introduced by Raja et al. (2010) with *Hyalorostratum brunneisporum* Raja & Shearer as type species which was collected from freshwater habitat in north America. Raja et al. (2010) suggested that *Hyalorostratum* belongs to the order Diaporthales based on results of their phylogenetic analyses, but they did

not assign it to any of families in Diaporthales and referred it as Diaporthales genera *incertae sedis*. In our phylogenetic analysis, two strains of *Hyalorostratum brunneisporum* formed a distinct subclade and basal to Jobellisiales, we also assign this genus to Diaporthomycetidae genera *incertae sedis*. Presently, a single species is accepted in this genus.

Hyalorostratum brunneisporum Raja & Shearer

Distribution: **USA**, Alaska, Headquarters, Lake Kenai Wildlife Refuge; New Hampshire, Hubbard Brook Forest stream, on submerged woody debris, on submerged woody debris (Raja et al. 2010).

Asexual morph: Undetermined

Notes: Holotype ILL 40792. LSU and SSU sequence data are available.

Pseudostanjehughesia J. Yang & K.D. Hyde, Mycol Prog 17: 609 (2018)

Asexual morph Description and illustrations see Yang et al. (2018). **Sexual morph** Undetermined.

Type species: *Pseudostanjehughesia aquitropica* J. Yang & K.D. Hyde, Mycol. Progr. 17(5): 610 (2017)

Notes: The genus *Pseudostanjehughesia* was introduced by Yang et al. (a, b) with single species which was collected from freshwater habitats in Thailand. *Pseudostanjehughesia* resembles *Stanjehughesia* and *Linkosia* due to the absence or reduced conidiophores, and brown and obclavate conidia. *Linkosia* is easily distinguished from *Pseudostanjehughesia* by the lageniform or ampulliform conidiogenous cells and distoseptate conidia. It is difficult to separate *Pseudostanjehughesia* from *Stanjehughesia* as both genera share similar morphological characters of conidiophores, conidiogenous cells and conidia. However, they are phylogenetically distinct.

Pseudostanjehughesia aquitropica J. Yang & K.D. Hyde

Distribution: **Thailand**, Prachuap Khiri Khan Province, on decaying wood submerged in a freshwater stream (Yang et al. 2018a).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0857, isotype GZAAS 17–0010. ITS, LSU, SSU and TEF1 α sequence data are available.

Pseudostanjehughesia lignicola Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555662, Facesoffungi number: FoF 05436, Fig. 33

Etymology: Referring to this fungus dwelling on wood

Holotype: DLU 078

Saprobic on decaying, submerged wood in freshwater habitats. **Asexual morph** Hyphomycetous. Colonies effuse, dark brown, scattered, glistening. Mycelium partly superficial, composed of brown, septate, branched hyphae. Conidiophores indistinct. Conidiogenous cells holoblastic,

monoblastic, integrated, terminal, cylindrical. Conidia 51–62 μm long, 16–22 μm wide ($\bar{x} = 57 \times 19 \mu\text{m}$, $n = 20$), acrogenous, solitary or group in 2–3 conidia, ovoid, slightly curved, multi-euseptate, verrucose, dark brown at base, tapering and becoming pale brown towards the apex, truncate at the base. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, saprobic on decaying wood submerged in Heilong stream in Cangshan Mountain. 15 March 2014, Z.L. Luo, HLXM 7-4 (DLU 078, holotype) ex-type living culture MFLUCC 15–0352.

Notes: *Pseudostanjehughesia lignicola* morphologically resembles *P. aquitropica* in having terminal, monoblastic conidiogenous cells, acrogenous, multi-euseptate, verrucose conidia dark brown at base, tapering and becoming pale brown towards the apex (Yang et al. 2018a). However, *P. lignicola* differs from *P. aquitropica* in having ovoid, shorter conidia (51–62 μm vs. 55–120 μm), while *P. aquitropica* have rostrate conidia which are oval or ellipsoidal when young, fusiform or obclavate when mature. Phylogenetic analysis shows that *Pseudostanjehughesia lignicola* clusters with *P. aquitropica* with strong support (100% ML) (Fig. 1, clade 10). Following Jeewon and Hyde's (2016) recommendations on species delimitation for new species, we delved into pairwise dissimilarities of DNA sequences and noted that there are indeed differences in the ribosomal ITS sequences, 68 noticeable nucleotide differences including 11 gaps among the 485 nucleotides analysed between *Pseudostanjehughesia lignicola* and *P. aquitropica*. *Pseudostanjehughesia lignicola* is the second species for *Pseudostanjehughesia* and both species are collected from freshwater habitats.

Subclass Hypocreomycetidae O.E. Erikss. & Winka

Coronophorales Nannf. (=Melanosporales N. Zhang & M. Blackw.)

Bertiaceae Smyk

Bertia De Not., G. bot. ital. 1(1): 334 (1844)

Asexual morph Undetermined. **Sexual morph** Updated descriptions and illustrations see Maharachchikumbura et al. (2016).

Type species: *Bertia moriformis* (Tode) De Not., G. bot. ital. 1(1): 335 (1844)

Notes: The genus *Bertia* was introduced by De Notaris (1844) and 48 epithets are listed in Index Fungorum (December 2018). Among these species, only *Bertia convolutispora* K.D. Hyde was collected from freshwater habitats (Hyde 1995c).

Bertia convolutispora K.D. Hyde

Distribution: **Australia**, north Queensland, on wood submerged in stream (Hyde 1995c).

Asexual morph: Undetermined

Notes: Holotype BRIP 22512. Sequence data is not available.

Glomerellales Chadeff. ex Réblová et al.

Reticulascaceae Réblová & W. Gams

Cylindrotrichum Bonord., Handbuch der allgemeinen Mykologie: 88 (1851)

Asexual morph Hyphomycetous. Colonies in vivo brown to black, hairy, effuse. *Setae* absent. *Conidiophores* macronematous, mononematous, cylindrical, straight. *Conidiogenous cells* usually monophialidic, rarely polyphialidic with up to two lateral enteroblastic openings, collarete hyaline to subhyaline. *Conidia* cylindrical, slightly tapering, rounded at apex, obtuse at base, 1-septate, not constricted at septum, hyaline, guttulate, smooth. **Sexual morph** *Stroma* absent. *Ascomata* superficial, solitary, or gregarious, brown, venter subglobose to conical. *Ostium* periphysate. *Peridium* fragile, 2-layered. *Paraphyses* septate, hyaline, filiform, forming a branching and anastomosing “network”. *Asci* 8-spored, unitunicate, cylindrical-clavate, short-stipitate. *Ascospores* ellipsoidal to fusiform, septate, hyaline.

Type species: *Cylindrotrichum oligospermum* (Corda) Bonord., Handb. Allgem. mykol. (Stuttgart): 88 (1851)

Notes: Réblová et al. (2011) introduced a new genus *Reticulascus* including two species. *Reticulascus clavatus* with its asexual morph *Cylindrotrichum clavatum* is a common dweller of submerged wood in lotic sites in France. *Cylindrotrichum* includes 23 names (Rambelli and Onofri 1987) while *Reticulascus* includes only two names (Réblová et al. 2011). Given its widespread use, priority, and greater number of names, Réblová et al. (2016b) recommend the use of *Cylindrotrichum* over *Reticulascus*.

Cylindrotrichum aquaticum (Luo et al.) Z.L. Luo & K.D. Hyde *comb. nov.*

≡ *Blastophorum aquaticum* Luo et al., Fungal Divers 80:177 (2016)

Index Fungorum: IF 555663; Facesoffungi number: FoF 05437

Description: For a complete description of this taxon see Hyde et al. (2016) as *Blastophorum aquaticum*.

Notes: Holotype DLU 084. ITS and LSU sequence data are available. This fungus was introduced as *Blastophorum aquaticum* by Hyde et al. (2016). It resembles *Cylindrotrichum* species in morphology of conidiophores, conidiogenous cells and conidia. In this study, the phylogenetic analysis shows that the isolate from type clusters within the genus *Cylindrotrichum* with strong support (Fig. 1, clade 42). Based on the morphology and phylogeny, we synonymized *Blastophorum aquaticum* under *Cylindrotrichum aquaticum*.

Cylindrotrichum clavatum W. Gams & Hol.-Jech., Studies in Mycology 43: 54 (1976).

Distribution: **China**, Yunnan Province, on submerged wood (Maharachchikumbura et al. 2018); **France**, on submerged wood of *Alnus glutinosa*, *Fraxinus* sp., *Platanus* sp. (Réblová et al. 2011).

Asexual morph: see Réblová et al. (2011).

Notes: Holotype CBS 128.76, other specimens collected from freshwater habitats: PRM 915717, PRM 915719, DLU 0575, DLU 0572. ITS, LSU, SSU and RPB2 sequence data are available. *Cylindrotrichum clavatum* was found on submerged wood in freshwater habitats in France and China respectively (Réblová et al. 2011; Maharachchikumbura et al. 2018).

Cylindrotrichum gorii Lunghini

Distribution: **China**, Yunnan Province, Dali, on submerged in a stream in Jizu Mountain (Maharachchikumbura et al. 2018).

Sexual morph: Undetermined

Notes: Specimen collected from freshwater habitats: MFLU 17–1965. ITS, LSU and RPB2 sequence data are available.

Cylindrotrichum submersum Z.L. Luo, H.Y. Su & K.D. Hyde *sp. nov.*

Index Fungorum number: IF 555664, Facesoffungi number: FoF 05439, Fig. 34

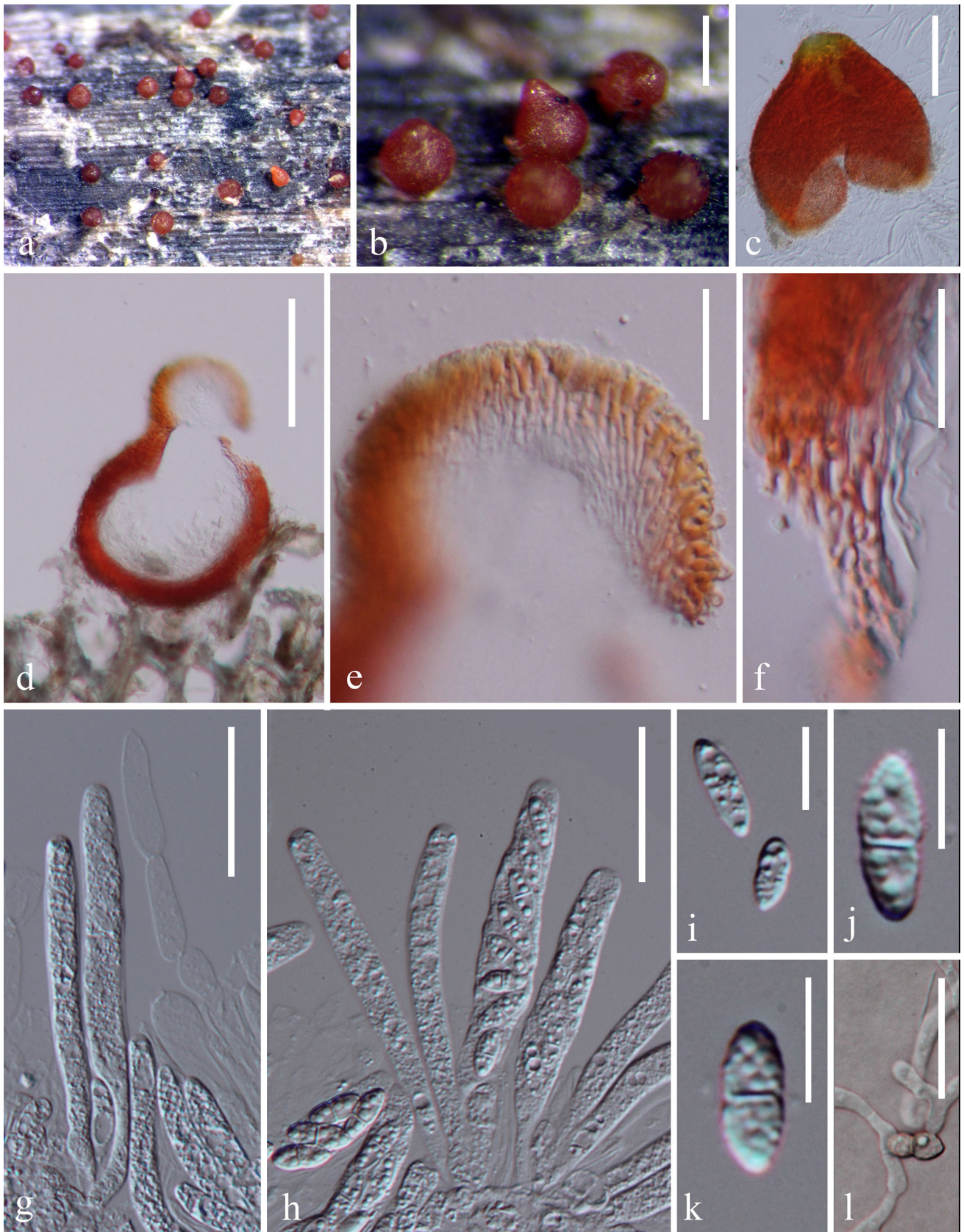
Etymology: Referring to the submerged habitats of this fungus

Holotype: MFLU 18–2320

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on natural substrate, effuse, superficial, brown to black, hairy, in groups. *Conidiophores* 77–135(–148) μm long, 4–6 μm wide (\bar{x} = 106 \times 5 μm , n = 20), macronematous, mononematous, solitary, cylindrical, erect, straight or slightly flexuous, unbranched, septate, dark brown, becoming pale brown to subhyaline towards the apex, smooth. *Conidiogenous cells* monophialidic, integrated, terminal, without a conspicuous collarete. *Conidia* 15–17 μm long, 4–6 μm wide (\bar{x} = 16 \times 5 μm , n = 20), acrogenous, cylindrical or clavate, rounded at apex, slightly tapering, guttulate, aseptate, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Jizu Mountain, saprobic on decaying wood submerged in a freshwater stream, October 2016, Z.L. Luo, S-988 (MFLU 18–2320, holotype), ex-type living culture DLUCC 0988.

Notes: *Cylindrotrichum submersum* resembles *C. clavatum* in having macronematous, solitary, cylindrical, erect, straight or slightly flexuous, unbranched, septate conidiophores of similar size and cylindrical or clavate, hyaline, smooth conidia. However, *Cylindrotrichum submersum* differs from *C. clavatum* in having monophialidic conidiogenous cells, aseptate, guttulate, longer (15–17 vs. 8.5–13 μm) conidia, while the later one has monophialidic



◀**Fig. 35** *Cosmospora aquatica* (MFLU 15–0072, holotype) **a, b** Ascumata on natural substrate. **c** Broken ascumata. **d** Section of ascumata. **e** Structure of papillate on ascumata. **f** Structure of peridium. **g, h** Asci. **i–k** Ascospores. **l** Germinating ascospore. Scale bars: **b** 200 μm , **c, d** 100 μm , **e, g, h** 30 μm , **l** 20 μm , **i–k** 10 μm

or polyphialidic conidiogenous cells, 1–2-septate conidia (Gams and Holubova-Jechova 1976; Maharachchikumbura et al. 2018). Furthermore, they are phylogenetically distinct species (Fig. 1, clade 42). To further support *Cylindrotrichum submersum* as a new species, we compared nucleotide differences with *C. aquaticum* (MFLUCC 15–0264) following the guidelines of Jeewon and Hyde (2016). Comparison of the 543 nucleotides across the ITS region reveals 36 bp differences including 6 gaps. Based on the differences of morphology and DNA nucleotide, we introduce our isolate as new species in *Cylindrotrichum*.

Kylindria DiCosmo et al., Mycologia 75 (6): 970 (1983)
Asexual morph Hyphomycetous. Colonies effuse, hairy, dark. *Conidiophores* macronematous, mononematous, setiform, solitary, erect, sometimes curved, unbranched, often in fascicles, multiseptate, thick-walled, dark brown below, paler above, smooth-walled. *Conidia* blasto-phia-lidic, 1-several-septate, oblong-ellipsoid or cylindrical, apex rounded, base tapered and truncate, hyaline, smooth-walled. **Sexual morph** Undetermined.

Type species: *Kylindria triseptata* (Matsush.) DiCosmo et al., Mycologia 75(6): 971 (1983)

Notes: DiCosmo et al. (1983) introduced the genus *Kylindria* based on *Cylindrotrichum triseptatum* Matsush. (Matsushima 1975). Presently, there are 21 species included in this genus (Mycobank 2019). Three species of *Kylindria* have been reported from freshwater habitats in China and UK (Hyde and Goh 1999; Maharachchikumbura et al. 2018).

Kylindria aquatica Luo et al.

Distribution: **China**, Yunnan Province, on submerged wood (Maharachchikumbura et al. 2018).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–1967, paratype MFLU 17–1966. ITS, LSU and RPB2 sequence data are available.

Kylindria chinensis Maharachch. et al.

Distribution: **China**, Yunnan Province, on submerged wood (Maharachchikumbura et al. 2018).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–1964. ITS, LSU and RPB2 sequence data are available.

Hypocreales Lindau

Bionectriaceae Samuels & Rossman

Didymostilbe Henn., Hedwigia 41: 148 (1902)

Asexual morph *Conidiomata* synnemayous, solitary, erect, straight, cylindrical to clavate, or subultra-capitate, *Conidiophores* macronematous, unbranched. *Conidiogenous cells* enteroblastic phialidic, integrated or discrete, terminal or lateral, hyaline, smooth-walled, cylindrical. *Conidia* acrogenous, hyaline, 0–1-septate, sometimes slightly constricted at septum, cylindrical to slight clavate, broadly rounded at the apex, subtruncate to obconically truncate at the base, thick-walled, smooth. **Sexual morph** Undetermined.

Type species: *Didymostilbe coffeae* Henn., Hedwigia 41: 148 (1902)

Notes: The genus *Didymostilbe* was established by Hennings (1902) with *D. coffeae* as the type species. Index Fungorum (2019) list 17 epithets for *Didymostilbe*. Only *Didymostilbe australiensis* Goh & K.D. Hyde is collected from freshwater habitats from Queensland, Australia (Hyde and Goh 1997).

Didymostilbe australiensis Goh & K.D. Hyde

Distribution: **Australia**, Queensland, Cape Tribulation, Mountain Lewis, on decaying wood submerged in a stream (Hyde and Goh 1997).

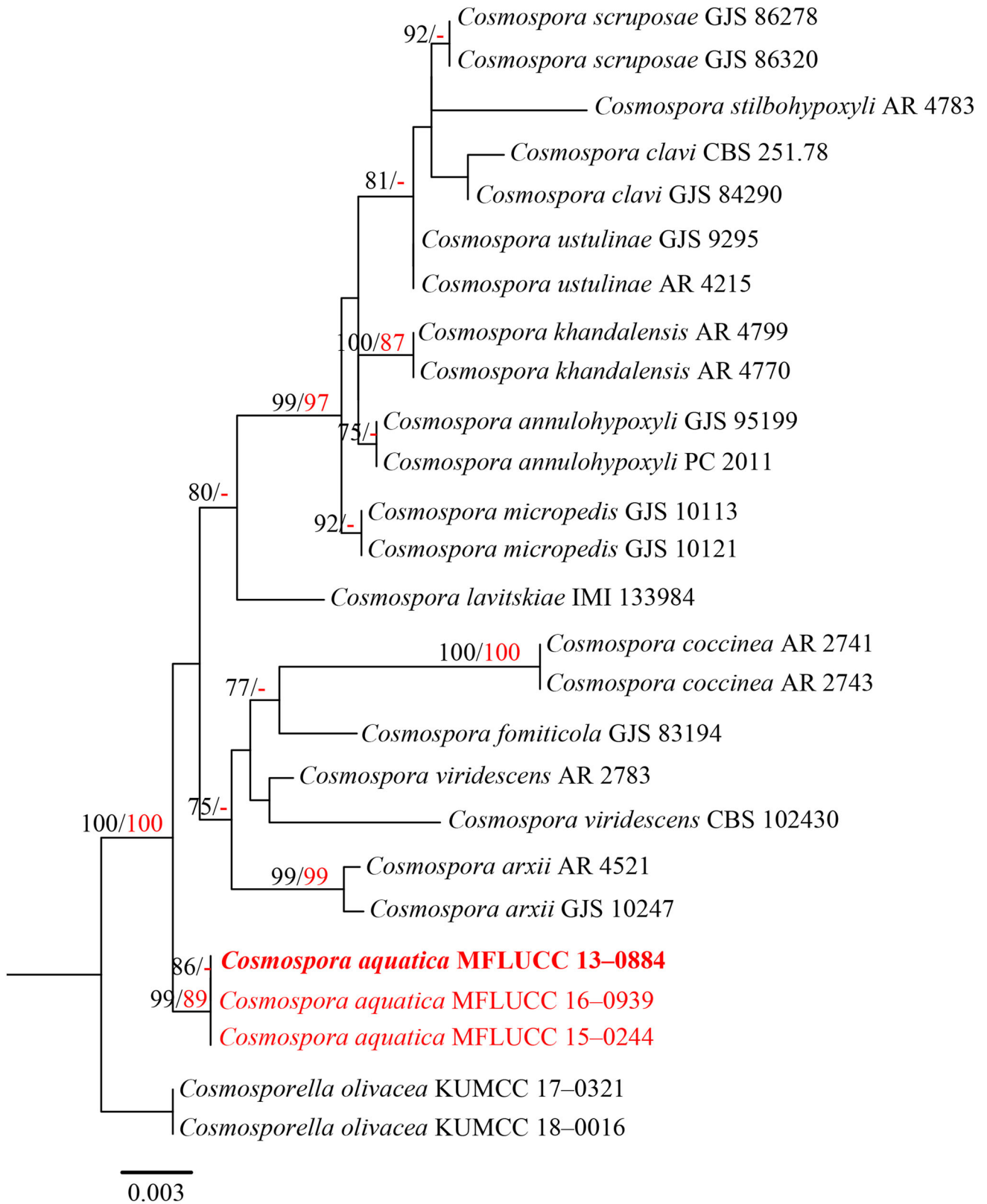
Sexual morph: Undetermined

Notes: Holotype ML 28 (BRIP). Sequence data is not available. *Didymostilbe australiensis* was introduced by Hyde and Goh (1997) based on their collection from freshwater habitats in Australia, and it is known only from the type locality.

Hypocreaceae De Not.

Trichoderma Pers., Neues Mag. Bot. 1: 92 (1794)

Asexual morph Hyphomycetous. Colonies usually growing rapidly, mycelium initially submerged, eventually with variably matted, floccose, woolly or arachnoid hyaline aerial mycelium. *Conidiophores* in most species with a broad main axis branched at regular intervals, usually with successive branches apically and distally progressively shorter and narrower, branches more or less divergent, solitary, paired or in verticils. *Conidiogenous cells* phialidic, typically disposed in divergent verticils terminally on branches of the conidiophore, or in whorls directly beneath septa along the conidiophore and branches, otherwise paired or solitary and irregularly disposed; cylindrical, subulate, lageniform, ampulliform or subglobose; usually attenuated to a narrow, short-cylindrical, conidium bearing neck. *Conidia* one-celled, typically green, or otherwise colourless, greyish, or brownish; smooth-walled to distinctly roughened, or with sinuate, bullate or winglike projections from the outer wall, subglobose, obovoid, ellipsoid, oblong or short-cylindrical; accumulating in gloeoid heads, sometimes enclosed in a sac-like sheath visible at high magnifications. **Sexual morph** *Stromata* solitary or aggregated, rounded or elongate, yellowish-brown to brown with white-yellow margin, becoming



◀**Fig. 36** Phylogram generated from maximum likelihood analysis based on combined ITS and LSU sequence data for species of *Cosmospora* (with *Cosmosporella olivacea* as outgroup). The best scoring RAxML tree with a final likelihood value of -2406.322240 is presented. RAxML bootstrap support values equal to or greater than 75% are given before the forward slash (black). Maximum parsimony bootstrap support values equal to or greater than 75% are given after the forward slash (red). Hyphen ('-') indicates a value lower than 75% for RAxML and maximum parsimony. Newly generated sequences are in red

pulvinate, more rarely turbinate or discoid, circular to irregular in outline, surface smooth to slightly uneven to granular, broadly attached, margin often becoming free and concolorous with stroma surface. *Ostiolar* openings visible as slightly raised, purple-brown spots. *Ascomata* immersed in stroma, densely disposed, globose to subglobose. *Peridium* colourless, consisting of laterally strongly compressed thin hyphae, basally and apically pseudo-parenchymatous, indistinct, scarcely differentiated from and merging with the surrounding tissue, apical part flanking the ostioles conspicuously thickened. *Asci* cylindrical, with short stipe, sometimes with a knob-like base, with apical minute pore. *Ascospores* 1-septate, dimorphic, distal part subglobose to oval, sometimes slightly tapered towards the upper end, proximal part oblong to wedge-shaped, with lower end broadly rounded, sometimes verrucose, hyaline.

Type species: *Trichoderma viride* Pers., Neues Mag. Bot. 1: 92 (1794)

Notes: The genus *Trichoderma* is cosmopolitan in soils and on decaying wood and vegetable matter. Species of *Trichoderma* are frequently from dominant components of the soil microflora in widely varying habitats (Kubicek and Harman 1998). Au et al. (1992) reported *T. glaucum* Abboott from freshwater habitats in Hong Kong, China.

Trichoderma glaucum Abboott

Distribution: **China**, Hong Kong, on submerged leaves (Au et al. 1992).

Sexual morph: Undetermined.

Notes: ITS sequence data is available in GenBank.

Nectriaceae Tul. & C. Tul.

Aquanectria L. Lombard & Crous, Stud. Mycol. 80: 207 (2015)

Holomorph Descriptions and illustrations refer to Lombard et al. (2015).

Type species: *Aquanectria penicillioides* (Ingold) L. Lombard & Crous, Stud. Mycol. 80: 207 (2015)

Notes: The aquatic genus *Aquanectria* was established by Lombard et al. (2015) to accommodate two fungal species previously treated as members of the genera *Flagellospora* and *Heliscus* (Ingold 1942; Ranzoni 1956a, b; Hudson 1961). Three species are included in this

genus and all were collected from freshwater habitats. In this study, description and illustrations for *Aquanectria penicillioides* are provided and it is new record for China. ***Aquanectria jacinthicolor*** Huang et al.

Distribution: **China**, Yunnan Province, Baoshan City, on submerged wood in a stream along the roadside (Huang et al. 2018a, b).

Asexual morph: Undetermined.

Notes: Holotype HKAS 99551, other specimen collected from freshwater habitat: HKAS 92802. ITS and LSU sequence data are available.

Aquanectria penicillioides (Ingold) L. Lombard & Crous

Distribution: **China**, Yunnan Province, Dali, Erhai lake, on submerged decaying wood (This study). **USA**, California, Napa County, Green Valley Falls, on decaying leaves of *Acer* sp. submerged in a stream (Lombard et al. 2015).

Sexual morph: Refer to Ranzoni (1956a, b).

Notes: Specimen collected from freshwater habitats: HKAS 92560. *Ac11*, *act*, *cmdA*, ITS, LSU, RPB1, RPB2 and *TEF1 α* sequence data are available.

Aquanectria submersa (H.J. Huds.) L. Lombard & Crous \equiv *Heliscus submersus* H.J. Huds., Trans. Br. mycol. Soc. 44(1): 91 (1961)

Distribution: **Jamaica**, St. Andrew, Hardwar Gap, on decaying leaves submerged in a stream (Hudson 1961).

Sexual morph: Undetermined

Notes: Holotype IMI 76792. *ac11*, *act*, *his3*, ITS, LSU, RPB1, RPB2 and *TEF1 α* sequence data are available.

Baipadisphaeria Pinruan, Mycosphere 1: 58 (2011)

Asexual morph Undetermined. **Sexual morph** *Ascomata* immersed, or semi-immersed, coriaceous, ostiolate, solitary. *Asci* 8-spored, unitunicate, clavate to ovoid, apedicellate, apically narrow and rounded, lacking any apical structure. *Paraphyses* elongate, unbranched, hyphal-like. *Ascospores* 3–4-seriate, fusiform to cylindrical, straight or curved, aseptate, hyaline to pale brown, smooth-walled.

Type species: *Baipadisphaeria spathulospora* Pinruan, Mycosphere 1: 58 (2011)

Notes: The genus *Baipadisphaeria* was introduced by Pinruan et al. (2010) with single species which was collected from freshwater habitats in Thailand.

Baipadisphaeria spathulospora Pinruan

Distribution: **Thailand**, Narathiwat Province, Sirindhorn Peat Swamp Forest, on submerged trunk of *Licuala longicalycata* (Pinruan et al. 2010).

Asexual morph: Undetermined

Notes: Holotype BBH, Pinruan Wah32A; LSU, SSU sequence data are available.

Chaetopsina Rambelli, Atti Accad. Sci. Ist. Bologna, Cl. Sci. Fis. Rendiconti 3: 5 (1956)

\equiv *Chaetopsinectria* J. Luo & W.Y. Zhuang, Mycologia 102: 979 (2010).

Asexual morph Descriptions and illustrations refer to Rambelli (1956). **Sexual morph** Descriptions and illustrations refer to Luo and Zhuang (2010).

Type species: *Chaetopsina fulva* Rambelli, Diagn. IV 3: 5 (1956)

Notes: The dematiaceous hyphomycete genus *Chaetopsina* was established by Rambelli (1956) with *C. fulva* as the type species. Luo and Zhuang (2010) established a sexual genus *Chaetopsinectria* based on *Cosmospora chaetopsinae* (Samuels 1985), for a group of fungi having *Chaetopsina* asexual morphs. Lombard et al. (2015) proposed that the sexual genus *Chaetopsinectria* (2010) be suppressed in favour of asexual genus *Chaetopsina* (1956), which has priority by date and would require no new combinations. *Chaetopsina hongkongensis* was introduced by Goh and Hyde (1997a) on decaying rachids of *Phoenix roebelenii*. Ho et al. (2002b) reported this species from freshwater habitats in Hong Kong, China. We provide the DNA sequence data for *Chaetopsina beijingensis* based on the specimen collected from decaying wood submerged in a stream in Dali, Yunnan Province, China.

Chaetopsina hongkongensis Goh & K.D. Hyde

Distribution: **China**, Hong Kong, Tai Po Kau Forest Stream, on submerged wood (Ho et al. 2002a).

Sexual morph: Undetermined

Notes: Holotype IFRD 8729. Sequence data is not available.

Chaetopsina beijingensis Crous & Y. Zhang ter

Distribution: **China**, Yunnan Province, Jizu Mountain, saprobic on decaying wood submerged in a freshwater stream.

Sexual morph: Undetermined

Notes: Holotype CBS H-21718, specimen collected from freshwater MFLU 18–2327. ITS, LSU, SSU and TEF1 α sequence data are available. *Chaetopsina beijingensis* was introduced by Crous et al. (2014a) based on a collection obtained from needles of *Pinus tabulaeformis* in Beijing, China.

Cosmospora Rabenh., Hedwigia 2: 59 (1862)

Holomorph Descriptions and illustrations refer to Lombard et al. (2015).

Type species: *Cosmospora coccinea* Rabenh., Hedwigia 2: 59 (1862)

Notes: *Cosmospora* was established in 1862 and is typified with *C. coccinea* Rabenh. (Rossman et al. 1999). About 73 species have been attributed to *Cosmospora* sensu Rossman (Gräfenhan et al. 2011; Lombard et al. 2015; Zeng and Zhuang 2016). In this study, we introduce a new *Cosmospora* species based on the isolates obtained from submerged wood in freshwater habitats.

Cosmospora aquatica Z.L. Luo, H.Y. Su & K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 555665, Facesoffungi number: FoF 05442, Fig. 35

Etymology: Referring to the aquatic habitat of this fungus

Holotype: MFLU 15–0072

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Undetermined. **Sexual morph** *Ascomata* 210–318 μm high, 176–296 μm diam., perithecial, solitary, rarely gregarious, nonstromatic, superficial, globose to subglobose, papillate, surface smooth to slightly roughened, orange red. *Peridium* 20–27 μm , composed of irregular, thick walled cells. *Paraphyses* subhyaline, septate, constricted at septa. *Asci* 65–79 \times 7–9 μm (\bar{x} = 72 \times 8 μm , n = 10), 8-spored, unitunicate, cylindrical, subhyaline, with apical ring. *Ascospores* 9–11 \times 3.5–4.5 μm (\bar{x} = 10 \times 4 μm , n = 20), uniseriate, oval or oblong, guttulate, uniseptate, slightly constricted at septa, hyaline or subhyaline, smooth-walled.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on submerged decaying wood in a freshwater stream, September 2013, Z.L. Luo, ZL-32 (MFLU 15–0072, holotype; HKAS 86447, isotype), ex-type living culture MFLUCC 13–0884; *Ibid.*, on submerged wood in a freshwater stream, March 2014, H.Y. Su, S-026 (HKAS 83987, paratype), living culture MFLUCC 15–0244.

Notes: *Cosmospora aquatica* mostly resembles *C. lavitskiae* in having perithecial, superficial, globose to subglobose, orange red ascomata, unitunicate asci and uniseptate, hyaline or subhyaline, uniseriate ascospores (Zeng and Zhuang 2016). However, *Cosmospora aquatica* differs from *C. lavitskiae* in having larger asci (65–79 \times 7–9 vs. 40–52.5 \times 2.5–4.5 μm) with apical ring, while the asci of *C. lavitskiae* without apical ring, and guttulate, longer ascospores (9–11 vs. 4–6 μm). Phylogenetic analysis shows that *Cosmospora aquatica* is distinct from other *Cosmospora* species (Fig. 36).

Cosmosporella Huang et al., Cryptog. Mycol. 39(2): 179 (2018)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations refer to Huang et al. (2018b).

Type species: *Cosmosporella olivacea* S.K. Huang, R. Jeewon & K.D. Hyde, Cryptog. Mycol. 39(2): 181 (2018)

Notes: The genus *Cosmosporella* was introduced by Huang et al. (2018b) with *Cosmosporella olivacea* as type species which was collected from freshwater habitats in China.

Cosmosporella olivacea Huang et al.

Distribution: **China**, Xinjiang Province, a lake near by the snow mountains, on dead wood (Huang et al. 2018b).

Asexual morph: Undetermined

Notes: Holotype HKAS99607. ITS, LSU and β -tubulin sequence data are available.

Fusicolla Bonord., Handb. Allgem. mykol. (Stuttgart): 150 (1851)

Holomorph Descriptions and illustrations refer to Gräfenhan et al. (2011).

Type species: *Fusicolla betae* Bonord., Handb. Allgem. mykol. (Stuttgart): 150 (1851)

Notes: *Fusicolla* belongs to the Nectriaceae and comprises an estimated 8 species (Wijayawardene et al. 2017). *Fusicolla* has generally been considered a synonym of *Fusarium*. Gräfenhan et al. (2011) resurrected this genus typified by *F. betae*. Huang et al. (2018a, b) reported *Fusicolla aquaeductuum* from freshwater habitats in China.

Fusicolla aquaeductuum (Radlk. & Rabenh.) Gräfenhan et al.

Distribution: **China**, Xinjiang Province, a lake near by the snow mountains, on dead wood (Huang et al. 2018a, b).

Asexual morph: Undetermined

Notes: Specimen collected from freshwater HKAS99608. ITS, LSU and β -tubulin sequence data are available.

Gliocladiopsis S.B. Saksena, Mycologia 46: 662 (1954)

Holomorph Descriptions and illustrations refer to Lombard et al. (2015).

Type species: *Gliocladiopsis sagariensis* S.B. Saksena, Mycologia 46: 662 (1954)

Notes: The genus *Gliocladiopsis* was introduced by Saksena (1954) to accommodate a soil-born species *G. sagariensis*. Liu and Cai (2013) introduced a new *Gliocladiopsis* species, *G. guangdongensis*, which was the first isolation from freshwater habitats in China. Hyde et al. (2018) introduced the second *Gliocladiopsis* taxon from freshwater habitats in Thailand.

Gliocladiopsis aquaticus Lu et al., Mycosphere 9: 387 (2018)

Distribution: **Thailand**, Chiang Rai Province, Mae Fah Luang University, on submerged decaying wood in a freshwater lake in campus (Hyde et al. 2018).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–1976, paratype MFLU 17–1977. ITS, LSU, SSU, his3 and β -tubulin sequence data are available.

Gliocladiopsis guangdongensis F. Liu & L. Cai, Cryptog. Mycol. 34: 235 (2013)

Distribution: **China**, Guangdong Province, Zhaoqing, Dinghu Mountain, on submerged wood in a stream (Liu and Cai 2013).

Sexual morph: Undetermined

Notes: Holotype HMAS 244829, other specimen collected from freshwater habitats HMAS 244830. ITS, LSU, TEF1 α , his3 and β -tubulin sequence data are available.

Mariannaea G. Arnaud, Bull. trimest. Soc. mycol. Fr. 68: 196 (1952)

Holomorph Descriptions and illustrations refer to Lombard et al. (2015) and Hu et al. (2017).

Type species: *Mariannaea elegans* G. Arnaud, Bull. trimest. Soc. mycol. Fr. 68: 196 (1952)

Notes: The genus *Mariannaea* G. Arnaud ex Samson was established by Samson (1974) with *M. elegans* (Corda) Samson as type species. There are 21 records of *Mariannaea* in Index Fungorum (December 2018). Hu et al. (2017) revisited the genus *Mariannaea* and accepted 15 species in this genus based on morphology and molecular phylogeny. Species of *Mariannaea* were mostly reported from terrestrial habitats (Samson 1974; Samson and Bigg 1988; Matsushima 1989; Samuels 1989; Samuels and Seifert 1991; Tokumasu et al. 1994; Gräfenhan et al. 2011; Zeng and Zhuang 2014; Lombard et al. 2015; Nonaka et al. 2015). Cai et al. (2010) firstly reported a *Mariannaea* species from freshwater stream in northern Thailand. Hu et al. (2017) introduced four new species for *Mariannaea* and all of them were collected from freshwater habitats in China.

Mariannaea aquaticola Kurniawati et al.

Distribution: **Thailand**, Chiang Rai Province, Amphoe Mae Chan, on wood submerged in a freshwater stream (Cai et al. 2010).

Sexual morph: Undetermined

Notes: Holotype MFLU 09–0223, other specimens collected from freshwater habitats: MFLU 09–0224, MFLU 09–0225. ITS and LSU sequence data are available.

Mariannaea chlamyospora D.M. Hu & L. Cai

Distribution: **China**, Hubei Province, Shennongjia Scenic Area, Yakou Stream, on submerged wood (Hu et al. 2017).

Sexual morph: Undetermined

Notes: Holotype HMAS 245222. ITS, LSU and β -tubulin sequence data are available.

Mariannaea cinerea D.M. Hu & L. Cai

Distribution: **China**, Yunnan Province, Mengla county, Dashaba reservoir, on submerged wood (Hu et al. 2017).

Sexual morph: Undetermined

Notes: Holotype HMAS 245224. ITS, LSU and β -tubulin sequence data are available.

Mariannaea fusiformis D.M. Hu & L. Cai

Distribution: **China**, Hubei Province, Shennongjia Scenic Area, Yakou Stream, on submerged wood (Hu et al. 2017).

Sexual morph: Undetermined

Notes: Holotype HMAS 245223. ITS, LSU and β -tubulin sequence data are available.

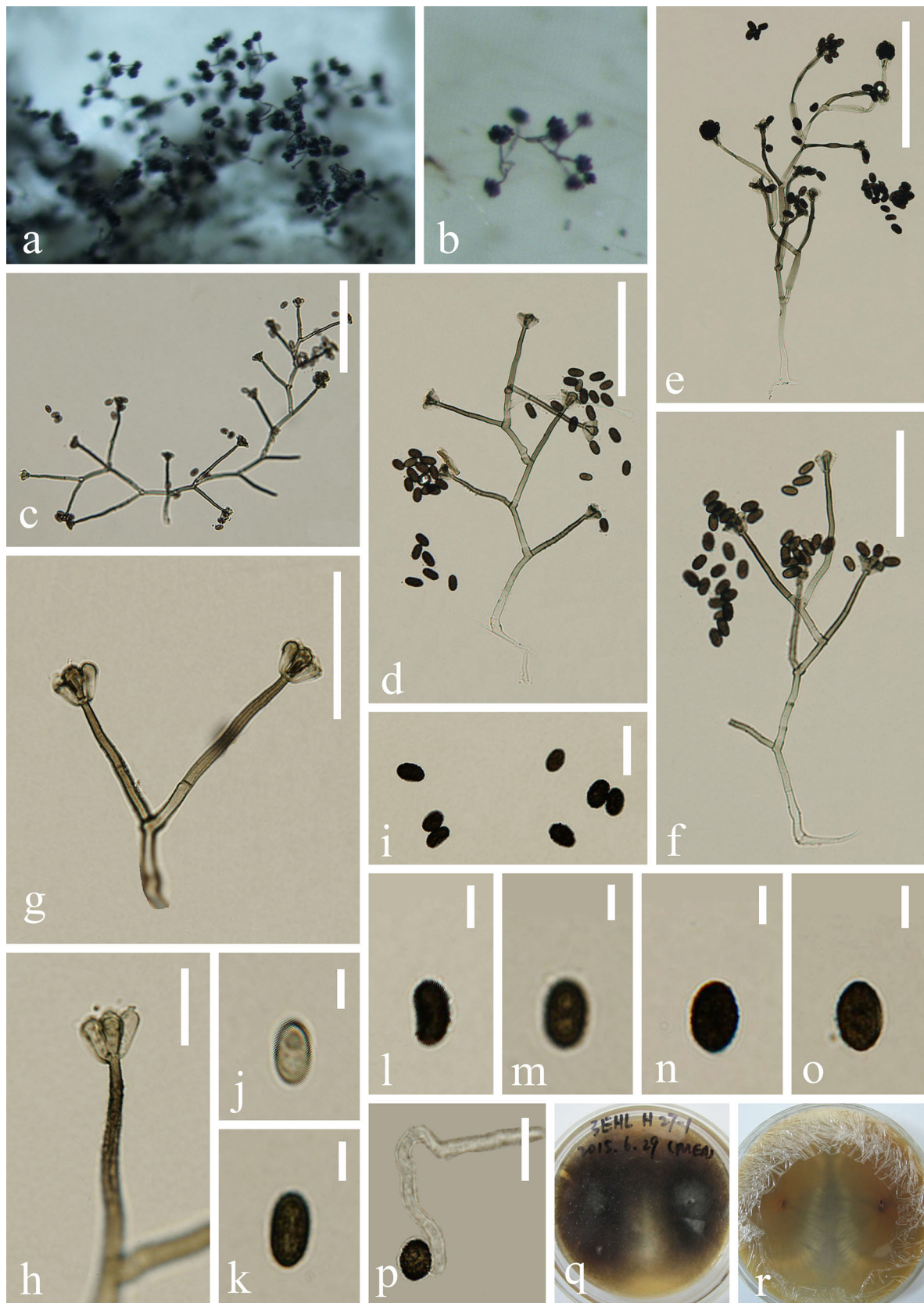


Fig. 37 *Stachybotrys chartarum* (MFLU 18–1637) **a, b** Colonies on wood. **c–f** Conidiophores with conidia. **g, h** Conidiogenous cells. **i–o** Conidia. **p** Germinating conidium. **q, r** Culture on MEA from above and reverse. Scale bars: **c** 100 μm , **d–g** 50 μm , **h, i, p** 10 μm , **j–o** 5 μm

Mariannaea lignicola D.M. Hu & L. Cai

Distribution: **China**, Jiangxi Province, Longnan County, Jiulianshan Mountain Natural Reserve, Xiagongtang Stream, on submerged wood (Hu et al. 2017).

Sexual morph: Undetermined

Notes: Holotype HMAS 245225. ITS, LSU and β -tubulin sequence data are available.

Mariannaea samuelsii Seifert & Bissett

Distribution: **China**, Yunnan Province, Dali, on submerged wood in a stream (This study)

Sexual morph: Undetermined

Notes: Holotype DAOM 235814, other specimen collected from freshwater habitats: MFLU 18–2328. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

Mariannaea superimposita (Matsush.) Samuels

Distribution: **China**, Yunnan Province, Jinsha river, on submerged wood (This study)

Sexual morph: Undetermined

Notes: Holotype Cultura in b/c desiccata, MFC-1409, specimen collected from freshwater MFLU 18–1632 (HKAS 92903). ITS and LSU sequence data are available.

Nectria (Fr.) Fr., Summa veg. Scand., Sectio Post. (Stockholm): 387 (1849)

Holomorph Descriptions and illustrations see Maharachchikumbura et al. (2016).

Type species: *Nectria cinnabarina* (Tode) Fr., Summa veg. Scand., Summa veg. Scand., Sectio Post. (Stockholm): 388 (1849)

Notes: Fries (1849) introduced the genus *Nectria* based on *Hypocrea* sect. *Nectria* Fr. Since then many species have been added to the genus. Based on morphological characteristics such as structure of ascomata and asexual morphs (Hirooka et al. 2010; Rossman et al. 1999) and LSU sequence data (Rehner and Samuels 1995). *Nectria* sensu lato was separated into a number of genera. Hirooka et al. (2012) recently revised *Nectria*, recognising 29 species within the genus.

Nectria chaetopsinae Samuels

Distribution: **Thailand**, Nakorn Ratchassima Province, on submerged *Xylia dolabriformis* baits in a stream (Sivichai et al. 2000a).

Asexual morph: Undetermined

Notes: Holotype PDD 44237. Sequence data is not available. Sivichai et al. (2000a) found *Nectria chaetopsinae* from freshwater in Thailand, but did not provide description and illustration for this species.

Nectria curta J. Webster

Distribution: **UK**, on submerged wood of *Fraxinus excelsior* (Webster 1993).

Asexual morph: *Flagellospora* sp. (Webster 1993).

Notes: Holotype IMI 353882. ITS and SSU sequence data are available. This species is originally collected from freshwater in UK (Webster 1993).

Nectria discophora Mont

Distribution: **UK**, on submerged wood in River Teign (Shearer and Webster 1991).

Asexual morph: Undetermined

Notes: ITS, LSU, SSU and RPB2 sequence data are available. Shearer and Webster (1991) found this species from a freshwater River in UK, but they did not provide descriptions and illustrations.

Nectria lugdunensis J. Webster

Distribution: **UK**, on submerged wood in River Teign (Shearer and Webster 1991).

Sexual morph: Undetermined

Notes: Holotype IMI 74951. ITS, LSU and SSU sequence data are available. Shearer and Webster (1991) first found this species from freshwater habitats.

Neocosmospora E.F. Sm., U.S.D.A. Div. Veg. Pathol. Bull. 17: 45 (1899)

Holomorph Descriptions and illustrations refer to Lombard et al. (2015).

Type species: *Neocosmospora vasinfecta* E.F. Sm., Bull. U.S. Department of Agriculture 17: 45 (1899)

Notes: The genera *Haematonectria* (1999), *Lachnidium* (1891) and *Neocosmospora* (1899) could be applied to this group of fungi (Rossman et al. 1999; Summerbell and Schroers 2002; Lombard et al. 2015). The generic name *Neocosmospora* was recommended for these fungi by Lombard et al. (2015) as the generic name *Lachnidium* is based on a nomen confusum (Madelin 1966; Kendrick 1974), and can therefore not be used and in addition, the generic name *Neocosmospora* (1899) is older than the generic name *Haematonectria* (1999).

Neocosmospora haematococca (Berk. & Broome) Samuels, Nalim & Geiser

Distribution: **China**, Hong Kong, on submerged wood (Tsui et al. 2001b, Tsui and Hyde 2004)

Asexual morph: Undetermined

Notes: ITS, LSU, SSU and RPB2 are available. *Neocosmospora haematococca* was found from freshwater in China, but without descriptions and illustration (Tsui et al. 2001b; Tsui and Hyde 2004).

Paracremonium L. Lombard & Crous, Stud. Mycol. 80: 233 (2015)

Asexual morph Descriptions and illustrations see Lombard et al. (2015) **Sexual morph** Undetermined.

Type species: *Paracremonium inflatum* L. Lombard & Crous, Stud. Mycol. 80: 233 (2015)

Notes: The genus *Paracremonium* was recently established for different strains from a group of fungi previously treated as *Acremonium recifei* (Lombard et al. 2015). Five species are currently accepted in *Paracremonium*; *P. binnewijzendii*, *P. contagium*, *P. inflatum*, *P. pembeum*, and *P. variiforme*. *Paracremonium binnewijzendii* was isolated



Fig. 38 *a Stachybotrys chlorohalonata* (MFLU 18–1638) **a, b** Colonies on wood. **c, d** Conidiophores with conidia and conidiogenous cells. **e–m** Conidia. **n** Germinating conidium. **o, p** Culture on MEA from above and reverse. Scale bars: **c, d** 50 μm , **e–n** 15 μm

from stream embankments (The Netherlands), while *P. contagium* (Canada) and *P. inflatum* (India, Colombia) were associated with human infections and *P. pembeum* with trees (*Acer negundo*, *Persea americana*, *Platanus racemosa*, *Ricinus communis*) and heads of *Euwallacea* sp. (California, USA), *P. variiforme* was collected from water in an unnamed karst cave (China) (Lombard et al. 2015; Lynch et al. 2016; Crous et al. 2017; Zhang et al. 2017a, b). In this study, we introduce a new species *P. aquaticum* and a new record of *P. binnewijzendii* for China, both of them are collected from freshwater habitats.

Paracremonium binnewijzendii Houbraken, van der Kleij & L. Lombard

Distribution: **China**, Yunnan Province, Erhai Lake, on submerged wood (This study)

Sexual morph: Undetermined

Notes: Holotype CBS H-23246, specimen collected from freshwater habitats: MFLU 18–1636. ITS, LSU and β -tubulin are available.

Payosphaeria W.F. Leong, Bot. Mar. 33: 511 (1990)

Asexual morph Undetermined. **Sexual morph** *Ascomata* globose to pyriform, superficial, papillate, ostiolate, lacking periphyses, membranous, hyaline, solitary to gregarious. *Neck* cylindrical, stout, hyaline. *Peridium* composed of a single layer of thin-walled elongate cells. *Paraphyses* branched, septate and hyaline. *Asci* unitunicate, 8-spored, long-cylindrical, short pedicellate, persistent, thin-walled and developing at the base of the ascoma. *Ascospores* uniseriate, round to oval, aseptate, hyaline, thin-walled, smooth.

Type species: *Payosphaeria minuta* H.Y.M. Leong, Bot. Mar. 33: 511 (1990)

Notes: The monotypic genus *Payosphaeria* was introduced by Leong et al. (1990) with the type species *P. minuta* Leong. *Payosphaeria minuta* is a common mangrove lignicolous species reported worldwide (Leong et al. 1990; Chinnaraj 1993; Ravikumar and Vittal 1996). The only report of *P. minuta* from freshwater habitats was provided by Cai et al. (2006a).

Payosphaeria minuta H.Y.M. Leong

Distribution: **China**, Yunnan Province, on submerged bamboo culm (Cai et al. 2006a).

Asexual morph: Undetermined.

Notes: Holotype IMI 327472. Sequence data is not available. The species *Payosphaeria minuta* was originally collected from mangrove wood in Singapore. Cai et al. (2006a) reported this species from freshwater in China without descriptions and illustration.

Varicosporella Lechat & J. Fourn., *Ascomycete.org* 7(1): 2 (2015)

Asexual morph *Fusarium* like, macroconidia cylindrical, slightly curved, acute at tip, truncate to rounded at base,

septate. **Sexual morph** *Ascomata* nonstromatic, solitary, superficial with base slightly immersed in substratum, soft-textured, greyish yellow to pale orange, becoming pale yellow in 3% KOH and in lactic acid, obpyriform, laterally collapsing when dry, uniloculate, translucent, with a broadly conical to rounded apex, composed of cylindrical yellow cells, thick-walled, septate, clavate at top. *Ascomatal wall* composed of subglobose to angular thick-walled cells, becoming more flattened inwardly. *Perithecial surface cells* forming a *textura angularis* in surface view. Basal hyphae sparse and short, thick-walled, hyaline. *Asci* 8-spored, unitunicate, cylindrical, short-stipitate, apically truncate to slightly rounded with a conspicuous, refractive apical apparatus. *Periphyses* copious, embedded in gel matrix, simple or branched, septate. *Ascospores* obliquely uniseriate, ellipsoid with narrowly to broadly rounded ends, equally two-celled, slightly constricted at septum, hyaline to pale yellowish brown, with two large guttules in each cell, wall roughened by short, sinuous, brown, thick ribs, sometimes anastomosed. Hyaline ascospores germinate more often than pigmented ones.

Type species: *Varicosporella aquatica* Lechat & J. Fourn., *Ascomycete.org* 7(1): 2 (2015)

Notes: The genus *Varicosporella* was introduced by Lechat and Fournier (2015) with single species *Varicosporella aquatica* which was collected from freshwater habitats in southern France.

Varicosporella aquatica Lechat & J. Fourn.

Distribution: **France**, Ariège and Lozère, on submerged twig of *Buxus sempervirens*, *Salix* sp. and *Alnus glutinosa* (Lechat and Fournier 2015).

Asexual morph: see Lechat and Fournier (2015).

Notes: Holotype LIP, Fournier 09197. ITS and LSU sequence data are available.

Niessliaceae Kirschst.

Paraniesslia Tsui et al., *Mycologia* 93(5): 1002 (2001)

Asexual morph Undetermined. **Sexual morph** *Ascomata* superficial, pyriform to subglobose, papillate, with setae, ostiolate, periphysate, solitary to gregarious. *Setae* acute, straight, unbranched, septate, black. *Peridium* membranous, *textura angularis* in longitudinal section, *textura epidermoidea* in surface view. *Paraphyses* septate, thin-walled, deliquescent. *Asci* 8-spored, unitunicate, clavate, pedicellate, with a nonamyloid discoid refractive apical ring. *Ascospores* overlapping uniseriate to biseriate, aseptate, verrucose, with or without a mucilaginous sheath.

Type species: *Paraniesslia tuberculata* Tsui et al., *Mycologia* 93(5): 1002 (2001)

Notes: *Paraniesslia* was established to accommodate a fungus collected from freshwater habitats in Hong Kong, China (Tsui et al. 2001d). Cai and Hyde (2007) introduced

the second species *Paraniesslia aquatica* which was collected from freshwater habitats.

Paraniesslia aquatica L. Cai & K.D. Hyde

Distribution: **China**, Yunnan Province, Kunming city, Qinglongxia, submerged wood in a small stream (Cai and Hyde 2007).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 10856 (now in IFRD). Sequence data is not available. *Paraniesslia aquatica* was introduced by Cai and Hyde (2007) and only known from the type locality.

Paraniesslia tuberculata Tsui et al.

Distribution: **China**, Hong Kong, on submerged wood (Tsui et al. 2001d).

Asexual morph: Undetermined

Notes: Holotype IFRD 8827; Sequence data is not available.

Stachybotryaceae L. Lombard & Crous

Koorchalomella Chona et al., Indian Phytopath. 11: 130 (1958)

Asexual morph Hyphomycetous. *Conidiomata* sporodochial, scattered or gregarious, superficial, raised, convex to pulvinate, circular, oval to elongate in outline. *Conidiophores* unbranched, aseptate, hyaline to apricot in color, smooth-walled, terminating in one conidiogenous cell. *Conidiogenous cells* phialides, arranged in a dense palisade, clavate with truncate base, hyaline to apricot in color. *Conidia* fusiform, unicellular, rarely one-septate, hyaline to apricot to salmon in color, smooth-walled. **Sexual morph** Undetermined.

Type species: *Koorchalomella oryzae* Chona et al., Indian Phytopath. 11: 130 (1958)

Notes: *Koorchalomella* is a monotypic genus established to accommodate *K. oryzae* which was collected from dead culms of *Oryza sativa* L. from damp ground in Bangalore, India. Subsequently, two species were introduced in this genus and one of them collected from freshwater habitats (Hyde et al. 2017).

Koorchalomella salmonispora Abdel-Aziz & Abdel-Wahab

Distribution: **Egypt**, Sohag City, on submerged decayed stem of *Phragmites australis* (Hyde et al. 2017).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1512. LSU sequence data is available.

Stachybotrys Corda, Icon. fung. (Prague) 1: 21 (1837)

Holomorph Description see Lombard et al. (2016).

Type species: *Stachybotrys chartarum* (Ehrenb.) S. Hughes, Can. J. Bot. 36: 812 (1958)

Notes: The genus *Stachybotrys* was established by Corda (1837) and is the type genus of the family *Stachybotryaceae*. Lombard et al. (2016) revised all the

Stachybotrys-like taxa by combining morphology and multi-locus phylogenetic analyses using cmdA, ITS, RPB2, TEF1 α and β -tubulin dataset, and 33 genera were accepted in the family *Stachybotryaceae*. The genus *Melanopsamma* was resurrected by Lombard et al. (2016) which was synonymised under *Stachybotrys* by Wang et al. (2015). Lombard et al. (2016) excluded *S. queenslandica* from the genus *Stachybotrys* due to the lacking of living type material to determine its phylogenetic placement, and noted that it might belong to the genus *Melanopsamma*.

Stachybotrys chartarum (Ehrenb.) S. Hughes

\equiv *Stilbospora chartarum* Ehrenb., Sylv. mycol. berol. (Berlin): 21 (1818)

Facesoffungi number: FoF 01247, Fig. 37

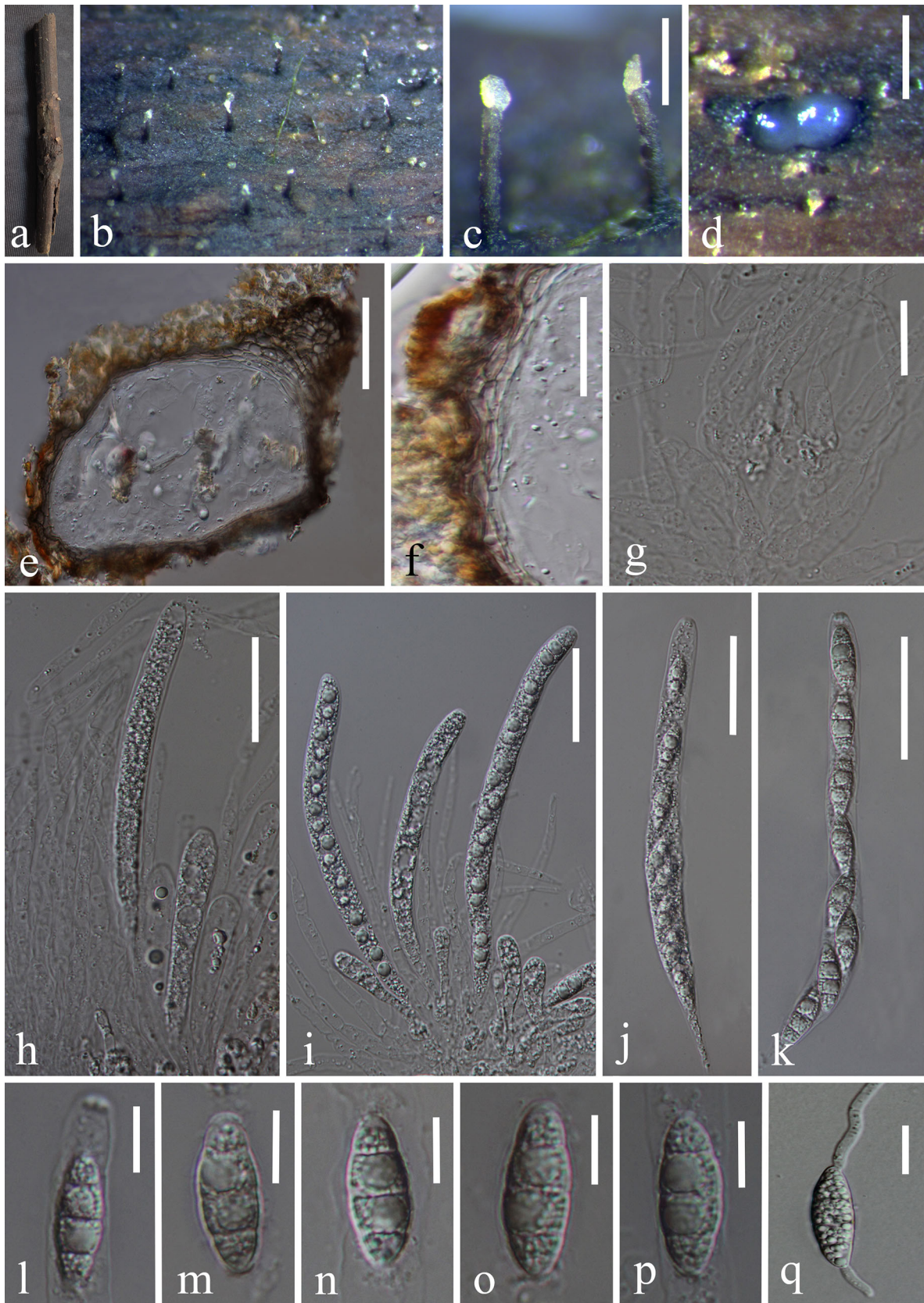
Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, dark brown to black, in groups. *Conidiophores* 41–65 μ m long, 3–5 μ m wide (\bar{x} = 53 \times 4 μ m, n = 20), macronematous, monone-matous, single or in groups, thin-walled, branched, erect, straight to slightly flexuous, subhyaline to olivaceous brown, septate, smooth, bearing 3–6 conidiogenous cells. *Conidiogenous cells* phialidic, clavate to subclavate, subhyaline to olivaceous brown, smooth, with conspicuous collarettes. *Conidia* 8–10 μ m long, 5–7 μ m wide (\bar{x} = 9 \times 6 μ m, n = 20), acrogenous, ellipsoidal to sub-cylindrical, verrucose, aseptate, thick-walled, olivaceous brown to dark brown, rounded at both ends. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Erhai Lake, saprobic on submerged decaying wood, June 2015, L.W. Wang, S-549 (MFLU 18–1637, ibid HKAS 92619), living culture MFLUCC 16–0966; Jinsha River, saprobic on submerged decaying wood, April 2015, Z.L. Luo, S-370, living culture MFLUCC 16–1337; Cangshan Mountain, saprobic on decaying wood submerged in a freshwater stream, September 2014, X.J. Su, S-223, living culture MFLUCC 16–1302; *Ibid.*, saprobic on decaying wood submerged in a freshwater stream, April 2016, X.J. Su, S-761, living culture MFLUCC 17–1322.

