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臺灣紅樹林海洋真菌誌

MARINE MANGROVE FUNGI OF TAIWAN

KA-LAI PANG, JEN-SHENG JHENG, E.B. GARETH JONES

國立臺灣海洋大學

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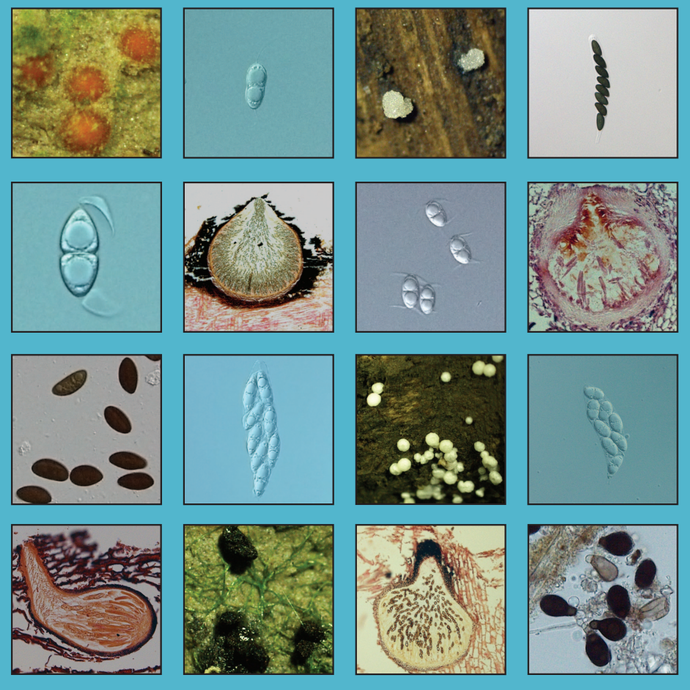

臺灣紅樹林海洋真菌誌
Marine Mangrove Fungi of Taiwan

Ka-Lai Pang
Institute of Marine Biology, National Taiwan Ocean University,
2 Pei-Ning Road, Chilung 20224, Taiwan (R.O.C.)

Jen-Sheng Jheng
Institute of Marine Biology, National Taiwan Ocean University,
2 Pei-Ning Road, Chilung 20224, Taiwan (R.O.C.)

E. B. Gareth Jones
Bioresources Technology Unit, National Center for Genetic Engineering and Biotechnology (BIOTEC), 113 Thailand Science Park, Phaholyothin Road, Khlong 1,
Khlong Luang, Pathumthani 12120, Thailand

國立臺灣海洋大學
National Taiwan Ocean University
Chilung

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Summary

Information on the diversity of marine fungi in Taiwan is lacking. Hsieh et al. (2002) previously documented 59 marine fungi, discovered from both mangrove environments and rocky shores around Taiwan. Up till now, a total of 69 species (in 52 genera) of marine fungi has been recorded from mangrove environments in Taiwan, including one new genus and species and 34 new records. In this monograph, 54 of the 69 species of marine mangrove fungi are illustrated, with added information on the peridial wall layers based on microtome sections. A key is provided for identification of the marine mangrove fungi of Taiwan.

本書摘要

針對臺灣海洋真菌多樣性之研究文獻上是較匱乏的。謝松源博士已於2002年的研究中記載了59種生長於紅樹林和海洋岩岸環境中的海洋真菌。但到目前為止，共有69種紅樹林海洋真菌被記錄，其中包含了一個新的屬種和34個新紀錄種。在本書中將介紹其中54種紅樹林海洋真菌生殖結構之形態，及其孢子器外膜的組織切片圖。此外本書附有一生物檢索表，可用作鑑定在臺灣紅樹林發現的海洋真菌種。

Preface

Taiwan is a treasure island. It locates in tropical and subtropical region, surrounded by sandy or rocky seashore, with drastic change of land topology, also isolated from nearby continents or islands, putting these factors together, eventually evolved with its own unique, precious and resourceful animal, plant and microbial diversity. To Taiwan, particularly marine fungi are crucial microbial resource, merit to explore thoroughly. Nevertheless, study of these fungi on mangrove or intimate riches are sketchy, though not until 2002, a monograph by Hsieh et al. got published. Fortunately, a more extensive and intensive study of this field continued rather more recently by Drs Pang, Jheng and Gareth Jones. Their devotions eventually come up with the currently scheduled to be published monograph "Marine Mangrove Fungi of Taiwan (臺灣紅樹林海洋真菌誌)". In this monograph, 54 out of 69 species of mangrove fungi, including one new genus and new species, and 34 new records were illustrated with a dichotomous key to all the described taxa. The contents of this monograph are magnificent, which not only precisely and picturesquely illustrated all the taxa, but also provided resourceful and valuable references and comments, including each taxon's current study status, habitat, substrate preference, distribution, prevalence, identification traits and phylogenic relatedness, etc. Without double the great contribution by this monograph will greatly enrich the biodiversity of Mycobiota Taiwanica. Indeed, rather than a great honor and pleasure for me to write a few words on the occasion of its publicity, and also being able to recommend this valuable monograph to all the readers and relevant researchers.

Prof. Shean-Shong Tzean (曾顯雄教授)
Department of Plant Pathology and Microbiology
National Taiwan University

Contents

Mangrove Sites in Taiwan

Taiwan has around 22 mangrove areas and some of these areas are made up of a fringe of mangrove trees along a river (Hsueh & Lee 2000). Tanshui is the largest mangrove stand in Taiwan and has a total area of 286.95 ha while in Chichin, only 12 trees of *Avicennia marina* and 2 trees of *Lumnitzera racemosa* are present (Hsueh & Lee 2000). The location of these mangrove areas is shown in Figure 1.

Tomlinson (1986) listed 114 species of true mangrove trees and mangrove associates. In Taiwan, only 4 true mangrove species are still thriving, including *Avicennia marina* (Figure 2a), *Kandelia obovata* (Figure 2b), *Lumnitzera racemosa* (Figure 2c) and *Rhizophora stylosa* (Figure 2d). *Kandelia obovata* is dominant in mangroves of northern Taiwan while the main mangrove tree in the south is *A. marina*. Disappearance of *Bruguiera gymnorrhiza* and *Ceriops tagal* was associated with the development of the Kaohsiung harbor in the 1950s (Hu 1959, Chen 1991).

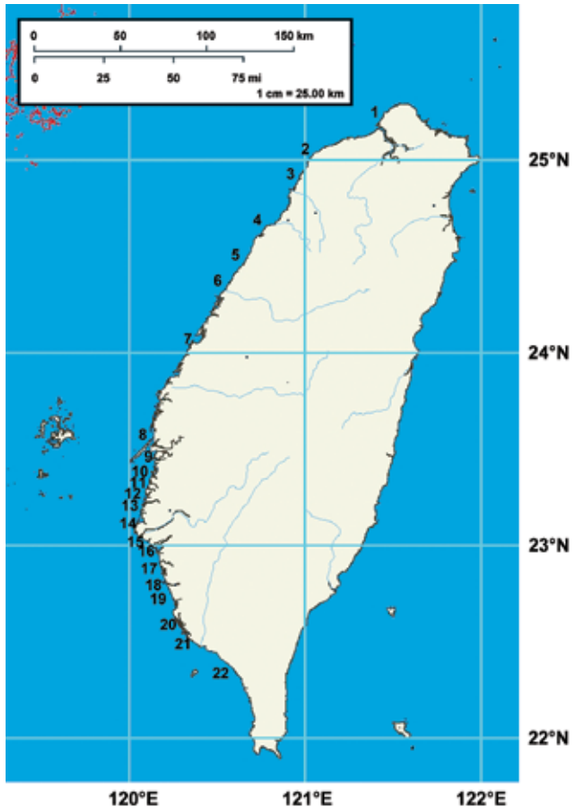
Marine Fungi

Marine fungi are an ecological group of microorganisms. An obligate marine fungus grows and sporulates exclusively in a marine or marine-related habitat, i.e. rocky shores, sandy beaches, salt marshes, mangroves, etc. (Kohlmeyer & Kohlmeyer 1979). Traditionally, marine fungi were commonly classified as 'higher' filamentous fungi (Ascomycota, Basidiomycota and mitosporic fungi) and 'lower' zoosporic fungi (thraustochytrids and halophytophthoras). Recently, Honda et al. (1999) have confirmed the phylogenetic position of thraustochytrids in the Kingdom Protista. Halophytophthoras are also shown to be related to other protists (Göker et al. 2007).

Marine fungi are an important group of organisms in marine ecosystems as they represent a diverse range of saprobes, pathogens and symbionts that form an integral part of coastal systems (Hyde et al. 1998). Marine fungi are mostly saprobes growing on various cellulosic materials including woody tissues, leaves, fruits, seagrasses, algae and seaweeds (Vrijmoed 2000). Some marine fungi are also reported on animal exoskeletons, keratinaceous substrates, sediments, sea foam and seawater (Vrijmoed 2000).

Research on Diversity of Marine Fungi

Before the 1990's, most research on marine fungi was mainly from Europe (Italy: Grasso et al. 1990, Ireland: Curran & Crumlish 1995, Iceland: Cavaliere 1968, UK: Byrne & Jones 1974, Denmark: Koch & Petersen 1996, France: Jones & Campion-Alsumard 1970, Germany: Schmidt 1985) and north America (Kirk & Brandt 1980, Kohlmeyer 1980, Booth 1981, Miller & Whitney 1981, Jones et al. 1998). In the last two decades, many ecological and taxonomical studies on marine fungi in Asia have been carried out including Brunei (Hyde 1988), China/Hong Kong/Macau (Vrijmoed et al. 1994, Jones & Vrijmoed 2003), India (Ananda et al. 1998, Prasannarai et al. 1999, Sarma & Vittal 2001, Maria & Sridhar 2004, Raveendran & Manimohan 2007), Indonesia (Hyde 1989), Japan (Nakagiri 1993), Malaysia (Jones 2007), Mauritius (Poonyth et al. 1999, 2001), Philippines (Jones et al. 1988), Seychelles (Hyde & Jones 1989), Singapore (Tan & Leong 1990, Leong et al. 1991) and Thailand (Sakayaroj et al. 2004). Information on the diversity of marine fungi can also be found in various studies elsewhere: Africa (South Africa: Steinke & Jones 1993, Egypt: El-Sharouny et al. 1998), Australasia (Australia:



Location no.	Mangrove area(s)	County	Mangrove tree species
1	Tanshui	Taipei	*Kandelia obovata*
2	Hsinwu	Taoyuan	*Kandelia obovata*
3	Hungmao, Keya, Haishanku	Hsinchu	*Avicennia marina, Kandelia obovata*
4	Chungkang	Miaoli	*Kandelia obovata*
5	Tunghsin	Miaoli	*Kandelia obovata*
6	Wenliao	Taichung	*Kandelia obovata*
7	Fangwan	Changhua	*Avicennia marina, Kandelia obovata*
8	Aoku	Chiayi	*Avicennia marina, Kandelia obovata*
9	Putzu	Chiayi	*Avicennia marina, Kandelia obovata*
10	Putai, Haomeiliao	Chiayi	*Avicennia marina, Kandelia obovata, Rhizophora stylosa*
11	Pachang	Tainan	*Avicennia marina, Kandelia obovata*
12	Chishui, Peimeng	Tainan	*Avicennia marina*
13	Chiangchun	Tainan	*Avicennia marina, Kandelia obovata*
14	Taliao, Chiku, Tsengwen, Nanhailiao	Tainan	*Avicennia marina, Lumnitzera racemosa*
15	Yenshui, Ssutsao	Tainan	*Avicennia marina, Lumnitzera racemosa, Rhizophora stylosa*
16	Anping	Tainan	*Avicennia marina, Lumnitzera racemosa, Rhizophora stylosa*
17	Chiehting	Kaohsiung	*Avicennia marina*
18	Akungtien	Kaohsiung	*Avicennia marina, Lumnitzera racemosa*
19	Tienbao	Kaohsiung	*Avicennia marina, Kandelia obovata, Rhizophora stylosa*
20	Houching	Kaohsiung	*Avicennia marina*
21	Chichin	Kaohsiung	*Avicennia marina, Lumnitzera racemosa*
22	Tapengwan	Pingtung	*Avicennia marina*

Figure 1. Location of mangrove areas of Taiwan.

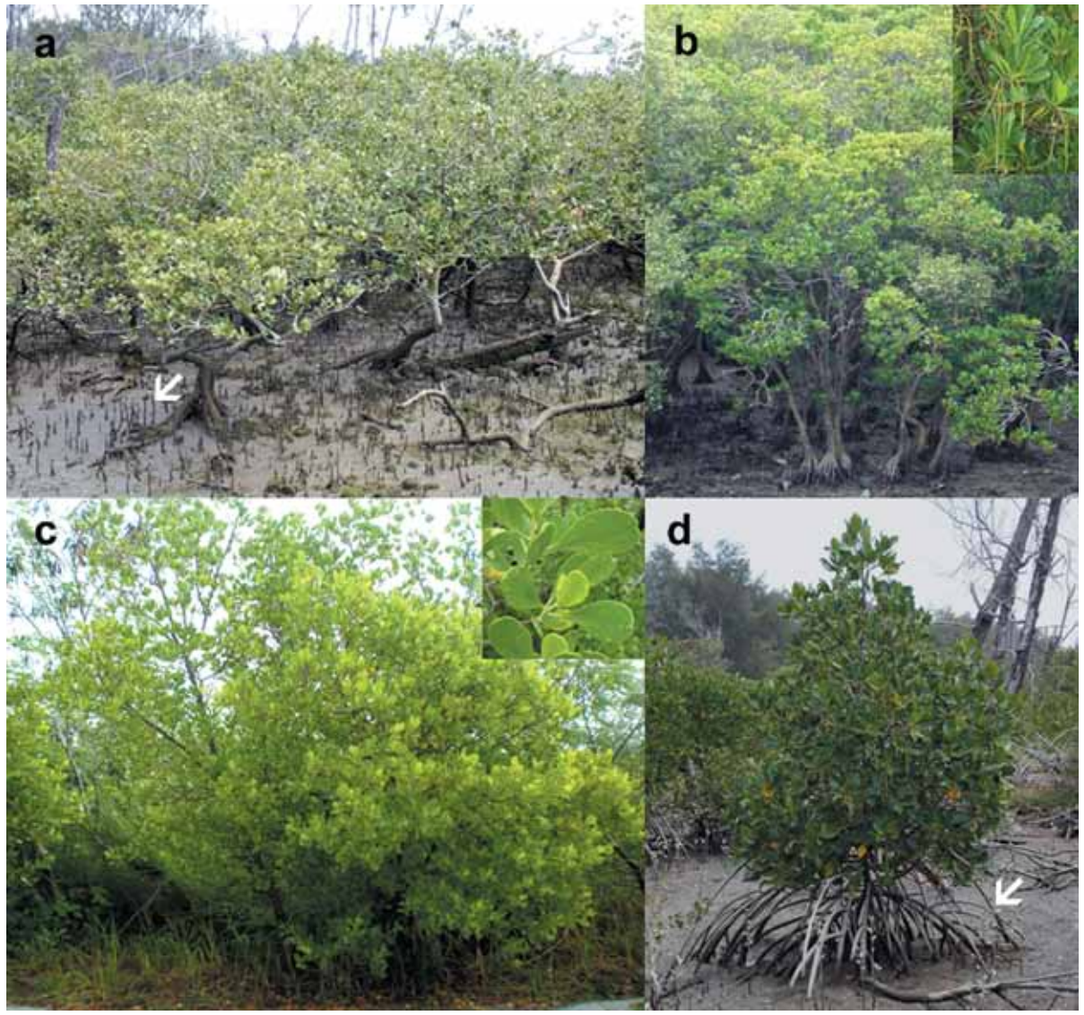


Figure 2. (a) *Avicennia marina*, with pneumatophores (arrow). (b) *Kandelia obovata* with droppers (small photo). (c) *Lumnitzera racemosa* with leaves invaginated at the tip (small photo). (d) *Rhizophora stylosa* with prop roots (arrow).

Hyde 1991, New Zealand: Lintott & Lintott 1982) and South America (Argentina: Peña & Arambarri 1997, Brazil: Booth 1983, Belize: Kohlmeyer & Volkmann-Kohlmeyer 1987b, Chile: Shearer & Burgos 1987, Easter Island: Kohlmeyer 1981, Galapagos: Kohlmeyer & Volkmann-Kohlmeyer 1987a, Mexico: Hyde 1992b). The most recent figure on the number of marine fungi is 530 (in 321 genera): Ascomycota 424 species (in 251 genera), anamorphic fungi 94 species (in 61 genera) and Basidiomycota 12 species (in 9 genera) (Jones et al. 2009).

Dversity of Marine Fungi in Taiwan

Little information is available on the diversity and distribution of marine fungi in Taiwan. Hsieh et al. (2002) documented 59 species of marine filamentous fungi with 33 species from mangrove environments. Fragmented information is available for the zoosporic group, *Halophytophthora*, which also inhabits mangrove environment. *Halophytophthora epistomium* was firstly reported from Tunghsin, Aoku and Tanshui (Ho et al. 1990). *Halophytophthora kandeliae* and *H. elongata* were later described from Tungshiao and Ssutsao, respectively (Ho et al. 1991, Ho et al. 2003).

Since the monograph by Hsieh et al. (2002) and the study by Ju & Rogers (2002), 34 new records of marine mangrove fungi have been made after one and a half years of intense collecting from various mangrove sites in Taiwan (Pang 2009), contributing a total of 69 species (in 52 genera).

In terms of number of species identified, 39 species of marine fungi were observed in Hungmao, 35 in Chungkang and 29 in Chiehting. The lowest number of species was recorded in Tsengwen (14), Wenliao (10) and Haishanku (6). Colonization frequency (total number of fungal occurrence/ total number of wood examined) is the highest in Hungmao, where nearly two different species were discovered on the same piece of wood. The lowest was observed in Peimeng and Haishanku, where only one species of marine fungi per wood was found. Examined wood has been kept as herbarium material for future studies.

Marinosphaera mangrovei was the only species that was found in all sites. Other dominant species included *Lignincola laevis* and *Saagaromyces abonnis*. Some species were common while others were rare. For example, *Dactylospora mangrovei* was found only abundantly in Tanshui but not at other sites. *Falciformispora lignatilis*, a rare fungus, was found on wood collected at Putzu. At least two new fungi were discovered, both in Chungkang.

Collection of Materials

Driftwood (Figure 3a) and attached (Figure 3b) wood of mangrove trees were collected from various mangrove stands in Taiwan (Figure 1). Wood samples were placed in zip-lock plastic bags and transported to the laboratory at the National Taiwan Ocean University, Chilung, Taiwan (R.O.C.). Wood pieces were incubated in sealed plastic trays lined with moist tissue paper and observed periodically for sporulating structures.

Photography of Fungi

Ascomata/basidiomata/pycnidia - Morphology of ascomata/basidiomata/pycnidia immersed, erumpent or exposed on wood was observed under an Olympus SZ61 stereomicroscope (Tokyo, Japan) with photographs taken on an Olympus DP20 Microscope Camera (Tokyo, Japan). For sections of fruiting bodies, wood pieces (1×1×1 cm^3) with ascomata/basidiomata/pycnidia, were cut out from a larger piece of collected wood and fixed by immersion in FAA solution (5% formaldehyde and 5% glacial acetic acid in 50% ethanol) overnight at 4 ºC. The fixed samples were rinsed three times in 50% ethanol. The samples were then dehydrated in a graduated t-butanol/ethanol/water series (10/40/50, 20/50/30, 35/50/15, 55/45/0, 75/25/0, 100/0/0, 100/0/0, in percentage), and infiltrated gradually and embedded in paraffin (Paraplast, Leica). Paraffin sections (7-10 µm) were cut on a FRM-200P rotary microtome (Tokyo, Japan), floated on 42 ºC water-bath to relax compression and mounted on microscope slides. Dried sections were deparaffinized and rehydrated through a graded series of ethanol. The sections were then stained with 1% safranin O in 50% ethanol (10 sec) and 0.5% Orange G in 95% ethanol (30 sec). After washing and dehydration, each stained section was permanently mounted with a cover slip and Permount (Fisher, USA). Specimens were observed on an Olympus BX51 microscope (Tokyo, Japan) and light micrographs taken.

Spores - For ascomycetes/coelomycetes, ascomata/pycnidia were cut open with a razor under the stereomicroscope. Centrum material was taken out with a fine forceps/needle and mounted in a drop of sterile sea water on a slide. Morphology of asci and ascospores were observed on a compound microscope and photographed. For hyphomycetes, spore morphology on wood was first observed under the stereomicroscope and photographed. Spores were then taken from the surface of the wood with a needle, mounted on a slide, observed on the compound microscope and photographed. For *Halocyphina villosa* and *Physalacria maipoensis*, basidiospores were directly taken from the tip of the basidiomata with a forceps, mounted on a slide and photographed.

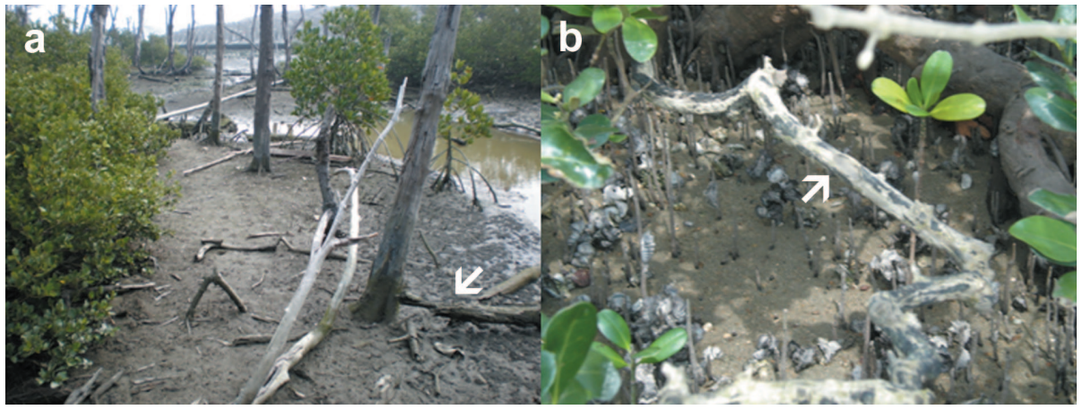


Figure 3. (a) Driftwood (arrow) on mangrove floor. (b) Attached wood (arrow) on a mangrove tree.

1a.	Sexual fruiting bodies (asci or basidia)	2
1b.	Asexual fruiting bodies (pycnidia) or naked spores on wood	3
2a.	Spores borne on basidia	4
2b.	Spores contained in asci	5
3a.	Spores exposed, borne directly from mycelia	59
3b.	Spores contained inside pycnidia	***Rhabdospora avicenniae***
4a.	Funnel-shaped basidiomata	***Halocyphina villosa***
4b.	Cap-like basidiomata	***Physalacria maipoensis***
5a.	Bitunicate asci	6
5b.	Unitunicate asci	17
6a.	Apothecial ascomata	7
6b.	Perithecial ascomata	9
7a.	Ascospores uniseptate	8
7b.	Ascospores multiseptate	***Patellaria atrata***
8a.	Ascospores smooth-walled	***Dactylospora mangrovei***
8b.	Ascospores striated	***Dactylospora haliotrepha***
9a.	Ascospores muriform	10
9b.	Ascospores with transverse septa	11
10a.	Ascospores with hyaline, pointed end cell	***Aigialus parvus***
10b.	Ascospores concolorous, with a well developed sheath	***Julella avicenniae***
11a.	Ascospores dark-colored	12
11b.	Ascospores hyaline	14
12a.	Ascospore wall ornamented	***Verruculina enalia***
12b.	Ascospore wall smooth	13
13a.	Ascospores 1-septate	***Kirschsteiniothelia maritima***
13b.	Ascospores 3-septate	***Leptosphaeria peruviana* c.f.**
14a.	Ascospores with multi-septa	15
14b.	Ascospores 1-septate	***Paraliomyces lentiferus***
15a.	Ascospores consistently 3-septate	16
15b.	Ascospores 6-8-septate	***Falciformispora lignatilis***
16a.	Ascospores with a sheath	***Morosphaeria velatospora***
16b.	Ascospores without a sheath	***Leptosphaeria australiensis***
17a.	Ascomata in a stroma or pseudostroma	18
17b.	Ascomata without a stroma or pseudostroma	22

18a.	Raised stroma/pseudostroma	19
18b.	Immersed stroma/pseudostroma	21
19a.	Ascomata superficial	20
19b.	Ascomata deeply embedded in wood	***Eutypella naqsii***
20a.	Ascospores with pointed ends	***Halorosellinia oceanica***
20b.	Ascospores with rounded ends	***Nemania maritima***
21a.	Asci with 8 spores	***Eutypa bathurstensis***
21b.	Asci with more than 8 spores	***Cryptovalsa mangrovei***
22a.	Ascomata carbonaceous	23
22b.	Ascomata coriaceous or membranous	24
23a.	Ascospores dark-colored	***Corollospora cinnamomea***
23b.	Ascospores hyaline	***Corollospora maritima***
24a.	Ascomata orange or pale brown	25
24b.	Ascomata hyaline or black	28
25a.	Asci with 8 spores	26
25b.	Asci with 16 spores	***Sedecimiella taiwanensis***
26a.	Asci clavate	27
26b.	Asci globose or subglobose	***Heleococcum japonense***
27a.	Ascospore wall smooth	***Kallichroma glabrum***
27b.	Ascospore wall striated	***Kallichroma tethys***
28a.	Hyphae-like paraphyses present	29
28b.	Paraphyses absent or with catenophyses	36
29a.	Ascospores with septum	30
29b.	Ascospores unicellular	***Phomatospora kandelae***
30a.	Ascospores with brown middle cells	31
30b.	Ascospores hyaline	33
31a.	Asci with 8 spores	32
31b.	Asci with 2 or 4 spores	***Savoryella paucispora***
32a.	Ascospores 33.5-46.5 ×7.5-12 µm	***Savoryella longispora***
32b.	Ascospores 24-36 × 8-12 µm	***Savoryella lignicola***
33a.	Ascospores with many septa	34
33b.	Ascospores 1-septate	35
34a.	Ascospores 26-33 × 6-8 µm, 7-9 septate	***Saccardoella mangrovei***
34b.	Ascospores 25-31 × 7.5-10 µm, 3 septate	***Saccardoella marinospora***
34c	Ascospores 19-26 × 6-8 µm, 4-6 septate	***Saccardoella rhizophorae***

35a.	Ascospores with setae-like appendages	***Etheirophora blepharospora***
35b.	Ascospores without appendages	***Swampomyces armeniacus***
36a.	Ascospores with appendages	37
36b.	Ascospores without appendages	55
37a.	Ascospores hyaline	38
37b.	Ascospores dark-coloured, with a sheath of parallel fibres	***Carbosphaerella leptosphaerioides***
38a.	Ascospores ellipsoidal	39
38b.	Ascospores filamentous filiform	***Lulworthia grandispora***
39a.	Ascospore appendages hamate, uncoiling in water	40
39b.	Ascospore appendages not uncoiling	49
40a.	Asci with apical structures (pore, ring, plug, plasmalemma retraction)	41
40b.	Asci with no apical structures or deliquescing	46
41a.	Ascospores relatively thick-walled	42
41b.	Ascospores relatively thin-walled	45
42a.	Ascospores with a unipolar appendage	43
42b.	Ascospores with bipolar appendages	44
43a.	Catenophyses present	***Tirispora unicaudata***
43b.	Catenophyses absent	***Tirispora mandoviana***
44a.	Ascospores 21-37 × 7-15 µm	***Aniptodera chesapeakensis s.l.***
44b.	Ascospores 35-55 × 12-17 µm	***Aniptodera lignatilis***
44c.	Ascospores 42-82 × 10-15 µm	***Aniptodera megalospora***
44d.	Ascospores 12-23 × 4-7 µm	***Aniptodera salsuginosa***
45a.	Ascospore appendages cap-like	***Halosarpheia marina***
45b.	Ascospore appendages hook-like, running along ascospore sides	***Saagaromyces abonnis***
46a.	Ascospores ellipsoidal	47
46b.	Ascospores cylindrical to fusiform	***Oceanitis cincinnatula***
47a.	Ascospore appendages cap-like	48
47b.	Ascospore appendages extending to the mid-septum	***Natantispora retorquens***
48a.	Ascospores 32-44 × 18-24 µm	***Halosarpheia fibrosa***
48b.	Ascospores 13-26 × 4-8 µm	***Panorbis viscosus***
49a.	Ascospore appendages unipolar	50
49b.	Ascospore appendages bipolar	51
50a.	Ascospores 1-septate	***Okeanomyces cucullata***
50b.	Ascospores 3-septate	***Torpedospora radiata***

51a.	Ascospore appendages 1 on each end	52
51b.	Ascospore appendages 2 or more on each end	53
52a.	Ascospores 22.5-26 × 8-10 µm	***Ceriosporopsis halima***
52b.	Ascospores 29-31.5 × 10.5-14.5 µm	***Ceriosporopsis cambrensis***
53a.	Ascospores consistently with 3 appendages at each end	54
53b.	Ascospores consistently with 2 appendages at each end	***Antennospora quadricornuta***
54a.	Ascospores fusiform or oblong	***Arenariomyces parvulus***
54b.	Ascospores ellipsoidal	***Haiyanga salina***
55a.	Ascospores with 1 septum	56
55b.	Ascospores unicellular	***Thalassogena sphaerica***
55c.	Ascospores 3-septate (non-septate when immature)	***Marinosphaera mangrovei***
56a.	Asci with apical structures (pore, ring, plug, plasmalemma retraction)	57
56b.	Asci with no apical apparatus	***Lignincola laevis***
57a.	Ascospores thin-walled	58
57b.	Ascospores thick-walled	***Aniptodera chesapeakensis s.s.***
58a.	Ascospores with many oil globules around the mid-band	***Saagaromyces glitra***
58b.	Ascospores without many intracellular oil globules	***Neptunella longirostris***
59a.	Conidia with transverse septa only	60
59b.	Conidia muriform	***Monodictys pelagica***
59c.	Conidia unicellular	***Periconia prolifica***
60a.	Conidia coiled into a ball (helicoid)	61
60b.	Conidia 1-3-septate, simple (not coiled)	62
61a.	Conidial cells less than 10 µm, up to 100 cells	***Halenospora varia***
61b.	Conidial cells over 10 µm, up to 40 cells	***Moromyces varius***
62a.	Conidia 10-38 × 8-18 µm	***Trichocladium alopallonellum***
62b.	Conidia 15-20 × 10-15 µm	***Trichocladium nypae***
62c.	Conidia 20-33.5 × 14.5-20.5 µm	***Bactrodesmium linderi***

List of Marine Mangrove Fungi Recorded in Taiwan

Basidiomycota **(2)**

Halocyphina villosa Kohlm. & E. Kohlm.
Physalacria maipoensis Inderb. & Desjardin

Ascomycota **(59)**

Aigialus parvus S. Schatz & Kohlm.
Aniptodera chesapeakensis Shearer & M.A. Mill.
Aniptodera lignatilis K.D. Hyde
Aniptodera megalospora K.D. Hyde, W.H. Ho & K.M. Tsui
Aniptodera salsuginosa Nakagiri & Tad. Ito
Antennospora quadricornuta (Cribb & J.W. Cribb) T.W. Johnson
Arenariomyces parvulus Jørg. Koch
Carbosphaerella leptosphaerioides I. Schmidt
Ceriosporopsis cambrensis I.M. Wilson
Ceriosporopsis halima Linder
Corollospora cinnamomea Jørg. Koch
Corollospora maritima Werderm.
Cryptovalsa mangrovei Abdel-Wahab & Inderb.
Dactylospora haliotrepha (Kohlm. & E. Kohlm.) Hafellner
Dactylospora mangrovei E.B.G. Jones, Alias, Abdel-Wahab & S.Y. Hsieh
Etheirophora blepharospora (Kohlm. & E. Kohlm.) Kohlm. & Volkm.-Kohlm.
Eutypa bathurstensis K.D. Hyde & Rappaz
Eutypella naqsii K.D. Hyde
Falciformispora lignatilis K.D. Hyde
Haiyanga salina (Meyers) K.L. Pang & E.B.G. Jones
Halorosellinia oceanica (S. Schatz) Whalley, E.B.G. Jones, K.D. Hyde & Læssøe
Halosarpheia fibrosa Kohlm. & E. Kohlm.
Halosarpheia kandeliae Abdel-Wahab & E.B.G. Jones
Halosarpheia marina (Cribb & J.W. Cribb) Kohlm.
Heleococcum japonense Tubaki
Julella avicenniae (Borse) K.D. Hyde
Kallichroma glabrum (Kohlm.) Kohlm. & Volkm.-Kohlm.
Kallichroma tethys (Kohlm. & Kohlm.) Kohlm. & Volkm.-Kohlm.
Kirschsteiniothelia maritima (Linder) D. Hawksw.
Leptosphaeria australiensis (Cribb & J.W. Cribb) G.C. Hughes
Leptosphaeria peruviana c.f. Speg.
Lignincola laevis Höhnk
Lulworthia grandispora Meyers
Marinosphaera mangrovei K.D. Hyde

Morosphaeria velatospora (K.D. Hyde & Borse) Suetrong, Sakayaroj, E.B.G. Jones & C.L. Schoch
Natantispora retorquens (Shearer & J.L. Crane) J. Campb., J.L. Anderson & Shearer
Nemania maritima Y.M. Ju & J.D. Rogers
Neptunella longirostris (Cribb & J.W. Cribb) K.L. Pang & E.B.G. Jones
Oceanitis cincinnatula (Shearer & J.L. Crane) J. Dupont & E.B.G. Jones
Okeanomyces cucullata (Kohlm.) K.L. Pang & E.B.G. Jones
Panorbis viscosus (I. Schmidt) J. Campb., J.L. Anderson & Shearer
Paraliomyces lentiferus Kohlm.
Patellaria atrata (Hedw.) Fr.
Phomatospora kandelae K.D. Hyde
Saagaromyces abonnis (Kohlm.) K.L. Pang & E.B.G. Jones
Saagaromyces glitra (J.L. Crane & Shearer) K.L. Pang & E.B.G. Jones
Saccardoella mangrovei K.D. Hyde
Saccardoella marinospora K.D. Hyde
Saccardoella rhizophorae K.D. Hyde
Savoryella lignicola E.B.G. Jones & R.A. Eaton
Savoryella longispora E.B.G. Jones & K.D. Hyde
Savoryella paucispora (Cribb & J.W. Cribb) J. Koch
Sedecimiella taiwanensis K.L. Pang, Alias & E.B.G. Jones
Swampomyces armeniacus Kohlm. & Volkm.-Kohlm.
Thalassogena sphaerica Kohlm. & Volkm.-Kohlm.
Tirispora mandoviana V.V. Sarma & K.D. Hyde
Tirispora unicaudata E.B.G. Jones & Vrijmoed
Torpedospora radiata Meyers
Verruculina enalia (Kohlm.) Kohlm. & Volkm.-Kohlm.

Anamorphic Fungi **(8)**

Bactrodesmium linderi (J.L. Crane & Shearer) M.E. Palm & E.L. Stewart
Halenospora varia (Anastasiou) E.B.G. Jones
Monodictys pelagica (T.W. Johnson) E.B.G. Jones
Moromyces varius (Chatmala & Somrith.) Abdel-Wahab, K.L. Pang, Nagahama, Abdel-Aziz & E.B.G. Jones
Periconia prolifica Anastasiou
Rhabdospora avicenniae Kohlm. & E. Kohlm.
Trichocladium alopallonellum (Meyers & R.T. Moore) Kohlm.
Trichocladium nypae K.D. Hyde & Goh

Total marine mangrove fungi in Taiwan **(69)**

New Taxa Described From Taiwan

New genus
Sedecimiella K.L. Pang, Alias & E.B.G. Jones

New species
Sedecimiella taiwanensis K.L. Pang, Alias & E.B.G. Jones

New Record For Taiwan

Basidiomycota
Halocyphina villosa Kohlm. & E. Kohlm.
Physalacria maipoensis Inderb. & Desjardin

Ascomycota
Aniptodera lignatilis K.D. Hyde
Aniptodera megalospora K.D. Hyde, W.H. Ho & K.M. Tsui
Aniptodera salsuginosa Nakagiri & Tad. Ito
Cryptovalsa mangrovei Abdel-Wahab & Inderb.
Dactylospora haliotrepha (Kohlm. & E. Kohlm.) Hafellner
Eutypa bathurstensis K.D. Hyde & Rappaz
Eutypella naqsii K.D. Hyde
Falciformispora lignatilis K.D. Hyde
Halosarpheia kandeliae Abdel-Wahab & E.B.G. Jones
Julella avicenniae (Borse) K.D. Hyde
Kallichroma glabrum (Kohlm.) Kohlm. & Volkm.-Kohlm.
Kallichroma tethys (Kohlm. & Kohlm.) Kohlm. & Volkm.-Kohlm.
Leptosphaeria peruviana c.f. Speg.
Nemania maritima Y.M. Ju & J.D. Rogers
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Periconia prolifica Anastasiou
Rhabdospora avicenniae Kohlm. & E. Kohlm

PHYLUM BASIDIOMYCOTA
SUBPHYLUM: AGARICOMYCOTINA
CLASS: AGARICOMYCETES
SUBCLASS: AGARICOMYCETIDAE
ORDER: AGARICALES
FAMILY: LACHNELLACEAE

Halocyphina Kohlm. & E. Kohlm., Nova Hedw. 9: 100 (1965)
Type species: *Halocyphina villosa* Kohlm. & E. Kohlm.

Halocyphina villosa Kohlm. & E. Kohlm., Nova Hedw. 9: 100 (1965)

Figure 4

Basidiomata 350-500 µm high, 310-440 µm diam. in the apex, 100-150 µm diam. in the stalk, cyphelloid, whitish or yellowish, turbinate or clavate, eventually funnel-shaped or cupulate, pedunculate, superficial in protected parts of the wood, soft, thin-walled, tomentose, solitary or gregarious. Peridium 25-40 µm thick, composed of closely packed hyaline, rarely branched hyphae with thin walls and rare clamp connections, (1.2-)3-4(-6) µm diam., external hairs up to 100 µm long, 4-5 µm diam. at the base, 1.5 µm at the apex, simple or dichotomously branched near the tip, hyaline. Basidia 13-22 × 5-9.5 µm, four-spored, clavate or cylindrical with a narrow base, non-septate, hyaline, with (two to) four evanescent sterigmata, about 3.5 µm long. Basidiospores 8-10.5 × (7-)8-9.5(-10.5) µm, subglobose, one-celled, smooth, hyaline, non-amyloid.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Belize, Bermuda, Brunei, Columbia, Egypt, Fiji, Ghana, Hong Kong, India, Indonesia, Liberia, Macau, Malaysia, Maldives, Mauritius, Nicobar Islands, Philippines, Republic of Trinidad and Tobago, Seychelles, Singapore, South Africa, Sri Lanka, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Chichi (Hualien County), Chungkang, Hsinwu, Hungmao, Tanshui.

COMMENTS: *Halocyphina villosa* is one of the core mangrove species, often colonizing the prop roots of *Rhizophora* species and commonly found in Taiwan. Hibbett & Binder (2001) assigned the species to the Agaricales (based on molecular data), rather than the Cyphellaceae as proposed by Jones & Agerer (1992) and Kirk et al. (2001). The species has been shown to cause white rot attack of wood (Mouzouras 1986) and growth is markedly inhibited by low temperatures (Panebianco 1994). Besitulo et al. (2010) indicated that a collection of *Halocyphina* from the Philippines may constitute a new species and future collections should be examined in greater detail.

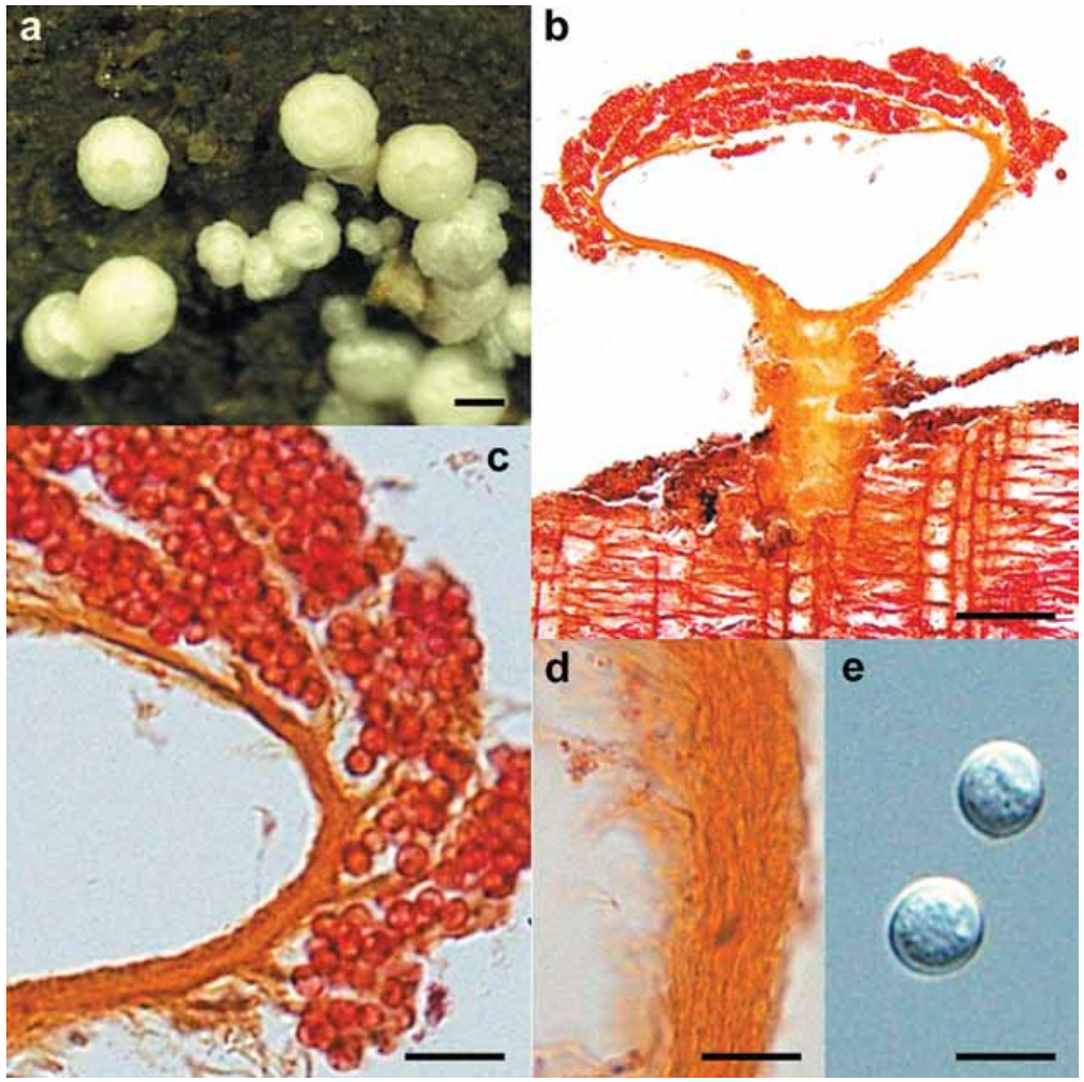

Figure 4. *Halocyphina villosa*. (a) Basidiomata on wood. (b-c) Basidia and basidiospores arranged in layers. (d) Wall of basidiome composed of cells of *textura angularis*. (e) Globose basidiospores. Scale bar: a=300 µm; b =100 µm; c = 30 µm; d, e=10 µm.

Family: Physalacriaceae

Physalacria Peck, Bull. Torrey bot. Club 9: 2 (1882)
Type species: *Physalacria inflata* (Schwein.) Peck

Physalacria maipoensis Inderb. & Desjardin, Mycologia 91: 666 (1999)

Figure 5

Basidiomata 0.5-2.5 mm high, stipitate-capitate, solitary. Capitulum 0.25-1.5 × 0.3-1.8 mm, globose to subglobose or rarely obtusely subconic, tapering slightly towards the stipe, pruinose, white at first, pale yellow when aged. Stipe 0.2-1.0 × 0.1-0.25 mm, central, cylindrical, sometimes twisted-fibrous, minutely pruinose, white overall. Subhymenial hyphae 3-4 µm diam., cylindrical, hyaline, non-amyloid, non-gelatinous, thin-walled. Lower portion of capitulum in larger mature basidiomata composed of a hymeniform layer of subglobose to broadly ventricose or sphaeropedunculate cells, 8-18 × 7-14.5 µm, scattered cells ventricose-rostrate, hyaline, thin-walled, non-amyloid, some basidiomata lacking sterile base. Stipe tissue monomitic, cortical hyphae 2.5-6.0 µm diam., parallel, cylindrical, hyaline, non-amyloid, non-gelatinous, non-incrusted, smooth, thin-walled, medullary hyphae 3-8(-10) µm diam. Stipitipellis of scattered but numerous caulocystidia and hyphal outgrowths, caulocystidia 11-36 × 4.5-8.5(-10) µm, fusoid to ventricose-rostrate, hyaline, thin-walled, stipe base with scattered, curled hyphal outgrowths 30-57 × 2-4 µm. Basidia 20-33 × 6.5-9.0 µm, clavate, (2-)4-spored, sterigmata 2.5-4.8 µm long. Basidioles fusoid. Hymenial gloeocystidia 32-62 × (7.2-)8-10 µm, narrowly ventricose-rostrate to fusoid-mucronate, hyaline, thin-walled, projecting 10-20 µm beyond basidia, rostrum 4.8-10 × 2.5-4.0 µm, subcylindrical, obtuse, often with a hyaline, resinous exudate adherent to the apex. Basidiospores (7.2-)8.0-10.5(-12) × (3.2-)4-5(-5.6) µm, elongate-ellipsoid to subcylindrical, smooth, hyaline, non-amyloid, thin-walled.

