

Tropical Marine Fungi*

JAN KOHLMAYER

Institute of Marine Sciences, University of North Carolina at Chapel Hill, 3407 Arendell Street, Morehead City, N. C. 28557, U. S. A.

With 16 figures and 2 tables

Key words: Marine fungi, mycogeography, *Ascomycetes*, *Basidiomycetes*, *Deuteromycetes*, mangrove, tropics, subtropics.

Abstract. Marine *Ascomycetes*, *Basidiomycetes* and *Deuteromycetes* were collected in tropical and subtropical regions (Australia, Belize, Fiji, Hawaii, Marshall Islands, Mexico, New Zealand, Palau, Thailand), and the known range of distribution for these fungi was extended. Exclusively tropical are 27 taxa, 9 are probably restricted to the tropics also, and 11 are cosmopolitan. Distribution maps are given for 5 taxa. New species (4), varieties (3), and combinations (2) of *Ascomycetes* are proposed, and keys to the taxa of *Halosarpheia* and *Lulworthia* are presented. Most of the species are decomposers of mangrove parts or of detritus in sandy beaches. Nine new host plants were found. Marine *Ascomycetes* were discovered for the first time living in shells of foraminifera.

Problem

Filamentous higher fungi are particularly important in the marine environment as decomposers of dead organic substrates, whereas the parasites appear to play a lesser role (KOHLMAYER & KOHLMAYER, 1979). Data on the distribution of marine fungi in the tropics and subtropics are scarce, because collections have been made predominantly in temperate areas (HUGHES, 1974; KOHLMAYER & KOHLMAYER, 1979; KOHLMAYER, 1983). Certain tropical habitats have been particularly neglected, for instance, the mangal (mangrove forests) and salt marshes. Mangrove trees are producing large amounts of litter in form of leaves and wood, but little is known about the mycota decomposing such substrates (FELL & MASTER, 1973, 1975; NEWELL, 1976). CHAPMAN (1976) lists more than 100 species of mangrove trees, but only eight have been recorded as hosts of marine fungi (KOHLMAYER & KOHLMAYER, 1979). In particular the trees of the eastern mangrove have not been examined for the occurrence of marine fungi.

The following data are based on collections of fungi from tropical and subtropical habitats, particularly from the mangal with submerged trunks and roots of mangroves (prop roots, pneumatophores). Other habitats included are marshes with species of *Batis* and *Salicornia*, sandy beaches with eroding roots of shoreline trees and washed up detritus (algae, seagrasses, wood), and inter-

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and subtidal areas with permanently fixed substrates, such as seagrasses, pilings, and shipwrecks. Marine foam collected along beaches also yielded a good number of spores, representing the arenicolous species of sandy habitats. Among the 47 taxa of higher fungi recorded in the following, there are four new species and three new varieties. Some new records of ubiquitous fungi from temperate areas are included to illustrate the geographical range of distribution of particular species. New distribution records published after the compilation by KOHLMAYER & KOHLMAYER (1979) are indicated for each species.

Material and Methods

Collecting techniques follow KOHLMAYER & KOHLMAYER (1979). Fruiting bodies were sectioned on an International Cryostat, Model CTI. Photographs were taken with a Zeiss photomicroscope on Kodak Technical Pan Film 2415 at ASA 100.

The material was collected by the author, except where indicated otherwise. The following abbreviations are used for the collecting sites.

Australia

HQ	= Heron Island, Great Barrier Reef, Queensland, 23°26'S, 152°E
NQ	= North Pine River near Brisbane, Queensland, 27°17'S, 153°04'E
WQ	= Weyba Creek, Noosa Heads, Queensland, 26°26'S, 153°04'E
TNSW	= Towra Point, Botany Bay near Sydney, New South Wales, 34°S, 151°10'E
KV	= Kirk Point, Werribee, Port Phillip Bay, Victoria, 38°S, 144°38'E
LV	= Loch Ard Gorge, Port Campbell Nat. Park, Victoria, 38°38'S, 142°50'E
PV	= Point Bunbury near Apollo Bay, Victoria, 38°48'S, 143°39'E
QV	= Queenscliff, Port Phillip Bay, Victoria, 38°15'S, 144°38'E
BSA	= Beachport, South Australia, 37°29'S, 140°E
CSA	= Cape Lannes near Robe, South Australia, 37°10'S, 139°45'E
LSA	= Laccpede Bay, Kingston, South Australia, 36°51'S, 139°49'E