Distribution: **China**, Yunnan Province, on submerged wood in Rivers and streams (This study)

Sexual morph: Undetermined

Notes: Epitype CBS H-18496, lectotype DAOM 51026, specimens collected from freshwater habitats: MFLU 18–1637, HKAS 92619. cmdA, ITS, LSU, SSU, RPB2, TEF1 α and β -tubulin sequence data are available. During our studies on lignicolous freshwater fungi of northwestern Yunnan Province, three isolates were obtained from submerged wood in freshwater. The morphology of our fungus fits well with *Stachybotrys* species. Phylogenetic analysis shows that our isolates cluster with *Stachybotrys chartarum* with good bootstrap support (Fig. 1, clade 39). Based on the morphology and phylogeny, we identify our



◀ **Fig. 39** *Ascocacculus fusiformis* (MFLU 15–0068, holotype) **a** Specimen. **b, c** Appearance of necks on substrate. **d** Horizontal section through ascumata. **e** Section through ascumata. **f** Structure of peridium. **g** Paraphyses. **h–k** Asci. **l–p** Ascospore. **q** Germinating ascospore. Scale bars: **c** 300 μm , **d** 200 μm , **e** 50 μm , **h–k** 30 μm , **g**, **f** 20 μm , **l–q** 10 μm

fungus as *S. chartarum*. Descriptions and illustration are provided and this is the first report of *S. chartarum* from freshwater habitats.

Stachybotrys chlorohalonata B. Andersen & Thrane

Facesoffungi number: FoF 05447, Fig. 38

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, dark brown to black, in groups. *Conidiophores* 117–264 μm long, 3.5–4.5 μm wide (\bar{x} = 175 \times 4 μm , n = 20), macronematous, mononematous, single or in groups, thin-walled, branched, erect, straight to slightly flexuous, subhyaline at base, often olivaceous brown toward the apex, and the upper portion is sometimes irregularly verrucose, septate, bearing 3–6 conidiogenous cells. *Conidiogenous cells* phialidic, clavate to subclavate, subhyaline to olivaceous brown, smooth, with conspicuous collarettes. *Conidia* 8–10 μm long, 7–9 μm wide (\bar{x} = 9 \times 8 μm , n = 20), acrogenous, ellipsoidal to obovoid, or subglobose, aseptate, blackish green or dark brown, opaque and verrucose. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Jinsha River, saprobic on submerged decaying wood, April 2015, Q. Dai, S-488 (MFLU 18–1638, HKAS 93029), living culture MFLUCC 16–1338.

Distribution: **China**, Yunnan Province, on submerged wood in Jinsha River (This study).

Sexual morph: Undetermined

Notes: Holotype C 60160, specimens collected from freshwater habitats: MFLU 18–1638, HKAS 93029. cmdA, ITS, LSU, SSU, RPB2, TEF1 α and β -tubulin sequence data are available. Morphological characters and phylogenetic analysis evidence identify our isolate as *Stachybotrys chlorohalonata* and it is the first report from freshwater habitats.

Hypocreales genera *incertae sedis*

Emericellopsis J.F.H. Beyma, Antonie van Leeuwenhoek 6: 264 (1940) [1939]

Asexual morph *Acremonium*-like. *Conidiophores* mostly simple orthotropic. *Conidiogenous cells* phialidic, terminal or lateral, smooth-walled, hyaline. *Conidia* narrowly ellipsoid, hyaline, smooth, adhering in slimy heads. *Chlamydospores* absent or mostly intercalary and hyaline. **Sexual morph** *Ascomata* superficial on the substratum, globose, non-ostiolate, dark brown. *Peridium* multi-

layered, pseudoparenchymatous, composed of several layers of compressed cells. *Asci* unitunicate, saccate, with thin deliquescent wall, soon dissolving, scattered irregularly in the ascocarp. *Ascospores* ellipsoid, pale brown, with uneven surfaces, surrounded by 3 or 5 longitudinal, subhyaline or hyaline appendages.

Type species: *Emericellopsis terricola* J.F.H. Beyma, Antonie van Leeuwenhoek 6: 265 (1940) [1939]

Notes: The genus *Emericellopsis* was introduced by Beyma (1940) and placed in Eurotiaceae based on the type species *E. terricola* Beyma. Grum-Grzhimaylo et al. (2013) placed this genus in Bionectriaceae, but later Maharachchikumbura et al. (2016) treated it as Hypocreales genera *incertae sedis*. The known *Emericellopsis* species were reported from soil, marine, soda lake and terrestrial habitats (Stolk 1955; Luppi-Mosca 1960; Borut & Johnson 1962; Park 1972; Grum-Grzhimaylo et al. 2013). Among these *Emericellopsis* species, only *E. terricola* has been found in freshwater in Ireland and Japan (Park 1972; Tubaki 1973).

Emericellopsis terricola J.F.H. Beyma

Distribution: **Ireland**, on submerged organic debris (Park 1972); **Japan**, in freshwater muds of Lake Sengari (Tubaki 1973).

Asexual morph: *Cephalosporium* sp.

Notes: ITS, LSU, SSU, RPB2 and β -tubulin sequence data are available.

Microascales Luttr. ex Benny & Kimbr.

Halosphaeriaceae E. Müll. & Arx, ex Kohlm

Aniptodera Shearer & M.A. Mill., Mycologia 69(5): 893 (1977)

Asexual morph Undetermined. **Sexual morph** *Ascomata* globose or subglobose, immersed or superficial, ostiolate, papillate, membranaceous, hyaline to light brown. *Necks* cylindrical, periphysate, brown at the tip. *Paraphyses* thin-walled cells filling venter of young ascumata, breaking up into catenophyses. *Asci* 8-spored, unitunicate, clavate, short pendunculate, thin-walled except for a thick-walled area below the apex, flattened and refractive at the tip, provided with a simple pore, slightly constricted below the apex, relatively persistent even at developing at the base of the ascumata venter. *Ascospores* ellipsoidal, 1–3-septate, hyaline, thick without appendages.

Type species: *Aniptodera chesapeakeensis* Shearer & M.A. Miller, Mycologia 69(5): 894 (1977)

Notes: The genus *Aniptodera* was established by Shearer and Miller (1977) with *A. chesapeakeensis* Shearer & M.A. Miller as the type species. The genus is characterized by having hyaline or light coloured ascumata, catenophyses, apically thickened persistent asci with a distinct pore and subapical retraction of cytoplasm, and hyaline, thick-

walled, 1-septate ascospores with or without appendages (Shearer and Miller 1977; Raja and Shearer 2008).

Aniptodera aquadulcis (Hsieh et al.) Campb. et al.

Distribution: **China**, Taiwan, Taipei, on decayed wood submerged in freshwater (Hsieh et al. 1995); **China**, Hong Kong, Tai Po, Lam Tsuen River, on submerged wood (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype WL0213 (Academia Sinica herbarium). Sequence data is not available.

Aniptodera aquibella J. Yang & K.D. Hyde

Distribution: **Thailand**, Prachuap Khiri Khan Province, Hua Hin, Kaeng Krachan, near Pala-U Waterfall, on submerged wood in a stream (Li et al. 2016a).

Asexual morph: Undetermined

Notes: Holotype MFLU 15–1140. LSU and SSU sequence data are available. This species was introduced by Li et al. (2016a, b) and only known from the type locality.

Aniptodera chesapeakensis Shearer & M.A. Mill.

Distribution: **Australia**, north Queensland, Crystal Cascades, on submerged wood (Hyde et al. 1999a); **Brazil**, Bahia, Santa Terezinha, on submerged twig (Barbosa et al. 2013); **Brunei**, Tutong River, on submerged wood (Fryar et al. 2004); **China**, Hong Kong, Tai Po Kau forest stream, on submerged wood (Hyde et al. 1999a); **India**, north Maharashtra, on submerged wood (Patil and Borse 2012); **Iraq**, Shatt al-arab River, on submerged dead stem of *Arundo donax* and *Phragmites australis* (Al-Saadoon and Al-Dossary 2014); **Japan**, on submerged wood (Minoura and Muroi 1978); **Mauritius**, near Tamarin, Black River, on submerged wood (Hyde et al. 1999a); **South Africa**, Durban, Palmiet River, on submerged wood (Hyde et al. 1998b); **USA**, Maryland, on submerged wood; Illinois, on submerged wood (Shearer and Miller 1977; Shearer and Crane 1986; Shearer 1989b).

Asexual morph: Undetermined

Notes: Holotype ILLS 36523, other specimens collected from freshwater habitats ILLS 36506–36514, ILLS 31524. ITS, LSU, SSU, RPB1, RPB2 and TEF1 α sequence data are available. Shearer and Miller (1977) firstly collected this species from submerged wood in freshwater. This species have been found from freshwater habitats worldwide.

Aniptodera fusiformis Shearer

Distribution: **Iraq**, Al-Kahlaa River, on submerged stem (Al-Saadoon and Al-Dossary 2014); **USA**, New York, on cottonwood twigs (*Populus deltoides*) submerged in Jordan Creek (Shearer 1989b).

Asexual morph: Undetermined

Notes: Holotype NY-00966728, isotype: NY-00966729. Sequence data is not available.

Aniptodera inflatiscigera Tsui et al.

Distribution: **China**, Hong Kong, Tai Po, Lam Tsuen River, on submerged wood (Tsui et al. 1997; Hyde et al. 1999a); **Philippines**, Negros Occidentalis, Barrio Alegria, Lupit River, on submerged wood (Tsui et al. 1997; Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype (HKU(M) 4682 (now in IFRD). Sequence data is not available.

Aniptodera lignatilis K.D. Hyde

Distribution: **Australia**, on submerged log in freshwater (Hyde 1992c); **China**, Hong Kong, on submerged wood in Tai Po Kau forest stream (Ho et al. 2001); **Philippines**, Luzon, Laguna, Los BaSos, Mt Maquiling, on wood submerged in a freshwater stream (Hyde et al. 1999a); **Seychelles**, Mahe, Riveire St Mare Louise, on submerged wood (Hyde et al. 1999a); **South Africa**, Durban, Palmiet River, on submerged wood (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype BRIP 17156. LSU sequence data is available.

Aniptodera lignicola Hyde et al.

Distribution: **Australia**, Crystal Cascades, on submerged wood (Hyde et al. 1999a); **Brunei**, Temburong, Kuala Belalong Field Studies Centre, Sungai Esu, on wood submerged in a stream (Hyde et al. 1999a); **India**, north Maharashtra, on submerged wood (Patil and Borse 2012); **Malaysia**, State Negara, Lipur Lentang Nature Reserve, on submerged wood (Hyde et al. 1999a); **Philippines**, Luzon, Laguna, Los Bados, Mt. Maquiling, on wood submerged in a freshwater stream (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 2863 (now in IFRD). Sequence data is not available.

Aniptodera limnetica Shearer

Distribution: **USA**, Illinois, on submerged wood in Wolf Lake (Shearer 1989b).

Asexual morph: Undetermined

Notes: Holotype NY-00966731, isotype: NY-00966732. Sequence data is not available. This species is known only from the type locality.

Aniptodera margarition Shearer

Distribution: **UK**, Cornwall, on unidentified woody debris submerged in a small stream (Shearer 1989b); **USA**, New York/Illinois, on a twig collected from the Sangamon River (Shearer 1989b).

Asexual morph: Undetermined

Notes: Holotype NY-00966730, other specimens collected from freshwater habitats: NY-2946622, NY-2946629. Sequence data is not available.

Aniptodera mauritaniensis Hyde et al.

Distribution: **Iraq**, Shatt Al-Arab River and Al-Kahlaa River, on submerged wood (Al-Saadoon and Al-Dossary

2014); **Mauritius**, near Tamarin, Black River, on submerged wood (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype IFRD 8646. Sequence data is not available. This species is only known from the type locality.

Aniptodera megaloscocarpa Raja & Shearer

Distribution: **USA**, Florida, Ocala National forest, on submerged decorticated woody debris (Raja and Shearer 2008).

Asexual morph: Undetermined

Notes: Holotype ILL 40109. Sequence data is not available. This species is only known from the type locality.

Aniptodera megalospora Hyde et al.

Distribution: **Brunei**, Temburong, Kuala Belalong Field Studies Centre, Sungai Esu, on wood submerged in a stream (Hyde et al. 1999a); **China**, Hong Kong, on submerged wood (Hyde et al. 1999a); **Malaysia**, State Negara, Lipur Lentang Nature Reserve, on submerged wood (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 2885 (now in IFRD). Sequence data is not available.

Aniptodera palmicola Hyde et al.

Distribution: **Iraq**, Shatt Al-Arab River and Al-Kahlaa River, on submerged wood (Al-Saadoon and Al-Dossary 2014); **South Africa**, Kwa Zulu-Natal, Mt Unzini, The National Monument, on submerged rachis of *Raphia australis* (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype IFRD 8647. Sequence data is not available. This species is only known from the type locality.

Ascosacculus Campb. et al., Mycologia 95(3): 545 (2003)
Asexual morph Undetermined. **Sexual morph** Description and illustrations see Campbell et al. (2003b).

Type species: *Ascosacculus aquaticus* (K.D. Hyde) Campb. et al., Mycologia 95(3): 545 (2003)

Notes: The genus *Ascosacculus* was introduced by Campbell et al. (2003b) to accommodate two *Halosarpheia* species which were originally introduced as *Halosarpheia aquatica* and *H. heteroguttulata*. Both species of *Ascosacculus* have been reported from freshwater habitats worldwide (Hyde et al. 1999a; Campbell et al. 2003b).

Ascosacculus aquaticus (K.D. Hyde) Campb. et al.

≡ *Halosarpheia aquatica* K.D. Hyde, Aust. Syst. Bot. 5(4): 407 (1992)

Distribution: **Australia**, north Queensland, Atherton Tablelands, Clohesy River, on submerged wood (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype BRIP 19331, other specimen collected from freshwater habitats: BRIP 19384. LSU sequence data is available. This species is only known from the type locality.

Ascosacculus heteroguttulatus (Wong et al.) Campb. et al.
 ≡ *Halosarpheia heteroguttulata* Wong et al., Can. J. Bot. 76(11): 1858 (1999) [1998]

Distribution: **Australia**, north Queensland, Crystal Cascades, on submerged wood (Hyde et al. 1999a); **Brunei**, Temburong, Kuala Belalong Field Studies Centre, Sungai Esu, on wood submerged in a stream (Hyde et al. 1999a); **China**, Hong Kong, New Territories, Plover Cove Reservoir, on submerged wood (Hyde et al. 1999a); **Mauritius**, Tamarin, Black River, on submerged wood (Hyde et al. 1999a); **Philippines**, Mindanao, Bukidnon, Impalatao, Natigbasan Creek, on submerged wood (Hyde et al. 1999a); **South Africa**, Durban, Palmiet River, on submerged wood (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype IFRD 8762. LSU and SSU sequence data are available.

Ascosacculus fusiformis Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555667, Facesoffungi number: FoF 05448, Fig. 39

Etymology: Referring to the fusiform ascospores of this fungus

Holotype: MFLU 15–0068

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Undetermined. **Sexual morph** *Ascomata* 175–205 µm high, 85–105 µm diam., immersed with neck erumpent through host surface, subglobose to ellipsoid, solitary, dark brown to black. *Ostiole* central, with straight upright, black, long neck, periphysate. *Peridium* 7–11 µm thick, composed of 2–3 layers of brown, thin-walled, angular cells, which are hyaline inwardly. *Paraphyses* 4–6 µm wide, hyaline, unbranched, septate, slightly constricted at the septum. *Asci* 127–159 × 10–14 µm (\bar{x} = 143 × 12 µm, n = 10), 8-spored, unitunicate, cylindrical, apically rounded, pedicellate, with a bilateral apical ring. *Ascospores* 21–23 × 8–10 µm (\bar{x} = 22 × 9 µm, n = 20), uni-seriate, fusiform, 3-septate, slightly constricted at the septa, with 2 prominent guttules, hyaline, smooth-walled, with a thin mucilaginous sheath.

Material examined: **THAILAND**, Chiang Mai Province, saprobic on decaying wood submerged in a freshwater stream, November 2013, Z.L. Luo, ZL-9 (MFLU 15–0068, holotype), ex-type living culture MFLUCC 14–0036.

Notes: *Ascosacculus fusiformis* resembles *A. aquaticus* and *A. heteroguttulatus* in having immersed, solitary, dark brown ascomata, central ostiole with long, black neck, thin-walled peridium of *textura angularis* in surface view and hyaline, fusiform, guttulate ascospores (Hyde 1992b).

However, *A. fusiformis* differs from *A. aquaticus* in having cylindrical, pedicellate asci with a bilateral apical ring and shorter (21–23 µm vs. 33.5–64 µm), 3-septate ascospores with a thin mucilaginous sheath (Hyde 1992b). *A. fusiformis* differs from *A. heteroguttulatus* in having thinner peridium (7–11 µm vs. 20–28 µm), smaller (21–23 × 8–10 µm vs. 27–37 × 9–17.5 µm), 3-septate ascospores with a thin mucilaginous sheath. Phylogenetically, *Ascococcus fusiformis* clusters with other *Ascococcus* species in good support with separate clade (Fig. 1, clade 40). *Ascococcus fusiformis* also shares similar morphology with *Annulatasascus* species in having cylindrical, pedicellate asci with a bilateral apical ring and hyaline, fusiform, septate, guttulate ascospores with a thin mucilaginous sheath. However, phylogenetic analysis based on LSU, SSU, RPB2 and TEF1 α sequence data shows that *Ascococcus* belongs in Halosphaeriaceae (Microascales), while *Annulatasascus* belongs to Annulatascales (Annulatascales) (Fig. 1, clade 17, 40).

Fluviatispora K.D. Hyde, Mycol. Res. 98(7): 720 (1994)
Asexual morph Undetermined. **Sexual morph** *Ascomata* globose, immersed in wood, subglobose or ellipsoidal, light-brown, ostiolate, membranous and solitary. *Asci* 8-spored, unitunicate, clavate or saccate, thin-walled, pedunculate and deliquescing early. *Ascospores* 2–3-seriate, unicellular, ellipsoidal, hyaline. with a mucilaginous sheath.

Type species: *Fluviatispora tunicata* K.D. Hyde, Mycol. Res. 98(7): 722 (1994)

Notes: *Fluviatispora* was introduced by Hyde (1994) to accommodate two taxa, *F. reticulata* and *F. tunicata* (Halosphaeriaceae) which were collected from freshwater habitats. The genus is characterised by hyaline, unicellular ascospores surrounded by a mucilaginous sheath, thin-walled and clavate to saccate, early deliquescing unitunicate asci and immersed thin-walled ascomata (Hyde 1994). Three species are accepted in this genus and two of them have been reported from freshwater habitats.

Fluviatispora reticulata K.D. Hyde

Distribution: **Papua New Guinea**, Western Province, Bensbach, Bensbach River, on frons submerged *Livistona* sp. (Hyde 1994).

Asexual morph: Undetermined

Notes: Holotype BRIP 21392; Sequence data is not available. This species is only known from the type locality.

Fluviatispora tunicata K.D. Hyde

Distribution: **Papua New Guinea**, Western Province, Bensbach, Bensbach River, on frons submerged *Livistona* sp. (Hyde 1994).

Asexual morph: Undetermined

Notes: Holotype BRIP 21391. Sequence data is not available. This species is only known from the type locality.

Luttrellia Shearer, Mycologia 70(3): 692 (1978)

Asexual morph Undetermined. **Sexual morph** *Ascomata* partially immersed to superficial, globose to subglobose, membranous. *Paraphyses* with catenophyses, septate, hyaline. *Asci* clavate to cylindrical, early deliquescent, thin-walled. *Ascospores* multiseptate, lacking appendages accumulating in a mass at tip of neck after discharge, hyaline.

Type species: *Luttrellia estuarina* Shearer, Mycologia 70(3): 693 (1978)

Notes: The genus *Luttrellia* (Halosphaeriaceae) was established by Shearer (1978) to accommodate

a single species, *L. estuarina*. Ferrer and Shearer (2007) introduced three *Luttrellia* species from temperate and tropical freshwater habitats. Index Fungorum (2018) lists eight epithets of *Luttrellia* and four of them have been reported from freshwater habitats.

Luttrellia estuarina Shearer

Distribution: **Canada**, Manitoba, Rennie River, on submerged decorticated wood (Ferrer and Shearer 2007); **USA**, Maryland, Patuxent River (Shearer 1978); Colorado, Florida, Illinois, Maryland, Minnesota, North Carolina, on submerged decorticated wood in a small stream (Ferrer and Shearer 2007).

Asexual morph: Undetermined

Notes: Holotype ILLS 36979. Sequence data is not available.

Luttrellia guttulata A. Ferrer & Shearer

Distribution: **Costa Rica**, Heredia, on submerged decorticated wood (Ferrer and Shearer 2007); **Panama**, Barro Colorado National Monument, on submerged decorticated wood in Wheeler Stream (Ferrer and Shearer 2007).

Asexual morph: Undetermined

Notes: Holotype ILL, AF181–1. Sequence data is not available.

Luttrellia halonata A. Ferrer & Shearer

Distribution: **Ecuador**, Yasuni National Park, Tiputini River, on submerged decorticated wood (Ferrer and Shearer 2007).

Asexual morph: Undetermined

Notes: Holotype ILL, AF134–1. Sequence data is not available.

Luttrellia parvulospora A. Ferrer & Shearer

Distribution: French Guiana, Degrad Eskol, Crique Gabrielle, Commune Noura, on submerged decorticated wood (Ferrer and Shearer 2007); **USA**, Mississippi/Louisiana, on submerged decorticated wood (Ferrer and Shearer 2007).

Asexual morph: Undetermined

Notes: Holotype ILL, Robertson A-276–5. Sequence data is not available.

Magnisphaera Campb. et al., Mycologia 95(3): 546 (2003)
Asexual morph Undetermined. **Sexual morph** Description and illustrations see Campbell et al. (2003b).

Type species: *Magnisphaera spartinae* (E.B.G. Jones) Campb. et al., Mycologia 95(3): 547 (2003)

Notes: The genus *Magnisphaera* was introduced by Campbell et al. (2003b) to accommodate *Halosarpheia spartinae* E.B.G. Jones and two undescribed isolates based on molecular and morphological data. The genus *Magnisphaera* is characterized by large, black, globose to flattened globose ascomata with a central neck that is short in proportion to the length of the ascoma. two-layered peridium composed of about 8–10 large cells. The asci are ellipsoid, thin-walled throughout, early deliquescent and lack an apical pore and apical apparatus. The ascospores are broadly acerose, phragmoseptate, constricted at the septa, with a large guttule in each of the central cells (Campbell et al. 2003b). Two species are accepted in this genus and only *Magnisphaera stevemossago* was collected from freshwater habitats.

Magnisphaera stevemossago J. Campb., J.L. Anderson & Shearer

Distribution: **USA**, Colorado, Alaska, on decorticated wood submerged in creek, pond and River (Campbell et al. 2003b).

Asexual morph: Undetermined

Notes: Holotype ILL, Shearer A409–1, other specimens collected from freshwater habitats: ILL A409–3, ILL A409–4, ILL A409–5. LSU, SSU and RPB2 sequence data are available.

Nais Kohlm., Nova Hedwigia 4: 409 (1962)

Asexual morph Undetermined. **Sexual morph** *Ascomata* immersed or semi-immersed, membranous, globose to ampulliform, ostiole central, beaked, black, solitary or gregarious. *Peridium* thin. *Paraphyses* absent. *Catenophyses* numerous. *Asci* 8-spored, saccate, deliquescent, thin-walled, pedunculate. *Ascospores* ellipsoid, bi-celled, not constricted at the septa, with a band of refringent globules around the equator, mostly with appendages, hyaline.

Type species: *Nais inornata* Kohlm, Nova Hedwigia 4: 409 (1962)

Notes: The genus *Nais* Kohlm was introduced by Kohlmeyer (1962) with *Nais inornata* Kohlm as type species. Subsequently, another two species *N. glitra* and *N. aquatica* were introduced by Crane and Shearer (1986) and Hyde (1992a) respectively. Pang et al. (2003) transferred *N. glitra* to the genus *Saagaromyces* as *Saagaromyces glitra* based on morphology and phylogenetic analysis. There are two species accepted in *Nais* and both of them

have been reported from freshwater habitats (Hyde et al. 1999a; Raja et al. 2009b).

Nais aquatica K.D. Hyde

Distribution: **Australia**, north Queensland, Millaa Millaa Falls, on submerged wood (Hyde et al. 1999a); **China**, Hong Kong, New Territories, Plover Cove Reservoir, on submerged wood in a stream (Hyde et al. 1999a); **South Africa**, Durban, Palmiet River, on submerged wood (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype BRIP 17378. Sequence data is not available.

Nais inornata Kohlm.

Distribution: **USA**, Florida, on submerged decaying wood (Raja et al. 2009b).

Asexual morph: Undetermined

Notes: LSU sequence is available. *Nais inornata* was introduced by Kohlmeyer (1962) and collected from rotten wood in salt water. Raja et al. (2009b) reported this species from freshwater habitats.

Natantispora Campb. et al., Mycologia 95(3): 543 (2003)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Campbell et al. (2003b).

Type species: *Natantispora retorquens* (Shearer & J.L. Crane) Campb. et al., Mycologia 95(3): 543 (2003)

Notes: The genus *Natantispora* was introduced by Campbell et al. (2003b) to accommodate two species which were originally introduced as *Halosarpheia lotica* and *H. retorquens*. Both species of *Natantispora* have been reported from freshwater habitats worldwide (Hyde et al. 1999a; Campbell et al. 2003b).

Natantispora lotica (Shearer) Campb. et al.

≡ *Halosarpheia lotica* Shearer, Mycotaxon 20(2): 505 (1984)

Distribution: **Australia**, north Queensland, Atherton Tablelands, Clohesy River, on submerged wood (Hyde et al. 1999a); **China**, Hong Kong, New Territories, Plover Cove Reservoir, on submerged wood in a stream (Hyde et al. 1999a); **Mauritius**, near Tamarin, Black River, on submerged wood (Hyde et al. 1999a); **Philippines**, Negros Occidental, Barrio Alagria, Lupit River, on submerged wood (Hyde et al. 1999a); **South Africa**, Durban, Palmier River, on submerged wood (Hyde et al. 1999a); **USA**, Wisconsin, Tomahawk River, on submerged decorticated wood (Campbell et al. 2003b).

Asexual morph: Undetermined

Notes: Holotype NY-00966744, other specimen collected from freshwater ILL A333-1. LSU, SSU sequence data is available.

Natantispora retorquens (Shearer & J.L. Crane) Campb. et al.

≡ *Halosarpheia retorquens* Shearer & J.L. Crane, Bot. Mar. 23: 608 (1981)

Distribution: **China**, Yunnan Province, on submerged wood (Cai et al. 2002a); **Mauritius**, near Tamarin, Black River, on submerged wood (Hyde et al. 1999a); **Philippines**, Luzon, Laguna, Los Bados, Mt. Maquiling, on wood submerged in a freshwater stream (Hyde et al. 1999a); **South Africa**, Kwa Zulu-Natal, Mt. Ubatuba, on submerged rachis of *Raphia australis* (Hyde et al. 1999a); **USA**, Minnesota, west arm of Lake Itasca, Lake Itasca State Park, on submerged *Typha* sp. (Campbell et al. 2003b).

Asexual morph: Undetermined

Notes: Specimens collected from freshwater: ILL A4–10, ILL A4–11. ITS, LSU and SSU sequence data are available.

Panorbis Campb. et al., Mycologia 95(3): 544 (2003)

Asexual morph Undetermined. **Sexual morph** Description and illustrations see Campbell et al. (2003b).

Type species: *Panorbis viscosus* (I. Schmidt) Campb. et al., Mycologia 95(3): 544 (2003)

Notes: Campbell et al. (2003b) established the genus *Panorbis* to accommodate *Halosarpheia viscosa*. Only one species was accepted in this genus and occurrence on woody and herbaceous plant debris in freshwater, brackish and marine habitats (Schmidt 1985; Campbell et al. 2003b).

Panorbis viscosus (I. Schmidt) Campb. et al.

≡ *Halosphaeria viscosa* I. Schmidt, Mycotaxon 24: 420 (1985)

Distribution: **Philippines**, Luzon, Laguna, Los Bados, Maquiling Mountain, on wood submerged in a freshwater stream (Hyde et al. 1999a); **South Africa**, Durban, Palmiet River, on submerged wood (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype No. 148, JE. LSU and SSU sequence data are available. This species was introduced by Schmidt (1985) as *Halosphaeria viscosa* I. Schmidt, and was collected from rotten wood submerged in seawater, Germany. Hyde et al. (1999b) collected *Halosphaeria viscosa* from freshwater habitats in Philippines and South Africa. Campbell et al. (2003b) established the genus *Panorbis* and synonymised *Halosphaeria viscosa* as *Panorbis viscosus* based on morphology and phylogeny.

Phaeonectriella R.A. Eaton & E.B.G. Jones, Nova Hedwigia 19(3–4): 779 (1971) [1970]

Asexual morph Undetermined. **Sexual morph** *Ascomata* immersed or partially immersed, globose to subglobose, hyaline to pale brown, membranous, ostiolate, papillate, periphysate. *Peridium* composed of textura angularis or compressed cells. *Catenophyses* absent. *Asci* 8-spored, clavate, pedicellate, thin-walled, apically truncate and

thickened, with apical pore and cytoplasm retracted below the ascus apex, persistent. *Ascospores* ellipsoidal to fusiform, bicelled, hyaline or pale brown, thin-walled, with appendages at each end.

Type species: *Phaeonectriella lignicola* R.A. Eaton & E.B.G. Jones, Nova Hedwigia 19(3–4): 779 (1971) [1970]

Notes: *Phaeonectriella* was described from test blocks exposed in a number of water cooling towers by Eaton and Jones (1970). Hyde et al. (1999b) provided descriptions and illustrations for the type species *Phaeonectriella lignicola* and introduced the second species *Phaeonectriella appendiculata* in this genus based on the collections from freshwater habitats of Australia, Mauritius and Philippines. ***Phaeonectriella appendiculata*** Hyde et al.

Distribution: **Australia**, north Queensland, Crystal Cascades, on submerged wood (Hyde et al. 1999a); **Philippines**, Luzon, Laguna, Los Bados, Mt. Maquiling, on wood submerged in a freshwater stream (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 2864 (now in IFRD). sequence data is not available.

Phaeonectriella lignicola R.A. Eaton & E.B.G. Jones

Distribution: **China**, Yunnan Province, Kunming city, on submerged wood in Dianchi lake (Luo et al. 2004); **Mauritius**, near Tamarin, Black River, on submerged wood (Hyde et al. 1999a).

Asexual morph: Undetermined

Notes: ITS, LSU and SSU sequence data are available.

Triadelphiaceae Y.Z. Lu, J.K. Liu, Z.L. Luo & K.D. Hyde, *fam. nov.*

Index Fungorum number: IF 555668, Facesoffungi number: FoF 05449

Etymology: ‘*Triadelphiaceae*’ referring to the type genus *Triadelphia*.

Saprobic on decaying wood, or pathogenic on human, or found from the gut of red palm weevils. **Sexual morph** Undetermined. **Asexual morph** Hyphomycetous. *Conidiophores* lacking. *Conidiogenous cells* holoblastic, monoblastic, integrated, flask-shaped, fusiform, cylindrical or clavate, arising from undifferentiated hyphae, hyaline to pale brown, smooth-walled. *Conidia* acrogenous, solitary, develop one to five forms in distinct species: form (a) cylindrical, oblong, or clavate, straight or slightly curved, brownish, 1–2 septate, septa covered with broad dark bands; form (b) clavate, club-shaped, dark brown, uniseptate, septum covered with a dark band; form (c) obclavate to acicular with a narrow long tip, hyaline or yellowish brown, multiseptate; form (d) fusiform, obclavate with acicular tips, or rounded at the tip, multi-septate, end cells pale brown, central cells brown to dark brown, dark band covering over the central septa; form (e) allantoid or

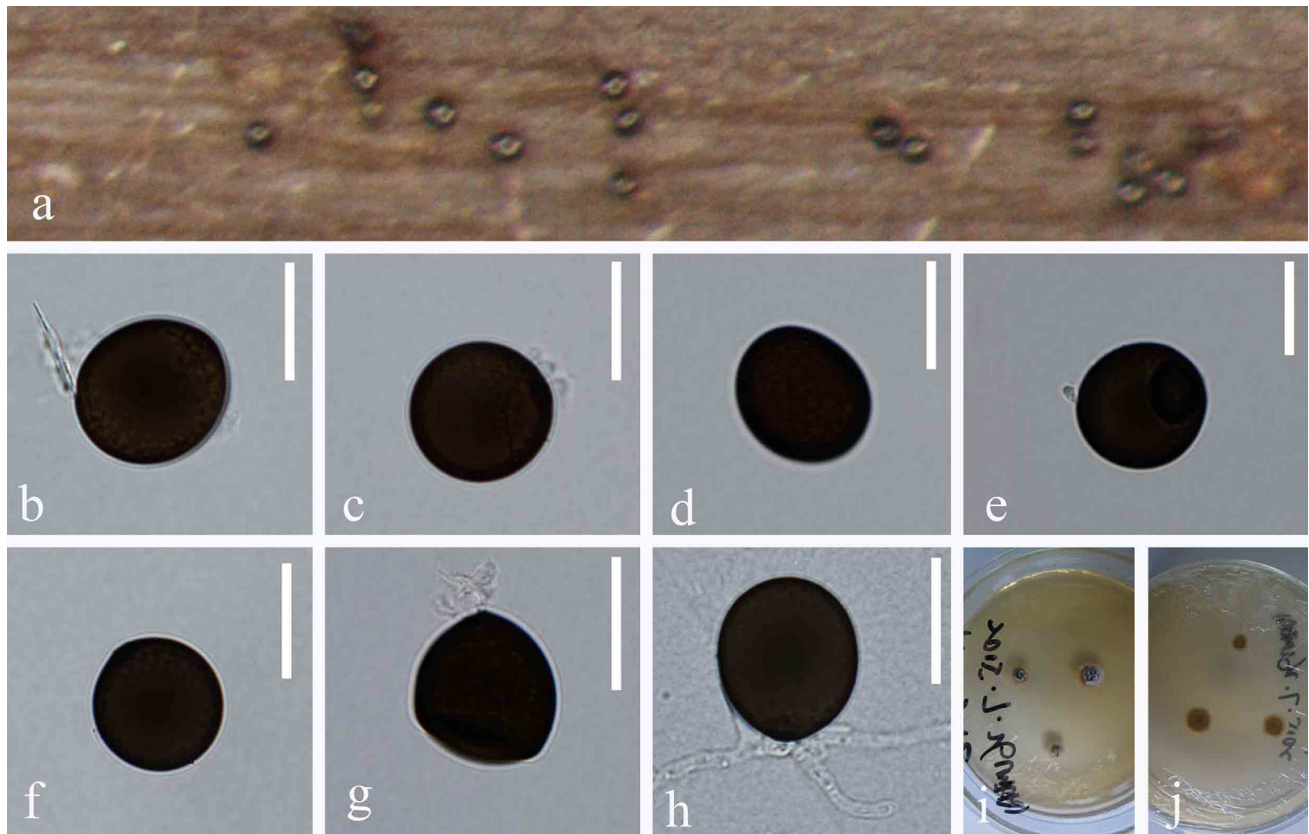


Fig. 40 *Conioscypha aquatica* (MFLU 18–1640, holotype) **a** Colony on natural substrate. **b–g** Conidia. **h** Germinating conidium. Culture on PDA from above (**i**) and reverse (**j**). Scale bars: **b–h** 20 μ m

reniform, hyaline or pale yellowish, 0–3-septate; form (f) obovate to broadly ellipsoidal, pale brown, unicellular. (Shearer and Crane 1971; Constantinescu and Samson 1982; Matsushima 1989, 1995; Tzean and Chen 1989; Abdel-Sater and Soliman 2017; Li and Ye 2017; Lu et al. 2018b).

Type genus: *Triadelfia* Shearer & J.L. Crane, Mycologia 63(2): 247 (1971)

Note: The genus *Triadelfia* was established by Shearer and Crane (1971) based on the type species *T. heterospora*, which is placed in the order Microascales as genera *incertae sedis* (Wijayawardene et al. 2017, 2018; Lu et al. 2018b). In this study, our multi-gene phylogenetic analyses show that the *Triadelfia* clade shares a sister relationship to the Graphiaceae clade with good bootstrap support (98% ML) (Fig. 1, clade 41). However, morphologically, *Triadelfia* taxa are obviously distinct from the species of Graphiaceae in conidial and conidiophore characters. Most *Triadelfia* species are pleomorphic, produce 2–5 forms of conidia, and lack or with a short conidiophores (Shearer and Crane 1971; Constantinescu and Samson 1982; Matsushima 1989, 1995; Tzean and Chen 1989; Abdel-Sater and Soliman 2017; Li and Ye 2017; Lu et al. 2018b), while the species of Graphiaceae have synnematos

conidiophores which are erect and 103–300 μ m long, with a cylindrical stipe and terminated in a slimy head of conidia (Gilgado et al. 2005; Jacobs et al. 2013). Therefore, *Triadelfiaceae fam. nov.* is introduced here.

Triadelfia Shearer & J.L. Crane, Mycologia 63(2): 247 (1971)

Asexual morph Colonies on natural substrate sparse, brown to dark brown. *Mycelium* immersed or superficial, composing of colorless to pale brown, smooth, septate hyphae. *Conidiogenous cells* gregarious to caespitose, globose to subglobose to ampulliform, borne directly on vegetative hyphae. *Conidia* aerenous, solitary, dry, septate, pleomorphic. **Sexual morph** Undetermined.

Type species: *Triadelfia heterospora* Shearer & J.L. Crane, Mycologia 63(2): 247 (1971)

Notes: The pleomorphic genus *Triadelfia* was introduced by Shearer and Crane (1971) with *T. heterospora* as type species. The sporodochial hyphomycete was isolated from wood blocks submerged in the Patuxent River, USA and characterized by two different forms of conidia. Li and Ye (2017) accepted 18 species in *Triadelfia* and provided key to species of this genus. Three *Triadelfia* species

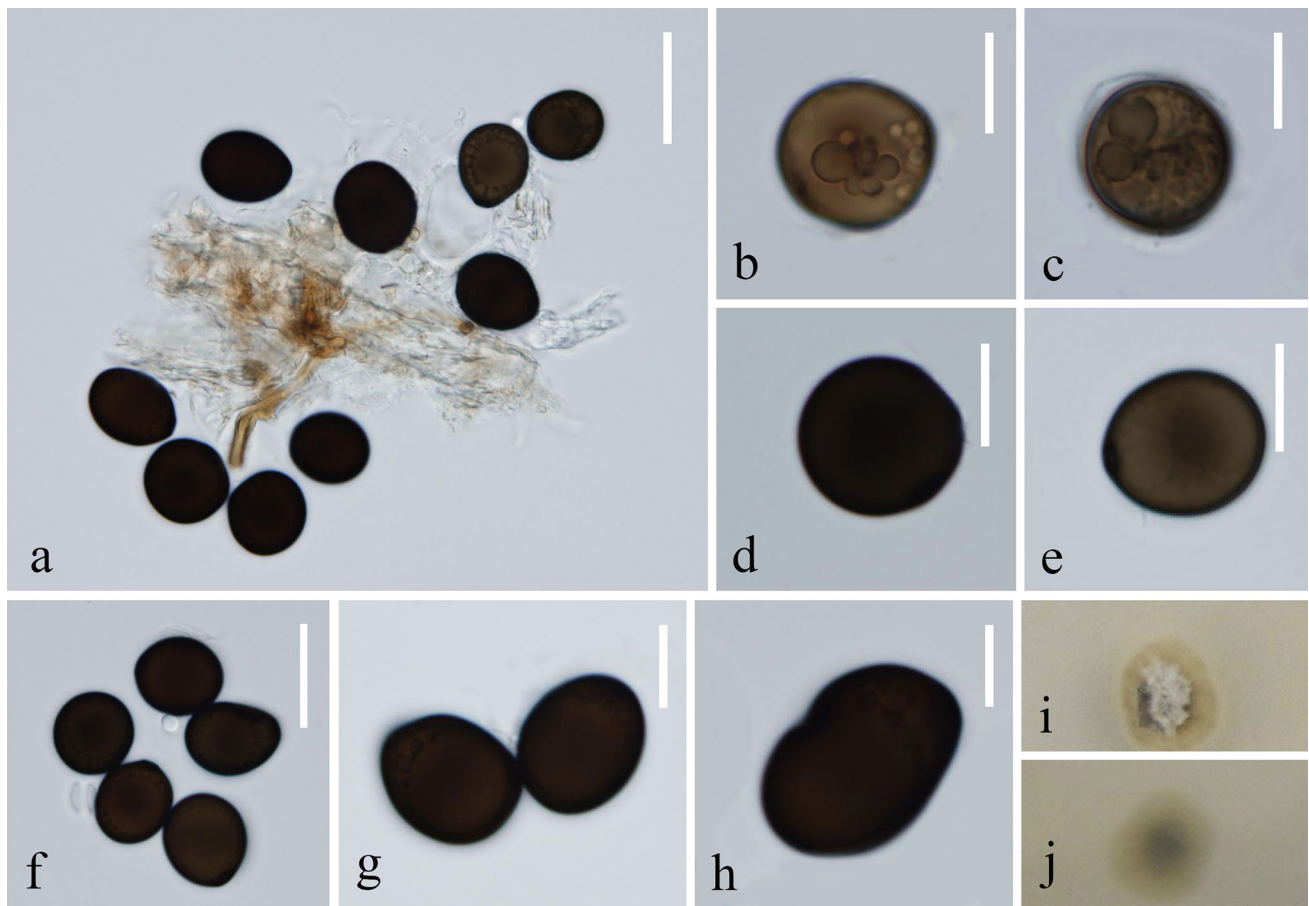


Fig. 41 *Conioscypha submersa* (MFLU 18–1639, holotype) **a–h** Conidia. Culture on PDA from surface (**i**) and reverse (**j**). Scale bars: **a**, **f** 20 μ m, **b–e**, **g**, **h** 10 μ m

have been reported from freshwater habitats (Shearer and Crane 1971; Révay 1992; Lu et al. 2018b).

Triadelphia fusiformis Lu et al.

Distribution: **Thailand**, Krabi, on submerged wood in a freshwater stream (Lu et al. 2018b).

Sexual morph: Undetermined

Notes: Holotype MFLU 18–1436. ITS, LSU and TEF1 α sequence data are available.

Triadelphia heterospora Shearer & J.L. Crane

Distribution: **USA**, Maryland, on wood blocks submerged in the Patuxent River (Shearer and Crane 1971).

Sexual morph: Undetermined

Notes: Holotype ILLS 34793, isotype DAOM 126798, IMI 14403. ITS and LSU sequence data are available.

Triadelphia morgoensis Révay

Distribution: **Hungary**, on submerged wood (Révay 1992).

Sexual morph: Undetermined

Notes: Holotype BP 664Fn. Sequence data is unavailable.

Torpedosporales Jones et al.

Juncigenaceae Jones et al.

Juncigena Kohlm. et al., Bot. Mar. 40(4): 291 (1997)

Asexual morph *Mycelium* composed of septate, branched, hyaline hyphae. *Conidiophores* obsolete or micronematous, cylindrical to clavate, acrogenous or laterally on the hyphae, hyaline to lightbrown. *Conidiogenous cells* monoblastic, integrated, terminal, determinate. *Conidia* acrogenous, irregularly helicoid, solitary, septate, constricted at the septa, yellow-brown to brown. The count of the conidial cells is less than ten. **Sexual morph** *Ascomata* immersed, subglobose to pyriform, ostiolate, coriaceous, fuscous, single. *Neck* cylindrical, hyaline to fuscous, periphysate. *Peridium* of ellipsoidal to subglobose cells, forming a textura angularis, dark on the outside, hyaline on the inside. *Paraphyses* composed of unbranched pseudoparaphyses attached at the top and bottom. *Asci* 8-spored, unitunicate, fusiform to cylindrical, short pedunculate, with a non-amyloid apical ring. *Ascospores* uni- to biseriolate, fusiform to ellipsoidal, 3-septate, hyaline.

Type species: *Juncigena adarca* Kohlm. et al., Bot. Mar. 40(4): 291 (1997)

Notes: The monotypic genus *Juncigena* was introduced by Kohlmeyer et al. (1997) and typified by *J. adarca* for an asexual morph which was described as *Cirrenalia adarca*. Later the asexual species was placed in the genus *Moheitospora* as *M. adarca* along with the type species, *M. fruticosae* (Abdel-Wahab et al. 2010), thus *Juncigena* and *Moheitospora* are synonyms. In case of *Juncigena* has priority and has greater use in the literature, Réblová et al. (2016b) recommended that *Juncigena* be used.

Juncigena fruticosae (Abdel-Wahab et al.) A.N. Mill. & Shearer

≡ *Moheitospora fruticosae* Abdel-Wahab et al., Mycol. Progr. 9(4): 551 (2010)

Distribution: **Egypt**, Alexandria, Lake Manzala, on submerged decayed stems of *Suaeda fruticosa* (Abdel-Wahab et al. 2010).

Sexual morph: Undetermined

Notes: Holotype IMI 391650. LSU and SSU sequence data are available. This species is only known from the type locality.

Hypocreomycetidae genera *incertae sedis*

Papulaspora Preuss, Linnaea 24: 112 (1851)

Asexual morph *Mycelium* branched, septate, hyaline or fuscous, more or less procumbent. *Bulbils* initially hyaline, becoming light brown to black, and opaque at maturity as a result of progressive darkening of cell walls, subglobose to irregular, variable in size, intercalary or less frequently terminal, developing on pedicels. *Primordium* a group of terminal or intercalary, terminating the pedicel, consists of one to three branches forming septate side branches by dichotomous division, the final divisions widen to spherical cells, which constitute the bulbil. *Conidia* on bottle-shaped sterigmata. **Sexual morph** Undetermined.

Type species: *Papulaspora sepedonioides* Preuss, Linnaea 24: 112 (1851)

Notes: *Papulaspora* was introduced by Preuss (1851) with *P. sepedonioides* Preuss as the type species which produced bulbils. Species of *Papulaspora* are known to be saprophytic (Hotson 1917, 1942; Fergus 1971). *Papulaspora coprophila* was reported as coprophilous fungus (Hotson 1912, 1917). Several are endophytes (Gezgin and Eltem 2009; Vitorino et al. 2012) and soil fungi (Watanabe 1991; He et al. 1997). *Papulaspora equi* can infect mammals (Shadomy and Dixon 1989). Among the *Papulaspora* species, *P. pulmonaria* and *P. sepedonioides* were reported from freshwater habitats (van Beverwijk 1954; Cai et al. 2006a).

Papulaspora pulmonaria Bever

Distribution: **UK, Netherlands**, on decaying leaves in water (van Beverwijk 1954)

Sexual morph: Undetermined.

Notes: Sequence data is not available. van Beverwijk (1954) mentioned that the type of this species was found from submerged leaves in an old tin filled with rain water in a garden, but the author did not give herbarium number for the type.

Papulaspora sepedonioides Preuss

Distribution: **China**, Yunnan Province, on submerged bamboo culms (Cai et al. 2006a)

Sexual morph: Undetermined.

Notes: ITS, LSU, RPB1, RPB2, TEF1 α and β -tubulin sequence data are available.

Subclass Lulworthiomycetidae Dayar. et al.

Pisorisporiales Réblová & J. Fourn.

Pisorisporiaceae Réblová & J. Fourn.

Achroceratosphaeria Réblová et al., Fungal Divers 43: 79 (2010)

Asexual morph Undetermined. **Sexual morph** *Ascomata* immersed to semi-immersed, nonstromatic, solitary or in small groups, venter globose to subglobose, sometimes depressed, subhyaline to pale brown. *Neck* cylindrical, hyaline to subhyaline to grey, sometimes hairy, periphysate. *Peridium* leathery to fragile, two-layered. *Paraphyses* septate, hyaline, tapering towards the tip, longer than the asci. *Asci* 8-spored, unitunicate, cylindrical to clavate, stipitate. *Ascospores* cylindrical-fusiform to cylindrical, septate, hyaline.

Type species: *Achroceratosphaeria potamia* Réblová et al., Fungal Divers 43: 79 (2010)

Notes: The genus *Achroceratosphaeria* was described for perithecial ascomycetes with similar morphology to *Ceratosphaeria* and *Pseudohalonestria* of the Magnaporthaceae (Réblová et al. 2010). Presently, *Achroceratosphaeria* comprises two freshwater and one terrestrial species characterised by immersed, subhyaline to pale brown ascomata with a fragile, hyaline to pale brown protruding neck, tapering paraphyses, unitunicate asci with a nonamyloid apical annulus and ellipsoidal to fusiform, septate ascospores (Réblová et al. 2010). For one of the freshwater *Achroceratosphaeria* species, collected from Hong Kong, China, was described as *Achroceratosphaeria* sp. by Réblová et al. (2010). Although the sequence of *Achroceratosphaeria* sp. was deposited in GenBank (under the name *Ascocollumdensa aquatica*), this fungus has never been validly published. The only known written records are the photographs and descriptions made by Ranghoo (1998) in her Ph. D thesis. New material needs to be recollected.

Achroceratosphaeria potamia Réblová, J. Fourn. & K.D. Hyde

Distribution: **France**, Ariège, Le Baup stream, on submerged wood of *Platanus* species (Réblová et al. 2010).

Asexual morph: Undetermined

Notes: Holotype PRM 915719. LSU and SSU sequence data are available. This species is known so far only from the type locality.

Pisorisporium Réblová & J. Fourn., *Persoonia* 34: 45 (2015)

Asexual morph Undetermined. **Sexual morph** Description and illustration see Réblová et al. (2015b).

Type species: *Pisorisporium cymbiforme* Réblová & J. Fourn., *Persoonia* 34: 45 (2015)

Notes: The genus *Pisorisporium* was introduced by Réblová et al. (2015b) with *Pisorisporium cymbiforme* Réblová & J. Fourn as type species which was collected from freshwater habitats. Presently, *Pisorisporium* comprises two species, one is from freshwater and another one from terrestrial habitats.

Pisorisporium cymbiforme Réblová & J. Fourn

Distribution: **France**, Ariège, valley of La Maille brook, on submerged decorticated wood of *Alnus glutinosa* and *Fraxinus excelsior* (Réblová et al. 2015b).

Asexual morph: Undetermined

Notes: Holotype PRM 924377, other specimens collected from freshwater habitats: PRM 924378, PRM 924379. LSU, SSU and RPB2 sequence data are available.

Subclass Savoriyellomycetidae Hongsanan et al.

Conioscyphales Réblová & Seifert

Conioscyphaceae Réblová & Seifert

Conioscypha Höhn., *Annls mycol.* 2(1): 58 (1904)

Asexual morph *Conidiophores* micronematous, monone-matous, erect, hyaline, smooth walled. *Conidiogenous cells* enteroblastic, terminal or intercalary, hyaline, cyathiform to doliiform, with multilayered, cup-like collarettes. *Conidia* often with a basal pore, formed singly and successively by percurrent regeneration of the apex of the conidiogenous cell, liberating by apical rupture of the outer wall of the conidiogenous cell, aseptate, brown., **Sexual morph** *Ascomata* perithecial, immersed to partially immersed, or superficial, globose to subglobose, with subcylindrical papilla or cylindrical elongated neck, ostiole periphysate. *Peridium* leathery, waxy, comprising two layers. *Paraphyses* filiform, unbranched, longer than the asci. *Asci* 8-spored, unitunicate, persistent, with a pronounced non-amyloid apical annulus, cylindrical-clavate, stipitate. *Ascospores* fusiform to fusiform-navicular, transversely multiseptate, hyaline, without mucilaginous sheath or appendages.

Type species: *Conioscypha lignicola* Höhn., *Annls mycol.* 2(1): 58 (1904)

Notes: The dematiaceous hyphomycetous genus *Conioscypha*, with *C. lignicola* as type species, includes species from freshwater and terrestrial habitats. The genus *Conioscyphascus*, typified by *C. varius*, was originally established for fungi with *Conioscypha* asexual morphs

(Réblová and Seifert 2004b). Based on priority and the greater number of species, Réblová et al. (2016b) recommended to use the name *Conioscypha*.

Conioscypha aquatica Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555669, Facesoffungi number: FoF 05450, Fig. 40

Etymology: Referring to the aquatic habitat of this fungus.

Holotype: MFLU 18–1640

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** *Colonies* on natural substrate superficial, effuse, dark brown to black. *Conidiophores* reduced to conidiogenous cells. *Conidia* 19–23 µm long, 17–21 µm wide ($\bar{x} = 21 \times 19$ µm, $n = 20$), dry, dark brown to black, mostly globose to subglobose, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Dulong River, saprobic on submerged decaying wood, May 2015, Z.L. Luo, S-447 (MFLU 18–1640, holotype; HKAS 92696, isotype), ex-type living culture MFLUCC 18–1333, KUMCC 15–0294.

Notes: *Conioscypha aquatica* resembles *C. hoehnelii* in having globose to subglobose, dark brown conidia (Kirk 1984). However, *Conioscypha aquatica* differs from *C. hoehnelii* in having larger conidia (19–23 × 17–21 vs. 12–17 × 11–15 µm). Phylogenetic analysis also shows that *Conioscypha aquatica* is distinct from *C. hoehnelii* (Fig. 1, clade 46).

Conioscypha gracilis (Munk) Zelski et al.

≡ *Debaryella gracilis* Munk, *Bot. Tidsskr.* 51: 226 (1954)

≡ *Cryptoleptosphaeria gracilis* (Munk) Rossman & Samuels, *Stud. Mycol.* 42: 185 (1999)

≡ *Conioscyphascus gracilis* (Munk) Réblová & Seifert, *Stud. Mycol.* 50:104 (2004)

Distribution: **Peru**, Cusco, Camanti, stream along Quincemil Trail, on submerged woody debris (Zelski et al. 2015).

Sexual morph: Undetermined

Notes: Specimens collected from freshwater habitats: ILL 41215, ILL 41203. LSU sequence data is available.

Conioscypha lignicola Höhn.

Distribution: **Australia**, on submerged wood (Höhnel 1904).

Sexual morph: Undetermined

Notes: Holotype IMI 270438. LSU, SSU and RPB2 sequence data are available.

Conioscypha nakagirii Chuaseehar. et al.

Distribution: **Thailand**, Nakhon Ratchasima Province, Pak Chong District, on unidentified submerged wood in a stream (Chuaseeharonnachai et al. 2017).

Asexual morph: see Chuaseeharonnachai et al. (2017)

Notes: Holotype BBH 40587, paratype BBH 40588. ITS, LSU, SSU and RPB2 sequence data are available.

Conioscypha peruviana Zelski et al.

Distribution: **Peru**, Cusco, Camanti, stream along Quincemil Trail, on submerged woody debris (Zelski et al. 2015).

Asexual morph: see Zelski et al. (2015)

Notes: Holotype ILL 41202, other specimens collected from freshwater habitats: ILL 41208, ILL 41209, ILL 41210, ILL 41211, ILL 41213, ILL 41214. LSU sequence data is available.

Conioscypha submersa Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555670, Facesoffungi number: FoF 05451, Fig. 41

Etymology: Referring to the submerge habitat of this fungus.

Holotype: MFLU 18–1639

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on natural substrate superficial, effuse, dark brown to black. *Conidiophores* reduced to conidiogenous cells. *Conidia* 17–19 µm long, 15–17 µm wide ($\bar{x} = 18 \times 16$ µm, $n = 20$), globose to subglobose, or ovoid, dry, guttulate, pale brown when young, dark brown to black when mature, smooth-walled.

Sexual morph Undetermined.

Material examined: **CHINA**, Yunnan Province, Nujiang River, saprobic on submerged decaying wood, October 2016, S.M. Tang, S-904 (MFLU 18–1639, holotype), ex-type living culture DLUCC 0904.

Notes: *Conioscypha submersa* resembles *C. lignicola* in having micronematous conidiophores, globose to subglobose, or ovoid, dark brown to black conidia with similar size (Matsushima 1975). However, phylogenetic analysis shows that *Conioscypha submersa* is distinct from *C. lignicola* (Fig. 1, clade 45).

Fuscosporellales Yang et al.

Fuscosporellaceae Yang et al.

Bactrodesmiastrum Hol.-Jech., Folia geobot. phytotax. 19(1): 103 (1984)

Asexual morph Emended description and illustration refer to Hernández-Restrepo et al. (2015a). **Sexual morph** Undetermined.

Type species: *Bactrodesmiastrum obscurum* Hol.-Jech., Folia geobot. phytotax. 19(1): 105 (1984)

Notes: The genus *Bactrodesmiastrum* is characterized by solitary or aggregated conidiophores, mostly reduced to brown, monoblastic, conidiogenous cells, arising from pulvinate to subpustulate sporodochial conidiomata, and moniliform or beaded hyphoid cells (Holubová-Jechová 1984; Hernández-Restrepo et al. 2015a). Five species are

accepted in this genus and one of them was collected from freshwater habitats (Calduch et al. 2002).

Bactrodesmiastrum obovatum (Calduch et al.) Mena et al. \equiv *Janetia obovata* Calduch et al., Mycologia 94(2): 355 (2002)

Distribution: **Spain**, Balearic Islands, Mallorca, Tramuntana Mountain, on unidentified submerged wood in Reservoir (Calduch et al. 2002).

Sexual morph: Undetermined

Notes: Holotype IMI 380443, Isotype FMR 6482, other specimen collected from freshwater habitats: FMR 7274. LSU sequence data is available.

Fuscosporella Yang et al., Cryptog. Mycol. 37(4): 457 (2016)

Asexual morph Descriptions and illustrations see Yang et al. (2016). **Sexual morph** Undetermined.

Type species: *Fuscosporella pyriformis* Yang et al., Cryptog. Mycol. 37(4): 458 (2016)

Notes: *Fuscosporella* is the type genus of the family Fuscosporellaceae with *F. pyriformis* as the type species (Yang et al. 2016a). Currently, two species are included in the genus and both are reported from freshwater streams in Thailand. *Fuscosporella* morphologically resembles *Bactrodesmiastrum* and *Bactrodesmium* which they share the characters as having sporodochial conidiomata, monoblastic conidiogenous cells and brown septate conidia (Hernández-Restrepo et al. 2013, 2015a). However, species in *Fuscosporella* have hyphoid, hyaline conidiogenous cells, while *Bactrodesmiastrum* species are characterized by solitary or aggregated conidiophores reduced to brown, single or moniliform conidiogenous cells (Holubová-Jechová 1984; Hernández-Restrepo et al. 2015a). *Bactrodesmium* differs from *Fuscosporella* in having hyaline or brown, simple or branched conidiophores supporting mono- or polyblastic conidiogenous cells (Ellis 1971; Holubová-Jechová 1972). Phylogenetic studies indicate that *Bactrodesmium* lies within the Dothideomycetes (Hernández-Restrepo et al. 2015a) while *Fuscosporella* belongs to Fuscosporellales, Sordariomycetes (Yang et al. 2016a, 2017).

Fuscosporella aquatica J. Yang & K.D. Hyde

Distribution: **Thailand**, Phang Nga Province, Bann Tom Thong Khang, on decaying wood submerged in a freshwater stream (Yang et al. 2017).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–1973. ITS, LSU and SSU sequence data are available.

Fuscosporella pyriformis Yang et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, on submerged wood in freshwater stream (Yang et al. 2016a).