SUBSTRATA: dead mangrove wood, senescent stems of *Acanthus ilicifolius*.

WORLDWIDE DISTRIBUTION: Hong Kong, Malaysia, Taiwan.

DISTRIBUTION IN TAIWAN: Hsinwu, Hungmao, Tanshui.

COMMENTS: The basidiomes from Malaysia (E.B.G. Jones, unpublished data) are very variable in morphology, ranging from capitiate, globose to triangular. Some 44 terrestrial *Physalacria* species have been described, and *Ph. maipoensis* is the only marine species. Phylogenetically, *Ph. maipoensis* groups with *Henningsomyces candidus* in the euagarics with *Schizophyllum commune* in a sister clade (Binder et al. 2001). It is a tropical species known from only three locations (Inderbitzin & Desjardin 1999, E.B.G. Jones, unpublished results).

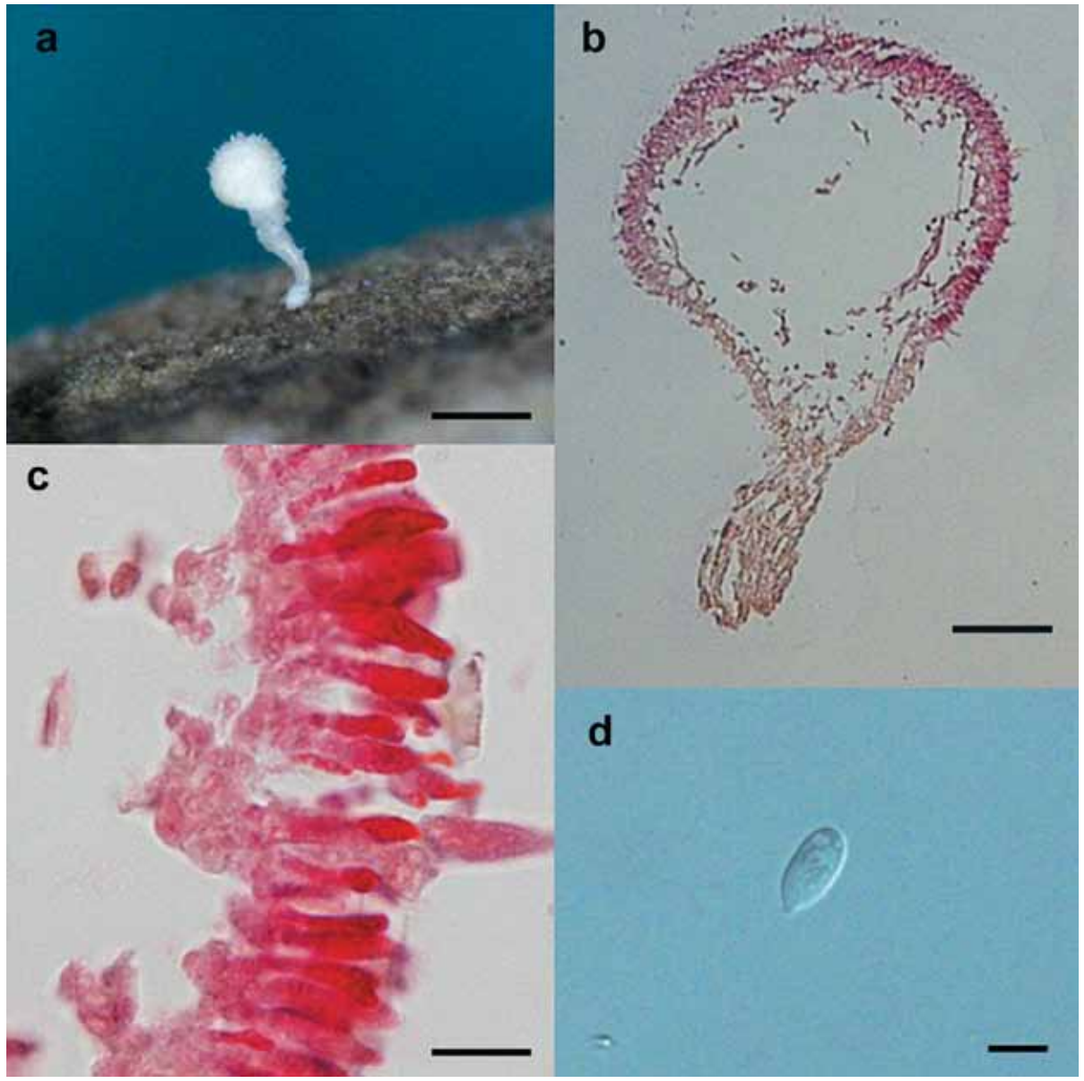

Figure 5. *Physalacria maipoensis*. (a) Basidioma on wood with a long stipe. (b) Section of hymenial layer. (c) Higher magnification of hymenial layer showing basidia. (d) Elongate-ellipsoid basidiospore. Scale bar: a=300 µm; b=100 µm; c=10 µm; d=5 µm.

PHYLUM ASCOMYCOTA
SUBPHYLUM: PEZIZOMYCOTINA
CLASS: DOTHIDEOMYCETES
SUBCLASS: PLEOSPOROMYCETIDAE
ORDER: PLEOSPORALES
FAMILY: AIGIALACEAE

Aigialus Kohlm. & S. Schatz, Trans. Br. Mycol. Soc. 85: 699 (1986)
Type species: *Aigialus grandis* Kohlm. & Schatz

Aigialus parvus S. Schatz & Kohlm., Trans. Br. Mycol. Soc. 85: 704 (1986) [1985]

Figure 6

Ascomata 788-1257 µm high, 954-1333µm wide, 305-405µm thick, subglobose in frontal view, fusiform in sagittal section, laterally compressed, immersed in a black stroma, with a longitudinal furrow at the top, ostiolate, carbonaceous to coriaceous, black, gregarious. 50-70 µm diam., depressed or slightly projecting, circular, ostiolar canal subglobose, filled with branched or forked septate periphyses, 3-4 µm thick. Peridium two-layered, outer layer 40-90 µm thick and clypeoid near the ostiole, 15-45 µm at the sides, composed of elongate, more or less irregular cells, encrusted with melanin particles, interspersed with cells of the host, inner layer 7-15 µm thick, composed of smaller, hyaline cells that merge with pseudoparaphyses, the peridium extends at the base into the locule with brown strands composed of pseudoparaphyses that separate above, become hyaline and are surrounded by a gelatinous matrix. Pseudoparaphyses 1.5-2 µm diam., trabeculate, unbranched at the base becoming branched and anastomosing above the asci, embedded in a gelatinous matrix. Asci 300-420 × 30-35 µm, eight-spored, cylindrical, pedunculate, thick-walled, fissitunicate, with a refractive apical plate in the ectoascus and a refractive apical ring in the endoascus, not bluing in IKI, ring 10-14.3 µm diam., 3.9-5.8 µm high, 3.1-3.0 µm thick. Ascospores (43.7-)49.4-71.3(-74.4) µm long, 19.4-25.9(-27.2) µm wide, (14.7)-16.2-20.9(-22.1) µm thick, biseriate, ellipsoidal to broadly fusiform, muriform, with (9-)10-11(-12) trans-septa and 1-3 longi-septa, yellow-brown except for hyaline to light brown apical cells, glabrous, with a gelatinous cap around apical and subapical cells.

SUBSTRATA: dead mangrove wood, dead mangrove leaves.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Brunei, Egypt, India, Indonesia, Malaysia, Maldives, Nicobar Islands, Philippines, Seychelles, Singapore, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Aoku, Haomeiliao.

COMMENTS: Currently, five species are accepted in the genus (Jones et al. 2009). The genus was initially assigned to the Melanommatales (Kohlmeyer & Schatz 1985). Subsequently, Barr (1979) suggested its affinity to the families Didymosphaeriaceae, Fenestellaceae, Microglaenaceae and Trypetheliaceae, but these were rejected. Hawksworth et al. (1995) referred the genus to the Massariaceae (Pyrenulales) while Tam et al. (2003), based on sequence data, showed it belonged in the Pleosporales. Suetrong et al. (2009) introduced a new family, the Aigialaceae (Pleosporales), to accommodate the marine genera *Aigialus*, *Ascocratera* and *Rimora*, based on sequence data. It is a widely collected species on diverse wood of mangrove trees, prop roots of *Rhizophora apiculata* and roots and pneumatophores of *Avicennia* sp. It is often an early coloniser of submerged mangrove wood in Mandai mangrove, Singapore (Tan et al. 1989, Leong et al. 1991), and Morib mangrove, Malaysia (Alias & Jones 2000). This fungus was only collected in Haomeiliao on wood of *Casuarina* sp.

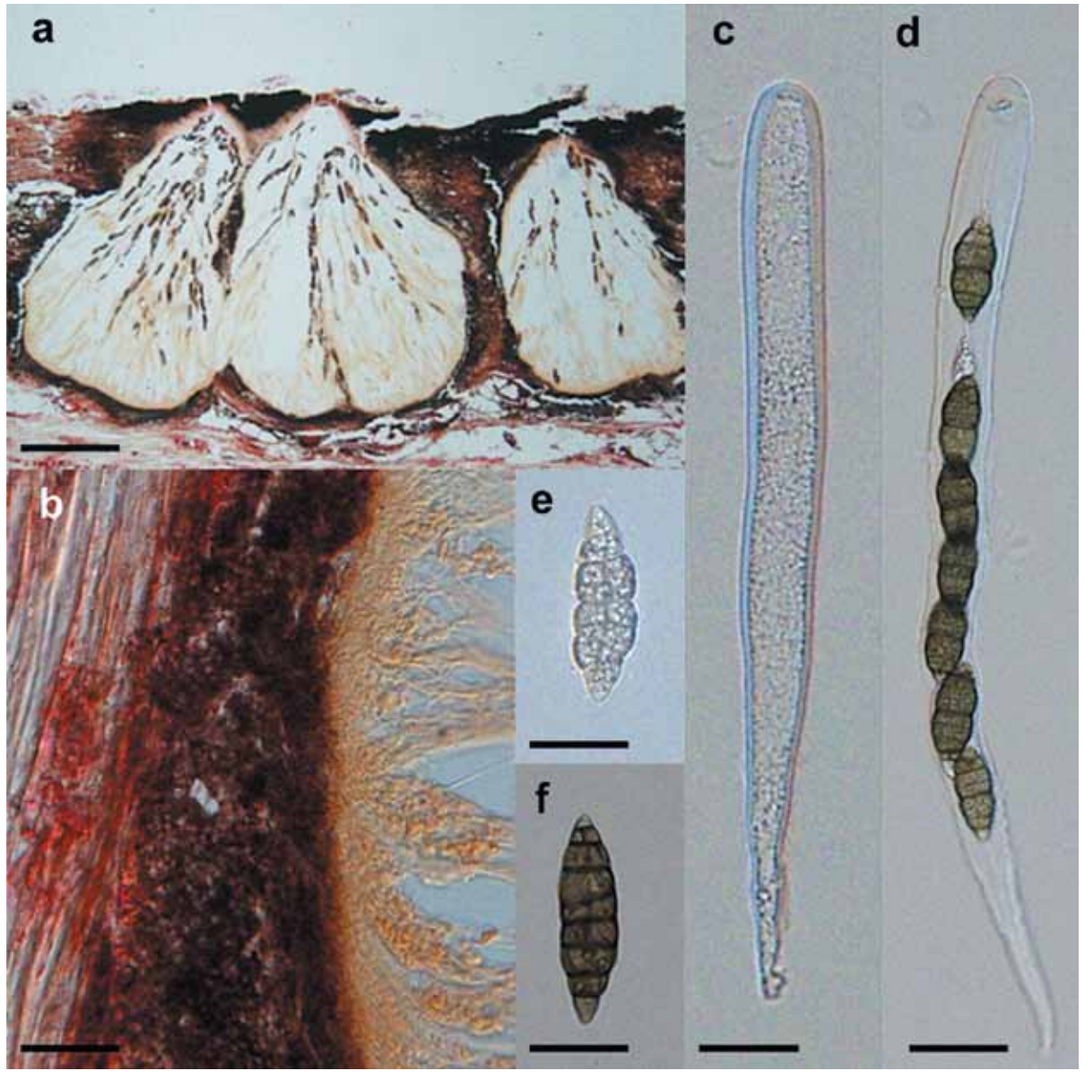

Figure 6. *Aigialus parvus.* (a) Section of a group of ascomata immersed in wood. (b) Peridium. (c-d) Immature and mature bitunicate asci. (e-f) Immature and mature ascospores. Scale bar: a=300 µm; b, e, f=30 µm; c, d=50 µm.

Family: Leptosphaeriaceae

Leptosphaeria Ces. & De Not., Comm. Soc. crittog. Ital. 1: 234 (1863)
Type species: ***Leptosphaeria doliolum*** (Pers.) Ces. & De Not.

Leptosphaeria australiensis (Cribb & J.W. Cribb) G.C. Hughes, Syesis 2: 132 (1969)
≡ *Metasphaeria australiensis* Cribb & J.W. Cribb, 3: 79 (1955)

Figure 7

Ascomata 100-200 µm high, 120-195 µm diam., obpyriform, immersed, ostiolate, papillate, coriaceous, fuscous or light brown, lighter colored at the base, solitary or gregarious. Necks 70-225 µm long, 30-50 µm diam. at the tip, 70-75 µm at the base, conical or subcylindrical, fuscous or almost hyaline, ostioles line with periphyses, 1.5-2.2 µm diam. Peridium 10-25 µm thick, two layer, outer layer composed of small, irregularly rounded, thick-walled, pigmented cells, forming a *textura angularis*, inner layer composed of thin-walled, light-colored, elongate cells. Pseudoparaphyses 1-2.2 µm diam., septate, somewhat branched, with gelatinous walls, persistent. Asci 70-105 × 10-15 µm, eight-spored, clavate-fusiform, pedunculate, indistinctly bitunicate, thick-walled when young, later relatively thin-walled, with apical apparatus, developing at the base of the ascoma venter. Ascospores 19-27 × 5.5-9 µm, biseriate, ellipsoidal, fusiform or clavate-fusiform, three-septate, constricted at the septa, hyaline.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Aldabra, Andaman Islands, Australia, Bahamas, Belize, Bermuda, Brazil, Brunei, Columbia, Fiji, Galapagos, Hong Kong, India, Indonesia, Liberia, Malaysia, Maldives, Martinique, Mauritius, Mexico, Nicobar Islands, Philippines, Republic of Trinidad and Tobago, Seychelles, Sierra Leone, Society Islands, South Africa, Taiwan, Thailand, USA, Venezuela.

DISTRIBUTION IN TAIWAN: Chungkang, Haomeiliao, Hungmao, National Taiwan Ocean University (Chilung City), Peikuan (Ilan County), Tunghsin, Tungpeichiao (Taipei County).

COMMENTS: This is another core mangrove species (Alias & Jones 2009), particularly on *Rhizophora* wood, and often an early colonizer of submerged wood. Five marine *Leptosphaeria* species are known growing on mangrove wood (*L. australiensis*, *L. avicenniae*, *L. peruviana* c.f.), *Spartina* culms (*L. pelagica*) and the brackish water palm *Nypa fruticans* (*L. nypicola*) (Jones et al. 2009). These species have not been studied at the molecular level to determine if they are monophyletic. However, another marine species (*Leptosphaeria orae-maris*) has been transferred to *Phaeosphaeria* based on molecular studies and morphological observation (Shoemaker & Babcock 1989, Khashnobish & Shearer 1996a, b).

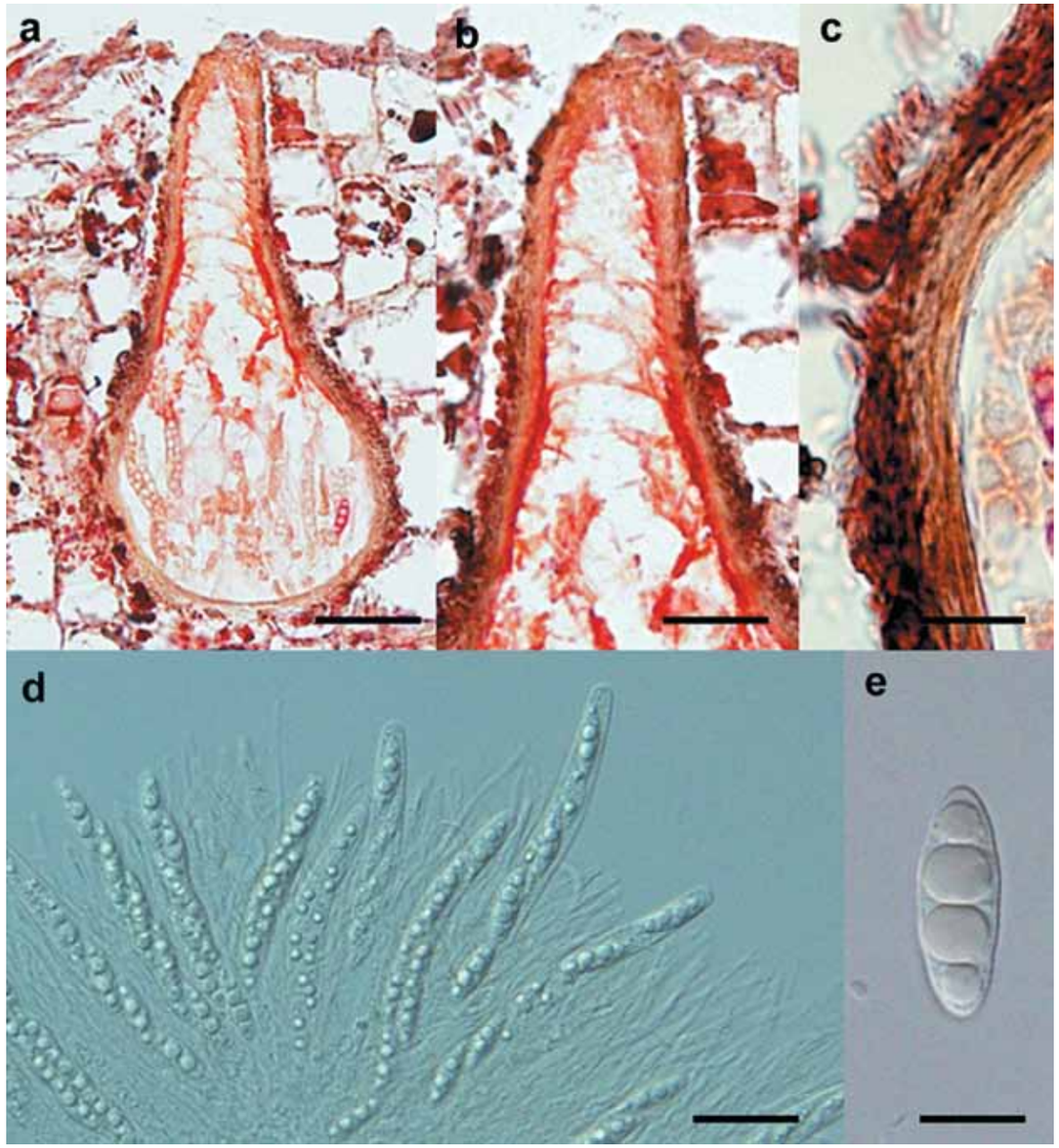

Figure 7. *Leptosphaeria australiensis.* (a) Section of immersed ascoma. (b) Neck with periphyses. (c) Two-layered peridium, outer layer of cells of *textura angularis*, inner layer of elongate cells. (d) Cylindrical bitunicate asci with an apical apparatus and pseudoparaphyses. (e) Hyaline, bicelled ascospore with large oil globules. Scale bar: a=50 µm; b, d=30 µm; c, e=10 µm.

Leptosphaeria peruviana c.f. Speg., Anal. Soc. cient. argent. 12: 179 (no. 168) (1881)
= *Leptosphaeria promontorii* Sacc., Syll. Fung. 2: 22-23 (1883)

Figure 8

Ascomata 120-210 µm high, 130-150 µm diam., lenticular-subglobose, immersed, mostly covered by the epidermis and perforating the cortex with a small ostiole, thin-walled, black. Necks 88-235 µm long, 64-88 µm diam., cylindrical, dark-colored. Peridium one-layered, composed of cells of *textura angularis*. Pseudoparaphyses absent. Asci 48-60 × 10-15 µm, eight-spored, cylindrical-clavate, at the apex obtusely rounded, at the base tapering into a short peduncle, bitunicate, thick-walled. Ascospores 12-16 × 4-5.5 µm, biseriate, cylindrical-ellipsoidal, obtusely rounded at both ends, three-septate, constricted at the septa, second cell from the top largest, dirty olive-brown.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Argentina, Egypt, Hong Kong, India, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Chiehting, Hungmao.

COMMENTS: This species was originally described from *Salicornia ambigua* but has also been reported on wood. It is a rare species and differs from the other marine *Leptosphaeria* species in having brown ascospores, and may be better referred to *Phaeosphaeria*. Identification as a *Leptosphaeria* is extremely doubtful, as the species is poorly described by Spegazzini (1881) and the type material is sparse. This species requires further study at the molecular level to determine its true identity.

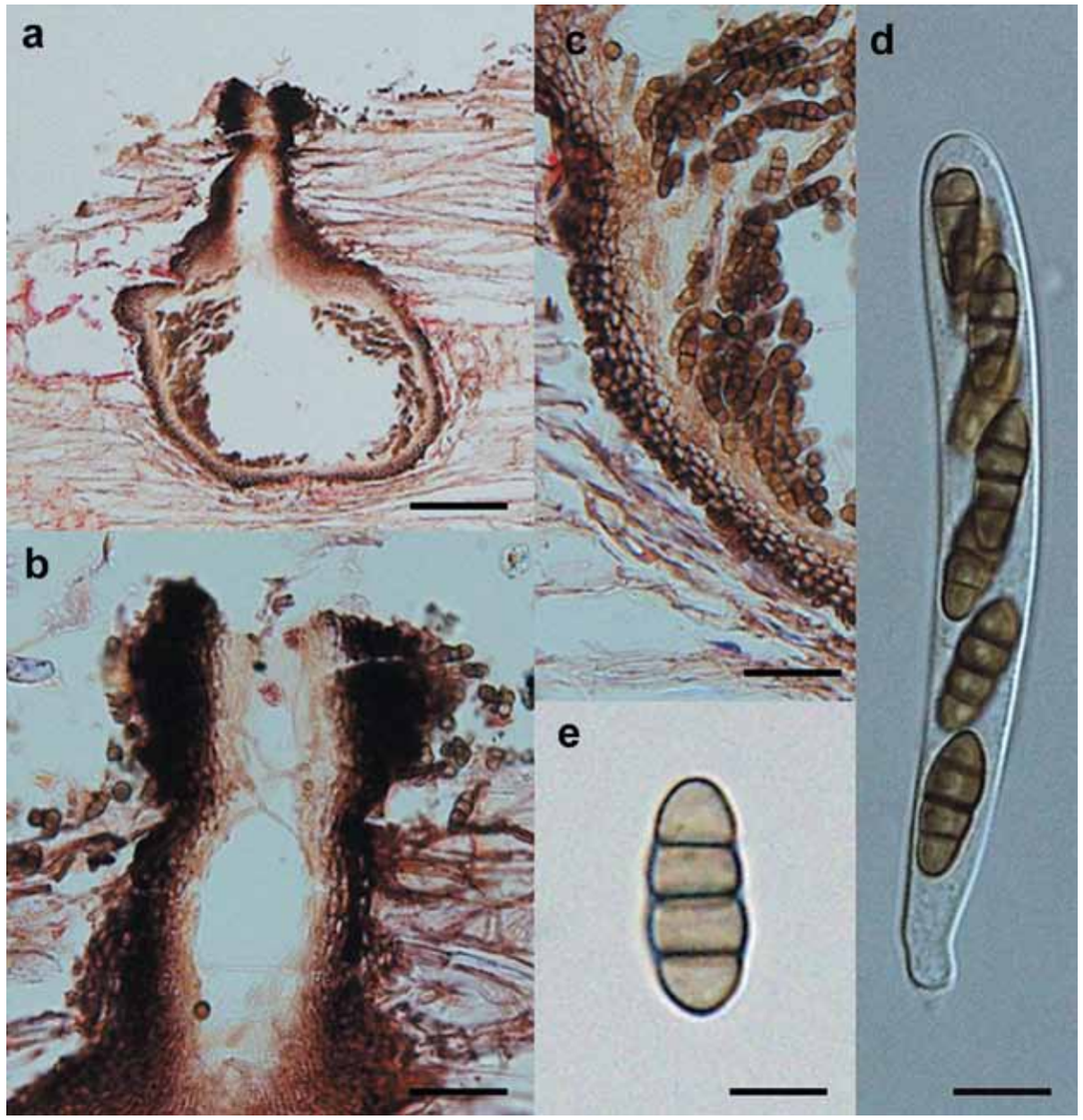

Figure 8. *Leptosphaeria peruviana* c.f. (a) Section of immersed ascoma with long neck. (b) Neck with periphyses. (c) Peridium composed of one layer of cells of *textura angularis*. (d) Cylindrical ascus with a short stalk. (e) Ascospore brown, 3-septate. Scale bar: a=100 µm; b, c=30 µm; d=10 µm; e=5 µm.

Family: Lophiostomataceae

Paraliomyces Kohlm., Nova Hedw. 1: 81 (1959)
Type species: *Paraliomyces lentiferus* Kohlm.

Paraliomyces lentiferus Kohlm., Nova Hedw. 1: 81 (1959)

Figure 9

Ascomata up to 680 µm high, 540 µm diam., subglobose to pyriform, subiculate or non-subiculate, immersed or erumpent, ostiolate, papillate or epapillate, carbonaceous, thick-walled, black, solitary. Papillae short or absent, ostiolar canal *ca.* 70 µm diam., periphysate. Peridium one-layered, composed of cells of *textura angularis*. Pseudoparaphyses 140-160 × 0.5-1.2 µm, filamentous, numerous, persistent. Asci 85-115 × 13-17 µm, eight-spored, cylindrical, short pedunculate, bitunicate, thick-walled, without apical apparatus, developing at the base of the ascoma. Ascospores 17-26.5(-27.5) × 8-12 µm, ellipsoidal to subfusiform, 1-septate below the middle, constricted at the septum, hyaline, at first surrounded by a gelatinous sheath that contracts to form a lateral, lentiform, viscous appendage over the septum, 7.5-12.5 µm diam., 1-3 µm thick.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Hong Kong, India, Mexico, Taiwan, USA.

DISTRIBUTION IN TAIWAN: Chungkang, Fangwan, Hsinwu, National Taiwan Ocean University (Chilung City), Tanshui, Tungpeichiao (Taipei County).

COMMENTS: This is a monotypic genus, occurring on submerged wood and geographically known only in the tropics (Tam et al. 2003). In a combined SSU and LSU DNA, TEF-1-α and RPB2 dataset, *P. lentiferus* clusters within a group of *Lophiostoma* species in the Lophiostomataceae (Suetrong et al. 2009). However, only one isolate was available for study and further sequences are required to confirm its generic assignment. Ultrastructurally, the ascospores of *P. lentiferus* are interesting because it has a single lateral, equatorial, lentiform, mucilaginous appendage (pad-like) which can be easily overlooked. Read et al. (1992) showed that the spores are surrounded by a mucilaginous sheath (340-380 nm), with numerous electron-opaque granules, while the appendage comprises longitudinally orientated fibrils in an amorphous matrix and is attached to the episporium. There is one report of the species from Italy, and this requires verification by further collections (Cuomo et al. 1988).

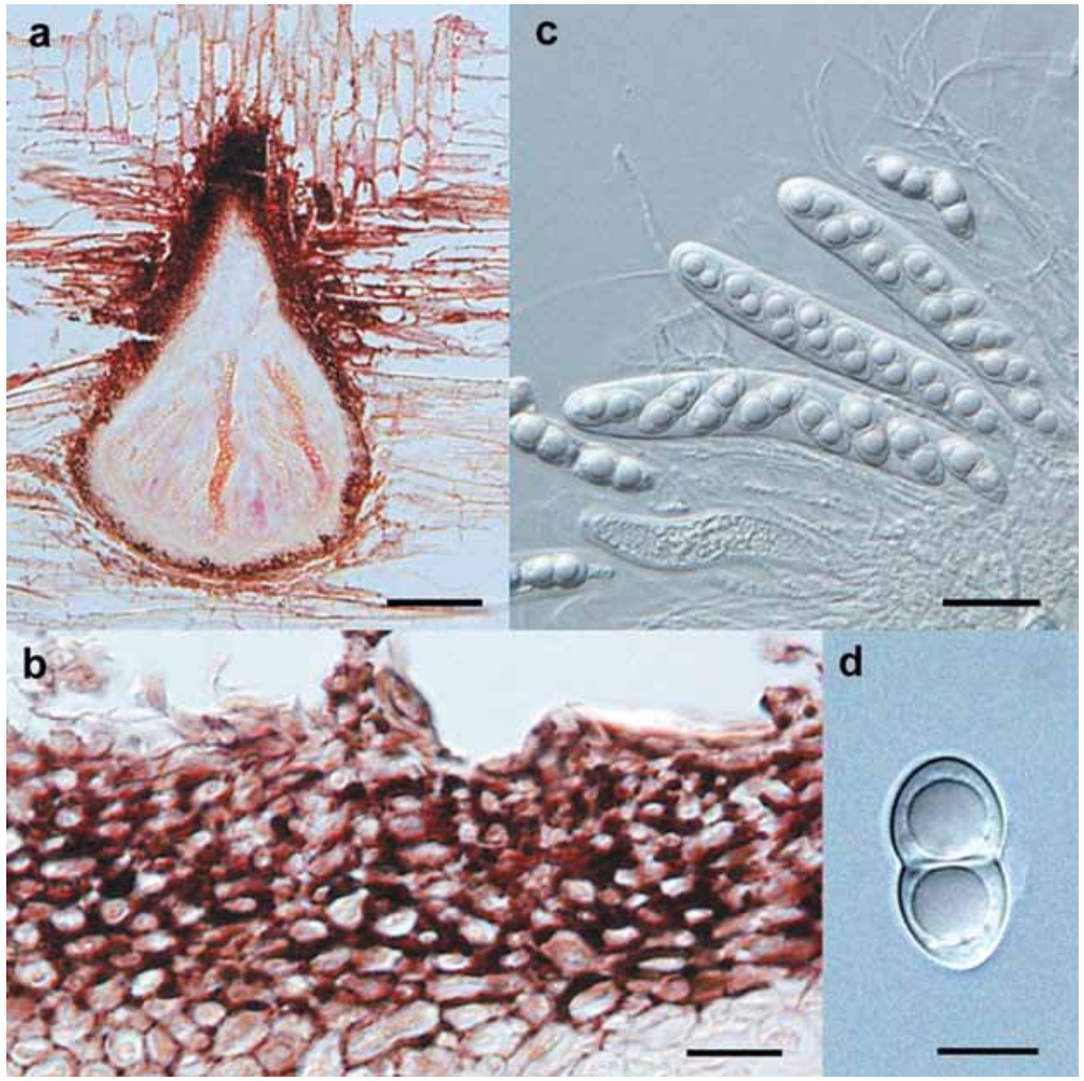

Figure 9. *Paraliomyces lentiferus.* (a) Section of immersed ascoma with a periphysate neck. (b) One-layered peridium of cells of *textura angularis*. (c) Cylindrical bitunicate asci and pseudoparaphyses. (d) Hyaline, bicelled ascospore with a pad-like appendage at the septum. Scale bar: a=100 µm; b, d=10 µm, c=30 µm.

FAMILY: MOROSPHAERIACEAE

Morosphaeria Suetrong, Sakayaroj, E.B.G. Jones & Schoch, Stud. Mycol. 64: 155 (2009)
Type species: *Morosphaeria velatospora* (K.D. Hyde & Borse) Suetrong, Sakayaroj, E.B.G. Jones & Schoch

Morosphaeria velatospora (K.D. Hyde & Borse) Suetrong, Sakayaroj, E.B.G. Jones & Schoch, Stud. Mycol. 64: 155 (2009)
≡ *Massarina velatospora* K.D. Hyde & Borse, Mycotaxon 27: 161 (1986)

Figure 10

Ascomata 530 µm high, 160 µm diam., solitary or gregarious, subglobose or depressed, immersed, becoming erumpent, ostiolate, papillate, coriaceous, brown to black. Necks 45-90 µm long, 45-60 µm diam., conical, black. Peridium one-layered, composed of cells of *textura angularis*. Asci 210-280 × 20-28 µm, eight-spored, cylindrical, pedunculate, with an apical apparatus, thick-walled, bitunicate. Ascospores 34-52 × 12-20 µm, uniseriate, fusiform to ellipsoidal, 1-3 septate, hyaline, constricted at the septa, central cells larger, apical cells when present small, surrounded by a mucilaginous sheath.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Belize, Brunei, Hong Kong, India, Indonesia, Malaysia, Maldives, Martinique, Mauritius, Nicobar Islands, Philippines, Republic of Trinidad and Tobago, Seychelles, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Tanshui.

COMMENTS: Ten marine *Massarina* species have been described occurring primarily on mangrove wood, while *M. cystophorae* is known from a brown alga, and *M. phragmiticola* from a salt marsh grass (Jones et al. 2009), but they are not monophyletic. Consequently, Suetrong et al. (2009) have transferred *Massarina velatospora* and *M. ramunculicola* to the new genus *Morosphaeria* and *Massarina thalassiae* to the new genus *Halomassarina* in the Trematosphaeriaceae, based on sequence data. *Morosphaeria velatospora* is a widely distributed species and known from the Atlantic, Indian and Pacific Oceans, occurring on wood of a wide range of mangrove trees, prop roots, and seedlings. It is an exclusively tropical marine species.

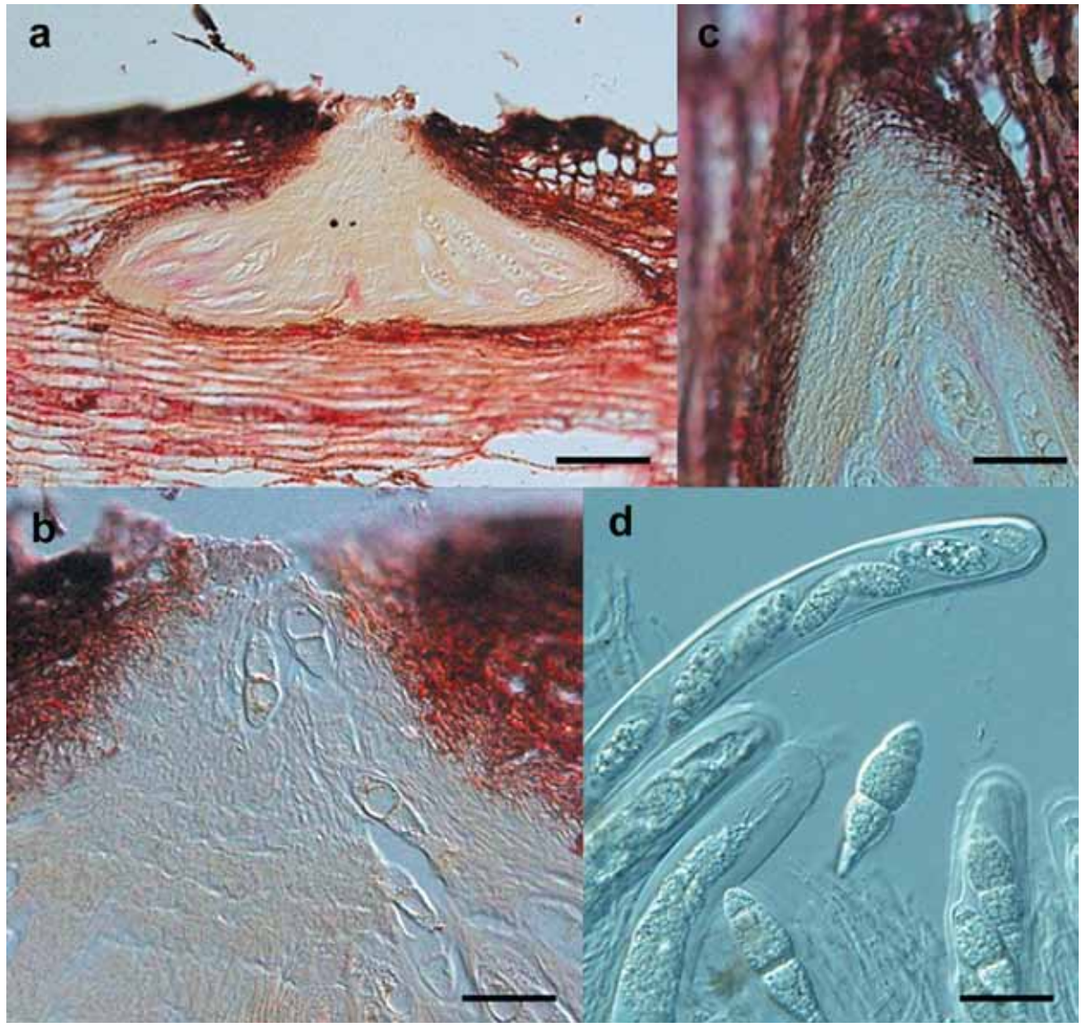

Figure 10. *Morosphaeria velatospora.* (a)Section of immersed ascoma with darkened wood surface. (b) Section of ascoma neck. (c) One-layered peridium of cells of *textura angularis*. (d) Cylindrical bitunicate asci and 3-septate ascospores. Scale bar: a=100 µm, b, c, d=30 µm.

FAMILY: TESTUDINACEAE

Verruculina Kohlm. & Volkm.-Kohlm., Mycol. Res. 94: 689 (1990)
Type species: *Verruculina enalia* (Kohlm.) Kohlm. & Volkm.-Kohlm.

Verruculina enalia (Kohlm.) Kohlm. & Volkm.-Kohlm., Mycol. Res. 94: 689 (1990)
≡ *Didymosphaeria enalia* Kohlm., Ber. dt. bot. Ges. 79: 28 (1966)
= *Lojkania enalia* (Kohlm.) M.E. Barr, N. Amer. Fl., Ser. 2 (New York) 13: 56 (1990)

Figure 11

Ascomata 295-480 µm high, 140-520 µm diam., subglobose, ampulliform or depressed ellipsoidal, black, carbonaceous, partly or completely immersed, clypeate, solitary, ostiolate, papillate. Necks 80-145 µm long, 140-300 µm diam., periphysate. Peridium 12.5-17.5 µm thick, one-layered, composed of about six or more layers of irregular roundish or elongate, thick-walled cells, forming a *textura angularis*. Pseudoparaphyses 1.5-2 µm diam., septate, rarely branched. Asci 117-135 × 12.5-15.5 µm, thick-walled, bitunicate, eight-spored, cylindrical, persistent, pedunculate. Ascospores 15.5-23 × 6.5-11 µm, dark brown, ellipsoidal, 1-septate, constricted at the septum, verrucose to verruculose, sometimes with a distinct small, hyaline tubercle at each apex, probably a germ pore.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Bahamas, Belize, Bermuda, Brazil, Brunei, China, Fiji, Galapagos, Guatemala, Hong Kong, India, Indonesia, Japan, Liberia, Macau, Malaysia, Maldives, Marshall Islands, Martinique, Mauritius, Mexico, Nicobar Islands, Philippines, Republic of Trinidad and Tobago, Seychelles, Sierra Leone, Singapore, Society Island, South Africa, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Aoku, Chichi (Hualien County), Chiehting, Chungkang, Fangwan, Haomeiliao, Hsinwu, Hungmao, Lungtung (Taipei County), National Taiwan Ocean University (Chilung City), Patoutzu (Chilung City), Peikuan (Ilan County), Putzu, Ssutsao, Tanshui, Tsengwen, Yingkeshih (Ilan County).

COMMENTS: Molecular data place this species in the Testudinaceae (Kruys et al. 2006, Schoch et al. 2006, Jones et al. 2009) and this is supported by a recent study by Suetrong et al. (2009) with *Ulospora bilgramii* and *Neotestudina rosatii* as a sister group with good support in a combined SSU and LSU rDNA and TEF-1-alpha dataset. Hawksworth & Booth (1974) and von Arx & Muller (1975) favoured the name Zopfiaceae in preference to Testudinaceae. The family is characterized by cleistothecoid ascomata, 1-septate, brown, glabrous or ornamented ascospores, and are mainly isolated from soils. *Verruculina enalia* is the only marine species in the family and morphologically shares few characters in common with other members in the Testudinaceae. *Verruculina enalia* is a core mangrove species (Alias & Jones 2009), a dominant colonizer of mangrove wood, dead roots, prop roots and pneumatophores of trees along the shore. It is also an early colonizer of mangrove wood (Leong et al. 1988, Tan et al. 1989, Alias & Jones 2000).

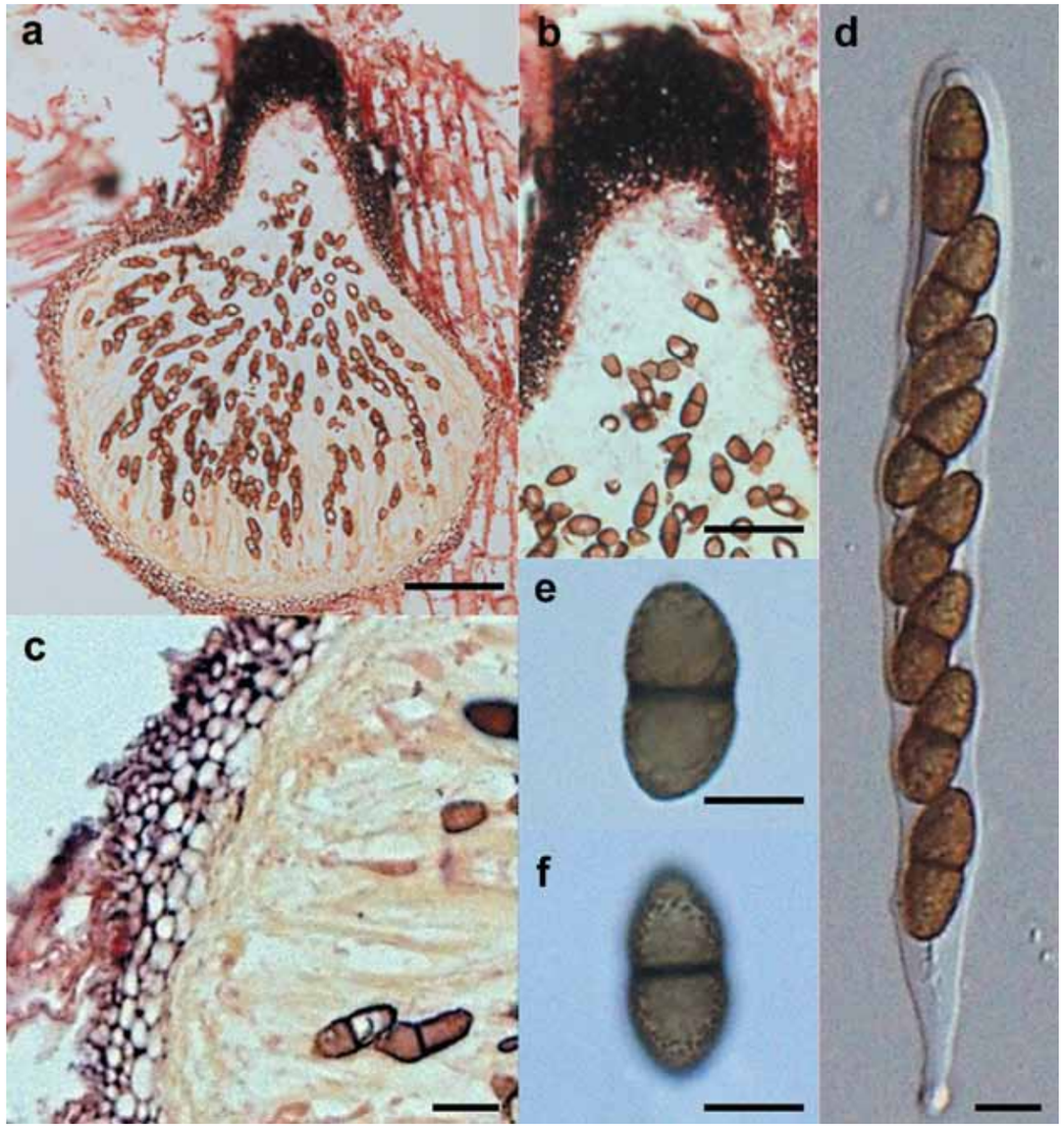

Figure 11. *Verruculina enalia.* (a) Section of immersed ascoma. (b) Section of short papillate neck. (c) One-layered peridium of cells of *textura angularis*. (d) Mature, cylindrical bitunicate ascus. (e) Dark brown, bicelled ascospore. (f) Ornamentations on ascospore outer wall. Scale bar: a=50 µm; b, d=30 µm; c, e, f=10 µm.

CLASS: DOTHIDEOMYCETES *INCERTAE SEDIS*

Patellaria Fr., Syst. mycol. (Lundae) 2: 158 (1822)
Type species: *Patellaria atrata* (Hedw.) Fr.