Belize, Central America

A	= West coast of Ambergris Cay, 18°02'N, 87°56'W
AA	= Punta Azul, Ambergris Cay, 18°05'N, 87°53'W
CPA	= Cayo Pajaros, near Ambergris Cay, 18°03'N, 87°58'30"W
MA	= Mariah Reef, Ambergris Cay, 17°58'15"N, 87°55'30"W
PA	= San Pedro River, Ambergris Cay, 17°55'N, 87°57'30"W
RA	= Reef Point, Ambergris Cay, 18°07'N, 87°50'W
CB	= Carrie Bow Cay, 16°48'N, 88°05'W
CC	= Curlew Cay, 16°47'N, 88°05'W
CP	= Coco Plum Cay, 16°53'30"N, 88°06'15"W
D	= Dangriga ("Pelican Beach"), 16°58'N, 88°13'W
MW	= Man-of-War Cay, 16°53'N, 88°06'15"W
SI	= Steward Island, 16°46'N, 88°10'W
SW	= South Water Cay, 16°49'N, 88°04'45"W
TC	= Twin Cays, 16°50'N, 88°06'W
TR	= Tobacco Range, 16°52'45"N, 88°05'30"W
WW	= Wee-Wee Cay, 16°45'45"N, 88°09'W

Fiji

B	= Beachcomber Island, near Lautoka, Viti Levu, 17°38'S, 177°16'E
M	= Mana Island, Mamanuca Group, near Lautoka, Viti Levu, 17°41'S, 177°07'E
S	= Suva, Lower Campus of Univ. of the Pacific, Viti Levu, 18°09'S, 178°27'E
T	= Tangange, Viti Levu, 18°18'S, 177°41'E

Marshall Islands

E = Enewetak Atoll, Lagoon side, 11°21'N, 162°20'E (leg. M. SALMON)

Mexico**Atlantic:**

C = Playa del Carmen, Quintana Roo, 20°37'15"N, 87°04'25"W
 CC = Castillo Real, Cozumel, 20°32'N, 86°45'W
 LC = Los Cocos, Cozumel, 20°29'N, 86°49'W
 MC = Punta Morena, Cozumel, 20°27'N, 86°51'W
 PC = El Presidente, Cozumel, 20°27'N, 87°W
 SC = Playa San Francisco, Cozumel, 20°21'30"N, 87°01'W
 TC = Punta Tormentos, Cozumel, 20°25'45"N, 87°01'W
 X = Xelha, Quintana Roo, 20°21'30"N, 87°21'W

Pacific: Baja California, Sea of Cortez

BB = Isla Bargo in Bahía Coyote, 26°43'N, 111°54'30"W
 BCB = Bahía Concepción, opposite Caléta Santispac, 26°45'30"N, 111°54'15"W
 CB = Isla Carmen, Puerto Ballandra, 26°01'N, 111°11'W
 CSB = Bahía Concepción, Caléta Santispac, 26°45'30"N, 111°54'45"W
 EB = Isla Espiritu Santo, Puerto Ballena, 24°27'N, 110°20'W
 JAB = Isla San José, Bahía Amortajada, 24°54'15"N, 110°34'W
 JB = Isla San José, Punta Colorado, 25°0'45"N, 110°33'30"W
 PB = Punta Pulpito, 26°32'N, 111°27'W
 SB = Isla Santa Catalan, 25°40'N, 111°0'W

New Zealand

KS = Kean Point, Kaikura, South Island, 42°25'S, 173°42'E
 LN = Leigh Marine Laboratory, Goat Island Bay, North Island, 36°16'15"S, 174°47'45"E
 MN = Matheson Bay, Cape Rodney, North Island, 36°18'30"S, 174°47'45"E
 ON = Omaha Bay, Flat Rock, Tawharanui Peninsula, North Island, 36°22'S, 174°50'E
 PN = Paekakariki, near Wellington, North Island, 41°S, 174°58'E
 PUN = Pukerua Bay, near Porirua, North Island, 41°02'S, 174°54'E

Palau Islands

P = Peleliu, Palau Group, 7°N, 134°10'E (leg. H. W. PAERL)

Thailand

P = Ban Phatthaya Beach, S. of Bangkok, 12°56'N, 100°53'E
 R = Si Racha, Chon Buri Province, 13°09'N, 100°54'E
 S = Bang Sai near Chon Buri, Chon Buri Province, 13°20'N, 100°55'E