Sexual morph: Undetermined

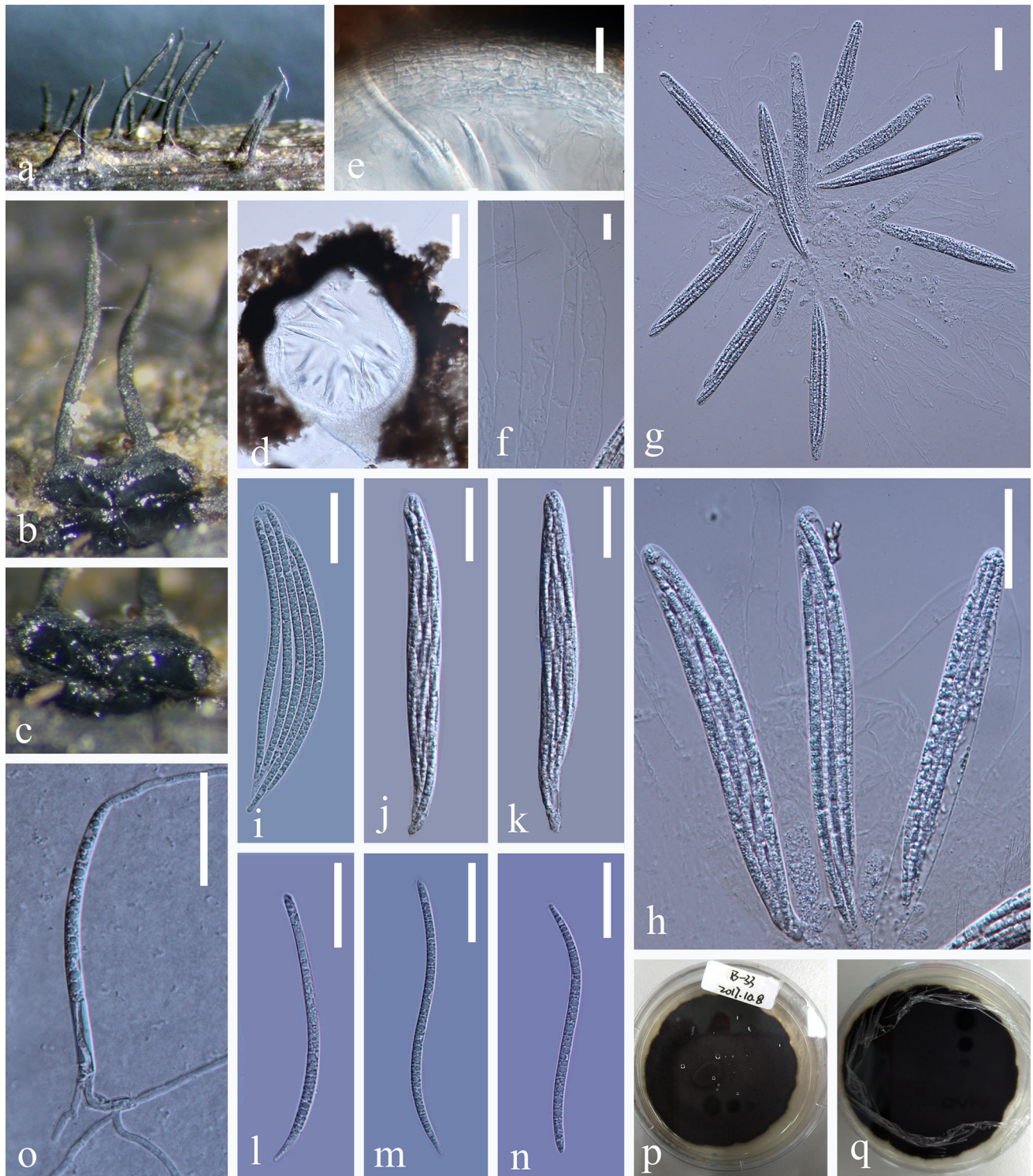


Fig. 42 *Phaeoisaria filiformis* (MFLU 18–1462, holotype). **a, b** Ascomata necks on decaying wood. **c** Ascomata **d** Section of ascomata. **e** Section of peridium. **f** Paraphyses. **g–k** Asci. **l–**

n Ascospore. **o** germinating ascospore. Cultures on PDA from above (**p**) and reverse (**q**). Scale bars: **d** 100 μ m, **e** 20 μ m, **f–o** 30 μ m

Notes: Holotype MFLU 16–1979, isotype HKAS 95050. ITS, LSU, SSU and RPB2 sequence data are available.

Asexual morph Descriptions and illustrations see Yang et al. (2016a). **Sexual morph** Undetermined.

Mucispora Yang et al., Cryptog. Mycol. 37(4): 466 (2016)

Type species: *Mucispora obscuriseptata* J. Yang, Bhat & K.D. Hyde, Cryptog. Mycol. 37(4): 466 (2016)

Notes: In the family Fuscosporellaceae, *Mucispora* is different from the asexual genera *Bactrodesmisatrum*, *Fuscosporella* and *Parafuscosporella* by its distinctive longer brown conidiophores. *Mucispora* is morphologically similar to *Acrogenospora* and *Monotosporella* in producing unbranched, percurrent conidiophores and brown conidia (Cai et al. 2006b). However, conidia in *Mucispora* and *Monotosporella* are septate while those in *Acrogenospora* are unicellular. Presently, two species are included in *Mucispora* and both were collected from freshwater habitats in Thailand (Yang et al. 2016a, 2017).

Mucispora obscuriseptata Yang et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, Hua Hin, stream flowing outside Kaeng Krachan National Park, on decaying submerged wood (Yang et al. 2016a).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1153, isotype HKAS 95047. ITS, LSU and SSU sequence data are available.

Mucispora phangngaensis J. Yang & K.D. Hyde

Distribution: **Thailand**, Phang Nga Province, Bann Tom Thong Khang, on decaying wood submerged in a freshwater stream (Yang et al. 2017).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–1974. ITS, LSU and SSU sequence data are available.

Parafuscosporella J. Yang & K.D. Hyde, Cryptog. Mycol. 37(4): 458 (2016)

Asexual morph Descriptions and illustrations see Yang et al. (2016a). **Sexual morph** Undetermined.

Type species: *Parafuscosporella moniliformis* J. Yang, Bhat & K.D. Hyde, Cryptog. Mycol. 37(4): 460 (2016)

Notes: The generic delimitation of *Parafuscosporella* and *Fuscosporella* is narrow. However, the two genera are phylogenetically distinct. Based on the morphology of sporulating on media, *Fuscosporella* is distinct from *Parafuscosporella* by multi-celled, filamentous to helicoid conidia, while *Parafuscosporella* produces globose to obpyriform, uniseptate conidia in culture. Three species are included in *Parafuscosporella* and all were reported from freshwater habitats in Thailand.

Parafuscosporella Garethii Boonyuen et al.

Distribution: **Thailand**, Chiang Mai Province, Chiang Dao District, a small stream at Ban Hua Thung community forest, on unidentified decaying submerged wood (Boonyuen et al. 2016).

Sexual morph: Undetermined

Notes: Holotype BBH 40839, paratype BBH 40840. LSU, SSU and RPB2 sequence data are available.

Parafuscosporella moniliformis Yang et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, on decaying wood submerged in a freshwater stream (Yang et al. 2016a).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1161, isotype HKAS 95049. ITS, LSU and SSU sequence data are available.

Parafuscosporella mucosa Yang et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, Hua Hin, stream flowing outside Kaeng Krachan National Park, on decaying submerged wood (Yang et al. 2016a).

Sexual morph: Undetermined

Notes: Holotype MFLU 16–1980, isotype HKAS 95051. ITS, LSU and SSU sequence data are available.

Plagiascoma Réblová & J. Fourn, Persoonia 37: 69 (2015) [2016]

Asexual morph Undetermined. **Sexual morph** *Ascomata* perithecial, immersed, gradually erumpent to semi-immersed, non-stromatic, conical, dark brown, lying obliquely to horizontally, papillate or with a neck. *Ostiole* periphysate. *Peridium* fragile, 2-layered. *Paraphyses* abundant, persistent, septate. *Asci* 8-spored, unitunicate, cylindrical to cylindricalfusiform, stipitate, apex with a non-amyloid apical annulus. *Ascospores* fusiform, transversely septate, hyaline.

Type species: *Plagiascoma frondosum* Réblová & J. Fourn., Persoonia 37: 69 (2015) [2016]

Notes: *Plagiascoma* is a monotypic genus placed at the basal branch in Fuscosporellales (Réblová et al. 2016a; Yang et al. 2016a, 2017; Hernández-Restrepo et al. 2017). *Plagiascoma frondosum* resembles species in *Annulatasacus*, e.g. *A. nilensis* and *A. tropicalis*, in having cylindrical asci with obvious non-amyloid apical annulus and fusiform, hyaline, multi-septate ascospores. Most *Annulatasacus* species have mucilaginous sheaths while no sheath or appendages were observed in *P. frondosum*. Presently, only one species is included in this genus which was collected from freshwater habitats and only known from the type locality.

Plagiascoma frondosum Réblová & J. Fourn.

Distribution: **France**, Midi-Pyrénées, Ariège, Rimont, valley of La Maille brook, submerged decorticated wood of *Fraxinus excelsior* (Réblová et al. 2016a)

Asexual morph: Undetermined

Notes: Holotype PRM 933854. LSU, SSU, RPB2 and MCM7 sequence data are available.

Pseudoascotaiwania Yang et al., Cryptog. Mycol. 37(4): 471 (2016)

Asexual morph Undetermined. **Sexual morph** *Ascomata* scattered, immersed, urniform, rostrate, membranous, black, paraphysate, ostiolate. *Ostiole* periphysate. *Peridium* several layers thick, brown, with *textura angularis*. *Paraphyses* simple or branched. *Asci* unitunicate, 8-spored,

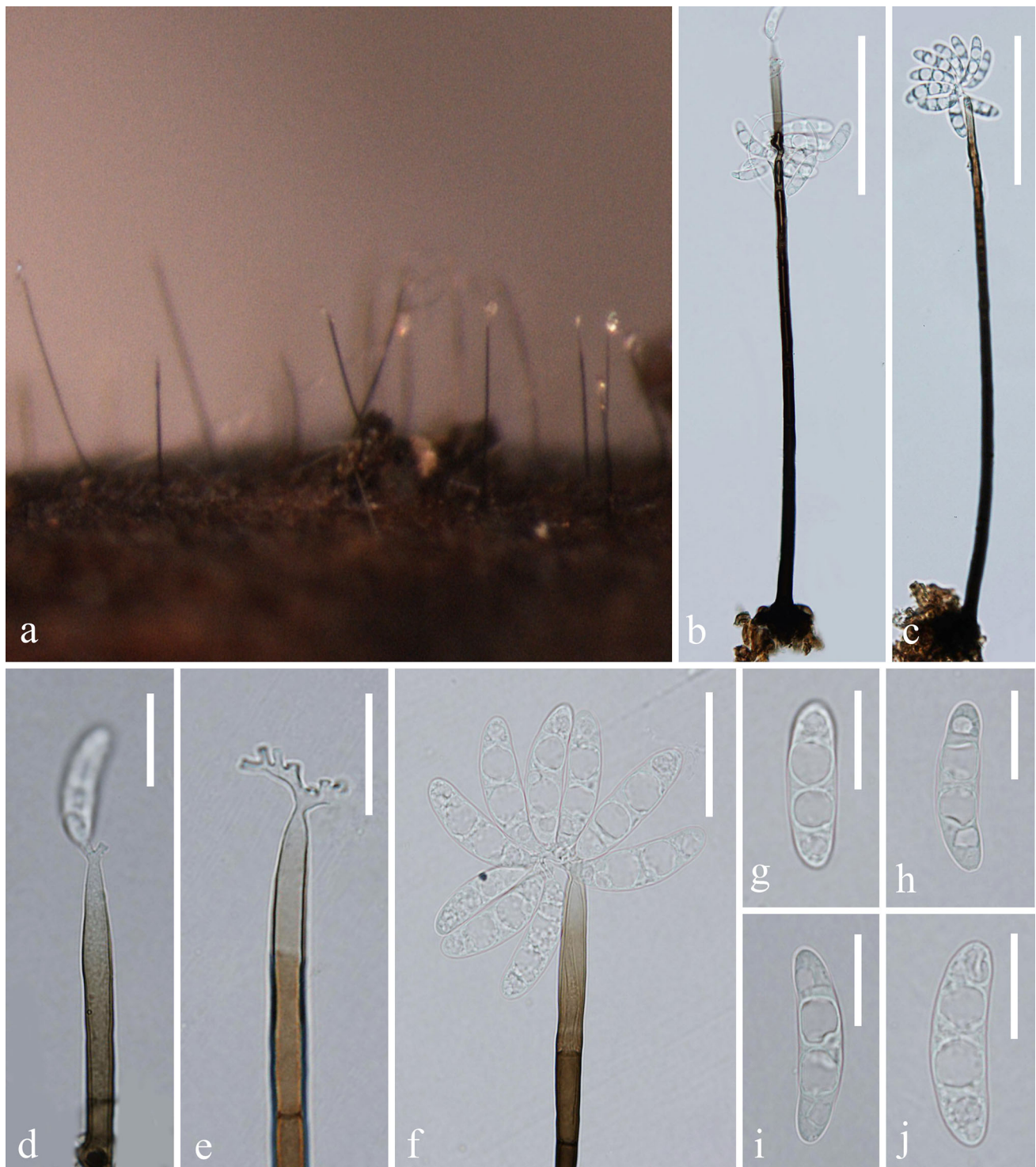


Fig. 43 a *Pleurothecium recurvatum* (DLU 0611) a Colonies on substrate. b, c Conidiophore with conidia. d–e conidiogenous cells with conidia. g–h Conidium. Scale bars: b, c 100 μ m, d–f 25 μ m, g–h 15 μ m

cylindrical, persistent, pedicellate, with a non-amyloid apical ring. *Ascospores* uniseriate, cylindrical to fusiform, 5–6-septate, sometimes slightly constricted at the septa, with central cells light brown, end cells hyaline.

Type species: *Pseudoascotaiwania persoonii* (Fallah et al.) Yang et al., *Cryptog. Mycol.* 37(4): 471 (2016)

Notes: *Ascotaiwania persoonii* is phylogenetically distinct from *Ascotaiwania* species in Savoryellales. Yang et al. (2016a) introduced a new genus *Pseudoascotaiwania*

to accommodate *Ascotaiwania personii* and assigned this genus in Fuscosporellales.

Pseudoascotaiwania personii (Fallah et al.) Yang et al.
 ≡ *Ascotaiwania personii* Fallah et al., Can. J. Bot. 77(1): 87 (1999)

Distribution: **Canada**, Manitoba, Grass River, on decorticated submerged wood (Fallah et al. 1999).

Asexual morph: Undetermined

Notes: Holotype ILLS 52298. LSU sequence data is available.

Pleurotheciales Réblová & Seifert

Pleurotheciaceae Réblová & Seifert

Monotosporella S. Hughes, Can. J. Bot. 36: 786 (1958)

Asexual morph Colonies on natural substrate effuse. Mycelium immersed, consisting of brown, septate, thin-walled, branched hyphae. Conidiophores macronematous, mononematous, solitary, erect, straight, unbranched, cylindrical, septate, smooth, thick-walled. Conidiogenous cells holoblastic, monoblastic, integrated, terminal, cylindrical. Conidia acrogenous, obovoid to pyriform, or clavate, septate, brown to black, paler towards the base, smooth-walled. Conidial sessesion schizolytic. **Sexual morph** Undetermined.

Type species: *Monotosporella setosa* (Berk. & M.A. Curtis) S. Hughes, Can. J. Bot. 36: 787 (1958)

Notes: *Monotosporella* was introduced by Hughes (1958) with *M. setosa* as the type species. *Monotosporella* is characterized by unbranched, percurrently proliferating conidiophores, septate, pyriform to obvoid, dark brown to black conidia. There are 12 species in this genus and two of them were reported from freshwater habitats (Ranghoo et al. 1999; Tsui et al. 2001e; Cai et al. 2003b).

Monotosporella microaquatica (Tubaki) Sv. Nilsson

≡ *Dactylella microaquatica* Tubaki, Bull. natn. Sci. Mus., Tokyo, N.S. 3: 256 (1957)

Distribution: **Philippines**, on submerged wood in the Liput River (Cai et al. 2003b)

Sexual morph: Undetermined

Notes: Holotype is not indicated. Sequence data is not available.

Monotosporella rhizoidea V. Rao & de Hoog

Distribution: **China**, Hong Kong, on submerged wood (Ranghoo et al. 1999; Tsui et al. 2001e).

Sexual morph: Undetermined

Notes: Sequence data is not available.

Phaeoisaria Höhn., Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1 118: 330 [56 repr.] (1909)

Asexual morph Conidiomata synnematal, indeterminate, scattered, erect, rigid, dark brown to black, composed of compactly and parallelly adpressed conidiophores. Conidiophores macronematous, synnematos, brown to dark brown, smooth. Synnemata erect, rigid, dark brown to

black, velvety, smooth, composed of compactly and parallelly adpressed conidiophores, with flared conidiogenous cells in the above half. Conidiogenous cells polyblastic, terminal and intercalary, mostly discrete, sometimes integrated, recurved, smooth, sympodial extended, denticulate, subhyaline to pale brown, sympodial, each with one to several denticulate conidiogenous loci. Conidia ellipsoidal to obovoidal or cylindrical-ovate, straight, guttulate, smooth-walled. **Sexual morph** Ascomata superficial to immersed, globose to elongate globose, with a long neck. Paraphyses numerous, filamentous, branched, septate, smooth. Asci 8-spored, unitunicate, cylindrical, thin-walled, with a small refractive apical apparatus, smooth-walled. Ascospores filiform, guttulate, tapered at both ends, septate, hyaline, smooth-walled.

Type species: *Phaeoisaria bambusae* Höhn., Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1 118: 329 (1909)

Notes: *Phaeoisaria* was introduced by Höhnelt (1909) for a collection on *Gigantochloa* sp. (Bambusae) and is typified by *P. bambusae* Höhn. Three species in *Phaeoisaria* have been reported from freshwater habitats and all of them were collected from southwestern China (Hyde et al. 2018; Luo et al. 2018b).

Phaeoisaria aquatica Luo et al.

Distribution: **China**, Yunnan Province, Jinsha River, saprobic on decaying wood submerged (Luo et al. 2018b).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0918. ITS, LSU and RPB2 sequence data are available. This species is only known from the type locality.

Phaeoisaria clematidis (Fuckel) S. Hughes

≡ *Stysanus clematidis* Fuckel, Jb. Nassau. Ver. Naturk. 23–24: 365 (1870)

Distribution: **China**, Yunnan Province, Lancang River, saprobic on submerged decaying wood (Luo et al. 2018b).

Sexual morph: Undetermined

Notes: Specimens collected from freshwater habitats: MFLU 17–0919, MFLU 17–0920. ITS, LSU, SSU and RPB2 sequence data are available.

Phaeoisaria guttulata J. Yang & K.D. Hyde

Distribution: **China**, Guizhou Province, Anshun city, Gaodang village, on decaying wood submerged in Suoluo River (Hyde et al. 2018).

Sexual morph: Undetermined

Notes: Holotype MFLU 18–0139; ITS, LSU, SSU sequence data are available.

Phaeoisaria filiformis D.F. Bao, Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555671, Facesoffungi number: FoF 05452, Fig. 42

Etymology: Referring to the filiform ascospores of this fungus.

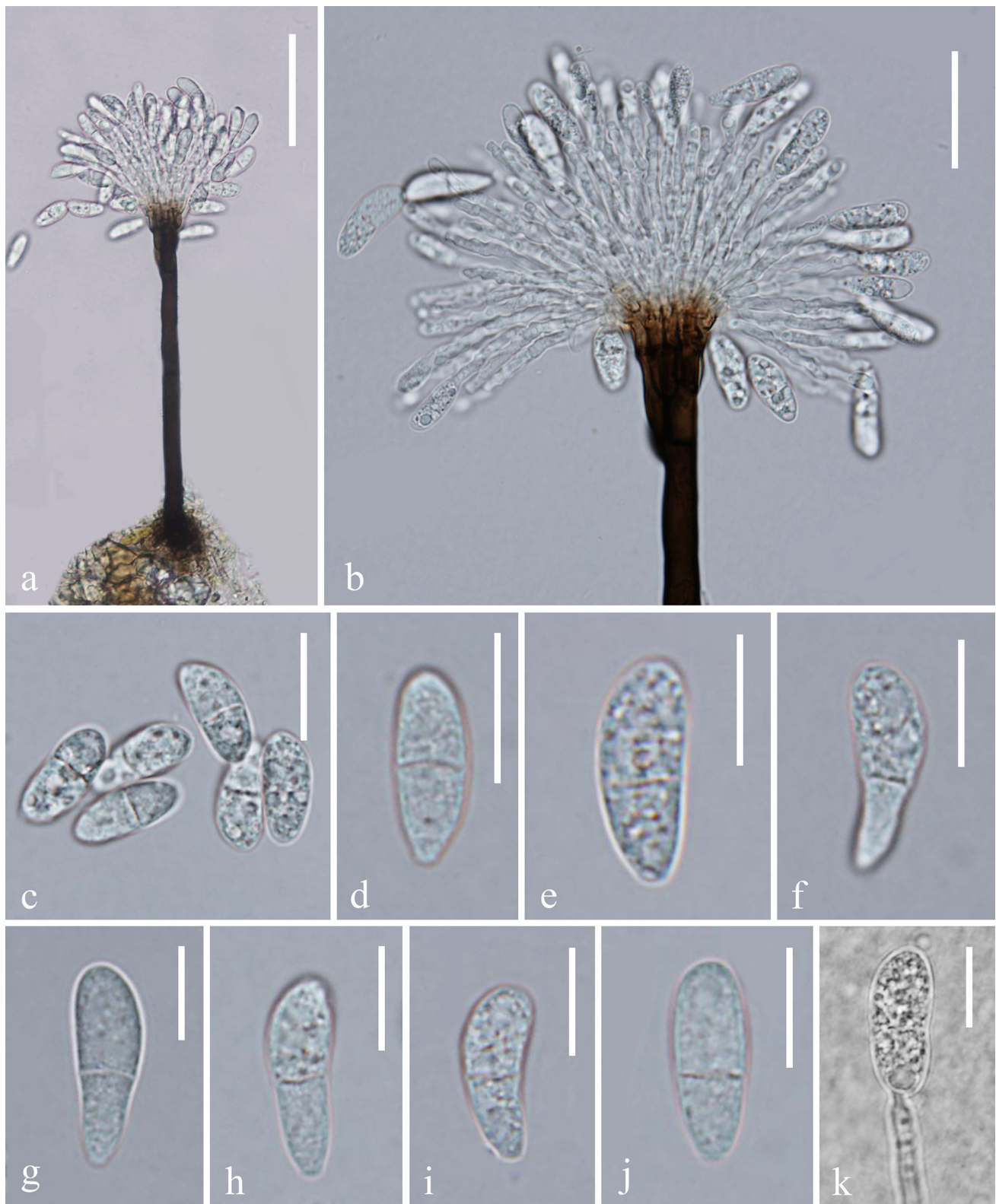


Fig. 44 *Sterigmatobotrys uniseptata* (HKAS 83988) **a** Conidiophore with conidia. **b** Conidiogenous cells with coidia. **c–j** Conidia. **k** Germinating conidium. Scale bars: **a** 50 μm , **b** 25 μm , **c** 15 μm , **d–k** 10 μm

Holotype: MFLU 18–1462

Saprobic on decaying wood submerged in freshwater.

Asexual morph Undetermined. **Sexual morph** *Ascomata* 350–450 µm diam., 400–450 µm high, immersed, globose to elongate globose, with a long, cylindrical, black neck. *Peridium* 29–31 µm thick, composed 2 layers, inner layer composed of hyaline, thin-walled cells of *textura angularis*, outer layer comprised of small angular cells with dark brown amorphous material. *Paraphyses* 7–11 µm wide, numerous, filamentous, branched, septate, smooth. *Asci* 120–136 × 12–14 µm (\bar{x} = 128 × 13 µm, n = 30), 8-spored, unitunicate, cylindrical, thin-walled, with a small refractive apical apparatus, smooth. *Ascospores* 88–116 × 2.5–3.5 µm (\bar{x} = 102 × 3 µm, n = 30), filiform, guttulate, tapering at both ends, multi-septate, hyaline, smooth-walled.

Material examined: **THAILAND**, Sai khu Waterfall, on submerged decaying wood, August 2017, K. Vinit, B-33 (MFLU 18–1462, holotype), ex-type living culture, MFLUCC 18–0214.

Notes: *Phaeoisaria filiformis* resembles species of *Ophioceras* and *Ceratosphaeria* in having immersed ascomata with a long, cylindrical, black neck, unitunicate, 8-spored, cylindrical asci and hyaline, guttulate, filiform ascospores (Niessl 1876; Saccardo 1883; Hu et al. 2012c). However, phylogenetic analysis shows that *Phaeoisaria filiformis* belongs to the Pleurotheciales while *Ophioceras* and *Ceratosphaeria* belong to Magnaporthales (Fig. 1, clade 19, 20, 43).

Pleurotheciella Réblová et al., Mycologia 104(6): 1304 (2012)

Asexual morph: Descriptions and illustrations see Réblová et al. (2012), Luo et al. (2018b). **Sexual morph:** Descriptions and illustrations see Réblová et al. (2012).

Type species: *Pleurotheciella rivularia* Réblová et al., Mycologia 104(6): 1304 (2012)

Notes: *Pleurotheciella* was introduced by Réblová et al. (2012) with two new species, *P. rivularia* and *P. centenaria* and both were collected from freshwater habitats. Presently, eleven species are accepted in this genus. *Pleurotheciella* is a representative freshwater fungal genus as all species in this genus were reported from freshwater and most of them were collected from Asia (Hyde et al. 2018; Luo et al. 2018b).

Pleurotheciella aquatica Luo et al.

Distribution: **China**, Yunnan Province, Jinsha River, saprobic on decaying wood submerged (Luo et al. 2018b).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0911. ITS, LSU, SSU and RPB2 sequence data are available.

Pleurotheciella centenaria Réblová et al.

Distribution: **Canada**, Ontario, Centennial Lake, on decaying submerged wood (Réblová et al. 2012).

Sexual morph: Undetermined

Notes: Holotype DAOM 229631. ITS, LSU, SSU and RPB2 sequence data are available.

Pleurotheciella fusiformis Luo et al.

Distribution: **China**, Yunnan Province, Erhai Lake, on decaying submerged wood (Luo et al. 2018b).

Asexual morph: see Luo et al. (2018b).

Notes: Holotype MFLU 17–0909, isotype HKAS 92582, other specimens collected from freshwater MFLU 17–0907, MFLU 17–0908, MFLU 17–0910. ITS, LSU, SSU and RPB2 sequence data are available.

Pleurotheciella guttulata Luo et al.

Distribution: **China**, Yunnan Province, Dulong River, on decaying submerged wood (Luo et al. 2018b).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0914, isotype HKAS 92699. ITS, LSU, SSU and RPB2 sequence data are available.

Pleurotheciella krabiensis J. Yang & K.D. Hyde

Distribution: **Thailand**, Krabi Province, on decaying wood submerged in a freshwater stream near Morakot lake (Hyde et al. 2018).

Sexual morph: Undetermined

Notes: Holotype MFLU 18–0140. ITS, LSU and SSU sequence data are available.

Pleurotheciella lunata Luo et al.

Distribution: **China**, Yunnan Province, Jinsha River, saprobic on decaying wood submerged (Luo et al. 2018b).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0913; ITS, LSU, SSU and RPB2 sequence data are available. This species is only known from the type locality.

Pleurotheciella rivularia Réblová et al.

Distribution: **France**, on decaying submerged wood of *Hedera helix* (Réblová et al. 2012).

Asexual morph: see Réblová et al. (2012)

Notes: Holotype PRM 899852, other specimen collected from freshwater habitats: PRM 899853. ITS, LSU, SSU and RPB2 sequence data are available.

Pleurotheciella saprophytica Luo et al.

Distribution: **China**, Yunnan Province, Jinsha River, saprobic on decaying wood submerged (Luo et al. 2018b).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0915. ITS, LSU, SSU and RPB2 sequence data are available. This species is only known from the type locality.

Pleurotheciella submersa Z.L. Luo & K.D. Hyde

Distribution: **China**, Yunnan Province, Jinsha River, saprobic on decaying wood submerged (Luo et al. 2018b).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0916. ITS, LSU, SSU and RPB2 sequence data are available. This species is only known from the type locality.

Pleurotheciella tropica J. Yang & K.D. Hyde

Distribution: **Thailand**, Phang Nga Province, Bann Tom Thong Khang, on decaying wood submerged in a freshwater stream (Hyde et al. 2018).

Sexual morph: Undetermined

Notes: Holotype MFLU 18–0141; ITS, LSU and SSU sequence data are available. This species is only known from the type locality.

Pleurotheciella uniseptata (Matsush.) Seifert.

≡ *Dactylaria uniseptata* Matsush.

Distribution: **China**, Yunnan Province, Jinsha River, saprobic on submerged decaying wood (Luo et al. 2018b).

Sexual morph: Undetermined

Notes: Specimen collected from freshwater habitats: MFLU 17–0912. ITS, LSU and RPB2 sequence data are available.

Pleurothecium Höhn., Ber. dt. bot. Ges. 37: 154 (1919)

Holomorph Descriptions and illustrations see Réblová et al. (2012).

Type species: *Pleurothecium recurvatum* (Morgan) Höhn., Centbl. Bakt. ParasitKde, Abt. II 60: 26 (1923) [1924]

Notes: *Pleurothecium* was introduced by Höhnelt (1919) with *P. recurvatum* (Morgan) Höhn as type species. Ten species are accepted in the genus *Pleurothecium* (Monteiro et al. 2016a; Hyde et al. 2017; Luo et al. 2018b) and four of them have been reported from freshwater habitats.

Pleurothecium aquaticum Luo et al.

Distribution: **China**, Yunnan Province, Dali, on decaying wood submerged in a stream (Luo et al. 2018b).

Sexual morph: Undetermined

Notes: Holotype MFLU 17–0922. ITS and LSU sequence data are available. This species is only known from the type locality.

Pleurothecium floriforme J. Yang & K.D. Hyde

Distribution: **Thailand**, Prachuap Khiri Khan Province, on decaying wood submerged in a freshwater stream (Hyde et al. 2017).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1163, isotype GZAAS 17–0013. ITS, LSU and SSU sequence data are available. This species is only known from the type locality.

Pleurothecium pulneyense Subram. & Bhat

Distribution: **China**, Yunnan Province, Jinsha River, saprobic on decaying wood submerged (Luo et al. 2018b); **India**, Western Ghats, on decomposing woody litter in a freshwater stream (Sridhar and Sudheep 2011).

Sexual morph: Undetermined

Notes: Specimen collected from freshwater MFLU 17–0921. LSU, SSU and RPB2 sequence data are available.

Pleurothecium recurvatum (Morgan) Höhn.

≡ *Acrothecium recurvatum* Morgan. J. Cincinnati Soc Nat Hist 18: 44 (1895)

Facesoffungi number: FoF 05453, Fig. 43

Saprobic on decaying wood submerged in freshwater.

Asexual morph Colonies effuse, superficial, hairy, brown to dark brown. Mycelium immersed or superficial. Conidiophores 299–371 μm long, 6–10 μm wide (\bar{x} = 335 \times 8 μm , n = 20), macronematous, mononematous, solitary, straight or slightly flexuous, septate, smooth, brown to dark brown, paler towards the apex. Conidiogenous cells holoblastic, polyblastic, integrated, terminal, denticulate, denticles cylindrical, hyaline or grayish. Conidia 25–31 μm long, 7–9 μm wide (\bar{x} = 28 \times 8 μm , n = 20), acrogenous, cylindrical or clavate, straight or slightly curved, rounded at both ends, 3-septate, guttulate, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Gaoligong Mountain, saprobic on decaying wood submerged in a freshwater stream, July 2015, X.J. Su, S-611 (DLU 0611), living culture DLUCC 0611.

Distribution: **China**, Yunnan Province, Baoshan city, on submerged wood in a stream in Gaoligong Mountain (This study).

Sexual morph: see Fernández et al. (1999)

Notes: Specimen collected from freshwater habitats: DLU 0611. ITS, LSU, SSU and RPB2 sequence data are available. Morgan (1895) introduced *Acrothecium recurvatum* and later this species was synonymised as *Pleurothecium recurvatum* by Höhnelt (1919). During the investigation on lignicolous freshwater fungi in China, a *Pleurothecium*-like fungus was collected from Yunnan Province. Morphologically, our new isolate fits well with *Pleurothecium recurvatum* in having macronematous, mononematous, solitary, straight or slightly flexuous, septate, smooth, brown to dark brown conidiophores paler towards the apex, integrated, terminal, polyblastic, denticulate, hyaline or grayish conidiogenous cells and cylindrical or clavate, straight or slightly curved, rounded at both ends, 3-septate, guttulate, smooth conidia with similar size (Höhnelt 1919; Goos 1969). Réblová et al. (2012) provided sequence data for *Pleurothecium recurvatum* and our phylogenetic analysis shows that the new isolate clusters with *P. recurvatum* with high support value (Fig. 1, clade 43). Based on the morphology and phylogeny, we identify our isolate as *Pleurothecium recurvatum* and provide descriptions and illustration.

Pleurothecium semifecundum Réblová et al.

Distribution: **France**, Haute Garonne, Mancieux, Ous-taus, le Rieutort Brook, on decaying submerged wood of *Sambucus nigra* (Réblová et al. 2012).

Asexual morph: see Réblová et al. (2012)

Notes: Holotype PRM1 899854, other specimen collected from freshwater habitats: PRM 899855. ITS, LSU and SSU sequence data are available.

Sterigmatobotrys Oudem.

Holomorph Descriptions and illustrations refer to Réblová and Seifert (2011).

Type species: *Sterigmatobotrys elata* (Sacc.) Oudem., Ned. kruidk. Archf., 2 sér. 4: 548 (1886)

Notes: *Sterigmatobotrys* was introduced by Oudemans (1886) with two species *S. elata* and *S. papyrogena*. It is a conspicuous, cosmopolitan dematiaceous hyphomycete genus with species occurring on decaying wood in both terrestrial (Sutton 1973; Hughes 1978; Thomas and Polwart 2003; Réblová and Seifert 2011) and freshwater (Eaton and Jones 1971; Eaton 1972; Chang 1991; Hyde and Goh 1999; Kane et al. 2002; Réblová and Seifert 2011). Three species are accepted in this genus (Réblová and Seifert 2011; Ertz et al. 2016).

Sterigmatobotrys macrocarpa (Corda) S. Hughes

≡ *Graphium macrocarpum* Corda, Icon. Fung. 3: 13 (1839) (holotype PRM 155517; epitype PRM 915682)

≡ *Harpographium macrocarpum* (Corda) Sacc., Syll. Fung. 4: 620 (1886)

= *Acrothecium bulbosum* Sacc., Michelia 1: 74 (1877)

= *Stachybotrys elata* Sacc., Michelia 2: 560 (1882)

Distribution: **Canada**, Ontario, on submerged wood in a stream (Réblová and Seifert 2011); **UK**, England, on submerged wood in River Coln (Hyde and Goh 1999).

Holomorph: see Réblová and Seifert (2011)

Notes: Epitype PRM 915682. LSU sequence data is available.

Sterigmatobotrys uniseptata H.S. Chang

Facesoffungi number: FoF 05454, Fig. 44

Saprobic on decaying wood submerged in freshwater.

Asexual morph Colonies effuse, hairy, brown to dark brown. Mycelium immersed. Conidiophores 90–138 µm long, 7–9 µm wide ($\bar{x} = 114 \times 8 \mu\text{m}$, $n = 20$), macronematous, mononematous, dark brown, septate, arising from stromatic cells, each composed of a well-defined stipe and a complex penicillate head consisting of series of penicillate branches and terminating with conidiogenous cells and a head of slimy conidia. Conidiogenous cells 32–48 µm long, 3–5 µm wide ($\bar{x} = 40 \times 4 \mu\text{m}$, $n = 20$), polyblastic, hyaline, parallel, smooth-walled. Conidia 15–19 µm long, 5–9 µm wide ($\bar{x} = 17 \times 7 \mu\text{m}$, $n = 20$), solitary, slimy, straight, cylindrical to subclavate, uniseptate, broad and rounded at the apex and gradually narrowing towards the base, thin-walled, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on decaying wood submerged in a

freshwater stream, March 2014, X.Y. Liu, S-030 (HKAS 83988), living culture MFLUCC 15–0358.

Distribution: **China**, Taiwan, on submerged wood (Chang 1991), Yunnan Province (This study).

Notes: Holotype WLG 0612, other specimen collected from freshwater HKAS 83988. ITS, LSU and SSU sequence data are provide in this study. *Sterigmatobotrys uniseptata* was introduced by Chang (1991). This species is characterized by its macronematous, mononematous, dark brown, septate conidiophores arising from stromatic cells, each composed of a well-defined stipe and a complex penicillate head consisting of series of penicillate branches and terminating with conidiogenous cells and a head of slimy conidia, polyblastic, hyaline conidiogenous cells and solitary, slimy, thin-walled, hyaline, smooth, uniseptate, straight, cylindrical to subclavate conidia (Chang 1991). During the investigation of lignicolous freshwater fungi in China, a *Sterigmatobotrys*-like fungus was collected from Yunnan Province. Morphologically, our isolate fits well with *Sterigmatobotrys uniseptata* (Chang 1991). Phylogenetic analysis shows that our isolate clusters together with *Sterigmatobotrys macrocarpa* (DAOM230059, MR2973) and *Sterigmatobotrys rudis* (DAOM 229838), but the topology supports they are distinct species (Fig. 1, clade 43). Based on morphology and phylogeny, we identify our isolate as *Sterigmatobotrys uniseptata* and provide the descriptions and illustrations for this species as well as sequence data.

Savoryellales Boonyuen et al.

Savoryellaceae Jaklitsch & Réblová

Ascotaiwania Sivan. & H.S. Chang, Mycol. Res. 96(6): 481 (1992)

Asexual morph Colonies scattered, glistening, black. Mycelium mostly immersed, consisting of hyaline hyphae. Conidiophores micronematous or semi-micronematous, mononematous, solitary, erect, smooth, pale brown, septate, sometimes reduced to conidiogenous cells. Conidiogenous cells monoblastic, integrated, terminal, cylindrical, hyaline to pale brown. Conidia acrogenous, fusiform, ellipsoidal or obovoid, dark brown, paler at the basal cell, smooth, 2–5-euseptate, with darker bands obscuring the septa. **Sexual morph** Ascomata immersed, semi-immersed, or superficial, solitary or aggregated. perithecioid, globose or subglobose, coriaceous, brown or black, papillate, ostiolate. Ostiole mostly central or if ascomata lying horizontal to the host surface, then at one end and curving upwards, long or short, usually brown or black, periphysate. Peridium comprising several layers of brown thick-walled compressed angular cells, hyaline at the inner walls. Paraphyses hyaline, filiform, tapering distally, septate. Ascii 8-spored, unitunicate, cylindrical, pedicellate, truncate at the apex, with a distinct non-amyloid apical annulus.

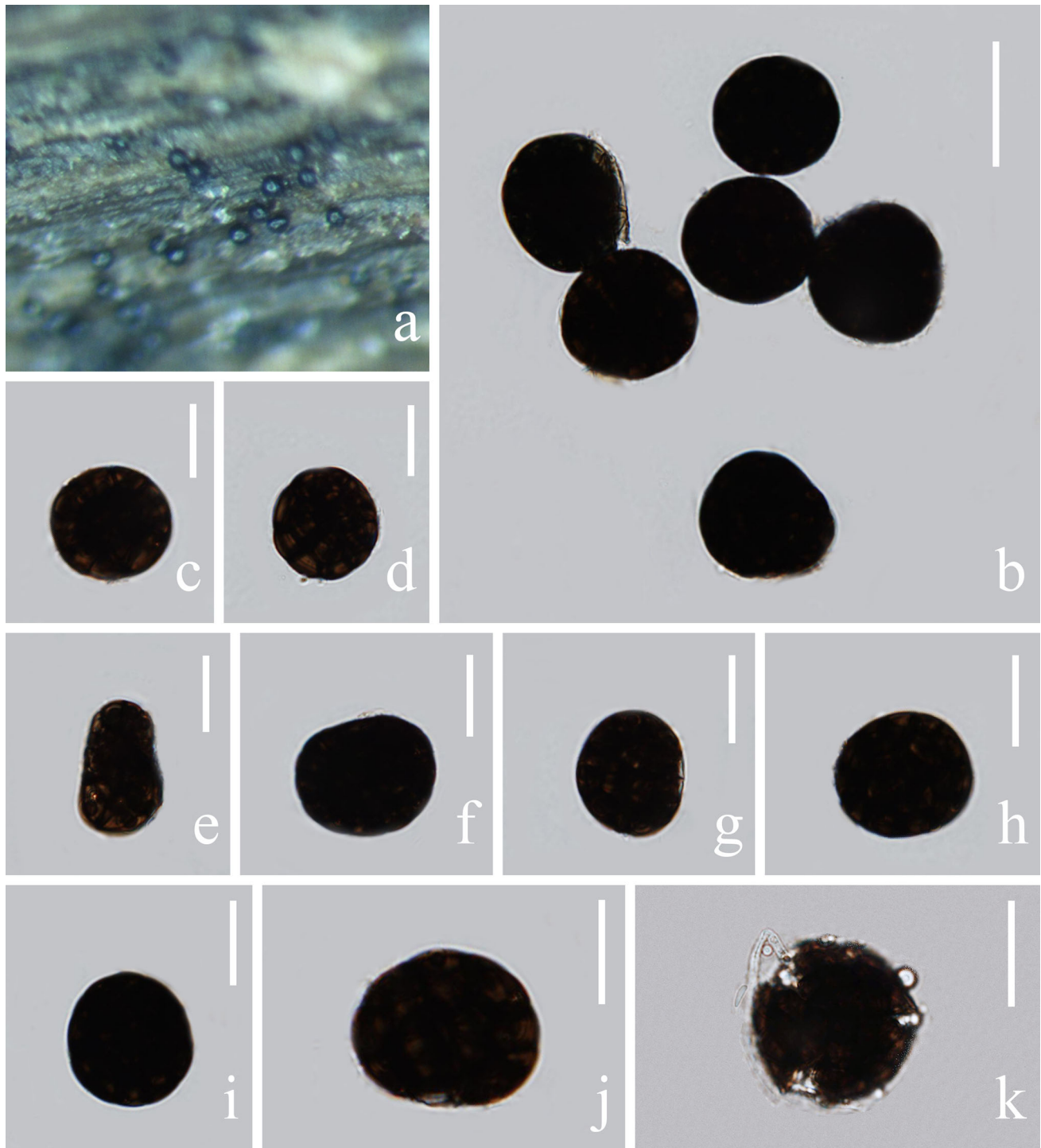


Fig. 45 *Dematiosporium aquaticum* (HKAS 92564, holotype) **a** Colony on natural substrate. **b–k** Conidia. Scale bars: **b** 25 μ m, **c–k** 15 μ m

Ascospores uniseriate or overlapping biseriata, fusiform, straight or somewhat curved, 3–7-euseptate, sometimes slightly constricted at the septa, with central cells brown, end cells hyaline or pale colour, smooth, thick-walled, with or without mucilaginous sheaths and appendages.

Type species: *Ascotaiwania lignicola* Sivan. & H.S. Chang, Mycol. Res. 96(6): 481 (1992)

Notes: *Ascotaiwania* was introduced by Sivanesan and Chang (1992) with *A. lignicola* as the type species. *Savoryella* is comparable to *Ascotaiwania*, but species of *Savoryella* have 3-euseptate ascospores, while in

Ascotaiwania, they can be 37-euseptate. Molecular studies revealed the placement of *Ascotaiwania* within *Savoryelales* along with the genera *Canalisporium* (*Ascothailandia*) and *Savoryella*, except *A. hughesii* which was placed in Pleurotheciales and *A. personii* (*Pseudoascotaiwania personii*) to Fuscosporellales (Boonyuen et al. 2011; Réblová et al. 2016a; Yang et al. 2016a). However, Hernández-Restrepo et al. (2017) investigated the phylogeny of *Savoryelales* and reported *Ascotaiwania* was polyphyletic within the order. We follow Boonyuen et al. (2011), Réblová et al. (2016c) and Yang et al. (2016) to treat *Ascotaiwania* as a monophyletic clade in *Savoryelales*.

Ascotaiwania fusiformis Yang et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, on decaying submerged wood in a stream (Yang et al. 2016a).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1156, isotype HKAS 95048. LSU, SSU and RPB2 sequence data are available. Yang et al. (2016a) introduced this asexual morph species based on collection from freshwater habitats in Thailand and it is only known from the type locality.

Ascotaiwania hsilio H.S. Chang & S.Y. Hsieh

Distribution: **China**, Taiwan, on submerged wood (Chang et al. 1998); **USA**, (Fallah et al. 1999; Raja et al. 2009b).

Asexual morph: see Chang (2001)

Notes: Holotype HAST, Chang WL0121-K-3. Sequence data is not available.

Ascotaiwania hughesii Fallah et al.

Distribution: **USA**, Wisconsin, Sparkling lake and Trout lake, on submerged wood (Fallah et al. 1999).

Asexual morph: *Helicoon farinosum* Linder (Fallah et al. 1999)

Notes: Holotype ILLS 53605, other specimens collected from freshwater ILLS 53607, ILLS 53608, ILLS 53609, ILLS 53610. LSU sequence data is available.

Ascotaiwania limnetica (H.S. Chang & S.Y. Hsieh) Réblová & J. Fourn.

≡ *Savoryella limnetica* H.S. Chang & S.Y. Hsieh, Mycol. Res. 102: 715. (1998)

Distribution: **China**, Taiwan, on submerged wood (Chang et al. 1998); **France**, on submerged wood (Van Vooren 2010; Réblová et al. 2016a); **India**, north Maharashtra, on submerged wood (Patil and Borse 2011);

Asexual morph: see Réblová et al. (2016c)

Notes: Holotype HAST, Chang WL0713-T-2, other specimens collected from freshwater PRM 933849, PRM 933851. ITS, LSU, SSU and MCM7 sequence data are available.

Ascotaiwania mitriformis Ranghoo & K.D. Hyde

Distribution: **China**, Hong Kong, Plover Cove Reservoir, on submerged wood (Ranghoo and Hyde 1998).

Asexual morph: see Ranghoo and Hyde (1998)

Notes: Holotype IFRD 8696. LSU sequence data is available. This species is only known from the type locality.

Ascotaiwania pallida K.D. Hyde & Goh

Distribution: **Australia**, on submerged wood (Vijaykrishna and Hyde 2006); **Brunei**, Tutong River, on submerged wood (Fryar et al. 2004); **UK**, Gloucestershire, nr Cheltenham, Chedworth Woods, River Coln, on submerged wood (Hyde and Goh 1999).

Asexual morph: Undetermined

Notes: Holotype IFRD 8697. Sequence data is not available.

Ascotaiwania palmicola K.D. Hyde

Distribution: **Australia**, Queensland, on submerged wood in a stream in Mt. Lewis (Hyde and Goh 1997)

Asexual morph: Undetermined

Notes: Holotype BRIP 22744. Sequence data is not available. This species is only known from the type locality.

Ascotaiwania sawadae H.S. Chang & S.Y. Hsieh

Distribution: **China**, on submerged wood (Chang et al. 1998); **Thailand**, Khao Yai National Park, on well-rotted, decorticated hard wood, submerged in a freshwater stream (Sivichai et al. 1998a).

Asexual morph: see state Sivichai et al. (1998a)

Notes: Holotype HAST, Chang HTP0329-A0-2. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available. This species is only known from the type locality.

Ascotaiwania wulai H.S. Chang & S.Y. Hsieh

Distribution: **China**, Taiwan, on submerged wood in freshwater stream (Chang et al. 1998).

Asexual morph: Undetermined

Notes: Holotype HAST, Chang HTP0421-W2. Sequence data is not available. This species is only known from the type locality.

Canalisporium Nawawi & Kuthub., Mycotaxon 34(2): 477 (1989)

Asexual morph Colonies sporodochial, scattered, punctiform, dark brown to black, glistening. Mycelium mostly immersed, consisting of branched, septate, smooth, thin-walled, pale to brown hyphae. Conidiophores microne-matous or semi-macronematous, septate, simple or sparsely branched, loosely fasciculate, becoming vesiculate and disintegrating as conidia mature, subhyaline or lightly pigmented, smooth, thin-walled. Conidiogenous cells holoblastic, monoblastic, integrated, terminal, determinate, hyaline or pale brown, globose to ellipsoid. Conidia acrogenous, solitary, dry, pale or pigmented, muriform, with ordered arrangement of vertical and transverse septa,

slightly constricted at the septa, complanate, usually with a pale basal cell, rarely with several small cells at the base, with cell lumen connected by septal canals, sometimes with one-cell layer thickened, smooth-walled. **Sexual morph** *Ascomata* immersed, semi-immersed or superficial, perithecioid, globose or subglobose, dark brown to black, solitary or scattered, ostiolate. *Ostiole* mostly central but curving upwards at one end if *ascomata* lying horizontal to the host surface, long or short, usually brown or black, periphysate. *Paraphyses* hypha-like, tapering distally, not embedded in a gelatinous matrix. *Asci* 8-spored, unitunicate, long cylindrical, pedunculate, truncate at the apex, with a refractive non-amyloid apical ring. *Ascospores* uniseriate, fusiform, straight or slightly curved, 3-euseptate and versicolurus.

Type species: *Canalisporium caribense* (Hol.-Jech. & Mercado) Nawawi & Kuthub., Mycotaxon 34(2): 479 (1989)

Notes: *Canalisporium* was established to accommodate *Berkleasium caribense*, *B. pulchrum* with a new species *C. elegans*. Twelve species are included in the genus with ten species encountered in freshwater habitats. Sri-indrasutdhi et al. (2010) introduced the only known sexual morph *Ascothailandia grenadoidea* in the genus with *Canalisporium* asexual morph sporulating from the culture. Further molecular studies supported the connection between *Ascothailandia* and *Canalisporium* and placed the genus within Savorielales (Sri-indrasutdhi et al. 2010; Jones et al. 2016; Réblová et al. 2016a). With the one fungus one name (Hawksworth 2011), the genus *Canalisporium* has priority and thus *Ascothailandia* was synonymized under *Canalisporium* (Réblová et al. 2016c).

Canalisporium caribense (Hol.-Jech. & Mercado) Nawawi & Kuthub.

≡ *Berkleasium caribense* Hol.-Jech. & Mercado, Česká Mykol 38: 99 (1984)

Distribution: **Brunei**, Temburong, Batu Apoi Forest Reserve, on submerged wood (Goh et al. 1998a); **China**, Hong Kong, New Territories, Tai Po, Tai Po Kau Country Park, on submerged wood (Goh et al. 1998a); **India**, Karnataka, River Kali (Sridhar et al. 2011), North Maharashtra (Patil et al. 2014); **Malaysia**, submerged wood in stream (Ho et al. 2001); **Panama**, Colon Province, Soberania National Park/Juan Grande River/Limbo River/Conrad stream, on submerged decorticated wood (Ferrer and Shearer 2005); **Thailand**, Chiang Rai Province, Hui Kang Pla waterfall National Park/Khun Korn Waterfall, on submerged wood (Zhang et al. 2014); **USA**, Florida (Raja et al. 2009b).

Sexual morph: Undetermined

Notes: Specimen collected from freshwater MFLU 11–1071. ITS, LSU, SSU and RPB2 sequence data are available.

Canalisporium elegans Nawawi & Kuthub

Distribution: **Brunei**, Temburong, Batu Apoi Forest Reserve, on submerged wood (Goh et al. 1998a); **Panama**, Colon Province, Soberania National Park/Limbo River/Frijoles River/Gatum lake/Wheeler stream, on submerged decorticated wood (Ferrer and Shearer 2005); **Thailand**, Chiang Rai Province, Hui Kang Pla waterfall National Park, on submerged wood (Zhang et al. 2014).

Sexual morph: Undetermined

Notes: Holotype IMI 326603, other specimen collected from freshwater MFLU 10–0181. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

Canalisporium exiguum Goh & K.D. Hyde

Distribution: **Australia**, north Queensland, Atherton Tablelands, Lake Barrine, on submerged wood (Goh et al. 1998a);

Sexual morph: Undetermined

Notes: Holotype IFRD 8720. ITS, LSU, SSU and RPB2 sequence data are available.

Canalisporium grenadoideum Sri-indr. et al.

Distribution: **Thailand**, Narathiwat Province, Hala Bala Wildlife Sanctuary, on submerged wood of *Wrightia tomentosa* (Sri-indrasutdhi et al. 2010).

Sexual morph: see Sri-indrasutdhi et al. (2010)

Notes: Holotype BBH 26384. LSU, SSU, RPB2 and TEF1 α sequence data are available.

Canalisporium jinghongensis Cai et al.

Distribution: **China**, Yunnan Province (Cai et al. 2003c); **Thailand**, Chiang Rai Province, Hui Kang Pla waterfall National Park, on submerged wood (Zhang et al. 2014).

Sexual morph: Undetermined

Notes: Holotype PDD 74130. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

Canalisporium kenyense Goh et al.

Distribution: **Panama**, Colon Province, Conrad stream/Wheeler stream on submerged decorticated wood (Ferrer and Shearer 2005); **USA**, Florida (Raja et al. 2009b).

Sexual morph: Undetermined

Notes: Holotype IMI 285428a. Sequence data is not available.

Canalisporium pallidum Goh et al.

Distribution: **China**, Hong Kong, New Territories, Tai Po, Tai Po Kau Country Park, on submerged wood (Goh et al. 1998a).

Sexual morph: Undetermined

Notes: Holotype HKU (M) 5903 (now in IFRD). ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available. This species is only known from the type locality.

Canalisporium panamense A. Ferrer & Shearer

Distribution: **Panama**, Colon Province, Soberania National Park, on submerged decorticated wood (Ferrer and Shearer 2005).



Fig. 46 *Chaetosphaeria aquatica* (MFLU 18-1618, holotype). **a–d** Conidiophores with conidia. **e, f** Conidiogenous cells. **g–j** conidia. **k** Germinating conidium. **l, m** Culture on PDA from above and reverse. Scale bars: **a–d** 30 μ m, **e–f** 15 μ m, **g–k** 10 μ m

Sexual morph: Undetermined

Notes: Holotype ILL, Ferrer E074–1. Sequence data is not available.

Canalisporium pulchrum (Hol.-Jech. & Mercado) Nawawi & Kuthub

≡ *Berkleasium pulchrum* Hol.-Jech. & Mercado, *Česká Mykol* 38(2): 101 (1984)

Distribution: **Australia**, north Queensland, Atherton Tablelands, Lake Barrine, on submerged wood; **Brunei**, Temburong, Batu Apoi Forest Reserve, on submerged wood, **China**, Hong Kong, New Territories, Plover Cove Reservoir, on submerged wood (Goh et al. 1998a); **Panama**, Colon Province, Frijoles stream, on submerged decorated wood (Ferrer and Shearer 2005); **Thailand**, Chiang Rai Province, Hui Kang Pla waterfall National Park, Chiang Mai Province, Doi Inthanon National Park, on submerged wood (Zhang et al. 2014).

Sexual morph: Undetermined

Notes: Specimens collected from freshwater MFLU 10–0168, MFLU 11–0973. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

Canalisporium variabile Goh & K.D. Hyde

Distribution: **Australia**, Queensland, Atherton Tablelands, Cowry Creek, on wood submerged in creek (Goh and Hyde 2000a).

Sexual morph: Undetermined

Notes: Holotype IFRD 8721. Sequence data is not available.

Dematiosporium Z.L. Luo, K.D. Hyde & H.Y. Su, *gen. nov.*

Index Fungorum number: IF 555672, Facesoffungi number: FoF 05455

Etymology: “Dematiosporium” referring to dematiaceous conidia of this genus.

Saprobic on decaying wood. **Asexual morph** Colonies on natural substrate superficial, effuse, dark brown to black. *Conidiophores* reduced to conidiogenous cells. *Conidia* dry, dark brown to black, mostly globose to subglobose, smooth. **Sexual morph** Undetermined.

Type species: *Dematiosporium aquaticum* Z.L. Luo, K.D. Hyde & H.Y. Su

Notes: During our study on lignicolous freshwater fungi of Erhai lake, a hyphomycetous fungus was collected from submerged wood. Morphologically, our collection resembles asexual morph of *Conioscypha* in having micronematous conidiophores, dry, dark brown to black, globose to subglobose conidia. However, phylogenetic analysis shows that our collection (MFLU 18–1641) belongs in Savoryellaceae (Savoryellales), while *Conioscypha* belongs in Conioscyphaceae (Conioscyphales) (Fig. 1, clade 44, 45). Phylogenetic analysis also shows that the species (MFLU 18–1641) is distinct from other genera in

Savoryellaceae (Fig. 1, clade 44). We therefore introduce a new genus *Dematiosporium* to accommodate this asexual fungus.

Dematiosporium aquaticum Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555673, Facesoffungi number: FoF 05456, Fig. 45

Etymology: Referring to the aquatic habitat of this fungus.

Holotype: MFLU 18–1641

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on natural substrate superficial, effuse, dark brown to black. *Conidiophores* reduced to conidiogenous cells. *Conidia* 25–31 μm long, 24–28 μm wide (\bar{x} = 28 \times 26 μm , n = 20), dry, mostly globose to subglobose, dark brown to black, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Erhai lake, saprobic on submerged decaying wood, April 2015, Q. Dai, S-623 (MFLU 18–1641, holotype; HKAS 92564, isotype).

Notes: *Dematiosporium aquaticum* mostly resembles *Conioscypha aquatica* in having micronematous conidiophores, dry, dark brown to black, globose to subglobose conidia. However, *Dematiosporium aquaticum* differs from *Conioscypha aquatica* in having larger conidia (25–31 \times 24–28 vs. 19–23 \times 17–21 μm) and *D. aquaticum* belongs to Savoryellaceae while *C. aquatica* belongs to Conioscyphaceae.

Savoryella E.B.G. Jones & R.A. Eaton, *Trans. Br. mycol. Soc.* 52(1): 161 (1969)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations see Maharachchikumbura et al. (2016).

Type species: *Savoryella lignicola* E.B.G. Jones & R.A. Eaton, *Trans. Br. Mycol. Soc.* 52(1): 162 (1969)

Notes: The genus *Savoryella* was established by Jones and Eaton (1969) with *S. lignicola* as the type species which colonized on the test-blocks in water cooling towers. *Savoryella* species are commonly reported from submerged wood in aquatic habitats and among the ten known species, of which six are from freshwater, four from marine or brackish water (including water cooling towers), while *S. melanospora* is known on driftwood from coastal sand dunes in Australia (Abdel-Wahab and Jones 2000; Jones et al. 2015, 2016). *Savoryella* is shown to be a monophyletic group as sister clade to *Ascotaiwania* and *Canalisporium* within Savoryellales (Boonyuen et al. 2011; Réblová et al. 2016a). Jones et al. (2016) provided a review on the genus, which discussed the history, significance of the genus, illustration of its morphology and discussed its role in the colonization and biodeterioration of

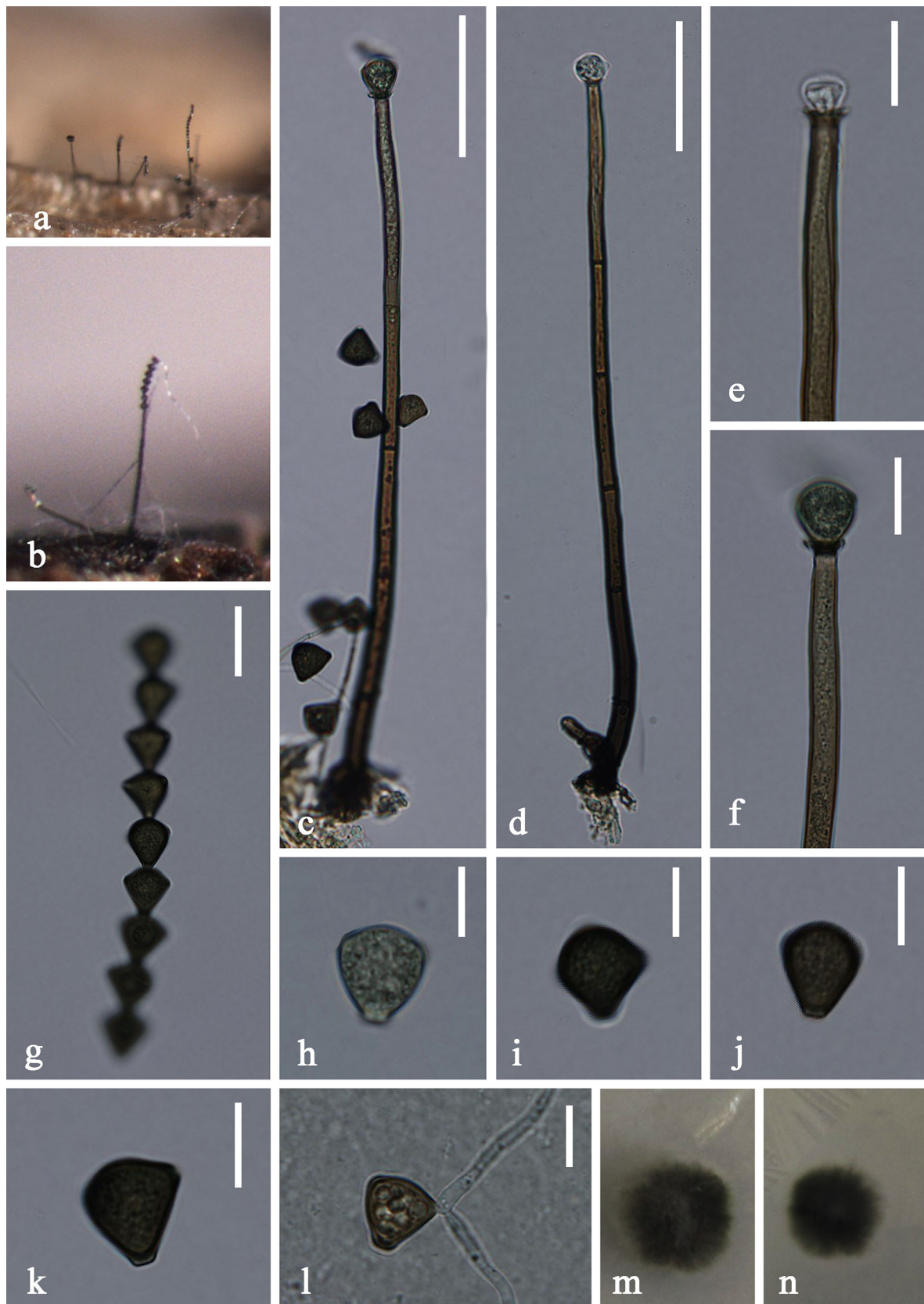


Fig. 47 *Chaetosphaeria catenulata* (MFLU 18-1620, holotype) **a, b** Colonies on wood. **c, d** Conidiophores with conidia. **e, f** Conidiogenous cells. **g–k** Conidia. **l** Germinating conidium. **m, n** Culture on PDA from above and reverse. Scale bars: **c, d** 50 μm , **e–g** 15 μm , **h–l** 10 μm



Fig. 48 *Chaetosphaeria cubensis* (MFLU 18–1621) **a, b** Colonies on wood. **c d** Conidiophores with conidia. **e, f** Conidiogenous cells with conidia. **g–n** conidia. **o** Germinating conidium. **p, q** Culture on PDA from above and reverse. Scale bars: **c, d** 40 μm , **e, f** 20 μm , **g–o** 5 μm



Fig. 49 *Chaetosphaeria guttulata* (MFLU 18-1617, holotype). **a, b** Conidiophores with conidia. **c, d** Conidiogenous cells. **e–i** conidia. **j** Germinating conidia. **k, l** Culture on PDA from above and reverse. Scale bars: **a, b** 35 μm , **c, d** 20 μm , **e–j** 10 μm

lignocellulosic materials. The role of *Savoryella* in soft rotten decaying wood was also discussed (Jones et al. 2016).