Patellaria atrata (Hedw.) Fr., Syst. mycol. (Lundae) 2: 158 (1822)
= *Lichen atratus* Hedw., Descr. micr.-anal. musc. frond. 2: 61 (1798)
= *Peziza atrata* (Hedw.) Schumach., Enum. pl. (Kjbenhavn) 2: 417 (1803)
= *Lecanidion atratum* (Hedw.) Endl., (1830) var. atratum
= *Lecanidion atratum* (Hedw.) Endl., (1830) f. atratum
= *Lecanidion atratum* (Hedw.) Endl., Flora Pason 1: 46 (1830)
= *Cycledium atratum* (Hedw.) Wallr. [as 'Cycledum atrum'], Fl. crypt. Germ. (Nürnberg) 2: 511 (1833)
= *Patellaria maura* Massee, Bull. Misc. Inf., Kew: 131 (1898)
= *Bilimbia sublubens* Paulson, Trans. Br. mycol. Soc. 12: 88 (1927)
= *Bacidia sublubens* (Paulson) Zahlbr., Cat. Lich. Univers. 8: 409 (1932)

Figure 12

Ascomata 0.3-0.9 mm wide, 0.6 mm high, arising singly, initially closed, later opening by a pore to form a flat or convex black disc, apothecioid, superficial, sessile, circular, subgelatinous when moist, margin entire, raised, incurved, outer surface of stalk smooth. Hypothecium 16-40 µm, composed of dark-colored, thick-walled cells of *textura angularis*. Hamathecium 96-172 × 1-2 µm, paraphysoidal, hyaline, branched above. Asci 92-150 × 14-40 µm, cylindric-clavate, with a stipe, bitunicate, thick-walled, with ocular chamber in apical dome, fissitunicate, eight-spored, J- in Melzer's reagent. Ascospores 24-48 × 6-24 µm, irregularly biseriate, clavate, slightly curved, not constricted at the septa, 4-9-septate, hyaline, no mucilaginous sheath.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Hong Kong, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Hsinwu, Hungmao, Peikuan (Ilan County).

COMMENTS: This fungus occurs on the dead branches that are still attached to mangrove trees. The branches are very often not submerged in sea water. In a study by Schoch et al. (2009), *Patellaria atrata* nestles in an unsupported clade, in the Patellariaceae (Patellariales) in a sister group to *Hysteropatella* species.

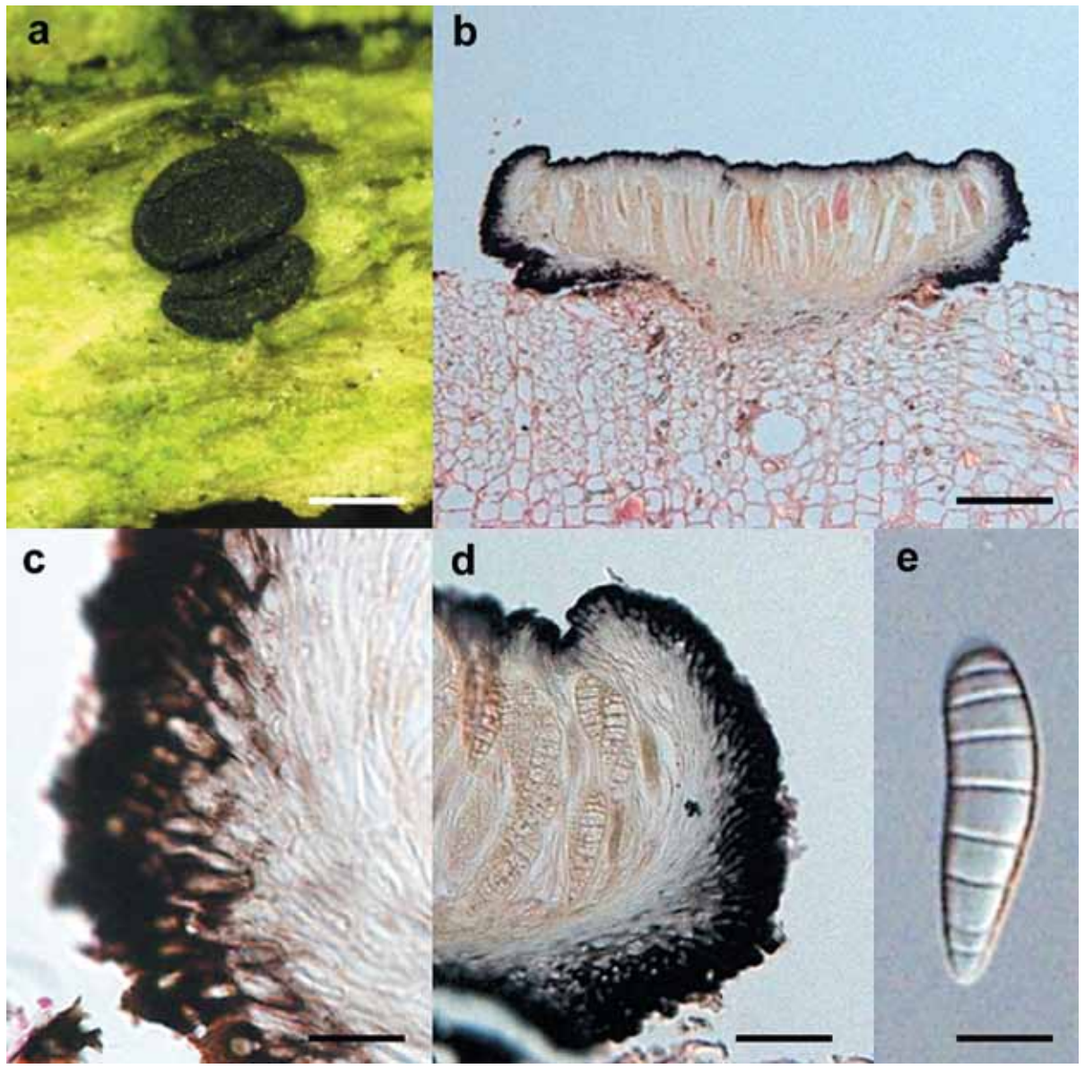

Figure 12. *Patellaria atrata.* (a) Black, disc-shaped apothecia with a curled edge on wood. (b) Section of apothecium seated on wood. (c) One-layered hypothecium of cells of *textura angularis*. (d) Broad, clavate asci, paraphysoid and peridial cells of *textura angularis*. (e) Ascospore with 8-septate. Scale bar: a=300 µm; b=100 µm; c, e=10 µm, d=30 µm.

CLASS: EUROTIOMYCETES
SUBCLASS: CHAETOTHYRIOMYCETIDAE *INCERTAE SEDIS*
FAMILY: DACTYLOSPORACEAE

Dactylospora Körb., Syst. lich. germ. (Breslau): 271 (1855)
Type species: *Dactylospora haliotrepha* (Kohlm. & E. Kohlm.) Hafellner

Dactylospora haliotrepha (Kohlm. & E. Kohlm.) Hafellner, Beih. Nova Hedw. 62: 111 (1979)
≡ *Buellia haliotrepha* Kohlm. & E. Kohlm., Nova Hedw. 9: 90 (1965)
= *Kymadiscus haliotrephus* (Kohlm. & E. Kohlm.) Kohlm. & E. Kohlm., Mycologia 63: 837 (1971)

Figure 13

Ascomata 200-320 µm high, 360-1000 µm diam., at first subglobose, becoming semiglobose or discoid, flat or convex, apothecia-like, superficial, sessile, rooted in the substrate with an obconical foot, fleshy-leathery, dark reddish-brown, appearing almost black when dry, solitary or gregarious. Excipula composed of thick-walled, subglobose to polygonal cells with large lumina, diverging from the center in parallel rows, merging into the sclerenchymatous foot, forming a *textura angularis*. Hypothecia two-layered, with an outer layer of thick-walled, subglobose to polygonal cells with large lumina and an inner layer of thin-walled cells of *textura angularis*. Pseudoparaphyses 85-125 × 1.2-1.9 µm at the apex, 2.5-4 µm diam., clavate, simple, rarely branching, septate, hyaline. Asci 70-100 × 17.5-20 µm, eight-spored, clavate, short pedunculate, bitunicate, apically thick-walled, thinner toward the base, without apical apparatus. Ascospores (15-)18-27.5(-31.5) × 7.5-11.5(-14.5) µm, obliquely uni- or biseriate, ellipsoidal or obovoid, 1-septate in the lower third, constricted at the septum, at first grayish-green, becoming brownish, epispore with delicate, forked, longitudinal striations.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Aldabra, Andaman Islands, Australia, Bahamas, Belize, Bermuda, Brunei, China, East South Africa, Egypt, Fiji, Hong Kong, India, Indonesia, Japan, Malaysia, Maldives, Martinique, Mauritius, Mexico, Nicobar Islands, Philippines, Republic of Trinidad and Tobago, Seychelles, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Aoku, Chungkang, Haomeiliao, Hsinwu, Hungmao, National Taiwan Ocean University (Chilung City), Tanshui.

COMMENTS: This species is one of the core mangrove fungi known from the Atlantic, Indian and Pacific Oceans, and can be found on mangrove wood of a variety of tree species and marine herbaceous plants. It is particularly common on well-degraded wood, but rarely found colonising freshly submerged wood. Three marine *Dactylospora* species have been reported (Jones et al. 2009) with two found on mangrove wood. Ascospores are 1-septate, pale brown and ridged. Au et al. (1996, 2002) showed that the wall ridges are outgrowths of the mesosporial layer and surrounded by a thin electron-dense episporial layer and an outer delimiting membrane. Condensed and homogenous mucilaginous material is present between the ridges. Jones et al. (2009) referred the genus to the order Lecanorales, but recent data indicated that it shows affinities with the Pyrenulales (Schoch et al. 2009). Rossman et al. (2010) showed that the marine *Dactylospora* species form a new lineage in the class Eurotiomycetes, but do not group within the order Chaetothyriales, Verrucariales or Pyrenulales.

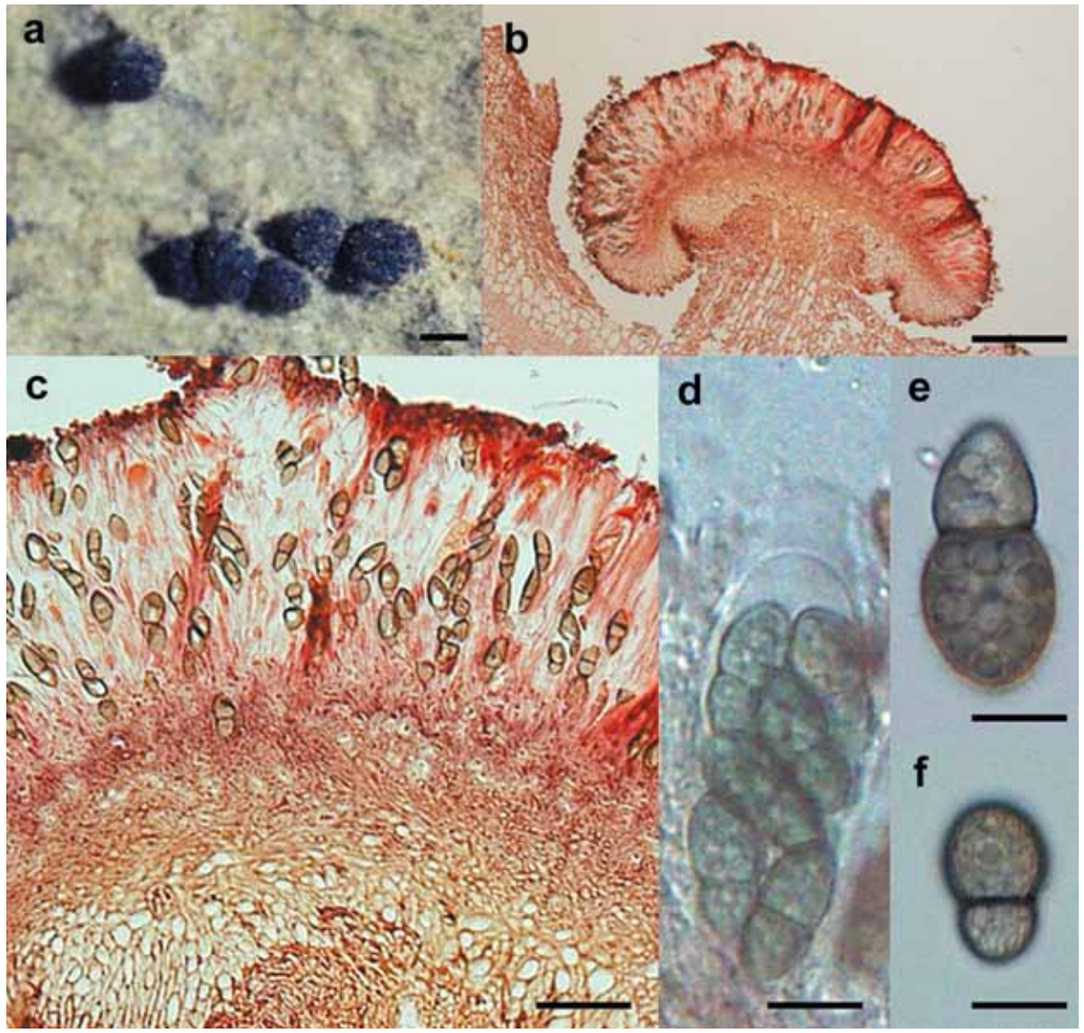

Figure 13. *Dactylospora haliotrepha.* (a) Black, disc-shaped apothecia on wood. (b) Section of convex apothecium with a foot attached to the wood. (c) Two-layered hypothecium, with outer layer of thick-walled, subglobose to polygonal cells with large lumina and inner layer of thin-walled cells of *textura angularis*. (d) Thick-walled clavate ascus. (e) Ascospore dark, ellipsoidal with unequal cells. (f) Striations on ascospore outer wall. Scale bar: a=300 µm; b=200 µm; c=50 µm; d, e, f=10 µm.

Dactylospora mangrovei E.B.G. Jones, Alias, Abdel-Wahab & S.Y. Hsieh, in Jones, Abdel-Wahab, Alias & Hsieh, Mycoscience 40: 317 (1999)

Figure 14

Ascomata 160-240 µm high, 400-640 µm diam., dark brown to black, at first subglobose, becoming semiglobose or discoid, flat or convex, apothecial-like, superficial, sessile, attached to the substratum by an obconical foot, fleshy-leathery, solitary or gregarious. Exciple composed of thick-walled, subglobose to polygonal cells with large lumina, diverging from the center in parallel rows, merging into the sclerenchymatous foot, forming a *textura angularis*, barely arching over hymenium. Hypothecia two strata, with an outer stratum of thick-walled, subglobose to polygonal cells with large lumina and an inner stratum of thin-walled cells of *textura angularis*. Epithecia brownish, crumbling, finally exposing the hymenium. Paraphyses 50-80 × 1-2 µm at the base, hyaline, apically swollen (2.5-4 µm) and staining dark brown to black with iodine. Asci 40-63 × 8.3-14.1 µm, eight-spored, clavate, short pedunculate, thick-walled, apically thicker but thinner toward the base, without an apical apparatus. Ascospores 10.9-17.2 × 3.5-6.4 µm, obliquely uni- to biseriate, ellipsoidal or obovoid, 1-septate, becoming reddish-brown, spore wall verrucose.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Bahamas, Hong Kong, Malaysia, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Tanshui.

COMMENTS: This species is less well known than *D. haliotrepha* and differs in that the ascospores are narrower and the wall surface has reticulate ridges (Jones et al. 1999). Kohlmeyer & Volkmann-Kohlmeyer (1998) report another marine *Dactylospora* (*D. canariensis*) from driftwood collected on the shores of Tenerife (Canary Islands). It differs from *D. haliotrepha* and *D. mangrovei* in that the ascospores are hyaline to pale-brown with 4-6 terminal, radiating, bristle-like, deciduous setae.

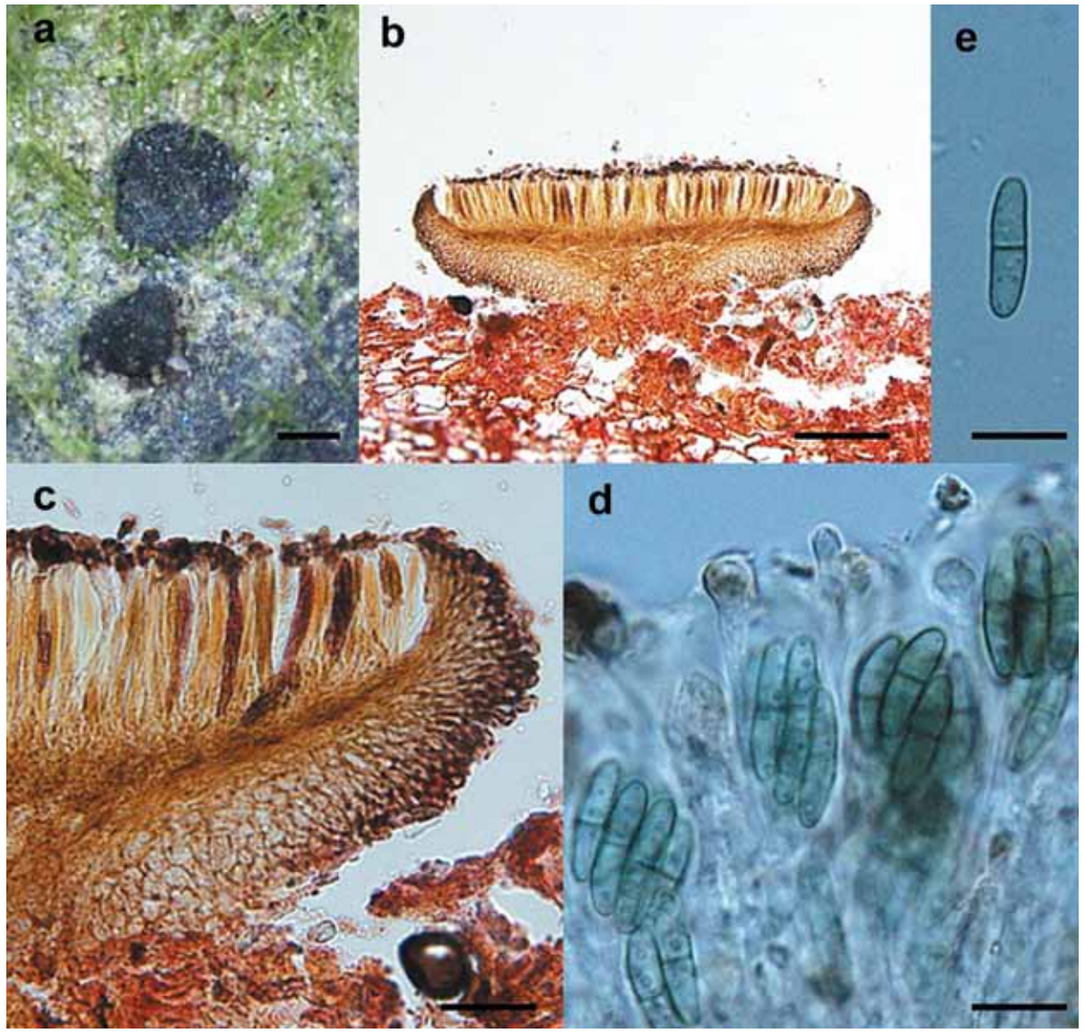

Figure 14. *Dactylospora mangrovei*. (a) Black, disc-shaped apothecia on wood. (b) Section of flat apothecium seated on the wood. (c) Two-layered hypothecium, outer layer of thick-walled, subglobose to polygonal cells with large lumina, inner layer of thin-walled cells of *textura angularis*. (d) Clavate, thick-walled asci and pseudoparaphyses. (e) Elongate-ellipsoidal ascospore. Scale bar: a=300 µm; b=100 µm; c=30 µm; d, e=10 µm.

CLASS: SORDARIOMYCETES
SUBCLASS: HYPOCREOMYCETIDAE
ORDER: HYPOCREALES
FAMILY: BIONECTRIACEAE

Kallichroma Kohlm. & Volkm.-Kohlm., Mycol. Res. 97: 759 (1993)
Type species: *Kallichroma tethys* (Kohlm. & Kohlm.) Kohlm. & Volkm.-Kohlm.

Kallichroma glabrum (Kohlm.) Kohlm. & Volkm.-Kohlm., Mycol. Res. 97: 759 (1993)
≡ *Hydronectria tethys* var. *glabra* Kohlm., Pubbl. Staz. Zool. Napoli, 1 5: 351 (1984)

Figure 15

Ascomata 275-380 µm high, 315-460µm diam., subglobose or depressed-ellipsoidal, partly or rarely completely immersed, ostiolate, epapillate or clypeoid thickened around the ostiole, fleshy-leathery, orange-yellowish, gregarious, or frequently confluent. Necks 17.5-32.5 µm diam., conical, lined with periphyses, 1-2 µm diam. Peridium above and at the sides 70-75 µm thick, at the base 20-30 µm, two-layered, outer layer composed of irregularly polygonal, thick-walled cells, inner layer of elongate, flattened cells that merge into paraphyses. Apical paraphyses 2 µm diam., septate, in the dome of the venter attached to large isodiametric cells with large lumina, finally deliquescing. Asci 90-105 × 15-23 µm, eight-spored, clavate or subcylindrical, short pedunculate, unitunicate, thin-walled at maturity, without apical apparatus, developing at the base of the ascoma venter. Ascospores 17-24(-27) × 8-10 µm, uni- or biseriate, ovoid, 1-septate, slightly constricted at the septum, hyaline, smooth.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Bahamas, Egypt, Hong Kong, India, Malaysia, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Hungmao, National Taiwan Ocean University (Chilung City), Ssutsao.

COMMENTS: This is a less common species than *K. tethys*, and differs in the lack of longitudinal ridges running the length of the ascospore. Unusually for the Bionectriaceae, no anamorph has been reported for the genus *Kallichroma*. Both species occur on decorticated, well-rotted wood.

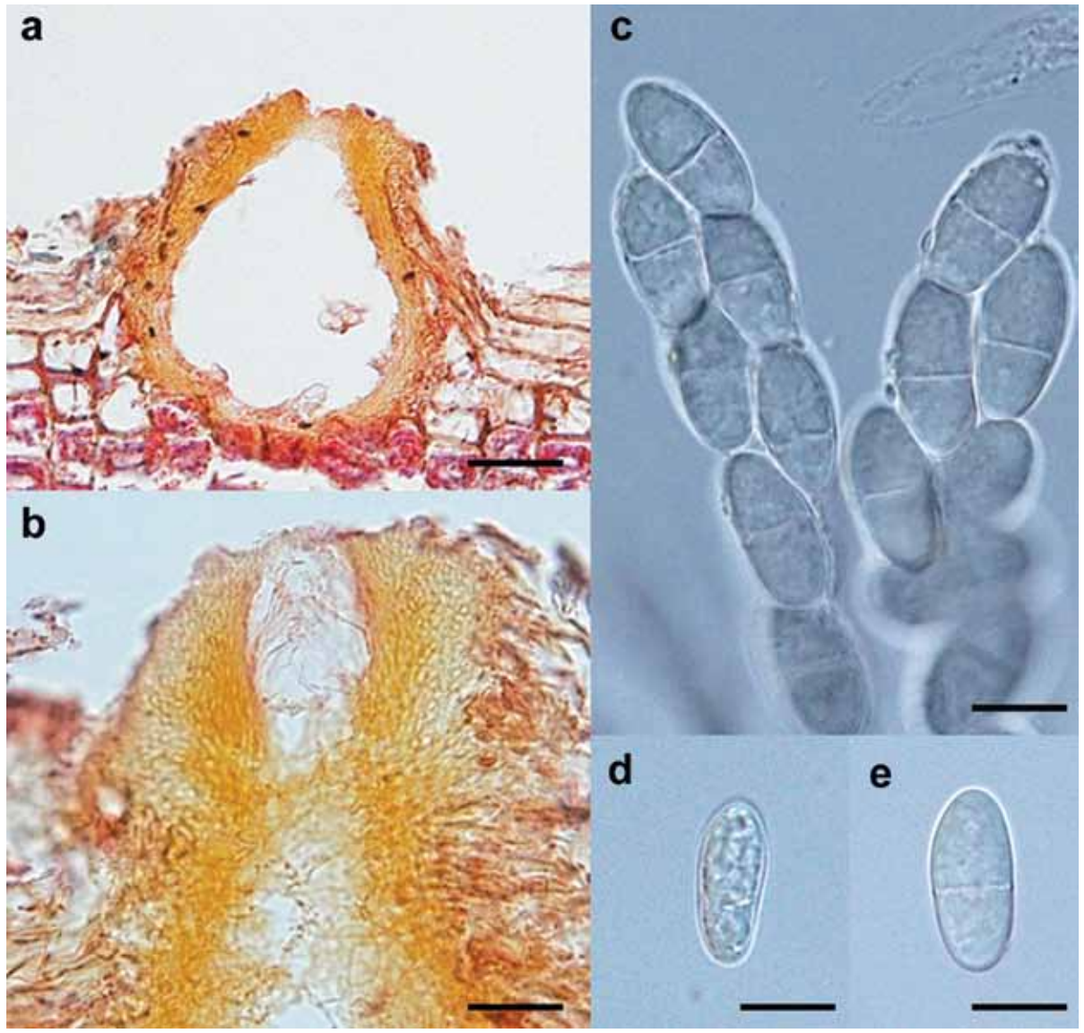

Figure 15. *Kallichroma glabrum*. (a) Section of erumpent ascoma on wood. (b) Section of neck with long periphyses. (c) Thin-walled asci with hyaline ascospores. (d-e) Smooth-walled ascospores. Scale bar: a=50 µm; b=30 µm; c, d, e=10 µm.

Kallichroma tethys (Kohlm. & Kohlm.) Kohlm. & Volkm.-Kohlm., Mycol. Res. 97: 759 (1993)
≡ *Hydronectria tethys* Kohlm. & E. Kohlm., Nova Hedw. 9: 95 (1965)

Figure 16

Ascomata 275-380 µm high, 315-460µm diam., subglobose or depressed-ellipsoidal, partly or rarely completely immersed, ostiolate, epapillate or clypeoid thickened around the ostiole, fleshy-leathery, orange-yellowish, gregarious, or frequently confluent. Necks 17.5-32.5 µm diam., conical, lined with periphyses, 1-2 µm diam. Peridium above and at the sides 70-75 µm thick, at the base 20-30 µm, two-layered, outer layer composed of irregularly polygonal, thick-walled cells of *textura angularis*, inner layer of elongate, flattened cells that merge into paraphyses. Apical paraphyses 2 µm diam., septate, in the dome of the venter attached to large isodiametric cells with large lumina, finally deliquescing. Asci 90-105 × 15-23 µm, eight-spored, clavate or subcylindrical, short pedunculate, unitunicate, thin-walled at maturity, without apical apparatus, developing at the base of the ascoma venter. Ascospores 17-26 × 8.5-13 µm, uni- or biseriate, ellipsoidal or ovoid, 1-septate somewhat below the centre, slightly constricted at the septum, hyaline, with about six longitudinal ridges, 0.5-0.8 µm diam., running around the spore from one pole to the other.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Bahamas, Belize, Bermuda, Brunei, East South Africa, Egypt, Fiji, Hong Kong, India, Malaysia, Mauritius, Mexico, Nicobar Islands, Philippines, Republic of Trinidad and Tobago, Seychelles, Society Islands, Thailand, Taiwan, USA.

DISTRIBUTION IN TAIWAN: Aoku, Chungkang, Fangwan, Haomeiliao, Hungmao, Peimeng, Yingkeshih (Ilan County).

COMMENTS: This is a widely documented mangrove species, found generally on well-rotten, decorticated wood. It is never an early colonizer of wood (Leong et al. 1988, Tan et al. 1989, Alias & Jones 2000). It can be readily identified on wood by the bright orange/red ascomata and differs from *K. glabrum* by the ridges running along the whole length of the ascospore wall. Molecular data support their placement in the Bionectriaceae, although the most distant genus in the family (Rossman et al. 2001, Schroers 2001). However, the two species need to be sequenced to determine if they are distinct species.

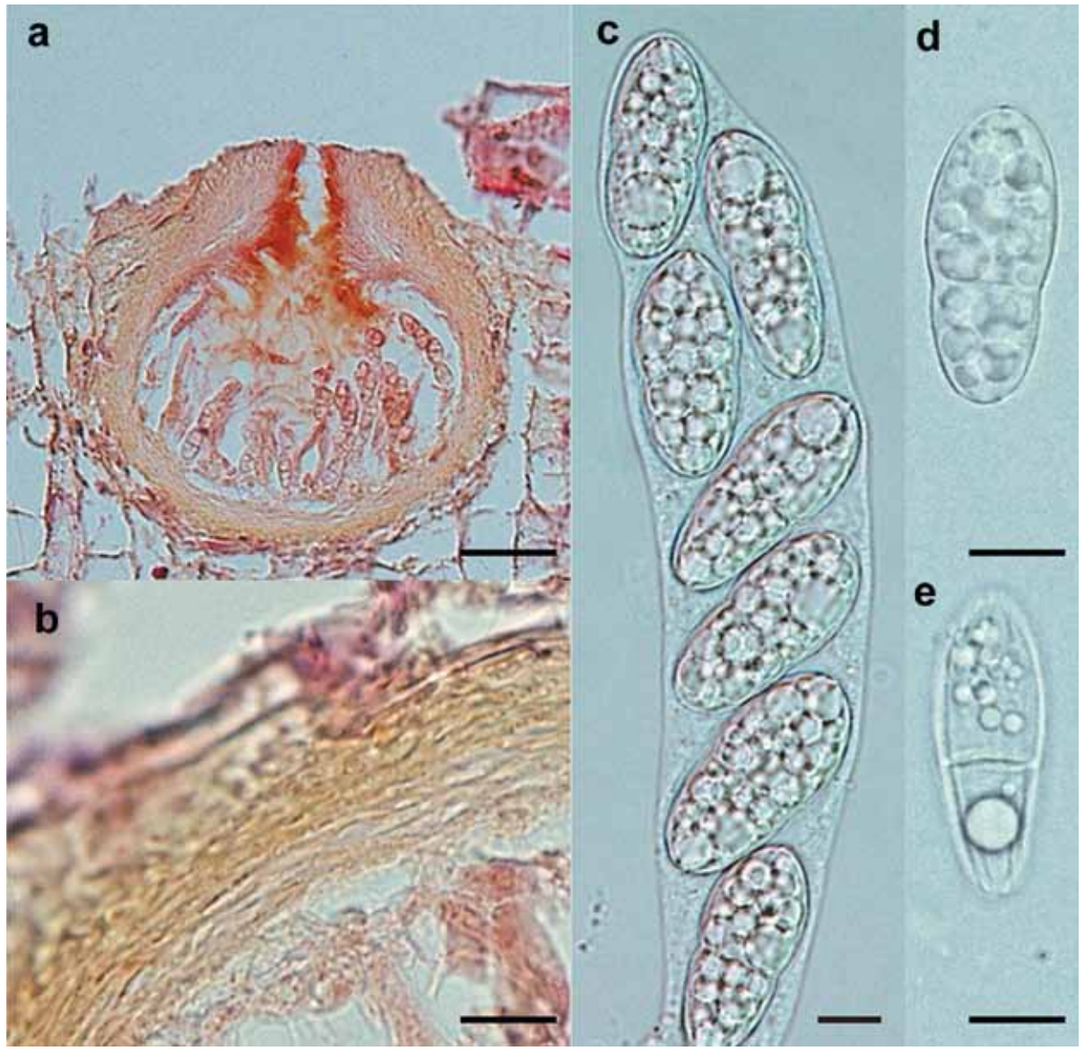

Figure 16. *Kallichroma tethys.* (a) Section of erumpent, globose ascoma. (b) Two-layered peridium, outer layer of cells of *textura angularis*, inner layer of elongate cells. (c) Subcylindrical ascus with hyaline ascospores. (d) Bicelled, hyaline ascospore with cells unequal in length. (e) Ridges on ascospore wall. Scale bar: a=50 µm; b, c, d, e=10 µm.

FAMILY: NIESSLIACEAE

Sedecimiella K.L. Pang, Alias & E.B.G. Jones, Bot. Mar. 53: 495 (2010)
Type species: *Sedecimiella taiwanensis* K.L. Pang, Alias & E.B.G. Jones

Sedecimiella taiwanensis K.L. Pang, Alias & E.B.G. Jones, Bot. Mar. 53: 495 (2010)

Figure 17

Ascomata 63-(110)-145 µm high, 65-(100)-140 µm diam., solitary, orange to dark brown, globose to subglobose, erumpent, coriaceous, no setae. Peridium 14-(17)-25 µm, dark-colored, two-layered, outer layer of 3-6 rows of cells of *textura angularis*, inner layer of 3-6 rows of elongate and hyaline cells. Necks 30-(63)-101 × 42-(66)-93 µm, thick, base of necks extends into the upper part of the ascoma centrum, periphyses present. Paraphyses 13.5-(25.3)-37.1 × 1.8-(3.4)-7.6 µm, branched. Asci 25.8-(30.3)-35.3 × 3.5-(4.3)-4.7 µm, cylindrical, short pedunculate, thin-walled, unitunicate, with no apical pore, sixteen-spored, persistent, developing on the inner wall of the ascoma. Ascospores 2.3-(2.8)-3.5 µm, globose, one-celled, hyaline, thin-walled, smooth-walled, without appendage or sheath.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: China, Malaysia, Taiwan.

DISTRIBUTION IN TAIWAN: Chungkang.

COMMENTS: This species has only been recently described and was tentatively assigned to the Niessliaceae, Hypocreales based on phylogenetic analyses of the SSU and LSU rRNA genes (Pang et al. 2010). The inner wall layer of the necks of *S. taiwanensis* extends into the upper part of the centrum, an anatomical feature that appears to be previously unknown in the Hypocreales. A similar structure has been observed in *Rostrupiella danica*, a *Lulworthia*-like marine fungus (Koch et al. 2007). It is one of the marine species with more than eight ascospores per ascus.

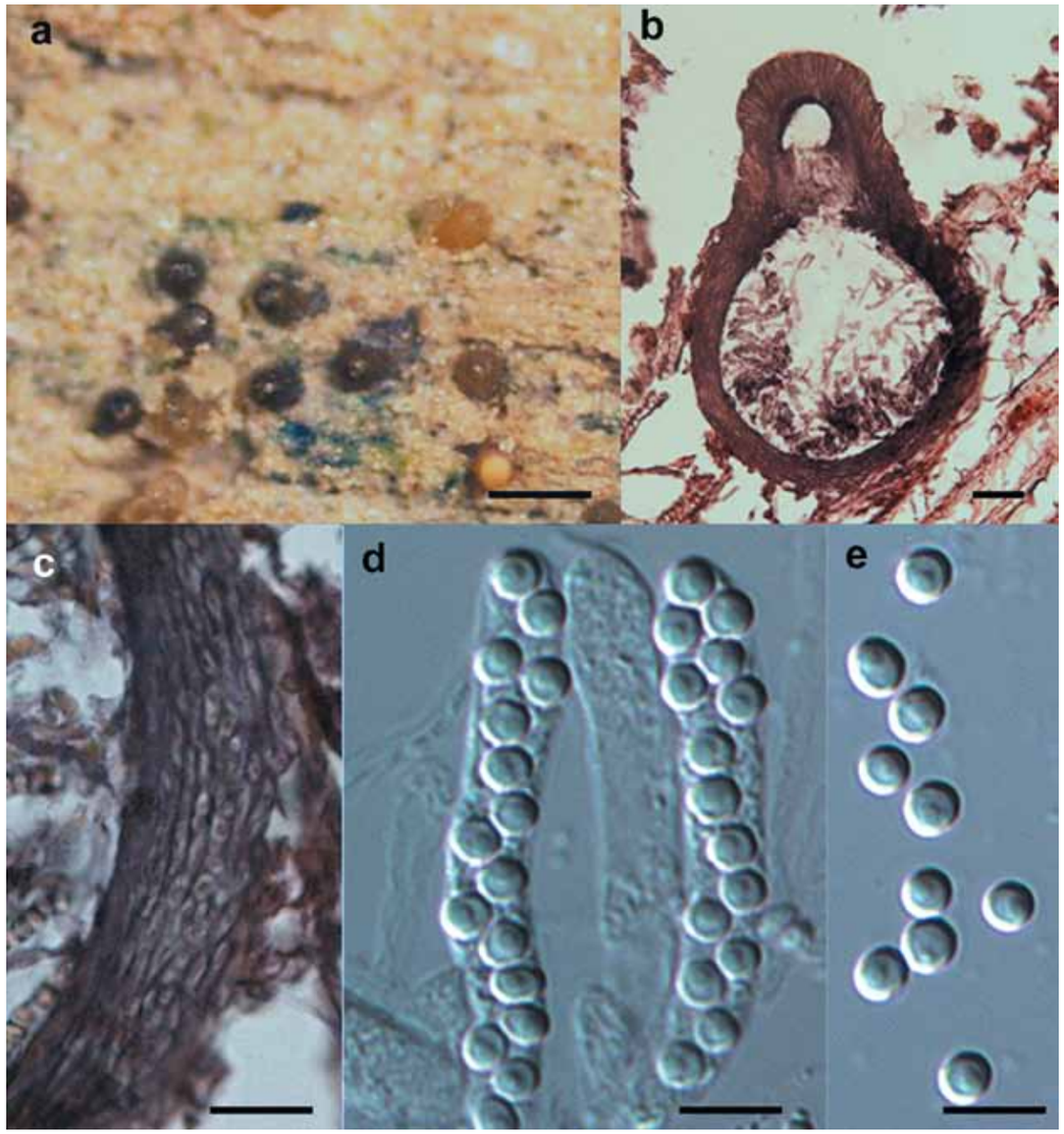

Figure 17. *Sedicimiella taiwanensis.* (a) Orange-colored ascomata on wood. (b) Section of globose ascoma. (c) Two-layered peridium, outer layer of cells of *textura angularis*, inner layer of elongate cells. (d) Cylindrical asci with 16 spores. (e) Globose ascospores. Scale bar: a=600 µm; b, c=30 µm; d, e=5 µm.

ORDER MICROASCALES
FAMILY HALOSPHAERIACEAE

Aniptodera Shearer & M.A. Mill., Mycologia 69: 893 (1977)
Type species: *Aniptodera chesapeakensis* Shearer & M.A. Mill.

Aniptodera chesapeakensis Shearer & M.A. Mill., Mycologia 69: 894 (1977)

Figure 18

Ascomata 130-(186)-300 µm high, 170-(221)-325 µm diam., globose to subglobose, hyaline greyish brown to dark brown, membranous, superficial or partially immersed, ostiolate. Necks 81-(204)-326 µm long, 36-(39)-76 µm diam., apical or subapical portion of the neck becoming dark, forming a ring around the neck, periphysate. Peridium two-layered, with an outer layer of cells of *textura angularis* and an inner layer of elongate cells. Asci 64-(94)-116 × 14-(28)-38 µm, unitunicate, eight-spored, clavate, deliquescing at maturity, with an apical pore, plasmalemma retracted below the apex, short pedicel. Catenophyses present. Ascospores 21-(32)-37 × 7-(11)-15 µm, hyaline, ellipsoidal, thick-walled, 1-septate, not constricted at the septum, appendaged or not. Appendages bipolar, thin, hamate extending over the mid-septum, unfurling into fine thread in water.

SUBSTRATA: dead mangrove wood, senescent mangrove leaves, dead marsh grasses, fern rachis.

WORLDWIDE DISTRIBUTION: Andaman Island, Australia, Belize, Brunei, China, Egypt, England, Hong Kong, India, Indonesia, Japan, Malaysia, Mauritius, Mexico, Panama, Philippines, Seychelles, Singapore, South Africa, Sri Lanka, Taiwan, Thailand, USA, Venezuela.

DISTRIBUTION IN TAIWAN: Aoku, Chiehting, Chungkang, Haomeiliao, Hsinwu, Hungmao, Peimeng, Putzu, Ssutsao, Tanshui, Toucheng (Ilan County), Tunghsin.

COMMENTS: The genus *Aniptodera* comprises both marine and freshwater species and is widely distributed in the tropics and temperate waters, although some species are rarely reported. Some species appear to be cosmopolitan in their distribution, e.g. *A. chesapeakensis*. *Aniptodera chesapeakensis* grows on a wide range of woody tree species to leaves of seagrasses. The monophyly of the genus is in doubt and warrants a major revision with wider taxon sampling. It is a genus that shares many characteristics with members of the *Halosarpheia* complex and it is surprising that so few species have been sequenced (Sakayaroj et al. 2011). There is some confusion over the identity of this species, originally described as ascospores with a thick wall and lacking appendages. Subsequently, Shearer (1989) broadened the concept of the species to include ascospores with bipolar unfurling appendages. Consequently, the genus currently comprises species with appendages and without appendages.

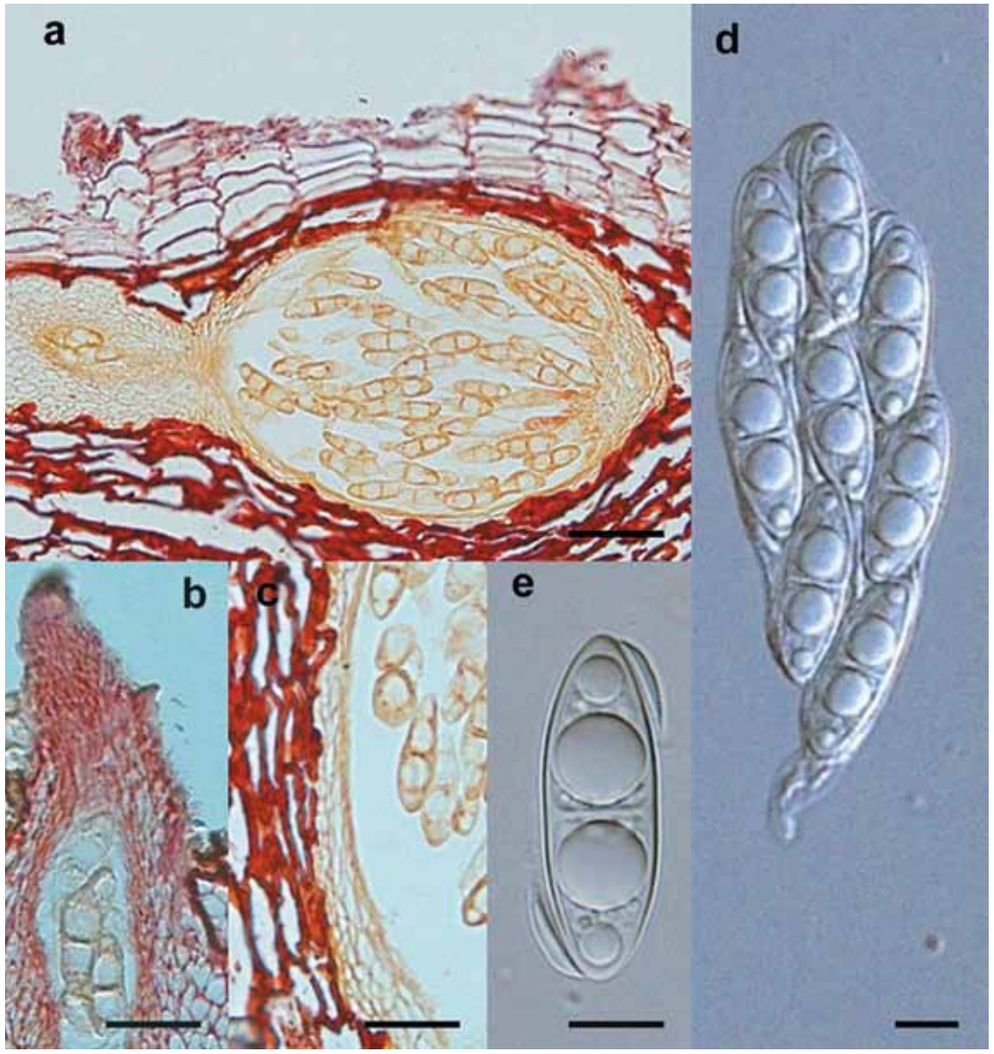

Figure 18. *Aniptodera chesapeakensis.* (a) Section of immersed, globose ascoma. (b) Section of ascoma neck with periphyses. (c) Two-layered peridium, outer layer of cells of *textura angularis*, inner layer of elongate cells. (d) Mature, clavate, thin-walled ascus with eight ascospores. (e)Thick-walled ascospore with bipolar hook-like appendages. Scale bar: a=50 µm; b, c=30 µm; d, e=10 µm.

Aniptodera lignatilis K.D. Hyde, Aust. Syst. Bot. 5: 111 (1992)

Figure 19

Ascomata 225-400 µm high, 160-350 µm diam., globose, subglobose to occasionally pyriform, hyaline to cream colored, membranous, immersed, semi-immersed or less commonly superficial, solitary or gregarious, ostiolate. Necks light-colored, periphysate. Peridium 18-23 µm thick, 3-6 layers of thick-walled, elongate cells. Catenophyses present. Asci 128-171 × 28-40 µm, unitunicate, eight-spored, clavate, persistent, with a flattened tip, tip thickened with an indistinct pore or plug, plasmalemma retracted below the apex, pedicellate. Ascospores 35-55 × 12-17 µm, hyaline, fusiform, thick-walled, 1-septate, not constricted at the septum, appendaged. Appendages bipolar, thin, hamate extending over the mid-septum, unfurling into fine thread in water.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Australia, Hong Kong, Macau, Malaysia, Mauritius, Philippines, Seychelles, South Africa, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Tanshui.