Savoryella aquatica K.D. Hyde

Distribution: **Australia**, north Queensland, Clohesy River, on submerged wood in freshwater (Hyde 1993a); **Brunei**, Temburong, Sungai Sitam, on submerged wood; **Malaysia**, Kuala Lumpur, State Negara, Lipur Lentang Nature Reserve, on submerged wood; **Philippines**, Mindanao, Bukidnon, Natigbasam Creek, on submerged wood (Ho et al. 1997); **South Africa**, Durban, Inharca River, on submerged wood (Ho et al. 1997), Palmiet River, on submerged wood (Hyde et al. 1998b); **Thailand**, Chiang Mai Province, on submerged wood (Ho et al. 1997).

Asexual morph: Undetermined

Notes: Holotype BRIP 19327, other specimen collected from freshwater habitats: BRIP 20613. ITS, LSU, SSU, RPB1, RPB2 and TEF1 α sequence data are available.

Savoryella curvispora Ho et al.

Distribution: **Malaysia**, State Negara, Lipur Lentang Nature Reserve, in ramulo submerge; **Mauritius**, Tamarin, Black River, on submerged wood; **Philippines**, Luzon, Laguna, Los Ban4 os, Mt Makiling, on wood submerged in a small stream; **South Africa**, Durban, Palmiet River, on submerged wood (Ho et al. 1997).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 2881 (now in IFRD). Sequence data is not available.

Savoryella fusiformis Ho et al.

Distribution: **Brunei**, Temburong, Sungai Sitam, on submerged wood (Ho et al. 1997).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 2923 (now in IFRD). ITS, MCM7, SSU, RPB2 and TEF1 α sequence data are available.

Savoryella grandispora K.D. Hyde

Distribution: **Australia**, Cape Tribulation, Cow Bay, on wood submerged in a River, **Malaysia**, State Negara, Lipur Lentang Nature Reserve, on submerged wood (Ho et al. 1997).

Asexual morph: Undetermined

Notes: Holotype BRIP 20918, other specimen collected from freshwater habitats: BRIP 20919. Sequence data is not available.

Savoryella lignicola E.B.G. Jones & R.A. Eaton

Distribution: **Australia**, north Queensland, Clohesy River, on submerged wood in freshwater (Hyde 1993a), Queensland, on submerged wood in a stream in Mt. Lewis (Hyde and Goh 1997); **Brunei**, Temburong, Sungai Sitam, on submerged wood, **China**, Hong Kong, New Territory, Tai Po Kau Forest Stream, on submerged wood (Ho et al. 1997); **Japan**, Koito River, on submerged wood (Tsui et al. 2001a); **Malaysia**, State Negara, Lipur Lentang Nature

Reserve, on submerged wood, **South Africa**, Durban, Palmiet River, on submerged wood (Ho et al. 1997).

Asexual morph: Undetermined

Notes: Holotype IMI 129784. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

Savoryella verrucosa Minoura & T. Muroi

Distribution: **Australia**, north Queensland, Crystal Cascade, near Cairns, on wood submerged in a River, **Brunei**, Temburong, Sungai Sitam, on submerged wood, **Japan**, Tochigi Pref. Nasugun, Nishinasuno, Shizunuma Pond, on submerged balsa wood, **Malaysia**, State Negara, Lipur Lentang Nature Reserve, on submerged wood (Ho et al. 1997).

Asexual morph: Undetermined

Notes: Holotype HUT 40006. ITS, LSU, SSU, RPB2, TEF1 α and MCM7 sequence data are available.

Savoryellomycetidae genera incertae sedis

Flammispora Pinruan et al., Stud Mycol 50(2): 384 (2004)

Asexual morph Undetermined. **Sexual morph** *Ascomata* immersed or partially immersed, coriaceous, ostiolate, solitary, black. *Asci* unitunicate, 8-spored, clavate to cylindrical clavate, or fusiform, deliquescent, thin-walled. *Ascospores* biseriate, fusiform or cylindrical, hyaline, septate, appendaged.

Type species: *Flammispora bioteca* Pinruan, Sakay., K.D. Hyde & E.B.G. Jones, Stud. Mycol. 50(2): 384 (2004)

Notes: The genus *Flammispora* was introduced by Pinruan et al. (2004a) with *F. bioteca* as type species. *Flammispora* resembles aquatic genera with polar appendaged ascospores, especially some species with cylindrical to filiform ascospores and the taxa such as *Ascosalculus aquaticus*, *Ascosalculus cincinnatum*, *A. viscidulum* and *A. unicaudatum*. However, these species differ from *Flammispora* in having hamate polar appendages, initially closely adpressed to the ascospore wall, then separating and eventually unfurling to form long, narrow appendages (Campbell et al. 2003b). Two species were accepted in the genus *Flammispora*, and *F. pulchra* occurred in a lake, while *F. bioteca* was reported from a peat swamp (Pinruan et al. 2004a; Raja and Shearer 2008).

Flammispora bioteca Pinruan et al.

Distribution: **Thailand**, Narathiwat, Sirindhorn Peat Swamp Forest, on submerged dead leaves of *Licuala longecalycata* (Pinruan et al. 2004a).

Asexual morph: Undetermined

Notes: Holotype BBH WAH 134. SSU sequence data is available.

Flammispora pulchra Raja & Shearer

Distribution: **USA**, Florida, Wildcat Lake, on submerged decorticated woody debris (Raja and Shearer 2008)

Asexual morph: Undetermined

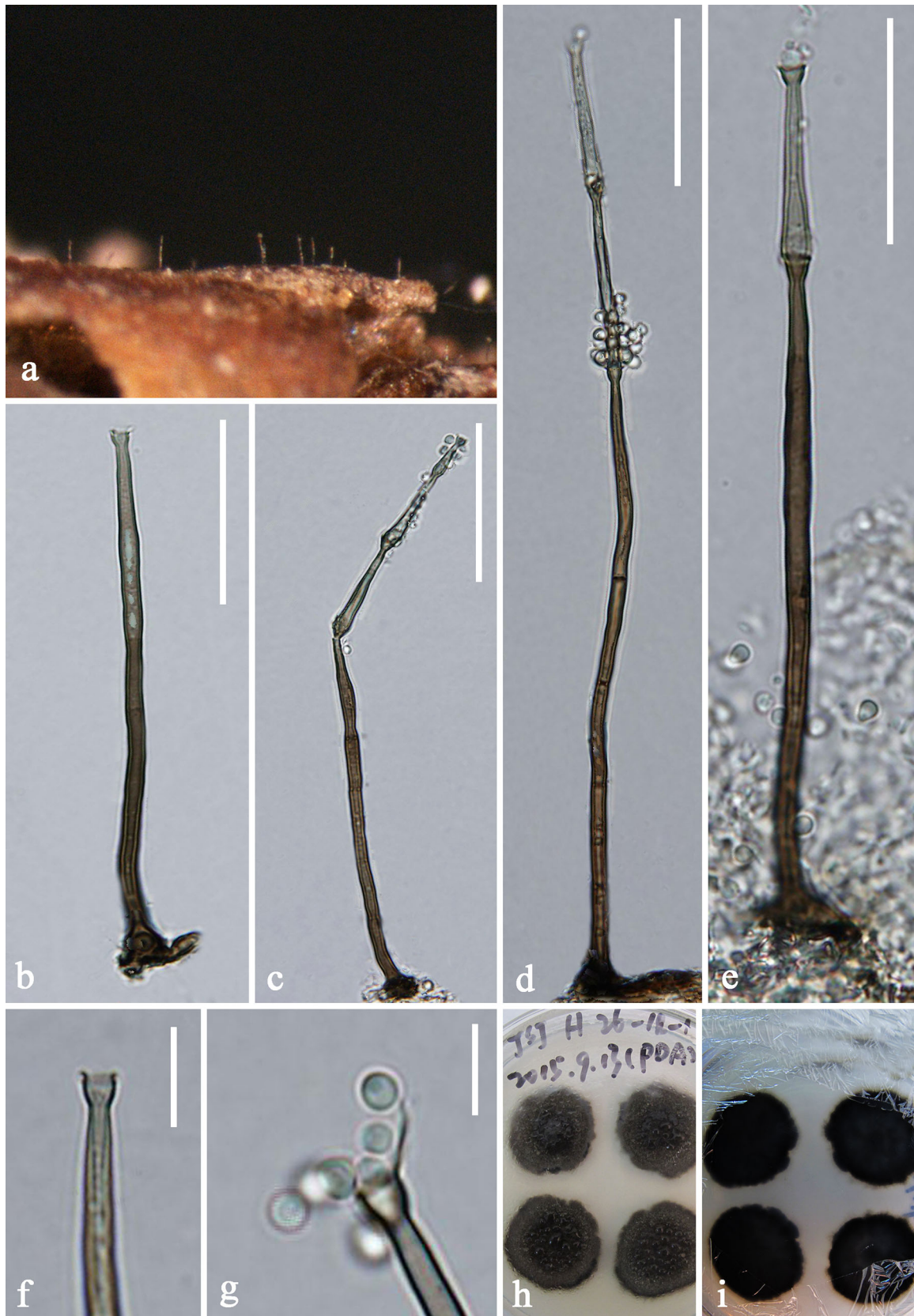


Fig. 50 *Chaetosphaeria myriocarpa* (HKAS 92985) **a** Colonies on wood. **b–e** Conidiophores with conidia. **f** Conidiogenous cells. **g** Conidia. **h, i** Culture on PDA from surface and reverse. Scale bars: **b–e** 30 μm , **f** 10 μm , **g** 5 μm

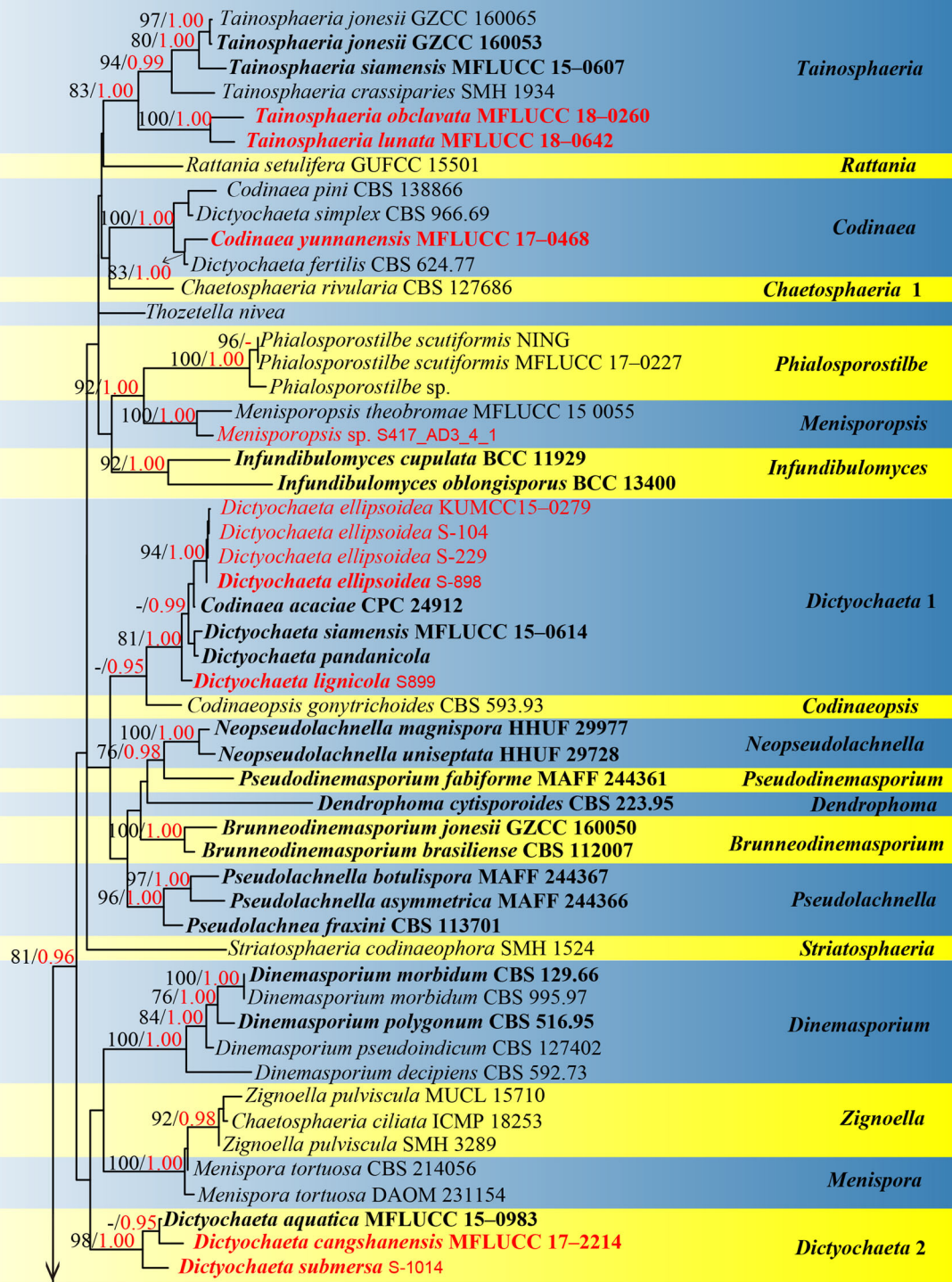


Fig. 51 Phylogram generated from maximum likelihood analysis based on ITS and LSU sequence data for species of Chaetosphaeriaceae (with *Sordaria fimicola* and *Gelasinospora tetrasperma* as outgroup). The best scoring RAxML tree with a final likelihood value of -20964.682820 is presented. RAxML bootstrap support values equal to or greater than 75% are given before the forward slash

(black). Bayesian posterior probability equal to or higher than 0.95 are given after the forward slash (red). Hyphen ('-') indicates a value lower than 75% for RAxML and bayesian posterior probability lower than 0.95. Newly generated sequences are in red. Ex-type or ex-epitype strains are in bold

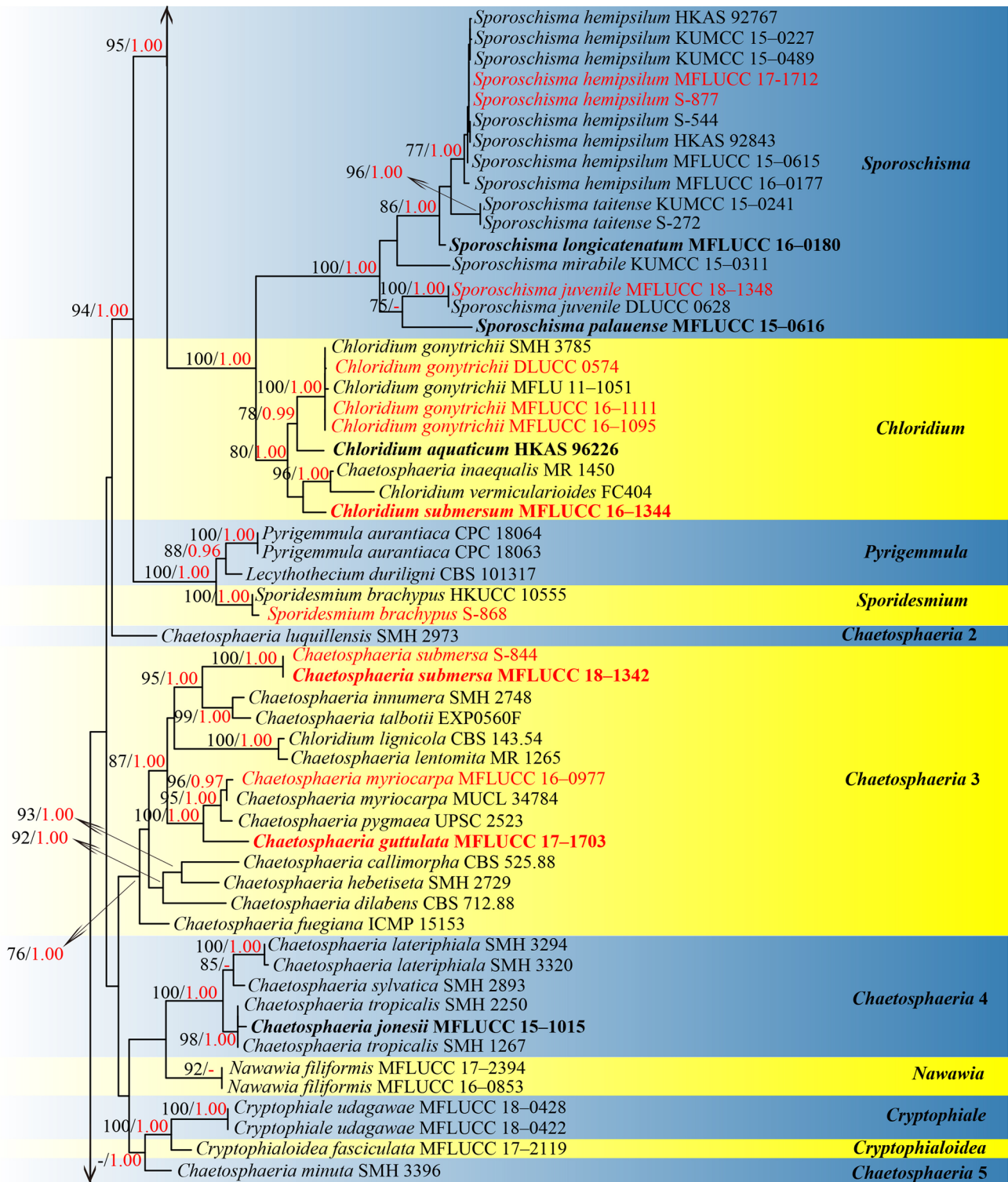


Fig. 51 continued

Notes: Holotype ILL 40119. Sequence data is not available. This species is only known from the type locality.

Subclass Sordariomycetidae O.E. Erikss & Winka
Chaetosphaeriales Huhndorf et al.
Chaetosphaeriaceae Réblová et al.

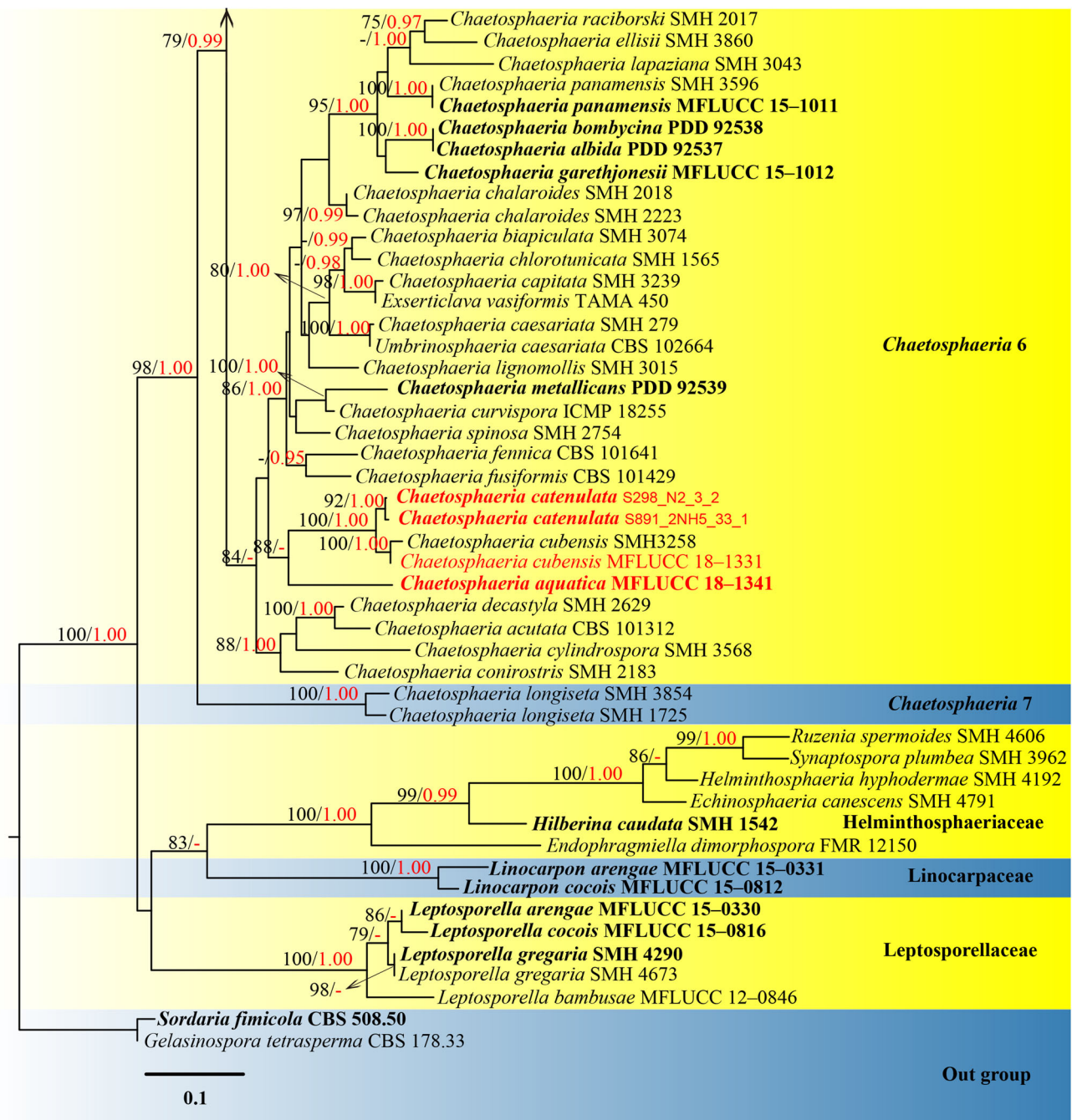


Fig. 51 continued

Brunneodinemasporium Crous & R.F. Castañeda, Persoonia 28: 128 (2012)

Asexual morph descriptions and illustrations refer to Crous et al. (2012). **Sexual morph** Undetermined.

Type species: *Brunneodinemasporium brasiliense* Crous & R.F. Castañeda, Persoonia 28: 129 (2012)

Notes: *Brunneodinemasporium* was introduced by Crous et al. (2012) with *B. brasiliense* as the type species, to accommodate a *Dinemasporium*-like species which has

tightly aggregated brown conidiogenous cells and pale brown conidia. Lu et al. (2016) introduced the second species for this genus and named as *Brunneodinemasporium jonesii* from freshwater habitats in China.

Brunneodinemasporium jonesii Lu et al.

Distribution: **China**, Guangxi Province, on decaying wood submerged in a freshwater stream (Lu et al. 2016).

Sexual morph: Undetermined

Notes: Holotype GZAAS 16–0062. ITS and LSU sequence data are available. This species is known so far only from the type locality.

Chaetosphaeria Tul. & C. Tul., *Select. fung. carpol.* (Paris) 2: 252 (1863)

Holomorph Descriptions and illustration see Maharachchikumbura et al. (2016).

Type species: *Chaetosphaeria innumera* Berk. & Broome ex Tul. & C. Tul., *Select. fung. carpol.* (Paris) 2: 252 (1863)

Notes: The genus *Chaetosphaeria* was introduced by Tulane and Tulane (1863) and is typified by *C. innumera*. The genus *Chaetosphaeria* is a lignicolous perithecial ascomycete and the genus has world-wide distribution. It is characterized by non-stromatic, dark, papillate ascomata, persistent paraphyses, unitunicate asci with a shallow, refractive Japical annulus and hyaline, ellipsoidal, fusiform to filiform, one to several-septate hyaline ascospores, although several species with versicolorous ascospores are also accommodated in the genus. Four species in this genus have been reported from freshwater habitats. Conidial phases in the genus *Chaetosphaeria* largely resemble asexual morph genus *Catenularia* Grove.

Chaetosphaeria anglica P.J. Fisher & Petrini

Distribution: **Brunei**, Batu Apoi Forest Reserve, on submerged wood (Ho et al. 2001); **Sudan**, Blue Nile, on submerged wood (Fisher and Petrini 1983); **UK**, River Exe, on submerged wood (Fisher and Petrini 1983).

Asexual morph: Undetermined

Notes: Holotype IMI 273041, other specimen collected from freshwater habitats: IMI 273042; Sequence data is not available.

Chaetosphaeria aquatica Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555674, Facesoffungi number: FoF 05457, Fig. 46

Etymology: Referring to the aquatic habitat of this fungus

Holotype: MFLU 18–1618

Saprobic on submerged decaying wood. **Asexual morph** Colonies amphigenous, effuse, brown or black, thinly hairy. *Mycelium* partly superficial, partly immersed, composed of septate, branched, dark brown, smooth hyphae. *Conidiophores* (111–)181–271 μm long, 5–7 μm wide ($\bar{x} = 226 \times 6 \mu\text{m}$, $n = 20$), mononematous, macronematous, solitary or in small groups, erect, straight or slightly flexuous, dark brown at base, pale brown at apex, septate, unbranched, percurrently growing, smooth. *Conidiogenous cells* monophialidic, with conspicuous collarette, integrated, percurrently proliferating, terminal, later becoming subterminal, pale brown. *Conidia* 20–24 μm long, 6–8 μm wide ($\bar{x} = 22 \times 7 \mu\text{m}$, $n = 20$), solitary, acropleurogenous, cylindro-oblong to reniform, rounded at apex, pointed at base, straight or slightly

curved, 1–3-septate, greyish brown when young, subhyaline at the end cells, brown at the 3 cells, remaining attached to the sides of conidiogenous cells on release, smooth-walled. **Sexual morph** Undetermined.

Material examined: CHINA, Yunnan Province, Nujiang River, saprobic on submerged decaying wood, May 2015, Z.L. Luo, S-752 (MFLU 18–1618, holotype), ex-type living culture MFLUCC 18–1341.

Notes: *Chaetosphaeria aquatica* resembles asexual morph of *C. conirostris* in having multiseptate, cylindrical, unbranched conidiophores and oblong to reniform conidia with similar size (Fernández and Huhndorf 2005). However, *Chaetosphaeria aquatica* differs from *C. conirostris* in having terminal to subterminal conidiogenous cells, 1–3-septate, grayish brown to brown conidia. Phylogenetic analysis based on ITS and LSU sequence data also shows that *Chaetosphaeria aquatica* is distinct from *C. conirostris* (Fig. 51).

Chaetosphaeria catenulata Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555675, Facesoffungi number: FoF 05458, Fig. 47

Etymology: Referring to the catenulate conidia of this fungus.

Holotype: MFLU 18–1620

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on the substratum superficial, scattered, brown. *Mycelium* immersed, brown to dark brown, composed of septate, brown hyphae. *Conidiophores* 187–283 μm long, 6–10 μm wide ($\bar{x} = 235 \times 8 \mu\text{m}$, $n = 20$), macronematous, mononematous, cylindrical, single, erect, straight, unbranched, thick-walled, dark brown, becoming paler towards the apex, smooth. *Conidiogenous cells* monophialidic, integrated, terminal, cylindrical-clavate, flared collarette. *Conidia* 13–15 μm long, 12–14 μm wide ($\bar{x} = 14 \times 13 \mu\text{m}$, $n = 20$), acrogenous, formed in chains, aseptate, turbinate-triangular, with 3 blunt protruding edges at the broader distal end, viewed from above 3-lobed or cruciform with blunt protruding corners, hyaline to subhyaline when young, greyish brown at mature, smooth-walled. **Sexual morph** Undetermined.

Material examined: CHINA, Yunnan Province, Nujiang River, saprobic on submerged decaying wood, October 2016, Z.L. Luo, S-891 (MFLU 18–1620, holotype), ex-type living culture DLUCC 0891; saprobic on decaying wood submerged in Nujiang River, May 2015, Z.L. Luo, S-298.

Notes: *Chaetosphaeria catenulata* resembles *C. cubensis* in having mononematous, macronematous, septate, unbranched, cylindrical conidiophores, integrated, terminal, monophialidic, percurrent conidiogenous cells and cuneiform, aseptate conidia (Holubova-Jechova 1982; this study). However, *Chaetosphaeria catenulata* differs from

C. cubensis in having larger conidia (13–15 × 12–14 vs. 5.5–9 × 3.5–5.5 µm). Phylogenetic analysis also shows that *Chaetosphaeria catenulata* is distinct from *C. cubensis* (Fig. 51)

***Chaetosphaeria cubensis* Hol.-Jech.**

Facesoffungi number: FoF 05459, Fig. 48

Saprobic on submerged decaying wood. **Asexual morph** Colonies on substratum, effuse, brown to black, superficial, groups, hairy. *Mycelium* partly superficial, composed of septate, branched, brown hyphae. *Conidiophores* 175–219 µm long, 5–7 µm wide (\bar{x} = 197 × 6 µm, n = 20), mononematous, macronematous, cylindrical, solitary or in small groups, straight or slightly flexuous, septate, greyish brown, gradually becoming paler towards the apex, smooth, septate, percurrently proliferating. *Conidiogenous cells* monophialidic, integrated, terminal, percurrent, calyciform. *Conidia* 6–8 µm long, 4–6 µm wide (\bar{x} = 7 × 5 µm, n = 20), cuneiform, with 3 blunt protruding edges at the broader distal end, aseptate, greyish brown to brown, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Dulong River, saprobic on submerged decaying wood, May 2015, Z.L. Luo, S-375 (MFLU 18–1621), living culture MFLUCC 18–1331.

Notes: Morphologically, our collection fits well to the *Chaetosphaeria* species with *Catenularia* asexual morph, such as *Ch. cubensis*, *Ch. cupulifera* and *Ch. novaezealandiae* (Rěblová 2004). The new collection resembles *Ch. cubensis* in having mononematous, macronematous, septate, unbranched, cylindrical conidiophores with similar size, integrated, terminal, monophialidic, percurrent conidiogenous cells and cuneiform, aseptate conidia with similar size (Holubova-Jechova 1982). Phylogenetic analysis based on ITS and LSU sequence data shows that our isolate (MFLUCC 18–1331) clusters with *Ch. cubensis* (SMH 3258) with high support values (100 ML/1.00 PP) (Fig. 51). Based on the morphology and phylogeny, we identify our isolate as *Ch. cubensis* and it is the first record for China and first collection from freshwater habitats as well.

***Chaetosphaeria guttulata* Z.L. Luo, K.D. Hyde & H.Y. Su, sp. nov.**

Index Fungorum number: IF 555676, Facesoffungi number: FoF 05460, Fig. 49

Etymology: Referring to the conidia with large guttules.

Holotype: MFLU 18–1617

Saprobic on submerged decaying wood. **Asexual morph** Colonies on substratum superficial, effuse, scattered, hairy, dark brown. *Mycelium* partly immersed, composed of septate brown, smooth, hyphae. *Conidiophores* 115–157 µm long, 5–7 µm wide (\bar{x} = 136 × 6 µm, n = 20), macronematous, mononematous, erect, straight or

slightly flexuous, septate, solitary, unbranched, smooth, brown to dark brown and gradually becoming paler towards the apex. *Conidiogenous cells* holoblastic, polyblastic, with many tiny protuberant conidiogenous loci, integrated, terminal, light brown or subhyaline, *Conidia* 17–21 µm long, 5–7 µm wide (\bar{x} = 19 × 6 µm, n = 20), acropleurogenous, ovoid or fusiform, dry, 3-septate, guttulate, rounded at apex, pointed at base, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on submerged decaying wood in a freshwater stream, June 2016, Q.X. R, S-771 (MFLU 18–1617, holotype), ex-type living culture MFLUCC 17–1703.

Notes: *Chaetosphaeria guttulata* resembles asexual morph of *Chaetosphaeria lignomollis* in having conidiophores septate, unbranched, brown to dark brown and gradually becoming paler towards the apex, conidiogenous cells polyblastic, integrated, terminal and conidia septate, hyaline, rounded at apex (Fernández and Huhndorf 2005). However, *Chaetosphaeria guttulata* differs from *C. lignomollis* by its ovoid or fusiform, guttulate, smaller conidia (17–21 × 5–7 vs. 26–31 × 7.3–8.6 µm). Phylogenetic analysis also shows that *Chaetosphaeria guttulata* and *C. lignomollis* are distinct species (Fig. 51). *Chaetosphaeria guttulata* clusters with *C. myriocarpa* (MUCL34784) and *C. pygmaea* (UPSC2523) with strong support (Fig. 51), however, their morphology are obviously different (Booth 1957; Gams and Holubová-Jechová 1976).

***Chaetosphaeria lentomita* W. Gams & Hol.-Jech**

Distribution: **China**, Hong Kong, on submerged wood (Ho et al. 2001).

Asexual morph: *Chloridium pachytrachelum*

Notes: Holotype CBS 645.75. ITS and LSU sequence data are available. Ho et al. (2001) found this species from freshwater in China, but did not provide description and illustration in their study.

***Chaetosphaeria lignomollis* F.A. Fernández & Huhndorf**

Distribution: **Brazil**, Bahia, on submerged twig (Barbosa et al. 2013).

Asexual morph: see Fernández and Huhndorf (2005).

Notes: Holotype F, Huhndorf 3015 (SMH 3015), specimens collected from freshwater habitats: HUEFS 158056, HUEFS 158081. ITS, LSU and β-tubulin sequence data are available. Barbosa et al. (2013) collected this species from freshwater habitats in Brazil and provided descriptions for this fungus.

***Chaetosphaeria myriocarpa* (Fr.) C. Booth**

≡ *Sphaeria myriocarpa* Fr., Syst. mycol. 2(2): 459 (1823)

Facesoffungi number: FoF 05461, Fig. 50

Saprobic on submerged decaying wood. Sexual morph: Undetermined. **Asexual morph** Colonies on the substratum superficial, scattered, hairy, brown to dark brown.

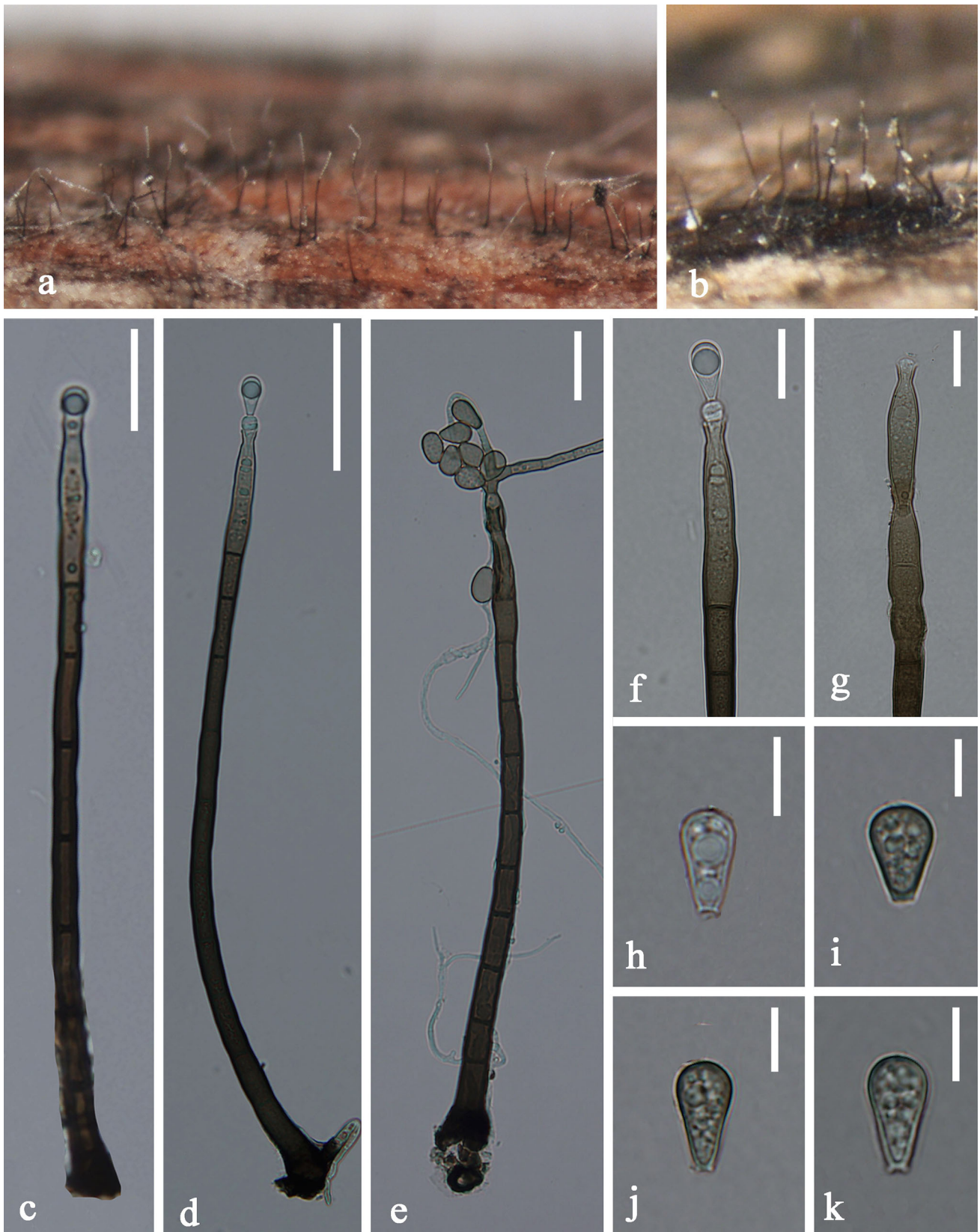


Fig. 52 *Chaetosphaeria submersa* (MFLU 18–1616, holotype). **a, b** Colonies on wood. **c–e** Conidiophores with conidia. **f, g** Conidiogenous cells. **h–k** Conidia. Scale bars: **c, e** 50 μm , **d** 40 μm , **f–g** 30 μm , **h–k** 15 μm

Mycelium mostly immersed, consisting of branched, septate, brown, smooth hyphae. *Conidiophores* 63–117 μm long, 2.5–3.5 μm wide (\bar{x} = 90 \times 3 μm , n = 20), macronematous, mononematous, cylindrical, straight or flexuous, septate, dark brown at the base and gradually paler towards the apex, unbranched, percurrently growing, smooth-walled. *Conidiogenous cells* monophialidic, percurrent, determinate, integrated, with flared pale brown collarette. *Conidia* 1–2 μm (\bar{x} = 1.5 μm , SD = 0.5, n = 20) diam., spherical or subspherical, aseptate, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Jinsha River, saprobic on submerged decaying wood, April 2015, X.J. Su, S-408 (HKAS 92985), living culture MFLUCC 16–0977, KUMCC 15–0416.

Notes: *Chaetosphaeria myriocarpa* was described by Fries (1823) under *Sphaeria* as *S. myriocarpa*. Booth (1957) synonymized *Sphaeria myriocarpa* as *Chaetosphaeria myriocarpa* based on morphology. Crous et al. (2018) collected an asexual morph of *Chaetosphaeria myriocarpa* from Ukraine and provided ITS, LSU and β -tubulin sequence data for this species. During the study of lignicolous freshwater fungi in China, a hyphomycetous fungus was collected from submerged wood in Yunnan Province and the morphological characters of our fungus fits well with *Chaetosphaeria myriocarpa* (Booth 1957; Crous et al. 2018). Phylogenetic analysis also shows that our isolate (MFLUCC 16–0977) clusters together with *Chaetosphaeria myriocarpa* (Fig. 51). Based on the morphology and phylogeny, we identify our collection as *Chaetosphaeria myriocarpa* and it is the first report of this species from freshwater habitats.

Chaetosphaeria rivularia R eblova & J. Fourn

Distribution: **France**, Midi-Pyr enes, Ari ge, Rimont, Grand Bois forest, Maury brook, on submerged wood of *Fagus sylvatica* associated with *Minutisphaera japonica* (Ariyawansa et al. 2015).

Asexual morph: see Ariyawansa et al. (2015).

Notes: Holotype PRM 933847. ITS and LSU sequence data are available. Ariyawansa et al. (2015) introduced this species based on collections from freshwater in France and it is only known from the type locality.

Chaetosphaeria submersa Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555677, Facesoffungi number: FoF 05462, Fig. 52

Etymology: Referring to the submerged habitat of this fungus.

Holotype: MFLU 18–1616

Saprobic on submerged decaying wood. **Asexual morph** Colonies on the substratum effuse, dark brown, with glistening mass of conidia at the tip of conidiophores. *Mycelium* partly immersed, partly superficial, composed of

branched septate, dark brown, smooth hyphae. *Conidiophores* 380–596(–691) μm long, 15–21 μm wide (\bar{x} = 493 \times 18 μm , n = 20), macronematous, mononematous, erect, solitary, cylindrical, straight or slightly flexuous, unbranched, percurrently growing, rarely branched at apex, thick-walled, 9–13-septate, brown to dark brown below, pale brown to subhyaline toward the apex, smooth. *Conidiogenous cells* monophialidic, percurrently proliferating, integrated, terminal, pale brown, cylindrical-clavate. *Conidia* 21–27 μm long, 12–14 μm wide (\bar{x} = 24 \times 13 μm , n = 20), acrogenous, solitary, cuneiform, aseptate, guttulate, rounded at apex, truncate at base, hyaline when young, light brown at mature, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on submerged decaying wood in freshwater stream, October 2016, Z.L. Luo, S-824 (MFLU 18–1616, holotype), ex-type living culture MFLUCC 18–1342.

Notes: *Chaetosphaeria submersa* resembles asexual morph of *Ch. novae-zelandiae* in having unbranched, septate conidiophores which brown to dark brown below, paler toward the apex, cuneiform, aseptate, brown conidia rounded at apex, truncate at base (Hughes 1965). However, *Ch. submersa* differs from *Ch. novae-zelandiae* by its larger conidiophores (380–596(–691) vs. 50–330 μm) and conidia (21–27 \times 12–14 vs. 12.6–17.5 \times 11.4–18.2 μm). *Ch. submersa* also resembles *Catenularia longispora* in having cylindrical, unbranched, septate conidiophores which brown to dark brown below, pale brown to subhyaline toward the apex, monophialidic, integrated, terminal conidiogenous cells and aseptate, cuneiform conidia (Hughes 1965). However, *Chaetosphaeria submersa* differs from *Catenularia longispora* in having 9–13-septate, longer conidiophores (380–596(–691) vs. 200–330 μm) and smaller conidia (21–27 \times 12–14 vs. 27–45 \times 16.8–24 μm).

Chloridium Link, Mag. Gesell. naturf. Freunde, Berlin 3(1–2): 13 (1809)

Asexual morph Colonies effuse, velvety, reverse dark brown to black. *Mycelium* partly immersed, partly superficial, composed of branched, hyaline, septate, smooth hypha. *Conidiophores* erect, unbranched, pigmented, apical, integrated, arising from submerged hyphae. *Conidiogenous cells* phialidic to poly-enteroblastic, with a wide or narrow, deep or short collarette, in some species with multiple conidiogenous loci. *Conidia* arranged in slimy heads or gradually extending cirrhi, rarely in simple chains, but then mostly imbricate, globose to ellipsoidal or cylindrical, mostly containing one or two guttules, hyaline or almost hyaline, smooth-walled. *Chlamydospores* present in some species, pigmented, globose or elongated, terminal,



Fig. 53 *Chloridium gonytrichii* (HKAS 93031) **a–c** Conidiophore. **d, e** Conidiogenous cells. **f–k** Conidia. **l** Germinating conidium. Scale bars: **a–c** 50 μm , **d, e** 30 μm , **f** 10 μm , **g–l** 5 μm

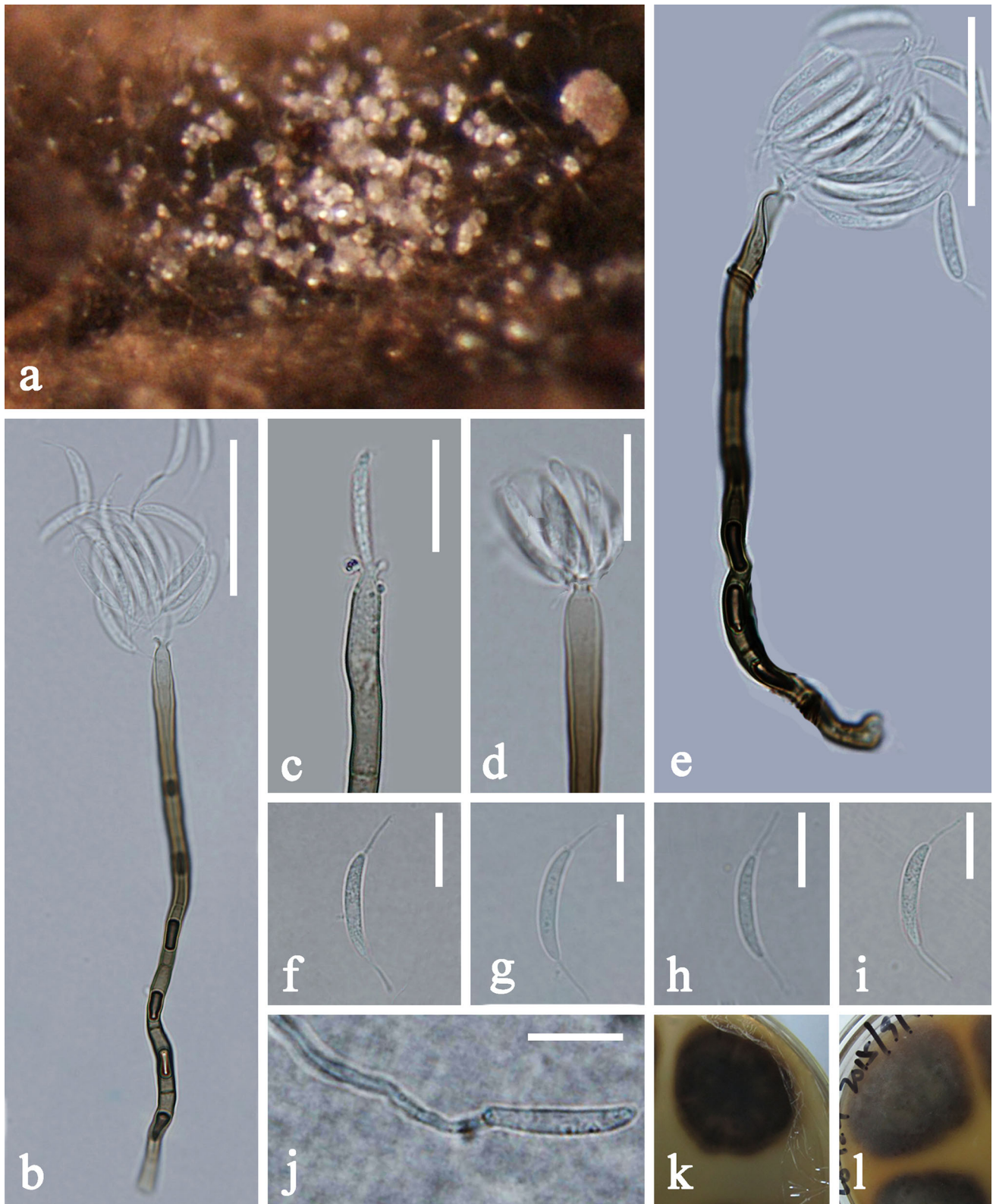


Fig. 54 *Codinaea yunnanensis* (MFLU 18–1611, holotype). **a** Colonies on wood. **b, d, e** Conidiophores with conidia. **e** Conidiogenous cells with conidium. **f–i** Conidia. **j** Germinating conidium. **k, l** Culture on PDA from above and reverse. Scale bars: **b, e** 30 μ m, **c, d** 15 μ m, **f–j** 10 μ m

lateral or more rarely intercalary. **Sexual morph** *Ascomata* broadly ovoid to globose, dark brown, separate, papillate, with a few, scattered setae, brown, multiseptate, slender, tapering to an attenuated apex. *Ascomatal wall* of *textura angularis* in surface view, composed of pseudoparenchymatic cells. *Ascomatal apex* papillate, opaque. *Paraphyses* unbranched, septate, hyaline. *Asci* 8-spored, cylindrical-clavate, short-stalked, thin-walled. *Ascospores* uniseriate, ellipsoid, septate, easily disarticulating into part-spores, hyaline (obtained from Fernández and Huhndorf (2005)).

Type species: *Chloridium viride* Link, Mag. Gesell. naturf. Freunde, Berlin 3(1–2): 13 (1809)

Notes: Index Fungorum (December 2018) lists 73 epithets of the genus *Chloridium* which was typified by *C. viride*. Three species in this genus have been reported from freshwater habitats in China.

Chloridium gonytrichii (F.A. Fernández & Huhndorf) Réblová & Seifert

≡ *Melanopsammella gonytrichii* F.A. Fernández & Huhndorf, Fungal Divers 18: 42 (2005)

≡ *Chloridium aseptatum* M.J. Wei & H. Zhang, Phytotaxa 362: 191 (2018)

Facesoffungi number: FoF 05463, Fig. 53

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** *Colonies* effuse, hairy, brown to dark brown. *Mycelium* superficial. *Conidiophores* 196–240 µm long, 6–8 µm wide ($\bar{x} = 218 \times 7$ µm, $n = 20$), macronematous, mononematous, single, unbranched, dark brown becoming light brown to subhyaline towards the apex, multiseptate, with 2–4 whorls of phialides in mid-section, with a single phialide at the apex. *Conidiogenous cells* phialides, cylindrical to lageniform, producing conidia from multiple entero-blastic conidiogenous loci, phialides borne on collar hyphae around the conidiophore, percurrent proliferation observed on the substrate. *Conidia* 3–5 µm long, 2–4 µm wide ($\bar{x} = 4 \times 3$ µm, $n = 20$), globose to subglobose, aseptate, with a guttulate, light green. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Lancang River, saprobic on submerged decaying wood, April 2015, Z.L. Luo, S-574 (HKAS 93031), living culture DLUCC 0574; Jinsha River, saprobic on submerged decaying wood, April 2015, H.Y. Su, S-360, living culture MFLUCC 16–1111, KUMCC 15–0444; *Ibid.*, saprobic on submerged decaying wood, April 2015, Z.L. Luo, S-380 (HKAS 93053), living culture MFLUCC 16–1095, KUMCC 15–0424.

Notes: Holotype SMH 3785, specimens collected from freshwater habitats: HKAS 93031, MFLU 11–1051. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available. *Chloridium gonytrichii* is originally described by Fernández and Huhndorf (2005) as *Melanopsammella gonytrichii*. Réblová et al. (2016b) synonymised *Melanopsammella*

gonytrichii under *Chloridium gonytrichii*. During our study on lignicolous freshwater fungi in China, three hyphomycetous fungi were collected, morphological characters of these fungi fit well with asexual of *Chloridium gonytrichii* in having macronematous, mononematous, single, multiseptate, unbranched conidiophores with whorls of phialides in midsection, globose to subglobose, light green, aseptate conidia. Based on the morphology, we identify our isolates as *Chloridium gonytrichii* and provided the sequence data for *Chloridium gonytrichii*.

Chloridium lignicola (F. Mangenot) W. Gams & Hol.-Jech
≡ *Bisporomyces lignicola* F. Mangenot, Revue Mycol., Paris 18: 136 (1953)

Distribution: **China**, Hong Kong, Tai Po Kau Forest Stream, on submerged wood (Ho et al. 2002a).

Sexual morph: Undetermined

Notes: ITS and LSU sequence data are available.

Chloridium matsushimae W. Gams & Hol.-Jech

Distribution: **China**, Hong Kong, on submerged wood (Tsui et al. 2000).

Sexual morph: Undetermined

Notes: Holotype MFC-1640. Sequence data is not available.

Chloridium pachytrachelum W. Gams & Hol.-Jech

Distribution: **China**, Hong Kong, Tai Po Kau Forest Stream, on submerged wood (Ho et al. 2002a).

Sexual morph: Undetermined

Notes: Holotype CBS 645.75. Sequence data is not available.

Codinaea Maire, Publ. Inst. Bot. 3(4): 15 (1937)

Asexual morph *Colonies* on the natural substrate, scattered, hairy, black. *Mycelium* superficial or immersed, composed of septate, branched, brown, smoothwalled hyphae. *Conidiophores* macronematous, mononematous or synnematous, brown to pale brown, septate. *Conidiogenous cells* mono- to polyphialidic, with flared collarete, terminal, determinate or indeterminate with a few sympodial extensions and sometimes with enteroblastic percurrent regenerations. *Conidia* unicellular or septate, falcate to lunate, hyaline, with a filiform appendage at each end. **Sexual morph** Undetermined.

Type species: *Codinaea aristata* Maire, Publ. Inst. Bot. 3(4): 15 (1937)

Notes: *Codinaea* was introduced by Maire (1937) with *C. aristata* Maire as the type species. The genus *Dictyochoaeta* (Spegazzini 1923) was considered as an earlier name for *Codinaea* (Maire 1937), but following the molecular analyses of Réblová and Winka (2000), both genera are accepted. Previous studies recommended that species with filiform appendages (setulate conidia) can be retained in *Codinaea* and taxa lacking appendages (asetulate conidia) can be placed in *Dictyochoaeta* (Réblová and

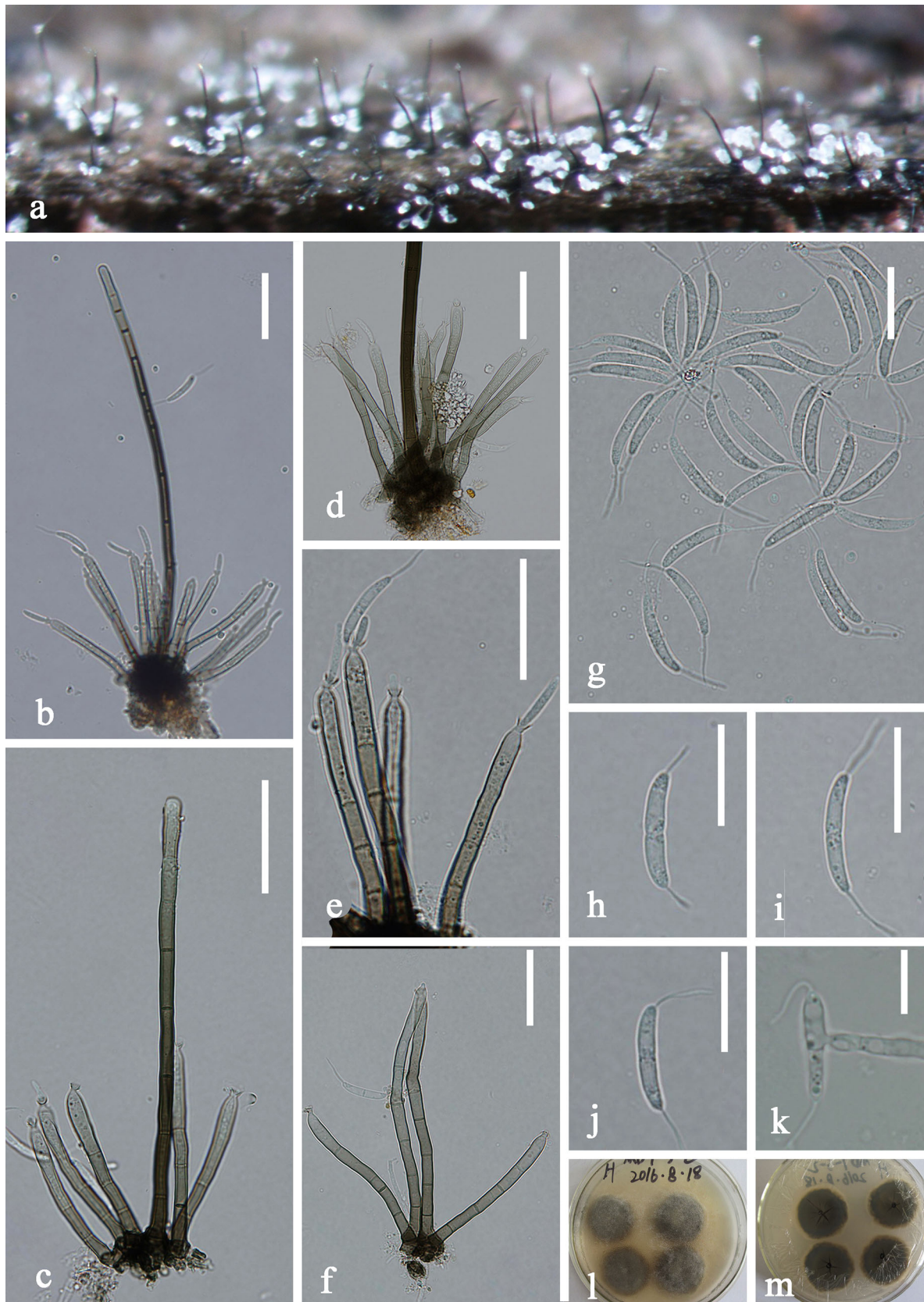


Fig. 55 *Dictyochaeta cangshanensis* (MFLU 18-1614, holotype). **a** Colonies on wood. **b, c** Conidiophores with conidia. **d–f** Conidiogenous cells. **g–i** Conidia. **k** Germinating conidium. **l, m** Culture on PDA from above and reverse. Scale bars: **b–c** 30 μm , **d–f** 25 μm , **g–k** 15 μm

Winka 2000; Li et al. 2012; Oliveira et al. 2015a). However, some other studies also introduced some *Dictyochaeta* species with filiform appendages based on molecular sequence data and morphology (Liu et al. 2016; Wei et al. 2018).

Codinaea aquatica Castaneda et al.

Distribution: **Brazil**, Pernambuco, on submerged decaying branches of unidentified plant in a River (Oliveira et al. 2015a).

Sexual morph: Undetermined

Notes: Holotype URM 87707. Sequence data is not available. This species is only known from the type locality.

Codinaea yunnanensis Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555678, Facesoffungi number: FoF 05464, Fig. 54

Etymology: Referring to the location where this fungus was collected, Yunnan Province, China.

Holotype: MFLU 18–1611

Saprobic on submerged decaying wood. **Asexual morph** Colonies effuse, hairy, greyish brown, shining, in groups. *Mycelium* immersed, consisting of greyish brown, branched, smooth hyphae. *Conidiophores* (62–)83–127 µm long, 4.5–5.5 µm wide (\bar{x} = 105 × 5 µm, n = 20), macronematous, mononematous, erect, unbranched, percurrently growing, straight or slightly flexuolls, smooth, septate, brown, paler towards the apex, smooth. *Conidiogenous cells* initially monophialidic, with a conspicuous collarete, later becoming poly-enteroblastic with sympodially conspicuous conidial primordia, integrated, terminal, cylindrical, hyaline to subhyaline. *Conidia* 15–17 µm long, 2.5–3.5 µm wide (\bar{x} = 16 × 3 µm, n = 20), acrogenous, aggregating in a globose mucoid mass, naviculate to long fusiform, narrow at both of ends, with polar appendage, aseptate, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Lancang River, saprobic on submerged decaying wood, April 2015, Z.L. Luo, S-439 (MFLU 18–1611, holotype, HKAS 92839, isotype), ex-type living culture MFLUCC 17–0468.

Notes: *Codinaea yunnanensis* resembles *C. pini* in having mononematous, unbranched, septate conidiophores, terminal conidiogenous cells, aseptate, hyaline, setulate conidia aggregating in a globose mucoid mass (Crous et al. 2014b). However, *C. yunnanensis* differs from *C. pini* by its poly-enteroblastic conidiogenous cells which *C. pini* has mono- to rarely polyphialidic conidiogenous cells, and *C. yunnanensis* has larger conidia (15–17 vs. 13–15 µm). Phylogenetic analysis also shows that *Codinaea yunnanensis* is distinct from *C. pini* (Fig. 51). In addition, *Codinaea yunnanensis* is phylogenetically close to

Dictyochaeta fertilis (CBS 624.77), but their morphologies are different (Menzies 1973).

Dictyochaeta Speg., Physis, Rev. Soc. Arg. Cienc. Nat. 7: 18 (1923)

Asexual morph Colonies effuse, brown to dark brown. *Mycelium* mostly immersed, comprising pale to medium brown, smooth, septate, branched hyphae. *Setae* fertile, erect, septate, straight, thick-walled, dark brown, gradually becoming paler towards the apex, smooth. *Conidiophores* macronematous, mononematous, simple, erect, smooth, straight to slightly flexuous, septate, pale brown to brown. *Conidiogenous cells* monophialidic, terminal, integrated, with a conspicuous collarete, smooth, pale brown to subhyaline. *Conidia* acicular with rounded bases, aseptate or septate, aggregated in colourless slimy masses, hyaline, smooth-walled. **Sexual morph** Undetermined.

Type species: *Dictyochaeta fuegiana* Speg., Physis, Rev. Soc. Arg. Cienc. Nat. 7: 18 (1923)

Notes: Reblová and Winka (2000) revealed that setulate and aseptate conidia of *Dictyochaeta* species grouped into distinct sub groups in their phylogenetic analysis. Therefore, they suggested to maintain the genus name *Dictyochaeta* for species without setulae and *Codinaea* for species with setulae. However, some researchers do not agree with Reblová (2000), whereas some follow. More fresh collections are needed to clarify the relationship and distinction of these groups.

Dictyochaeta aciculata S.S. Silva & Gusmão

Distribution: **Brazil**, Caracol, on submerged petiole (Silva and Gusmão 2013).

Sexual morph: Undetermined

Notes: Holotype HUEFS 192225. Sequence data is not available. This species is only known from the type locality.

Dictyochaeta aquatica W. Dong & H. Zhang

Distribution: **Thailand**, Prachuap Khiri Khan Province, n submerged wood in a small River (Wei et al. 2018).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–2691. ITS and LSU sequence data available. This species is only known from the type locality.

Dictyochaeta assamica (Agnihotr.) Aramb. et al.

≡ *Menisporella assamica* Agnihotr.

Distribution: **Malaysia**, Pahang, Lepar Forest Reserve, on decaying leaves of unidentified dicotyledon plant submerged in fast-flowing freshwater stream (Kuthubutheen and Nawawi 1991b).

Sexual morph: Undetermined

Notes: Specimen collected from freshwater: IMI 335369. Sequence data is not available. Kuthubutheen and Nawawi (1991b) collected four samples for this species and

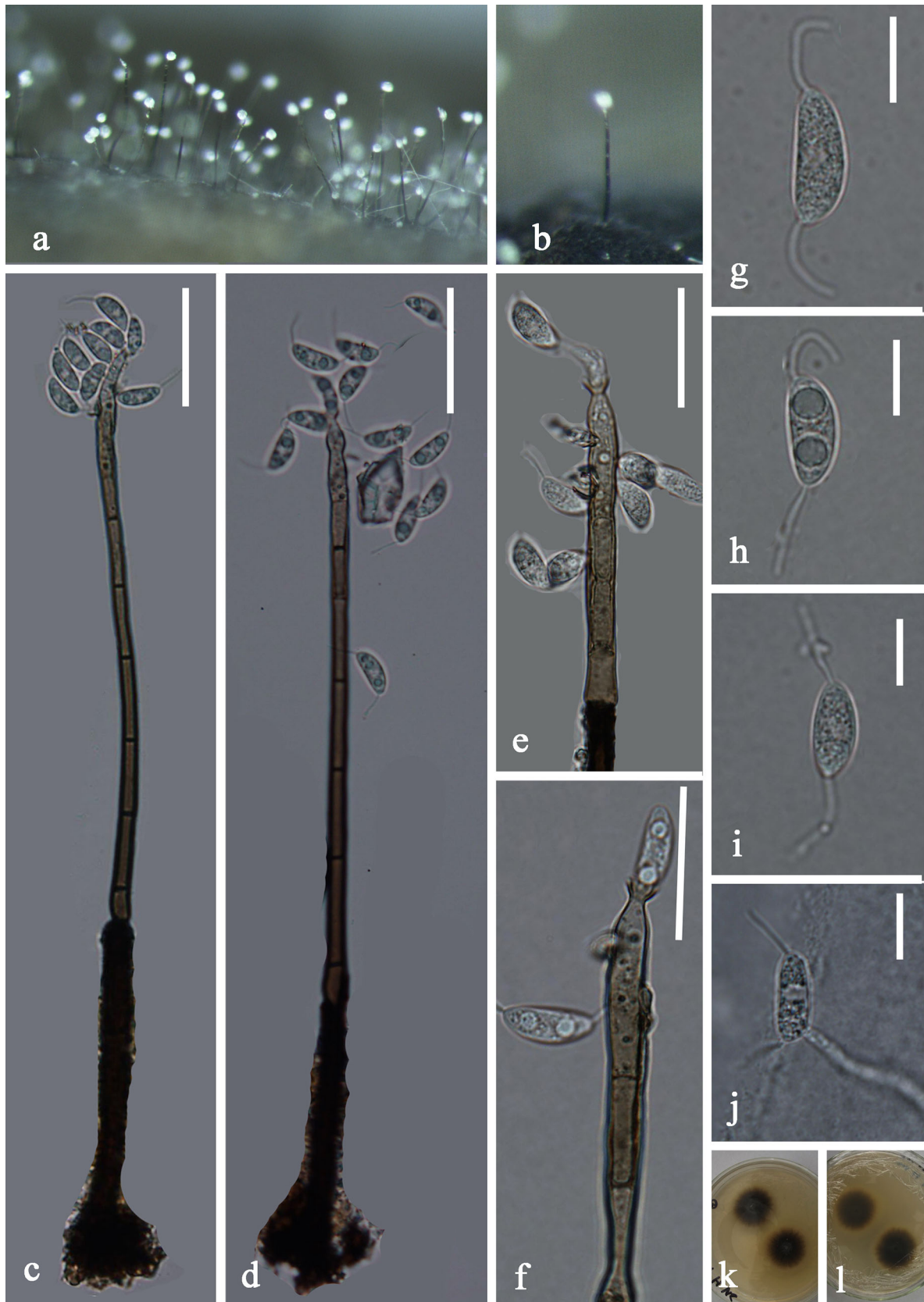


Fig. 56 *Dictyochaeta ellipsoidea* (MFLU 18–1612, holotype). **a, b** Colonies on wood. **c, d** Conidiophores with conidia. **e, f** Conidiogenous cells. **g–i** conidia. **j** Germinating conidium. Culture on PDA from above (**k**) and reverse (**l**). Scale bars: **c–d** 40 μ m, **e–f** 25 μ m, **g–j** 10 μ m

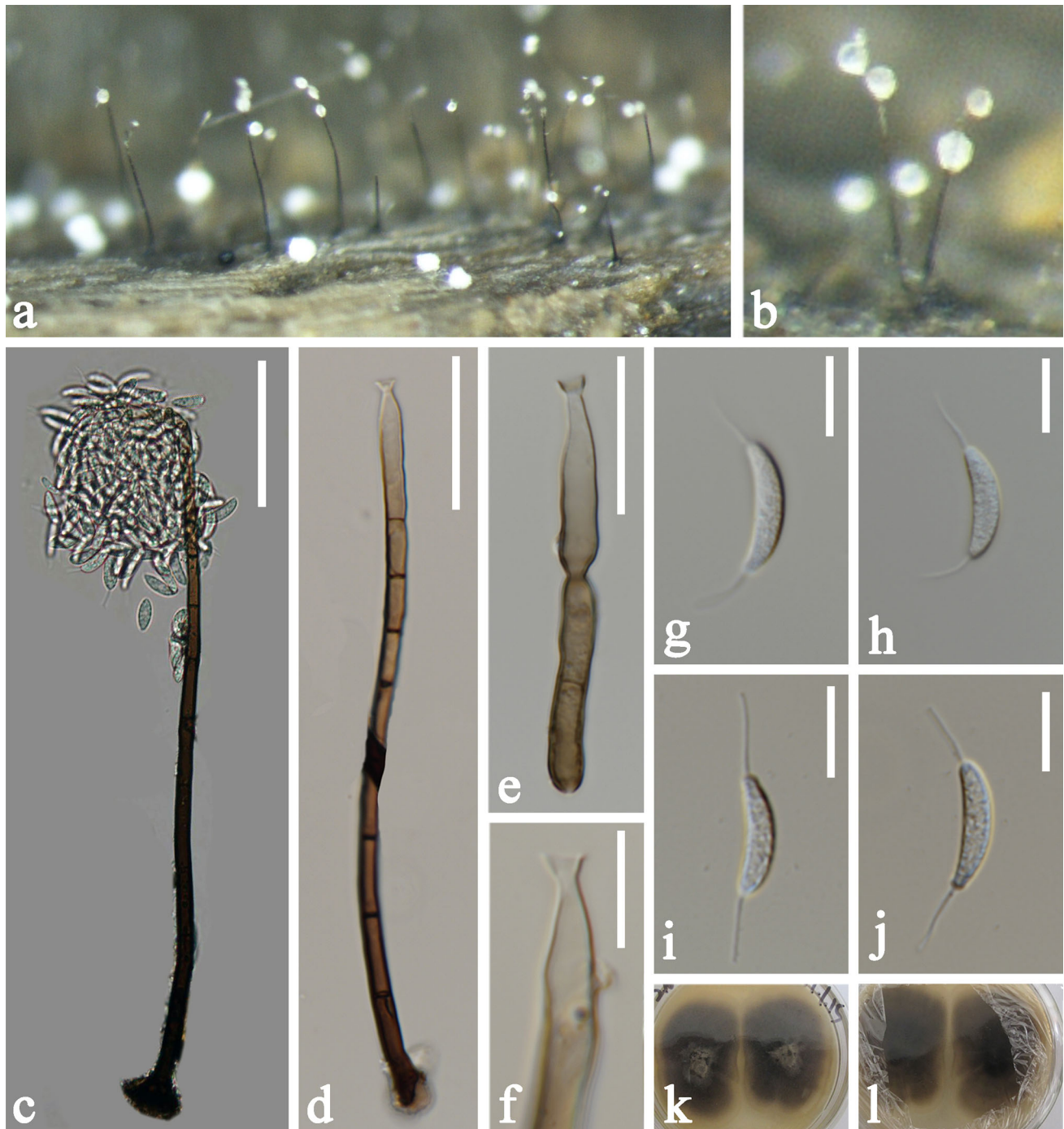


Fig. 57 *Dictyochaeta lignicola* (MFLU 18–1613, holotype). **a, b** Colonies on wood. **c** Conidiophores with conidia. **d** Conidiophores. **e, f** Conidiogenous cells. **g–j** Conidia. **k, l** Culture on PDA from above and reverse. Scale bars: **c, d** 30 μm, **e** 20 μm, **f–j** 10 μm

one of them was collected from freshwater habitats (IMI 335369).

Dictyochaeta cangshanensis Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555679, Facesoffungi number: FoF 05465, Fig. 55

Etymology: Referring to the location where the fungus was collected, Cangshan Mountain, China.

Holotype: MFLU 18–1614

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on substrate effuse, gregarious, brown, shining. **Mycelium** mostly immersed, composed of branched, septate, smooth, thin-walled, brown

hyphae. *Setae* 125–175 μm long, 4.5–6.5 μm wide (\bar{x} = 150 \times 5.5 μm , n = 20), erect, dark brown at the base, paler towards the apex, 7–10-septate, acerose to sub-acerose, unbranched, smooth. *Conidiophores* 39–53 μm long, 3.5–4.5 μm wide (\bar{x} = 46 \times 4 μm , n = 20), macronematous, mononematous, in groups from the mycelial knots from the bases of setae, short, brown, straight or slightly flexuous, 3–6-septate, unbranched, cylindrical, smooth. *Conidiogenous cells* monophialidic, with flared collarette, determinate, terminal, subhyaline. *Conidia* 15–18 μm long, 2.5–3.5 μm wide (\bar{x} = 16.5 \times 3 μm , n = 20), acrogenous, solitary, aggregating in a globose mass at apex of conidiophore, aseptate, cylindrical or long fusiform, curved, with hair-like appendages at both ends, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on submerged decaying wood in a freshwater stream, July 2016, H.Y. Su, S-829 (MFLU 18–1614, holotype), ex-type living culture MFLUCC 17–2214.

Notes: *Dictyochaeta cangshanensis* resembles *D. aquatica* in having septate, unbranched setae dark brown at the base, paler towards the apex, mononematous, septate, cylindrical, unbranched conidiophores with similar size, aseptate, cylindrical or long fusiform, hyaline conidia with hair-like appendages (Wei et al. 2018). However, phylogenetic analysis shows that *D. cangshanensis* is distinct from *D. aquatica*. *Dictyochaeta cangshanensis* also resembles *D. siamensis* in having septate, unbranched setae dark brown at the base, paler towards the apex, mononematous, septate, cylindrical, unbranched conidiophores, aseptate, cylindrical or long fusiform, hyaline conidia with hair-like appendages and aggregating in a globose mass at apex of conidiophore (Liu et al. 2016). However, *D. cangshanensis* differs from *D. siamensis* in having shorter setae (125–175 vs. 165–365 μm), shorter conidiophores (39–53 vs. 60–100 μm) and monophialidic conidiogenous cells while *D. siamensis* has monophialidic or rarely polyphialidic conidiogenous cells.

Dictyochaeta coffeae (Maggi & Persiani) Aramb. & Cabello

≡ *Codinaea coffeae* Maggi & Persiani

Distribution: **China**, Hong Kong, Lam Tsuen River, on submerged wood (Tsui et al. 2001b).

Sexual morph: Undetermined

Notes: Holotype H.B.R 107 S. Sequence data is not available.

Dictyochaeta curvispora Cai et al.

Distribution: **Philippines**, saprobic on submerged bamboo (Cai et al. 2004b).

Sexual morph: Undetermined

Notes: Holotype PDD 75040. Sequence data is not available. This species is only known from the type locality.

Dictyochaeta ellipsoidea Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555680, Facesoffungi number: FoF 05466, Fig. 56

Etymology: Referring to ellipsoid conidia of this fungus.

Holotype: MFLU 18–1612

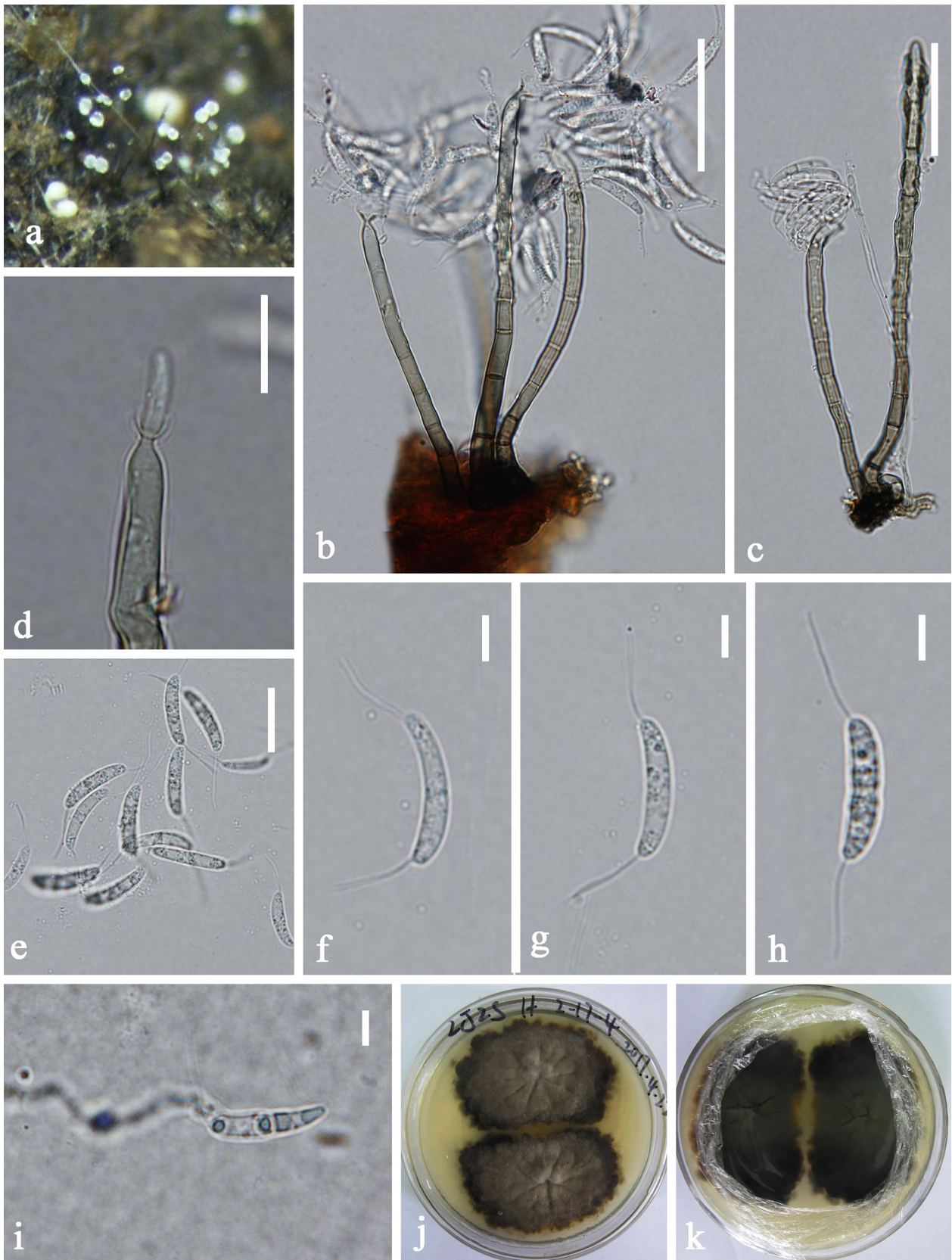
Saprobic on submerged decaying wood. **Asexual morph** Colonies effuse, greyish brown, shining. *Mycelium* partly immersed, composed of septate, hyaline hyphae. *Conidiophores* 254–288 μm long, 8–10 μm wide (\bar{x} = 271 \times 9 μm , n = 20), macronematous, mononematous, septate, unbranched, erect, flexuous, dark brown below, pale towards apex, smooth, percurrently proliferating. *Conidiogenous cells* monophialidic, confined to apical region on conidiophore, with conspicuous, flared, funnel-shaped collarette. *Conidia* 13–15 μm long, 5.5–6.5 μm wide (\bar{x} = 14 \times 6 μm , n = 20), acrogenous, ellipsoid, solitary, aggregating in a globose mucoid mass, curved, slightly pointed at both ends, with polar appendage, aseptate, guttulate, often accumulating at tip of phialide, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Nujiang River, saprobic on submerged decaying wood, October 2016, Z.L. Luo, S-898 (MFLU 18–1612, holotype), ex-type living culture MFLUCC 18–1574.

Notes: *Dictyochaeta ellipsoidea* mostly resembles *Dictyochaeta tropicalis* in having mononematous, septate, unbranched conidiophores dark brown below, pale towards apex, monophialidic, terminal conidiogenous cells with funnel-shaped collarette and hyaline, aseptate, ellipsoid conidia with one setulae at each end of conidium (Bhat and Kendrick 1993). However, *Dictyochaeta ellipsoidea* differs from *D. tropicalis* in having longer conidiophores (254–288 vs. 90–130 μm) and guttulate, larger conidia (13–15 \times 5.5–6.5 vs. 7.5–9.5 \times 3–5 μm). *Dictyochaeta ellipsoidea* also shares similar morphology with *D. multisetula* in having mononematous, septate, unbranched conidiophores dark brown at base, pale towards apex, monophialidic, terminal conidiogenous cells with funnel-shaped collarette and hyaline, aseptate, ellipsoid conidia (Whitton et al. 2000). However, *Dictyochaeta ellipsoidea* differs from *D. multisetula* in different sizes of conidiophores and conidia, the conidia of *D. ellipsoidea* with only one setulae at each end, but the conidia of *D. multisetula* are multi-setulate at each ends (Whitton et al. 2000).

Dictyochaeta fertilis (S. Hughes & W.B. Kendr.) Hol.-Jech
≡ *Codinaea fertilis* S. Hughes & W.B. Kendr.

Distribution: **Malaysia**, Kuala Lumpur, on decaying leaves of unidentified dicotyledon plant submerged in fast-



◀**Fig. 58** *Dictyochaeta submersa* (MFLU 18–2321, holotype) **a** Colonies on wood. **b** Conidiophores with conidia. **c** Conidiophores with setae. **d** Conidiogenous cells. **e–h** Conidia. **i** Germinating conidium. **j, k** Culture on PDA from above and reverse. Scale bars: **b**, **c** 50 μm , **d**, **e** 15 μm , **f–i** 5 μm

flowing freshwater stream (Kuthubutheen and Nawawi 1991b).

Sexual morph: Undetermined

Notes: Holotype PDD 20965, specimen collected from freshwater habitats: IMI 335368. ITS sequence data is available.

Dictyochaeta guadalcanalensis (Matsushima) Kuthubutheen & Nawawi

≡ *Phialogeniculata guadalcanalensis* Matsush.

Distribution: **Malaysia**, Bako National Park, on decaying twig of unidentified angiosperm submerged in fast-flowing freshwater stream (Kuthubutheen and Nawawi 1991b).

Sexual morph: Undetermined

Notes: Specimen collected from freshwater habitats: IMI 343460; Sequence data is not available.

Dictyochaeta lignicola Z.L. Luo, H.Y. Su & K.D. Hyde, *sp. nov.*

Index Fungorum number: IF 555681, Facesoffungi number: FoF 05467, Fig. 57

Etymology: Referring to this fungus dwelling on wood.

Holotype: MFLU 18–1613

Saprobic on submerged decaying wood. **Asexual morph** Colonies on natural substrate, effuse, superficial, hairy, greyish brown, in groups. *Mycelium* immersed, composed of branched septate, smooth haphae. *Conidiophores* 204–276 μm long, 7.5–8.5 μm wide (\bar{x} = 240 \times 8 μm , n = 20), macronematous, mononematous, solitary, cylindrical, erect, straight or slightly flexuous, unbranched, septate, brown, becoming pale brown towards the apex, smooth. *Conidiogenous cells* mono- to polyphialidic, determinate, terminal, subhyaline. *Conidia* 13–15 μm long, 4.5–5.5 μm wide (\bar{x} = 14 \times 5 μm , n = 20), solitary, aggregating in a globose mass at apex of conidiophore, aseptate, navicular to fusiform, curved, with appendages at both ends, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Nujiang River, saprobic on submerged decaying wood, October 2016, Z.L. Luo, S-899 (MFLU 18–1613, holotype), ex-type living culture DLUCC 0899.

Notes: *Dictyochaeta lignicola* resembles *D. renispora* in having mononematous, cylindrical, unbranched, septate conidiophores, hyaline, aseptate, setulate conidia aggregating in a globose mucoid mass (Whitton et al. 2000). However, *D. lignicola* differs from *D. renispora* in having

longer conidiophores (204–276 vs. 95–220 μm) and polyphialidic conidiogenous cells, while *D. renispora* with monophialidic conidiogenous cells and *D. lignicola* has larger conidia (13–15 \times 4.5–5.5 vs. 6–8.5 \times 3–4.5 μm).

Dictyochaeta longispora (S. Hughes & W.B. Kendr.) Whitton et al.

≡ *Codinaea longispora* S. Hughes & W.B. Kendr.

Distribution: **Malaysia**, Pahang, Lepar Forest Reserve, on decaying leaves of unidentified dicotyledon plant submerged in fast-flowing freshwater stream (Kuthubutheen and Nawawi 1991b).

Sexual morph: Undetermined

Notes: Holotype PDD 25755, specimen collected from freshwater habitats: IMI 335366; Sequence data is not available.

Dictyochaeta lunulospora (Hewings & J.L. Crane) Hol.-Jech.

≡ *Codinaea lunulospora* Hewings & J.L. Crane

Distribution: **Malaysia**, Selangor, Mimaland, on decaying twig of unidentified dicotyledon plant submerged in fast-flowing freshwater stream (Kuthubutheen and Nawawi 1991b).

Sexual morph: Undetermined

Notes: Holotype Dumont-VE 4619 (NY), specimen collected from freshwater habitats: IMI 335363; Sequence data is not available.

Dictyochaeta plovercovensis Goh & K.D. Hyde

Distribution: **China**, Hong Kong, Plover Cove Reservoir, on submerged wood (Goh and Hyde 1999), Yunnan Province, Dianchi lake, on submerged wood (Luo et al. 2004); **Philippines**, Liput River, on submerged bamboo (Cai et al. 2003b).

Sexual morph: Undetermined

Notes: Holotype IFRD 8744; Sequence data is not available. *Dictyochaeta plovercovensis* was originally collected from freshwater by Goh and Hyde (1999) in Hong Kong, China. Cai et al. (2003a) reported this species from Philippines. Luo et al. (2004) reported this species from a freshwater lake in Yunnan Province, China. However, both the later studies did not provide descriptions and illustrations for this species.

Dictyochaeta subfuscospora Kuthub. & Nawawi

Distribution: **Australia**, Queensland, on submerged wood in a stream in Mountain Lewis (Hyde and Goh 1997).

Sexual morph: Undetermined

Notes: Holotype IMI 343458; Sequence data is not available.

Dictyochaeta siamensis J. Yang, K.D. Hyde & J.K. Liu

Distribution: **Thailand**, Prachuap Khiri Khan Province, Hua Hin, Kaeng Krachan, on submerged wood (Liu et al. 2016).

Sexual morph: Undetermined

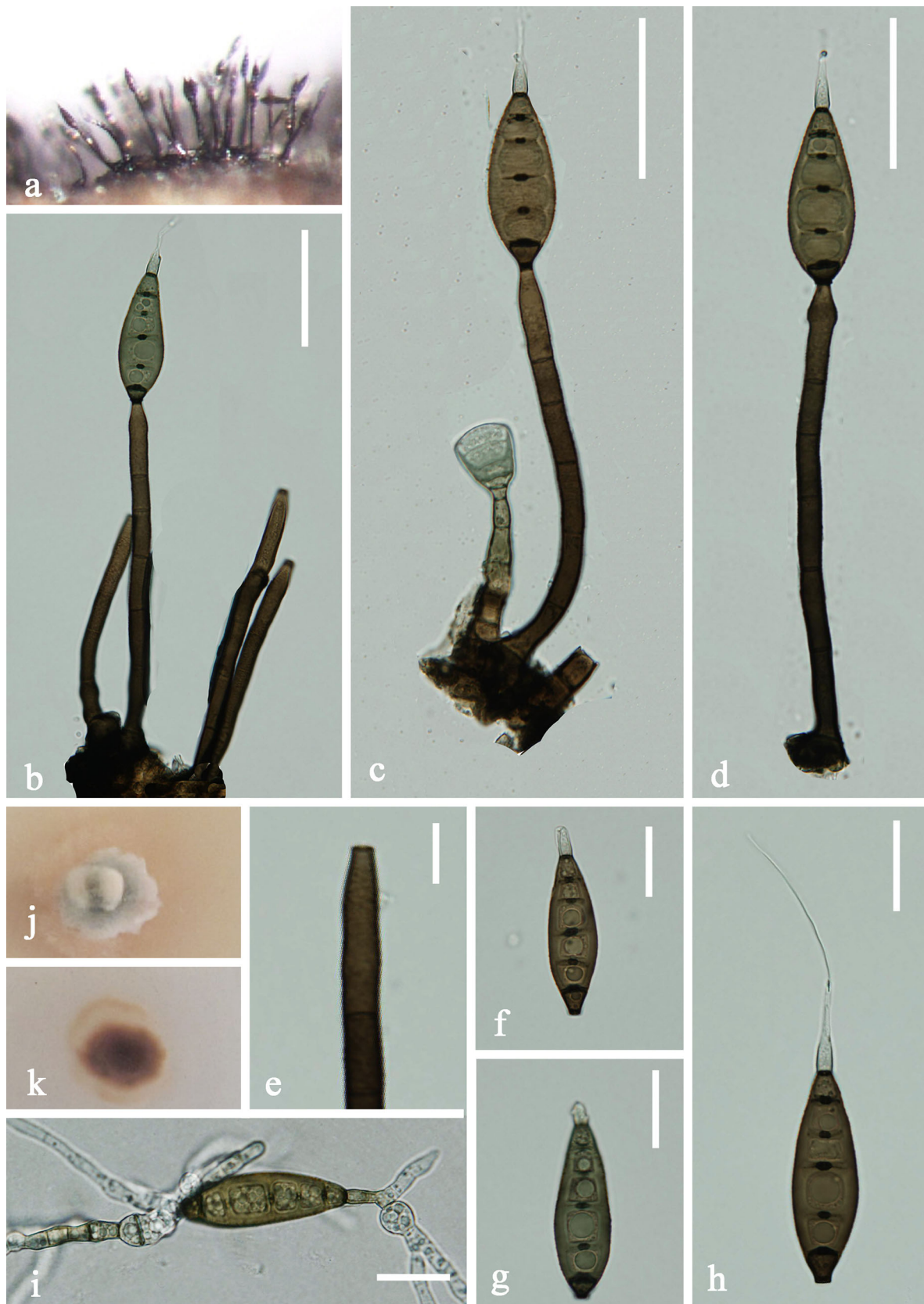


Fig. 59 *Sporidesmium brachypus* (MFLU 18–1615). **a** Colonies on wood. **b–d** Conidiophores with conidia. **e** Conidiogenous cells. **f–h** conidia **i** Germinating conidium. **j, k** Culture on PDA from above and reverse. Scale bars: **b–d** 40 μm , **e** 10 μm , **f–i** 20 μm

Notes: Holotype MFLU 15–1149; ITS, LSU and TEF1 α sequence data are available. This species is only known from the type locality.

Dictyochaeta submersa Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555682, Facesoffungi number: FoF 05468, Fig. 58

Etymology: Referring to the submerged habitat of this fungus.

Holotype: MFLU 18–2321

Saprobic on submerged decaying wood. **Asexual morph** Colonies on the substratum superficial, effuse, greyish brown, shining. *Mycelium* partly immersed, partly superficial, consisting of branched, septate, brown, smooth hyphae. *Setae* erect, cylindrical, straight, septate, unbranched, pale brown to brown. *Conidiophores* 62–122(–152) μm long, 3–5 μm wide (\bar{x} = 92 \times 4 μm , n = 20), macronematous, mononematous, erect, solitary or in small groups, unbranched, cylindrical, 4–6-septate, straight or slightly flexuous, pale brown, smooth. *Conidiogenous cells* monophialidic, terminal, determinate, subhyaline, narrowing below the collarette. *Conidia* 13.5–16.5 μm long, 2.5–3.5 μm wide (\bar{x} = 15 \times 3 μm , n = 20), acrogenous, solitary, aggregating in a globose mass at apex of conidiophore, fusiform, curved, rounded and narrow at both ends, with polar appendages, aseptate, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Jizu Mountain, saprobic on decaying wood submerged in a freshwater stream, March 2017, N. Zhao, S-1014 (MFLU 18–2321, holotype), ex-type living culture DLUCC 1014.

Notes: *Dictyochaeta submersa* resembles *D. aquatica* in having mononematous, unbranched, cylindrical, septate conidiophore, monophialidic, terminal conidiogenous cells with conspicuous funnel-shaped collarettes and aseptate, hyaline conidia with polar appendages (Wei et al. 2018). However, *D. submersa* differs from *D. aquatica* in having longer conidiophores (62–122(–152) vs. 47–68 μm) and aseptate, fusiform conidia, while *D. aquatica* has 0–1-septate, oblong to allantoid conidia. Phylogenetic analysis also shows that *D. submersa* and *D. aquatica* are distinct species (Fig. 51).

Sporidesmium brachypus (Ellis & Everh.) S. Hughes

\equiv *Helminthosporium brachypus* Ellis & Everh., Publications of the Field Columbia Museum, Bot. series 1: 92 (1896)

\equiv *Ellisemia brachypus* (Ellis & Everh.) Subram., Proc. Indian natn Sci. Acad., Part B. Biol. Sci. 58(4): 183 (1992)

Facesoffungi number: FoF 05469, Fig. 59

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, scattered, dark brown. *Mycelium* partly immersed, composed of septate,

branched, smooth, hyphae. *Conidiophores* 86–114 μm long, 5–7 μm wide (\bar{x} = 100 \times 6 μm , n = 20), macronematous, mononematous, solitary, erect, unbranched, 7–9-septate, straight or flexuous, percurrently growing, dark brown, smooth. *Conidiogenous cells* holoblastic, monoblastic, integrated, terminal, dark brown. *Conidia* 45–63 μm long, 13–17 μm wide (\bar{x} = 54 \times 15 μm , n = 20), acrogenous, solitary, ovoid to fusiform, 5–6-pseudoseptate, truncate at base, with a short and hyaline rostrate tip at apex, brown, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Nujiang River, saprobic on submerged decaying wood, October 2016, Z.L. Luo, S-868 (MFLU 18–1615), living culture MFLUCC 18–1573.

Notes: Specimens collected from freshwater habitats: MFLU 18–1615. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available. Ellis (1971) described the species *Sporidesmium brachypus* from twigs of various trees. Shirouzu and Harada (2004) collected and described this species as *Ellisemia brachypus* and provided descriptions and illustrations. Shenoy et al. (2006) provided LSU sequence data for this species (*Ellisemia brachypus* HKUCC 10555). Su et al. (2016) treated *Ellisemia* as a synonym of *Sporidesmium* based on the molecular data, we follow this and use *Sporidesmium brachypus* in this study. During an investigation on lignicolous freshwater fungi in China, a *Sporidesmium*-like fungus was collected from submerged wood in Yunnan Province, and morphological characters of this fungus fit well with *Sporidesmium brachypus* (Shirouzu and Harada 2004). Phylogenetic analysis shows that our strain clusters with *Ellisemia brachypus* (HKUCC 10555) with good support value. We therefore identify our fungus as *Sporidesmium brachypus* based on the morphology and molecular evidence and provide descriptions and illustrations.

Menisporopsis S. Hughes, Mycol. Pap. 48: 59 (1952)

Asexual morph Colonies superficial, scattered, effuse, white to pale brown. *Mycelium* partly immersed, composed of brown hyphae. *Setae* central, solitary, erect, straight, brown, septate, thick-walled, septate. *Conidiophores* synnematous, macronematous, septate, unbranched, cylindrical, lower part narrow, upper part wider, erect, straight or slightly flexuous, brown, smooth, thin- to thick-walled. *Conidiogenous cells* monophialidic, terminal, integrated, pale brown, with collarette. *Conidia* acrogenous, fusiform, gently curved or straight, with appendages at each end, aseptate, hyaline, thin-walled, smooth. **Sexual morph** Undetermined.

Type species: *Menisporopsis theobromae* S. Hughes, Mycol. Pap. 48: 59 (1952)

Notes: The genus *Menisporopsis* was established by Hughes (1952) with *M. theobromae* S. Hughes as the type species. There are ten species accepted in the genus *Menisporopsis*. Liu et al. (2016) provided the molecular data for the type species *Menisporopsis theobromae* and it is the first time provide sequence data for this genus. Two species of *Menisporopsis* have been reported from freshwater habitats.

Menisporopsis multisetulata Tsui et al.

Distribution: **China**, Hong Kong, New Territories, Tai Po, Lam Tsuen River, on submerged wood (Tsui et al. 1999).

Sexual morph: Undetermined

Notes: Holotype IFRD 8806. Sequence data is not available. This species is known so far only from the type locality.

Menisporopsis theobromae S. Hughes

Distribution: **Thailand**, Chiang Rai Province, stream flowing near Tham Luang Nang Non Cave, on submerged wood (Liu et al. 2016).

Sexual morph: Undetermined

Notes: Holotype IMI 39099a, specimen collected from freshwater habitats: MFLU 15–1168. ITS and LSU sequence data are available. Liu et al. (2016) collected this species from freshwater in northern Thailand and provided descriptions and illustrations.

Nawawia Marvanová, Trans. Br. mycol. Soc. 75(2): 227 (1980)

Asexual morph Colonies on the natural substratum effuse, hairy, dark brown, with glistening mass of conidia at the tip of conidiophores. Mycelium partly immersed and partly superficial, composed of pale brown, septate hyphae. Conidiophores cylindrical to slightly clavate, single or in small groups, erect, straight, unbranched, smooth. Conidiogenous cells integrated, terminal, phialidic. Conidia with a filiform appendage at each blunt corner, hyaline. **Sexual morph** Undetermined.

Type species: *Nawawia filiformis* (Nawawi) Marvanová, Trans. Br. mycol. Soc. 75(2): 227 (1980)

Notes: The asexual genus *Nawawia* was introduced by Marvanová (1980) based on *Clavatospora filiformis* Nawawi (Nawawi 1973), a hyphomycete found on submerged decaying twigs and petioles. Six species of *Nawawia* have thus far been described, three from Malaysia (Nawawi 1973; Kuthubutheen et al. 1992; Crous et al. 2009; Goh et al. 2014), one from South Africa (Hyde et al. 1996), one from Russia (Mel'nik and Hyde 2006) and one from China (Peng et al. 2016). Presently, five *Nawawia* species have been reported from freshwater habitats.

Nawawia dendroidea K.D. Hyde, Goh & Steinke

Distribution: **South Africa**, Durban, Palmiet River, on submerged pieces of stems of *Phragmites* (Hyde et al. 1996).

Sexual morph: Undetermined

Notes: Holotype BRIP 22870, Paratype BRIP 22871. Sequence data is unavailable.

Nawawia filiformis (Nawawi) Marvanová

≡ *Clavatospora filiformis* Nawawi, Trans. Br. mycol. Soc. 61(2): 390 (1973)

Distribution: **Malaysia**, on submerged wood (Nawawi 1973; Marvanová 1980; Kuthubutheen et al. 1992); **Thailand**, Trat Province, on decaying wood submerged in a freshwater stream (Yang et al. 2018b)

Sexual morph: Undetermined

Notes: Holotype IMI 177451, other specimens collected from freshwater habitats: MFLU 18–1500, MFLU 18–1501, HKAS 102155. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available.

Nawawia nitida Kuthub. et al.

Distribution: **Malaysia**, Pahang, Leper Forest Reserve, on decaying wood submerged in a fast-flowing freshwater stream (Kuthubutheen et al. 1992).

Sexual morph: Undetermined

Notes: Holotype IMI 344361. Sequence data is unavailable.

Nawawia quadrisetulata Goh et al.

Distribution: **Malaysia**, Perak, Menglembu, Bukit Kle-dang, on submerged wood (Goh et al. 2014).

Sexual morph: Undetermined

Notes: Holotype UTAR(M)-0004. Sequence data is unavailable.

Nawawia oviformis J. Peng & Z.F. Yu

Distribution: **China**, Sichuan Province, Gaosun County, on submerged leaves of an unidentified dicotyledonous plant in a stream (Peng et al. 2016).

Sexual morph: Undetermined

Notes: Holotype YMF 1.04361. Sequence data is unavailable.

Phialogeniculata Matsush., Sci. Mus., Tokyo, N.S. 14: 471 (1971)

Asexual morph Colonies on natural substrate effuse, brown. Conidiophores macronematous, mononematous, solitary, erect, simple, straight or repeatedly geniculate, septate, sometimes slightly constricted at the septa, smooth-walled. Conidiogenous cells monoblastic or polyphialidic, integrated, terminal. Conidia formed in colourless slimy masses, obclavate, hyaline, smooth-walled. **Sexual morph** Undetermined.

Type species: *Phialogeniculata guadalcanalensis* Matsush., Bull. natn. Sci. Mus., Tokyo 14(3): 472 (1971)

Notes: The genus *Phialogeniculata* was introduced Matsushima (1971) with *P. guadalcanalensis* as the type



Fig. 60 *Sporoschisma juvenile* (MFLU 18–1608). **a, b** Colonies on wood. **c, d** Conidiophores with conidia. **e, f** Conidiogenous cells. **g–j** Conidia. **k** Germinating conidium. Scale bars: **c, d** 50 μ m, **e–h** 20 μ m, **i–k** 15 μ m

species. Two more species were described by Matsushima (1993), namely *Phialogeniculata dimorpha* and *P. mulliseplata*. Hyde et al. (1998a) introduced a freshwater species in this genus named as *Phialogeniculata africana* which was collected from freshwater in South Africa.

Phialogeniculata africana Goh et al.

Distribution: **South Africa**, Duban, Palmiet River, on submerged wood (Hyde et al. 1998b).

Sexual morph: Undetermined

Notes: Holotype IFRD 8830. Sequence data is not available. This species is only known from the type locality.

Sporoschisma Berk. & Broome, Gard. Chron., London: 540 (1847)

Asexual morph Colonies on the substratum superficial, effuse, gregarious, hairy. Mycelium immersed, composed of pale to dark brown hyphae. Setae scattered, capitate, with hyaline, mucilaginous substances at the swollen apex, septate, smooth-walled. Conidiophores macronematous, mononematous, smooth, black, erect, straight or slightly flexuous, solitary, each composed of a bulbous base, a cylindrical stipe and a swollen venter. Conidiogenous cells monophialidic, integrated, terminal, determinate, brown. Conidia solitary, in pseudo-chains, cylindrical, septate, verruculose or smooth, developing endogenously in basipetal succession. **Sexual morph** Ascomata superficial, solitary, scattered, anchored to substrate by an indistinct basal stroma, wall smooth and shiny. Setae stiff, erect, unbranched, dark brown to black, capitate, arising from all over surface of ascomatal wall. Paraphyses filiform, septate, longer than asci, hyaline. Asci unitunicate, cylindrical to narrowly clavate, apex with a refractive, non-amyloid ring. Ascospores partially biserial to biserial, fusiform, slightly curved, pale brown.

Type species: *Sporoschisma mirabile* Berk. & Broome, London: 540 (footnote) (1847)

Notes: The genus *Sporoschisma* was introduced by Berkeley (1847) with *S. mirabile* Berk. & Broome as the type species. *Sporoschisma* is cosmopolitan distribution, largely reported from moist terrestrial habitats in Asia, Europe and Africa (Berkeley 1847; Rao and Rao 1964; Bhat and Kendrick 1993; Goh et al. 1997; Sivichai et al. 2000b; Zelski et al. 2014; Yang et al. 2016a, b). Several species are known from aquatic habitats (Goh et al. 1997; Sivichai et al. 2000b; Zelski et al. 2014; Luo et al. 2016; Yang et al. 2016a, b). There are 14 species accepted in *Sporoschisma*.

Sporoschisma australiense (Goh & K.D. Hyde) Réblová

≡ *Sporoschismopsis australiensis* Goh & K.D. Hyde, Mycol. Res. 101: 1302. 1997.

Distribution: **Australia**, On submerged wood in a freshwater stream (Goh et al. 1997).

Sexual morph: Undetermined

Notes: Holotype HKU (M) 2313 (now in IFRD). Sequence data is not available. Goh et al. (1997) introduced this species as *Sporoschismopsis australiensis*, Réblová et al. (2014) transferred *Sporoschismopsis australiensis* to the genus *Sporoschisma* as *Sporoschisma australiense*. Goh et al. (1997) mentioned the holotype of this species as HKU (M) 2313, the isotype of this species was deposited in IMI herbarium.

Sporoschisma hemipsila (Berk. & Broome) Zelski et al.

≡ *Sphaeria hemipsila* Berk. & Broome, Bot. J. Linn. Soc. 14: 126 (1873).

Distribution: **China**, Yunnan Province, saprobic on decaying wood submerged in Nujiang River (Luo et al. 2016); **Thailand**, Nakorn Ratchassima Province/Prachuap Khiri Khan Province: on submerged wood in freshwater (Sivichai et al. 2000b; Yang et al. 2016b); **Perú**, Cusco, on submerged, decomposing woody and herbaceous debris in freshwater habitats (Zelski et al. 2014).

Sexual morph: see Goh et al. (1997)

Notes: Specimens collected from freshwater habitats: HKAS 92767, HKAS 92843, MFLU 15–1150, MFLU 16–1324, PE0177–21a, PE0177–21b, PE0177–21c. ITS, LSU and RPB2 sequence data are available.

Sporoschisma juvenile Boud.

≡ *Sporoschisma aquaticum* Luo et al.

Facesoffungi number: FoF 03440, Fig. 60

Saprobic on submerged decaying wood. **Asexual morph** Colonies effuse, gregarious, hairy, shining, pale brown to black. Mycelium mostly immersed, composed of septate, smooth, pale to dark brown hyphae. Setae in groups mixed with conidiophores, erect, straight or flexuous, 0–3-septate, smooth, brown, paler towards the apex. Conidiophores 211–233 µm long, 12–14 µm wide (\bar{x} = 222 × 13 µm, n = 20), macronematous, mononematous, erect, solitary or in groups of 2–3, associated with 2–6 capitate setae, straight or slightly flexuous, smooth, dark brown, each composed of a bulbous base, a cylindrical stipe and a swollen venter with a long cylindrical neck. Conidiogenous cells monophialidic, terminal, integrated, pale brown. Conidia 25–31 µm long, 9–10 µm wide (\bar{x} = 28 × 9.5 µm, n = 20), solitary, forming linear false-chains, cylindrical, 2–3-septate, guttulate at maturity, hyaline to pale brown when young, brown at maturity, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Nujiang River, saprobic on submerged decaying wood, October 2016, Z.L. Luo, S-906 (MFLU 18–1608), living culture MFLUCC 18–1348.

Distribution: **China**, Yunnan Province, saprobic on decaying wood submerged in Nujiang River (Luo et al. 2016); **Perú**, Cusco, on submerged, decomposing woody

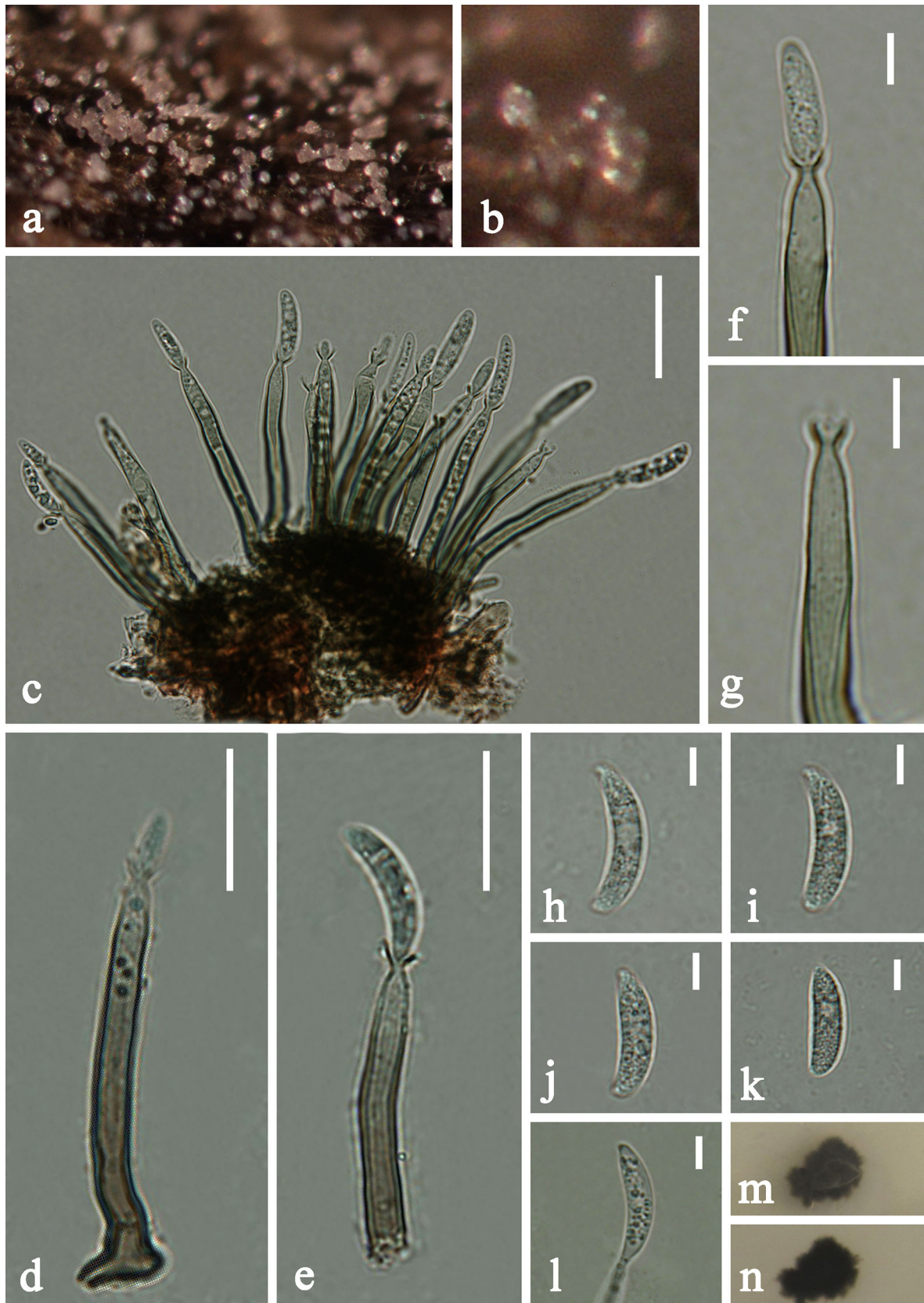


Fig. 61 *Tainosphaeria lunata* (MFLU 18–1610, holotype). **a, b** Colonies on wood. **c–e** Conidiophores with conidia. **f, g** Conidiogenous cells. **h–k** conidia **l** Germinating conidium. **m, n** Culture on PDA from above and reverse. Scale bars: **c** 50 μm , **d–e** 30 μm , **f–g** 10 μm , **h–l** 5 μm

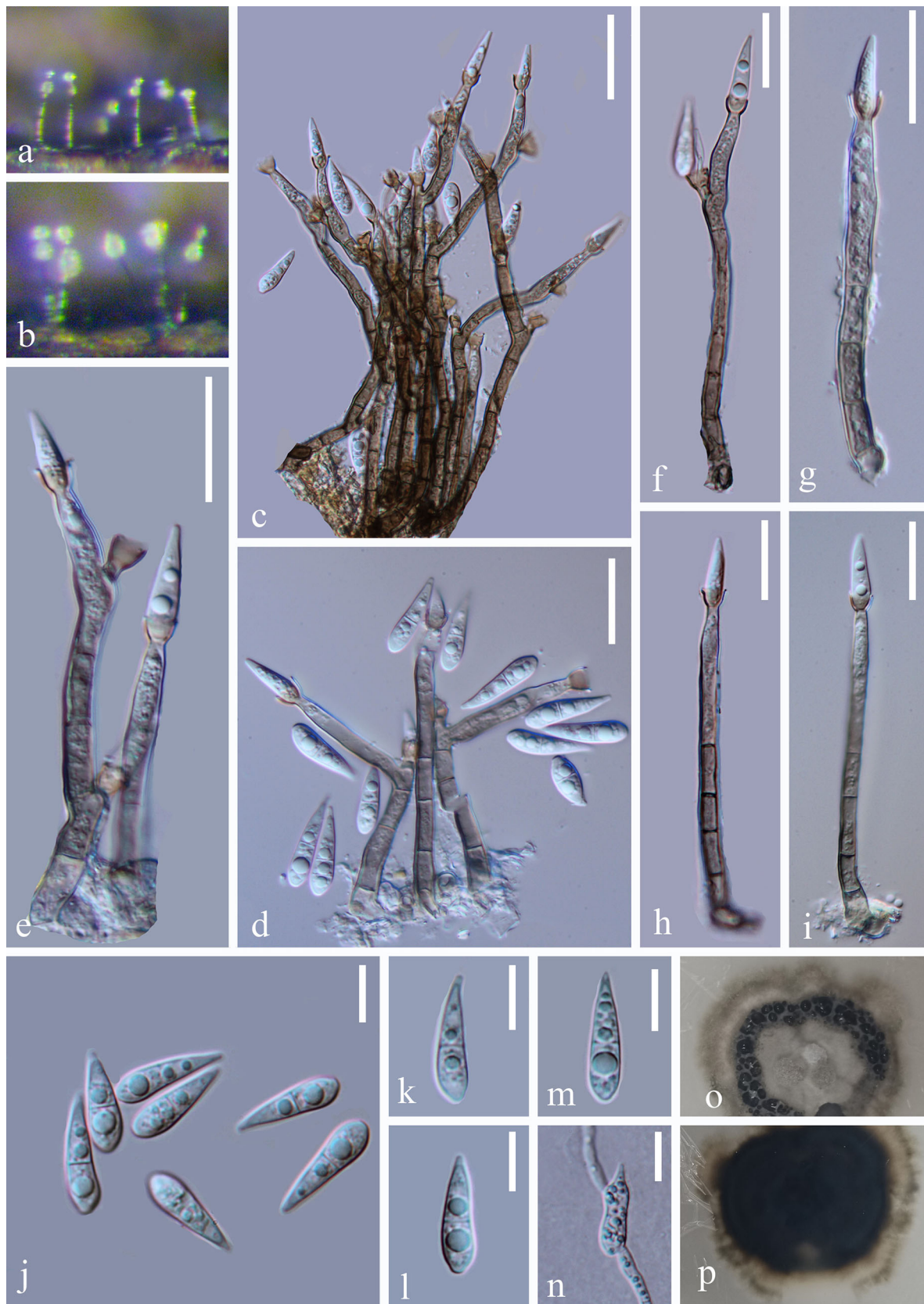


Fig. 62 *Tainosphaeria obclavata* (MFLU 18–1455, holotype). **a, b** Colonies on wood. **c–d** Conidiophores with conidia. **f–i** Conidiogenous cells and conidia. **j–l** Conidia. **n** Germinating conidium. **o, p** Culture on PDA from above and reverse. Scale bars: **c** 30 μm , **d–i** 20 μm , **j–n** 10 μm

and herbaceous debris in freshwater habitats (Zelski et al. 2014).

Sexual morph: Undetermined

Notes: Epitype E00817146, other specimens collected from freshwater habitats: DLU 628, MFLU 18–1608. ITS, LSU, SSU and TEF1 α sequence data are available.

Sporoschisma longicatenatum J. Yang & K.D. Hyde

Distribution: **Thailand**, Prachuap Khiri Khan Province: Hua Hin, stream outside Kaeng Krachan National Park, on submerged wood (Yang et al. 2016b).

Sexual morph: Undetermined

Notes: Holotype MFLU 16–1325, isotype HKAS 95044. ITS and LSU sequence data are available.

Sporoschisma mirabile Berk. & Broome

Distribution: **China**, Yunnan Province, saprobic on decaying wood submerged in Dulong River (Luo et al. 2016).

Sexual morph: Undetermined

Notes: Specimen collected from freshwater: HKAS 92727. ITS and LSU sequence data are available.

Sporoschisma nigroseptatum D. Rao & P. Rag. Rao

Distribution: **China**, Yunnan Province, saprobic on decaying wood submerged in a stream in Cangshan Mountain (Luo et al. 2016); **India**, Western Ghats, Kali River, submerged woody litter (Sudheep and Sridhar 2011).

Sexual morph: Undetermined

Notes: Holotype V.V.C.B.L. No. 355, other specimen collected from freshwater habitats: DLU 629. Sequence data is not available.

Sporoschisma palauense J. Yang & K.D. Hyde

Distribution: **Thailand**, Prachuap Khiri Khan Province: Hua Hin, stream outside Kaeng Krachan National Park, on submerged wood (Yang et al. 2016b).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1151, isotype HKAS 95042. ITS and LSU sequence data are available.

Sporoschisma phaeocentri Ho et al.

Distribution: **China**, Yunnan Province, saprobic on decaying wood submerged in a stream in Cangshan Mountain (Luo et al. 2016).

Sexual morph: Undetermined

Notes: Holotype HKU (M) 2897 (now in IFRD), other specimen collected from freshwater habitats: HKAS 84039. Sequence data is not available.

Sporoschisma saccardoii E. W. Mason & S. Hughes

Distribution: **Perú**, Cusco, on submerged, decomposing woody and herbaceous debris in freshwater habitats (Zelski et al. 2014).

Sexual morph: see (Zelski et al. 2014).

Notes: Holotype IMI 25206, other specimen collected from freshwater habitats: PE0349–1. Sequence data is not available. Zelski et al. (2014) reported *Sporoschisma*

saccardoii from freshwater habitats and provided the descriptions and illustrations for asexual and sexual morph of this species.

Sporoschisma taitense (Mugambi & Huhndorf) A.N. Mill. \equiv *Melanochaeta taitensis* Mugambi & Huhndorf, Sydowia 60: 263 (2008).

Distribution: **China**, Yunnan Province, saprobic on decaying wood submerged in a stream in Cangshan Mountain (Luo et al. 2016).

Sexual morph: see Mugambi and Huhndorf (2008)

Notes: Holotype EA, Mugambi 156 N, other specimen collected from freshwater habitats: DLU 272. ITS and LSU sequence data are available.

Sporoschisma uniseptatum Bhat & W.B. Kendr

Distribution: **India**, Western Ghats, Kali River, submerged woody litter (Sudheep and Sridhar 2011); **Perú**, Cusco, on submerged, decomposing woody and herbaceous debris in freshwater habitats (Zelski et al. 2014).

Sexual morph: see Sivichai et al. (2000b)

Notes: Holotype DAOM 214614, other specimen collected from freshwater habitats: PE0172–8. Sequence data is not available.

Tainosphaeria F.A. Fernández & Huhndorf, Fungal Divers 18: 44 (2005)

Asexual morph *Mycelium* composed of partly immersed and partly superficial, hyaline to pale brown, septate, erect hyphae with glistening conidial masses at their apices. *Conidiophores* superficial, macronematous, mononematous, erect, unbranched, bowed to dark brown below half, pale brown towards the apex, septate, smooth-walled. *Conidiogenous cells* monophialidic, integrated, terminal, determinate. *Conidia* fusiform or cylindrical, aseptate, gently curved, rarely straight, hair-like appendages at both ends, hyaline, smooth, thin-walled. **Sexual morph** *Ascomata* superficial on the substratum, subglobose to broadly ovoid, dark brown, roughened surface, separate to gregarious, distinctly papillate. *Ascomatal wall* in surface view, opaque in water, of textura angularis in lactophenol. *Ascomatal apex* broad, papillate, short. *Paraphyses* unbranched, septate, hyaline, tapering. *Asci* unitunicate, cylindrical to clavate, short-stalked, thin-walled, apical ring very small. *Ascospores* narrow-fusiform, septate, with rounded ends, often inequilateral, hyaline.

Type species: *Tainosphaeria crassiparies* F.A. Fernández & Huhndorf, Fungal Divers 18: 44 (2005)

Notes: The genus *Tainosphaeria* was introduced by Fernández and Huhndorf (2005) based on the type species *T. crassiparies* and both the asexual and sexual morphs were found from the substrate and described. Liu et al. (2016) described the second species in the genus *Tainosphaeria* based on a collection from freshwater habitats in

Thailand. Lu et al. (2016) introduced another species collected from freshwater in China.

Tainosphaeria jonesii Lu et al.

Distribution: **China**, Guangxi Province, on decaying wood submerged in a freshwater stream (Lu et al. 2016).

Sexual morph: Undetermined

Notes: Holotype GZAAS 16–0065. ITS and LSU sequence data are available.

Tainosphaeria siamensis Yang et al.

Distribution: **Thailand**, Prachuap Khiri Khan Province, Hua Hin, Kaeng Krachan, on submerged wood (Liu et al. 2016).

Sexual morph: Undetermined

Notes: Holotype MFLU 15–1142. ITS and LSU sequence data are available. This species is only known from the type locality.

Tainosphaeria lunata Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555683, Facesoffungi number: FoF 05470, Fig. 61

Etymology: Referring to the lunate conidia.

Holotype: MFLU 18–1610

Saprobic on submerged decaying wood. **Asexual morph** Colonies effuse, greyish brown, in groups. *Mycelium* partly superficial, composed of septate, branched, brown, smooth hyphae. *Conidiophores* 71–103 µm long, 6–8 µm wide ($\bar{x} = 87 \times 7 \mu\text{m}$, $n = 20$), macronematous, mononematous, aseptate or 1–2-septate, unbranched, erect, flexuous, greyish black, pale towards apex, in groups, arising from a common stroma. *Conidiogenous cells* monophialidic, with conspicuous, flared collarette, terminal, determinate. *Conidia* 16–19 µm long, 4.5–5.5 µm wide ($\bar{x} = 17.5 \times 5 \mu\text{m}$, $n = 20$), acrogenous, fusiform, solitary, guttulate, aseptate, curved, narrow and rounded at both ends, without polar appendages, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Nujiang River, saprobic on submerged decaying wood, October 2016, Z.L. Luo, S-871 (MFLU 18–1610, holotype), ex-type living culture MFLUCC 18–0642.

Notes: *Tainosphaeria lunata* resembles *T. jonesii* and *T. siamensis* in having macronematous, unbranched conidiophores, monophialidic, integrated, terminal conidiogenous cells and smooth, hyaline, aseptate conidia (Liu et al. 2016; Lu et al. 2016). However, *T. lunata* differs from *T. jonesii* in having wider conidiophores (6–8 vs. 2.5–3.5 µm) and conidia without polar appendages. *T. lunata* differs from *T. siamensis* by its wider conidiophores (6–8 vs. 2.5–4 µm) and fusiform, guttulate conidia without polar appendages. Phylogenetic analysis shows that *Tainosphaeria lunata* is distinct from other *Tainosphaeria* species.