COMMENTS: This species was originally described on wood from freshwater habitats and was not included in the recent monograph of marine fungi (Jones et al. 2009). Recently, this species has been collected from mangroves in Taiwan, Malaysia and Thailand. Dimension of the ascospores from one collection to another differs quite significantly but within the reported range. Phylogenetic analysis of the SSU and LSU rRNA sequences confirms the various collections as a single species (K.L. Pang, unpublished results).

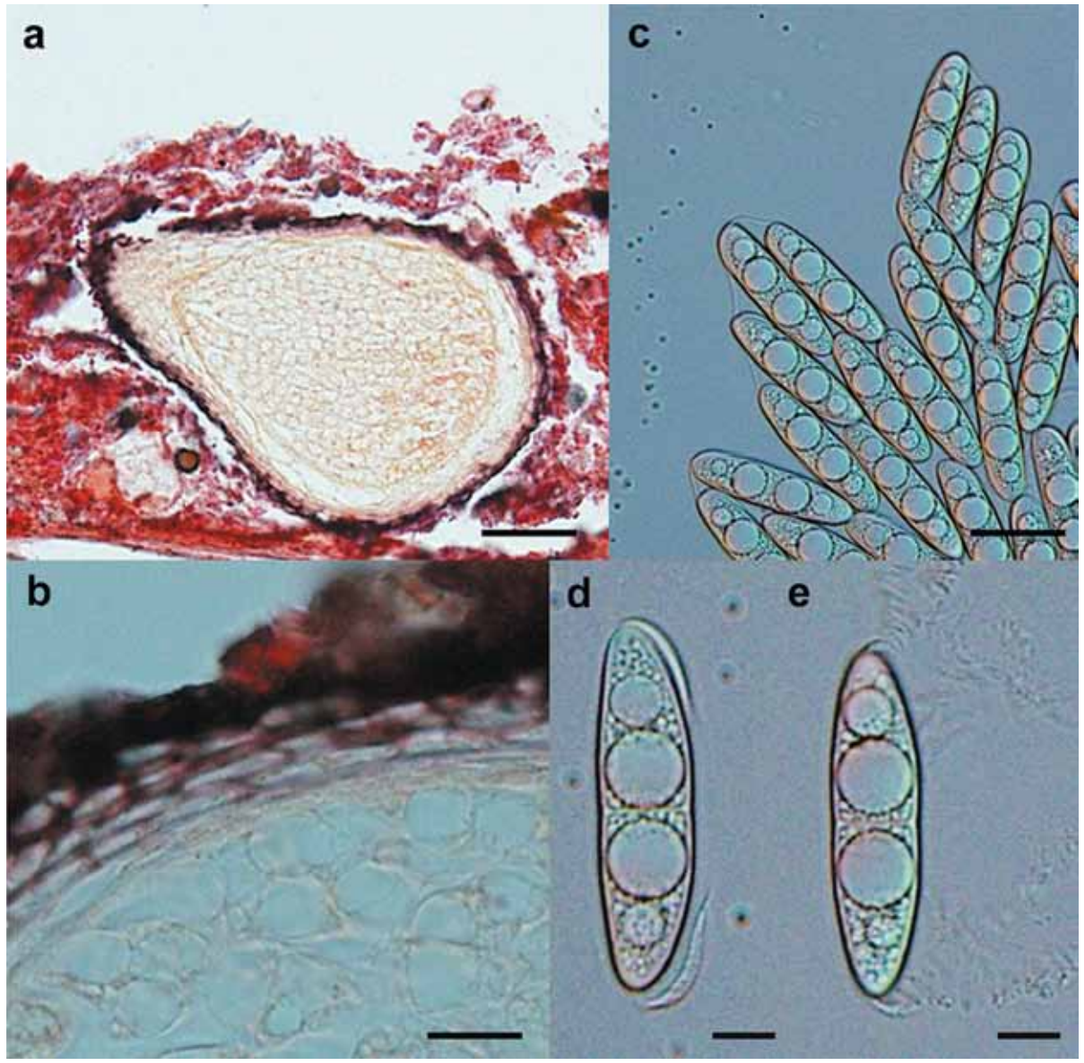

Figure 19. *Aniptodera lignatilis*. (a) Section of immersed, subglobose ascoma. (b) One-layered peridium, composed of elongate cells. (c) Mature, thin-walled asci. (d-e) Fusiform ascospore with bipolar hook-like appendages. Scale bar: a=50 µm; b, d, e=10 µm; c=30 µm.

Aniptodera salsuginosa Nakagiri & Tad. Ito, Mycol. Res. 98: 931 (1994)

Figure 20

Ascomata 92-112 µm high, 240-280 µm diam., ellipsoidal to flattened cortex, black upper side, hyaline bottom, membranous, immersed, solitary, ostiolate, papillate. Necks 280-520 µm long above the wood surface, 100-160 µm long in the wood, 35-48 µm diam., hyaline to subhyaline in the upper region, black in the lower region, periphysate. Peridium 6-10 µm thick, outer layer composed of black elongate cells, interspersed among host cells, inner layer of hyaline flat cells. Catenophyses present. Asci 76-90 × 12-14 µm, thin-walled, unitunicate, eight-spored, cylindrical to clavate, persistent, apex truncate with an apical thickening (ring), with an apical pore, plasmalemma retracted below the apex, pedicellate. Ascospores (12-)14-(16)-20(-23) × 4-(6)-7 µm, hyaline, ellipsoidal to fusiform, 1-septate, not constricted at the septum, appendaged. Appendages bipolar, 9-14 µm long, unfurling into threads in seawater.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Hong Kong, India, Japan, Malaysia, Taiwan.

DISTRIBUTION IN TAIWAN: Chiehting, Chungkang, Hungmao, Tsengwen.

COMMENTS: This species was originally described from Japan from mangrove wood of *Bruguiera gymnorrhiza* and *Rhizophora stylosa*. Nakagiri & Ito (1994) reported that the unfurling for the hamate, bipolar appendage is dependent on the salinity of the seawater. At salinities of 20-30 ‰, appendages are slow to unfurl, taking 15-40 minutes; in 10 ‰ seawater, they uncoil within 5 minutes; in 5 ‰ and in freshwater, the appendages are lost immediately without unfurling. Nakagiri & Ito (1994) suggest that this may be an adaptation to brackish water ecosystems, such as mangroves. In *A. salsuginosa*, the ascospores are discharged through a fissure between the apical disc and ascus wall and is unique within the genus.

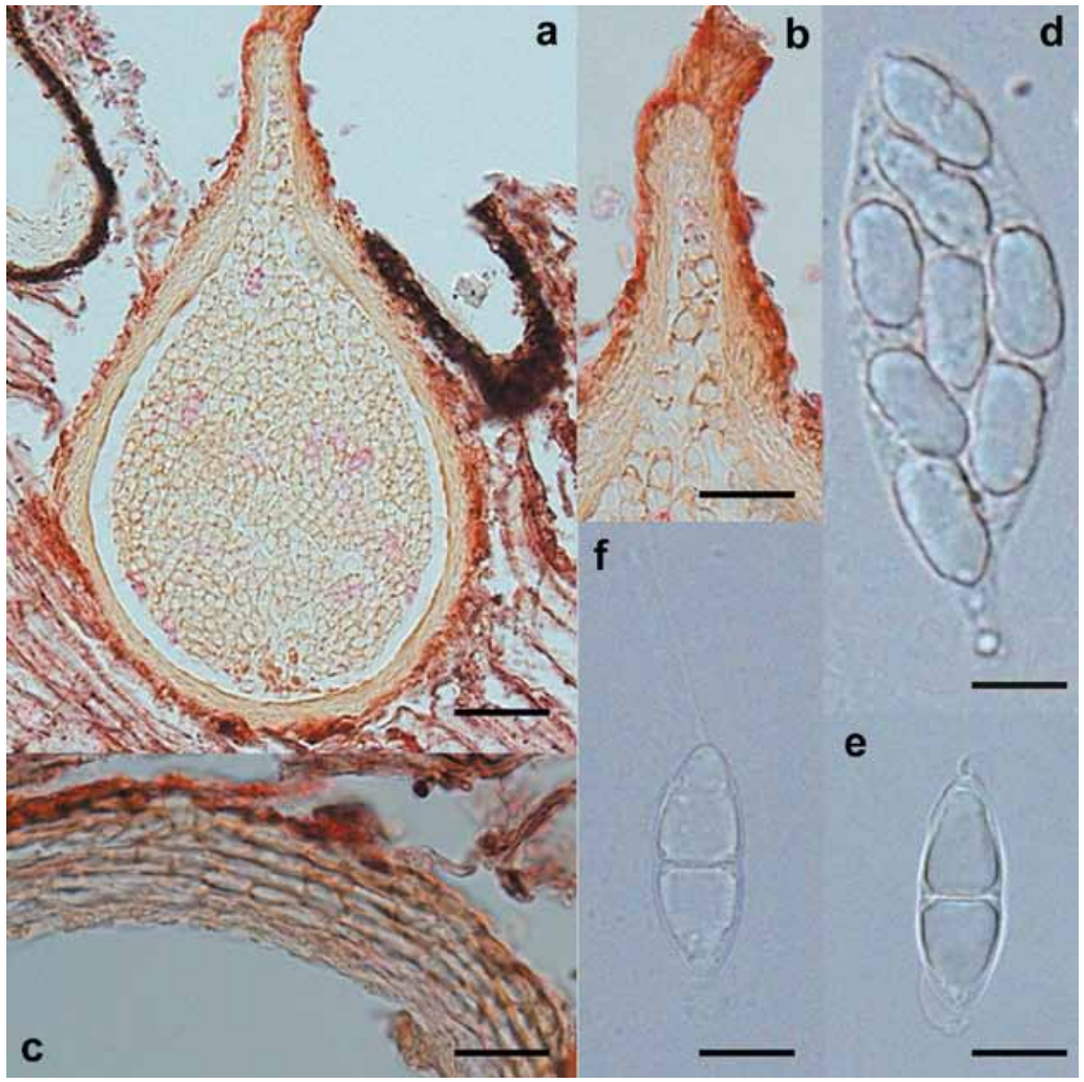

Figure 20. *Aniptodera salsuginosa.* (a) Section of immersed, subglobose ascoma. (b) Section of neck with periphyses. (c) One-layered peridium, composed of elongate cells. (d) Thin-walled clavate ascus with a flattened tip. (e-f) Ascospores with bipolar, unfurling appendages. Scale bar: a=50 µm; b=30 µm; c=20 µm; d, e, f=10 µm.

Antennospora Meyers, Mycologia 49: 501 (1957)
Type species: *Antennospora quadricornuta* (Cribb & J.W. Cribb) T.W. Johnson

Antennospora quadricornuta (Cribb & J.W. Cribb) T.W. Johnson, J. Elisha Mitchell Sci. Soc. 74: 46. 1958.
≡ *Halosphaeria quadricornuta* Cribb & J.W. Cribb, Univ. Queensl. Pap. Dep. Bot. 3: 99. 1956.
= *Antennospora caribbea* Meyers, Mycologia 49: 503. 1957.

Figure 21

Ascomata 130-260(-514) µm high, 140-285 µm diam., subglobose or ellipsoidal, immersed or becoming exposed, ostiolate, papillate, coriaceous or sub-carbonaceous, dark brown to black, often surrounded by dark brown hyphae, solitary or gregarious. Necks 70-560 µm long, 20-70(-93) µm diam., subconical or cylindrical, centric or eccentric, ostiolar canal indistinctly periphysate. Peridium 9-12.5 µm thick, composed of three or four layers of small, irregular, polygonal, thick-walled, elongate cells, merging more or less abruptly into the large-celled pseudoparenchyma of the venter. Pseudoparenchyma of thin-walled, large, polygonal or ellipsoidal, thin-walled cells filling venter of young ascomata. Asci eight-spored, clavate, pedunculate, unitunicate, thin-walled, without apical apparatus, deliquescing before ascospore maturity, developing at the base of the ascomata venter on a small-celled ascogenous tissue. Ascospores 20-35 × (6-)8-12 µm, ellipsoidal, 1-septate, not or slightly constricted at the septum, hyaline, appendaged, at each end two subterminal, cylindrical, attenuate, stiff appendages, 20-37 µm long, 1-2 µm diam., pairs of appendages at right angles to one another.

SUBSTRATA: dead mangrove wood, fern rachis, calcareous tubes of marine borers.

WORLDWIDE DISTRIBUTION: Antigua and Barbuda, Australia, Bahamas, Belize, Bermuda, Brunei, Colombia, Cuba, Haiti, Egypt, Fiji, Galapagos, Hong Kong, India, Japan, Kuwait, Liberia, Malaysia, Martinique, Mexico, Mozambique, Panama, Philippines, Puerto Rico, Republic and Trinidad and Tobago, Seychelles, Singapore, Taiwan, Tahiti, Thailand, USA, Venezuela, Yemen.

DISTRIBUTION IN TAIWAN: Aoku, Chichi (Hualien County), Chiehting, Chinmen, Hepingtao (Chilung City), Hungmao, Juipin (Taipei County), Lanyu (Taitung County), Ken-ting (Pingtung County), Lungdung (Taipei County), Nanliao (Hsinchu County), National Taiwan Ocean University (Chilung City), Sanhsientai (Taitung County), Tanshui, Yingkeshih (Ilan County).

COMMENTS: This is a widely distributed, tropical, lignicolous marine fungus, generally from oceanic waters. It can also be found on mangrove substrata (Schmit & Shearer 2003). It is currently a monotypic genus as *Antennospora salina* has been transferred to *Haiyanga* (Pang et al. 2008). It has been reported from a wide range of substrata: driftwood, test panels of different timbers, dead mangrove roots, fruits, calcareous tubes of molluscs (tubes of shipworms) and mantle of tunicates.

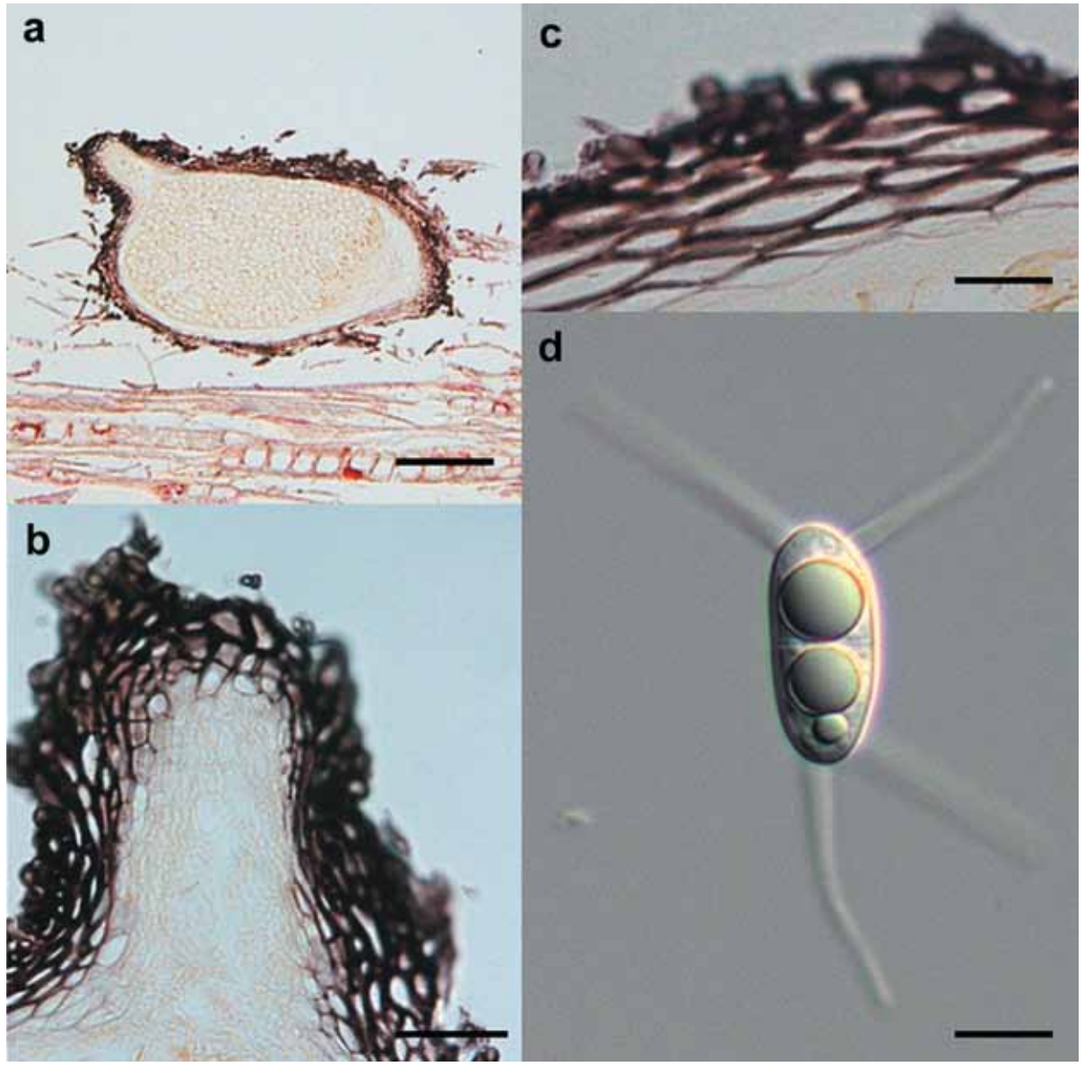

Figure 21. *Antennospora quadricornuta.* (a) Section of erumpent, subglobose ascoma. (b) Ascoma neck with ostiolar canal filled with pseudoparenchymatous cells. (c) One-layered peridium, composed of elongate cells. (d) Ellipsoidal ascospore with two subterminal, cylindrical appendages at each end. Scale bar: a=100 µm; b=20 µm; c, d=10 µm.

Ceriosporopsis Linder, Farlowia 1: 408 (1944)
Type species: *Ceriosporopsis halima* Linder

Ceriosporopsis halima Linder, Farlowia 1: 409 (1944)

Figure 22

Ascomata 80-481 µm high, 130-503 µm diam., subglobose, ellipsoidal or cylindrical, immersed or superficial, ostiolate, papillate, coriaceous, dark brown to black, reddish-brown when empty, solitary or gregarious. Necks up to 706 µm long, 16-30(-56) µm diam., centric or eccentric, cylindrical, ostiolar canal at first filled with a small-celled pseudoparenchyma. Peridium 8-26 µm thick, composed of three to four (to ten) layers of thin-walled, elongate cells with large lumina, merging into the pseudoparenchyma of the venter. Pseudoparenchyma of thin-walled, polygonal cells filling venter of young ascomata. Asci 56-89 × 14-22 µm, eight-spored, ellipsoidal, subclavate or subfusiform, short pedunculate, unitunicate, thin-walled, deliquescing before ascospore maturity, without apical apparatus, developing at the base of the ascoma venter. Ascospores 18-27(-35) × 6-12 µm, ellipsoidal to fusiform-ellipsoidal, 1-septate, slightly or strongly constricted at the septum, hyaline, surrounded by a gelatinous, exosporic sheath that is pierced at each apex by an outward growing appendage. Appendages 5-8 µm diam., of variable length, terminal, simple, subcylindrical, tapering, finally becoming viscous and filamentous. Chlamydospores from pure cultures 6-17 µm diam., reddish-brown, catenulate, chains up to 90 µm long, up to 13-celled, terminal, simple or rarely ramose, curved, frequently ½ or ¾ times coiled, single cells globose, ellipsoidal or subcylindrical, sometimes increasing in diameter from base to apex.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Argentina, Australia, Bahamas, Brazil, Bulgaria, Canada, China, Denmark, England, Egypt, France, Germany, Greece, Hong Kong, Iceland, India, Ireland, Isle of Man, Italy, Japan, Kuwait, Malaysia, Mexico, New Zealand, Norway, Peru, Poland, Portugal, Republic of Trinidad and Tobago, Russia, Scotland, Seychelles, Singapore, South Africa, Spain, Sri Lanka, Sweden, Taiwan, Thailand, USA, Wales.

DISTRIBUTION IN TAIWAN: Hsinwu, Aoku, Chichi (Hualien County), Chinmen, Chinshan (Taipei County), Hemei (Taipei County), Hepingtao (Chilung City), Hungmao, Juipin (Taipei County), Kuanyin (Taoyuan County), Lanyu (Taitung County), Lungdung (Taipei County), Nanliao (Hsinchu County), Nanya (Taipei County), National Taiwan Ocean University (Chilung City), Shihcheng (Ilan County), Tanshui, Tungpeichiao (Chilung City), Yenliao (Hualien County), Yingkeshih (Ilan County).

COMMENTS: This is a cosmopolitan species and it has been reported from the Atlantic, Pacific and Indian Oceans. It occurs on a wide range of timbers (e.g. oak, spruce), but generally on coniferous wood in oceanic waters. It is closely related to *C. cambrensis*, and differs slightly in the dimension of the ascospores (Wilson 1954). A wider range of isolates from different geographical locations is required to determine if *C. halima* represents a complex of species. The ultrastructure of the ascospores and the ontogeny of the polar appendages have been studied at the SEM and TEM level (Johnson et al. 1987, Jones 1994).

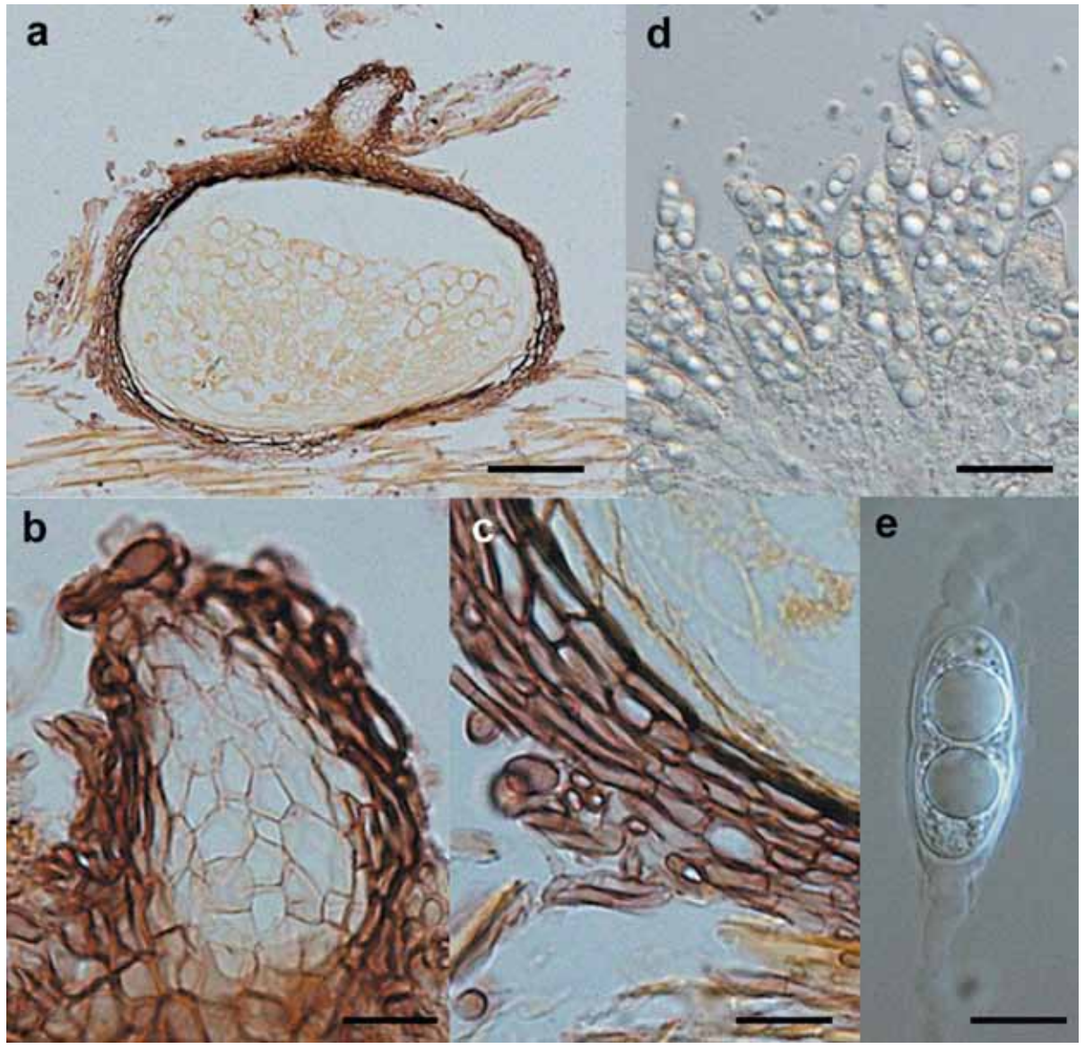

Figure 22. *Ceriosporopsis halima.* (a) Section of superficial, ellipsoidal ascoma. (b) Ostiolar canal filled with pseudoparenchymatous cells. (c) One-layered peridium, composed of elongate cells. (d) Clavate, deliquescing asci. (e) Ascospore with bipolar appendages emerging through a gelatinous sheath. Scale bar: a=50 µm; b, c, e=10 µm; d=30 µm.

Corollospora Werderm., Notizbl. Bot. Gart. Berlin-Dahlem 8: 248 (1922)
Type species: *Corollospora maritima* Werderm.

Corollospora maritima Werderm., Notizblatt des Königl. bot. Gartens u. Museum zu Berlin 8: 248 (1922)

Figure 23

Ascomata 98-400 µm diam., globose or subglobose, superficial or partly immersed, often seated with subicula on grains of sand or other hard surfaces, with or without ostioles, papillate or epapillate, carbonaceous, metallic black, solitary or gregarious. Papillae, when present, 17-72 µm long, 21-55 µm diam., conical or subcylindrical, apically, laterally, or near the basal subiculum and pointing downward. Peridium 12-40 µm thick, two-layered, outer layer of dark, thick-walled cells of *textura angularis* and inner layer of thick-walled, elongate cells. Pseudoparenchyma of thin-walled, polygonal or rounded cells filling venter of young ascomata, deliquescing at ascospore maturity. Asci 72-140 × 17-50 µm, eight-spored, fusiform or subclavate, sometimes apiculate, short stipitate, unitunicate, thin-walled, without apical apparatus, early deliquescing. Ascospores 20-34(-53) × (4-)6-11(-14) µm, fusiform or subellipsoidal, 1-septate, constricted at the septum, hyaline, appendaged, at both ends with a single, terminal appendage, 7-17.5(-23) × 1-1.5 µm, spine- or thorn-like, slender, attenuate, rigid, straight or somewhat curved, at the tip with a refractive body and bearing a small cap or fibers, 8-10 µm long, that develop by peeling off of the exosporium, peritrichous around the septum with 8 or more flexible ribbon-shaped setae, 5-16(-20) × 1 µm, which develop by fragmentation of the exosporium, setae attached to a narrow equatorial, belt-like thickening of the wall.

SUBSTRATA: dead mangrove wood, dead mangrove leaves, dead seaweeds, dead seagrasses, sand.

WORLDWIDE DISTRIBUTION: Argentina, Australia, Bahamas, Belize, Bermuda, Brazil, Brunei, Bulgaria, Canada, Columbia, Denmark, England, Egypt, Fiji, France, Germany, Hong Kong, Iceland, India, Ireland, Italy, Japan, Kuwait, Malaysia, Martinique, Mexico, New Zealand, Peru, Portugal, Republic of Trinidad and Tobago, Samoa, Scotland, Seychelles, Sierra Leone, Singapore, Society Islands, South Africa, Sri Lanka, Spain, Sweden, Taiwan, Thailand, USA, Wales, Former Yugoslavia.

DISTRIBUTION IN TAIWAN: Aoku, Chinmen, Chinshan (Taipei County), Chungkang, Hsinwu, Hungmao, Kenting (Pingtung County), Lanyu (Taitung County), Tanshui, Tungpeichiao (Taipei County).

COMMENTS: This is one of the most commonly collected species on wood, often associated with sand (Cuomo et al. 1988, Sundari et al. 1996, Lintott & Lintott 2002). However, the monophyly of this cosmopolitan species has been questioned (Kohlmeyer & Charles 1981, Roberts et al. 1996, Abdel-Wahab et al. 2009). Geographical races were first reported by Bebout et al. (1987), based on temperature requirements for growth and at the molecular level (Roberts et al. 1996). Abdel-Wahab et al. (2009) described two new species (*C. anglusa*, *C. portsaidica*) that are morphologically similar to *C. maritima*, and greater care is now required in the identification of tropical collections of *C. maritima*-like species. Ascospore appendage ontogeny has been investigated at the SEM and TEM level, with polar appendages formed by outgrowth of the episporium and mesosporium, and the secondary appendages are formed by fragmentation of the exosporium (Jones et al. 1983).

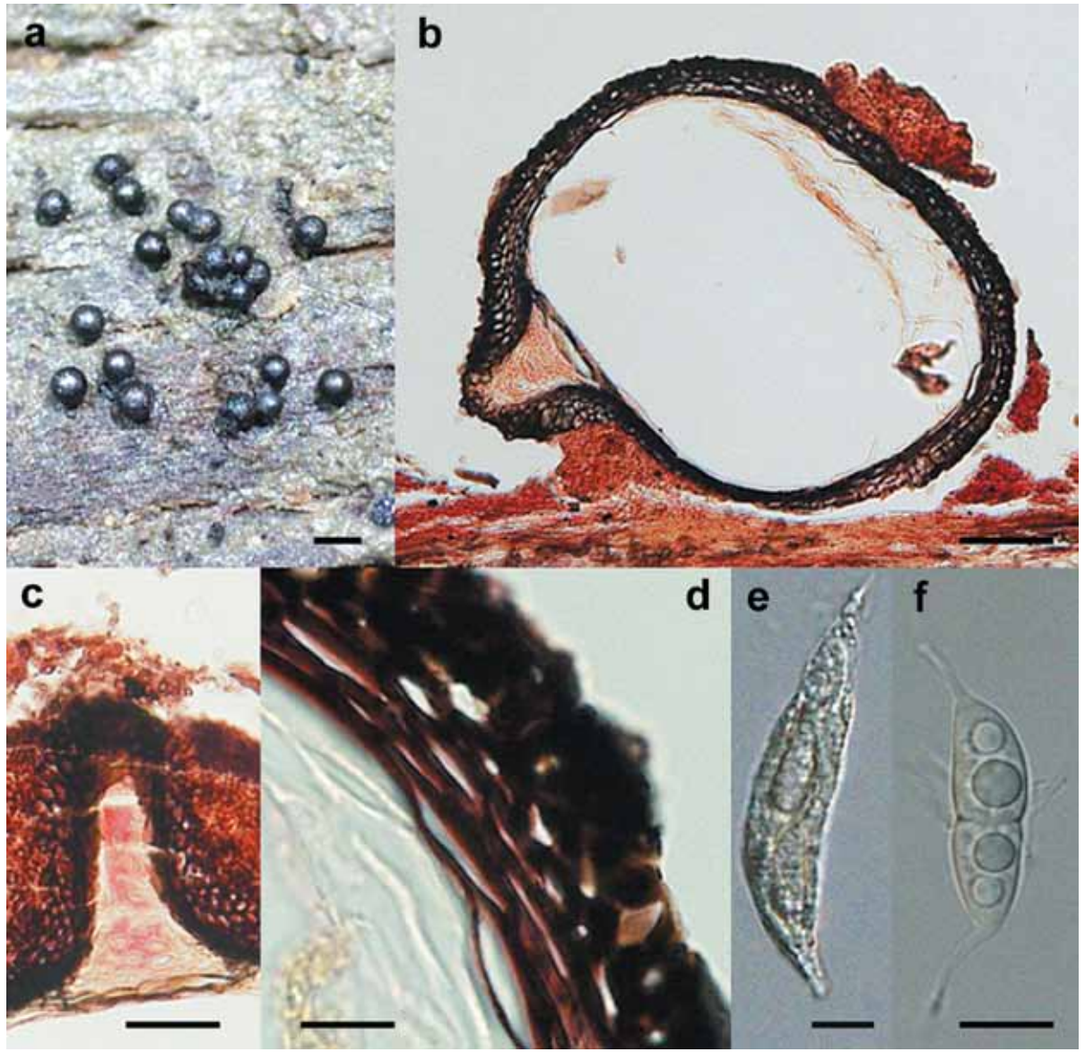

Figure 23. *Corollospora maritima.* (a) A group of ascomata on wood surface. (b) Section of superficial, globose ascoma. (c) Ascoma papilla filled with pseudoparenchymatous cells. (d) Two-layered peridium, outer layer composed of cells of *textura angularis*, inner layer composed of elongate cells. (e) Clavate, thin-walled ascus. (f) Fusiform ascospore with bipolar, thorn-like appendages bearing fibres and equatorial setae. Scale bar: a=300 µm; b=50 µm; c, e=30 µm; d, f=10 µm.

Haiyanga K.L. Pang & E.B.G. Jones, The Raffles Bull. Zool. 19: 8 (2008)
Type species: *Haiyanga salina* (Meyers) K.L. Pang & E.B.G. Jones

Haiyanga salina (Meyers) K.L. Pang & E.B.G. Jones, The Raffles Bull. Zool. 19: 8 (2008))
≡ *Arenariomyces salina* Meyers, Mycologia 49: 505 (1957)
= *Remispora salina* (Meyers) Kohlm., Mycologia 60: 262 (1968)
= *Halosphaeria salina* (Meyers) Kohlm., Can. J. Bot. 50: 1957 (1972)
=*Antennospora salina* (Meyers) Yusoff, E. B. G. Jones & S. T. Moss, Can. J. Bot. 72: 1003 (1994)

Figure 24

Ascomata 100-425 µm diam., globose or subcylindrical, immersed, partly immersed, or becoming exposed, ostiolate, papillate, membranous or coriaceous, dark brown to black, surrounded by brown hyphae, solitary or gregarious. Necks 68-165 µm long, 28-52 µm diam., cylindrical or conical, ostiolar canal in the upper part filled with a thin-walled pseudoparenchyma, in the lower part with thick-walled, hyaline cells. Peridium 8-12 µm thick, composed of three to five layers of thick-walled, elongate cells with large lumina, merging into the pseudoparenchyma of the venter. Pseudoparenchyma of thin-walled, large, polygonal to ellipsoidal cells, filling venter of young ascoma. Asci 60-80 × 29-41 µm, eight-spored, clavate or ellipsoidal, short pedunculate, unitunicate, thin-walled, without apical apparatus, early deliquescing, developing at the base of the ascoma venter. Ascospores 19-28 × 8-13.5 µm, ellipsoidal, 1-septate, not or slightly constricted at the septum, hyaline, appendaged, at each end three or four (rarely five) radiating appendages, developing by fragmentation of the exosporium, appendages 12-19 µm long, 1.5-2.5 µm diam. at the base, subterminal, obclavate, curved, attenuate, semirigid, indistinctly spoon-shaped at the base, inconspicuously striate by fiber-like elements embedded in the subgelatinous matrix.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Bahamas, Belize, Colombia, Hong Kong, India, Liberia, Malaysia, Mexico, Philippines, Republic of Trinidad of Tobago, South Africa, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Chichi (Hualien County), Chinmen, Chinshan (Taipei County), Hemei (Taipei County), Hsinwu, Juipin (Taipei County), Lungdung (Taipei County), Nanya (Taipei County), National Taiwan Ocean University (Chilung City), Pawengweng (Hualien County), Sanhsientai (Taitung County), Tanshui, Toucheng (Ilan County), Tungpeichiao (Taipei County), Yenliao (Hualien County), Yingkeshih (Ilan County).

COMMENTS: Initially described by Meyers (1957) as *Arenariomyces salina*, the identification of this species has been in doubt as is demonstrated by the long synonymy above. The confusion is based on the mode of development of the polar appendages. Kohlmeyer (1968) referred the species to *Remispora* (Kohlmeyer 1972), but later transferred all *Remispora* species to *Halosphaeria*. All these genera possess ascospores with 2-4 polar appendages, but an ultrastructural study by Yusoff et al. (1994) demonstrated that in *H. salina*, the appendages arise from the mesosporium with the apical portion containing mucilage that is released when mounted in water. In *Remispora*, appendages arise by fragmentation of an exosporium, while in *Arenariomyces*, they are outgrowths of the spore wall, each appendage having a bulbous base with a unique substructure (Johnson et al. 1984). The species has been collected on a wide range of substrata, including intertidal and drift wood, test panels (e.g. pine, beech), fruits of *Cocos nucifera* and lining of teredinid tubes (shipworm).

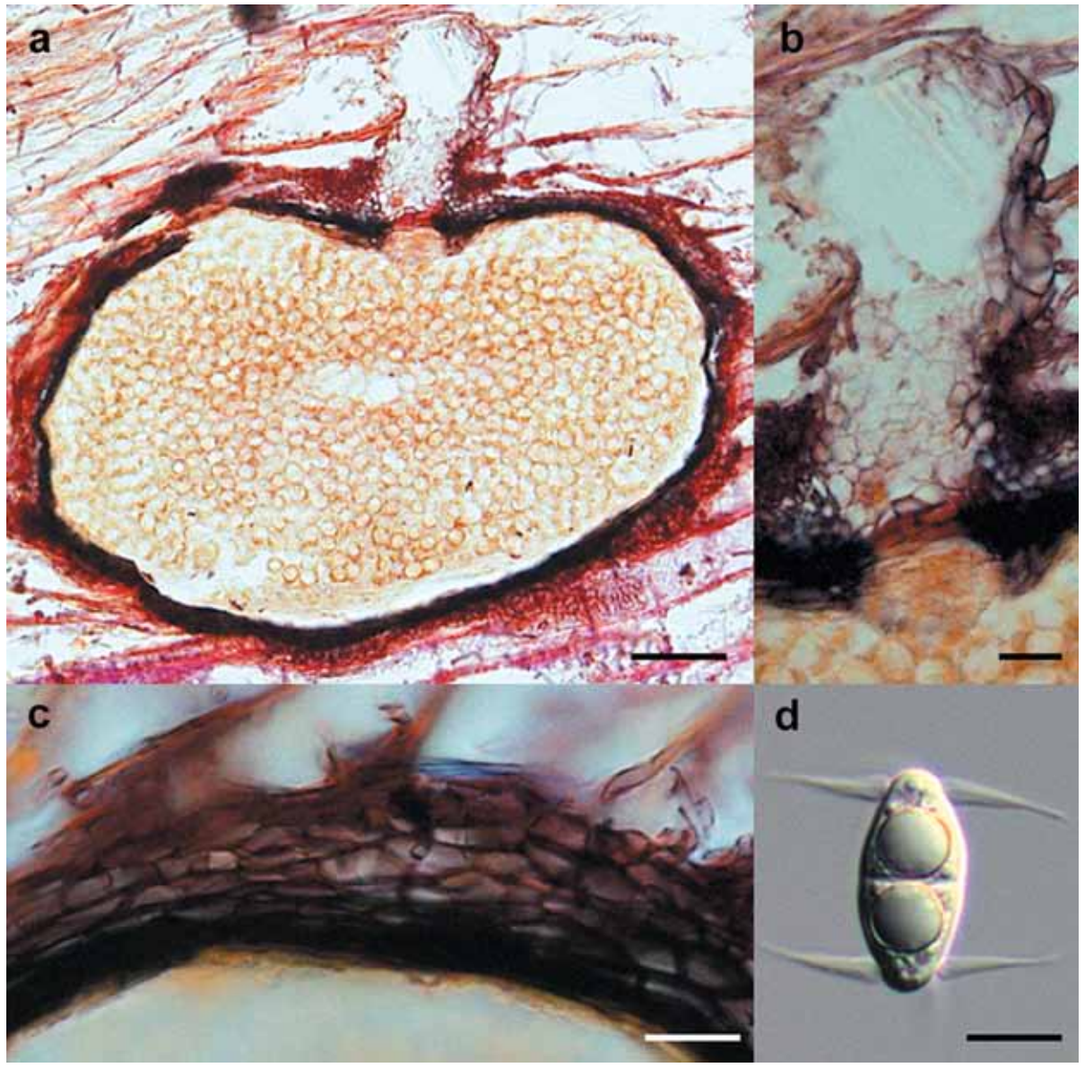

Figure 24. *Haiyanga salina.* (a) Section of immersed, subglobose ascoma. (b) Ascoma neck filled with pseudoparenchymatous cells. (c) One-layered peridium of cells of *textura angularis*. (d) Ascospore with bipolar, subterminal, obclavate, curved, attenuate appendages. Scale bar: a=50 µm; b, c, d=10 µm.

Halosarpheia Kohlm. & E. Kohlm., Trans. Br. Mycol. Soc. 68: 208 (1977)
Type species: *Halosarpheia fibrosa* Kohlm. & E. Kohlm.

Halosarpheia fibrosa Kohlm. & E. Kohlm., Trans. Br. Mycol. Soc. 68: 208 (1977)

Figure 25

Ascomata 380-440 µm high, 340-450 µm diam., obpyriform to subglobose, brown to black, immersed part lighter-colored than the exposed neck and top, coriaceous, immersed or partly immersed, ostiolate, papillate. Necks 140-530 µm long, 130-200 µm diam. at the base, 90-110 µm diam. at the apex, periphysate. Peridium 40-60 µm thick, two-layered, forming a *textura angularis*, outer layer composed of a few layers of polygonal or subglobose dark or light brown cells with small lumina, inner layer composed of 7-10 layers of hyaline cells with large lumina. Asci 160-220 × 34-46 µm, thin-walled, unitunicate, eight-spored, clavate, persistent, thick-walled below the apex, pedicellate. Catenophyses present. Ascospores 32-44 × 18-24 µm, hyaline, broad ellipsoidal, 1-septate, not constricted at the septum, appendaged. Appendages 3-5 µm thick × 6-8(-11) µm diam., bipolar, unfurling into fine thread in water, 0.5-1 µm diam.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Australia, Belize, Bermuda, Brazil, Brunei, China, Egypt, Hong Kong, India, Japan, Kuwait, Macau, Malaysia, Mauritius, Seychelles, South Africa, Taiwan, USA.

DISTRIBUTION IN TAIWAN: Aoku, Chungkang, Fangwan, Haomeiliao, Hungmao, Patoutzu (Chilung City), Peimeng, Tanshui.

COMMENTS: *Halosarpheia* species occur in freshwater, brackish and marine habitats and currently nine species have been described. Sequence data have shown that the genus is polyphyletic and many species have been transferred to new genera: *Ascosacculus*, *Magnisphaera*, *Natantispora*, *Oceanitis*, *Panorbis* and *Saagaromyces* (Campbell et al. 2003, Pang et al. 2003b, Jones et al. 2009). Currently, only three species are recognised in *Halosarpheia sensu stricto*, with a further six species awaiting study at the molecular level. *Halosarpheia fibrosa* was described from a mangrove in the Bahamas (Kohlmeyer & Kohlmeyer 1977) and subsequently found to be widespread in its geographical distribution. It is not a common species and has not been found to colonize decorticated wood exposed in mangrove habitats, suggesting that it is not an early colonizer and perhaps needs the presence of bark for growth.

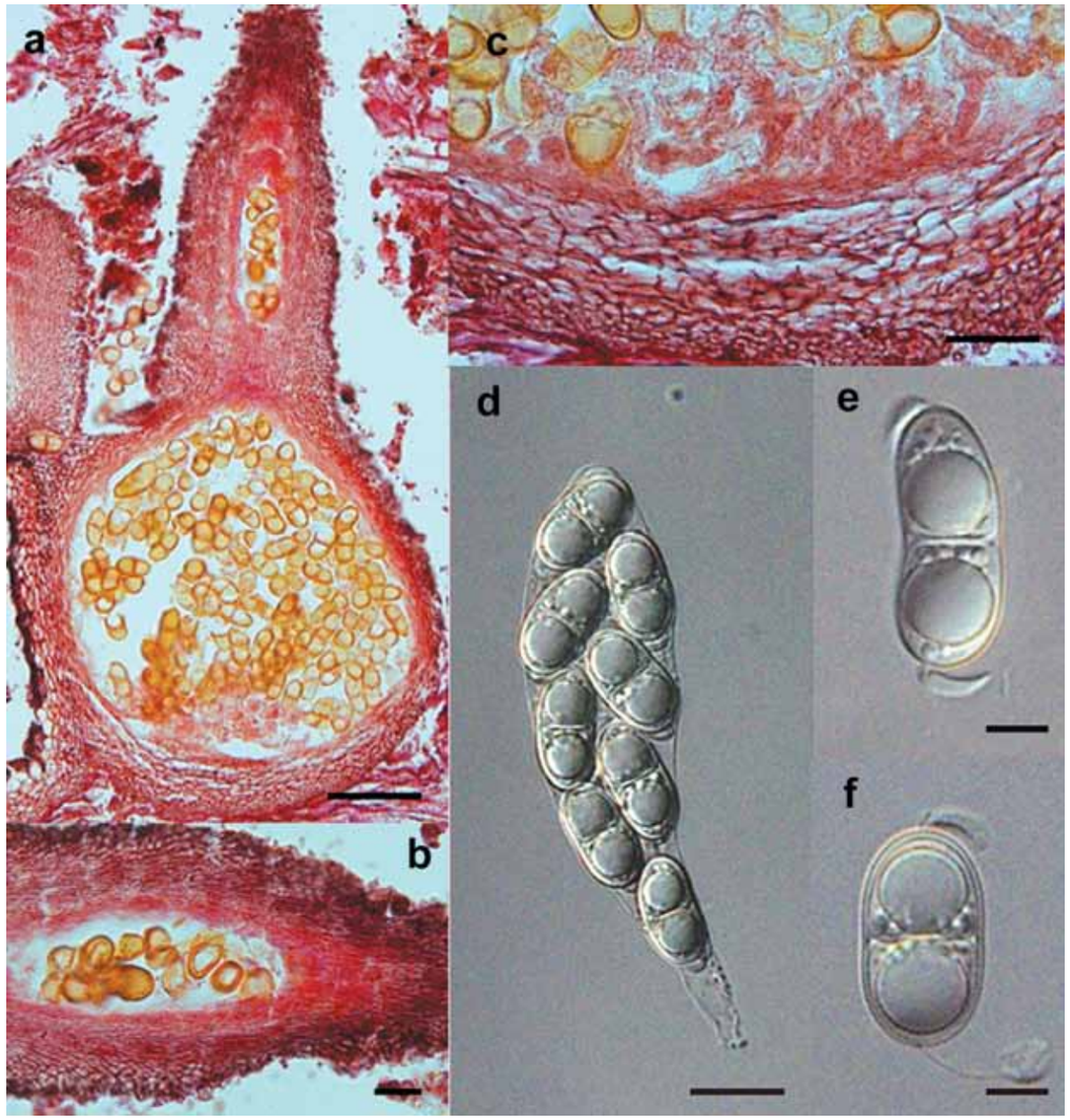

Figure 25. *Halosarpheia fibrosa.* (a) Section of globose ascoma with a long neck. (b) Ascoma neck with short periphyses. (c) Two-layered peridium, outer layer of small cells of *textura angularis*, inner layer of large cells of *textura angularis*. (d) Mature, thin-walled, clavate ascus. (e) Ascospore with bipolar appendages. (f) Unfurling polar appendages. Scale bar: a=100 µm; b, c, d=30 µm; e, f=10 µm.