Tainosphaeria obclavata D.F. Bao, Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555684, Facesoffungi number: FoF 05471, Fig. 62

Etymology: Referring to the obclavate conidia of this fungus

Holotype: MFLU 18–1455

Saprobic on submerged decaying wood. **Asexual morph** Colonies effuse, greyish brown, shining. *Mycelium* mostly immersed, composed of septate, branched, brown, smooth hyphae. *Conidiophores* 60–106 µm long, 4.5–5.5 µm wide ($\bar{x} = 83 \times 5 \mu\text{m}$, $n = 20$), macronematous, mononematous, single or in groups, 3–6-septate, unbranched, erect, flexuous, greyish brown, paler towards the apex, smooth. *Conidiogenous cells* monophialidic, with conspicuous, flared, funnel-shaped collarette, light brown, terminal, sometimes becoming intercalary, determinate, sometimes sympodial, narrowing below the collarette. *Conidia* 17–21 µm long, 5–6 µm wide ($\bar{x} = 19 \times 5.5 \mu\text{m}$, $n = 20$), solitary, straight, obclavate, gradually narrow towards the apex, tapering at the apex, rounded at the base, 1-septate, with 2–3 guttules in each cell, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **THAILAND**, Khwaeng Phra Khanong Nuea, Khet Watthana Krung Thep Maha Nakhon, on submerged decaying wood, October 2017, Z.L. Luo, B-49 (MFLU 18–1455, holotype), ex-type culture, MFLUCC 18–0260.

Notes: *Tainosphaeria obclavata* resembles *T. jonesii*, *T. siamensis* and *T. lunata* in having macronematous, unbranched conidiophores, monophialidic, integrated, terminal conidiogenous cells with conspicuous, flared, funnel-shaped collarette and smooth, hyaline conidia (Liu et al. 2016; Lu et al. 2016). However, *T. obclavata* can easily be distinguished from other *Tainosphaeria* species by having obclavate, uniseptate, guttulate conidia which gradually narrow towards the apex. Phylogenetic analysis also shows that *Tainosphaeria obclavata* is distinct from other *Tainosphaeria* species (Fig. 51).

Thozetella Kuntze, Revis. gen. pl. (Leipzig) 2: 873 (1891) **Asexual morph** Colonies cream and light brown, flat, woolly to subfelty, margin incised and indistinct. *Conidiomata* sporodochial or effuse, superficial, sessile, forming a convex or flat hymenium, topped by a moist spore mass. *Conidiophores* macronematous, brown, irregularly cylindrical, branched, arising from a basal plate. *Conidiogenous cells* monophialidic, integrated, determinate, terminal, light brown, irregularly cylindrical, with no or minute collarette, with periclinal wall thickening. *Microawns* produced from conidiophores, sigmoid or L-shaped, aseptate, smooth, apical part acerose, straight or slightly undulating, thick-walled, hyaline, aseptate. *Conidia* lunate, aseptate, finely

guttulate, hyaline, smooth-walled. **Sexual morph** Undetermined.

Type species: *Thozetella nivea* (Berk.) Kuntze, Revis. gen. pl. (Leipzig) 2: 873 (1891)

Notes: *Thozetella* O. Kuntze (1891) is a nomen novum for *Thozetia* Berk. et F. Mueller, which was antedated by *Thozetia* F. Mueller ex Bentham (Asclepiadaceae). Pirozynski and Hodges (1973) revised the genus and accepted four species. Since then, a further 18 species were introduced in this genus.

Thozetella coronata Monteiro et al.

Distribution: **Brazil**, Pará State, submerged decaying plant materials in freshwater stream in Brazilian Amazon forest (Monteiro et al. 2016b).

Sexual morph: Undetermined

Notes: Holotype HUEFS 196471. Sequence data is not available.

Thozetella nivea (Berk.) Kuntze

≡ *Thozetia nivea* Berk

Distribution: **Thailand**, Khao Yai National Park, Tad Ta Phu, on submerged wood in a freshwater stream (Sivichai et al. 2002).

Sexual morph: Undetermined

Notes: ITS and LSU sequence data are available. Sivichai et al. (2002) reported this species from freshwater in Thailand, but did not provide descriptions and illustrations.

Thozetella ypsiloidea Monteiro et al.

Distribution: **Brazil**, Pará State, submerged decaying plant materials in freshwater stream in Brazilian Amazon forest (Monteiro et al. 2016b).

Sexual morph: Undetermined

Notes: Holotype HUEFS 196464. Sequence data is not available.

Helminthosphaeriaceae Samuels, Cand. & Magni

Diplococcium Grove, J. Bot., Lond. 23: 167 (1885)

=*Luxuriomyces* R.F. Castañeda, Fungi Cubenses III: 23 (1988)

=*Tretendophragma* Subram., Kavaka 20/21: 58 (1995)

Asexual morph Colonies effuse, dark, cottony or velvety. *Mycelium* partly superficial, partly immersed. *Conidiophores* macronematous, mononematous, straight or flexuous, brown, smooth or verruculose, simple or branched. *Conidiogenous cells* polytretic, integrated, terminal and intercalary, determinate, cylindrical, brown. *Conidia* catenate, acropleurogenous, simple, short, clavate, ellipsoidal or oblong rounded at the ends, 0–12-septate but mostly 1-septate, constricted at the septa, pale or dark brown, smooth-walled. **Sexual morph** Undetermined.

Type species: *Diplococcium spicatum* Grove, J. Bot., Lond. 23: 167 (1885)

Notes: The genus *Diplococcium* was introduced by Grove (1885) to accommodate *D. spicatum* Grove.

Presently, 28 species are accepted in the genus (Goh and Hyde 1998; Wang and Sutton 1998; Hernández-Restrepo et al. 2012; Ma et al. 2012; Silva et al. 2014; Almeida et al. 2015). The genus *Diplococcium* is morphologically similar to *Spadicoides* by having mononematous, simple or branched conidiophores with polytretic, terminal or intercalary conidiogenous cells producing acropleurogenous, euseptate conidia (Ellis 1971; Seifert et al. 2011; Ma et al. 2012). The sole distinguishing diagnostic character between these two genera is that conidia are solitary in *Spadicoides* whereas those of *Diplococcium* are catenate (Sinclair et al. 1985; Ma et al. 2012).

Diplococcium aquaticum Goh et al.

Distribution: **Australia**, Queensland, Atherton Tablelands, Lake Barrine, on submerged wood (Goh et al. 1998b).

Sexual morph: Undetermined

Notes: Holotype HKU (M) 3201 (now in IFRD). Sequence data is not available.

Endophragmiella B. Sutton, Mycol. Pap. 132: 58 (1973)

Asexual morph Colonies effuse to tufted, hairy to velutinous. *Mycelium* partly superficial, partly immersed. *Conidiophores* macronematous, mononematous, straight or flexuous, branched, septate, pale brown to dark brown, smooth. *Conidiogenous cells* monoblastic, integrated, terminal, sometimes determinate mostly percurrent, cylindrical. *Conidia* acrogenous, solitary, dry, simple, straight or slightly curved, broadly fusiform, ellipsoidal, oblong rounded at the ends or clavate, 1–3-septate, with a small, protuberant thin-walled peg at the base, pale brown, smooth or minutely verruculose. **Sexual morph** *Phaeotrichosphaeria* like and *Lasiosphaeria* like.

Type species: *Endophragmiella pallescens* B. Sutton, Mycol. Pap. 132: 62 (1973)

Notes: The genus *Endophragmiella* was proposed by Sutton (1973) for two species, *E. pallescens* B. Sutton and *E. canadensis* (Ellis & Everh.) B. Sutton (= *E. subolivacea* (Ellis & Everh.) S. Hughes). Hughes (1979) revised the genera *Endophragma* Duvernoy et Maire and *Endophragmiella*, some of the *Endophragma* species were transferred to *Endophragmiella* and an emended description of *Endophragmiella* was provided. The reported sexual morphs that linked to the genus *Endophragmiella* were *Phaeotrichosphaeria* and *Lasiosphaeria* (Sivanesan 1983; Hilber et al. 1987a). *Selenosporella*, a hyphomycetous genus, was reported as the synanamorph of the *Endophragmiella* (Hughes 1979; Matsushima 1989).

Endophragmiella mexicana Mena et al.

Distribution: **China**, Hong Kong, Tai Po Kau Forest Stream, on submerged wood (Ho et al. 2002a).

Sexual morph: Undetermined

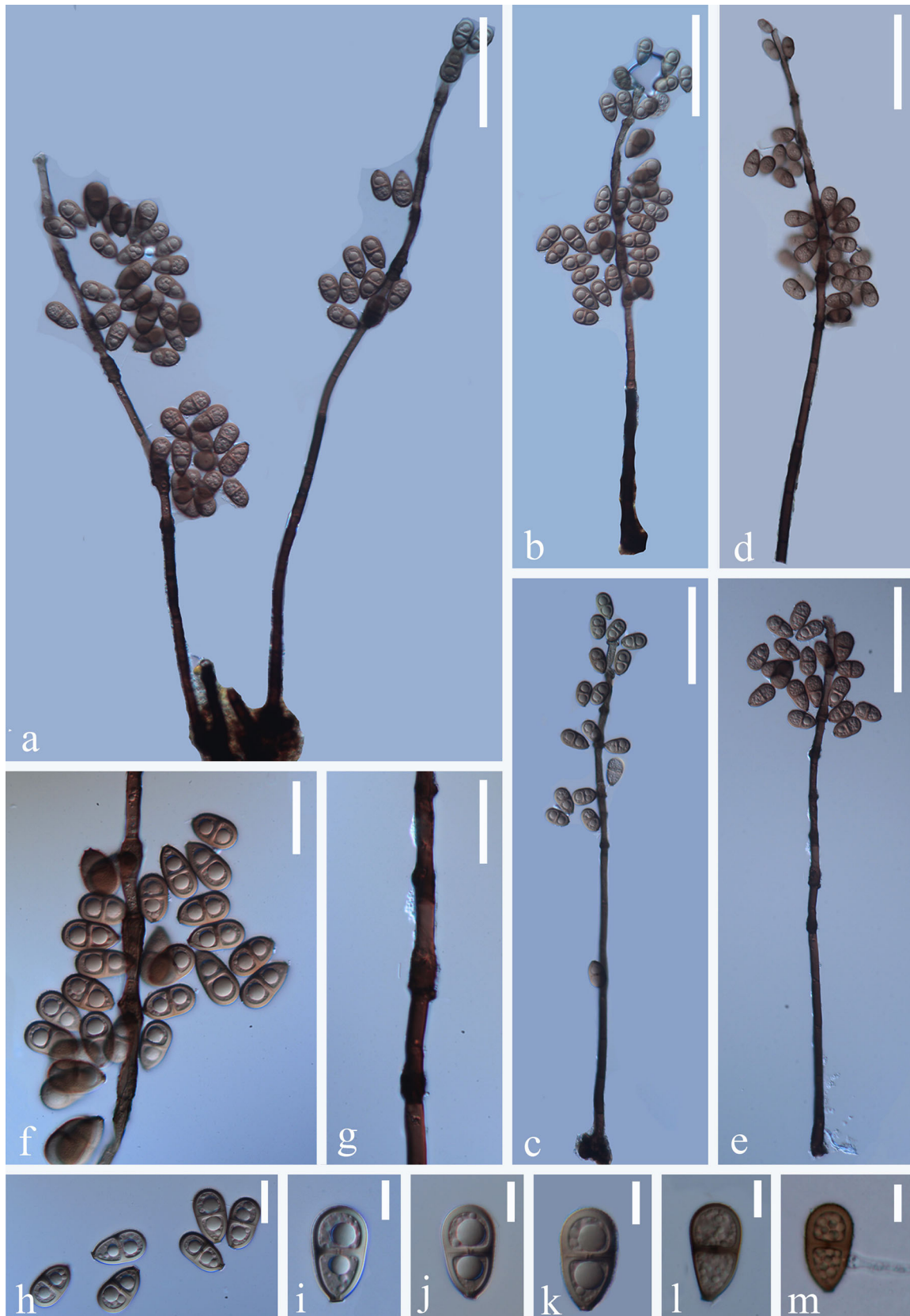


Fig. 63 *Cordana abramovii* (MFLU 18-1454). **a–e** Conidiophores with conidia. **f–g** Conidiogenous cells and conidia. **h–l** Conidia. **m** Germinating conidium. Scale bars: **a–e** 80 μm , **f, g** 30 μm , **h** 20 μm , **i–m** 10 μm

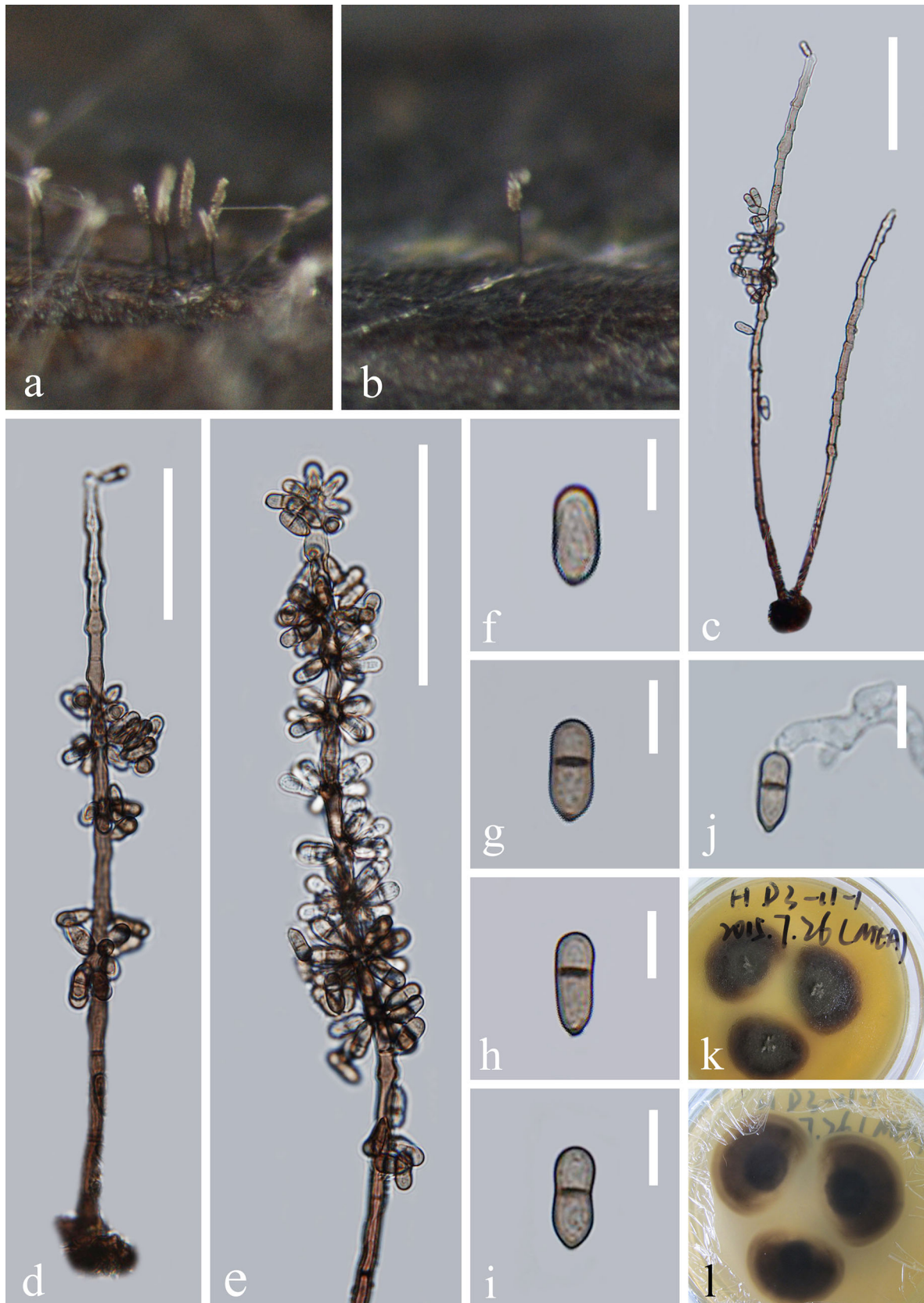
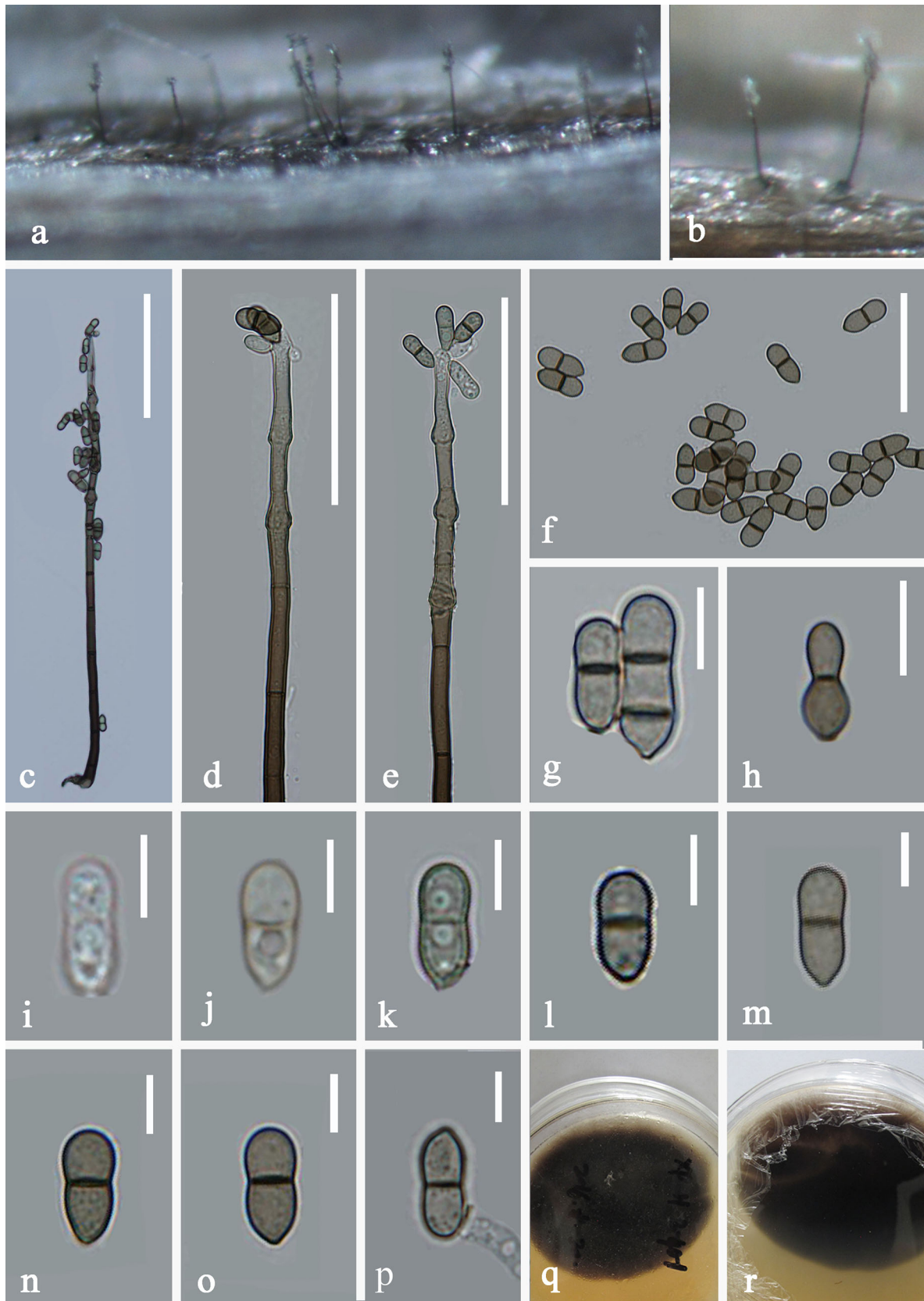


Fig. 64 *Cordana aquatica* (MFLU 18-1625, holotype). **a, b** Colony on natural substrate. **c, d** Conidiophore with conidia. **e** Conidiogenous cells with conidia. **f–i** Conidium. **j** Germinating conidium. Culture on PDA from above (**k**) and reverse (**l**). Scale bars: **c–e** 50 μm , **f–i** 5 μm



◀**Fig. 65** *Cordana lignicola* (MFLU 18–1624, holotype). **a, b** Colony on natural substrate. **c** Conidiophore with conidia. **d, e** Conidiogenous cells with conidia. **f–o** Conidium. **p** Germinating conidium. Culture on PDA from above (**q**) and reverse (**r**). Scale bars: **c–e** 50 μm , **f** 25 μm , **g–p** 5 μm

Notes: Holotype XAL CB618. Sequence data is not available. The species *Endophragmiella mexicana* was introduced by Mercado et al. (1995). Ho et al. (2002b) reported this species from freshwater habitats in China, but did not provide descriptions and illustrations.

Endophragmiella occidentalis Castañeda et al.

Distribution: **China**, Hong Kong, Tai Po, Kau Forest Stream, on submerged wood (Ho et al. 2002a).

Sexual morph: Undetermined

Notes: Holotype INIFAT C94/18. Sequence data is not available.

Endophragmiella ramificata Hol.-Jech

Distribution: **China**, Hong Kong, Tai Po Kau Forest Stream, on submerged wood (Ho et al. 2002a).

Sexual morph: Undetermined

Notes: Sequence data is not available.

Endophragmiella triseptata Tsui et al.

Distribution: **China**, Hong Kong, Tai Po, Lam Tsuen River, on submerged wood (Tsui et al. 2001).

Sexual morph: Undetermined

Notes: Holotype IFRD 8755. Sequence data is not available.

Hilberina Huhndorf & A. N. Mill., Mycol. Res. 108(1): 31 (2004)

Asexual morph Undetermined. **Sexual morph** Descriptions refer to Miller and Huhndorf (2004).

Type species: *Hilberina caudata* (Fuckel) Huhndorf & A.N. Mill., Mycol Res 108:31 (2004)

Notes: The genus *Hilberina* was introduced by Miller and Huhndorf (2004) with *H. caudata* as type species. There are 17 species accepted in this genus (Index Fungorum 2018) and only one species has been reported from freshwater habitats (Ho et al. 2001; Luo et al. 2004).

Hilberina breviseta (P. Karst.) Huhndorf & A.N. Mill.

Distribution: **Brunei**, on submerged wood in freshwater stream (Ho et al. 2001); **China**, Yunnan Province, on submerged wood in Dianchi Lake (Luo et al. 2004).

Asexual morph: Undetermined

Notes: Sequence data is not available.

Linocarpaceae Konta & K.D. Hyde

Linocarpon Syd. & P. Syd., Anns mycol. 15(3/4): 210 (1917)

Holomorph: Updated descriptions and illustrations refer to Konta et al. (2017).

Type species: *Linocarpon pandani* Syd. & P. Syd., Anns mycol. 15(3/4): 210 (1917)

Notes: The genus *Linocarpon* was introduced by Sydow and Sydow (1917), monographed by Hyde (1992d, 1997) with 23 accepted species. Konta et al. (2017) introduced a new family Linocarpaceae with *Linocarpon* as the type genus based on morphology and phylogenetic analyses. Four species of *Linocarpon* have been reported from freshwater habitats.

Linocarpon apiculatum K.D. Hyde

Distribution: **Indonesia**, Irian Jaya, Manokwari, in freshwater swamp on decaying palm petiole (Hyde 1997).

Asexual morph: Undetermined

Notes: Holotype IFRD 8785. Sequence data is not available. Hyde (1997) introduced this species from freshwater habitats and is only known from the type locality.

Linocarpon appendisporum K.D. Hyde

Distribution: **Indonesia**, Irian Jaya, Manokwari, on dead *Pandanus* leaves in freshwater swamp (Hyde 1997).

Asexual morph: Undetermined

Notes: Holotype IFRD 8786. Sequence data is not available. Hyde (1997) introduced this species from freshwater habitats and is only known from the type locality.

Linocarpon bambusicola L. Cai & K.D. Hyde

Distribution: **Philippines**, saprobic on submerged bamboo (Cai et al. 2004b).

Asexual morph: Undetermined

Notes: Holotype PDD 75040. Sequence data is not available. Cai et al. (2004b) introduced this species from freshwater habitats and is only known from the type locality.

Linocarpon pandanicola K.D. Hyde

Distribution: **Indonesia**, Irian Jaya, on decaying *Pandanus* leaves submerged in freshwater swamp (Hyde 1997).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 1120 (now in IFRD). Sequence data is not available.

Coniochaetales Huhndorf et al.

Coniochaetaceae Malloch & Cain

Coniochaeta (Sacc.) Cooke, Grevillea 16(no. 77): 16 (1887)

Holomorph Descriptions and illustrations refer to Maharachchikumbura et al. (2016).

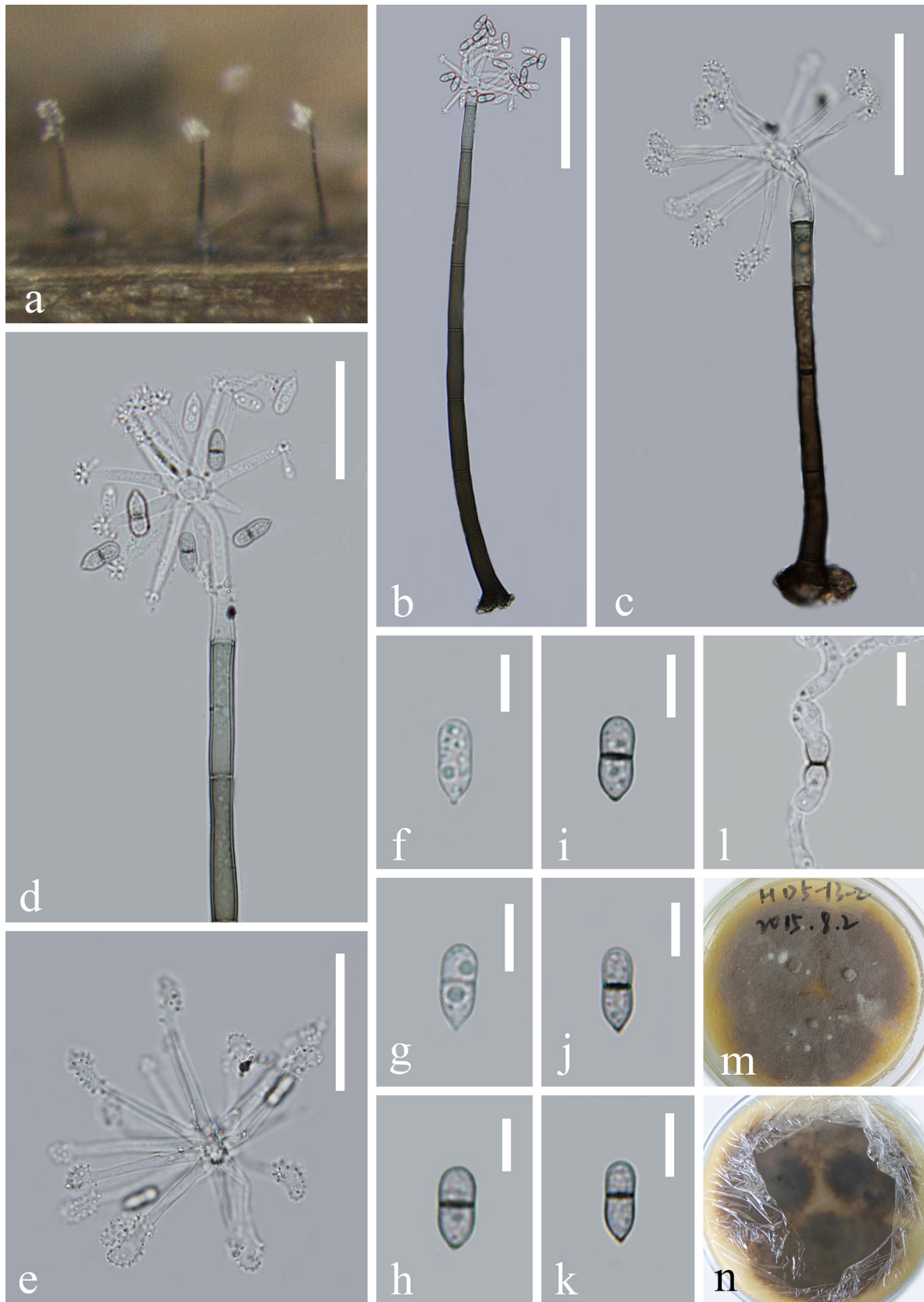
Type species: *Coniochaeta ligniaria* (Grev.) Cooke, Grevillea 16(no. 77): 16 (1887)

Notes: The genus *Coniochaeta* was introduced by Greville (1823–1824) with *C. ligniaria* as type species. *Coniochaeta* is an important ascomycete because its members live in diversified habitats and nutritional modes. Most of the species are reported from Europe and Eastern Asia (Asgari et al. 2007; GBIF-accessed in 2018).

Coniochaeta gigantospora Fourn. et al.

Distribution: **France**, Vendée, Sauvaget, the River Vendée, on submerged wood of *Fraxinus excelsior* (Raja et al. 2012).

Asexual morph: Undetermined



◀**Fig. 66** *Cordana terrestris* (MFLU 18–1623). **a** Colony on natural substrate. **b, c** Conidiophore with conidia. **d** Conidiogenous cells with conidia. **e** Conidiogenous cells. **f–k** Conidium. **l** Germinating conidium. Culture on PDA from above (**m**) and reverse (**n**). Scale bars: **b, c** 50 μm , **d, e** 30 μm , **f–k** 5 μm

Notes: Holotype ILLS 60816. ITS and LSU sequence data are available. This species is known only from the type locality.

Coniochaeta leucoplaca (Sacc.) Cain

≡ *Hypocopra leucoplaca* Sacc., Syll. fung. (Abellini) 1: 244 (1882)

Distribution: **USA**, Illinois, Goose pond, on submerged wood (Shearer and Crane 1986).

Asexual morph: Undetermined

Notes: Specimen collected from freshwater habitats: ILLS 43771; LSU sequence data is available.

Coniochaeta ligniaria (Grev.) Cooke

≡ *Sphaeria ligniaria* Grev., Scott. crypt. fl. (Edinburgh) 2: 82 (1824)

Distribution: **UK**, England, on submerged wood in cooling tower (Eaton 1972).

Asexual morph: Undetermined

Notes: Holotype Carmichael s.n.. ITS, LSU and RPB2 sequence data are available.

Coniochaeta renispora J.L. Crane & Shearer

Distribution: **USA**, Arkansas, on submerged wood in freshwater (Crane and Shearer 1995).

Asexual morph: Undetermined

Notes: Holotype ILLS 51242. Sequence data is not available.

Coniochaeta velutina (Fuckel) Cooke

≡ *Rosellinia velutina* Fuckel, Jb. nassau. Ver. Naturk. 23–24: 49 (1870)

Distribution: **USA**, Illinois, Goose pond, on submerged wood (Shearer and Crane 1986).

Asexual morph: Undetermined

Notes: Specimen collected from freshwater habitats: ILLS 37049. ITS, LSU, SSU and RPB2 sequence data are available.

Coniochaeta kellermanii (Ellis & Everh.) Munk

≡ *Rosellinia kellermanii* Ellis & Everh., Proc. Acad. nat. Sci. Philad. 42: 227 (1890)

Distribution: **USA**, Maryland and Illinois, Patuxent River, on submerged wood (Shearer 1972; Shearer and Crane 1986).

Asexual morph: Undetermined

Notes: Specimen collected from freshwater habitat: ILLS 37699. Sequence data is not available.

Cordanales M. Hern.-Rest. & Crous

Cordanaceae Nann., Repert. mic. uomo: 498 (1934)

Cordana Preuss, Linnaea 24: 129 (1851)

Holomorph Descriptions and illustrations refer to Hernández-Restrepo et al. (2014) and Maharachchikumbura et al. (2016).

Type species: *Cordana pauciseptata* Preuss, Linnaea 24: 129 (1851)

Notes: The genus *Cordana* was introduced by Preuss (1851) for three species with *C. pauciseptata* as type species. Hernández-Restrepo et al. (2014) accepted 19 species in this genus and provided a key for their identification. *Cordana* species have been recorded from various temperate and tropical regions in the world, including Africa, South America, South East Asia and New Zealand (Maharachchikumbura et al. 2016).

Cordana abramovii Seman & Davydk.

Facesoffungi number: FoF 05472, Fig. 63

Saprobic on submerged decaying wood. **Asexual morph** colonies effuse, scattered, dark brown to black. *Mycelium* partly immersed, composed of septate, branched, dark brown, smooth hyphae. *Conidiophores* 348–490 μm long, 7–11 μm wide ($\bar{x} = 434 \times 9 \mu\text{m}$, $n = 20$), macronematous, mononematous, erect, straight or slightly flexuous, unbranched, septate, singly or in small groups, brown, paler towards the apex, smooth. *Conidiogenous cells* polyblastic, terminal and intercalary, one swelling per cell, dark brown. *Conidia* 20–24 μm long, 11.5–13.5 μm wide ($\bar{x} = 22 \times 12.5 \mu\text{m}$, $n = 20$), acropleurogenous, solitary, tan to reddish brown, pyriform to obovate, truncated at the base, rounded at the apex, 1-septate, mostly with one guttulate in each cell, thick walled. **Sexual morph** Undetermined.

Material examined: **THAILAND**, on submerged decaying wood, October 2017, Z.L. Luo, B-98 (MFLU 18–1454), living culture MFLUCC 18–1605.

Distribution: **Perú**, Cusco, on submerged, decomposing woody and herbaceous debris in freshwater habitats (Zelski et al. 2014); **Thailand**, on submerged decaying wood (This study).

Sexual morph: Undetermined

Notes: Specimens collected from freshwater habitats: ILL 41204, MFLU 18–1454. ITS, LSU, SSU, RPB2 and TEF1 α sequence data are available. Zelski et al. (2014) redescribed *Cordana abramovii* based on the collections from freshwater habitats in Perú and provided illustrations and LSU sequence data. During an investigation of lignicolous freshwater fungi in Thailand, a *Cordana*-like fungus was collected from southern Thailand. Morphologically, our collection fits well with *Cordana abramovii* in having macronematous, mononematous, erect, straight or slightly flexuous, unbranched, septate conidiophores, polyblastic, terminal and intercalary, conidiogenous cells with one swelling per cell and tan to reddish brown, pyriform to obovate, thick walled, 1-septate conidia with one guttulate in each cell (Zelski et al. 2014). Phylogenetically, the

newly isolate clusters with other *Cordana* species in a well-supported monophyletic clade and groups with *Cordana abramovii* (PE0053–24a) with strong support (99% ML, 77% MP) (Fig. 67). Based on morphology and phylogeny, we identify our isolate as *Cordana abramovii* and provide

the descriptions and illustration here. This is the first record of this species in Thailand.

Cordana aquatica Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

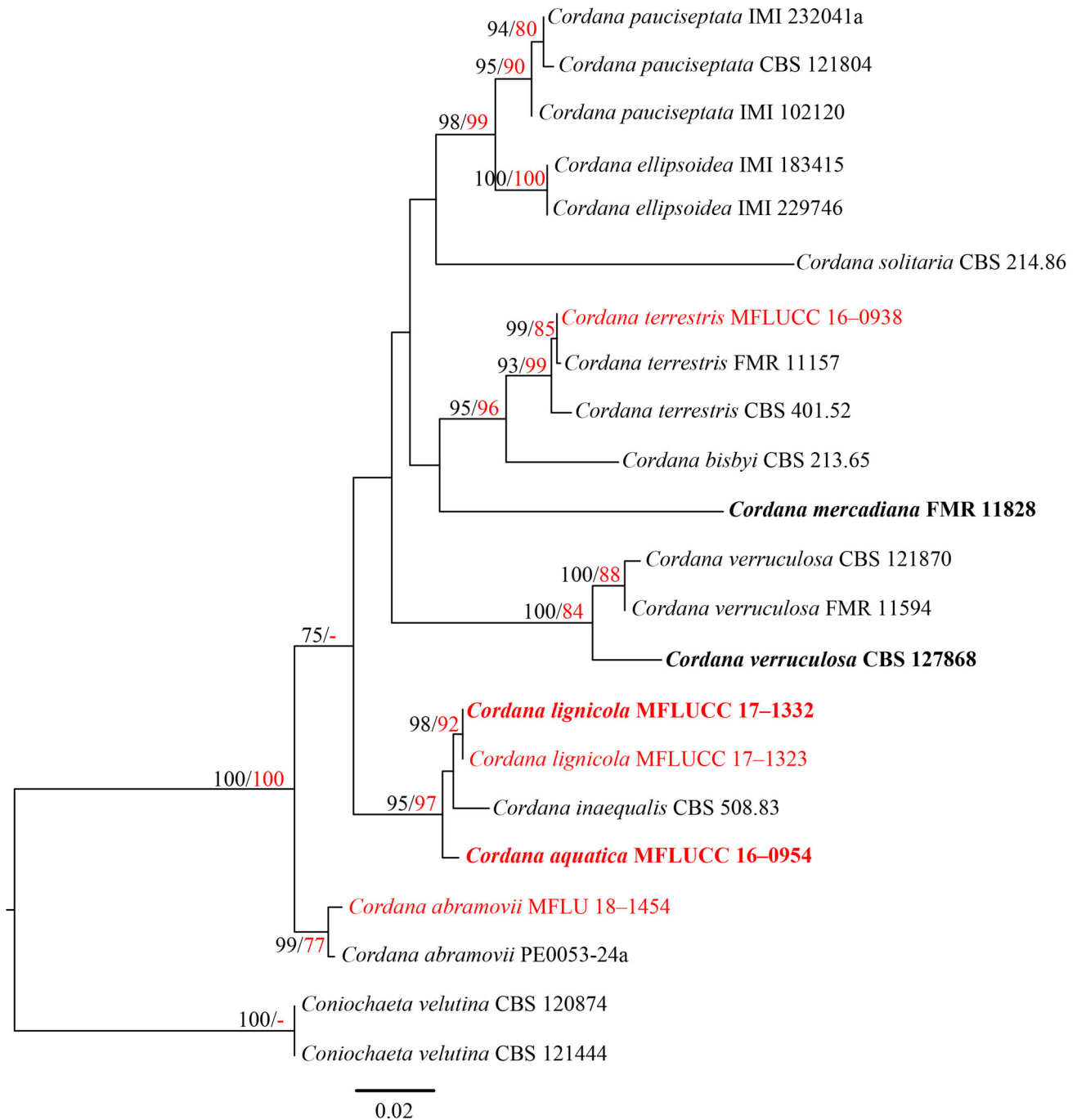


Fig. 67 Phylogram generated from maximum likelihood analysis based on ITS sequence data for species of *Cordana* (with *Coniochaeta velutina* as outgroup). The best scoring RAxML tree with a final likelihood value of -3697.331198 is presented. RAxML bootstrap support values equal to or greater than 75% are given

before the forward slash (black). Maximum parsimony bootstrap support values equal to or greater than 75% are given after the forward slash (red). Hyphen ('-') indicates a value lower than 75% for RAxML and Maximum parsimony. Newly generated sequences are in red. Ex-type strains are in bold

Index Fungorum number: IF 555685, Facesoffungi number: FoF 05473, Fig. 64

Etymology: Referring to the aquatic habitat of this fungus

Holotype: MFLU 18–1625

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on natural substrate superficial, effuse, hairy, brown to dark brown. *Mycelium* immersed, composed of septate, branched, smooth, subhyaline hyphae. *Conidiophores* 184–234 μm long, 5–7 μm wide ($\bar{x} = 209 \times 6 \mu\text{m}$, $n = 20$), macronematous, mononematous, solitary, erect, unbranched, septate, straight or flexuous, with intercalary nodes, cylindrical, dark brown at the base and lighter towards the apex. *Conidiogenous cells* polyblastic, integrated, terminal, becoming intercalary, percurrent, sympodial, denticulate, usually inflated at the conidiogenous loci. *Conidia* 8–10 μm long, 3–5 μm wide ($\bar{x} = 9 \times 4 \mu\text{m}$, $n = 20$), acropleurogenous, dry, mostly oblong, sometimes ellipsoid, 1-septate, slightly constricted at septate, rounded at the apex, darker at septum, brown, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Dulong River, saprobic on submerged decaying wood, May 2015, Z.L. Luo, S-520 (MFLU 18–1625, holotype, HKAS 92702, isotype), ex-type living culture MFLUCC 16–0954, KUMCC 15–0293.

Notes: *Cordana aquatica* resembles *C. verruculosa* in having macronematous, unbranched, smooth, straight or flexuous conidiophores with intercalary nodes, polyblastic, integrated, denticulate, terminal and intercalary conidiogenous cells usually inflated at the conidiogenous loci and dry, solitary conidia (Hernández-Restrepo et al. 2014). However, *C. aquatica* differs from *C. verruculosa* by its septate, larger conidiophores (184–234 \times 5–7 μm vs. up to 187 \times 2.5–3 μm) and smooth, uniseptate, oblong, larger conidia (8–10 \times 3–5 μm vs. 3–5.5 \times 2–3.5 μm), while *C. verruculosa* has verruculose, aseptate, ellipsoid to obovoid conidia. The phylogenetic analysis shows that *Cordana aquatica* is close to *C. lignicola*, but their morphology is different.

Cordana lignicola Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555686, Facesoffungi number: FoF 05474, Fig. 65

Etymology: Referring to this fungus dwelling on wood

Holotype: MFLU 18–1624

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on natural substrate superficial, effuse, hairy, brown to dark brown. *Mycelium* immersed, composed of septate, branched, smooth,

subhyaline hyphae. *Conidiophores* 164–198 μm long, 4–6 μm wide ($\bar{x} = 181 \times 5 \mu\text{m}$, $n = 20$), macronematous, mononematous, solitary, erect, unbranched, septate, straight or flexuous, with intercalary nodes, cylindrical, dark brown at the base and lighter towards the apex. *Conidiogenous cells* polyblastic, integrated, terminal, becoming intercalary, percurrent, sympodial, denticulate, usually inflated at the conidiogenous loci. *Conidia* 9–11 μm long, 3.5–4.5 μm wide ($\bar{x} = 10 \times 4 \mu\text{m}$, $n = 20$), acropleurogenous, dry, mostly oblong, sometimes ellipsoid, aseptate, 1–2-septate, slightly constricted at septate, rounded at the apex, darker at septum, hyaline when young, brown when mature, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on decaying wood submerged in a freshwater stream, April 2016, S.M. Tang, S-825 (MFLU 18–1624, holotype), ex-type living culture MFLUCC 17–1332; *Ibid.*, saprobic on decaying wood submerged in a freshwater stream, April 2016, X.J. Su, S-707 (MFLU 18–1626, Paratype), living culture MFLUCC 17–1323.

Notes: *Cordana lignicola* resembles *C. mercadiana* in having macronematous, unbranched, straight or flexuous conidiophores with intercalary nodes, polyblastic, integrated, terminal, becoming intercalary, denticulate conidiogenous cells and dry, smooth, brown conidia slightly constricted at septate (Hernández-Restrepo et al. 2014). However, *Cordana lignicola* differs from *C. mercadiana* by its septate, larger conidiophores (164–198 \times 4–6 μm vs. 57–150 \times 2.5–3 μm) and 1–2-septate, oblong conidia, while *C. mercadiana* have 0–1-septate, oblong, obovoid or cylindrical conidia. Phylogenetic analysis shows that *Cordana lignicola* is distinct from other *Cordana* species.

Cordana terrestris (Timonin) Hern.-Restr. et al.

\equiv *Spicularia terrestris* Timonin, Can. J. Res. 18: 315 (1940)

\equiv *Pseudobotrytis terrestris* (Timonin) Subram., Proc. Indian Natn. Sci. Acad. Biol. Sci. 43:277, 1956

\equiv *Umbellula terrestris* (Timonin) E.F. Morris, Mycologia 47:603 (1955)

= *Pseudobotrytis fusca* Krzemien. & Badura, Acta Soc. Bot. Pol. 23: 762 (1954)

= *Porosphaerella borinquensis* F.A. Fernández & Huhndorf, Fungal Divers 17:12 (2004)

Facesoffungi number: FoF 05475, Fig. 66

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on natural substrate superficial, effuse, hairy, pale brown. *Mycelium* immersed, composed of septate, branched, smooth, subhyaline hyphae. *Conidiophores* (90–)141–223 μm long, 5–7 μm wide ($\bar{x} = 182 \times 6 \mu\text{m}$, $n = 20$), macronematous,

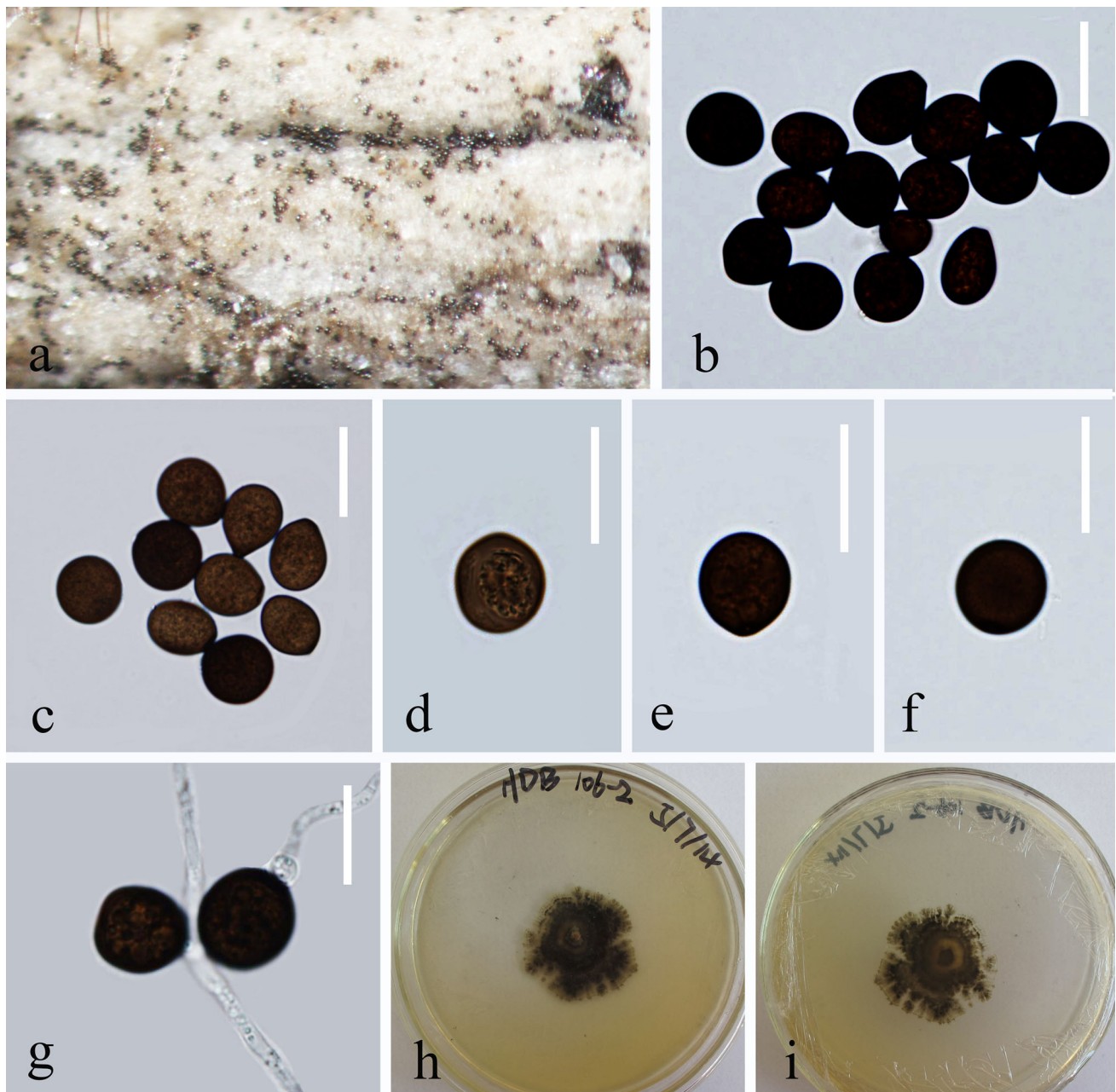


Fig. 68 *Chaetomium globosum* (S-164) **a** Colony on natural substrate. **b–f** Conidia. **g** Germinating conidia. Culture on PDA from above (**h**) and reverse (**i**). Scale bars: **b–g** 15 μm

mononematous, solitary, erect, unbranched, septate, straight or flexuous, cylindrical, dark brown at the base and lighter towards the apex. *Conidiogenous cells* holoblastic, polyblastic, terminal, discrete, hyaline, in groups of 8–14 arranged in umbels, with multiple conidiogenous loci appearing as spinules, subhyaline. *Conidia* 6–8 μm long, 2.5–3.5 μm wide ($\bar{x} = 7 \times 3 \mu\text{m}$, $n = 20$), acropleurogenous, mostly oblong, sometimes ellipsoid, guttulate, uniseptate, slightly constricted at sptate, darker at septum, light brown, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Dulong River, saprobic on submerged decaying wood, May 2015, H.Y. Su, S-515 (MFLU 18–1623, *ibid* HKAS 92728), living culture MFLUCC 16–0938, KUMCC 15–0308.

Distribution: **China**, Yunnan Province, Dulong River, saprobic on decaying wood submerged in freshwater River (This study).

Sexual morph: Undetermined

Notes: Specimens collected from freshwater habitat: MFLU 18–1623, HKAS 92728. ITS, LSU, SSU, RPB2 and

TEF1 α sequence data are available. Hernández-Restrepo et al. (2014) synonymised *Spicularia terrestris*, *Pseudobotrytis fusca* and *Porosphaerella borinquensis* as *C. terrestris*. Our collection morphologically fits well with asexual morph of *Cordana terrestris* in having macrone-matous, erect, unbranched, septate, straight or flexuous, cylindrical conidiophores, terminal, discrete, hyaline conidiogenous cells in groups of 8–14 arranged in umbels, with multiple conidiogenous loci appearing as spinules and light brown, uniseptate, guttulate conidia (Hernández-Restrepo and Huhndorf 2004). The phylogenetic analysis shows that our isolate (MFLUCC 16–0938) clusters with *Cordana terrestris* with strongly support value (Fig. 67). Based on the morphology and phylogeny, we identify our fungus as *Cordana terrestris*. This is the first record of this species in China and it is the first report collected from freshwater habitats.

Cordana uniseptata Cai et al.

Distribution: **China**, Yunnan Province, Yiliang, on *Phyllostachys bambusoides* submerged in a small forest stream (Cai et al. 2004a).

Sexual morph: Undetermined

Notes: Holotype IFRD 8734. Sequence data is not available.

Phyllachorales M.E. Barr

Phyllachoraceae Theiss. & H. Syd.

Ascovaginospora Fallah et al., Mycologia 89(5): 813 (1997)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations refer to Fallah et al. (1997).

Type species: *Ascovaginospora stellipala* Fallah et al., Mycologia 89(5): 813 (1997)

Notes: The genus *Ascovaginospora* was introduced by Fallah et al. (1997) and typified by *Ascovaginospora stellipala*. There is only one species was accepted in this genus and is only known from the type locality.

Ascovaginospora stellipala Fallah et al.

Distribution: **USA**, Northern Wisconsin, on submerged dead stems and leaves of *Carex limosa* (Fallah et al. 1997).

Asexual morph: Undetermined

Notes: Holotype ILLS 52319, other specimens collected from freshwater habitats: ILLS 53005, ILLS 53006, ILLS 53007, ILLS 53009, ILLS 53010. LSU and SSU sequence data are available.

Phyllachora Nitschke ex Fuckel, Jb. nassau. Ver. Naturk. 23–24: 216 (Fuckel 1870) [1869–70]

Holomorph Descriptions and illustrations refer to Maharachchikumbura et al. (2016).

Type species: *Phyllachora graminis* (Pers.) Fuckel, Jb. nassau. Ver. Naturk. 23–24: 216 (1870) [1869–70]

Notes: *Phyllachora* is a large genus with more than 1500 species currently recognized (Index Fungorum 2018). This

large number of species is a result of naming species on the basis of host association (Cannon 1988). Only one *Phyllachora* species has been reported from freshwater, namely *Phyllachora therophila* growing on *Juncus filiformis*, collected in Austria (Magnes and Hafellner 1991).

Phyllachora therophila (Desm.) Arx & E. Müll.

≡ *Sphaeria therophila* Desm.

Distribution: **Austria**, Eastern Alps, on *Juncus filiformis* in mountain lake (Magnes and Hafellner 1991).

Asexual morph: Undetermined

Notes: Sequence data is not available.

Tamsiniella Wong et al., Can. J. Bot. 76(2): 334 (1998)

Asexual morph Undetermined. **Sexual morph** *Ascomata* semi-immersed to immersed, dark brown, subglobose, ostiolate, papillate, periphysate, solitary or gregarious. *Peridium* comprising 1–2 layers of elongated angular, brown cells, lined with a layer of very pale brown, disintegrated tissue. Paraphyses cellular, septate, sparse. *Asci* 8-spored, unitunicate, cylindrical, short pedicellate, apically truncate, with a nonamyloid, refractive, bifurcate apical ring and an external thickening. *Ascospores* uniseriate to biseriate, ellipsoidal-fusiform, unicellular, surrounded by a narrow, roughened mucilaginous sheath, hyaline.

Type species: *Tamsiniella labiosa* Wong et al., Can. J. Bot. 76(2): 334 (1998)

Notes: The genus *Tamsiniella* was introduced by Wong et al. (1998) with single species which was collected from freshwater stream. There is only one species described in this genus.

Tamsiniella labiosa Wong et al.

Distribution: **Australia**, north Queensland, Mount Lewis, on wood submerged in a small stream (Wong et al. 1998b).

Asexual morph: Undetermined

Notes: Holotype IFRD 8862. Sequence data is not available. This species is only known from the type locality.

Sordariales Chad. ex D. Hawksw. & O.E. Erikss.

Chaetomiaceae G. Winter

Chaetomium Kunze, in Kunze & Schmidt, Mykologische Hefte (Leipzig) 1: 15 (1817)

Holomorph Descriptions and illustrations see Maharachchikumbura et al. (2016).

Type species: *Chaetomium globosum* Kunze, in Kunze & Schmidt, Mykologische Hefte (Leipzig) 1: 16 (1817)

Notes: *Chaetomium* is a cosmopolitan genus with more than 150 species (Asgari and Zare 2011; Maharachchikumbura et al. 2016). *Chaetomium* species can be potential biological control agents (Soytong et al. 2001), they can produce bioactive metabolites (Wang et al.

2012; Li et al. 2014), or can produce mycotoxins and infect skin and nails in humans (Pieckova 2003).

Chaetomium globosum Kunze

Facesoffungi number: FoF 02196, Fig. 68

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on natural substrate effuse, dark brown to black. *Conidiophores* not observed. *Conidiogenous cell* not observed. *Conidia* 12–14 µm long, 11–13 µm ($\bar{x} = 13 \times 12$ µm, $n = 20$) wide, dry, globose to subglobose, guttulate, dark brown to black, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on submerged decaying wood in a freshwater stream, June 2014, Z.L. Luo, S-164 living culture KUMCC 15–0342; *Ibid.*, saprobic on decaying wood submerged in a freshwater stream, June 2014, Z. Li, S-166, living culture MFLUCC 16–1102, KUMCC 15–0344.

Notes: *Chaetomium globosum* can produce bioactive metabolites and is known as an endophytic fungus (Wang et al. 2012; Li et al. 2014). During the investigation on lignicolous freshwater fungi in China, a hyphomycetous fungus was collected from submerged decaying wood in freshwater streams. Phylogenetic analysis shows that our isolate clusters with *Chaetomium globosum* (CBS 160.62) with good support value (Fig. 1, clade 29). We therefore identify our newly collections as asexual morph of *Chaetomium globosum*. It is the first report of this species collected from freshwater habitats.

Corynascella Arx & Hodges, Stud. Mycol. 8: 23 (1975)

Asexual morph Undetermined. **Sexual morph** *Ascomata* mostly superficial, scattered or clustered in small groups, globose to subglobose, nonostiolate, dark brown to black. *Mycelium* composed of hyaline to pale brown, branched, septate hyphae. *Peridium* coriaceous, cephalothecoid, brown to dark brown. *Paraphyses* hyaline, filiform, septate. *Asci* 8-spored, clavate, rounded at the top, short-stipitate. *Ascospores* broadly ellipsoidal, brown to dark brown, smooth, thick-walled.

Type species: *Corynascella humicola* Arx & Hodges, Stud. Mycol. 8: 23 (1975)

Notes: The genus *Corynascella* was introduced by von Arx (1975) for a single species *C. humicola*. Four species were accepted in this genus and only one species has been reported from freshwater habitats.

Corynascella inquinata Udagawa & S. Ueda

Distribution: **Japan**, isolated from sewage sludge (Udagawa and Ueda 1979).

Asexual morph: Undetermined

Notes: Holotype NHL 2841. ITS, RPB2 and TEF1 α sequence data are available.

Humicola Traaen, Nytt Mag. Natur. 52: 31 (1914)

Asexual morph Colonies effuse, velvety or cottony, pale grey to brown or black. *Mycelium* superficial or immersed, composed of hyaline to subhyaline, branched, septate, smooth hyphae. *Conidiophores* micronematous, unbranched, hyaline, smooth, or differentiation inconspicuous. *Conidiogenous cells* monoblastic, terminal or lateral, hyaline to pale brown, smooth. *Conidia* solitary, unicellular, mostly spherical or subspherical, or sometimes pyriform, pale brown to brown, smooth-walled. **Sexual morph:** *Hyphae* hyaline, septate, branched, smooth-walled. *Ascomata* oval to subglobose, ostiolate, brown to black-brown. *Peridium* brown, textura irregularis. *Rhizoids* well developed, septate, pale brown. *Ascomatal hair* unbranched, tapering, septate, yellow to brown, verrucose. *Asci* fasciculate, clavate, long-stalked. *Ascospores* limoniform to subglobose, dark brown, thick-walled.

Type species: *Humicola fuscoatra* Traaen, Nytt Mag. Natur. 52: 33 (1914)

Notes: *Humicola* was introduced by Traaen (1914) for two species of fungi with hyaline hyphae, namely *Humicola fuscoatra* (type) Traaen and *H. grisea* Traaen. Only one species has been reported from freshwater habitats (Raja et al. 2009a, b).

Humicola asteroidea Udagawa & Y. Horie

Distribution: **USA**, Florida, on submerged wood in freshwater (Raja et al. 2009b).

Asexual morph: Undetermined

Notes: Sequence data is not available.

Trichocladium Harz, Bull. Soc. Imp. nat. Moscou 44(1): 125 (1871)

Asexual morph Colonies effuse, at first hyaline and becoming black. *Mycelium* composed of branched, septate, light brown hyphae. *Conidiophores* micronematous, mononematous, smooth, thin- or thick-walled, hyaline or light brown. *Conidiogenous cells* holoblastic, integrated, terminal or intercalary, smooth, cylindrical. *Conidia* solitary, subglobose to obpyriform, septate. **Sexual morph** Undetermined.

Type species: *Trichocladium asperum* Harz, Bull. Soc. Imp. nat. Moscou 44(1): 125 (1871)

Notes: Species of *Trichocladium* are frequently encountered in aquatic environment (Crane and Shearer 1978; Kohlmeyer and Volkmann-Kohlmeyer 1995), and five species have been reported from freshwater habitats.

Trichocladium englandense K.D. Hyde & Goh

Distribution: **UK**, Gloucestershire, River Coln, on submerged wood (Hyde and Goh 1999).

Sexual morph: Undetermined

Notes: Holotype IFRD 8867. Sequence data is not available. This species is only known from the type locality.