Halosarpheia marina (Cribb & J.W. Cribb) Kohlm., P.S.Z.N.I. Mar. Ecol. 5: 345 (1984)
≡ *Gnomonia marina* Cribb & J.W. Cribb, Pap. Univ. Queensl. Dept. Bot. 3: 100 (1956)

Figure 26

Ascomata 140-300 µm diam., bottle-shaped, subhyaline, light brown or fuscous, membranous, mostly immersed, solitary or gregarious, ostiolate, papillate. Necks 100-560 µm long, 42-140 µm diam., lighter colored than the ascomata, periphysate. Peridium one-layered, composed of cells of *textura angularis* with large lumina. Catenophyses present. Asci 95-132 × 18-28 µm, thin-walled, unitunicate, eight-spored, clavate to subcylindrical, persistent, apically truncate, thickened at the apex, with an apical pore, short pedicellate. Ascospores: 18-23(-26) × 9-12 µm, hyaline, cylindrical-ellipsoidal, 1-septate, not or slightly constricted at the septum, appendaged. Appendages 2-3 µm long, bipolar, unfurling into fine thread in water.

SUBSTRATA: dead mangrove wood, fern rachis.

WORLDWIDE DISTRIBUTION: Australia, Brunei, China, Egypt, Hong Kong, India, Indonesia, Liberia, Malaysia, Mauritius, Mexico, Philippines, Samoa, Seychelles, Singapore, South Africa, Thailand, Taiwan, USA.

DISTRIBUTION IN TAIWAN: Aoku, Chinmen, Chungkang, Hemei (Taipei County), Hungmao, Nanya (Taipei County), Peimeng, Tanshui, Tunghsin.

COMMENTS: This is a species that has been widely collected, primarily in tropical locations on mangrove wood. Originally described as a *Gnomonia* species, its ascospores were shown to possess polar unfurling appendages and therefore, transferred to *Halosarpheia* (Kohlmeyer 1984). One *Halosarpheia marina* sequence is available and it was found to be related to *Nimbospora effusa* (Campbell et al. 2003). However, many attempts have been made to isolate this species but the ascospores did not germinate and direct extraction of DNA from spores has not been successful. Therefore, its taxonomic position could not be resolved at this stage.

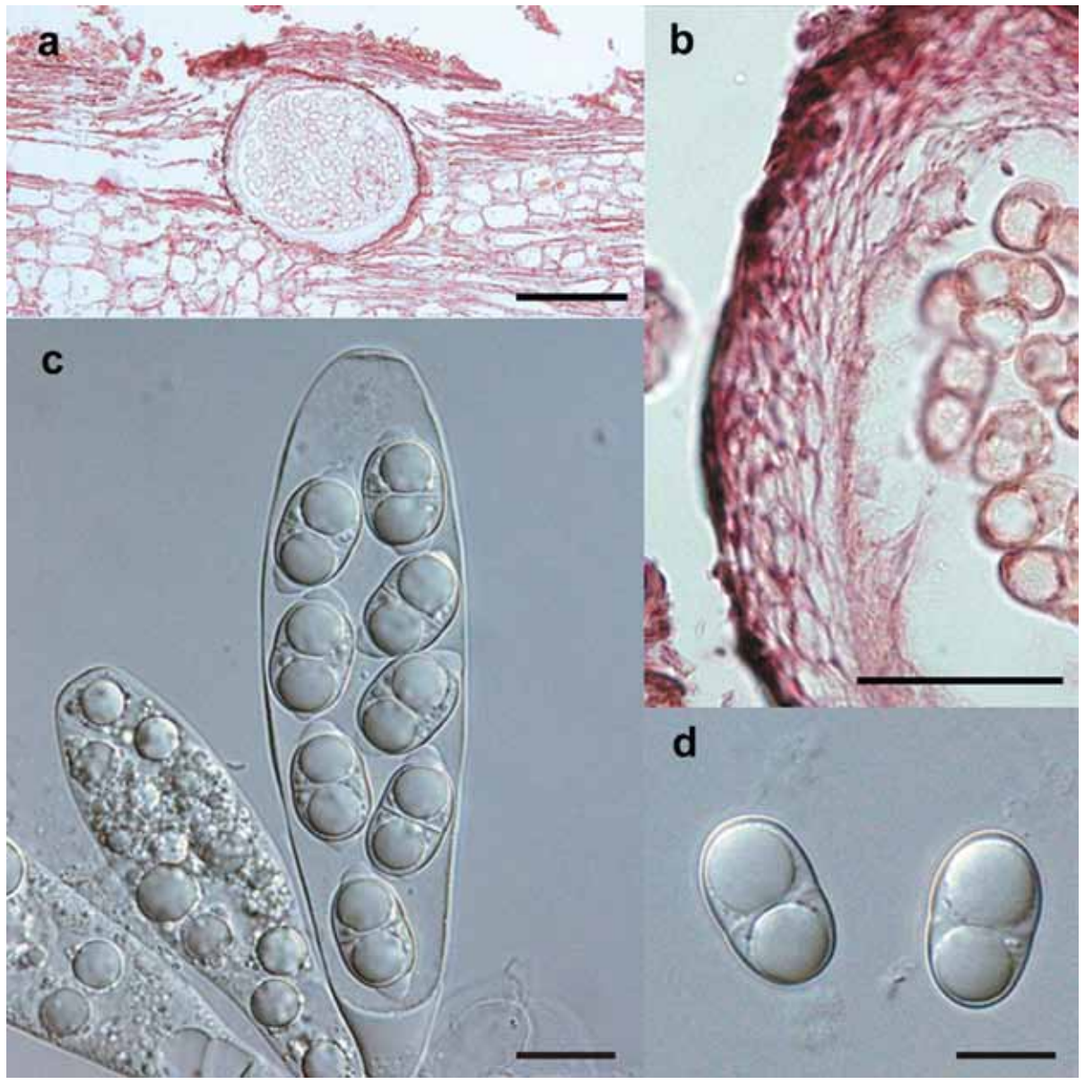

Figure 26. *Halosarpheia marina.* (a) Section of immersed ascoma. (b) One-layered peridium of cells of *textura angularis* with large lumina. (c) Mature ascus with a flattened apex and a pore and eight ascospores with bipolar appendages. (d) Ellipsoidal ascospores with rounded ends with unfurling appendages. Scale bar: a=100 µm; b=30 µm; c, d=10 µm.

Lignincola Höhnk, Veröff. Inst. Meeresf. Bremerhaven 3: 216 (1955)
Type species: *Lignincola laevis* Höhnk

Lignincola laevis Höhnk, Veröff. Inst. Meeresf. Bremerhaven 3: 216 (1955)

Figure 27

Ascomata 125-250(-386) µm diam., subglobose to ellipsoidal, hyaline, light brown, fuscous to blackish, coriaceous, superficial or immersed, solitary or gregarious, ostiolate, papillate. Necks up to 4 mm long, 25-40 µm diam., periphyses absent. Peridium 13-16 µm thick, composed of two to five layers of elongate, thick-walled cells with large lumina, forming a *textura angularis*. Catenophyses present. Asci 49-69 × 15-20 µm, thin-walled, unitunicate, eight-spored, clavate to subfusiform, persistent, sometimes slightly thickened at the apex, central part of ascus swelling in water, short pedicellate. Ascospores (13-) 16-24 × (5-)6-8 µm, hyaline, ellipsoidal, thin-walled, 1-septate, slightly constricted at the septum, not appendaged.

SUBSTRATA: dead mangrove wood, dead mangrove leaves, dead marsh grasses, fern rachis.

WORLDWIDE DISTRIBUTION: Aldabra, Andaman Islands, Australia, Belize, Bermuda, Brazil, Brunei, Canada, Cayman Islands, China, England, Egypt, Fiji, Germany, Guatemala, Hong Kong, Iceland, India, Indonesia, Japan, Macau, Malaysia, Maldives, Martinique, Mauritius, Mexico, Nicobar Islands, Philippines, Portugal, Republic of Trinidad and Tobago, Seychelles, Singapore, Society Islands, South Africa, Spain, Sweden, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Aoku, Chiehting, Chinmen, Chinshan (Taipei County), Chungkang, Fangwan, Fengpin (Hualien County), Haishanku, Haomeiliao, Hemei (Taipei County), Hungmao, Hsinwu, Lanyu (Taitung County), Nanliao (Hsinchu County), Nanya (Taipei County), National Taiwan Ocean University (Chilung City), Peimeng, Putzu, Sanhsientai (Taitung County), Ssutsao, Taan (Taichung County), Tanshui, Toucheng (Ilan County), Tungpeichiao (Taipei County), Yingkeshih (Ilan County).

COMMENTS: *Lignincola laevis* is a cosmopolitan species, widely distributed in the Atlantic, Indian and Pacific Oceans (Pang et al. 2003b). *Lignincola laevis* occurs on wide range of substrata and is a common species on mangrove wood, especially twigs with intact bark. It has been shown to be an early colonizer of wood exposed in mangroves (Leong et al. 1988, Tan et al. 1989, Alias & Jones 2000). Currently, two other species are referred to the genus: *L. nypae* and *L. tropica*. The taxonomic position of the latter has become confused as it was originally described with an ascus with an apical pore (Kohlmeyer 1984). However, Kohlmeyer & Volkmann-Kohlmeyer (1988) revised their description of the species to asci lacking an apical pore. Clearly, this species does not belong in *Lignincola* and further taxon sampling is required (Pang et al. 2003b).

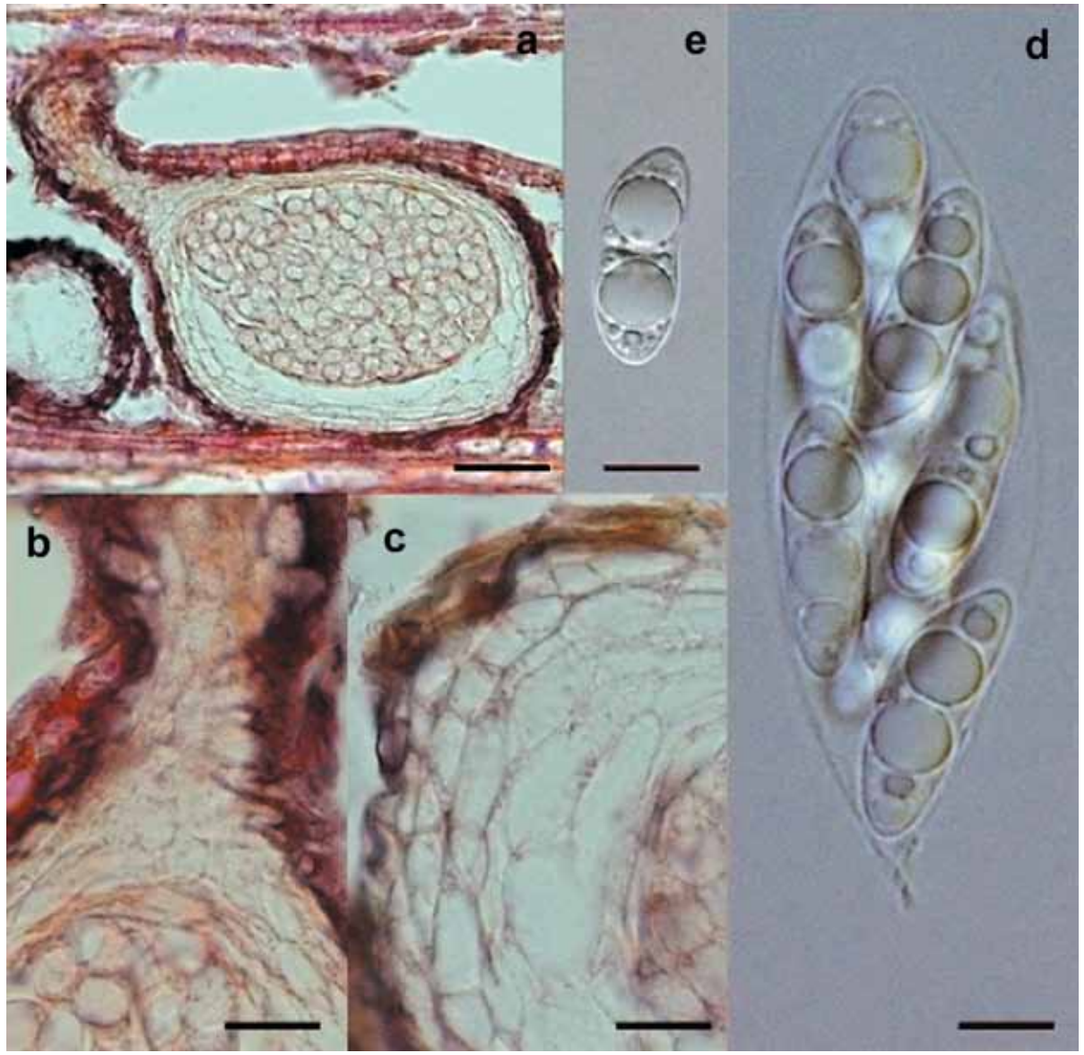

Figure 27. *Lignincola laevis*. (a) Section of immersed ascoma. (b) Ascoma neck filled with pseudoparenchymatous cells. (c) One-layered peridium of elongate cells of *textura angularis*. (d) Clavate, thin-walled ascus with a short stalk. (e) Thin-walled, bicelled ascospore. Scale bar: a=30 µm; b, c, d, e=10 µm.

Natantispora J. Campb., J.L. Anderson & Shearer, Mycologia 95: 543 (2003)
Type species: *Natantispora retorquens* (Shearer & J.L. Crane) J. Campb., J.L. Anderson & Shearer

Natantispora retorquens (Shearer & J.L. Crane) J. Campb., J.L. Anderson & Shearer, Mycologia 95: 543 (2003)
≡ *Halosarpheia retorquens* Shearer & J.L. Crane, Bot. Mar. 23: 608 (1980)

Figure 28

Ascomata 150-(230)-326 µm high, 150-(222)-366 µm diam., globose to subglobose, hyaline at first becoming black, membranous, superficial or immersed, solitary or gregarious, ostiolate. Necks 108-(269)-564 µm long, 14-(31)-50 µm diam., dark at base, hyaline at apex, periphysate. Peridium pseudoparenchymatous, multilayered, brown to black, composed of elongate cells. Catenophyses present. Asci 53-(80)-144 × 14-(18)-24 µm, thin-walled, unitunicate, eight-spored, clavate, deliquescing before or at maturity. Ascospores 20-(27)-33 × 7-(8)-11 µm, hyaline, ellipsoidal, thin-walled, 1-septate, not constricted at the septum, appendaged. Appendages bipolar, hamate, longer than the mid-septum, unfurling into fine thread in water.

SUBSTRATA: dead mangrove wood, dead mangrove leaves, fern rachis.

WORLDWIDE DISTRIBUTION: Australia, Brunei, Canada, China, Hong Kong, India, Macau, Malaysia, Mauritius, Philippines, Portugal, Singapore, South Africa, Sri Lanka, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Hemei (Taipei County), Hungmao, Shihcheng (Ilan County), Tanshui, Yingkeshih (Ilan County).

COMMENTS: This is a species known from a variety of substrata, from decaying culms of *Spartina* in temperate climates, to woody tissue of mangrove trees in the tropics. Originally described as a *Halosarpheia* species, it was transferred to *Natantispora* based on molecular data, although it differs slightly from other *Halosarpheia* species in the morphology of ascospores, in particular the long bipolar appendages that extend to the mid-septum of the spore (Campbell et al. 2003). Mouzouras (1986) has shown that this species causes soft-rot attack of wood.

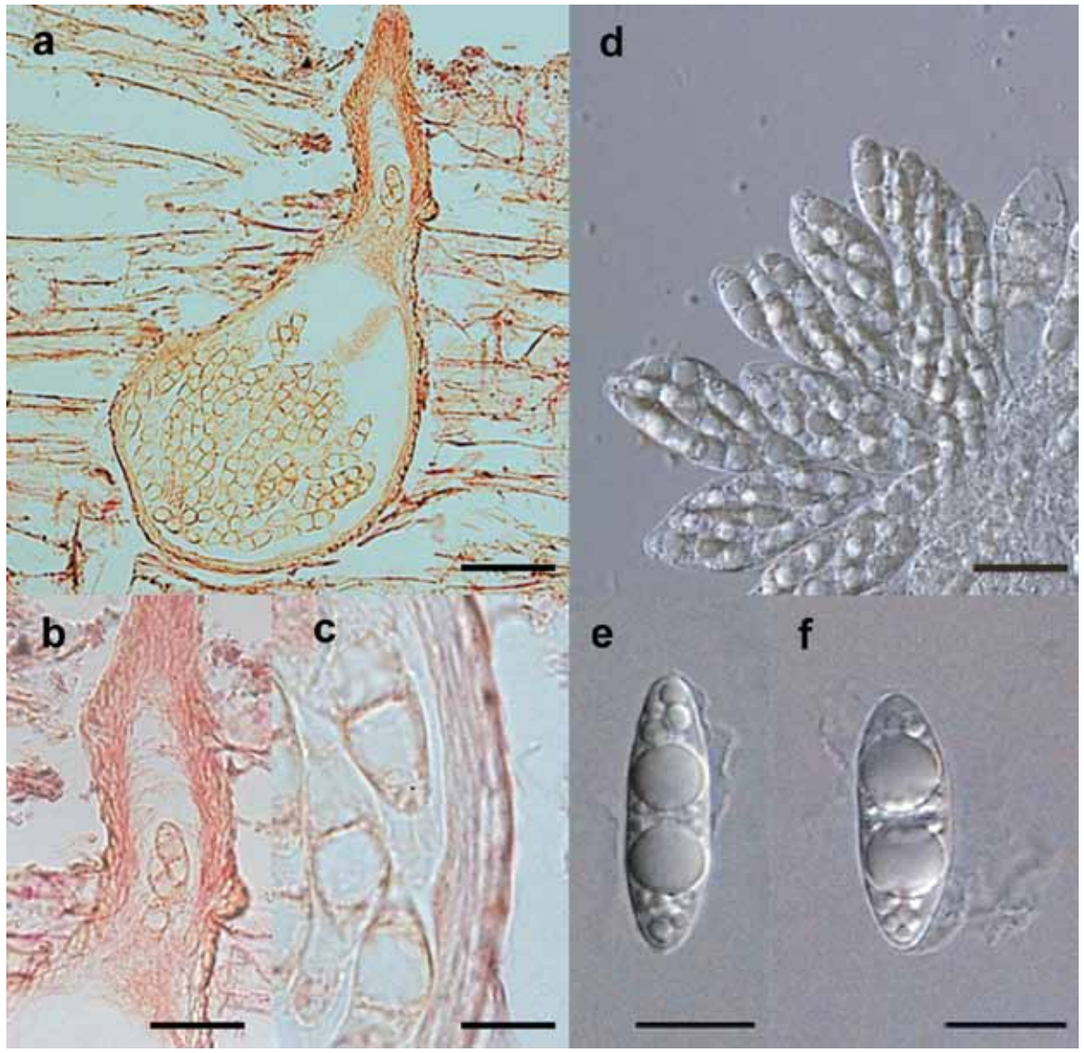

Figure 28. *Natantispora retorquens*. (a) Section of immersed ascoma. (b) Ascoma neck with periphyses. (c) One-layered peridium of elongate cells. (d) Clavate, thin-walled asci. (e) Ascospore with bipolar appendages. (f) Unfurling polar appendages. Scale bar: a=50 µm; b, c, d=30 µm; e, f=10 µm.

Neptunella K.L. Pang & E.B.G. Jones, Mycol. Progr. 2: 35 (2003)
Type species: *Neptunella longirostris* K.L. Pang & E.B.G. Jones

Neptunella longirostris (Cribb & J.W. Cribb) K.L. Pang & E.B.G. Jones, Mycol. Progr. 2: 35 (2003)
≡ *Gnomonia longirostris* Cribb & J.W. Cribb, Pap. Dept. Bot. (formerly Biol.) Univ. Qd. 3: 101 (1956)
=*Lignincola longirostris* (Cribb & J.W. Cribb) Kohlm., P.S.Z.N.I. Mar. Ecol. 5: 353 (1984)

Figure 29

Ascomata 100-200 µm diam., subglobose to bottle-shaped, hyaline or brown, membranous, immersed or partly immersed, solitary or gregarious, ostiolate. Necks 80-1125 µm long, 13-40 µm diam., periphyses absent. Peridium one stratum, composed of a few layers of elongate cells. Catenophyses absent. Asci 50-80 × 17-21 µm, unitunicate, eight-spored, cylindrical-clavate, ellipsoidal-clavate to subfusiform, irregularly deliquescing, at first thick-walled apically, becoming thin-walled, with an apical pore, short pedicellate. Ascospores 13-20 × 4-8 µm, hyaline, elongate-ellipsoidal to irregularly ellipsoidal, 1-septate, slightly constricted at or near the septum, not appendaged.

SUBSTRATA: dead mangrove wood, dead mangrove leaves.

WORLDWIDE DISTRIBUTION: Australia, Bermuda, Brunei, China, England, Hong Kong, India, Japan, Malaysia, Mauritius, Philippines, Republic of Trinidad and Tobago, Singapore, Society Islands, South Africa, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Aoku, Chungkang, Haomeiliao, Hsinwu, Hungmao, Putzu, Ssutsao, Tanshui.

COMMENTS: It is another species that was initially described as a *Gnomonia* from mangrove wood collected in Queensland, Australia by Cribb & Cribb (1956). Clearly, it did not belong to this genus and was transferred to *Lignincola* by Kohlmeyer (1984). Morphologically it differs from *L. laevis* in that the ascus has an apical pore and the plasmalemma retracts apically from the ascus wall and the ascospores has a thin exosporial wall layer (Jones 1995). Subsequently, molecular data indicated that it is not monophyletic with *L. laevis* and the genus *Neptunella* was introduced to accommodate it (Pang et al. 2003b). Although widely distributed geographically, it is not a common species (Alias & Jones 2009).

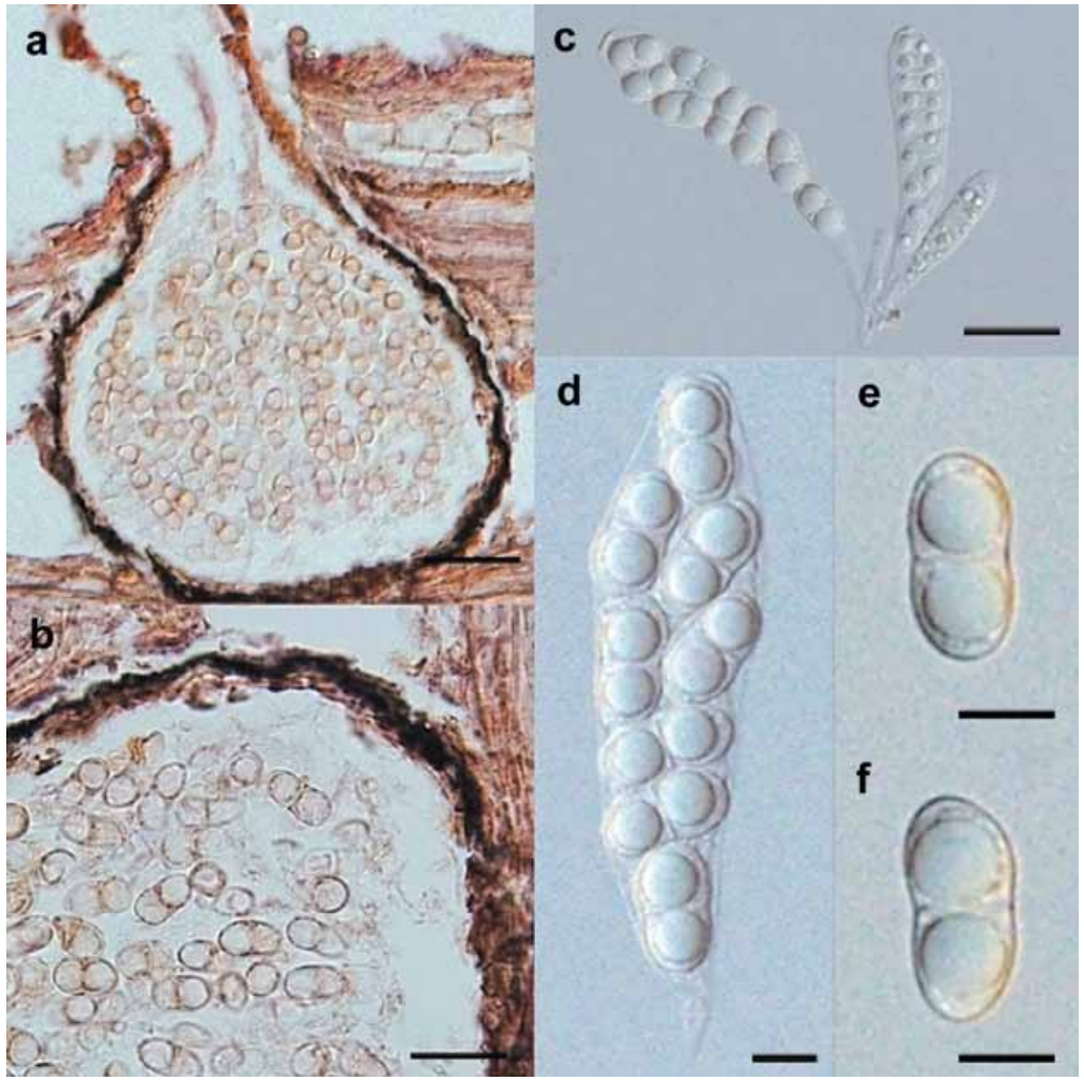

Figure 29. *Neptunella longirostris*. (a) Section of immersed ascoma with a short neck. (b) One-layered peridium of elongate cells. (c) Asci at different stages of development. (d) Mature, thin-walled ascus with a short stalk. (e, f) Hyaline, bicelled ascospores. Scale bar: a=50 µm; b, c=30 µm; d, e, f=10 µm.

Oceanitis Kohlm., Rev. Mycol. 41: 193 (1977)
Type species: *Oceanitis scuticella* Kohlm., Rev. Mycol. 41: 193, 1977.

Oceanitis cincinnatula (Shearer & J.L. Crane) J. Dupont & E.B.G. Jones, Mycol. Res. 113: 1357 (2009)
≡ *Halosarpheia cincinnatula* Shearer & J.L. Crane, Bot. Mar. 23: 613 (1980)
= *Falcatispora cincinnatula* (Shearer & J.L. Crane) K.L. Pang & E.B.G. Jones, Nova Hedw. 77: 14 (2003)
= *Ascosalsum cincinnatulum* (Shearer & J.L. Crane) J. Campb., J.L. Anderson & Shearer, Mycologia 95: 546 (2003)

Figure 30

Ascomata 68-(188)-284 µm high, 66-158-243 µm diam., globose to subglobose, hyaline, membranous, superficial or slightly immersed, solitary, ostiolate. Necks 113-(223)-465 µm long, 22-(35)-46 µm diam., hyaline, periphysate. Peridium one-layered, composed of a few layers of elongate cells with large lumina. Catenophyses absent. Asci 41-(52)-62 × 11-(13)-(16) µm, thin-walled, unitunicate, eight-spored, ellipsoidal to clavate, deliquescing. Ascospores 34-(50)-60 × 4-5 µm, hyaline, cylindrical to fusiform, 5-11-septate, appendaged. Appendage unipolar, unfurling into fine thread in water.

SUBSTRATA: dead mangrove wood, fern rachis.

WORLDWIDE DISTRIBUTION: Brunei, Hong Kong, India, Malaysia, Seychelles, Singapore, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Tanshui, Yingkeshih (Ilan County).

COMMENTS: This species was described as a *Halosarpheia* by Shearer & Crane (1980) from balsa wood, collected in Maryland, USA. However, it differs from members of the *Halosarpheia sensu stricto* in that, the ascospores are falcate to needle-shaped, 5-11-septate with a single polar hamate appendage that unfurls to form a long thread-like appendage (Shearer & Crane 1980). Based on morphological and molecular data, it was transferred by Pang et al. (2003a) to *Falcatispora*, but this name was superseded by *Ascosalsum* (Campbell et al. 2003). Wider taxon sampling showed that it grouped with isolates of *Oceanitis scuticella* collected in the Gulf of Angola, Atlantic Ocean by Dupont et al. (2009), a species known from deep waters. *Oceanitis cincinnatula* is known from a variety of substrata, especially the culms of marsh plants, e.g. *Spartina* (Shearer & Crane 1980).

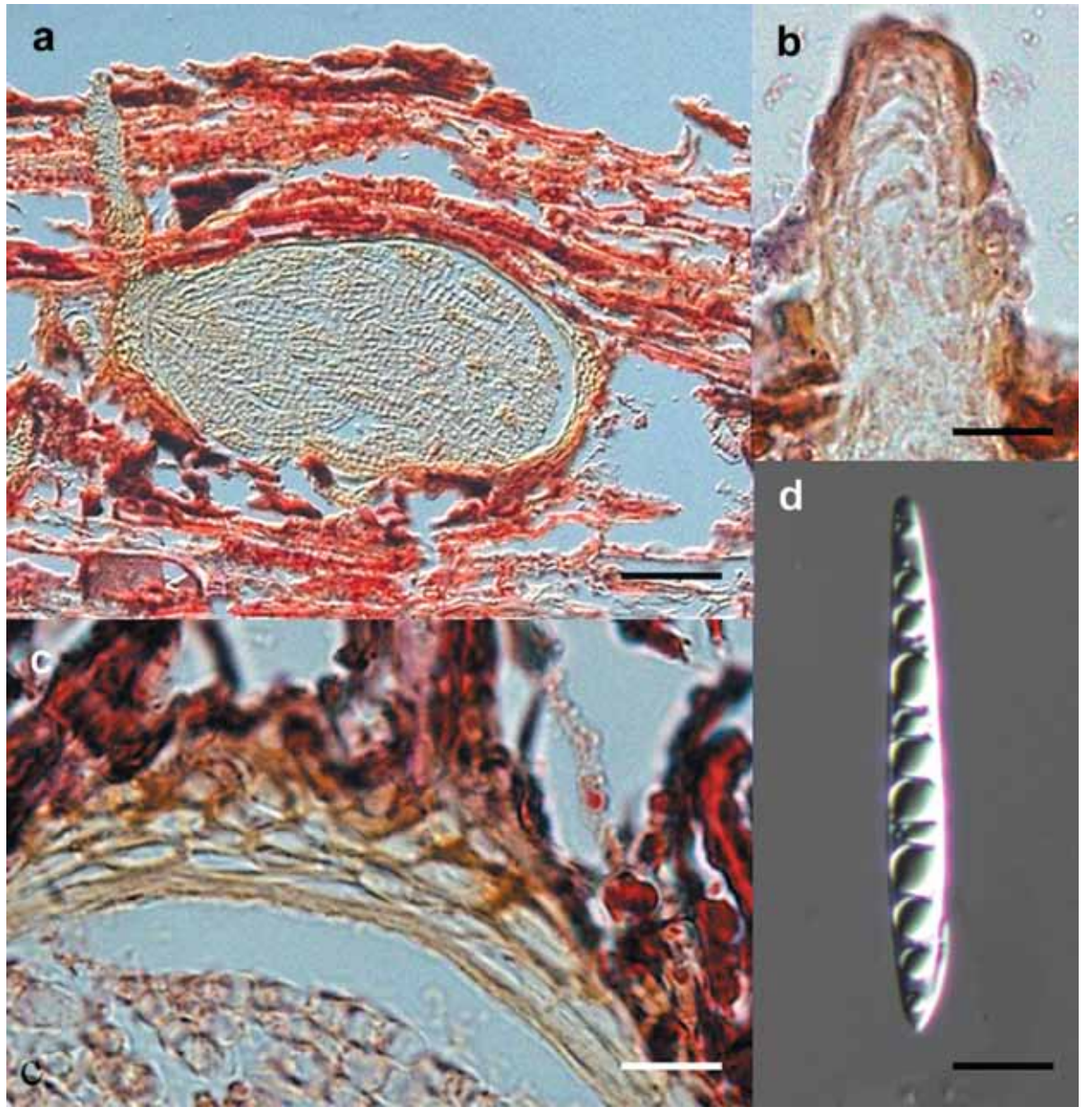

Figure 30. *Oceanitis cincinnatula.* (a) Section of immersed ascoma. (b) Ascoma neck with periphyses. (c) One-layered peridium of elongate cells with large lumina. (d) Cylindrical ascospore with an unfurling appendage at one end. Scale bar: a=50 µm; b, c, d=10 µm.

Panorbis J. Campb., J.L. Anderson & Shearer, Mycologia 95: 544 (2003)
Type species: *Panorbis viscosus* (I. Schmidt) J. Campb., J.L. Anderson & Shearer

Panorbis viscosus (I. Schmidt) J. Campb., J.L. Anderson & Shearer, Mycologia 95: 544 (2003)
≡ *Halosphaeria viscosa* I. Schmidt, Mycotaxon 24: 420 (1985)

Figure 31

Ascomata 68-(248)-455 µm high, 68-(250)-385 µm diam., globose to subglobose, at first hyaline becoming black, membranous, superficial or immersed, ostiolate. Necks 73-(262)-648 µm high, 18-(36)-54 µm diam., dark at base becoming hyaline at apex, periphysate. Peridium two-layered, composed of an outer layer of cells of *textura angularis* and an inner layer of elongate cells with large lumina. Catenophyses absent. Asci 36-(65)-114 × 9-(13)-23 µm, thin-walled, unitunicate, eight-spored, ellipsoid to clavate, deliquescing. Ascospores 13-(20)-26 × 4-(7)-8 µm, hyaline, ellipsoidal, thin-walled, 1-septate, appendaged. Appendages bipolar, hamate shorter than the mid-septum, unfurling into fine thread in water.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Australia, Brunei, China, Denmark, Egypt, Fiji, Germany, Hong Kong, India, Indonesia, Malaysia, Mauritius, Philippines, Portugal, Seychelles, South Africa, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Hungmao, National Taiwan Ocean University (Chilung City), Tanshui.

COMMENTS: An uncommon species on mangrove wood and not reported widely. *Panorbis viscosus* resembles *Natantispora retorquens* morphologically, although they are not phylogenetically related (Campbell et al. 2003). However, the two species can only be morphologically separated by ascospore shape and measurements.

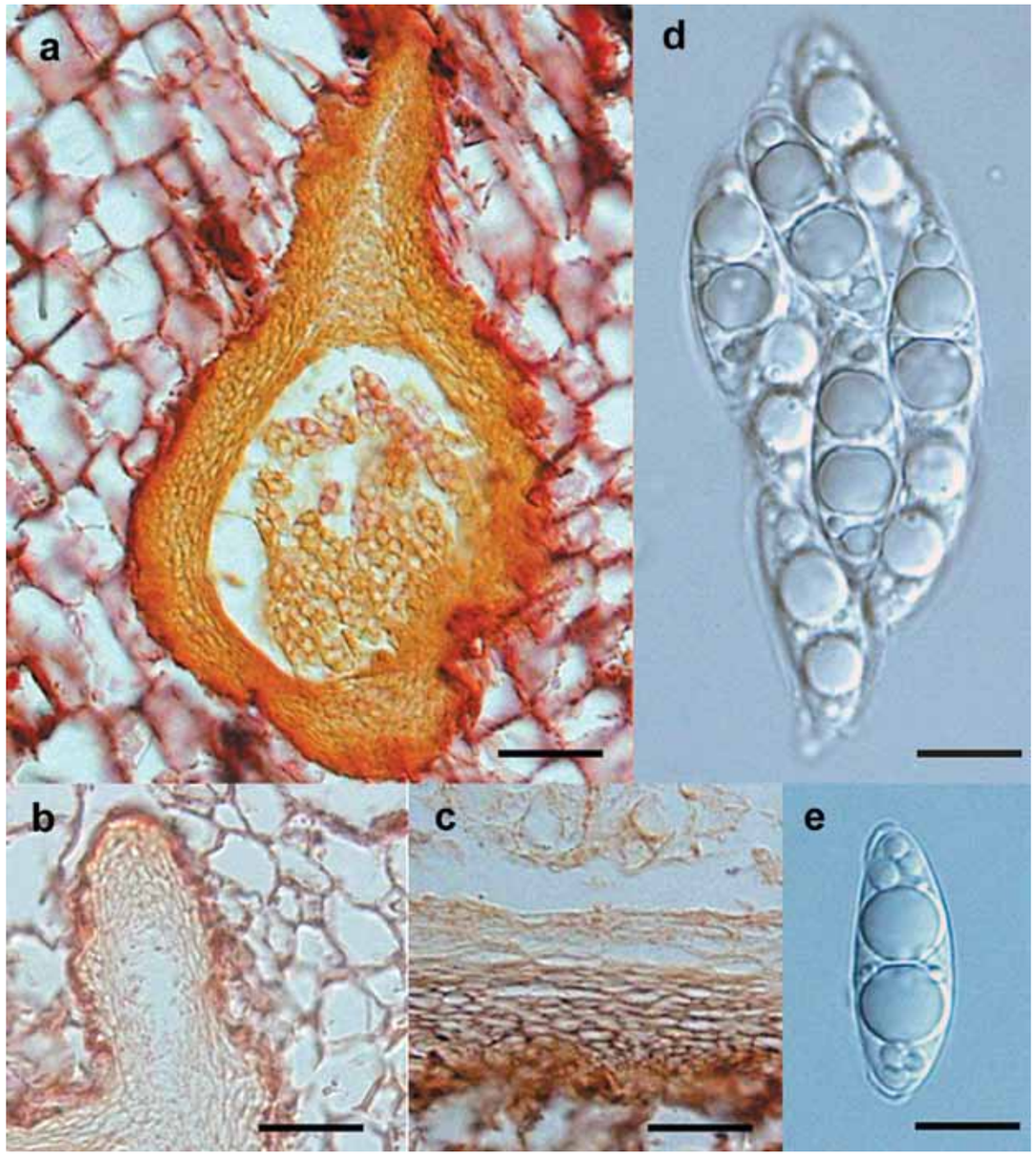

Figure 31. *Panorbis viscosus.* (a) Section of immersed ascoma with a periphysate neck. (b) Ascoma neck with periphyses. (c) Two-layered peridium, outer layer of cells of *textura angularis*, inner layer of elongate cells with large lumina. (d) Thin-walled, clavate ascus. (e) Thin-walled ascospore with bipolar, unfurling appendages. Scale bar: a=50 µm; b, c=30 µm; d, e=10 µm.

Saagaromyces K.L. Pang & E.B.G. Jones, Mycol. Progr. 2: 35 (2003)
Type species: *Saagaromyces ratnagiriensis* (Kohlm.) K.L. Pang & E.B.G. Jones

Saagaromyces abonnis (Kohlm.) K.L. Pang & E.B.G. Jones, Mycol. Progr. 2: 35 (2003)
≡ *Halosarpheia abonnis* Kohlm., P.S.Z.N.I. Mar. Ecol. 5: 339 (1984)
= *Littispora abonnis* (Kohlm.) J. Campb., J.L. Anderson & Shearer, Mycologia 95: 549 (2003)

Figure 32

Ascomata 450-600 µm high, 300-450 µm diam., ellipsoidal, light-brown, coriaceous, immersed, ostiolate, papillate. Necks 350-450 µm long, 80-180 µm diam., periphysate. Peridium 20-45 µm thick, two-layered, composed of an outer layer of small, subglobose cells forming a *textura angularis*, an inner layer of large, elongate and flattened cells. Catenophyses present. Asci 210-290 × 30-54 µm, thin-walled, unitunicate, eight-spored, clavate, persistent, thickened at the apex, pedicellate. Ascospores 33-47 × 16-22 µm, hyaline, ellipsoidal, 1-septate, slightly constricted at the septum, appendaged. Appendages bipolar, thick, hamate extending to the mid-septum, unfurling into fine thread in water.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Bahamas, Belize, Bermuda, Brunei, China, Egypt, Hong Kong, India, Indonesia, Japan, Malaysia, Mauritius, Mexico, Seychelles, South Africa, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Aoku, Chungkang, Fangwan, Haomeiliao, Hsinwu, Hungmao, Peimeng, Tanshui.

COMMENTS: This species was initially described as a *Halosarpheia* species, but the large ascospores, prominent bipolar appendages and a long ascus stalk distinguish it from species in that genus. Molecular data confirm that it is not monophyletic with *Halosarpheia sensu stricto*, and a new genus, *Saagaromyces*, was introduced to accommodate it and *S. ratnagiriensis* and *S. glitra* (Pang et al. 2003b). A species frequently collected on mangrove wood, with perithecia deeply embedded in the host wood, but it is not a colonizer of freshly exposed wood in mangroves (Tan et al. 1989, Leong et al. 1991). Ultrastructural studies of the ascospores and their appendages have been undertaken by Baker (1991).

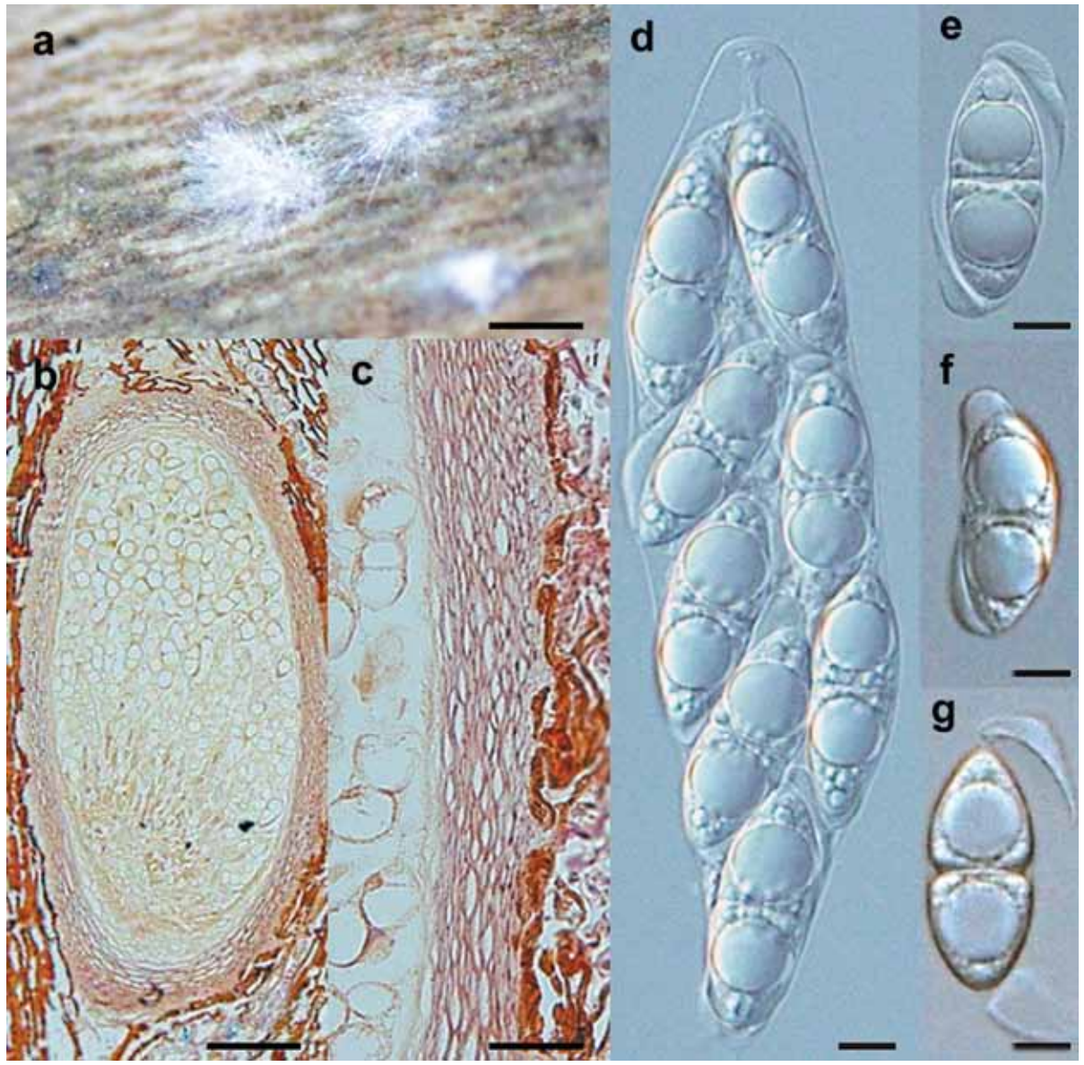

Figure 32. *Saagaromyces abonnis.* (a) Emerging necks at the tip of ascomata embedded in wood. (b) Section of ellipsoidal ascoma. (c) Two-layered peridium, outer layer of cells of *textura angularis*, inner layer of elongate cells. (d) Clavate, thin-walled ascus with a thickened apex. (e-g) Ascospores with bipolar, unfurling appendages. Scale bar: a=300 µm; b=100 µm; c=30 µm; d=50 µm; e, f, g=10 µm.

Saagaromyces glitra (J.L. Crane & Shearer) K.L. Pang & E.B.G. Jones, Mycol. Progr. 2: 35 (2003)
≡ *Nais glitra* J.L. Crane & Shearer, Trans. Br. Mycol. Soc. 86: 509 (1986)

Figure 33

Ascomata 400-450 µm diam., globose to subglobose, cream-colored becoming black with age, membranous, immersed, ostiolate. Necks 544-1780 µm long, 148-297 µm diam., dark brown at base becoming light brown to subhyaline at apex, periphysate. Peridium two-layered, with an outer layer of cells of *textura angularis* and an inner layer of elongate cells with large lumina. Catenophyses present. Asci 240-312 × 43-62 µm, thin-walled, unitunicate, eight-spored, clavate to ellipsoid, deliquescing at maturity, with an apical pore, long pedicellate. Ascospores 42-59 × 21-31 µm, hyaline, oblong to obovate, walls up to 1.0 µm thick, 1-septate, slightly constricted at the septum, with granular deposits, apical cell may be either equal in length and width or longer (1.0-15.8 µm) and broader (1.0-6.9 µm) than the basal cell, not appendaged.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Brunei, Hong Kong, India, Indonesia, Malaysia, Singapore, South Africa, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Chungkang, Haomeiliao, Tanshui.

COMMENTS: This species was originally described in *Nais* with its characteristic small oil globules around the middle septum of the ascospores (Crane & Shearer 1986). Phylogenetic analysis of the LSU rRNA gene sequence grouped this species with *Halosarpheia abonnis* and *H. ratnagiriensis*, but this group was unrelated to *Halosarpheia fibrosa* and *Nais inornata* (Pang et al. 2003b). Therefore, a new genus *Saagaromyces* was proposed to accommodate this group. All three species possess large and oval ascospores with a heavy guttulation pattern and cylindrical-clavate asci with a long pedicel and an apical plate (Pang et al. 2003b). However, ascospores of *S. glitra* lack bipolar appendages and may have lost during evolutionary times. It also indicates that unfurling ascospore appendages are not important in the delineation of genera in the Halosphaeriaceae.

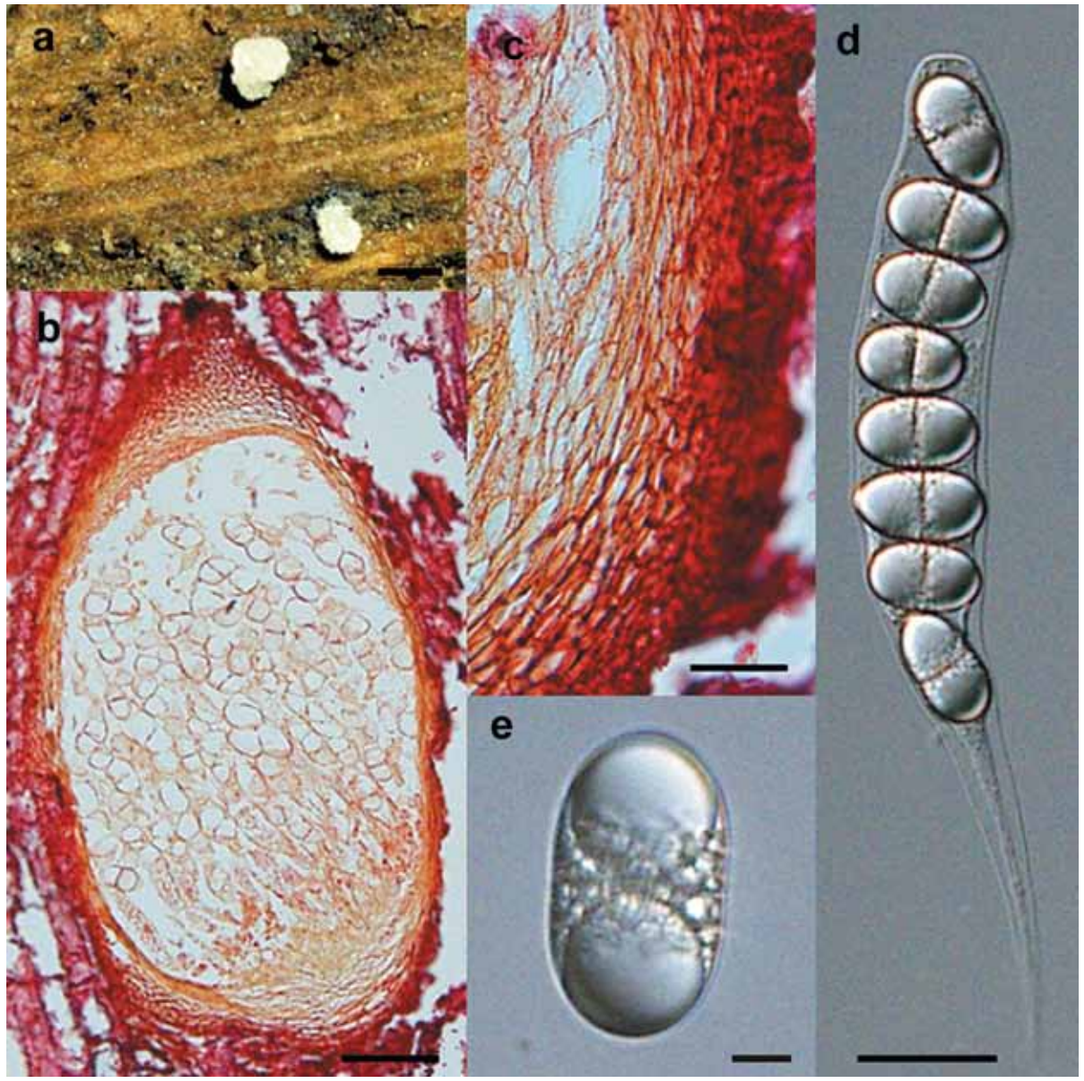

Figure 33. *Saagaromyces glitra.* (a) Mass of ascospores oozed from the ascomata embedded in wood. (b) Section of immersed, subglobose ascoma. (c) Two-layered peridium, outer layer of cells of *textura angularis*, inner layer of elongate cells with large lumina. (d) Cylindrical ascus with a long stalk. (e) Hyaline, bicelled, ellipsoidal ascospore with many oil globules. Scale bar: a=400 µm; b=100 µm; c=30 µm; d=50 µm; e=10 µm.

Thalassogena Kohlm. & Volkm.-Kohlm., Syst. Ascomycet. 6: 223 (1987)
Type species: *Thalassogena sphaerica* Kohlm. & Volkm.-Kohlm.

Thalassogena sphaerica Kohlm. & Volkm.-Kohlm., Syst. Ascomycet. 6: 225 (1987)

Figure 34

Ascomata 150-260 µm diam., subglobose, cream-colored, coriaceous, superficial or immersed, solitary, ostiolate, papillate. Necks 230-570 µm long, 50-85 µm diam., periphysate. Peridium 10-16 µm thick, composed of 4-5 layers of elongate cells with large lumina, especially the inner few layers of cells. Catenophyses present. Asci 72-89 × 22-27 µm, thin-walled, unitunicate, eight-spored, clavate, persistent, flattened at the apex and with a pore, pedicellate. Ascospores 13-(15)-17 µm, hyaline, subglobose, rarely ellipsoidal, one-celled, not appendaged.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Belize, Brunei, Denmark, Hong Kong, Mauritius, Philippines, South Africa, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Chungkang, Tanshui.

COMMENTS: This is an uncommon species in mangrove environments. A phylogenetic study is required to investigate the relationship between this species and other taxa with unappendaged ascospores in the Halosphaeriaceae, including *Anisostagma*, *Lignincola*, *Nais* and *Neptunella*. Although collected on a few occasions in Taiwan, induction of ascospore germination has not been successful (K.L. Pang, personal observation).

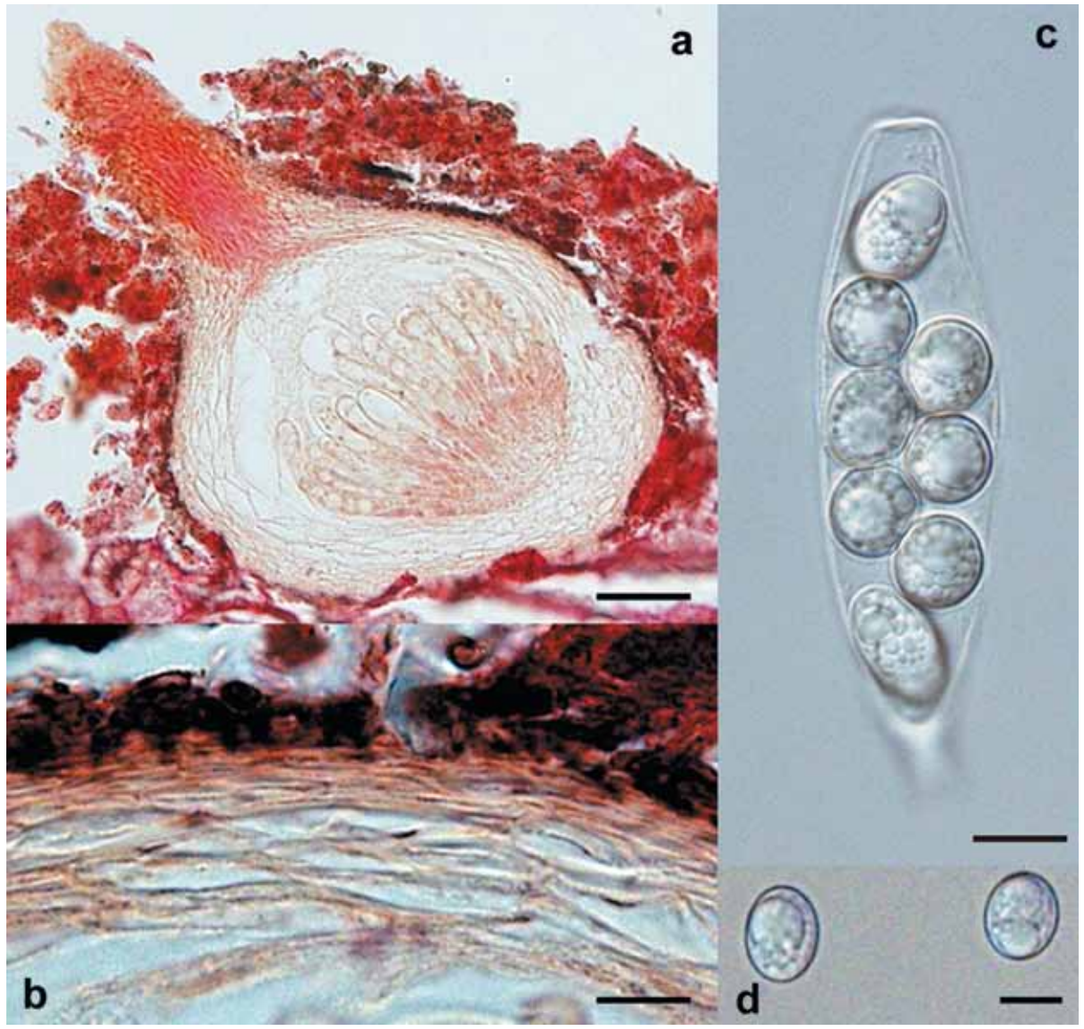

Figure 34. *Thalassogena sphaerica.* (a) Section of immersed, globose ascoma. (b) One-layered peridium of elongate cells with large lumina, especially the inner few layers. (c) Clavate, thin-walled ascus with a flattened apex. (d) Globose to subglobose ascospores. Scale bar: a=50 µm; b, c, d=10 µm.

Tirispora E.B.G. Jones & Vrijmoed, Can. J. Bot. 72: 1373 (1994)
Type species: *Tirispora unicaudata* E.B.G. Jones & Vrijmoed

Tirispora unicaudata E.B.G. Jones & Vrijmoed, Can. J. Bot. 72: 1373 (1994)
=*Aniptodera indica* Ananda & Sridhar, J. Environ. Biol. 22: 283 (2001)

Figure 35

Ascomata 90-(184)-300 µm high, 66-(134)-216 µm diam., globose to subglobose, pale to dark brown, superficial, solitary, ostiolate, papillate. Necks 22-(32)-48 µm long, 12-(32)-46 µm diam., periphysate. Peridium thin, 4-6 layers of elongate cells. Catenophyses present. Asci 40-(62)-80 × 14-(21)-28 µm, thick-walled, unitunicate, eight-spored, clavate, persistent, with a ring and apical plate, pedicellate. Ascospores 24-(29)-32 × 8-(10)-12 µm, hyaline, ellipsoidal, thick-walled, 1-septate, not constricted at the septum, appendaged. Appendages unipolar, unfurling into fine thread in water.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Egypt, Hong Kong, India, Malaysia, Taiwan.

DISTRIBUTION IN TAIWAN: Hungmao.

COMMENTS: This is a rare species, only collected in mangrove environments. This species is morphologically similar to *Aniptodera chesapeakensis* with the main difference in the presence of unipolar, unfurling appendages on the ascospores. Phylogenetically, both *Aniptodera* and *Tirispora* shared a clade with other morphologically allied taxa, but they were not monophyletic (Pang et al. 2003a).

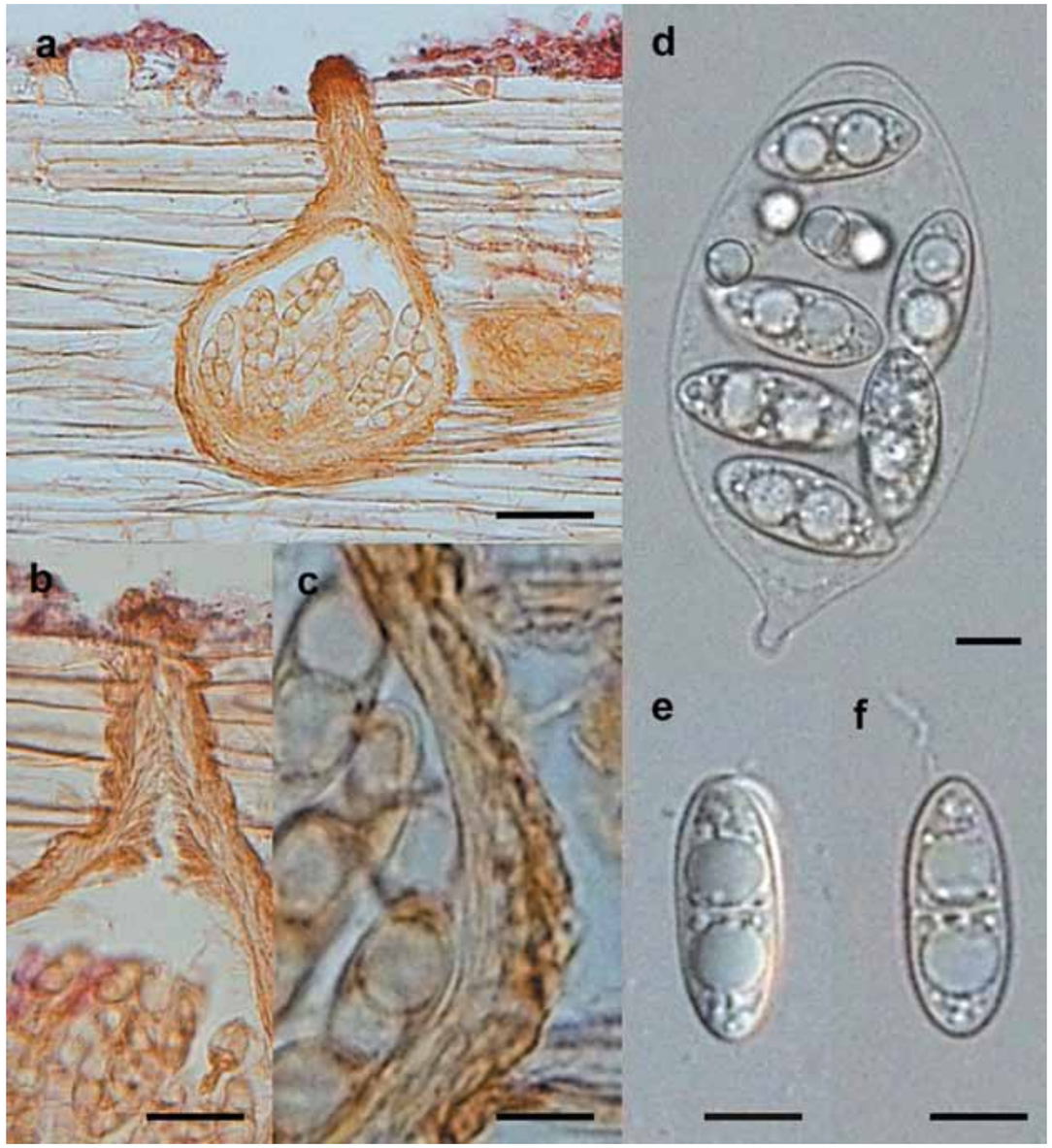

Figure 35. *Tirispora unicaudata.* (a) Section of immersed ascoma. (b) Periphysate ascoma neck. (c) One-layered peridium of elongate cells. (d) Ellipsoidal thin-walled ascus. (e-f) Ascospores with an unfurling appendage at one end. Scale bar: a=50 µm; b, c, d, e, f=10 µm.

SUBCLASS: HYPOCREOMYCETIDAE *INCERTAE SEDIS*
ACS (*Ascotaiwania, Canalisporium, Savoryella*) CLADE

Savoryella E.B.G. Jones & R.A. Eaton, Trans. Br. Mycol. Soc. 52: 161 (1969)
Type species: *Savoryella lignicola* E.B.G. Jones & R.A. Eaton

Savoryella lignicola E.B.G. Jones & R.A. Eaton, Trans. Br. Mycol. Soc. 52: 161 (1969)

Figure 36

Ascomata 170-350 µm high, 120-250 µm diam., globose, subglobose or ellipsoidal, immersed, partly immersed or superficial, ostiolate, papillate, membranous, and pale to dark brown. Necks (48-)80-165 µm long, up to 72 µm diam., brown, with periphyses. Peridium brown, one-layered, composed of several layers of thick-walled angular cells forming *textura angularis*. Paraphyses present, but sparse. Asci 100-(128)-180 × 16-24 µm, eight-spored, cylindrical or clavate, short-stalked, unitunicate, persistent, with an apical truncate non-amyloid apical thickening containing a pore. Ascospores 24-36 × 8-12 µm, uni- or biseriate, ellipsoidal, tri-septate, not markedly constricted at the septa, central cells brown (10-6-16 µm), apical cells smaller and hyaline (2.6-6 µm).

SUBSTRATA: dead mangrove wood, fern rachis.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Brunei, Canada, China, England, Egypt, Hong Kong, India, Indonesia, Japan, Macau, Malaysia, Maldives, Mauritius, Mexico, Philippines, Portugal, Seychelles, Singapore, South Africa, Sri Lanka, Taiwan, Thailand, USA, Wales.

DISTRIBUTION IN TAIWAN: Aoku, Chiehting, Chungkang, Hemei (Taipei County), Hungmao, Lanyu (Taitung County), Nanliao (Hsinchu County), Tanshui.

COMMENTS: *Savoryella lignicola* was initially described from test panels of *Fagus sylvestris* and *Pinus sylvestris*, exposed in a water cooling tower run with brackish water (Eaton & Jones 1971). This species can be commonly found in freshwater and marine environments. Taxonomically, *Savoryella* has been referred to several orders, including the *Sphaeriales incertae sedis* (Kohlmeyer & Kohlmeyer 1979), ascomycetes *incertae sedis* (Kohlmeyer 1986, Eriksson & Hawksworth 1986), Amphisphaeriaceae (Eriksson & Hawksworth 1987), Sordariales (Jones & Hyde 1992) and Halosphaeriales (Barr 1990, Read et al. 1993). *Savoryella elongata* and *S. longispora* were found to be related to the Hypocreales based on LSU rDNA phylogeny (Vijaykrishna 2006). Recently, *Savoryella* together with *Ascotaiwania*, *Ascothailandia* (and its anamorph *Canalisporium*) formed a distinct clade (ACS clade) in the Hypocreomycetidae (Sordariomycetes), based on phylogenetic analyses of the SSU and LSU rRNA, RPB2, and TEF-1-alpha genes (N. Boonyuen, personal communication). It can occur early in the colonization of timber test panels and also on well-decayed wood (Eaton & Jones 1971) and causes active soft-rot decay of wood (Mouzouras 1986).

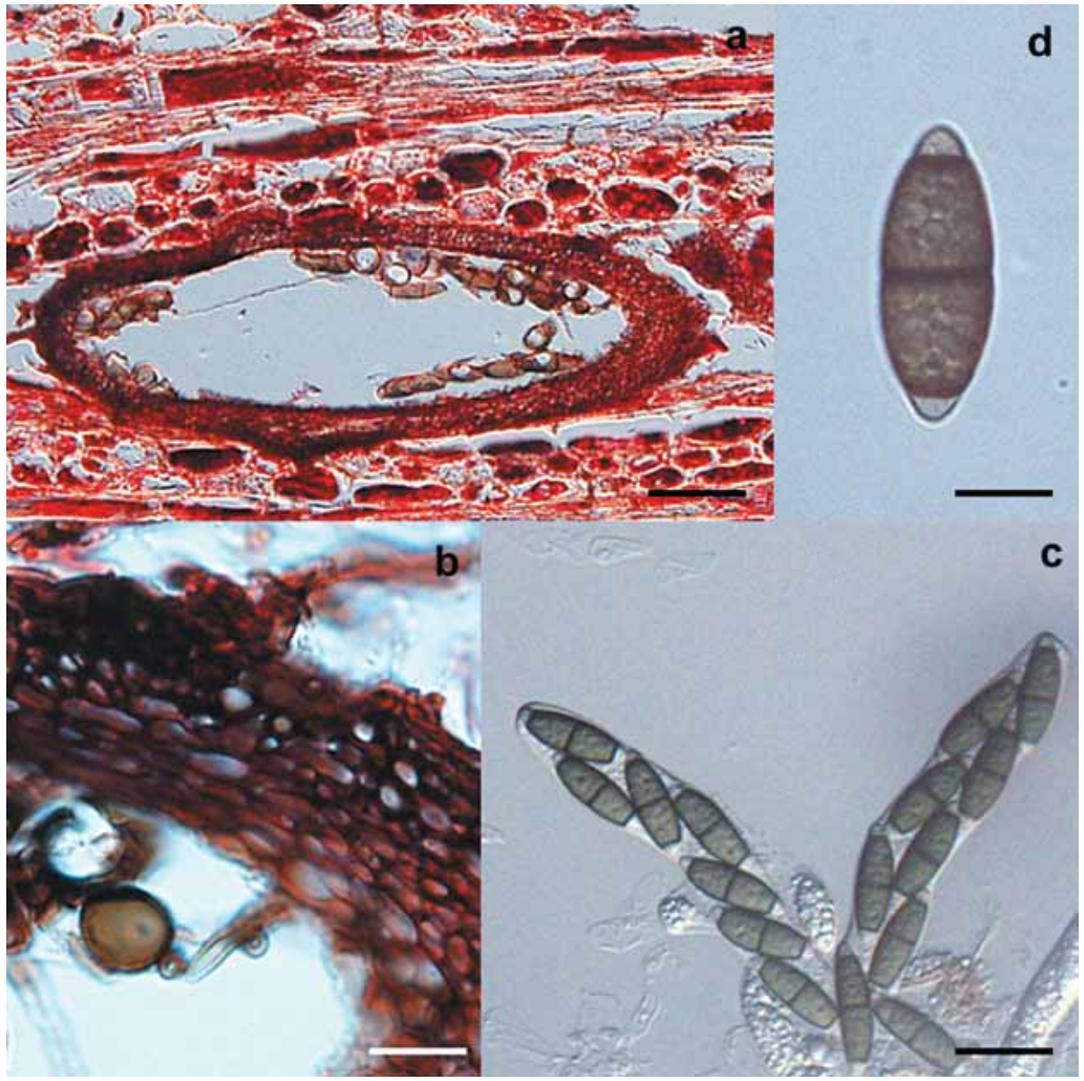

Figure 36. *Savoryella lignicola.* (a) Section of immersed ascoma. (b) One-layered peridium composed of thick-walled cells of *textura angularis*. (c) Mature, thin-walled, cylindrical asci. (d) Ascospore 3-septate, central cells brown and end cells hyaline. Scale bar: a=50 µm; b, d=10 µm; c=30 µm.

Savoryella longispora E.B.G. Jones & K.D. Hyde, Bot. Mar. 35: 84 (1992)

Figure 37

Ascomata 170-350 µm high, 120-250 µm diam., globose, subglobose or ellipsoidal, immersed, partly immersed or superficial, ostiolate, papillate, membranous, and pale to dark brown. Necks (48-)80-165 µm long, up to 72 µm diam., brown, with periphyses. Peridium brown, one-layered, composed of several layers of thick-walled angular cells forming *textura angularis*. Paraphyses present, but sparse. Asci 100-(128)-180 × 16-24 µm, 8-spored, cylindrical or clavate, short-stalked, unitunicate, persistent, with an apical truncate non-amyloid apical thickening containing a pore. Ascospores 33.5-46.5 × 7.5-12 µm, uni- or biseriate, ellipsoidal, tri-septate, not markedly constricted at the septa, central cells brown, apical cells smaller and hyaline.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Australia, Brunei, India, Malaysia, Philippines, Singapore, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Hungmao.

COMMENTS: This species is rare compared with *S. lignicola*. Morphologically, it is very similar to *S. lignicola* but the ascospores are longer. Phylogenetically, this species groups in a well-supported, monophyletic *Savoryella* clade (N. Boonyuen, personal communication).

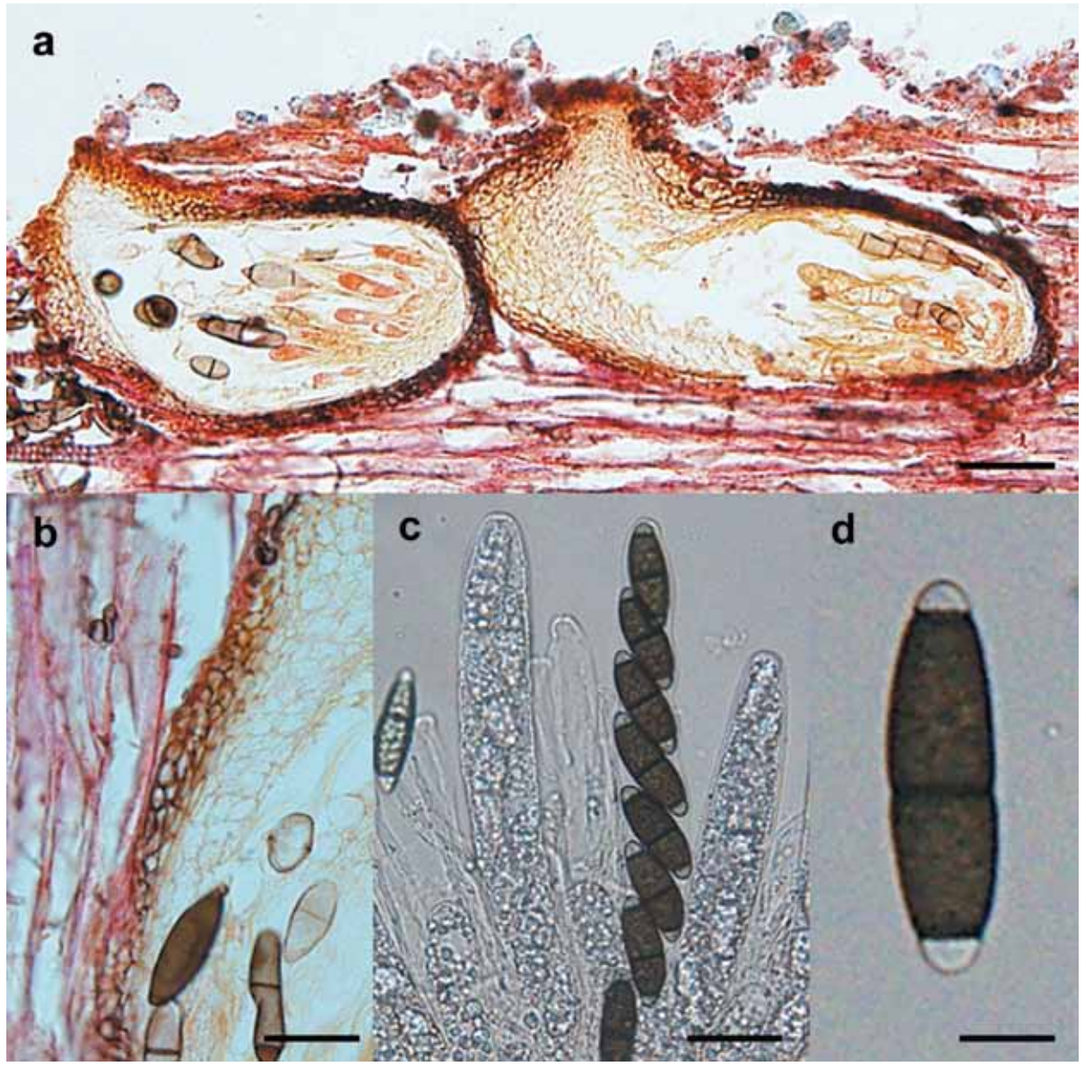

Figure 37. *Savoryella longispora.* (a) Section of immersed ascomata with periphysate necks. (b) One-layered peridium, composed of cells of *textura angularis*. (c) Cylindrical asci at different stages of development. (d) Ascospore 3-septate, central cells brown and end cells hyaline. Scale bar: a, c=50 µm; b=30 µm; d=10 µm.

Savoryella paucispora (Cribb & J.W. Cribb) J. Koch, Nordic J. Bot. 2: 169 (1982)
≡ *Leptosphaeria paucispora* Cribb & J.W. Cribb, Pap. Dept. Bot. (formerly Biol.) Univ. Qd. 4: 41 (1960)

Figure 38

Ascomata 220-248 µm high, 84-140 µm diam., flask-shaped to ellipsoidal, immersed or superficial, ostiolate, papillate, membranous, cream-colored, brown to dark brown, solitary or in groups. Necks 70-100 µm long, 40-55 µm diam., stout, lighter in color at the tips. Peridium one-layered, composed of 3-6 layers of elongate cells. Paraphyses present. Asci 82-106 × 18-23 µm, two-spored, cylindrical, but generally clavate, short-stalked, unitunicate, persistent, with a non-amyloid apical thickening containing a pore. Ascospores (36-)44-50(-60) × 12-16.5 µm, tri-septate, fusoid-ellipsoidal, slightly constricted at the septa, central cells brown, apical cells hyaline, without appendages.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Australia, Andaman Island, Brunei, Hong Kong, India, Indonesia, Japan, Macau, Malaysia, Mauritius, Philippines, Seychelles, Singapore, South Africa, Sri Lanka, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Aoku, Chungkang, Hungmao, Tanshui.

COMMENTS: This species has very small ascomata and only a few asci are present in one ascoma and is characterised by asci with only two large ascospores (Koch 1982). Phylogenetically, this species groups in a well-supported, monophyletic *Savoryella* clade (N. Boonyuen, personal communication).

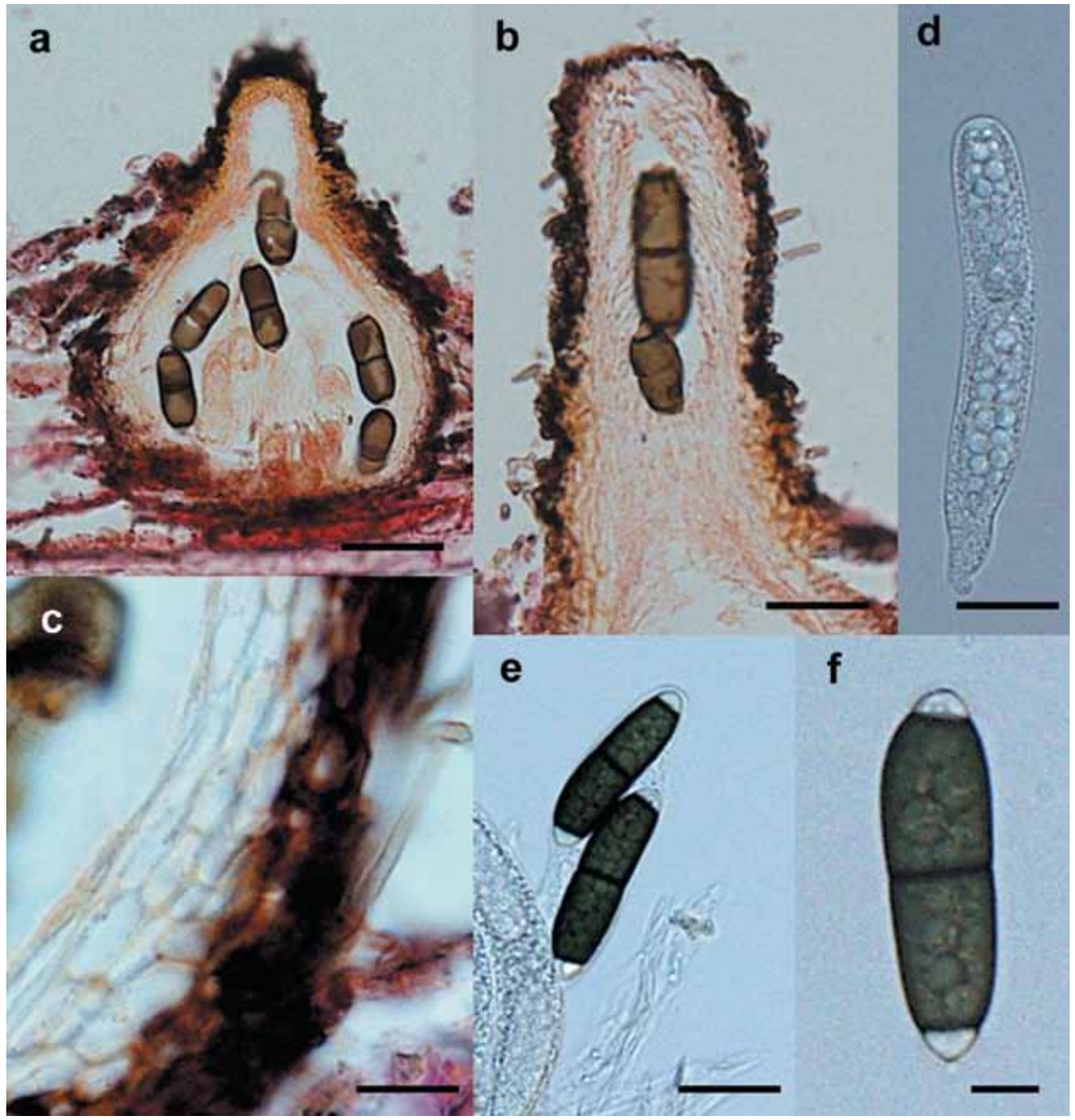

Figure 38. *Savoryella paucispora.* (a) Section of immersed ascoma with an exposed neck. (b) Periphysate neck. (c) One-layered peridium, composed of elongate cells. (d) Immature ascus. (e) Mature ascus with 2 ascospores. (f) Ascospore 3-septa, central cells brown and end cells hyaline. Scale bar: a=50 µm; b, d, e=30 µm; c, f=10 µm.

TBM (*Torpedospora, Bertia, Melanospora*) CLADE

Etheirophora Kohlm. & Volkm.-Kohlm., Mycol. Res. 92: 414 (1989)
Type species: *Etheirophora bijubata* Kohlm. & Volkm.-Kohlm.

Etheirophora blepharospora (Kohlm. & E. Kohlm.) Kohlm. & Volkm.-Kohlm., Mycol. Res. 92: 415 (1989)
≡ *Keissleriella blepharospora* Kohlm. & E. Kohlm., Nova Hedw. 9: 97 (1965)

Figure 39

Ascomata 125-230 µm high, 225-425 µm diam., depressed ellipsoidal, subglobose or pyriform, immersed in the bark, ostiolate, papillate, coriaceous, subhyaline, clypeate, solitary or gregarious. Papillae short, subconical, surrounded by a brownish-black, 30-37.5 µm thick pseudoclypeus that encloses bark cells of the host, ostiolar canal 12.5-27.5 µm diam., periphysate. Peridium 10-15 µm thick, hyaline to light brown, composed of several layers of subglobose, ellipsoidal or elongate, thick-walled cells, forming a *textura prismatica*, at the edge intimately connected to decomposing bark cells. Pseudoparaphyses 1.5-2.5 µm diam., sparsely septate, rarely branched, sometimes connected by mucilage to one another, attached at the base and apex. Asci 62-75 × 11-15 µm, eight-spored, cylindrical or oblong-ventricose, apically truncate, short pedunculate, indistinctly bitunicate, thin-walled, thick-walled at the apex and provided with an apical plate, developing at the base of the ascoma venter. Ascospores 12-21 × 6-8 µm, uni- or biseriate, ellipsoidal, 1-septate, not or slightly constricted at the septum, thin-walled, hyaline, appendaged at one end, four to seven radiating, terminal setae, deciduous, about 13 µm long.

SUBSTRATA: dead mangrove wood, bark of seedlings and roots.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Bahamas, Belize, Bermuda, Brunei, Columbia, Fiji, India, Maldives, Mauritius, Mexico, Peru, Republic of Trinidad and Tobago, Seychelles, Society Island, Taiwan, USA.

DISTRIBUTION IN TAIWAN: National Taiwan Ocean University (Chilung City), Tanshui, Tunghsin, Tungpeichiao (Taipei County), Yingkeshih (Ilan County).

COMMENTS: Hawksworth et al. (1995) and Kirk et al. (2001) referred the genus to the Halosphaeriales, but molecular and morphological data place it in the TBM (*Torpedospora*, *Bertia*, *Melanospora*) clade in the Hypocreomycetidae, with affinities to the Coronophorales (Schoch et al. 2006). The genus groups with a range of unresolved taxa: *Juncigera*, *Swampomyces*, and *Torpedospora*, and the anamorphic genera *Glomerulispora* and *Moheitospora*, in the TBM clade with a high bootstrap value (Abdel-Wahab et al. 2010). The TBM clade forms sister group to the Hypocreales, with affinities to the Coronophorales and Melanosporales (Schoch et al. 2006). Although widely collected, it is not a common species in mangrove environments, but can be found on trapped wood of rocky shores in Taiwan.

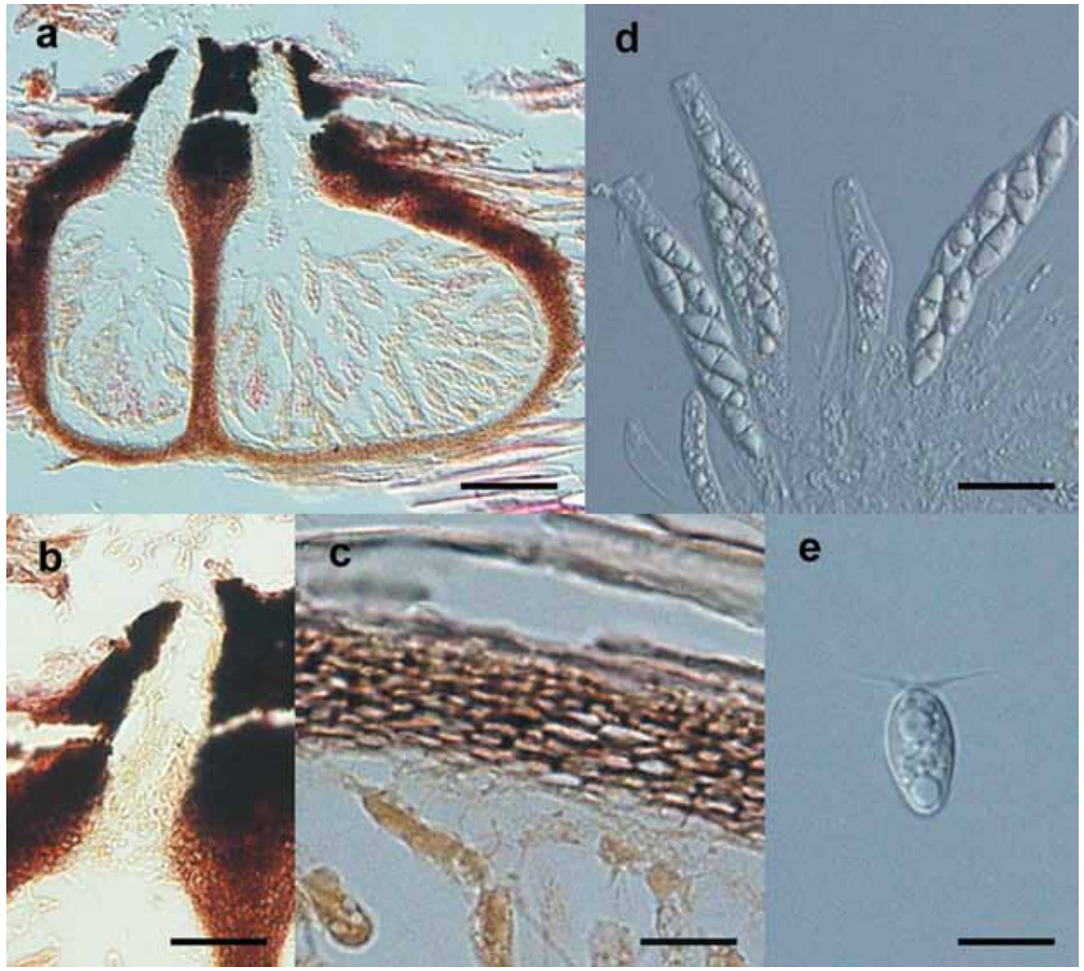

Figure 39. *Etheirophora blepharospora*. (a) Section of immersed ascomata. (b) Periphysate neck. (c) One-layered peridium, composed of a few layers of elongate cells. (d) Cylindrical asci with a truncated apex and plate. (e) Ascospore ellipsoidal, with 4 appendages at one pole. Scale bar: a=50 µm; b, d=30 µm; c, e=10 µm.

Torpedospora Meyers, Mycologia 49: 496 (1957)
Type species: *Torpedospora radiata* Meyers

Torpedospora radiata Meyers, Mycologia 49: 496 (1957)

Figure 40

Ascomata 100-300 µm high, 120-328 µm diam., solitary or gregarious, globose, subglobose to pyriform, superficial or immersed, ostiolate, papillate, subcoriaceous, dark brown above, subhyaline, gray or brownish below. Necks 100-320 µm high, 26-70 µm diam., cylindrical, light brown to black. Peridium two-layered, with an outer layer of cells of *textura angularis* and an inner layer of elongate cells. Paraphyses present. Asci 46-66 × 14-23 µm, eight-spored, clavate, short pedunculate, without an apical apparatus, thin-walled, unitunicate, deliquescing early. Ascospores 20-81 × 4-8 µm, cylindrical or clavate, broader at the apex, tri-septate, not or slightly constricted at the septa, hyaline. Appendages three or four, rarely five, radiating on the lower end, 19-34 × 1.5-3 µm, semi-rigid, straight or slightly curved, with a thick base, tapering towards the apex.

SUBSTRATA: dead mangrove wood, sand, seagrasses, dead leaves, dead bamboo, driftwood.

WORLDWIDE DISTRIBUTION: Australia, Bahamas, Belize, Brazil, Brunei, Egypt, France, Galapagos, Hong Kong, India, Indonesia, Italy, Ivory Coast, Japan, Kuwait, Liberia, Malaysia, Martinique, Mexico, New Zealand, Norway, Philippines, Portugal, Republic of Trinidad and Tobago, Samoa, Seychelles, Sierra Leone, Society Islands, Sri Lanka, Spain, Taiwan, Thailand, USA, Wales.

DISTRIBUTION IN TAIWAN: Aoku, Chinmen, Chinshan (Taipei County), Fengpin (Hualien County), Hungmao, Lanyu (Taitung County), National Taiwan Ocean University (Chilung City), Shihcheng (Ilan County), Toucheng (Ilan County), Tunghsin, Tungpeichiao (Taipei County), Yingkeshih (Ilan County).

COMMENTS: This is a common species and has a worldwide distribution on woody substrata, generally in oceanic waters. A second species *T. ambispinosa* is generally found in temperate waters and is less common than *T. radiata*. Although they differ morphologically from one another, they have been shown to be monophyletic (Sakayaroj et al. 2005). However, the genus cannot be assigned to any known order of the Ascomycota, but groups with *Juncigera* and *Swampomyces* in the TBM clade (Sakayaroj et al. 2005, Schoch et al. 2006). *Torpedospora radiata* generally occurs on decorticated wood, but has rarely been reported in colonization of submerged wood in the sea.