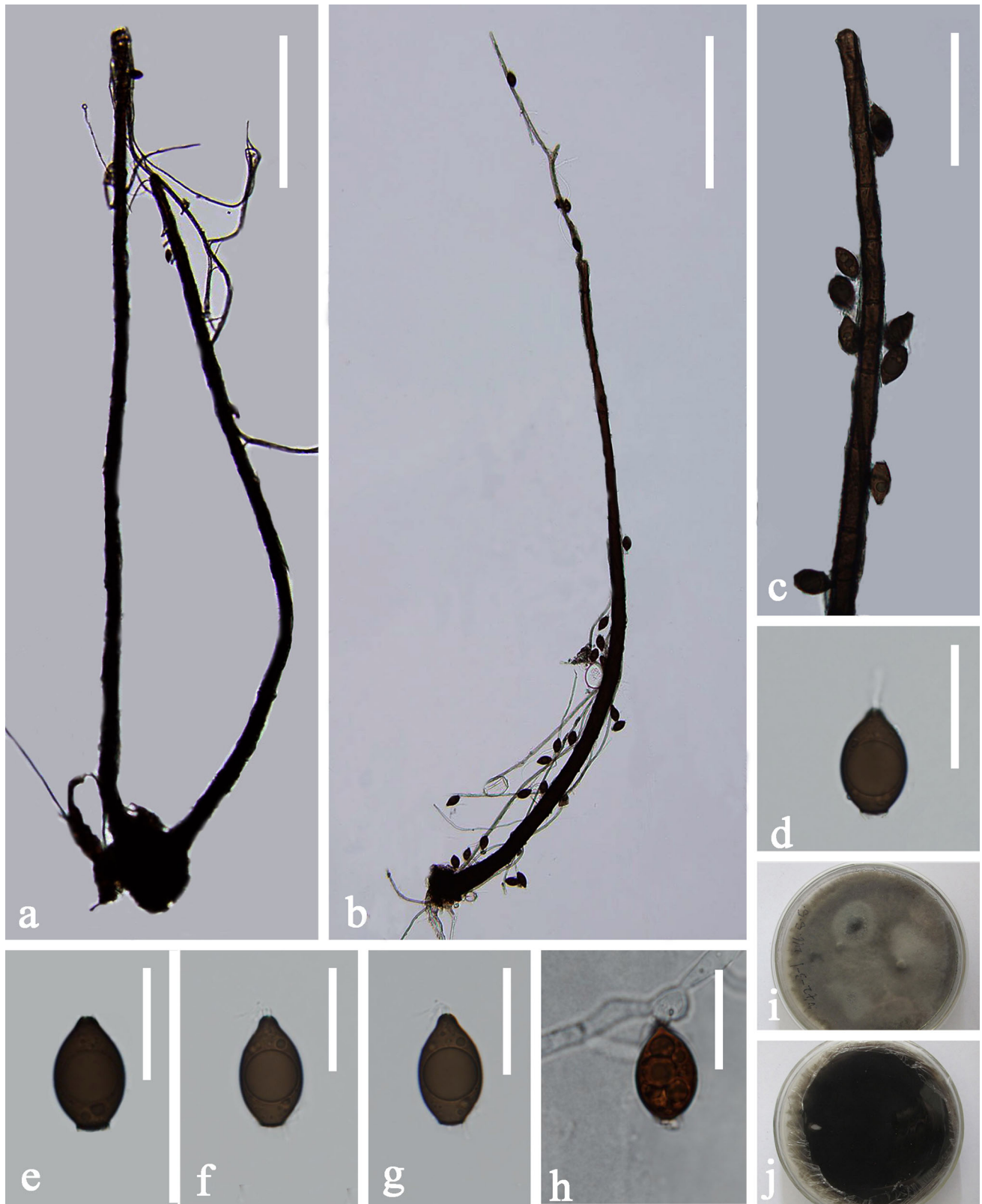


Fig. 69 *Cercophora caudata* (HKAS 92795) **a, b** Conidiophores with conidia. **c** Conidiogenous cells with conidia. **d–g** Conidium. **h** Germinating conidium. Culture on PDA from above (**j**) and reverse (**k**). Scale bars: **a, b** 150 μm , **c** 50 μm , **d–h** 20 μm

Trichocladium lignicola I. Schmidt

Distribution: **China**, Yunnan Province, Lake Fuxian, on submerged wood (Cai et al. 2002a); **UK**, England, River Severn, on submerged wood (Kane et al. 2002).

Sexual morph: Undetermined

Notes: Holotype JE No. 238, paratype JE No. 227; Sequence data is not available.

Trichocladium linderi J.L. Crane & Shearer

Distribution: **USA**, Maryland, on balsa wood submerged in the Patuxent River (Crane and Shearer 1978).

Sexual morph: Undetermined

Notes: Holotype ILLS 37019, isotype NY-01042730. Sequence data is not available.

Trichocladium lobatum Sutton

Distribution: **USA**, Illinois, from a Cypress Swamp, on submerged wood (Crane and Shearer 1978).

Sexual morph: Undetermined

Notes: Holotype IMI 188290, specimen collected from freshwater habitats: ILLS 37060. Sequence data is not available.

Trichocladium moenitum J.L. Crane & Shearer

Distribution: **USA**, Illinois, from Elvira Cypress Swamp and Wolf lake, on submerged wood (Crane and Shearer 1978).

Sexual morph: Undetermined

Notes: Holotype ILLS 36986, isotype NY-01042731, other specimen collected from freshwater habitats: ILLS 37028. Sequence data is not available.

Lasiosphaeriaceae Nannf.

Apiosordaria Arx & W. Gams, Nova Hedwigia 13: 201 (1967)

Asexual morph *Chrysosporium*-like. **Sexual morph** *Ascomata* immersed to superficial, globose, subglobose to pyriform, ostiolate or non-ostiolate, with or lacking agglutinated hairs. *Peridium* membranaceous, brownish-orange to brown; outer layer with textura intricata, inner layer composed by thin-walled polygonal cells. *Asci* 4 or 8-spored, cylindrical to clavate, rounded at apex. *Ascospores* globose, subglobose or broadly fusiform, hyaline when young, black when mature, two celled.

Type species: *Apiosordaria verruculosa* (C.N. Jensen) Arx & W. Gams, Nova Hedwigia 13: 201 (1967)

Notes: Arx & Gams (1967) introduced the genus *Apiosordaria* Arx & W. Gams (Lasiosphaeriaceae, Sordariales) based on the type species *Pleurage verruculosa* C.N. Jensen [\equiv *A. verruculosa*]. Krug et al. (1983) synonymised *Echinopodospora* and *Lacunosporea* under *Apiosordaria* based on morphological similarities. *Apiosordaria* currently comprises 23 species with a worldwide distribution in soil, dung or decaying wood (Warcup 1951a, b; Stchigel et al. 2000). Some species have also been found associated with plant material (Rostrup

et al. 1916) and the insect *Plecia nearctica* (Kish et al. 1974). Wu et al. (2016) introduced a new species *Apiosordaria hamata* which was collected from sediment in a freshwater lake.

Apiosordaria hamata Wu et al.

Distribution: **China**, Hubei Province, Wuhan City, isolated from sediment in Donghu Lake (Wu et al. 2016).

Asexual morph: Undetermined

Notes: Holotype HMAS 246231. ITS and LSU sequence data are available.

Cercophora Fuckel, Jb. nassau. Ver. Naturk. 23–24: 244 (1870) [1869–70]

Asexual morph Obtained from culture. *Hyphae* thin-walled, hyaline to pale brown. *Conidiogenous cells* monophialidic or polyphialidic, polytretic commonly produced from pale brown hyphae as single terminal or several lateral phialides, delimited by a basal septum, monophialidic or polyphialidic, cylindrical to obpyriform, mostly pale brown, constricted below the collarette, collarette short, slightly flaring, inconspicuous, same colour as phialide. *Conidia* subglobose to pyriform, truncate at base, hyaline. **Sexual morph** *Ascomata* superficial, perithecial ovoid or subglobose to broadly obpyriform, with a conical to hemispherical neck, clustered in small groups, at times in contact, dark brown to black. *Ascomatal wall* of textura angularis in surface view, cells thickwalled, pale to dark brown. *Paraphyses* filiform, hyaline, thin-walled, abundant, septate, unbranched. *Asci* 8-spored, unitunicate, cylindrical, bi- to triseriate, spore-bearing part fusoid-ventricose, apex rounded, long-stipitate. *Ascospores* cylindrical, ends rounded, straight to slightly sigmoid, geniculate in lower quarter, aseptate, densely guttulate. ascospore becoming differentiated into an apical swollen head and a basal tail while inside the ascus; head ellipsoid, hyaline, rarely pigmented, pale brown; tail septate, hyaline, rarely pigmented, pale brown.

Type species: *Cercophora mirabilis* Fuckel, Jb. nassau. Ver. Naturk. 23–24: 245 (1870)

Notes: The genus *Cercophora* Fuckel was established by Fuckel (1870) for *C. conica*, *C. fimiseda* and *C. mirabilis*. Fuckel (1873) synonymized *Cercophora* under *Sordaria*. Lundqvist (1972) revised the Sordariaceae s. lat. and resurrected the genus *Cercophora*. The genus is characterized by membraneous to coriaceous, dark colored, large ascomata and hyaline, cylindrical ascospores which develop a swollen, pigmented head (Miller and Huhndorf 2001). Currently, more than 50 species were accepted and most of the species are lignicolous and coprophilous. Phylogenetic studies inferred from LSU or multi-gene sequence data indicated that *Cercophora* species are polyphyletic (Miller and Huhndorf 2001; Chang et al. 2010). Asexual morph of *Cercophora* species are *cladorrhinum*- or *phialophora*-like

(Miller and Huhndorf 2001; Cai et al. 2006c; Doveri 2016). Key to *Cercophora* species of the complex-sordarioides and key to *Cercophora* species with a carbonaceous peridium were provided by Doveri (2016), key to species of *Cercophora* from China (Taiwan) was provided by Chang and Wang (2005).

Cercophora appalachianensis O. Hilber & R. Hilber

Distribution: **China**, Hong Kong, Tai Po Kau Forest stream, on submerged wood (Ho et al. 2001).

Asexual morph: Undetermined

Notes: Hilber et al. (1987b) mentioned the holotype of *Cercophora appalachianensis* was deposited in BPI, isotype was deposited in NY, but did not give the herbarium number. ITS and LSU sequence data are available. Ho et al. (2001) reported this species from freshwater in Hong Kong, China, but did not provide descriptions and illustrations.

Cercophora aquatica Chaudhary et al.

Distribution: **France**, on submerged wood of *Quercus* (Chaudhary et al. 2007).

Sexual morph: *Phialophora*-like, see Chaudhary et al. (2007)

Notes: Holotype ILLS 58443. ITS, LSU and MCM7 sequence data are available.

Cercophora caudata (Sacc.) N. Lundq.

≡ *Sphaeria caudata* Curr., Trans. Linn. Soc. London 22: 320 (1859)

≡ *Sordaria caudata* Sacc., Syll. fung. (Abellini) 1: 236 (1882)

Facesoffungi number: FoF 05476, Fig. 69

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies effuse, hairy, dark brown to black. *Mycelium* immersed, composed of septate, branched, smooth, brown hyphae. *Conidiophores* 893–1123 µm long, 12–22 µm wide (\bar{x} = 1008 × 17 µm, n = 20), macronematous, mononematous, solitary, erect, unbranched, septate, straight or flexuous, cylindrical, dark brown to black, smooth. *Conidiogenous cells* polytretic, integrated, terminal, brown. *Conidia* 18.5–21.5 µm long, 11–13 µm wide (\bar{x} = 20 × 12 µm, n = 20), acrogenous, ellipsoidal or obovoid, papillate at the apex, truncate at the base, guttulate, brown to dark brown, smooth-walled.

Sexual morph Undetermined.

Material examined: CHINA, Yunnan Province, Nujiang River, saprobic on submerged decaying wood, May 2015, Z.L. Luo, S-779, living culture MFLUCC 17–0475; *Ibid.*, saprobic on submerged decaying wood, May 2015, S.M. Tang, S-346 (HKAS 92795), living culture MFLUCC 16–1271.

Distribution: **China**, Yunnan Province, on submerged wood (This study).

Sexual morph: see Lundqvist (1972)

Notes: Holotype K(M) 68753, specimen collected from freshwater habitats: HKAS 92795. ITS, LSU, SSU, RPB2, TEF1 α and β -tubulin sequence data are available.

Cercophora costariensis (Carroll & Munk) O. Hilber & R. Hilber

≡ *Bombardia costaricensis* G.C. Carroll & Munk, Mycologia 56(1): 80 (1964)

Distribution: **China**, Hong Kong, on submerged wood in a freshwater stream (Tsui et al. 2000).

Asexual morph: Undetermined

Notes: Sequence data is not available.

Cercophora squamulosa Miller et al.

Distribution: **France**, Ariège, Le Pujol stream and Peyrau brook, on submerged wood (Crous et al. 2016a).

Asexual morph: *Phialophora*-like, see Crous et al. (2016a)

Notes: Holotype ILLS 79803, other specimen collected from freshwater habitats: ILLS 79954. ITS and LSU sequence data are available.

Cercophora vinosa A.N. Mill. & J. Fourn

Distribution: **France**, Ariège, Artillac stream, on partly submerged wood (Crous et al. 2016b).

Asexual morph: from culture, see Crous et al. (2016b)

Notes: Holotype ILLS 79802. ITS, LSU and β -tubulin sequence data are available.

Cladorrhinum Sacc. & Marchal, in Marchal, Bull. Soc. R. Bot. Belg. 24(1): 64 (1885)

Holomorph Descriptions refer to Mouchacca and Gams (1993).

Type species: *Cladorrhinum foecundissimum* Sacc. & Marchal, Bull. Soc. R. Bot. Belg. 24(1): 64 (1885)

Notes: The genus *Cladorrhinum*, typified by *C. foecundissimum*, was established by Marchal (1885) based on a fungus isolated from dung. *Cladorrhinum* species are found on dung and plant material and in soil.

Cladorrhinum samala (Subram. & Lodha) W. Gams & Mouch

Distribution: **Brunei**, on submerged wood (Ho et al. 2001).

Sexual morph: Undetermined

Notes: Holotype IMI 113129. ITS and LSU sequence data are available. Ho et al. (2001) reported this species from freshwater habitats in Brunei, but did not provide description and illustration.

Echria (N. Lundq.) Krüys et al., Fungal Divers 70: 106 (2015)

Asexual morph Undetermined. **Sexual morph** *Ascomata* superficial to partially immersed, subiculate or not, tomentose, scattered, obpyriform, ostiolate, membranous. *Neck* cylindrical to conical, opaque, black, inside lined with hyaline, filiform periphyses, covered with pointed, unbranched, tapering, long tufts of agglutinated, rigid, septate, cylindrical, brown hairs measuring. *Peridium*

pseudoparenchymatous in surface view, semitransparent; in longitudinal section, inner layer composed of elongated, flattened, thin-walled, hyaline to brown cells; outer layer composed of brown, thin-walled, angular cells. *Paraphyses* hyaline, filiform-ventricose, septate, abundant. *Asci* 8-spored, unitunicate, thin-walled, broadly clavate, with a long stipe, swelling in water. *Ascospores* irregularly arranged, one-celled, hyaline when young, ranging from golden to dark brown at maturity.

Type species: Kruys et al. (2015) raised the *Arnium* section *Echria* to genus level but did not designate the type species for this genus.

Notes: Kruys et al. (2015) raised the *Arnium* section *Echria* to genus level and accepted two species, *E. gigantospora* (Raja and Shearer) Kruys, Huhndorf and A.N. Mill. and *E. macrotheca* (P. Crouan and H. Crouan) Kruys, Huhndorf and A.N. Mill., based on morphology and molecular data. The genus *Echria* is characterized by having ascomata covered with long pointed tufts of agglutinated rigid hairs and striated gelatinous sheaths that swell in water and surround their ascospores (Kruys et al. 2015).

Echria gigantospora (Raja & Shearer) Kruys et al.

Distribution: **USA**, Ocala National Forest, Lake Kerr, on submerged, decorticated wood (Kruys et al. 2015).

Asexual morph: Undetermined

Notes: Holotype ILL, slide made from a specimen on submerged, decorticated wood, F77-1. ITS, LSU and β -tubulin sequence data are available.

Immersiella A. N. Mill. & Huhndorf, Mycol. Res. 108(1): 31 (2004)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations refers to Miller and Huhndorf (2004).

Type species: *Immersiella immersa* (P. Karst.) A.N. Mill. & Huhndorf, Mycol. Res. 108(1): 31 (2004)

Notes: The genus *Immersiella* was introduced by Miller and Huhndorf (2004) with two species and *Immersiella immersa* as type. *Immersiella* is distinguished from *Lasiosphaeria* and *Lasiosphaeris* in having immersed to erumpent ascomata covered with long, flexuous, brown hairs (Hilber & Hilber 1983). *Lasiosphaeria* and *Lasiosphaeris* have superficial ascomata covered with either tomentum or setae respectively. *Immersiella* can also be distinguished from *Lasiosphaeria* in having hyaline centrum contents.

Immersiella immersa (P. Karst.) A.N. Mill. & Huhndorf

Distribution: **China**, Hong Kong, on submerged wood in freshwater stream (Tsui et al. 2000).

Asexual morph: Undetermined

Notes: LSU sequence data is available.

Zopfiella G. Winter, Rabenh. Krypt.-Fl., Edn 2 (Leipzig) 1.2: 56 (1884)

Asexual morph Undetermined. **Sexual morph** *Ascomata* solitary to gregarious, superficial or immersed in substrate, covered with septate, flexuous, subhyaline hairs, cleistothecial, globose to subglobose, light brown. *Peridium* pseudoparenchymatous, membranous, semi-transparent, light brown. *Asci* 8-spored, cylindrical to clavate, apex rounded, stipitate, evanescent. *Ascospores* triangular, sides often concave, corners rounded, one truncate and bearing a refractile scar at the former point of attachment of basal cell, one bearing a germ pore, and one broadly rounded, dark brown, thick-walled.

Type species: *Zopfiella tabulata* (Zopf) G. Winter, Rabenh. Krypt.-Fl., Edn 2 (Leipzig) 1.2: 56 (1884)

Notes: The genus *Zopfiella* was established by Winter (1884) for *Z. curvata* and *Z. tabulata*. Lundqvist (1972) revised the Sordariaceae s. lat. and the genus was accepted within the family Lasiosphaeriaceae. Based on the phylogenetic analysis by using LSU sequence data, Huhndorf et al. (2004) revised the family Lasiosphaeriaceae and other families in the Sordariales, the genus *Zopfiella* was transferred from Lasiosphaeriaceae to Chaetomiaceae since the only one used *Zopfiella* species (*Z. ebriosa*) in their study. To investigate the phylogenetic relationships of *Zopfiella* and allied genera in the Sordariales, phylogenetic analyses based on partial ITS, LSU and partial β -tubulin sequences were carried out by Cai et al. (2006) and their results showed that *Zopfiella* is polyphyletic, familial replacement of *Zopfiella* in the family *Chaetomiaceae* was not accepted. The most recent classification placed the genus *Zopfiella* within the family *Lasiosphaeriaceae* (Maharachchikumbura et al. 2016; Hongsanan et al. 2017; Wijayawardene et al. 2017, 2018).

Zopfiella cephalothecoidea Guarro et al.

Distribution: **Iraq**, Euphrates, On submerged dead twig (Guarro et al. 1996).

Asexual morph: Undetermined

Notes: Holotype FMR 5307, Isotype in IMI and BSRA (10412). Sequence data are not available.

Zopfiella latipes (N. Lundq.) Malloch & Cain

\equiv *Tripterospora latipes* N. Lundq., Bot. Notiser 122: 592 (1969)

Distribution: **China**, Yunnan Province, Lake Fuxian, on submerged wood (Cai et al. 2002a); **Egypt**, Nile River, on submerged wood (Abdel-Aziz 2016).

Asexual morph: Undetermined

Notes: ITS, LSU and β -tubulin sequence data are available. *Zopfiella latipes* is a fairly common species found on various herbaceous and woody substrates in both marine and terrestrial environments (Guarro et al. 1991).



Fig. 70 *Cuspidatispora xiphiago* (MFLU 18–1622). **a** Colony on substrate. **b** Conidiophores with conidia. **c** Conidiogenous cells with conidia. **d–m** Conidia. **n** Germinating conidium. Culture on PDA from above (**o**) and reverse (**p**). Scale bars: **b** 140 μ m, **c** 95 μ m, **d** 15 μ m, **e–n** 10 μ m

Cai et al. (2002a) reported this species from freshwater lake in China, and provided photos for asci and ascospores of this species but did not mention the information of specimen.

Zopfiella leucotricha (Speg.) Malloch & Cain

≡ *Sordaria leucotricha* Speg., *Michelia* 1(no. 2): 225 (1878)

Distribution: **Egypt**, Nile River, on submerged wood (Abdel-Aziz 2016).

Asexual morph: Undetermined

Notes: Sequence data is not available. Abdel-Aziz (2016) reported this species from Nile River, but did not provide descriptions and illustration for it.

Zopfiella lundqvistii Shearer & J.L. Crane

Distribution: **USA**, Illinois, Elvira Cypress Swamp, on submerged wood (Shearer & Crane 1978).

Asexual morph: Undetermined

Notes: Holotype ILLS 36931, other specimens collected from freshwater habitats: ILLS 36933, ILLS 36934; ITS and LSU sequence data are available.

Zopfiella submersa Guarro, Al-Saadoon, Gené & Abdullah

Distribution: **Iraq**, Euphrates River, on submerged dead culms of *Phragmites* sp. (Guarro et al. 1997).

Asexual morph: Undetermined

Notes: Holotype IMI 370952, isotype FMR 5646, other specimen collected from freshwater habitats: FMR 5647. Sequence data is not available.

Sordariales genera *incertae sedis*

Ascolacicola Ranghoo & K.D. Hyde, *Mycologia* 90(6): 1055 (1998)

Asexual morph *Vegetative hyphae* partly superficial and partly immersed, branched and septate, not constricted at the septa, hyaline. *Conidiogenous cells* thin-walled, hyaline, sometimes thickened and pigmented near the base, subglobose, ampulliform, or irregularly cylindrical, bearing a single terminal conidium. *Conidia* broadly obovoid, 1-septate near the base, slightly constricted at the septa when mature, dark-brown, thick-walled. **Sexual morph** *Ascomata* superficial, subglobose, black, coriaceous, solitary to gregarious and beaked. *Peridium* comprising several layers of brown flattened angular cells. *Paraphyses* filamentous, hyaline, numerous, flexuous, septate, rounded at the ends. *Asci* 8-spored, unitunicate, cylindrical, short pedicellate, apically rounded, with a J-, refractive, discoid, apical ring. *Ascospores* overlapping uniseriate, ellipsoidal, celled, not constricted at the septa, brown with hyaline to pale brown end cells, smooth-walled.

Type species: *Ascolacicola aquatica* Ranghoo & K.D. Hyde, *Mycologia* 90(6): 1056 (1998)

Notes: Ranghoo and Hyde (1998) introduced the genus *Ascolacicola* Ranghoo & K.D. Hyde with *A. aquatica* Ranghoo & K.D. Hyde as type species which was collected

from freshwater habitats. Up to now, there is one species accepted in this genus and is only known from the type locality.

Ascolacicola aquatica Ranghoo & K.D. Hyde

Distribution: **China**, Hong Kong, Tai Po, Lam Tsuen River, on submerged wood (Ranghoo and Hyde 1998).

Asexual morph: *Trichocladium uniseptatum* (Ranghoo and Hyde 1998).

Notes: Holotype IFRD 8693. LSU sequence data is available.

Cuspidatispora Shearer & Bartolata, *Mycoscience* 47(4): 220 (2006)

Asexual morph *Mycelium* immersed, composed of septate, branched, smooth hyphae. *Conidiophores* macronematous, mononematous, solitary, erect, unbranched, septate, straight or flexuous, cylindrical, subhyaline to pale brown, smooth. *Conidiogenous cells* holoblastic, polyblastic, integrated, terminal, subhyaline. *Conidia* acrogenous, obpyriform, papillate, guttulate, brown to dark brown, smooth-walled. **Sexual morph** Descriptions and illustrations see Miller et al. (2006).

Type species: *Cuspidatispora xiphiago* Shearer & Bartolata, *Mycoscience* 47(4): 220 (2006)

Notes: The genus *Cuspidatispora* was introduced by Miller et al. (2006) and typified by *C. xiphiago* which was collected from submerged in a creek.

Cuspidatispora xiphiago Shearer & Bartolata

Facesoffungi number: FoF 05477, Fig. 70

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** *Colonies* on natural substrate superficial, effuse, brown. *Mycelium* immersed, composed of septate, branched, smooth hyphae. *Conidiophores* 250–300 µm long, 2–4 µm wide ($\bar{x} = 275 \times 3 \mu\text{m}$, $n = 20$), macronematous, mononematous, solitary, erect, unbranched, septate, straight or flexuous, cylindrical, subhyaline to pale brown, smooth. *Conidiogenous cells* holoblastic, polyblastic, integrated, terminal, subhyaline. *Conidia* 10–12 µm long, 4–6 µm wide ($\bar{x} = 11 \times 5 \mu\text{m}$, $n = 20$), acrogenous, obpyriform, papillate, guttulate, brown to dark brown, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Dulong River, saprobic on submerged decaying wood, May 2015, H.Y. Su, S-505 (MFLU 18–1622, HKAS 90735), living culture MFLUCC 16–1277, KUMCC 15–0312.

Distribution: **China**, Yunnan Province, Dulong River, on submerged wood (This study); **USA**, Illinois, Vermilion County, Jordan Creek, on submerged wood (Miller et al. 2006).

Sexual morph: see Miller et al. (2006)

Notes: Holotype ILL, Shearer A184-1, isotype ILLS 57515, other specimens collected from freshwater habitats: MFLU 18–1622, HKAS 90735. ITS, LSU, SSU, RPB2, TEF1 α and β -tubulin sequence data are available.

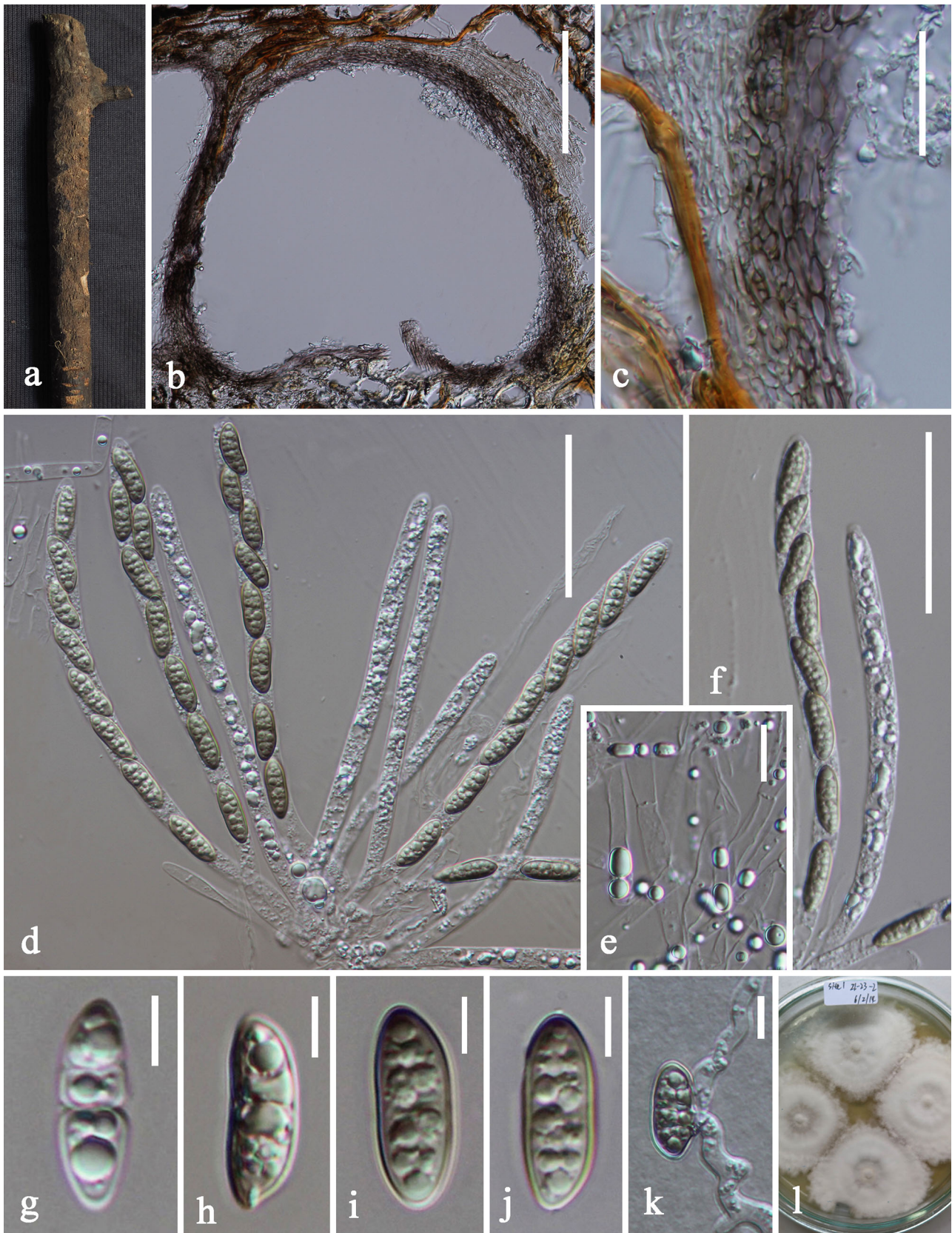
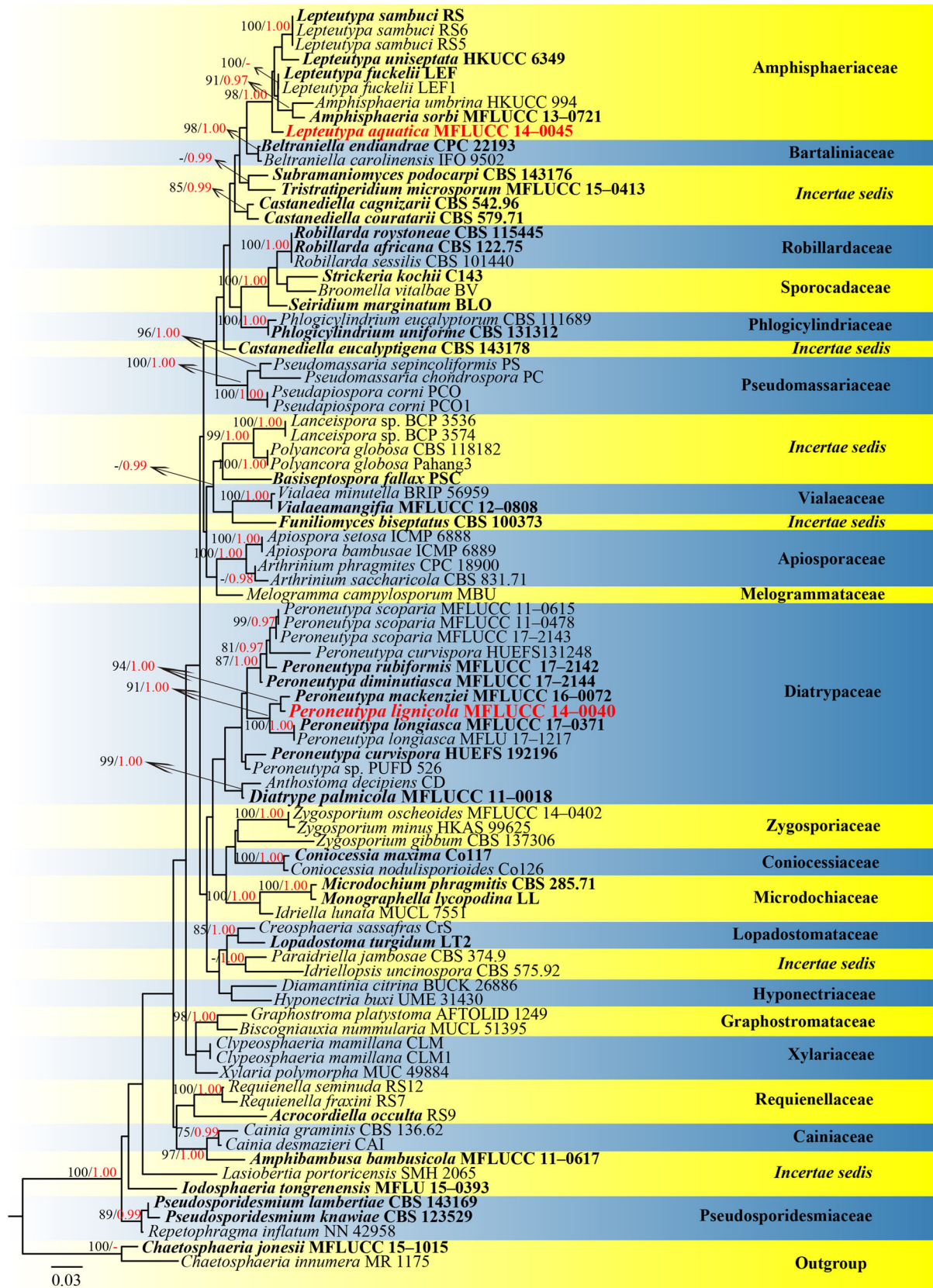


Fig. 71 *Lepteutypa aquatica* (MFLU 15–0077, holotype). **a** Specimen. **b** Section through ascomata. **c** Section of peridium. **d, f** Asci. **e** Paraphyses. **g–j** Ascospores. **k** Germinating ascospore. **l** Colony on MEA. Scale bars: **b** 100 μ m, **d, f** 50 μ m, **c** 25 μ m, **e** 10 μ m, **g–k** 5 μ m



◀**Fig. 72** Phylogram generated from maximum likelihood analysis based on ITS and LSU sequence data for the selected taxa of Xylariales (with *Chaetosphaeria innumera* and *Ch. jonesii* as outgroup). The best scoring RAxML tree with a final likelihood value of -11696.396327 is presented. RAxML bootstrap support values equal to or greater than 75% are given before the forward slash (black). Bayesian posterior probability equal to or higher than 0.95 are given after the forward slash (red). Hyphen ('-') indicates a value lower than 75% for RAxML and Bayesian posterior probability lower than 0.95. Newly generated sequences are in red. Ex-type strains are in bold

Cuspidatispora xiphiago Shearer & Bartolata was introduced by Miller et al. (2006) with sexual morph which was collected from freshwater habitats. During our investigation on lignicolous freshwater fungi in China, a hyphomycetous fungus was collected from decaying wood submerged in freshwater habitats. It is characterized by macronematous, mononematous, solitary, erect, unbranched, septate, straight or flexuous, cylindrical conidiophores, polyblastic, integrated, terminal and subterminal conidiogenous cells and brown to dark brown, obpyriform, papillate, guttulate, smooth conidia. Phylogenetic analysis

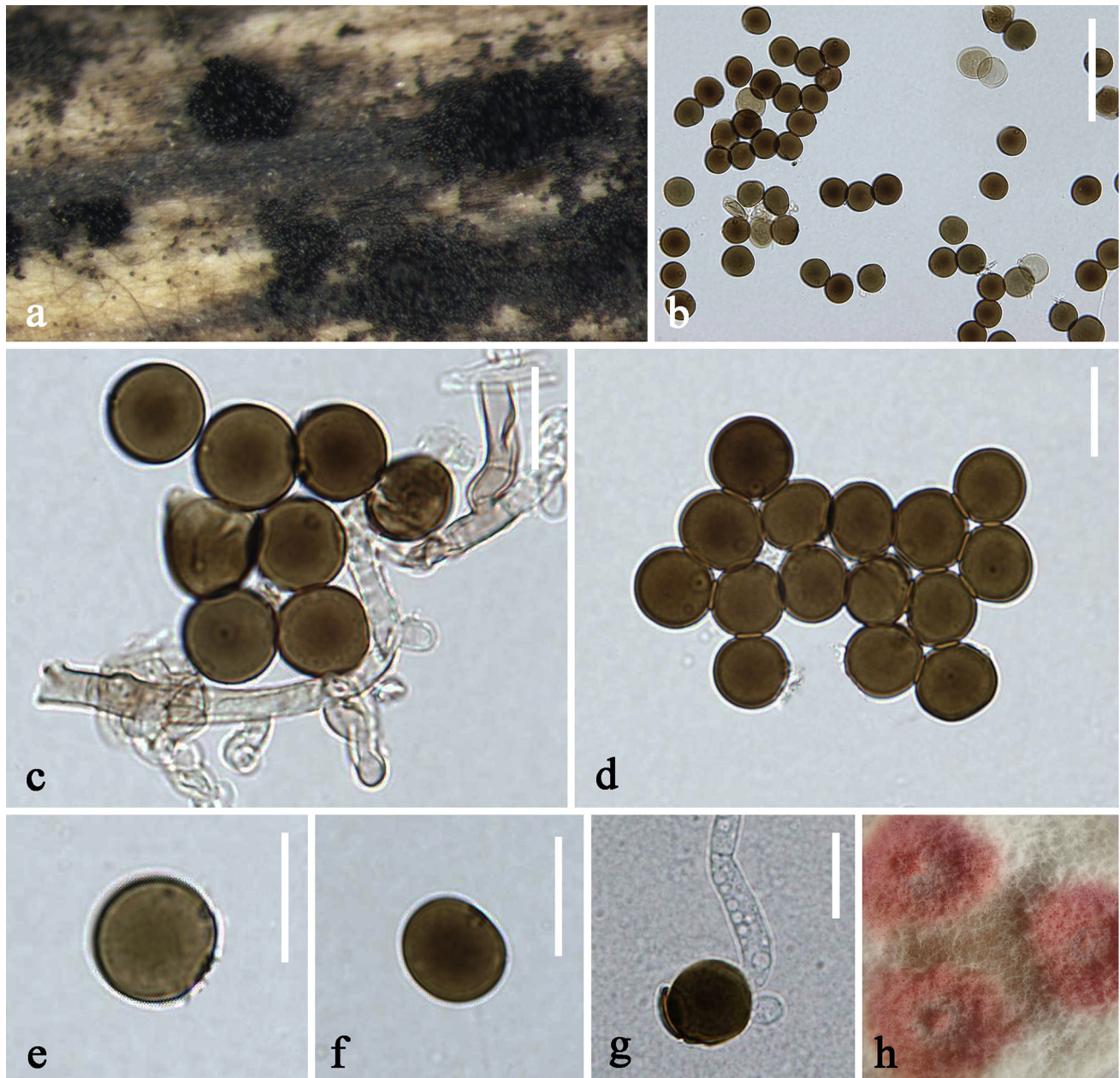
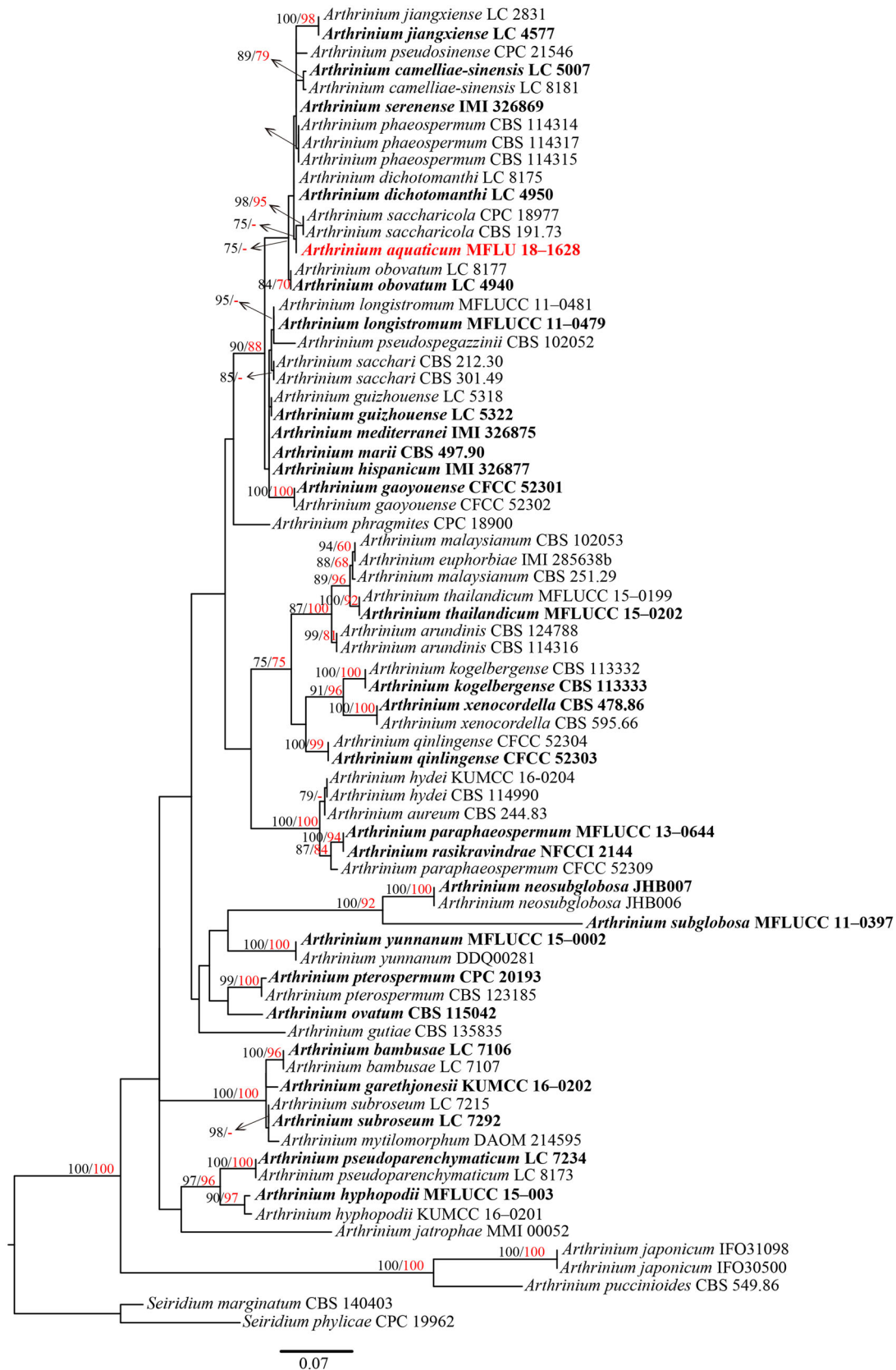


Fig. 73 *Arthrimum aquaticum* (MFLU 18–1628, holotype). **a** Colonies on wood. **b, d–f** Conidia. **c** Conidiogenous cells and conidia. **g** Germinating conidium. **h** Culture on PDA from surface. Scale bars: **b** 30 μm , **c–g** 10 μm



◀**Fig. 74** Phylogram generated from maximum likelihood analysis based on ITS sequence data for species of *Arthrinium* (with *Seiridium marginatum* and *S. phyllicae* as outgroup). The best scoring RAxML tree with a final likelihood value of -4218.246068 is presented. RAxML bootstrap support values equal to or greater than 75% are given before the forward slash (black). Maximum parsimony bootstrap support values equal to or greater than 75% are given after the forward slash (red). Hyphen ('-') indicates a value lower than 75% for RAxML and maximum parsimony. Newly generated sequences are in red. Ex-type strains are in bold

shows that our isolate clusters with *Cuspidatispora xiphago* with strong support. We therefore identify it as asexual morph of *Cuspidatispora xiphago* based on the one fungus one name rule. It is the first record for China.

Lockerbia K.D. Hyde, Sydowia 46(1): 23 (1994)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations see Hyde (1993b), Raja and Shearer (2008).

Type species: *Lockerbia palmicola* K.D. Hyde, Sydowia 46(1): 24 (1994)

Notes: The genus *Lockerbia*, typified by *L. palmicola*, was originally found on a terrestrial palm rachis in a rainforest in Queensland, Australia (Hyde 1993b). Raja and Shearer (2008) introduced the second species for this genus and named it as *Lockerbia striata* Raja & Shearer, it was originally found on submerged decorticated woody debris in a creek on an unidentified piece of herbaceous debris in a lake. *Lockerbia striata* was also found on submerged decorticated wood in two lotic habitats in Mississippi (Raja and Shearer 2008).

Lockerbia striata Raja & Shearer

Distribution: **USA**, Florida, Blackwater River State Forest, Horns Creek Swamp/Andrew Lake near Silver Lake Recreation Area, on submerged herbaceous debris; Mississippi, Big black River, on submerged decorticated woody debris (Raja and Shearer 2008).

Asexual morph: Undetermined

Notes: Holotype ILL 40118. Sequence data is not available.

Sordariomycetidae genera *incertae sedis*

Hanliniomyces Raja & Shearer, Mycologia 100(3): 471 (2008)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustration see Raja and Shearer (2008).

Type species: *Hanliniomyces hyaloapicalis* Raja & Shearer, Mycologia 100(3): 471 (2008)

Notes: Raja and Shearer (2008) introduced the genus *Hanliniomyces* with single species *Hanliniomyces hyaloapicalis* Raja & Shearer which was collected from freshwater habitats. Presently, only one species was reported in this genus.

Hanliniomyces hyaloapicalis Raja & Shearer

Distribution: **USA**, Florida, Big Cypress National Preserve, Cypress Swamp Loop Road 5/Blackwater River State Forest, Penny Creek/Blackwater River, north end at Kennedy Bridge, on submerged partially decorticated woody debris (Raja and Shearer 2008).

Asexual morph: Undetermined

Notes: Holotype ILL 40116, other specimens collected from freshwater habitats: F37–1, F37–2. Sequence data is not available.

Hydromelitis Ferrer et al., Mycologia 104(4): 876 (2012)
Asexual morph Undetermined. **Sexual morph** Descriptions and illustration see Ferrer et al. (2012).

Type species: *Hydromelitis pulchella* Ferrer et al., Mycologia 104(4): 877 (2012)

Notes: The genus *Hydromelitis* was introduced by Ferrer et al. (2012) with one species *Hydromelitis pulchella* which was collected from freshwater habitats. The single species is only known from the type locality.

Hydromelitis pulchella Ferrer et al.

Distribution: **Costa Rica**, Alajuela and Heredia, on submerged wood (Ferrer et al. 2012).

Asexual morph: Undetermined

Notes: Holotype ILL, Ferrer & Salazar, Ferrer 284–2, other specimens collected from freshwater habitats: AF284–1, A468–1, A468–2, A468–4. LSU and SSU sequence data are available.

Subclass Xylariomycetidae O.E. Erikss & Winka

Xylariales Nannf.

Hyponectriaceae Petr

Physalospora Niessl, Verh. nat. Ver. Brünn 14: 170 (1876)

Asexual morph Undetermined. **Sexual morph** *Ascomata* scattered, immersed to partially immersed, becoming erumpent, ostiolate, globose to subglobose, membranous, dark brown to black, papillate. *Peridium* composed of layers of elongated pseudoparenchymatic cells. *Paraphyses* abundant, simple, septate, immersed in a gel matrix, extending above the asci. *Asci* unitunicate, cylindrical to clavate, with a apical ring. *Ascospores* oblong, broadly obovoid, or subglobose to oval, surrounded by a gelatinous sheath, aseptate, hyaline, or pale brownish-yellow (Shear 1907; Raja and Shearer 2008).

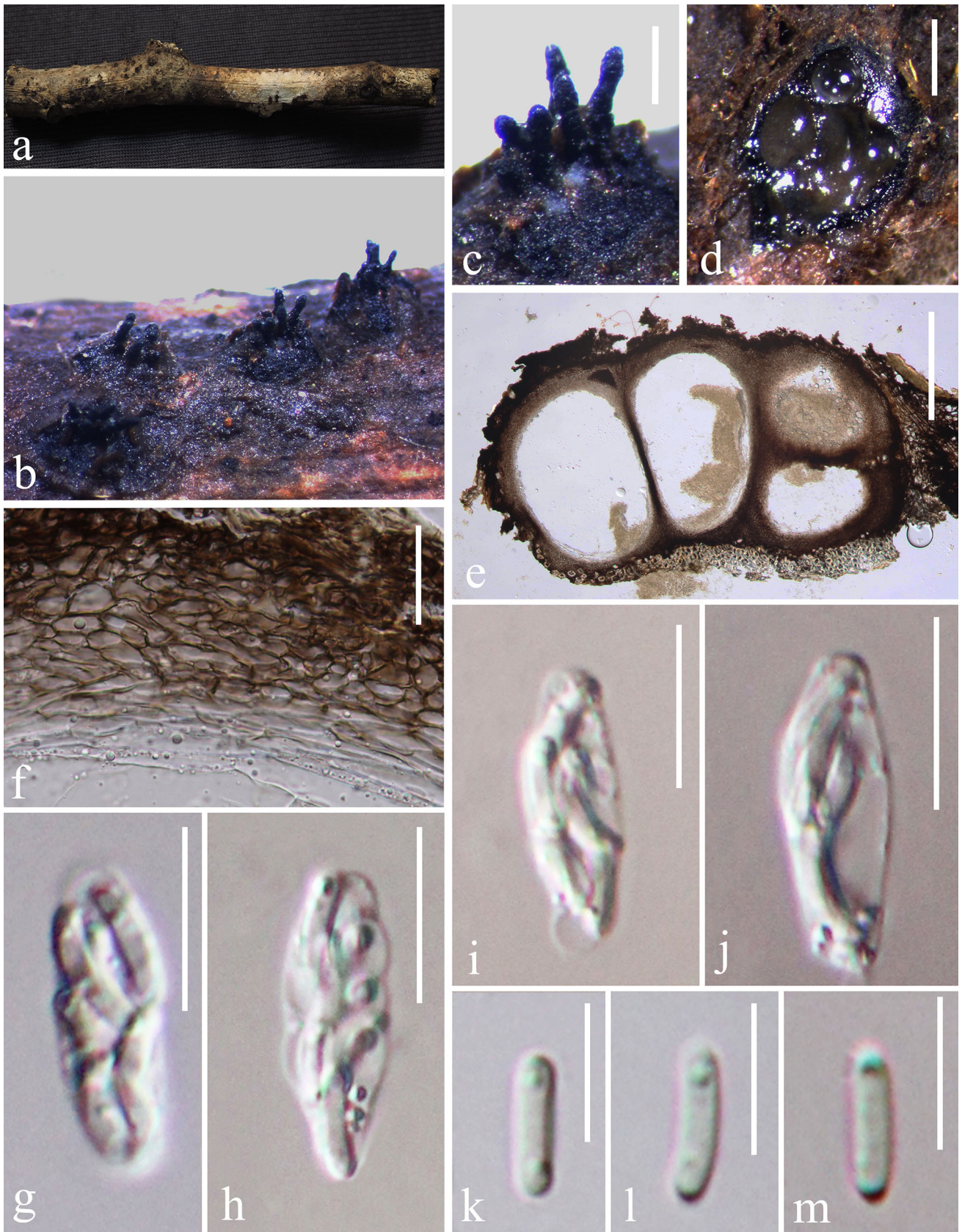
Type species: *Physalospora alpestris* Niessl, Verh. nat. Ver. Brünn 14: 170 (1876)

Notes: *Physalospora* is a widespread genus and more than 450 epithets are listed in Index Fungorum (Taylor et al. 2001; Index Fungorum 2018). Presently, two species have been reported from freshwater habitats.

Physalospora aquatica Ingold

Distribution: **UK**, Anglia, Lancashire, on submerged *Eleocharis palustris* (Ingold 1955).

Asexual morph: Undetermined



◀**Fig. 75** *Peroneutypa lignicola* (MFLU 15–0081). **a** Specimen. **b**, **c** Appearance of stromata on substrate. **d** Horizontal section through stroma. **e** Vertical section through stroma. **f** Section of peridium. **g–j** Asci. **k–m** Ascospores. Scale bars: **c**, **d** 500 μm , **e** 300 μm , **f** 25 μm , **g–j** 10 μm , **k–m** 5 μm

Notes: Holotype IMI 51811. Sequence data is not available.

Physalospora limnetica Raja & Shearer

Distribution: **USA**, Florida, Apalachicola National Forest, on submerged herbaceous debris (Raja and Shearer 2008).

Asexual morph: Undetermined

Notes: Holotype ILL40115. Sequence data is not available. This species is only known from the type locality.

Amphisphaeriaceae G. Winter

Lepteutypa Petr., Ann. Mycol. 21: 276 (1923)

Asexual morph Undetermined. **Sexual morph** *Saprobic* on decaying wood. *Ascomata* single or in groups, immersed, globose or subglobose, black. *Peridium* brown, pseudoparenchymatous, hyaline inside. *Paraphyses* numerous, simple, sometimes multiguttulate. *Asci* 8-spored, unitunicate, cylindrical, oblong, thick-walled. *Ascospores* uniseriate, oblong to ellipsoid, straight, rarely curved, normally with a central scarcely constricted euseptum, guttulate, aseptate or septate, light to yellow- or medium brown, thick-walled.

Type species. *Lepteutypa fuckelii* (G.H. Otth) Petr., Annls mycol. 21(3/4): 276 (1923)

Notes: *Lepteutypa* Petr. was introduced to accommodate a single species *L. fuckelii* (Nitschke) Petr. (Petra, 1923). Several papers have since then dealt with *Lepteutypa*, the most recent one is Jaklitsch et al. (2016).

Lepteutypa uniseptata (Tsui et al.) Jaklitsch & Voglmayr, Persoonia 37: 88 (2016)

Distribution: **China**, Hong Kong, Tai Po, Lam Tsuen River, on submerged wood (Tsui et al. 2001d).

Asexual morph: Undetermined

Notes: Holotype IFRD 8733. LSU, SSU and RPB2 sequence data are available.

Lepteutypa aquatica Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555687, Facesoffungi number: FoF 05478, Fig. 71

Etymology: Referring to the aquatic habitat of this fungus

Holotype: MFLU 15–0077

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Undetermined. **Sexual morph** *Ascomata* immersed in wood, subglobose to depressed globose, 250–320 μm high, 300–330 μm diam. *Peridium*

consisting of a dark brown, 21–27 μm thick pseudo-parenchymatous outer layer and a narrow hyaline to yellowish hyphal inner layer. *Paraphyses* apically free, simple, septate, hyaline, 4–6 μm wide, multi-guttulate. *Asci* 126–138 \times 8–10 μm (\bar{x} = 132 \times 9 μm , n = 20), 8-spored, unitunicate, long cylindrical, thick-walled, hyaline to pale brown. *Ascospores* 15–17 \times 5–7 μm (\bar{x} = 16 \times 6 μm , n = 20), uniseriate, oblong to reniform, straight to slightly curved, guttulate, pale brown, smooth, thick-walled.

Material examined: **THAILAND**, Chiang Rai Province, saprobic on submerged decaying wood in a freshwater stream, November 2013, K.D. Hyde, ZL-23 (MFLU 15–0077, holotype), ex-type living culture MFLUCC 14–0045.

Notes: *Lepteutypa aquatica* resembles *L. uniseptata* in having subglobose, black, immersed ascomata, paraphyses ca 5 μm wide, septate, multiguttulate, asci long cylindrical and smooth, thick-walled, pale brown ascospores with similar size (Tsui et al. 2001d). However, *Lepteutypa aquatica* differs from *L. uniseptata* in having thicker peridium, asci without apical ring and oblong to reniform, aseptate ascospore. Phylogenetic analysis also shows that *Lepteutypa aquatica* is distinct from *L. uniseptata* (Fig. 72).

Apiosporaceae Hyde et al.

Arthrinium Kunze, Mykologische Hefte (Leipzig) 1: 9 (1817)

Holomorph Descriptions and illustration refer to Maharachchikumbura et al. (2016).

Type species: *Arthrinium caricicola* Kunze & J.C. Schmidt, Mykologische Hefte (Leipzig) 1: 9 (1817)

Notes: *Arthrinium*, an asexual typified genus which has been traditionally linked to the sexual typified genus *Apiospora* (Ellis 1971; Seifert et al. 2011). *Arthrinium* was confirmed as the asexual morph of *Apiospora* by molecular data (Crous and Groenewald 2013; Senanayake et al. 2015) and *Apiospora*, *Cordella* and *Pteroonium* were reduced to synonymy with *Arthrinium* (Crous and Groenewald 2013). *Arthrinium* species are geographically widely distributed in various hosts (Wang et al. 2018). Many species of *Arthrinium* are associated with plants as endophytes or saprobes, as well as plant pathogens on some important ornamentals (Chen et al. 2014; Li et al. 2016b). In this study, we introduced a new *Arthrinium* species collected from submerged wood in freshwater.

Arthrinium aquaticum Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555688, Facesoffungi number: FoF 05479, Fig. 73

Etymology: Referring to the aquatic habitat of this fungus

Holotype: MFLU 18–1628

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on the substratum superficial, dark brown to black. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* erect, aggregated in clusters on hyphae, hyaline to pale brown, smooth, doliform to ampulliform. *Conidia* 9–11 µm long, 8–10 µm wide ($\bar{x} = 10 \times 9$ µm, $n = 20$), globose to subglobose, olivaceous to brown, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Lancang River, saprobic on submerged decaying wood, April 2015, Z.L. Luo, S-642 (MFLU 18–1628, holotype, HKAS 92855, isotype), ex-type living culture DLUCC 0642.

Notes: *Arthrinium aquaticum* resembles *A. camelliae-sinensis* in having conidiophores reduced to conidiogenous cells, erect, hyaline to pale brown, smooth, doliform to ampulliform conidiogenous cells, globose to subglobose, smooth conidia with similar size (Wang et al. 2018). However, Phylogenetic analysis shows that they are different species in this genus (Fig. 74). *A. aquaticum* also shares similar morphological characters with *A. saccharicola* in having conidiophores reduced to conidiogenous cells, ampulliform conidiogenous cells, globose to subglobose, smooth conidia (Crous et al. 2014a, b). However, *A. aquaticum* differs from *A. saccharicola* by its smooth conidiogenous cells, larger conidia (9–11 × 8–10 µm vs. 8–9 × 4–6 µm).

Diatrypaceae Nitschke

Peroneutypa Berl., Icon. fung. (Abellini) 3(3–4): 80 (1902)
Asexual morph Coelomycetous, forming pycnidia on PDA medium. *Conidiomata* superficial, solitary or aggregated, subconical, globose to subglobose, shiny, with smooth surface, white, dark brown to black. *Pycnidial walls* comprising several layers of dark brown, compressed hyphae, arranged in a textura intricata. *Conidiogenous cells* holoblastic, cylindrical, straight or curved, apically distorted on conidial secession. *Conidia* lunate to filiform, curved or rarely straight, with flattened base and blunt apex, hyaline. **Sexual morph** *Stromata* solitary to gregarious, locules, immersed, becoming raised to erumpent by a long ostiolar canal, black, glabrous, circular to irregular in shape. *Ascomata* perithecial, immersed in a stroma, black, globose to subglobose. *Ostioles* cylindrical, black. *Peridium* thick, dark brown to brown of out layer, subhyaline of inner layer. *Asci* 8-spored, unitunicate, hyaline. *Ascospores* allantoid, elongate, straight to curved, hyaline to pale yellowish, smooth-walled.

Type species: *Peroneutypa bellula* (Desm.) Berl., Icon. fung. (Abellini) 3(3–4): 81 (1902)

Notes: Berlese (1902) introduced the genus *Peroneutypa* (Diatrypaceae) to accommodate *P. bellula*, *P. corniculata* and *P. heteracantha* without designating the type species. Rappaz (1987) proposed *P. bellula* as the type species

because of the good condition of the herbarium of this species. Carmarán et al. (2006) reinstated *Peroneutypa* and accepted eight species from *Eutypella* and *Echinomyces* in this genus. Shang et al. (2018) revised the taxonomy of the genus based on morphology and combined ITS and TUB2 sequence data, and an updated key to 13 *Peroneutypa* species was also provided. In this study, we introduce one new species *Peroneutypa lignicola* based on morphology and phylogeny and it is the first time to collect *Peroneutypa* species from freshwater habitats.

Peroneutypa lignicola Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555689, Facesoffungi number: FoF 05480, Fig. 75

Etymology: Referring to this fungus dwelling on wood
 Holotype: MFLU 15–0081

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Undetermined. **Sexual morph** *Stromata* 609–685 µm high, 1196–1246 µm diam., solitary to gregarious, 4–6 locules, immersed, becoming raised to erumpent by a long ostiolar canal, black, glabrous, circular to irregular in shape, arranged in longitudinally, with conspicuous, clustered, cylindrical prominent ostioles on substrate surface. *Ascomata* 448–662 µm high, 355–445 µm diam., perithecial, immersed in a stroma, black, globose to subglobose. *Ostioles* cylindrical, black. *Peridium* 62–92 µm thick, composed of two type layers, outer layer comprising thick-walled, dark brown to black cells of *textura angularis*, inner layer comprising of thin-walled, hyaline cells of *textura angularis* to *textura prismatica*. *Asci* 15–17 × 5–7 µm ($\bar{x} = 16 \times 6$ µm, $n = 20$), 8-spored, unitunicate, oblong or cylindrical, sessile, hyaline. *Ascospores* 5–7 × 1.5–2.5 µm ($\bar{x} = 6 \times 2$ µm, $n = 20$), seriate, elongate-allantoid, straight to slightly curved, aseptate, with olive-green guttules at both ends, hyaline, smooth-walled.

Material examined: **THAILAND**, Chiang Rai Province, saprobic on decaying wood submerged in a freshwater stream, November 2013, Z.L. Luo, ZL-14 (MFLU 15–0081, holotype), ex-type living culture MFLUCC 14–0040.

Notes: *Peroneutypa lignicola* mostly resembles *P. mackenziei* in having solitary to gregarious, immersed, loculate stromata, perithecial, black, globose to subglobose ascomata immersed in a stroma, unitunicate, 8-spored, sessile asci and aseptate, elongate-allantoid ascospores with similar size (Shang et al. 2017). However, *Peroneutypa lignicola* differs from *P. mackenziei* in having thicker peridium (62–92 vs. 45–65 µm) and ascospores with obviously olive-green guttules at both ends. Phylogenetic analysis also shows that *Peroneutypa lignicola* is distinct from *P. mackenziei* (Fig. 72).