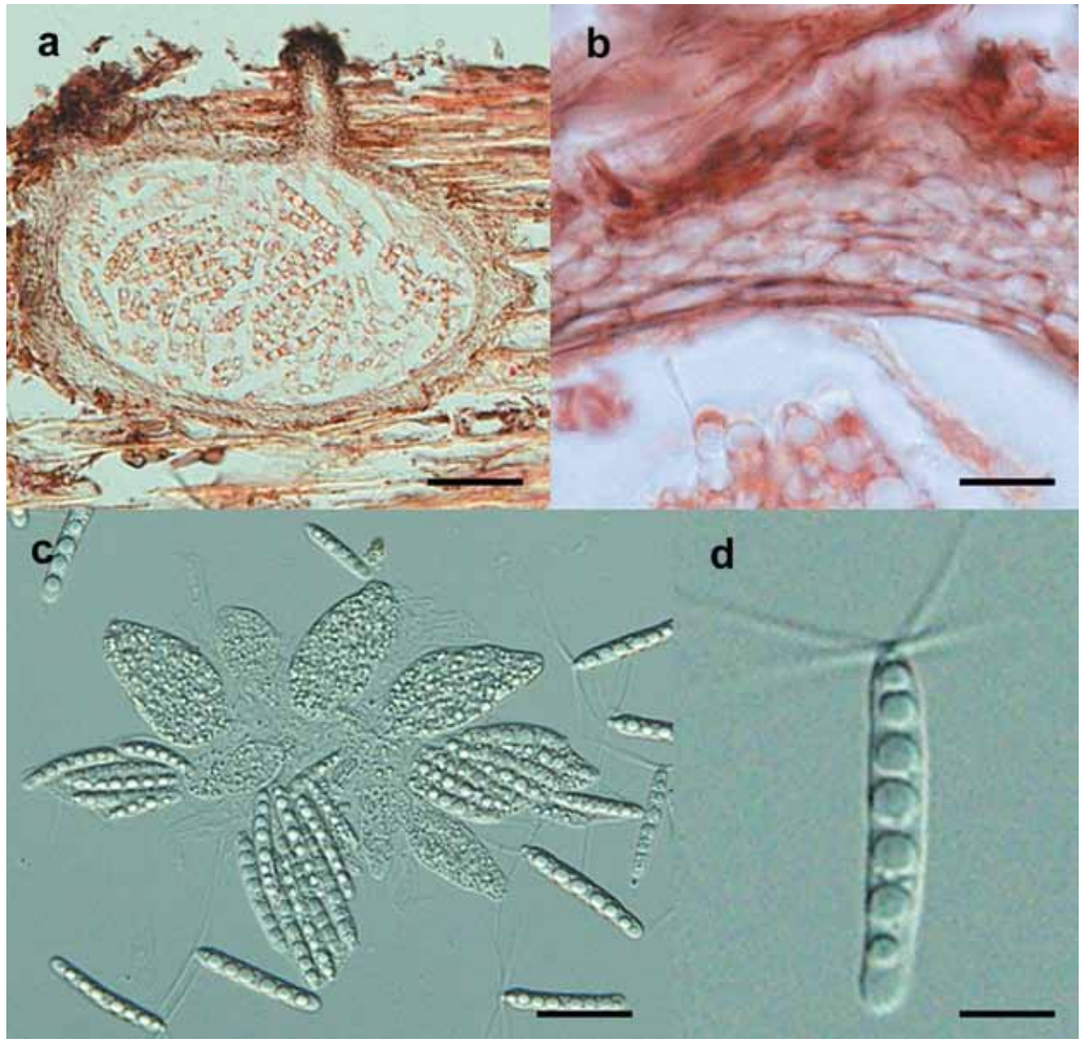

Figure 40. *Torpedospora radiata.* (a) Section of immersed, ellipsoidal ascoma. (b) Two-layered peridium, outer layer of cells of *textura angularis*, inner layer of elongate cells. (c) Clavate asci at different stages of development. (d) Ascospore 3-septate, with 4 radiating appendages at one end. Scale bar: a=50 µm; b, d=10 µm; c=30 µm.

SUBCLASS: SORDARIOMYCETIDAE
ORDER: DIAPORTHALES
FAMILY: VALSACEAE

Cryptovalsa Ces. & De Not. ex Fuckel, Jb. nassau. Ver. Naturk., Wiesbaden 23-24: 212 (1870)
Type species: *Cryptovalsa protracta* (Pers.) De Not.

Cryptovalsa mangrovei Abdel-Wahab & Inderb., Mycol. Res. 103: 1628 (1999)

Figure 41

Entostroma effuse, a faint black line between the groups sometimes present, wood softened, a thin layer of white pulvinate fungal material sometimes present around the ascomal venter. Ascomata 240-270 µm high, 260-350 µm diam., subglobose to broadly ellipsoidal, with a flattened base, immersed, raising the substratum, or erumpent. Necks 180-230 µm long, 190-210 µm diam., ostiolate, periphysate (36 × *ca.* 1 µm), comprising an outer layer of completely melanized cells, 32-40 µm wide, and an inner layer, up to 32 µm wide, of less pigmented, elongate cells. Peridium two-layered, with an outer layer of small, thick-walled, melanized, rounded cells 8-20 µm wide, and an inner layer, up to 12 µm wide, of hyaline, elongate cells of *textura angularis*. Paraphyses hyaline, septate, deliquescent, up to 160 ×11 µm. Asci (77-)88-180(-206) × 9.5-15 µm, clavate, truncate, with a stalk, spore-bearing part 45-96 (-136) µm long, multi-spored, apex up to 4 µm thick, with a refractive subapical, non-amyloid ring at the base of an invagination of the ascus apex. Ascospores (5.5-)8-15.5(-18) × 1.5-3.5 µm, allantoid, pale yellow to pale brown, *ca.* 128 per ascus.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Bahamas, Hong Kong, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Aoku, Hungmao, Peimeng, Ssutsao.

COMMENTS: This is a species with a limited distribution. *Cryptovalsa* is mainly a terrestrial genus while Jones et al. (2009) only accepted 2 marine species: *C. mangrovei* and *C. halosarceicola*. However, *Cryptovalsa suaedicola* has been described from the salt marsh plant *Suaeda fruticosa* (Spooner 1981). *Cryptovalsa mangrovei* can be easily recognized by the 128 ascospores in an ascus (Inderbitzin et al. 1999).

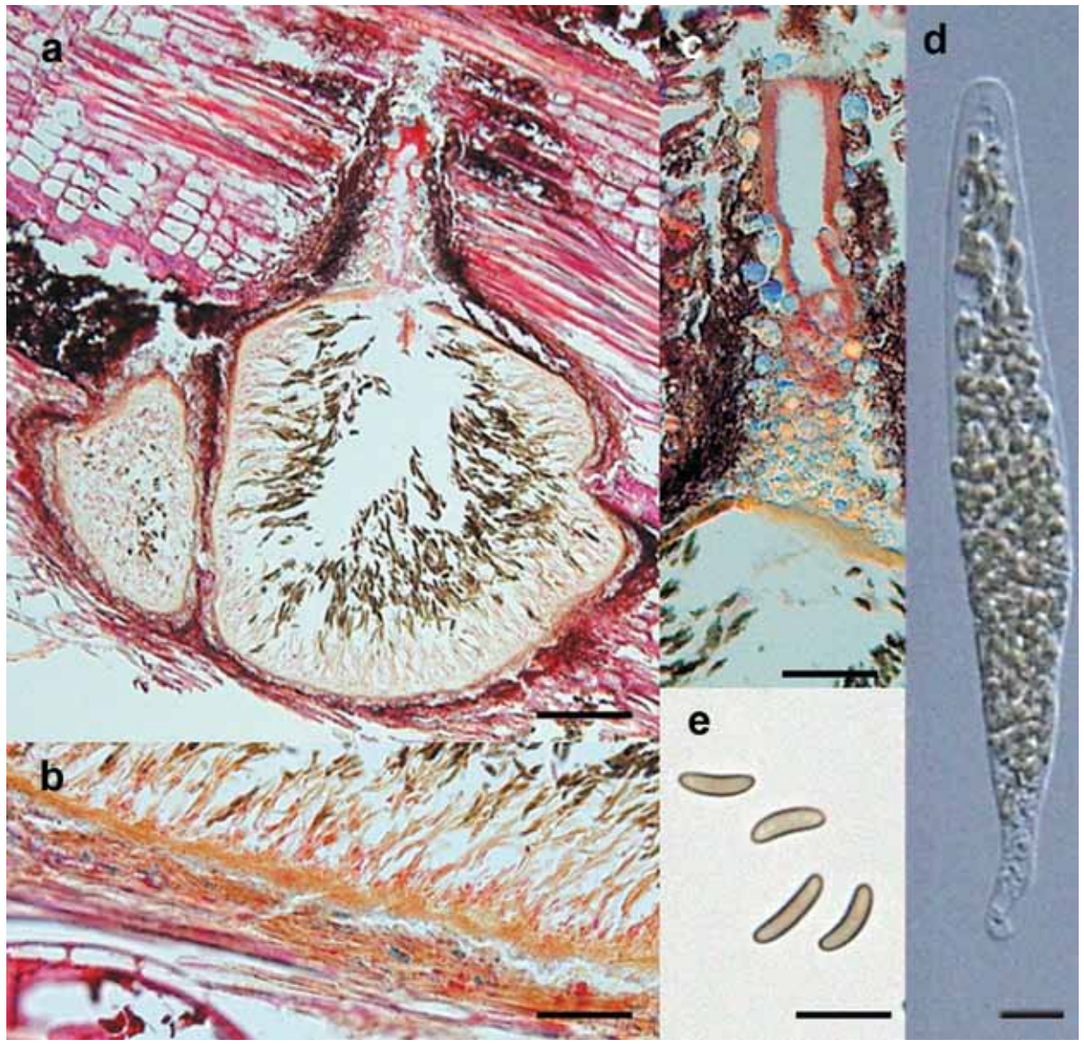

Figure 41. *Cryptovalsa mangrovei.* (a) Section of immersed ascomata in an entostroma. (b) Peridium. (c) Periphysate neck. (d) Clavate, thin-walled ascus with *ca.* 128 spores. (e) Curved, allantoid ascospores. Scale bar: a=100 µm; b=50 µm; c, d=30 µm; e=10 µm.

SUBCLASS: XYLARIOMYCETIDAE
ORDER: XYLARIALES
FAMILY: DIATRYPACEAE

Eutypa Tul. & C. Tul., Select. fung. carpol. (Paris) 2: 52 (1863)
Type species: *Eutypa lata* (Pers.) Tul. & C. Tul.

Eutypa bathurstensis K.D. Hyde & Rappaz, Mycol. Res. 97: 861 (1993)

Figure 42

Entostroma prosenchymatous, poorly developed, dorsally limited by a black zone binding the fruiting areas. Ascomata 0.3-0.6 mm high, up to 0.8 mm diam., spherical to flattened, submerged in the wood. Necks up to 0.5 mm long, not raising the uniformly blackened wood surface, or occasionally weakly raised, then wood surface blackened only under one or a few ascomata. Ostiole poorly developed or conical, up to 300 µm high, (120)150-200 µm diam., not sulcate. Peridium enclosing fragments of crystals in the external layer, 35-50 µm wide or wider near the ostiolar canal. Paraphyses numerous, persistent. Asci 50-65(90) µm × 8-10 µm, clavate, pedicellate. Ascospores (6-)7-10(-12) × 2-2.8 µm olive-brown, allantoid, containing oil droplets and limited by a thin epispore.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Australia, Bahamas, Egypt, Hong Kong, India, Malaysia, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Aoku, Chungkang, Fangwan, Hungmao, Peimeng, Ssutsao, Taan (Taichung County), Yingkeshih (Ilan County).

COMMENTS: An anamorphic stage (Figure 42 f, g) is associated with this fungus and it only appeared on wood above the ascomata after incubation. Hyde & Rappaz (1993) placed this species in the Diatrypaceae but it differs from them in having a thick hyaline part as a thin white line under the black hymenium. Whether this species belongs to this family requires a molecular study.

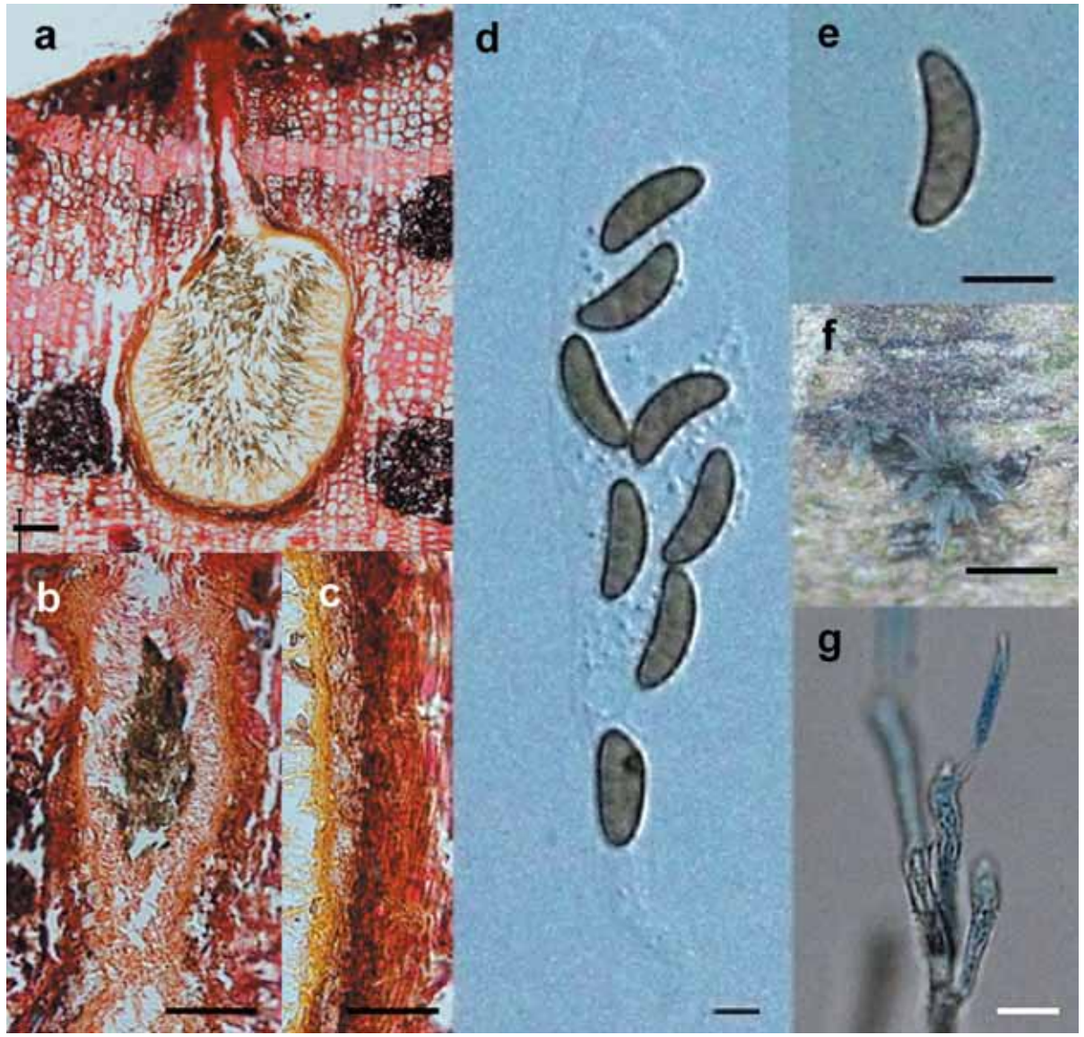

Figure 42. *Eutypa bathurstensis*. (a) Section of immersed ascoma with darkened area on the wood surface. (b) Ascoma neck with periphyses. (c) Peridium merging with the wood tissue. (d) Elongate-clavate ascus with 8 ascospores. (e) Olive-brown, allantoid, curved ascospore. (f) Synnemata of anamorph of *E. bathurstensis* formed at tip of ascomata on wood surface. (g) Conidiophores and a conidium. Scale bar: a=100 µm; b=50 µm; c=30 µm; d, g=10 µm; e=5 µm; f=300 µm.

Eutypella (Nitschke) Sacc., Atti Soc. Veneto-Trent. Sci. Nat., Padova 4: 80 (1875)
Type species: *Eutypella cerviculata* (Fr.) Sacc.

Eutypella naqsii K.D. Hyde, Mycol. Res. 99: 1462 (1995)

Figure 43

Stromata up to 80 µm thick, forming a blackened crust on the host surface, with ectostromatal cushions occurring around each ascoma, comprising host cells and intracellular blackened fungal hyphae. Ascomata 520-650 µm high, 650-840 µm diam., globose or subglobose, with periphysate necks collectively erumpent through pustulate discs. Peridium up to 50 µm wide, composed of elongate cells, comprising outer few layers of pigmented, fungal and host cells, fusing with the stroma on the outside and inners layer of thin-walled, compressed, hyaline cells. Paraphyses up to 8 µm wide at the base, hypha-like, sparse, septate, hyaline, and tapering distally. Asci 28-50 × 3.6-6.4 µm, eight-spored, cylindric-clavate, long pedunculate, thin-walled, unitunicate, apically truncate, with a J- apical thickening. Ascospores 6.4-8 × 1.2-1.6 µm, allantoid, straight or mostly curved, hyaline to pale-yellow, unicellular.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Australia, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Chungkang, Hungmao, Ssutsao, Tanshui.

COMMENTS: This species is morphologically similar to *Eutypa bathurstensis* but differs in having small groups of ascomata developing under a blackened stroma and hyaline to pale yellow ascospores (Hyde 1995). Also, no anamorph has been reported for *Eutypella naqsii*. A molecular study is required to determine its relationship with other terrestrial *Eutypella* species.

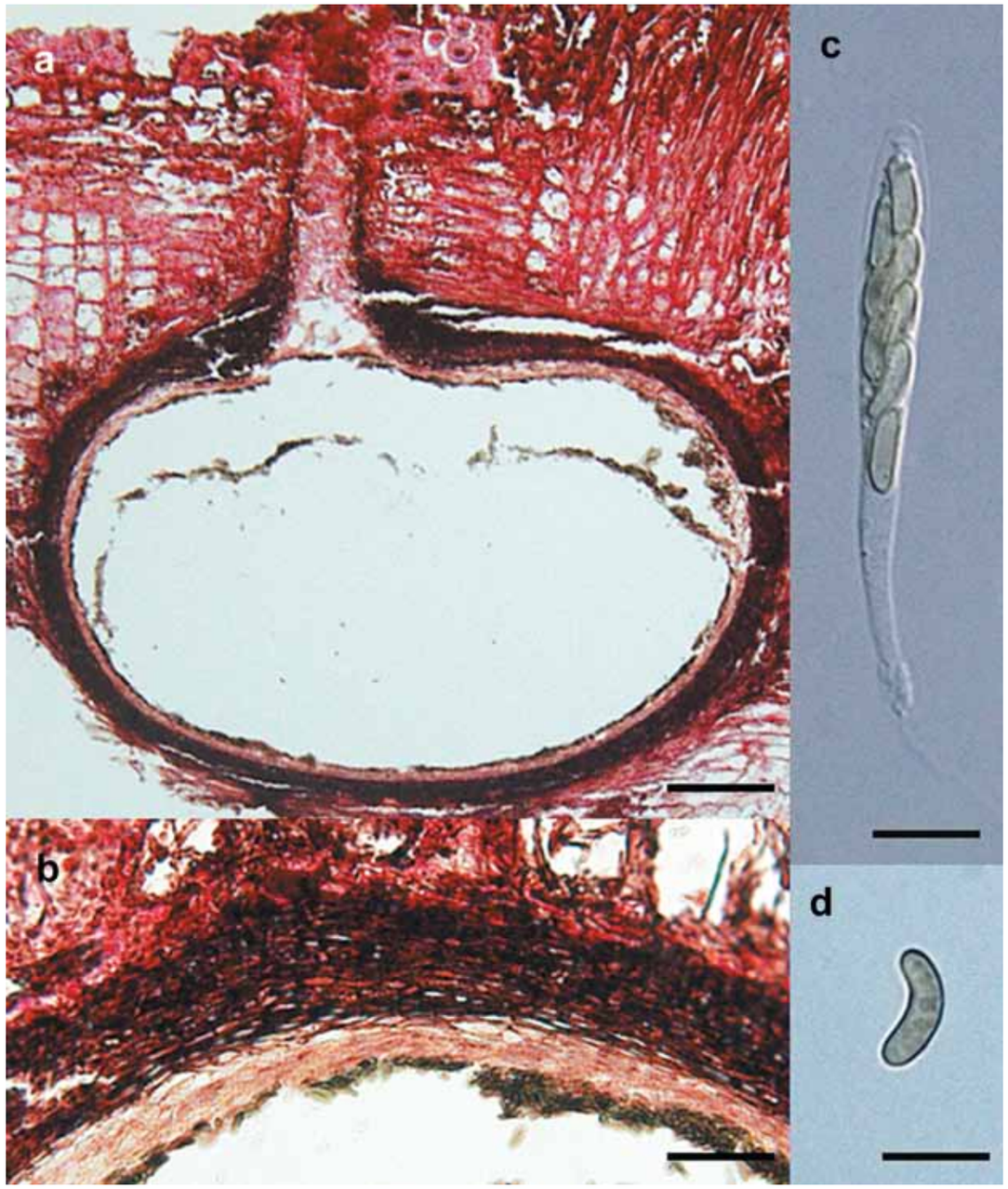

Figure 43. *Eutypella naqsii.* (a) Section of immersed, globose ascoma. (b) One-layered peridium, composed of thick-walled, elongate cells. (c) Cylindrical, thin-walled ascus with an apical ring. (d) Light-colored, allantoid ascospore. Scale bar: a=100 µm; b=30 µm; c, d=10 µm.

FAMILY: XYLARIACEAE

Halorosellinia Whalley, E.B.G. Jones, K.D. Hyde & Læssøe, Mycol. Res. 104: 368 (2000)
Type species: *Halorosellinia oceanica* (S. Schatz) Whalley, E.B.G. Jones, K.D. Hyde & Læssøe

Halorosellinia oceanica (S. Schatz) Whalley, E.B.G. Jones, K.D. Hyde & Læssøe, Mycol. Res. 104: 370 (2000)
≡ *Hypoxylon oceanicum* S. Schatz, Mycotaxon 33: 413 (1988)

Figure 44

Pseudostromata 0.4-0.8 mm diam., seated on decorticated wood, occasionally embedded at the base, pulvinate to hemispherical, single, in clusters of up to 30 uni-peritheciate pseudostromata, linear to suborbicular, surface leathery in fresh material, at maturity black, generally with conspicuous ascomatal projections. In section pseudostromata comprising host cells filled with light brown fungal cells in the form of *textura globulosa* or amorphous black fungal material. Ascomata immersed in pseudostroma, subglobose to hemispherical, soft to leathery, black, ostioles papillate. Peridium 25-35 µm wide, two-layered, composed of an outer layer of cells of *textura angularis* and an inner layer of elongate cells. Paraphyses 2-2.5 µm wide at the base, abundant, persistent, remotely septate. Asci 177-219 × 17-23 µm, eight-spored, cylindrical, unitunicate, subapical apparatus dark blue in Melzer's reagent, tapering with a distinct apical rim, (4.7-)5.6-6.6 × 4.2-4.7 µm. Ascospores (17.9-)18.7-26(-28) × 7.5-13(-13.5) µm, uniseriate to obliquely uniseriate or partially biseriate at the upper end of the ascus, dark grey-olive to opaque brown, more or less inequilaterally ellipsoid, upper end broadly rounded, lower end slightly pointed, one-celled throughout ascospore development, bi-guttulate, wall smooth and relatively thick, without appendages or loosening perispore, germination slit usually clearly seen on the ventral side, straight, conspicuous, ½-¾ total length of spore.

SUBSTRATA: dead mangrove wood, *Cocos* fruits.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Belize, Bermuda, Brazil, Brunei, China, Hong Kong, India, Indonesia, Japan, Macau, Malaysia, Mauritius, Nicobar Islands, Philippines, Portugal, Republic of Trinidad and Tobago, Seychelles, Singapore, South Africa, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Chungkang, Fushan (Taitung County), Haishanku, Hsinwu, Hungmao, Tanshui.

COMMENTS: This species is extremely common on the upper level of the mangroves. It was originally described as a *Hypoxylon* species, but was transferred to a new genus *Halorosellinia* because *Hypoxylon* has: (i) a *Nodulisporium*-like anamorph, (ii) uni-partite stromata, (iii) solid and homogeneous stromatal tissue, and (iv) height of the stromata less than the length and breadth (Whalley et al. 2000). Sequence analyses based on SSU and LSU rRNA genes suggested a relationship with *Xylaria hypoxylon* but did not group with *Hypoxylon curta*, suggesting that the genus *Hypoxylon* might be polyphyletic (Smith et al. 2003). *Halorosellinia oceanica* produces a wide range of bioactive compounds, including cytochalasins, which is consistent with the taxonomic affinity with Xylariales (Schlingham et al. 1998, Li et al. 2001).

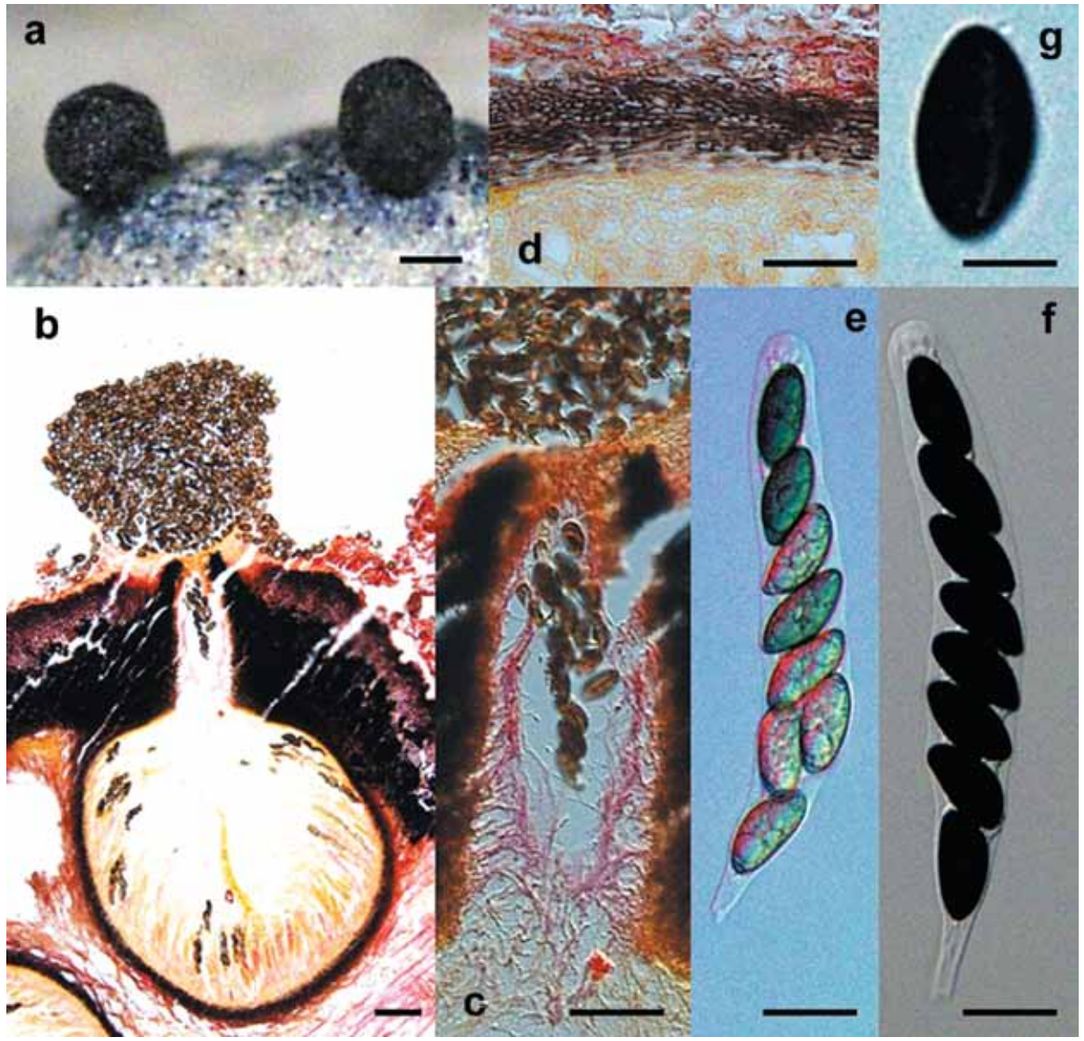

Figure 44. *Halorosellinia oceanica.* (a) Surface of pseudostroma with masses of discharged spores above the ostiole. (b) Section of immersed ascoma in the pseudostroma. (c) Ascoma neck with periphyses. (d) Two-layered peridium, outer layer of cells of *textura angularis*, inner layer of elongate cells. (e) Ascus with near-mature ascospores. (f) Mature ascus with subapical apparatus. (g) Ascospore dark brown with a longitudinal germ-slit. Scale bar: a=300 µm; b=100 µm; c, d, e, f=30 µm; g=10 µm.

Nemania Gray, Nat. Arr. Brit. Pl. (London) 1: 508, 516 (1821)
Type species: *Nemania serpens* (Pers.) Gray

Nemania maritima Y.M. Ju & J.D. Rogers, Nova Hedw. 74: 102 (2002)

Figure 45

Stromata 0.5-0.6 mm diam., scattered, subglobose to globose, enclosing one to several perithecia, erumpent, with lower to middle part embedded in the substrate, surface dark-brown, smooth, carbonaceous immediately beneath the surface and between the perithecia, tissue beneath the perithecial layer inconspicuous. Ostioles obtusely conical, black. Peridium one-layered, composed of cells of *textura angularis* with large lumina, merging with the wood. Asci 80-100 µm × 6-9 µm, short-stipitate, with apical ring blueing in Melzer's iodine reagent, cuneate, 1.5 µm high, 3 µm diam. Ascospores 9-12 × 5-6(-6.5) µm, light brown to brown, unicellular, ellipsoidal, with broadly rounded ends, with straight germ slit much less than spore-length.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Bahamas, Denmark, England, Hong Kong, Malaysia, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Aoku, Chungkang, Haomeiliao, Hungmao, Tanshui.

COMMENTS: This species is known only from a few locations and was described from material collected in Taiwan (Ju & Rogers 2002). This species can be easily confused with *Halorosellinia oceanica*, which produces a dark pseudostroma and dark ascospores (Whalley et al. 2000). However, ascospores of *N. maritima* are smaller, and a pronounced decolorization of the wood around the stroma can be observed. Ju & Rogers (2002) suggested that a new genus could be created to accommodate *N. maritima*.

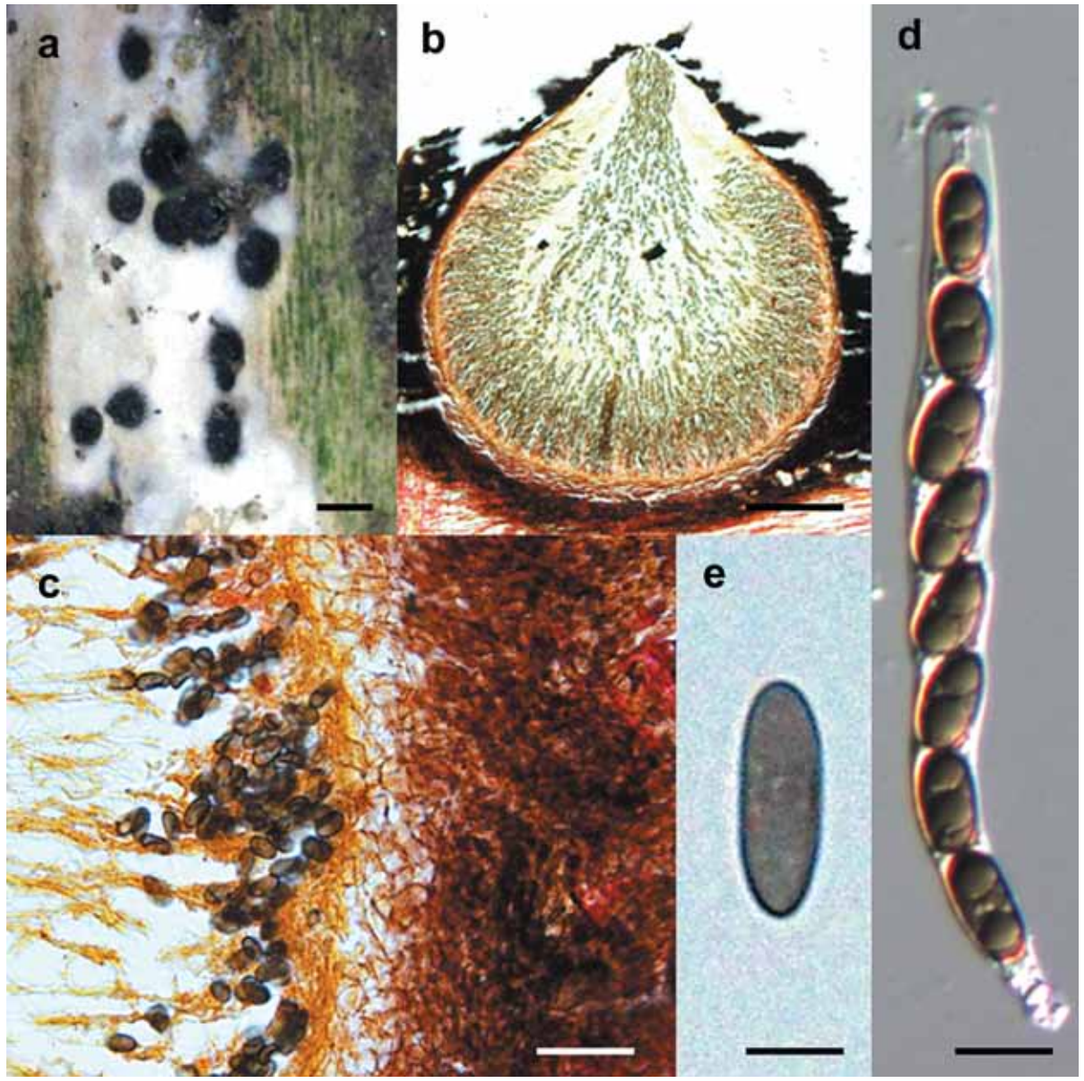

Figure 45. *Nemania maritima.* (a) Black, exposed ascomata on wood. (b) Section of globose ascoma with a short papilla. (c) One-layered peridium of cells of *textura angularis* with large lumina, merging with the wood tissue. (d) Cylindrical thin-walled ascus with an apical apparatus. (e) Ascospore, dark-colored, unicellular. Scale bar: a=200 µm; b=100 µm; c=30 µm; d=10 µm; e=5 µm.

CLASS: SORDARIOMYCETES *INCERTAE SEDIS*

ORDER: LULWORTHIALES

Lulworthia G.K. Sutherl., Trans. Br. Mycol. Soc. 5: 259 (1916)
Type species: *Lulworthia fucicola* G.K. Sutherl.

Lulworthia grandispora Meyers, Mycologia 49: 513 (1957)

Figure 46

Ascomata 180 × 306 µm diam., globose or subglobose to pyriform, immersed or superficial, ostiolate, with a long neck, brown to black, solitary or gregarious. Necks 75-1400 × 15-33 µm, cylindrical, straight or curved, sometimes two on one ascoma. Peridium two-layered, composed of an outer layer of cells of *textura angularis* and an inner layer of elongate cells with large lumina. Paraphyses absent. Asci eight-spored, elongate-fusiform or cylindrical, unitunicate, thin-walled, early deliquescing. Ascospores 500-756 × 3-5 µm (including apical chambers), filamentous, curved, hyaline, tapering at each end into an elongate, conical process or apical chamber, processes 3.6-7 µm long, acute or rounded, filled with mucus that is released through an apical pore.

SUBSTRATA: dead mangrove wood, dead mangrove leaves, dead mangrove fruits, fronds of *Nypa fruticans*, dead mangrove seedlings.

WORLDWIDE DISTRIBUTION: Aldabra, Andaman Islands, Australia, Bahamas, Belize, Bermuda, Brazil, Brunei, Egypt, Fiji, Ghana, Guatemala, Hong Kong, India, Indonesia, Japan, Kuwait, Liberia, Malaysia, Maldives, Mexico, Nicobar Islands, Peru, Philippines, Republic of Trinidad and Tobago, Seychelles, Singapore, South Africa, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Aoku, Chungkang, Fangwan, Haomeiliao, Hungmao, Peimeng, Ssutsao, Tanshui, Tsengwen, Tunghsin, Yenliao (Taipei County), Hemei (Taipei County).

COMMENTS: This species was originally described from yellow pine wood, but it has been mostly reported from mangrove habitats. The most distinguishing character of this taxon from other *Lulworthia* species is the over-500 µm long ascospores, otherwise, other characters are similar. Taxonomy of the genus *Lulworthia* has been problematic as there are few morphological characters to separate them. Campbell et al. (2005) studied the phylogeny of *Lulworthia* species using SSU and LSU rRNA gene sequences and created a number of new genera: *Lulwoana* for *L. uniseptata* and *Lulwoidea* for *L. lignoarenaria*, as both do not group with the type species, *L. fucicola*. A new genus should also be suggested for *Lulworthia grandispora*, as it also did not group with *L. fucicola* (Koch et al. 2007, Jones et al. 2009). Caution should be taken, however, as the '*L. fucicola*' available in the GenBank was isolated from wood, in contrast to the original substrate, the brown alga *Fucus vesiculosus* (Sutherland 1916).

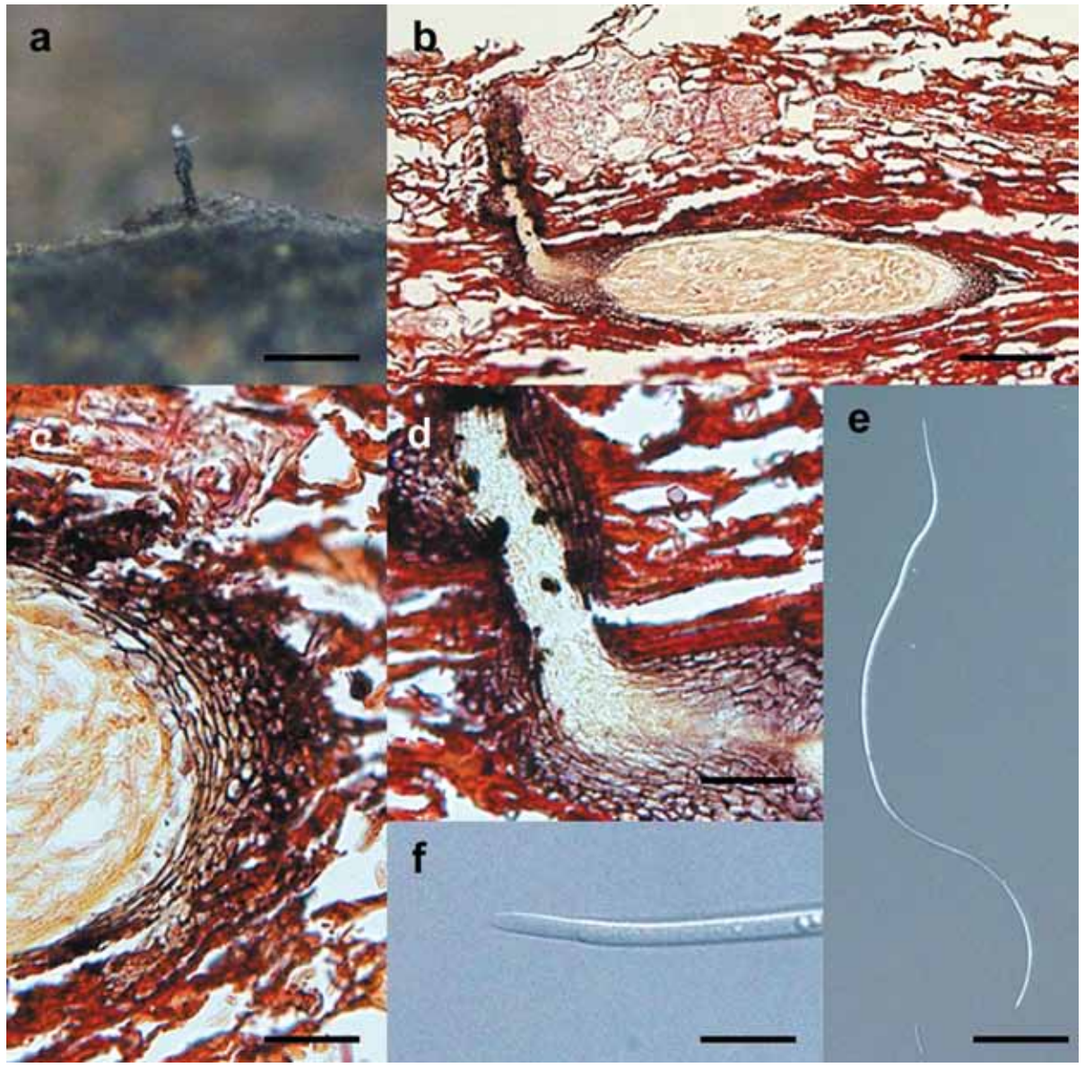

Figure 46. *Lulworthia grandispora.* (a) Long neck protruding from the wood. (b) Section of immersed ascoma. (c) Two-layered peridium, outer layer of cells of *textura angularis*, inner layer of elongate cells with large lumina. (d) Ascoma neck filled with pseudoparenchymatous cells. (e) Ascospore filiform. (f) Ascospore end-chamber at both ends. Scale bar: a, e=100 µm; b=50 µm; c, d=30 µm; f=10 µm.

ORDER: PHYLLACHORALES

Marinosphaera K.D. Hyde, Can. J. Bot. 67: 3080 (1989)
Type species: *Marinosphaera mangrovei* K.D. Hyde

Marinosphaera mangrovei K.D. Hyde, Can. J. Bot. 67: 3080 (1989)

Figure 47

Ascomata 107-228 µm high, 98-199 µm diam., ellipsoidal, globose, subglobose or pyriform, immersed, ostiolate, papillate, membranous, light to dark brown, periphysate, solitary. Necks up to 397.6 µm long, hyaline, but dark at the base. Peridium 8.5-17.4 µm thick, hyaline to brown, composed of angular cells of *textura angularis*. Paraphyses 1.6-6 µm wide, simple, septate. Asci 88.4-112 × 18.5-22.7 µm, eight-spored, clavate, short pedunculate, persistent, unitunicate, not blueing in Melzer's reagent, treatment with lactophenol reveals a subapical plate through which a faint pore may be observed, developing from ascogenous tissue at the base of the ascoma. Ascospores 25.5-31 × 6-8.5 µm, 2-3 seriate in ascus, broad ellipsoidal to fusiform, non-septate when young, becoming 3-septate in older specimens, hyaline, smooth-walled, hyaline in mass.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Australia, Brunei, China, Egypt, Hong Kong, India, Indonesia, Macau, Malaysia, Maldives, Mauritius, Philippines, Singapore, Society Island, South Africa, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Aoku, Chiehting, Fangwan, Haishanku, Haomeiliao, Hsinwu, Hungmao, National Taiwan Ocean University (Chilung City), Peimeng, Ssutsao, Taan (Taichung County), Tanshui, Tsengwen, Tunghsin, Tungpeichiao (Taipei County), Yingkeshih (Ilan County).

COMMENTS: This is an extremely common species in Taiwan, both in mangroves and rocky shores. Hyde (1989) suggested its affinity to the Phyllachorales but members of this order are mainly biotrophic. The characteristic features of the species are the ascus tip that is thickened with a small flattened ocular chamber, and wide paraphyses that are constricted at the septa. Using SSU and LSU rRNA gene sequences, it is placed within the Hypocreomycetidae but does not group with any known order (Jones et al. 2009). It shows similarity with *Argentinomyces* but in *Argentinomyces*, the asci are clavate and paraphyses are absent. Alias (1996) regards this species as an early colonizer of wood in Malaysia.