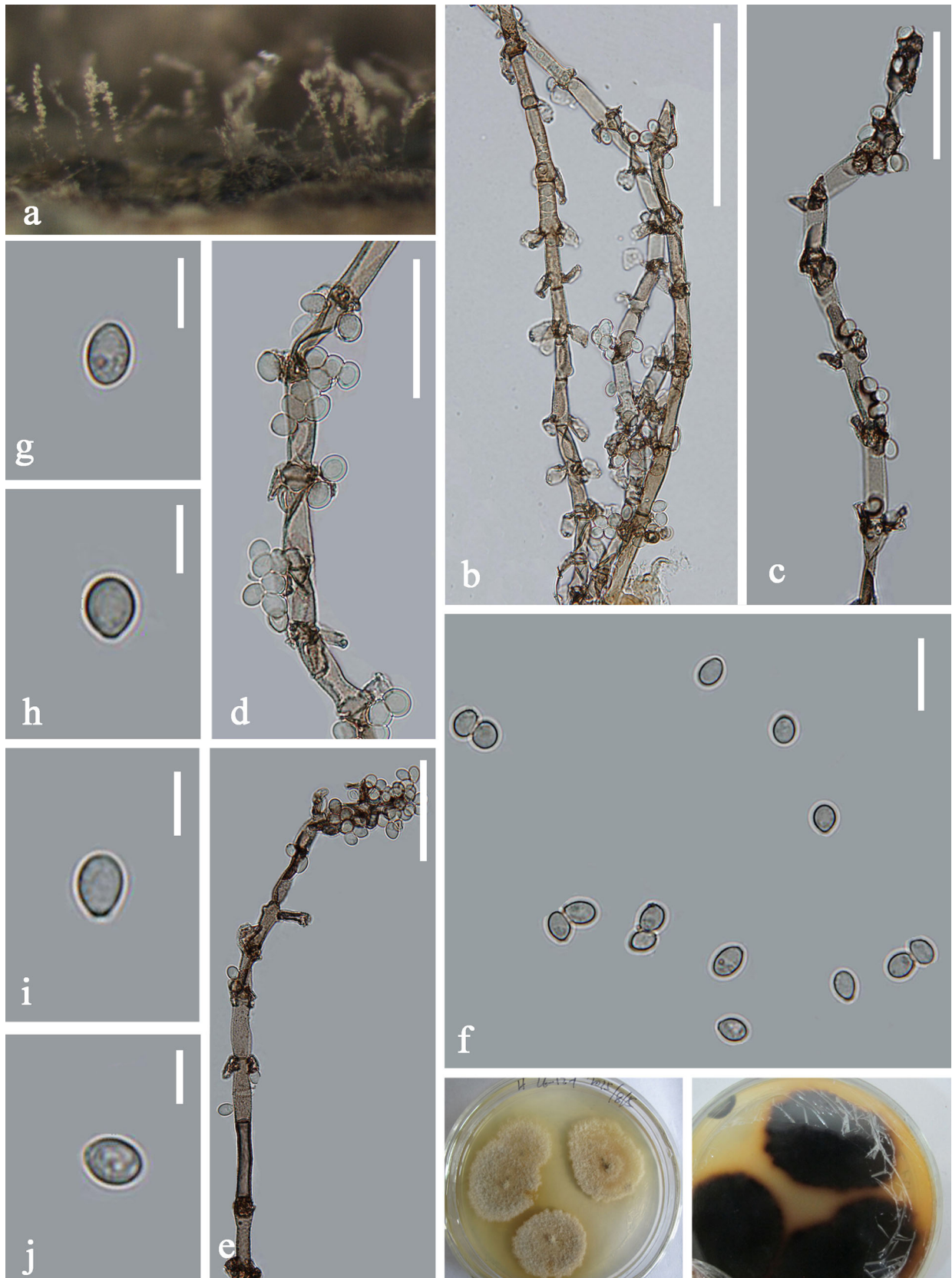


Fig. 76 *Hypoxylon lignicola* (MFLU 18–1629, holotype). **a** Colonies on wood. **b–e** Conidiophores, Conidiogenous cells with conidia. **f–j** conidia. **l, m, n** Culture on PDA from above and reverse. Scale bars: **b** 50 µm, **c–e** 25 µm, **f** 10 µm, **g–j** 5 µm

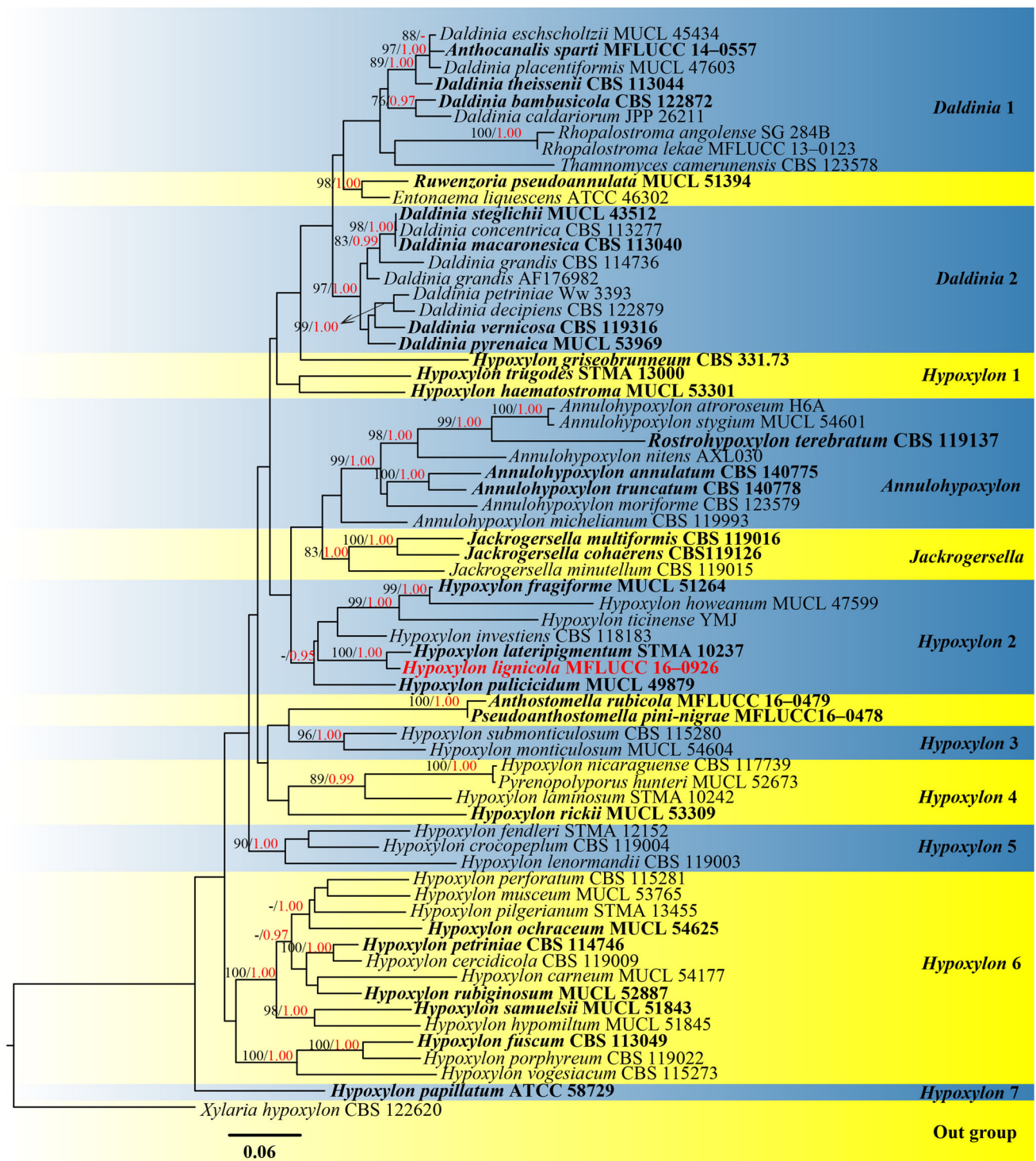


Fig. 77 Phylogram generated from maximum likelihood analysis based on ITS sequence data for species of Hypoxylaceae (with *Xylaria hypoxylon* as outgroup). The best scoring RAxML tree with a final likelihood value of -30247.954400 is presented. RAxML bootstrap support values equal to or greater than 75% are given before

the forward slash (black). Bayesian posterior probability equal to or higher than 0.95 are given after the forward slash (red). Hyphen ('-') indicates a value lower than 75% for RAxML and Bayesian posterior probability lower than 0.95. Newly generated sequences are in red. Ex-type strains are in bold

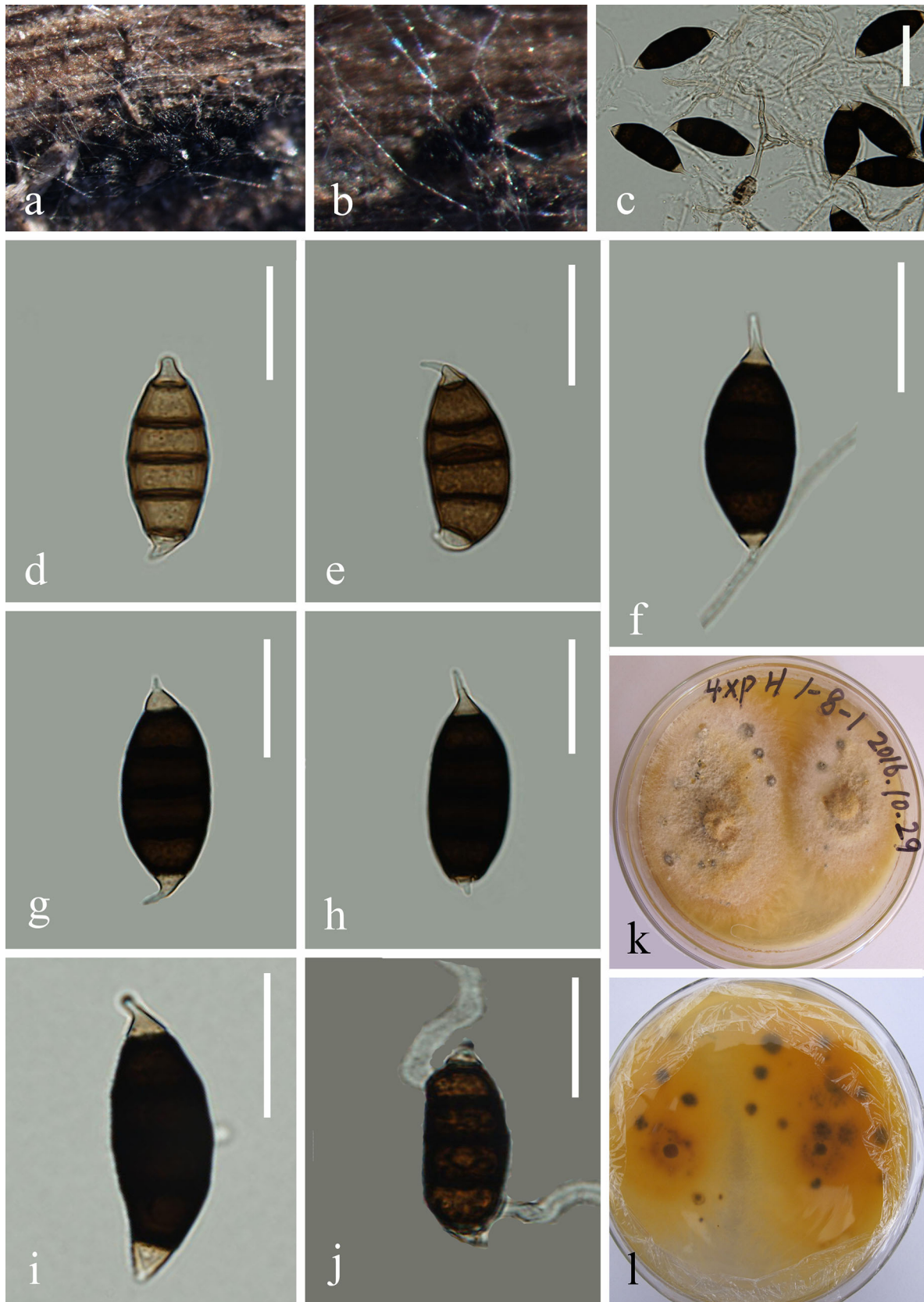
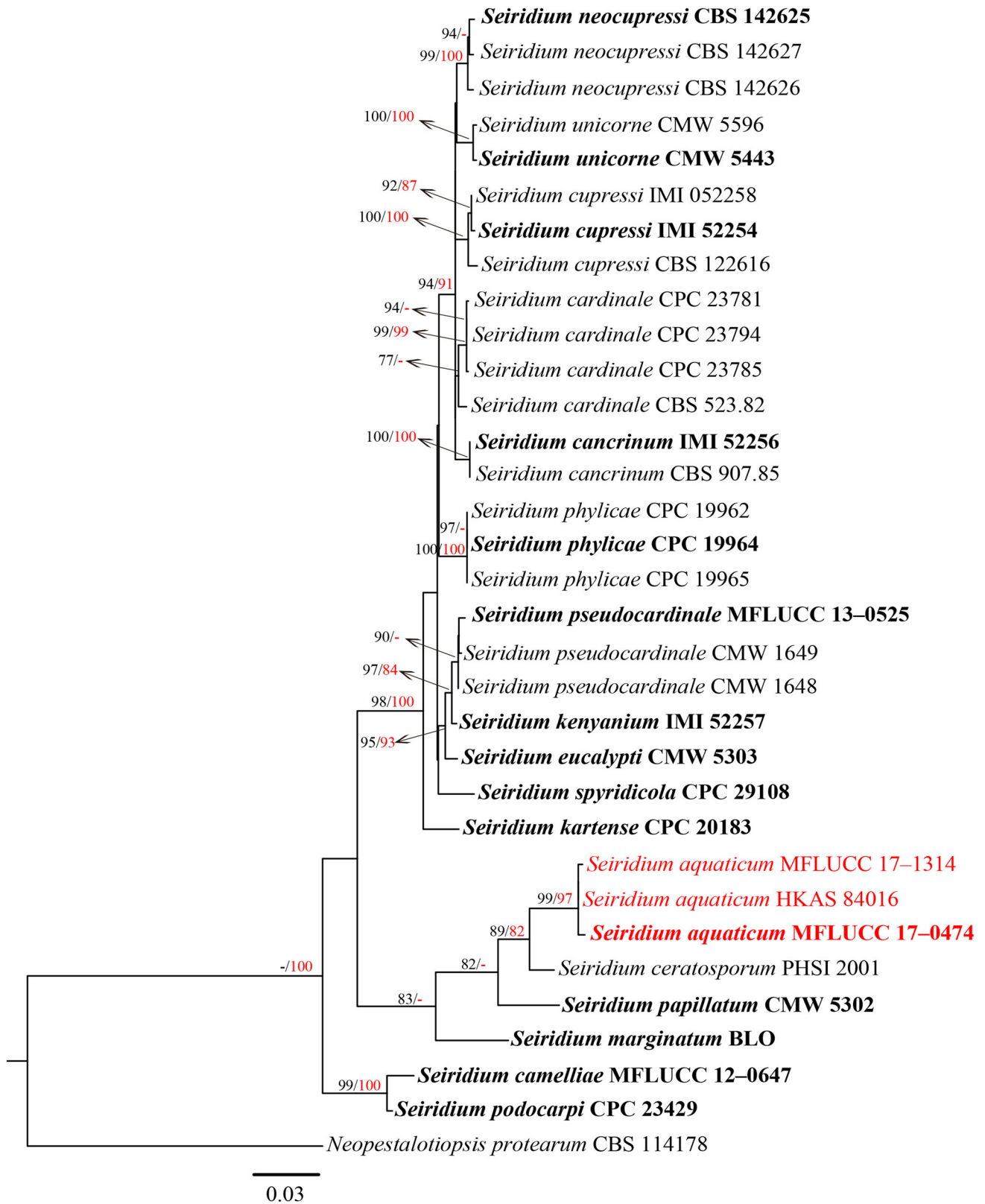


Fig. 78 *Seiridium aquaticum* (MFLU 18–1627, holotype). **a, b** Colonies on wood. **c** Conidiogenous cells and conidia. **d–i** Conidia. **g** Germinating conidium. **h** Culture on PDA from above and reverse. Scale bars: **c–j** 20 μ m



◀**Fig. 79** Phylogram generated from maximum likelihood analysis based on ITS and RPB2 sequence data for species of *Seiridium* (with *Neopestalotiopsis protearum* as outgroup). The best scoring RAxML tree with a final likelihood value of -4999.544181 is presented. RAxML bootstrap support values equal to or greater than 75% are given before the forward slash (black). Maximum parsimony bootstrap support values equal to or greater than 75% are given after the forward slash (red). Hyphen ('-') indicates a value lower than 75% for RAxML and maximum parsimony. Newly generated sequences are in red. Ex-type strains are in bold

Hypoxylaceae DC.

Hypoxylon Bull., Hist. Champ. Fr. (Paris) 1: 168 (1791)

Asexual morph Colonies on the substratum, effuse, superficial, gray to pale brown. *Conidiophores* macronematous, mononematous, cylindrical, single, straight to curved, unbranched, septate, pale brown to brown. *Conidiogenous cells* integrated, intercalary, hyaline to pale brown, smooth. *Conidia* globose to subglobose, or ellipsoid, gray to pale brown, smooth-walled. **Sexual morph** Descriptions refer to Daranagama et al. (2017).

Type species: *Hypoxylon fragiforme* (Pers.) J. Kickx f., Fl. crypt. Louvain (Bruxelles): 116 (1835)

Notes: *Hypoxylon* is a species rich genus with more than 170 known species (Kuhnert et al. 2014), and it is extensively studied for its morphology, phylogeny and chemotaxonomy. With a cosmopolitan distribution, *Hypoxylon* species inhabit mainly woody substrates as saprobes (Ju and Rogers 1996; Stadler et al. 2008; Kuhnert et al. 2014). In this study, we introduce a new species *Hypoxylon lignicola* based on morphology and phylogenetic analysis, and it is the first time to report *Hypoxylon* species from freshwater habitats.

Hypoxylon lignicola Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555690, Facesoffungi number: FoF 05481, Fig. 76

Etymology: Referring to this fungus dwelling on wood
Holotype: MFLU 18–1629

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on the substratum, effuse, superficial, gray to pale brown. *Conidiophores* 258–320 μm long, 4.5–5.5 μm wide ($\bar{x} = 289 \times 5 \mu\text{m}$, $n = 20$), macronematous, mononematous, cylindrical, single, straight to curved, unbranched, septate, pale brown to brown. *Conidiogenous cells* polyblastic, integrated, intercalary, hyaline to pale brown, smooth. *Conidia* 3–5 μm long, 3–4 μm wide ($\bar{x} = 4 \times 3.5 \mu\text{m}$, $n = 20$), globose to subglobose, or ellipsoid, gray to pale brown, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Lancang River, saprobic on submerged decaying wood, April 2015, Z.L. Luo, S-331 (MFLU 18–1629, holotype, HKAS 92856, isotype), ex-type living culture MFLUCC 16–0926; KUMCC 15–0332.

Notes: *Hypoxylon lignicola* resembles the asexual morph of *H. griseobrunneum* in having macronematous conidiophores, ellipsoid, smooth conidia with similar size (Kuhnert et al. 2014). However, *H. lignicola* differs from *H. griseobrunneum* in having unbranched, pale brown to brown conidiophores, intercalary, hyaline to pale brown conidiogenous cells, gray to pale brown conidia. Phylogenetic analysis shows that *H. lignicola* is distinct from other *Hypoxylon* species (Fig. 77).

Sporocadaceae Corda

Hymenopleella Munk, Dansk bot. Ark. 15(no. 2): 89 (1953)

Holomorph Descriptions and illustration refer to (Liu et al. 2019).

Type species: *Hymenopleella hippophaëicola* Jaklitsch & Voglmayr, Persoonia 37: 96 (2016)

Notes: *Dyrithiopsis* was introduced by Jeewon et al. (2003) with *D. lakefuxianensis* as type species which was collected from a lake in Yunnan, China. Liu et al. (2019) synonymised *Dyrithiopsis* under *Hymenopleella* based on morphology and phylogenetic studies.

Hymenopleella lakefuxianensis (L. Cai et al.) Liu et al.

\equiv *Dyrithiopsis lakefuxianensis* L. Cai, Jeewon & K.D. Hyde

Distribution: **China**, Yunnan Province, Lake Fuxian, on submerged wood (Jeewon et al. 2003).

Asexual morph: See Jeewon et al. (2003)

Notes: Holotype IFRD 8807. LSU sequence data is available.

Seiridium Nees, Syst. Pilze (Würzburg): 22 (1816) [1816–17]

Holomorph Descriptions and illustrations see Bonthond et al. (2018).

Type species: *Seiridium marginatum* Nees, Syst. Pilze (Würzburg): 23 (1816) [1816–17]

Notes: The genus *Seiridium* was established based on *S. marginatum* (Nees 1817), collected from rose stems in Germany and recently epitypified by Jaklitsch et al. (2016). Bonthond et al. (2018) investigated the phylogeny of the genus *Seiridium*, and epitypified species for which no ex-type culture is currently available. *Seiridium* (Sordariomycetes, Xylariales, Sporocadaceae) comprises a variety of mainly plant pathogenic fungi, such as *S. cardinale*, *S. cupressi* and *S. unicorne* are considered responsible for a pandemic of cypress canker disease, impacting plantations for wood production and ornamental tree cultivation (Boesewinkel 1983; Graniti 1986, 1998; Bonthond et al. 2018).

Seiridium aquaticum Z.L. Luo, K.D. Hyde & H.Y. Su, *sp. nov.*

Index Fungorum number: IF 555691, Facesoffungi number: FoF 05482, Fig. 78

Etymology: Referring to the aquatic habitat of this fungus

Holotype: MFLU 18–1627

Saprobic on decaying wood submerged in freshwater habitats. **Asexual morph** Colonies on the substratum superficial, dark brown to black. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* subcylindrical, hyaline, smooth. *Conidia* 29–35 µm long, 12–14 µm wide ($\bar{x} = 32 \times 13$ µm, $n = 20$), straight to slightly curved, 5-septate, bearing minute marginal frills, four median cells, smooth, doliform to ellipsoidal, dark brown to black, septa darker than the rest of the cells; basal cell obconic with a truncate base, hyaline, smooth-walled; apical cell conical, hyaline, smooth-walled. **Sexual morph** Undetermined.

Material examined: **CHINA**, Yunnan Province, Cangshan Mountain, saprobic on decaying wood submerged in a freshwater stream, September 2016, S.M. Tang, S-793 (MFLU 18–1627, holotype), ex-type living culture MFLUCC 17–0474; *Ibid.*, saprobic on decaying wood submerged in a freshwater stream, April 2016, S.M. Tang, S-837, living culture MFLUCC 17–1314; *Ibid.*, saprobic on decaying wood submerged in a freshwater stream, July 2014, L.W. Wang, S-136 (HKAS 84016, paratype), living culture MFLUCC 18–1308.

Notes: *Seiridium aquaticum* resembles *S. spyridicola* in having subcylindrical, hyaline, smooth conidiogenous cells, septate conidia bearing marginal frills, with hyaline cells at both ends (Bonthond et al. 2018). However, *S. aquaticum* differs from *S. spyridicola* in having larger conidia (29–35 × 12–14 vs. 24–28 × 8–10.5 µm). *Seiridium aquaticum* is also distinct from other *Seiridium* species by its minute marginal frills at both ends of conidia. Phylogenetic analysis shows that *Seiridium aquaticum* is distinct from other *Seiridium* species (Fig. 79).

Xylariaceae Tul. & C. Tul.

Anthostomella Sacc., Atti Soc. Veneto-Trent. Sci. Nat., Padova, Sér. 4 4: 84 (1875)

Holomorph Descriptions and illustrations refer to Daranagama et al. (2017).

Type species: *Anthostomella tomicoides* Sacc., Atti Soc. Veneto-Trent. Sci. Nat., Padova, Sér. 4 4: 101 (1875)

Notes: Many *Anthostomella* species are distributed in tropics, subtropics and even temperate regions (Daranagama et al. 2017). A world monograph of *Anthostomella* was published by Lu and Hyde (2000). The phylogenetic placement of *Anthostomella* was established by Daranagama et al. (2015, 2016) based on molecular data. Only one species has been reported from freshwater habitats.

Anthostomella aquatica K.D. Hyde & Goh

Distribution: **Australia**, north Queensland, Lake Barine, on submerged wood (Hyde and Goh 1998b).

Asexual morph: see Hyde and Goh (1998b)

Notes: Holotype IFRD 8653. SSU sequence data is available.

Sordariomycetes genera *incertae sedis*

Aquadulciospora Fallah & Shearer, Mycologia 93(3): 570 (2001)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations see Fallah and Shearer (2001).

Type species: *Aquadulciospora rhomboidia* Fallah & Shearer, Mycologia 93(3): 571 (2001)

Notes: *Aquadulciospora* was introduced by Fallah and Shearer (2001) to accommodate *A. rhomboidia* which is characterized by immersed, scattered or in rows, globose or obpyriform, papillate ascomata, nitunicate, numerous, basal, fasciculate, cylindrical-clavate asci and ellipsoid-rhomboid to fusoid, multiguttulate, hyaline, smooth ascospores. Currently, there is only one species accepted in this genus.

Aquadulciospora rhomboidia Fallah & Shearer

Distribution: **USA**, Wisconsin, Sparkling Lake, on submerged decomposed stems of *Scirpus validus* (Fallah and Shearer 2001).

Asexual morph: Undetermined

Notes: Holotype ILLS 53999, other specimens collected from freshwater habitats: ILLS 54001, ILLS 54002, ILLS 54003, ILLS 54004, ILLS 54006, ILLS 54007. Sequence data is not available.

Aquasphaeria K.D. Hyde, Nova Hedwigia 61: 122 (1995)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations see Hyde (1995a).

Type species: *Aquasphaeria dimorphospora* K.D. Hyde, Nova Hedwigia 61(1–2): 123 (1995)

Notes: The genus *Aquasphaeria* was introduced by Hyde (1995a) based on the collection from submerged wood in freshwater habitats. Currently, this genus includes only one species.

Aquasphaeria dimorphospora K.D. Hyde

Distribution: **Australia**, Queensland, on submerged wood (Hyde 1995b).

Asexual morph: Undetermined

Notes: Holotype BRIP 21482. Sequence data is not available.

Ascoyunnania L. Cai & K.D. Hyde, Fungal Divers 18: 2 (2005)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations see Cai et al. (2005).

Type species: *Ascoyunnania aquatica* L. Cai & K.D. Hyde, Fungal Divers 18: 3 (2005)

Notes: The genus *Ascoyunnania* was introduced by Cai et al. (2005) based on the collection from submerged wood in freshwater habitats in China. Currently, this genus includes only one species.

Ascoyunnania aquatica L. Cai & K.D. Hyde

Distribution: **China**, Yunnan Province, Jinghong City, on submerged bamboo in a small forest stream (Cai et al. 2005).

Asexual morph: Undetermined

Notes: Holotype PDD 75039. Sequence data is not available. This species is only known from the type locality.

Paoayensis Cabanela et al., Cryptog. Mycol. 28(4): 303 (2007)

Asexual morph Undetermined. **Sexual morph** Descriptions and illustrations see Cabanela et al. (2007).

Type species: *Paoayensis lignicola* Cabanela et al., Cryptog. Mycol. 28(4): 304 (2007)

Notes: *Ascoyunnania* was introduced by Cabanela et al. (2007) with single species which was collected from freshwater habitats. One species was accepted in this genus.

Paoayensis lignicola Cabanela et al.

Distribution: **Philippines**, Ilocos Norte, on submerged wood in Paoay Lake (Cabanela et al. 2007).

Asexual morph: Undetermined

Notes: Holotype HKU (M) 17516 (now in IFRD). LSU and SSU sequence data are available.

Rivulicola K.D. Hyde, Nova Hedwigia 64(1–2): 186 (1997)

Asexual morph Undetermined. **Sexual morph** *Ascomata* scattered to gregarious, hyaline to light brown, membranous; venter globose to subglobose, ostiolate. *Neck* hyaline, periphysate. *Peridium* comprising several layers of hyaline to light brown, elongated, flattened cells. *Paraphyses* simple, septate, filamentous. *Asci* unitunicate, numerous, basal, fasciculate, cylindrical, with apical ring. *Ascospores* septate, ellipsoidal, hyaline, smooth-walled.

Type species: *Rivulicola incrustata* K.D. Hyde, Nova Hedwigia 64(1–2): 186 (1997)

Notes: *Rivulicola* was introduced for a freshwater ascomycete with hyaline ascomata, cylindrical asci with a discoid refractive apical ring, hyaline, multiseptate, and ellipsoidal ascospores (Hyde et al. 1997). Two more species were introduced by Ranghoo et al. (2000) and Raja et al. (2009a) respectively. All species of this genus were collected from freshwater habitats.

Rivulicola aquatica Ranghoo & K.D. Hyde

Distribution: **China**, Hong Kong, Tai Po, on submerged wood in freshwater (Ranghoo et al. 2000).

Asexual morph: Undetermined

Notes: Holotype IFRD 8843. Sequence data is not available. This species is only known from the type locality.

Rivulicola cygnea Raja & Shearer

Distribution: **USA**, Florida, Apalachicola National Forest, on submerged decorticated wood in a unnamed lake (Raja et al. 2009a).

Asexual morph: Undetermined

Notes: Holotype ILL 40111. Sequence data is not available. This species is only known from the type locality.

Rivulicola incrustata K.D. Hyde

Distribution: **Australia**, Queensland, on submerged wood (Hyde et al. 1997).

Asexual morph: Undetermined

Notes: Holotype BRIP 23340. Sequence data is not available. This species is only known from the type locality.

Saccardoella Speg., Michelia 1(no. 5): 461 (1879)

Asexual morph Undetermined. **Sexual morph** *Ascomata* perithecioid, solitary or gregarious, immersed or erumpent, globose to subglobose, coriaceous or carbonaceous, dark brown to black, papillate. *Ostirole* mostly central, conical, short, brown to black, periphysate. *Peridium* medium, composed of two strata. *Paraphyses* hyphae-like, filiform, numerous, septate, not embedded in a gelatinous matrix. *Asci* 8-spored, long-cylindrical or filiform, short-pedicellate, with apical ring. *Ascospores* fusiform, multi-septate, euseptate or distoseptate, sometimes slightly constricted at the septum, guttulate, some are surrounded by mucilaginous sheath, hyaline, smooth, thick-walled.

Type species: *Saccardoella montellica* Speg., Michelia 1(no. 5): 461 (1879)

Notes: *Saccardoella* is a widespread genus and comprises 22 epithets in Index Fungorum (December 2018). Among these species, four of them have been reported from freshwater habitats.

Saccardoella aquatica Tsui et al.

Distribution: **China**, Hong Kong, New Territories, Lam Tsuen River, on submerged wood (Tsui et al. 1998b); **South Africa**, Durban, Palmet River, on submerged wood (Tsui et al. 1998b).

Asexual morph: Undetermined

Notes: Holotype IFRD 8846. Sequence data is not available.

Saccardoella horizontalis Fallah & Shearer

Distribution: **Philippines**, Liput River, on submerged wood (cai et al. 2003b); **USA**, Wisconsin, on submerged wood (Fallah and Shearer 2001).

Asexual morph: Undetermined

Notes: Holotype ILLS 54025. Sequence data is not available.

Saccardoella lacustris Fallah & Shearer

Distribution: **USA**, Wisconsin, on submerged wood (Fallah and Shearer 2001).

Asexual morph: Undetermined

Notes: Holotype ILLS 54026. Sequence data is not available.

Saccardoella minuta L. Cai & K.D. Hyde

Distribution: **Philippines**, Liput River, on submerged bamboo and wood (Cai et al. 2002c; cai et al. 2003b).

Asexual morph: Undetermined

Notes: Holotype PDD 75037, isotype IFRD 8847. Sequence data is not available.

Stanjehughesia Subram., Proc. Indian natn Sci. Acad., Part B. Biol. Sci. 58(4): 184 (1992)

Asexual morph Colonies on natural substrate effuse, black. Mycelium superficial, composed of branched, septate, pale brown to brown, smooth-walled hyphae. Conidiophores absent or short, septate, brown to dark brown. Conidiogenous cells holoblastic, monoblastic, determinate, simple, brown. Conidia solitary, acrogenous, straight or curved, obclavate to obclavate-rostrate, distoseptate, septate, brown to dark brown, smooth-walled. **Sexual morph** Undetermined.

Type species: *Stanjehughesia hormiscioides* (Corda) Subram., Proc. Indian natn Sci. Acad., Part B. Biol. Sci. 58(4): 184 (1992)

Notes: Subramanian (1992) established *Stanjehughesia* to accommodate five *Sporidesmium* species. The genus is mainly characterized by very reduced or absent conidiophores and solitary, euseptate conidia seceding schizolytically from monoblastic, determinate, lageniform or ampulliform, short conidiogenous cells.

Stanjehughesia clavata D.A.C.Almeida & Gusmão

Distribution: **Brazil**, Bahia, on submerged decaying bark (de Almeida et al. 2014).

Sexual morph: Undetermined

Notes: Holotype HUEFS 155078. Sequence data is not available.

Discussion

Our morphological and phylogenetic study on freshwater Sordariomycetes has resulted in taxa belonging to different orders and genera. These are: Annulatascales (10 genera), Atractosporales (2 genera), Chaetosphaeriales (16 genera), Coniochaetales (1 genus), Conioscyphales (1 genus), Cordanales (1 genus), Coronophorales (1 genus), Diaporthales (5 genera), Distoseptisporales (2 genera), Fuscosporellales (6 genera), Glomerellales (2 genera), Hypocreales (19 genera), Jobellisiales (1 genus), Magnaporthales (4 genera), Microascales (10 genera), Myrmecridiales (1 genus), Ophiostomatales (1 genus), Phomatosporales (1 genus), Phyllachorales (2 genera), Pisorisporiales (2 genera), Pleurotheciales (5 genera), Savoryellales (4 genera), Sordariales (13 genera), Sporidesmiales (1 genus),

Tirisporellales (1 genus), Togniniales (1 genus), Torpedosporales (1 genus), Trichosphaeriales (2 genera), Xenosporicoidales (3 genera) and Xylariales (8 genera).

Diaporthomycetidae

Annulatascales

The order Annulatascales was introduced by Maharachchikumbura et al. (2015) and includes the single family Annulatascaleae which was established by Wong et al. (1998a) to accommodate species of *Annulatascus* (typified by *A. velatispora*) and related genera. Members of Annulatascaleae are primarily characterized by the presence of relatively massive, wedge-shaped, bipartite asci with J-apical ascular ring (Wong et al. 1998a). However, Réblová and Winka (2001) showed that species characterized by these characters are polyphyletic. To clarify the taxonomy of these polyphyletic species, even new genera, such as *Annulusmagnus* has been established to accommodate the distantly related species *Annulatascus triseptatus*. Dayarathne et al. (2016) provided the epitype for the type species of *Annulatascus*. Réblová et al. (2018) synonymized *Annulatascus biatriisporus* under *Torrentispora biatriispora* based on morphology and phylogeny. The relationship and placement of several species in *Annulatascus* are more resolved now and the taxonomic problems of polyphyly were addressed.

Zhang et al. (2017a, b) studied Annulatascaleae-like taxa and introduced one new order and six new families based on morphology and phylogenetic analyses. In their study, *Aquaticola*, *Dictyospora*, *Fusoidispora* and *Pseudoannulatascus* are excluded from Annulatascaleae and placed in Diaporthomycetidae genera *incertae sedis*. Conlariaceae was introduced for the genus *Conlarium*, Pseudoproboscisporaceae includes *Pseudoproboscispora* and *Diluviicola*, while Atractosporaceae includes the genera *Rubellisphaeria* and *Atractospora*. *Cyanoannulus* was assigned to the new family Woswasiaceae in Diaporthomycetidae families *incertae sedis*. Later, Réblová et al. (2018) synonymized *Fusoidispora* under *Torrentispora*.

In our phylogenetic analysis, the Annulatascales clade (Fig. 1, clade 17) includes seven genera, viz. *Annulatascus*, *Annulusmagnus*, *Ascitendus*, *Longicollum*, *Paoayensis*, *Pseudoproboscispora* and *Submersisphaeria*. This clade appears to be related to Myrmecridiales, though the statistical support is low. The genera *Pseudoproboscispora* and *Submersisphaeria* appear in distinct lineages (Fig. 1). Zhang et al. (2017a, b) introduced a new species *Pseudoproboscispora thailandensis* and transferred *Pseudoproboscispora* to the new family Pseudoproboscisporaceae. However, in our phylogenetic analysis, *Pseudoproboscispora caudae-suis* does not cluster with the new described

species. This needs to be further verified by more taxon sampling especially the inclusion of type-derived DNA data.

Although *Annulusmagnus* has been established to accommodate *Annulatasacus triseptatus* which is phylogenetically distant to *A. velatisporus*, the remaining members in *Annulatasacus* still deserves some taxonomic consideration. For instance, while *A. saprophyticus*, *A. velatisporus*, *A. hongkongensis* and *A. nilensis* constitute a moderate supported monophyletic group, the type strain of *Annulatasacus aquatorba* is phylogenetically distant to the former species (Fig. 1, clade 17). We presume that only further collections of *Annulatasacus* species will clarify whether we should still consider it as a polyphyletic genus.

Atractosporales

The order Atractosporales was established by Zhang et al. (2017a, b) comprising three families, viz. Atractosporaceae, Conlariaceae and Pseudoproboscisporaceae. In morphology, species in this three families share similar characters in having perithecial, non-stromatic, immersed to semi-immersed ascomata with neck, unitunicate, eight-spored asci with apical ring and hyaline, fusiform ascospores (Hyde et al. 1998c; Liu et al. 2012; Réblová et al. 2016b; Zhang et al. 2017a, b). However, in the phylogenetic analyses of Zhang et al. (2017a, b), these three families cluster together but without bootstrap support. Our phylogenetic analysis shows that these three families do not cluster together as Pseudoproboscisporaceae appears related to Junewangiaceae (Fig. 1, clade 1 and 2); species of Atractosporaceae cluster together with strong bootstrap support (Fig. 1, clade 3) and Conlariaceae formed a distinct clade as well (Fig. 1, clade 5). There is however, no support to conclusively interpret phylogenetic relationships among these families. Given the uncertain phylogenetic placement of Conlariaceae and Pseudoproboscisporaceae, we therefore suggest that Atractosporales only accepts for the type family Atractosporaceae, while Conlariaceae and Pseudoproboscisporaceae be assigned as Diaporthomycetidae family *incertae sedis*.

Papulosaceae

Maharachchikumbura et al. (2015) placed two freshwater genera, *Brunneosporella* and *Fluminicola* in this family. Khemmuk et al. (2016) added *Wongia* to Papulosaceae based on the phylogenetic analysis and morphological characters. Later, Zhang et al. (2017a, b) showed that the genus *Platytrachelon* is affiliated to Papulosaceae in their phylogenetic analysis thus added *Platytrachelon* to Papulosaceae. However, in our multi-gene phylogenetic analysis, *Platytrachelon* did not cluster in Papulosaceae and it is

more related to Acrodicthyaceae but with weak support (Fig. 1, clade 11).

Pseudoproboscisporaceae

The genus *Cateractispora* has never been validly published (Zhang et al. 2017a, b). Ranghoo (1998) provided the LSU sequence data for the ex-type strain HKUCC3710 and illustrations for *C. recepticuli*, but without any descriptions. Zhang et al. (2017a, b) showed that *C. recepticuli* clusters with *Pseudoproboscispora thailandensis* (MFLUCC 15–0989) with strong support and this is supported in our study (Fig. 1, clade 2). Morphologically, *Cateractispora recepticuli* shares similar characters with *Pseudoproboscispora thailandensis* as well. According to the morphology and phylogeny analysis, *Cateractispora* is likely to be an invalidly published synonym of *Pseudoproboscispora*. However, Ranghoo (1998) did not provide the information for herbarium of *Cateractispora recepticuli* and the specimen is unavailable for loan to verify the morphology. Therefore, we follow Zhang et al. (2017a, b) to keep the name in our phylogenetic tree. Fresh collections are needed in future study to clarify the classification of this species.

Diaporthales and Tirisporellales

Seven freshwater species in five genera are listed for the order Diaporthales in this study. The order Tirisporellales was introduced by Jones et al. (2015) in the class Sordariomycetes, subclass Diaporthomycetidae and includes a single family Tirisporellaceae based on SSU and LSU rDNA sequence analysis. However, Hongsanan et al. (2017) showed that the order Tirisporellales had a divergence time at 112 MYA and shared a common ancestor with Sydowiellaceae and Pseudovalsariaceae in their MCC analysis and Tirisporellales was also closely related to Pseudovalsaceae in the phylogenetic tree. Our phylogenetic analysis based on LSU, SSU, RPB2 and TEF1 α sequence data shares corroborates those of Hongsanan et al. (2017) in that the placement of Tirisporellales is not well supported, but falls within Diaporthales. Tirisporellaceae is probably a family of the Diaporthales. However, we following Hongsanan et al. (2017) to keep Tirisporellales as an order under Diaporthomycetidae and further study is needed to clarify the placement of Tirisporellales.

Distoseptisporales

Su et al. (2016) introduced the family Distoseptisporaceae typified by *Distoseptispora* with two species. Yang et al. (2018a, b) emended description for the genus *Distoseptispora*. In the past 3 years, thirteen species have been

introduced in the genus (Hyde et al. 2016b; Su et al. 2016; Yang et al. 2018a; Luo et al. 2018a). In our phylogenetic analysis, all Distoseptisporaceae species cluster together with high support value (98% ML) and formed distinct clade with other orders or families in Diaporthomycetidae. We therefore introduce a new order Distoseptisporales to accommodate the family Distoseptisporaceae.

Magnaporthales

In Magnaporthales, the freshwater fungi mainly include members from Ophiocerales and Pseudohalonectriaceae with eleven and seven known species, respectively. Magnaporthales has been shown to be monophyletic and including four families Magnaporthaceae, Ophiocerales, Pseudohalonectriaceae and Pyriculariaceae (Thongkantha et al. 2009; Maharachchikumbura et al. 2015, 2016; Hongsanan et al. 2017). In our phylogenetic analysis, and that of Thongkantha et al. (2009) and Cai et al. (2014), one strain of *Ophioceras tenuisporum* (SMH 1643) was distinct from other *Ophioceras* species and clustered with *Ceratosphaeria* species. However, ex-type strain of *Ophioceras tenuisporum* (ATTC 56671) clusters with other *Ophioceras* species (Fig. 1, clade 20). The LSU sequence data of *Ophioceras tenuisporum* (SMH 1643) was provided by Huhndorf et al. (2004), but without any illustrations, descriptions and herbarium information for this strain. Therefore, further studies are needed to resolve the placement of this strain. On the other hand, most of *Ceratosphaeria* species were published at 1880s to 1990s, sequence data are not available for those species. The specimen needs to be relooked into and sequenced to clarify its taxonomy.

Wijayawardene et al. (2018) accepted 23 genera in the family Magnaporthaceae. In this study, the genus *Ceratosphaeria* is excluded from Magnaporthaceae based on morphology and phylogeny. In our phylogenetic analyses, the genera *Ceratosphaerella* and *Mycoleptodiscus* do not group with other genera in Magnaporthaceae. *Ceratosphaerella* clusters with *Ophioceras* species and species of *Mycoleptodiscus* formed a separate clade and basal to other families in Magnaporthales (Fig. 15). Therefore, further studies on *Ceratosphaerella* and *Mycoleptodiscus* are needed in order to resolve the placement of these two genera.

Xenospadicoidales

The order Xenospadicoidales was established by Réblová et al. (2018) with a single family Xenospadicoidaceae including four genera, viz. *Calyptosphaeria*, *Lentomitella*, *Spadicoides* and *Torrentispora*. Species in *Spadicoides* and *Torrentispora* have been reported from freshwater habitats.

In our phylogenetic analysis, four newly generated isolates forms a distinct subclade within Xenospadicoidales with strong support (Fig. 1, clade 6). Here, we introduce *Neospadicoides* as a new genus in the family Xenospadicoidaceae with three new species.

Hypocreomycetidae

Hypocreales

35 species in 19 genera of freshwater fungi for Hypocreales are listed in this study. In our phylogenetic analysis, species of Hypocreales cluster together with good support value (Fig. 1, clade 38, 39).

Microascales

Microascales proposed by Luttrell (1951) and validly introduced by Benny and Kimbrough (1980) to accommodate Chadefaudiellaceae, Microascaceae and Pithoascaceae, and later expanded to include Ceratocystidaceae, Gondwanamycetaceae, Halosphaeriaceae and Graphiaceae (Réblová et al. 2011). Maharachchikumbura et al. (2016) and Hongsanan et al. (2017) accepted Ceratocystidaceae, Chadefaudiellaceae, Gondwanamycetaceae, Graphiaceae, Halosphaeriaceae and Microascaceae in Microascales. 32 species of freshwater fungi have been reported for Microascales. Halosphaeriaceous species are one of the most typical and common freshwater Sordariomycetes on submerged wood. In Fig. 1 (clade 40), 15 freshwater strains cluster in the family Halosphaeriaceae. The genus *Triadelphia* is currently placed in the order Microascales as genera *incertae sedis* (Wijayawardene et al. 2017, 2018; Lu et al. 2018b). In our phylogenetic analysis, strains of *Triadelphia* formed a distinct clade with strong bootstrap support (Fig. 1, clade 41) and close to the family Graphiaceae. *Triadelphia* can be easily separated from other genera in Ceratocystidaceae, Chadefaudiellaceae, Gondwanamycetaceae, Graphiaceae, Halosphaeriaceae and Microascaceae in having 2–5 forms of conidia (Shearer and Crane 1971; Li and Ye 2017; Lu et al. 2018b). Based on morphological characters and phylogenetic evidence, we introduce a new family Triadelpiaceae in this study.

Sordariomycetidae

Chaetosphaeriales

The order Chaetosphaeriales was established in Sordariomycetidae based on molecular analysis of LSU sequence data (Huhndorf et al. 2004). In our phylogenetic analysis (Fig. 1, clade 26), Chaetosphaeriales is close to Phyllachorales. Presently, the order comprises

Table 1 Checklist of the freshwater species currently assigned as Ascomycota genera *incertae sedis*

Genus	Species	Distribution	Holotype	References
<i>Angulospora</i>	<i>A. aquatica</i> Sv. Nilsson	India, Venezuela	Not indicated	Nilsson (1962)
<i>Arachnophora</i>	<i>A. combuensis</i> Monteiro et al.	Brazil	UEFS 196432	Monteiro et al. (2014)
	<i>A. longa</i> Fryar & K.D. Hyde	Australia	BRI AQ522463	Fryar and Hyde (2018)
<i>Arbusculina</i>	<i>A. fragmentans</i> Marvanová	Slovenia	IMI 317746	Marvanová (1988)
<i>Arthrotaeniolella</i>	<i>A. aquatica</i> Conç. et al.	Brazil	HUEFS 224988	Monteiro et al. (2017a)
<i>Ascagilis</i>	<i>A. bipolaris</i> K.D. Hyde	Australia	BRIP 17155	Hyde (1992c)
<i>Ascomauritiana</i>	<i>A. lignicola</i> Ranghoo & K.D. Hyde	Mauritius	IFRD 8694	Ranghoo and Hyde (1999)
<i>Blastoheterospora</i>	<i>B. catenata</i> Monteiro et al.	Brazil	HUEFS 216679	Monteiro et al. (2017b)
<i>Brachydesmiella</i>	<i>B. anthostomelloidea</i> Goh & K.D. Hyde	Australia	BRIP 23200	Goh and Hyde (1996b)
	<i>B. biseptata</i> G. Arnaud	Thailand	BIOTEC SS285	Sivichai et al. (1998b)
	<i>B. caudata</i> V. Rao & de Hoog	China, India, Thailand	CBS-H 3847	Sivichai et al. (1998b)
	<i>B. orientalis</i> (V. Rao & de Hoog) Goh	Thailand	Not indicated	Sivichai et al. (1998b)
<i>Brevicatenospora</i>	<i>B. verrucosa</i> Goh et al.	Malaysia	IFRD 8712	Sivichai et al. (1998b)
	<i>B. enteroproliferata</i> Castañeda et al.	Cuba	INIFAT C04/ 111	Castañeda-Ruiz et al. (2006)
<i>Cacumisporium</i>	<i>C. rugosum</i> Tsui et al.	China	HKU (M) 5548	Tsui et al. (2001e)
	<i>C. uniseptatum</i> Wongs. et al.	China	HMAS 196815	Wongsawas et al. (2009)
<i>Candelosynnema</i>	<i>C. ranunculosporum</i> K.D. Hyde & Seifert	Australia	BRIP 19446	Hyde and Seifert (1992)
<i>Cheiromyces</i>	<i>Ch. lignicola</i> Ho et al.	China	HKU (M) 5937	Ho et al. (2000)
<i>Clavariana</i>	<i>C. aquatica</i> Nawawi	Malaysia	IMI 195181	Descal et al. (1976)
<i>Cryptophiale</i>	<i>C. multiseptata</i> Goh & K.D. Hyde	Australia	BRIP 23150	Goh and Hyde (1996c)
<i>Delortia</i>	<i>D. aquatica</i> Goh & K.D. Hyde	Australia	BRIP 23323	Goh and Hyde (1997b)
	<i>D. tumidiapicis</i> Goh & K.D. Hyde	Australia	BRIP 23322	Goh and Hyde (1997b)
<i>Dictyoaquaphila</i>	<i>D. appendiculata</i> Monteiro et al.	Brazil	HUEFS 216013	Monteiro et al. (2016c)
<i>Dictyotrichocladium</i>	<i>D. aquaticum</i> Fiuza et al.	Brazil	HUEFS 215954	Fiuza et al. (2017)
<i>Diplocladiella</i>	<i>aquatica</i> Lee et al.	Brunei	HKU (M) 8260	Lee et al. (1998)
	<i>D. appendiculata</i> Nawawi	Malaysia	IMI 309529	Nawawi (1987)
	<i>D. tricladioides</i> Nawawi	Malaysia	IMI 289094	Nawawi (1985)
<i>Filosporella</i>	<i>F. annelidica</i> (Shearer & J.L. Crane) J.L. Crane & Shearer	USA	ILLS 36352	Crane and Shearer (1977)
	<i>F. aquatica</i> Nawawi	Malaysia	IMI 177454	Nawawi (1976)
	<i>F. exilis</i> Gulis & Marvanová	Belarus	IMI 378148	Gulis and Marvanová (1998)
	<i>F. pinguis</i> Marvanová & Bärli.	New Brunswick	DAOM 220746	Marvanová and Bärlocher (1998)
<i>Frigidispora</i>	<i>F. versimorpha</i> Marvanová et al.	UK	IMI 344098	Marvanová et al. (1992)
	<i>F. colnensis</i> K.D. Hyde & Goh	UK	IFRD 8759	Hyde and Goh (1999)
<i>Janetia</i>	<i>J. curviapicis</i> Goh & K.D. Hyde	Australia	BRIP 23223	Goh and Hyde (1996d)
<i>Linkosia</i>	<i>L. aquatica</i> Conç. et al.	Brazil	HUEFS 216022	Conceição et al. (2016)
<i>Melanocephala</i>	<i>M. triseptata</i> (Shearer et al.) S. Hughes	USA	ILLS 36154	Shearer et al. (1976)

Table 1 (continued)

Genus	Species	Distribution	Holotype	References
<i>Mirandina</i>	<i>M. uncinata</i> Fiuza et al.	Brazil	HUEFS 216003	Fiuza et al. (2016)
<i>Neta</i>	<i>N. angliae</i> K.D. Hyde & Goh	UK	HKU (M) 3243	Hyde and Goh (1999)
	<i>N. patuxentica</i> Shearer & J.L. Crane	USA	ILLS 34520	Shearer and Crane (1971)
	<i>lignicola</i> Shearer	USA	ILLS 35536	Shearer and Crane (1971)
<i>Paraceratocladium</i>	<i>P. malaysianum</i> Goh & K.D. Hyde	Malaysia	IFRD 8825	Goh and Hyde (2000a, b)
<i>Phaeomonilia</i>	<i>P. pleiomorpha</i> Castañeda et al.	Mexico	XAL CB746	Castañeda-Ruiz et al. (2007)
<i>Phalangispora</i>	<i>P. constricta</i> Nawawi & J. Webster	Malaya	IMI 256650	Nawawi and Webster (1982)
<i>Potamomyces</i>	<i>P. armatisporus</i> K.D. Hyde	Australia	BRIP 21490	Hyde (1995b)
<i>Proboscispora</i>	<i>P. aquatica</i> S.W. Wong & K.D. Hyde	Australia	HKU (M) 2792	Wong and Hyde (1999a, b)
<i>Pseudofuscophialis</i>	<i>P. lignicola</i> Sivan. & H.S. Chang	China	IMI 356633	Cai and Hyde (2007)
<i>Pyramidospora</i>	<i>P. quadricellularis</i> Oliveira et al.	Brazil	URM 87706	Oliveira et al. (2015b)
<i>Sirothecium</i>	<i>S. triseriale</i> Hu et al.	China	YMF 6.00017	Hu et al. (2007)
<i>Tricellula</i>	<i>T. aquatica</i> J. Webster	UK	K(M) 235168	Webster (1959)
<i>Triscelophorus</i>	<i>T. acuminatus</i> Nawawi	Malaysia	IMI 184587	Nawawi (1975)
	<i>T. magnificus</i> R.H. Petersen	USA	NY	Petersen (1962)
	<i>T. monosporus</i> Ingold	UK	Not indicate	Ingold (1943)
<i>Vanakripa</i>	<i>V. fasciata</i> Castañeda et al.	Cuba	MUCL 45276	Castañeda-Ruiz et al. (2005)
	<i>V. menglensis</i> Hu et al.	China	IFRDC 8882	Hu et al. (2010)
<i>Yinmingella</i>	<i>Y. mitriformis</i> Goh et al.	China	HKU (M) 8042	Goh et al. (1998c)
<i>Ypsilina</i>	<i>Y. graminea</i> (Ingold et al.) Descals et al.	UK	IMI 123908	Ingold et al. (1968)
<i>Zelotetraploa</i>	<i>Z. aquatica</i> Monteiro et al.	Brazil	HUEFS 216680	Monteiro et al. (2017b)

Chaetosphaeriaceae, Helminthosphaeriaceae, Leptosporellaceae and Linocarpaceae (Huhndorf et al. 2004; Maharachchikumbura et al. 2016; Konta et al. 2017). There are several studies have been reported many freshwater species in Chaetosphaeriaceae in the past 3 years (Liu et al. 2016; Lu et al. 2016; Luo et al. 2016; Yang et al. 2016b; Wei et al. 2018). In this study, we provide the phylogenetic tree for Chaetosphaeriales based on combined ITS and LSU sequence data (Fig. 51).

Morphological characters of the sexual morph of *Chaetosphaeria* are similar and hardly distinguishable, while the asexual morph characters are considered as distinctive characters to identify the species of *Chaetosphaeria* (Gams and Holubova-Jechova 1976; Huhndorf et al. 2004). The asexual morph of *Chaetosphaeria* is hyphomycetous with macronematous, mononematous conidiophores, monophialidic or polyphialidic, hyaline,

conidiogenous cells with a distinct funnel-shaped collarette and hyaline to brown, aseptate to multi-septate, guttulate or eguttulate conidia, with or without appendages (Maharachchikumbura et al. 2016). Three newly obtained isolates are morphologically identical to *Catenularia*. However, phylogenetic analysis showed that they cluster with *Chaetosphaeria* species with good support value (Fig. 51). Previous studies have reported that some *Chaetosphaeria* species with *Catenularia* asexual morph, such as *Ch. cubensis*, *Ch. cupulifera* and *Ch. novaezelandiae* (Holubova-Jechova 1982; Réblová 2004). We therefore accommodate our isolates in the genus *Chaetosphaeria*. *Catenularia* appears to be a synonym of *Chaetosphaeria* and further studies on these groups are needed to resolve the placement of these two genera.

In our phylogenetic analysis, species of *Chaetosphaeria* forms seven distinct clades within Chaetosphaeriaceae

(Fig. 51). Further study incorporating herbarium loaning, sampling and DNA sequencing are needed to resolve the species placement of this genus.

Coniochaetales

Shearer and Raja (2018) listed eight freshwater *Coniochaeta* species belonging to this order with *C. gigantospora* and *C. renispora* originally described from freshwater habitats (Crane and Shearer 1995; Raja et al. 2012). However, among these eight species, *Coniochaeta kellermanii* is an invalid name (Index Fungorum 2018) and another record is named as *Coniochaeta* sp. 4022 (Shearer and Raja 2018), we therefore only accepted six freshwater *Coniochaeta* species.

Cordanales

The order Cordanales was introduced by Hernández-Restrepo et al. (2015b) to accommodate the family Cordanaceae with a single genus *Cordana* Preuss. Previous studies described two freshwater *Cordana* species, viz. *Cordana abramovii* and *C. uniseptata*, which were collected from submerged wood in Perú and China respectively (Cai et al. 2004a; Zelski et al. 2014). In this study, we introduce two new species *C. aquatica* and *C. lignicola*, and provide descriptions, illustrations and DNA sequence data for *C. abramovii* and *C. terrestris*. Four *Cordana* species have been reported from freshwater habitats.

Sordariales

In this study, we list 26 species of Sordariales that have been reported from freshwater habitats based on the available literature. In our phylogenetic analysis, species of Chaetomiaceae and Sordariaceae form monophyletic lineages respectively with good support (Fig. 1, clade 29). However, further study is needed to resolve the species placement of genera in Lasiosphaeriaceae.

Savoryellomycetidae

Fuscosporellales

Fuscosporellales is a recently established order with most of its members from freshwater environment (Yang et al. 2016a, 2017). Fuscosporellales is characterized by astromatic, immersed to semi-immersed ascomata, fragile, several layered peridium, cylindrical to cylindrical-fusiform asci, fusiform, uniseriate, transversely septate ascospores and sporodochial conidiomata, micronematous or macronematous conidiophores usually reduced to conidigenous cells, obovate to obpyriform conidia (Yang et al.

2016a). Thirteen strains including eleven freshwater strains of Fuscosporellales represent a monophyletic group and sister to Conioscyphales, Pleurotheciales and Savoryellales within the Savoryellomycetidae (Fig. 1, clade 46).

Pleurotheciales

Twenty-four species in five genera of freshwater fungi have been reported for the Pleurotheciales, mostly were known as new species growing on submerged wood (Réblová et al. 2016a; Hyde et al. 2018; Luo et al. 2018b). In our phylogenetic analysis, 34 freshwater strains cluster in Pleurotheciales with well support (99% ML). In the phylogenetic analysis of Xia et al. (2017), *Rhexoacrodictys* species clustered in Savoryellaceae with strong support values (100% ML, 0.99 PP), and *Rhexoacrodictys* was assigned to Savoryellaceae. However, they did not include species of Conioscyphales, Fuscosporellales and Pleurotheciales in their study. Species of Conioscyphales, Fuscosporellales, Pleurotheciales and Savoryellales are included herein and results show that *Rhexoacrodictys* species cluster in Pleurotheciellaceae (Fig. 1, clade 43). Therefore we accommodate *Rhexoacrodictys* as a genus of Pleurotheciellaceae.

Savoryellales

Boonyuen et al. (2011) established the order Savoryellales based on morphology and combined LSU, SSU and RPB2 DNA sequence data. Freshwater species in this order are accommodated in *Ascotaiwania*, *Canalisporium* and *Savoryella*. In this study, we introduce a new genus *Dematiosporium* to accommodate an asexual fungus collected from freshwater habitats. 26 freshwater species have been reported in the order Savoryellales.

Xylariomycetidae

Xylariales

The classification of Xylariomycetidae is rather controversial. Senanayake et al. (2015) re-validated the order Amphispheeriales based on both sequence data and morphology. However, Maharachchikumbura et al. (2016) showed that there was little support to validate the order Amphispheeriales and the placement of the families within the subclass Xylariomycetidae were not stable. However, Hongsanan et al. (2017) provided evidence to maintain the Amphispheeriales and Xylariales as distinct orders in Xylariomycetidae based on molecular clock evidence, but still with weak support. In our phylogenetic analysis, the placement of families within Xylariomycetidae was also not stable (Fig. 1). We therefore follow

Maharachchikumbura et al. (2016) to keep the order Xylariales to represent the taxa in the Xylariomycetidae until further data are available to support to validate the order Amphisphaerales.

We introduce five new freshwater species in Xylariales based on morphology and DNA sequence data. Eleven species of freshwater fungi are accepted in the order Xylariales.

The use of DNA sequence data coupled with phylogenetic analyses has significantly improved our understanding on the phylogeny and evolution of freshwater ascomycetes (Vijajkrishna et al. 2006). Most of the new genera and species of freshwater fungi published in the past ten years are provided with molecular data, for example: *Aquapteridospora*, *Baipadisphaeria*, *Conlarium*, *Distoseptispora* and *Mucispora* (Pinruan et al. 2010; Liu et al. 2012; Yang et al. 2015, 2017, 2018a; Su et al. 2016; Luo et al. 2018a). However, there are still some new genera and species of freshwater fungi published without molecular data, such as *Arthrotaeniolella*, *Dictyoaquaphila*, *Linkosia* and *Zelotetraploa* (Conceição et al. 2016; Monteiro et al. 2016c, 2017a, b). The placement of many freshwater Sordariomycetes are currently uncertain and suffers from lack of living cultures and type sequences. Therefore, to obtain a better understanding of phylogeny in freshwater Sordariomycetes in a natural classification system, further investigations are needed. Future studies should put high priority to obtain living cultures. We also provide a checklist of the freshwater species which are currently assigned to Ascomycota genera *incertae sedis* (Table 1). Further studies incorporating herbarium materials, more sampling and DNA sequencing are needed to resolve the placement of these genera.

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