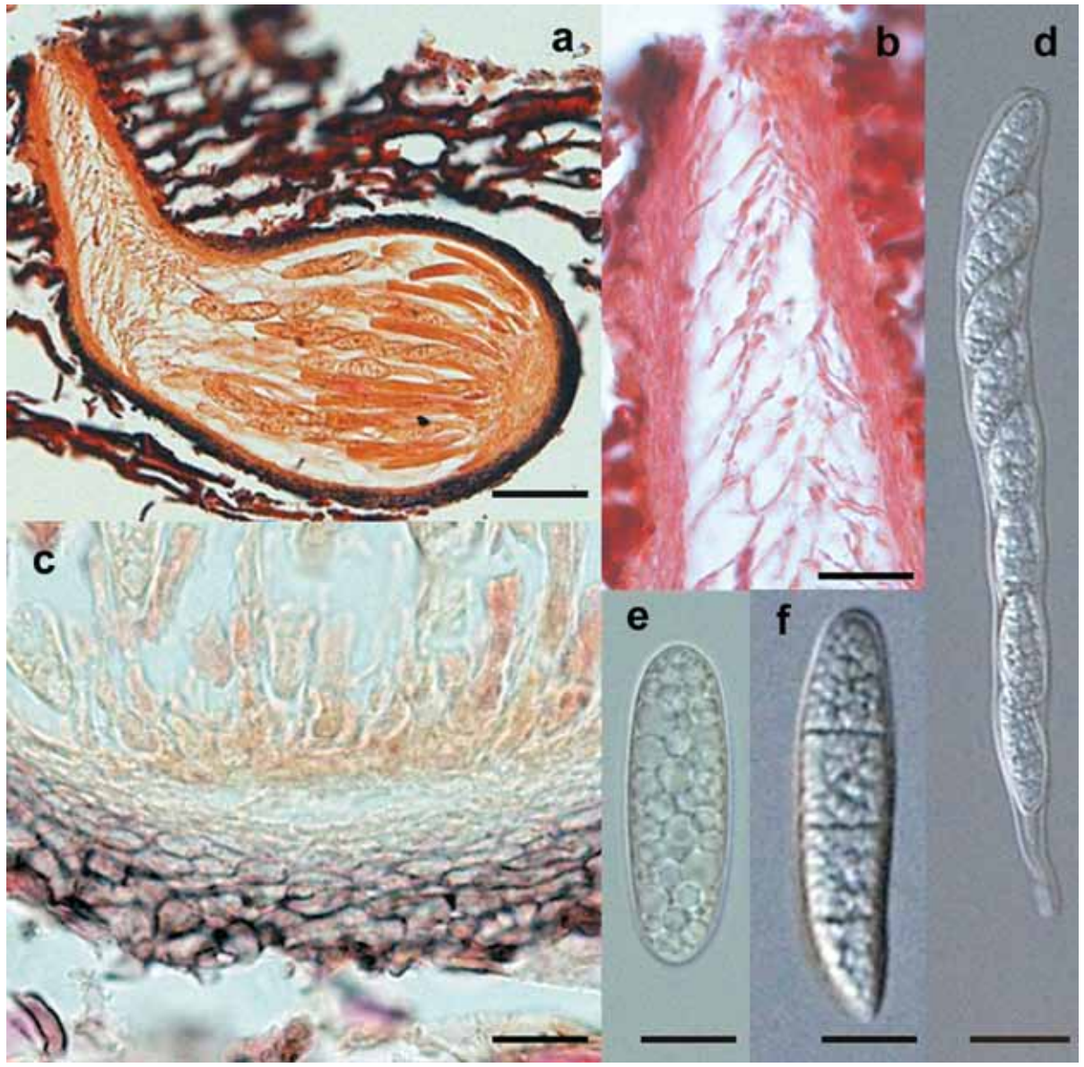

Figure 47. *Marinosphaera mangrovei.* (a) Section of immersed ascoma. (b) Ascoma neck with periphyses. (c) One-layered peridium, composed of cells of *textura angularis* with large lumina. (d) Cylindrical, thin-walled ascus. (e) Immature ascospore. (f) Mature ascospore, 3-septate. Scale bar: a=50 µm; b, d=20 µm; c, e, f=10 µm.

UNITUNICATE ASCOMYCOTA GENERA *INCERTAE SEDIS*

Saccardoella Speg., Michelia 1: 461 (1879)
Type species: *Saccardoella montellica* Speg.

Saccardoella marinospora K.D. Hyde, Mycologia 84: 806 (1992*)*

Figure 48

Ascomata 780-1040 µm high, 650-960 µm diam., globose or subglobose, immersed under a clypeus, ostiolate, short papillate, coriaceous, brown-black, solitary or gregarious. Papilla up to 240 µm high, black, blunt conical, ostiole rounded, periphyses not observed. Peridium up to 9 0µm thick, comprised of two-layered, the outer layer composed of cells in the form of *textura angularis*, the inner layer of brown elongate cells. Hamathecium up to 2 µm thick, hyphae-like, filamentous, septate, rarely branching, numerous, gelatinous and attached to the base and top of the ascomata. Asci 190-240 × 10-12 µm, eight-spored, cylindrical, thin-walled, unitunicate, short pedunculate, apically rounded or flattened, with a small, ring-like, subapical apparatus. Ascospores 25-31 × 7.5-10 µm, overlapping uni-seriate, hyaline at maturity, cylindrical with acute poles, three-septate, not constricted at the septa, surrounded by a thin sheath which swells in water to become large and indistinct.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Australia, Brunei, China, Hong Kong, India, Malaysia, Maldives, Mauritius, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Chiehting, Tanshui.

COMMENTS: *Saccardoella* is a genus with terrestrial, freshwater and brackish water species. The ascus structure of *Saccardoella* is still controversial as to whether it is unitunicate or bitunicate. Mathiassen (1989) emphasized it as a bitunicate fungus while Barr (1990) classified it in the unitunicate family Clypeosphaeriaceae (Xylariales). Kirk et al. (2008) in the Dictionary of Fungi leave it as Sordariomycetes *incertae sedis*. A phylogenetic study is urgently required to resolve the taxonomic position of this genus.

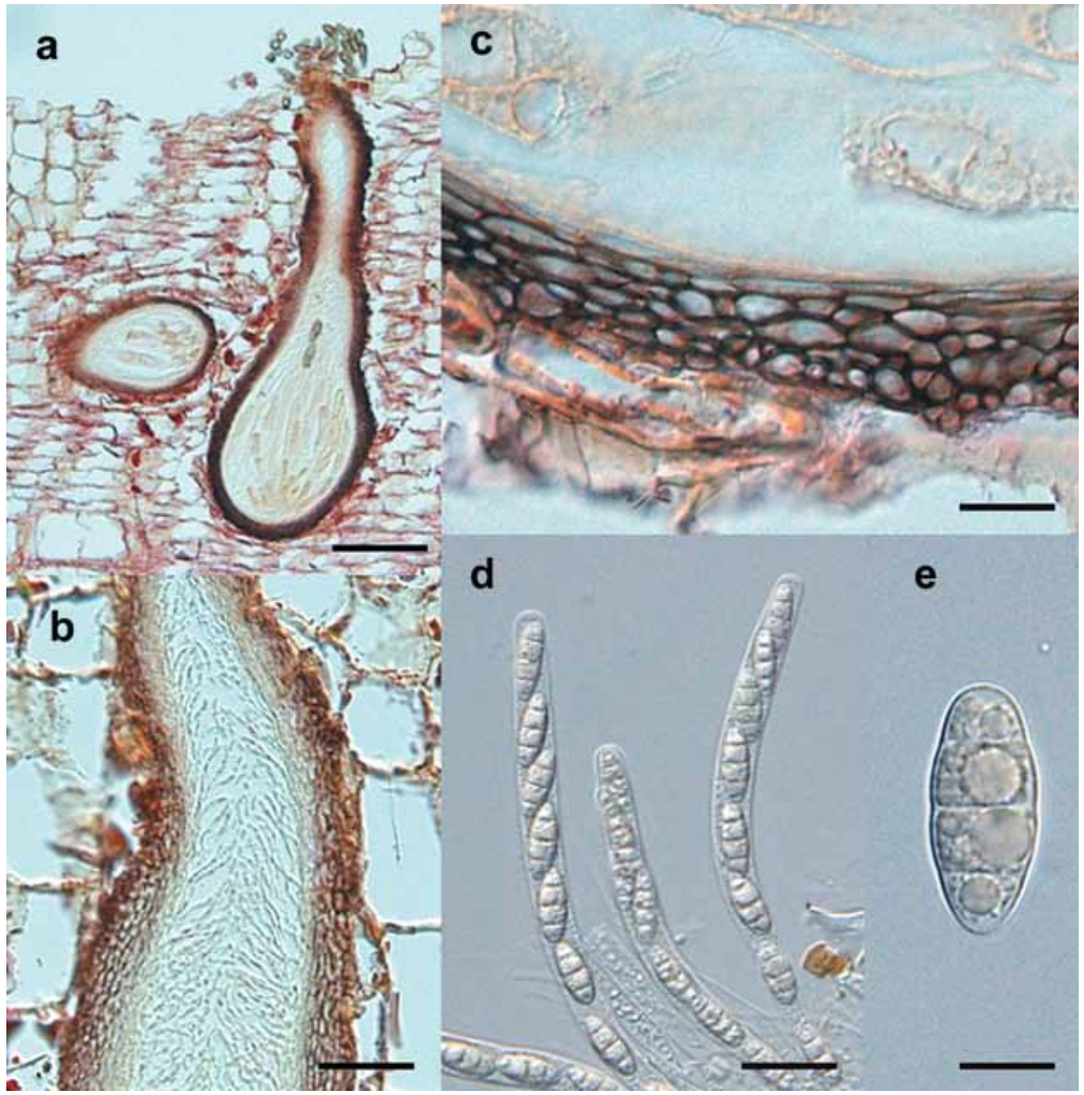

Figure 48. *Saccardoella marinospora.* (a) Section of ascomata deeply embedded in wood. (b) Ascoma neck with periphyses. (c) Two-layered peridium, outer layer of of cells of *textura angularis*, inner layer of elongate cells. (d) Cylindrical asci with an apical apparatus. (e) Ascospore ellipsoidal, 3-septate. Scale Bar: a=100 µm; b, d=30 µm; c, e=10 µm.

Saccardoella rhizophorae K.D. Hyde, Mycologia 84: 806 (1992)

Figure 49

Ascomata 325-455 µm high, up to 364 µm diam., immersed, globose or subglobose, ostiolate, ostiole rounded in section, short papillate, coriaceous, brown or black, neck surrounded by a small clypeus, solitary or gregarious. Peridium, up to 58 µm thick, composed of one-layered, composed of thin-walled, brown, angular cells forming *textura angularis* with large lumina, individual cells up to 12 × 3 µm. Hamathecium up to 2 µm thick, filamentous, septate, rarely branching, numerous and in a gel. Asci 135-160 × 8-10 µm, eight-spored, cylindrical, thin-walled, unitunicate, short pedunculate, apically rounded or flattened with a faint ring-like subapical apparatus. Ascospores 19-26 × 6-8 µm, overlapping uni-seriate, young ascospores two-celled, becoming (4-)5(-6)-septate when mature, hyaline, ellipsoidal, surrounded by a thin sheath which swells in water.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Fiji, India, Malaysia, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Chiehting, Ssutsao, Tanshui.

COMMENTS: This species is morphologically similar to *S. mangrovei*, but ascospores of *S. rhizophorae* are smaller and with fewer septa (Hyde 1992a).

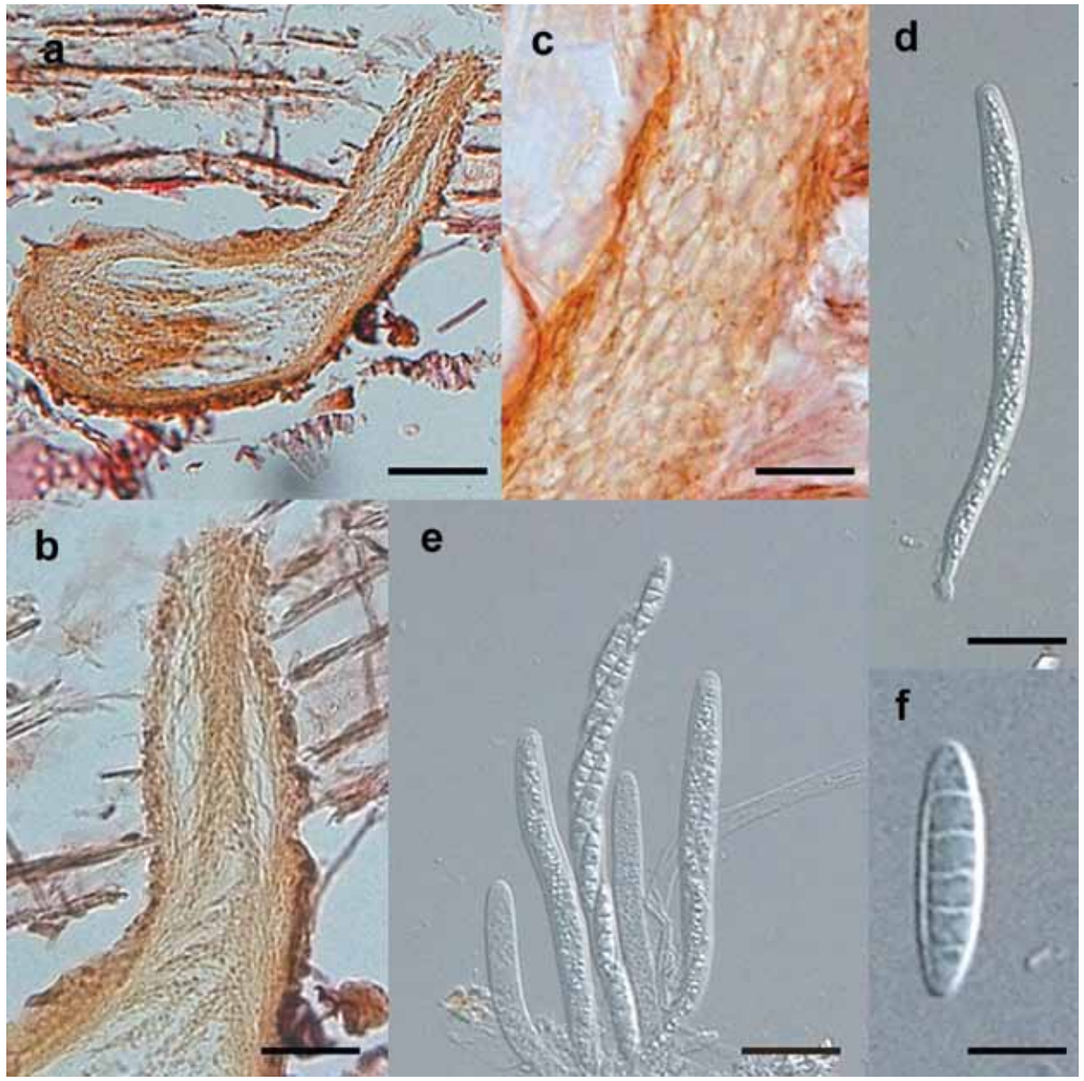

Figure 49. *Saccardoella rhizophorae.* (a) Section of immersed ascoma. (b) Ascoma neck with periphyses. (c) One-layered peridium, composed of cells of *textura angularis* with large lumina. (d) Immature ascus. (e) Asci at different stages of development. (f) Ascospore hyaline, 5-septate. Scale bar: a=50 µm; b, d, e=30 µm; c, f=10 µm.

ANAMORPHIC FUNGI

Bactrodesmium Cooke, Grevillea 12: 35 (1883)
Type species: *Bactrodesmium abruptum* (Berk. & Broome) E.W. Mason & S. Hughes

Bactrodesmium linderi (J.L. Crane & Shearer) M.E. Palm & E.L. Stewart, Mycotaxon 15: 319 (1982)
≡ *Trichocladium linderi* J.L. Crane & Shearer, Mycologia 70: 866 (1978)

Figure 50

Colonies sporodochial, hyaline becoming black, conidiophores micronematous, smooth, thin-walled, hyaline or thick-walled brown, conidiogenous cells holoblastic, integrated, terminal or intercalary, smooth, cylindrical, determinate, conidia solitary, subglobose to obpyriform, 1-2-septate, not constricted at the septa, dark brown to black, 20-33.6 × 14.5-20.5 µm.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Brunei, China, Hong Kong, India, Macau, Malaysia, Seychelles, Singapore, South Africa, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Chichi (Hualien County), Hungmao, National Taiwan Ocean University (Chilung City), Tanshui.

COMMENTS: Conidial morphology of this species is similar to *Trichocladium* species. Conidia in *B. linderi* are borne in sporodochia on wood, rather than mononematous and scattered conidiophores as *Trichocladium* species. This is a common species locally on mangrove substrata but can easily be confused with *Trichocladium nypae*. A molecular study is warranted to determine its phylogenetic relationship as the genus *Trichocladium* has been shown to be polyphyletic (K.L. Pang, unpublished results).

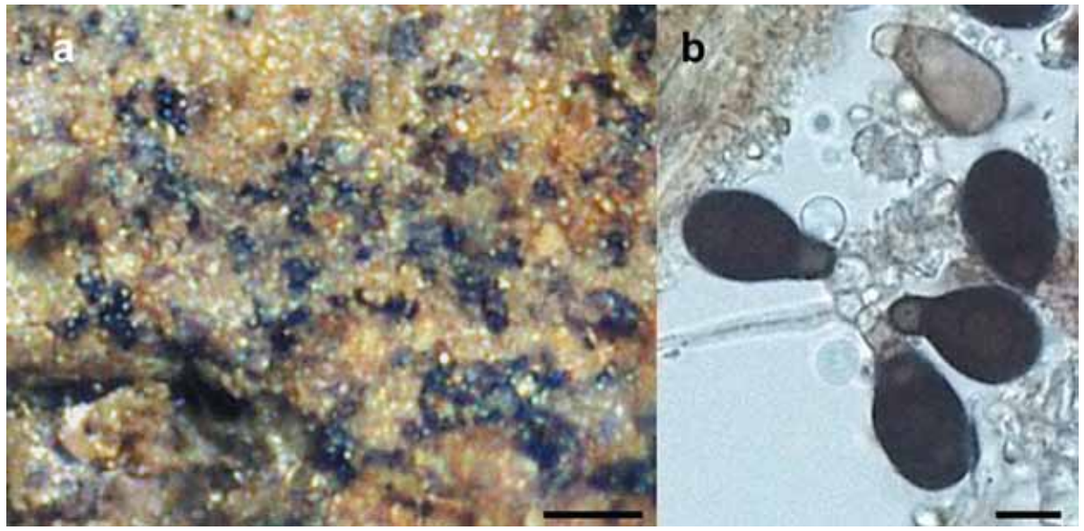

Figure 50. *Bactrodesmium linderi.* (a) Conidia on wood surface. (b) Dark-colored, obpyriform conidia. Scale bar: a=300 µm; b=10 µm.

Halenospora E.B.G. Jones, Fungal Divers. 35: 154 (2009)
Type species: *Halenospora varia* (Anastasiou) E.B.G. Jones

Halenospora varia (Anastasiou) E.B.G. Jones, Fungal Divers. 35: 154 (2009)
≡ *Zalerion varium* Anastasiou, Can. J. Bot. 41: 1136 (1963)

Figure 51

Hyphae septate, branched, immersed, hyaline. Conidiophores up to 30 µm × 2-3.5 µm, micronematous, simple, cylindrical, septate, sometimes absent, superficial, hyaline to light olive-colored. Conidia 15-65 × 13.5-56 µm, solitary, irregularly helicoid or coiled in three planes, forming a knot or ball of about 10 to 30 cells, conidial filament lateral, rarely branched or subtending an additional conidium, thick-walled, smooth, brown to dark brown, appearing black in mass, cells 5-13 × 4-10.5 µm, additional complex conidia composed of up to several hundred cells may be formed in the substrate.

SUBSTRATA: dead mangrove wood, drift coconuts, dead mangrove seedlings, dead mangrove leaves.

WORLDWIDE DISTRIBUTION: Andaman Islands, Bahamas, Belize, Brunei, Canada, Chile, China, Egypt, Gambia, Germany, Guatemala, Hong Kong, India, Japan, Malaysia, Maldives, Mexico, Nicobar Islands, Palau Islands, Philippines, Portugal, Samoa, Seychelles, Singapore, Sri Lanka, Spain, Sweden, Taiwan, Thailand, USA, West Guatemala.

DISTRIBUTION IN TAIWAN: Chichi (Hualien County), Fushan (Taitung County), Hsinwu.

COMMENTS: This species was originally accommodated in *Zalerion* (Anastasiou 1963). However, Bills et al. (1999), using ITS sequences, discovered that *Z. varia* grouped in the Leotiaceae while the type species, *Z. maritima*, resided in the Lulworthiales (Campbell et al. 2005). As a result, Jones et al. (2009) removed this species from *Zalerion* and transferred it to a new genus, *Halenospora*. A number of fungi with similar morphology have been observed and deserve particular attention (Abdel-Wahab et al. 2010, Pang et al. 2011).

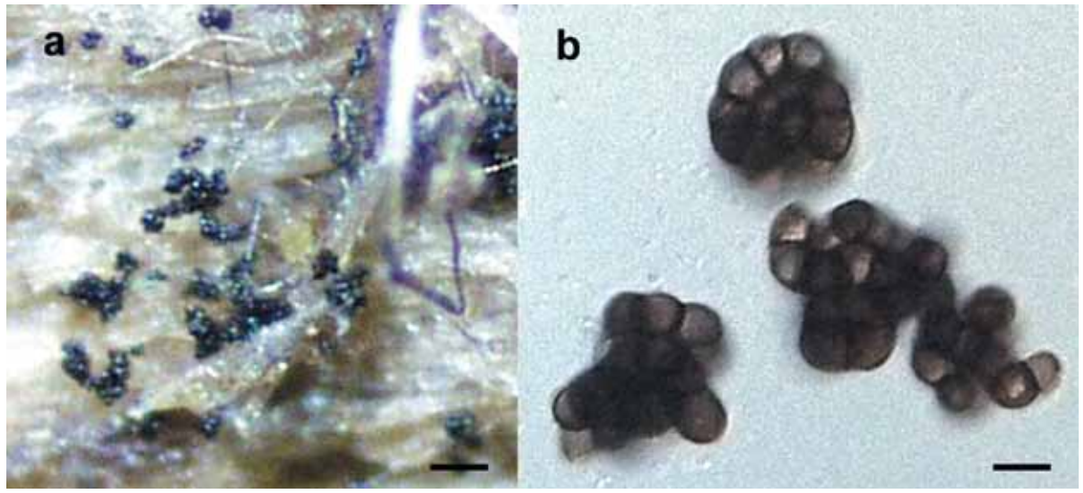

Figure 51. *Halenospora varia.* (a) Conidia on wood surface. (b) Dark-colored, coiled conidia. Scale bar: a=100 µm; b=10 µm.

Monodictys S. Hughes, Can. J. Bot. 36: 785 (1958)
Type species: *Monodictys putredinis* (Wallr.) S. Hughes

Monodictys pelagica (T.W. Johnson) E.B.G. Jones, Trans. Br. Mycol. Soc. 46: 138 (1963)
≡ *Piricauda pelagica* T.W. Johnson, J. Elisha Mitchell scient. Soc. 74: 42 (1958)
= *Piricuada articoceanourm* R.T. Moore, Rhodora 61: 95 (1958)

Figure 52

Hyphae septate, rarely branched, dark brown or fuscous. Conidiophores short or lacking, cylindrical, zero to two-septate, simple, lateral, dark brown. Conidia 15-41(-44) µm × 12.5-37 µm, obpyrifrom, ovoid or rarely subglobose, muriform, not or slightly constricted at the septa, smooth, black, with one to three yellowish or light brown basal cells, solitary, the septation is only visible in immature conidia. Chlamydospores 48-155 µm × 6.5-21 µm, dark brown, intercalary, catenulate, composed of 4-25 cells, chains simple, rarely muriform.

SUBSTRATA: dead mangrove wood, test panels, *Spartina*, *Typha*.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Brunei, Canada, Chile, Denmark, England, France, Gambia, Germany, Hong Kong, Iceland, India, Iceland, Ireland, Italy, Ivory Coast, Japan, Kuwait, Malaysia, Mexico, New Zealand, Panama, Portugal, Russia, Scotland, Seychelles, Sierra Leone, Spain, Sweden, Taiwan, Thailand, USA, Wales.

DISTRIBUTION IN TAIWAN: Tanshui.

COMMENTS: This is a very common species and it appears more often than its teleomorph *Nereiospora cristata* (Mouzouras & Jones 1985).

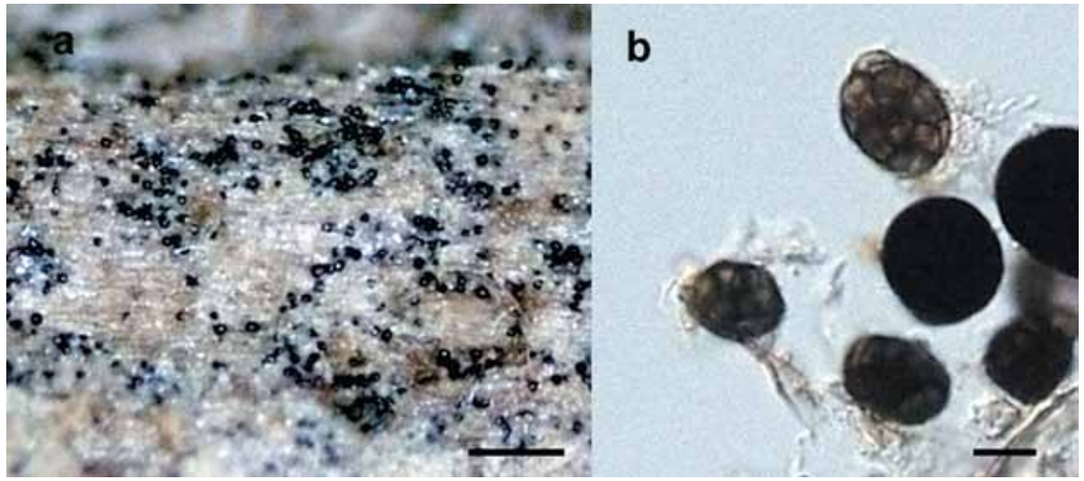

Figure 52. *Monodicyts pelagica.* (a) Conidia on wood surface. (b) Dark-colored, obpyriform, muriform conidia. Scale bar: a=300 µm; b=10 µm.

Moromyces Abdel-Wahab, K.L. Pang, Nagahama, Abdel-Aziz & E.B.G. Jones, Mycol. Progr. 9: 555 (2010)
Type species: *Moromyces varius* (Chatmala & Somrith.) Abdel-Wahab, K.L. Pang, Nagahama, Abdel-Aziz & E.B.G. Jones

Moromyces varius (Chatmala & Somrith.) Abdel-Wahab, K.L. Pang, Nagahama, Abdel-Aziz & E.B.G. Jones, Mycol. Progr. 9: 555 (2010)
≡ *Cumulospora varia* Chatmala & Somrith., Fungal Divers. 17: 3 (2004)

Figure 53

Hyphae septate, branched, superficial or immersed, pale brown. Conidiophores absent. Conidiogenous cells holoblastic, integrated, terminal, determinate. Conidia 24-87 × 21-51 µm, dark grey to fuscous, solitary, scattered or gregarious, muriform. Conidia initially spiral, but cell division in several planes, leads to a tangled knot of cells that may number 40 or more and up to 20 µm diam. or more of each individual cell.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Egypt, Japan, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Chungkang, Hungmao, Tsengwen.

COMMENTS: *Moromyces varius* was recently transferred from *Cumulospora* based on the phylogenetic analyses of the SSU and LSU rRNA genes. *Moromyces varius* differs from *Cumulospora marina* by having a muriform, irregularly helicoid conidia (Abdel-Wahab et al. 2010). This species forms a sister group to *Lulwoana uniseptata* and its anamorph *Zalerion maritima* in the Lulworthiales (Jones et al. 2008).

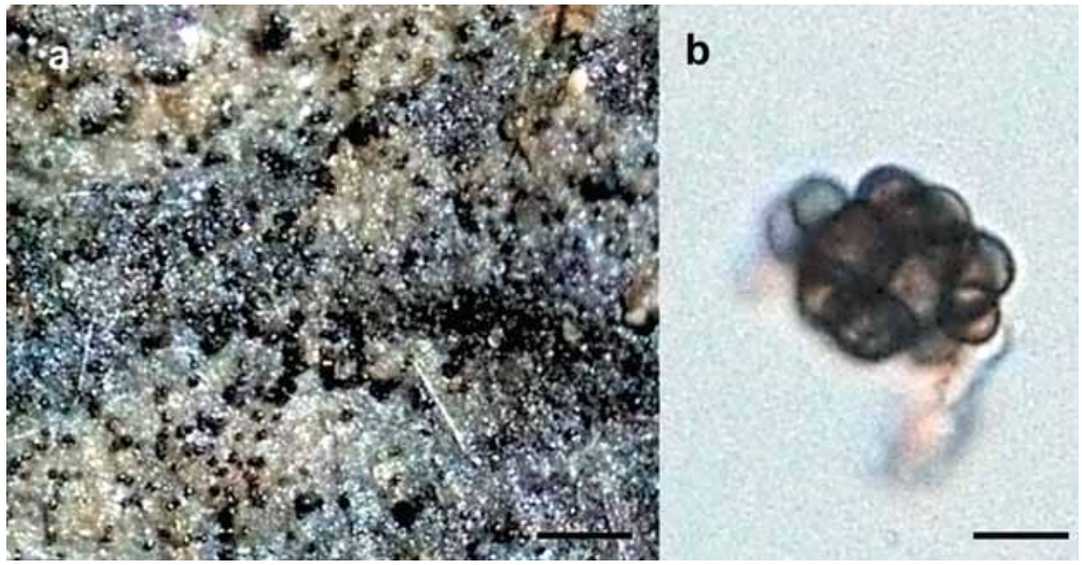

Figure 53. *Moromyces varius*. (a) Conidia on wood surface. (b) Dark-colored conidia consisting of a ball of cells. Scale bar: a=200 µm; b=10 µm.

Periconia Tode, Fung. mecklenb. sel. (Lüneburg) 2: 2 (1791)
Type species: *Periconia lichenoides* Tode

Periconia prolifica Anastasiou, Nova Hedw. 6: 260 (1963)

Figure 54

Conidiophores 5-200 × 2.5 µm, cylindrical, septate, simple or branched, hyaline, often forming pustules on the surface of the substrate, conidiogenous cell ellipsoidal or ovoid, hyaline, produced acrogenously. Conidia 6-13(-20) µm diam., one-celled, subglobose or ovoid, smooth, thick-walled, light brown with a reddish tint or dark brown, developing basipetally, catenulate, cells finally separating.

SUBSTRATA: dead mangrove wood, dead mangrove seedlings, fern rachis.

WORLDWIDE DISTRIBUTION: Andaman Islands, Australia, Bahamas, Belize, Bermuda, Brazil, Brunei, China, Egypt, Ghana, Guatemala, Hong Kong, India, Indonesia, Japan, Kuwait, Malaysia, Maldives, Martinique, Mauritius, Mexico, Nicobar Islands, Philippines, Portugal, Republic of Trinidad and Tobago, Saudi Arabia, Seychelles, Sierra Leone, Singapore, Society Islands, South Africa, Taiwan, Thailand, USA.
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DISTRIBUTION IN TAIWAN: Aoku, Chinshan (Taipei County), Chungkang, Fangwan, Fushan (Taitung County), Haomeiliao, Hsinwu, Hungmao, Patoutzu (Chilung City), Peimeng, Taan (Taichung County), Tanshui, Tungpeichiao (Taipei County), Yingkeshih (Ilan County).

COMMENTS: This is a cosmopolitan species, occurring on a wide range of substrata and geographical locations. Teleomorph of this species is *Okeanomyces cucullata* (Halosphaeriaceae) and germination of the ascospores always result in the anamorph (K.L. Pang, personal observation).

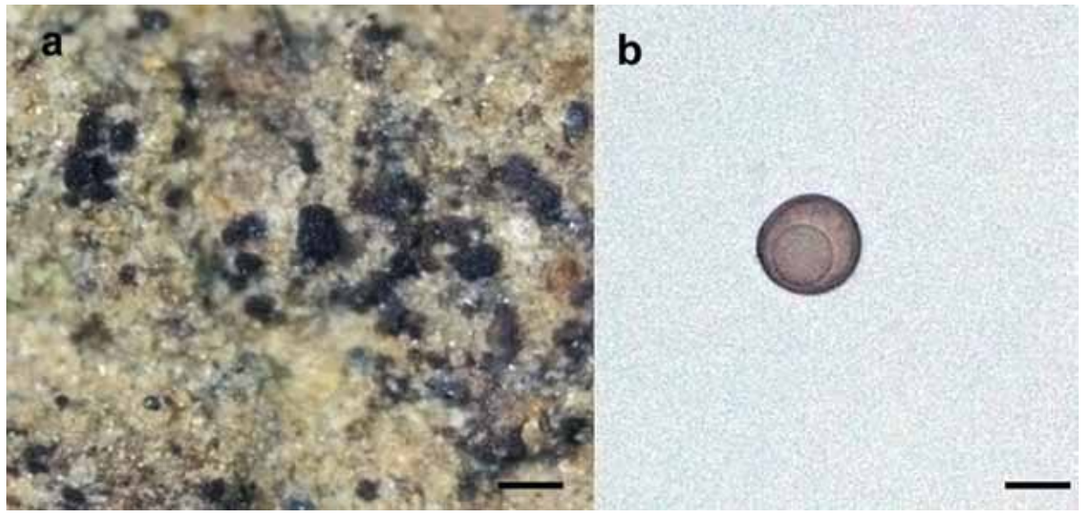

Figure 54. *Periconia prolifica.* (a) Conidia on wood surface. (b) Dark-colored, globose conidium. Scale bar: a=500 µm; b=10 µm.

Rhabdospora (Durieu & Mont. ex Sacc.) Sacc., Syll. fung. (Abellini) 3: 578 (1884)
Type species: *Rhabdospora oleandri* Durieu & Mont.

Rhabdospora avicenniae Kohlm. & E. Kohlm., Mycologia 63: 851 (1971)

Figure 55

Pycnidia 70-110 µm high, 70-115 µm diam., subglobose, immersed or half immersed, ostiolate, papillate or epapillate, coriaceous, dark brown or black, solitary or gregarious. Papillae short or absent, ostiole 6-15 µm diam. Peridium 14-20 µm thick above, 8-12 µm at the base, dark brown, composed of polygonal cells forming a *textura angularis*. Conidiophores 5-12 µm × 1.2-2.5 µm, cylindrical or attenuate, simple, forming conidia singly at the apex, lining the wall of the pycnidial cavity. Conidia 9-12.5 × 1.5-2 µm, botuliform or filiform, one-celled, straight or slightly curved hyaline.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Bahamas, Belize, Bermuda, Columbia, Liberia, Malaysia, Mexico, South Africa, Taiwan, Thailand, USA.

DISTRIBUTION IN TAIWAN: Hsinwu, Hungmao, Peimeng, Ssutsao, Tsengwen.

COMMENTS: This species is very common in southern Taiwan. The pycnidia of this species are deeply embedded in wood and the conidia always accumulate on the wood surface as orange masses. A similar species with much larger conidia has also been observed but molecular data are needed to prove if the two are distinct species.

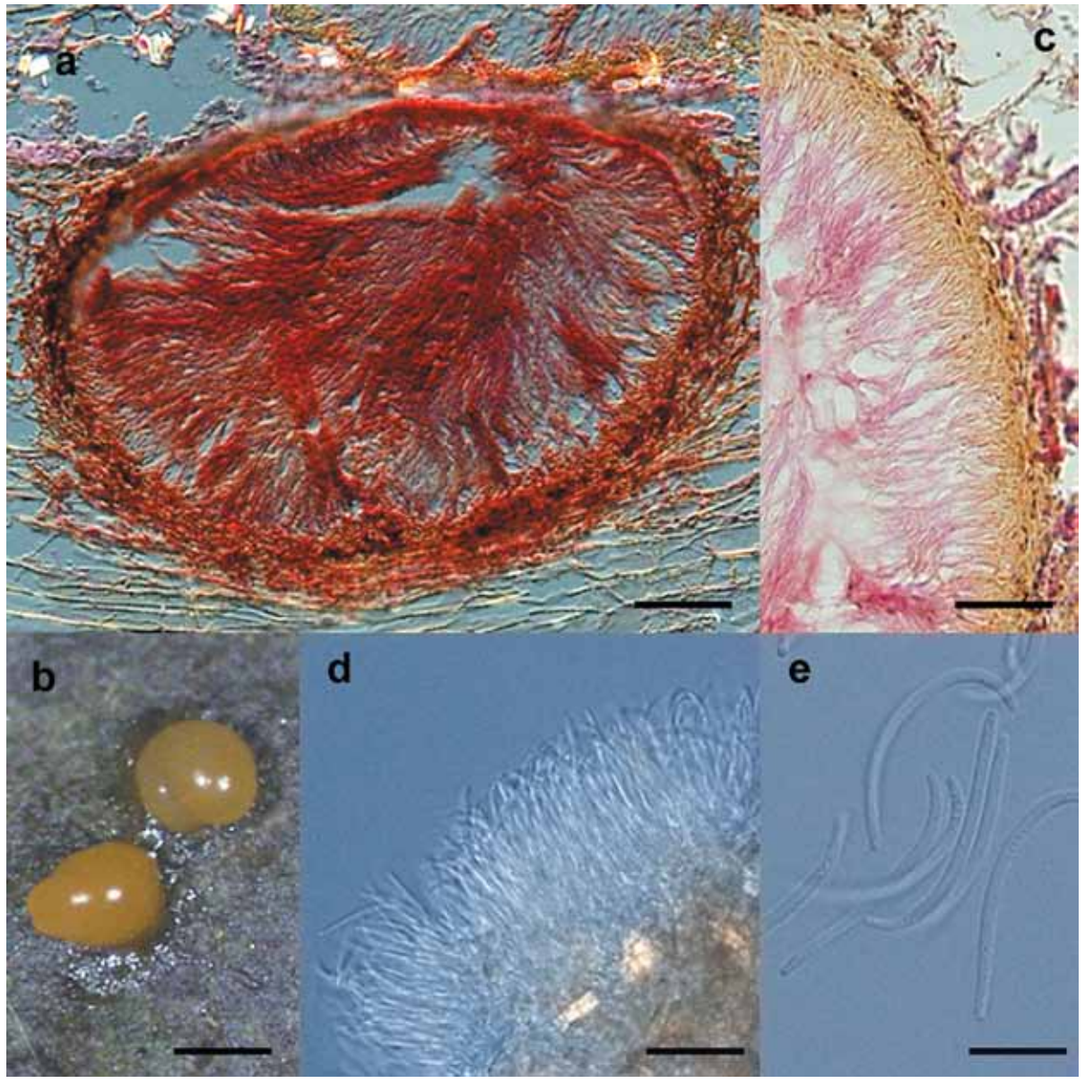

Figure 55. *Rhabdospora avicenniae.* (a) Section of immersed pycnidium. (b) Orange spore masses discharged from pycnidia on wood. (c) Pycnidial wall made of elongate cells. (d) Conidiophores. (e) Cylindrical conidia. Scale bar: a=50 µm; b=300 µm; c, d=30 µm; e=10 µm.

Trichocladium Harz, Bull. Soc. Imp. nat. Moscou 44: 125 (1871)
Type species: *Trichocladium asperum* Harz

Trichocladium alopallonellum (Meyers & R.T. Moore) Kohlm., Mycotaxon 53: 352 (1995)
≡ *Humicola alopallonella* Meyers & R.T. Moore, Am. J. Bot. 47: 346 (1960)

Figure 56

Hyphae hyaline to light brown, septate, branched. Conidiophores micronematous, mononematous, resemble non-specialised short lateral vegetative hyphae or conidiophore indistinct, conidia developing directly on hyphae. Conidia 14-24 µm × 7-11 µm, solitary, thick-walled, smooth, straight, two-celled, strongly constricted at the septa, apical cell large subglobose, ellipsoidal, ovoidal to obpyriform, fuscous, reddish-brown to dark brown, basal cell smaller, obconical, light brown.

SUBSTRATA: dead mangrove wood.

WORLDWIDE DISTRIBUTION: Aldabra, Andaman Islands, Australia, Bahamas, Belize, Bermuda, Brazil, Brunei, Cameroon, Canada, England, Egypt, France, Galapagos, Germany, Ghana, Hong Kong, India, Indonesia, Italy, Ivory Coast, Japan, Liberia, Malaysia, Maldives, Marshall Islands, Mauritius, Mexico, Nicobar Islands, Norway, Philippines, Republic of Trinidad and Tobago, Samoa, Scotland, Seychelles, Singapore, Society Islands, South Africa, Sri Lanka, Taiwan, Thailand, USA, Wales, Yemen.

DISTRIBUTION IN TAIWAN: Aoku, Fengpin (Hualien County), Tunghsin.

COMMENTS: This species was originally described in *Humicola*, a genus with one-celled conidia. Conidia of this species are two-celled and were subsequently transferred to *Trichocladium* (Kohlmeyer & Volkmann-Kohlmeyer 1995).

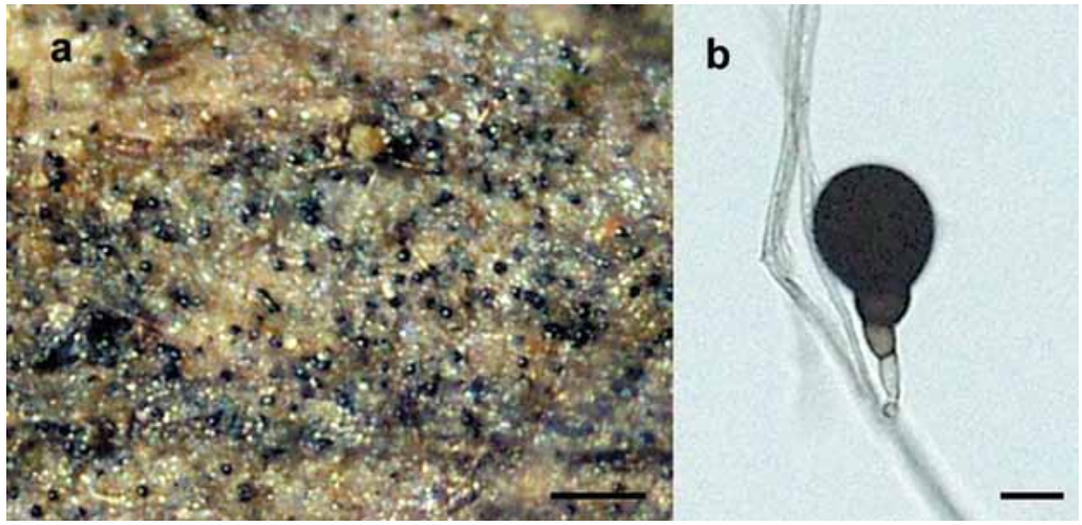

Figure 56. *Trichocladium alopallonellum.* (a) Conidia on wood surface. (b) Dark-colored conidium strongly constricted at the septa. Scale bar: a=300 µm; b=10 µm.

Trichocladium nypae K.D. Hyde & Goh, Mycol. Res. 103: 1420 (1999)

Figure 57

Mycelium composed of branched, septate, subhyaline to pale brown, 1-2 µm wide hyphae. Conidiophores micronematous, mononematous, smooth, thin-walled, hyaline to very pale brown. Conidiogenous cells holoblastic, integrated, terminal or intercalary, smooth, cylindrical, determinate. Conidia holoblastic, solitary, dry, pyriform to ellipsoidal, straight or slightly curved, (1-)2-septate, usually accentuated at the distal septa, not constricted at the septa, smooth, 15-20 × 10-13(-15) µm, apical cell larger, thick-walled, dark brown, 10-13 µm high, middle cell pale to medium brown, basal cell subhyaline or very pale brown.

SUBSTRATA: dead mangrove wood, petiole of *Nypa fruticans*.

WORLDWIDE DISTRIBUTION: Brunei, Malaysia, Taiwan, Thailand.

DISTRIBUTION IN TAIWAN: Aoku, Chinshan (Taipei County), Chungkang, Fengpin (Hualien County), Hsinwu, Hungmao, Tanshui, Tunghsin, Tungpeichiao (Taipei County).

COMMENTS: This species was originally described from the brackish water palm, *Nypa fruticans* (Hyde et al. 1999) but later found on wood. Morphologically, it resembles *Bactrodesmium linderi* with only smaller conidia. A phylogenetic study is required to test if the two species are congeneric.

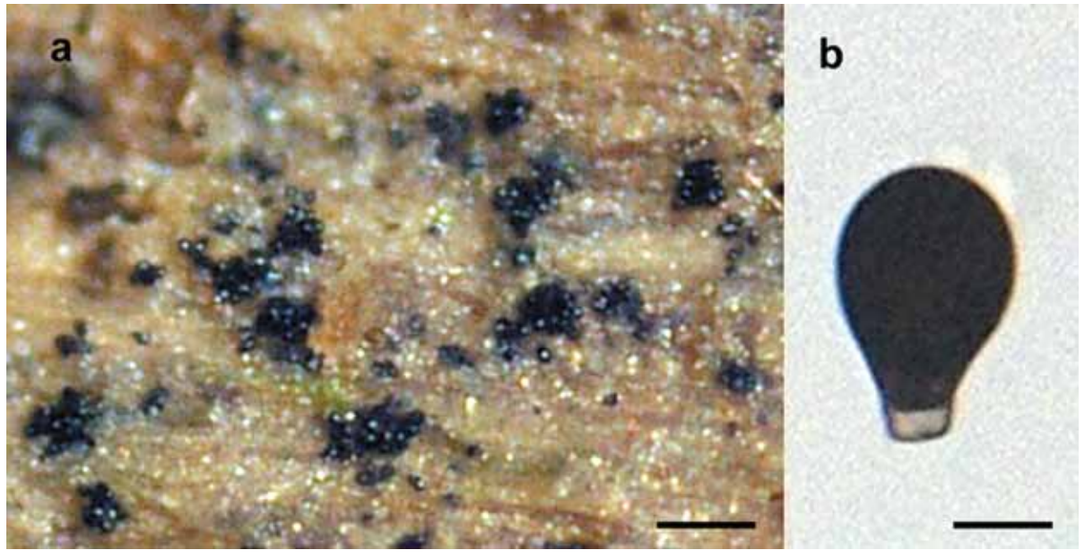

Figure 57. *Trichocladium nypae.* (a) Conidia on wood surface. (b) Dark-colored, obpyriform conidium. Scale bar: a=300 µm; b=10 µm.

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Authors: K.L. Pang, J.S. Jheng and E.B.G. Jones

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