U. S. A.

CA = California, Encinitas, San Diego County, 33°02'N, 117°18'W

Hawaii

H = Hilo Bay, Hawaii, 19°43'N, 155°05'W
 HK = Haena Beach Park, Kauai, 22°13'N, 159°35'W
 PK = Poipu Beach Park, Kauai, 21°23'N, 159°27'30"W
 WBK = Waiokapua Bay, Kauai, 22°N, 159°46'W
 WK = Wailua, Kauai, 22°03'30"N, 159°20'W
 WRK = Mouth of Wainiha River, Wainiha, Kauai, 22°13'N, 159°32'W
 HBM = Honomanu Bay, Maui, 20°52'N, 156°10'W
 HM = Hana Bay State Park, Maui, 20°45'30"N, 155°59'W
 KM = Kihei, Maui, 20°46'N, 156°27'30"W
 WBM = Wailea Beach Park, Maui, 20°41'N, 156°26'45"W
 WM = Wahikuli Beach Park, Maui, 20°54'15"N, 156°41'30"W

Results

1. Ascomycetes

Aniptodera chesapeakeensis SHEARER & MILLER

Material: **Belize:** CPA, 9 Nov. 1982, in pond (sal. 14.2‰, 28°C), on dead submerged branch of *Laguncularia racemosa* GAERTNER, J. K. 4264.

Ascospore appendages that occurred in some collections (KOCH, 1982; SHEARER & CRANE, 1980) were not observed in the present material. This species is known only from a few sites, viz., the Atlantic Ocean (Belize, U. S. A.: Maryland, North Carolina), Indian Ocean (Sri Lanka), and Pacific Ocean (Japan, MINOURA & MUROI 1978). The mangrove *L. racemosa* is a new substrate.

Arenariomyces trifurcatus HÖHNK [Synonym = *Corollospora trifurcata* (HÖHNK) KOHLM.] (Fig. 1)

Material (ascospores in foam, except where indicated otherwise): **Belize:** AA, 10 Nov. 1982, (sal. 36.6‰, 31°C), also submerged plywood (incubated 7 mo), J. K. 4291, 4255; 12 Nov. 1982, dead eroding runners of *Canavalia rosea* (SW.) DC. (incubated 4 mo), J. K. 4315; CPA, 9 Nov. 1982, (sal. 8.8‰, 26°C), between washed-up leaves of *Thalassia testudinum* BANKS ex KÖNIG and algae, and on detritus (incubated 4 mo), J. K. 4292, 4316; MA, 12 Nov. 1982, (sal. 36.1‰, 26°C), J. K. 4281; D, 27 Mar. 1983, (sal. 31.7‰, 30°C), J. K. 4325; CB, 1 Apr. 1983, intertidal tree trunk (incubated 11 mo), J. K. 4495; MW, 8 Apr. 1983, on shell fragments on washed-up detritus (*Thalassia* leaves and algae, incubated 11 mo), J. K. 4502. **Mexico:** CC, 1 Feb. 1983, (sal. 38.3‰, 27°C), J. K. 4287; MC, 28 Jan. 1983, washed-up detritus (incubated 5 mo), J. K. 4423, 4424.

Australia: HQ, 16–18 Aug. 1981, (sal. 37.2‰, 22°C), also on sand grains 25–50 cm below the beach surface, subtidal wood in a tidal pool, intertidal wood, J. K. 4136, 4146, 4210, 4227; NQ, 14 Aug. 1981, washed-up debris (sal. 36‰, 21°C), J. K. 4416; TNSW, 23 Aug. 1981, (sal. 34.5‰, 13°C), J. K. 4143; QV, 30 Aug. 1981, (sal. 35.0‰, 13°C), J. K. 4142; LV, 2 Sept. 1981, (sal. 35.0‰, 14°C), J. K. 4138. **Fiji:** M, 16 Sept. 1981, (sal. 35.5‰, 25°C), J. K. 4132. **New Zealand:** PN, 11 Sept. 1981, (sal. 35.0‰, 13°C), J. K. 4133; MN, 14 Sept. 1981, (sal. 34.0‰, 14°C), J. K. 4134. **Thailand:** P, 15 Sept. 1983, spores in foam and washed-up detritus (sal. 32.2‰, 32°C), J. K. 4464, 4503; R, 13 Sept. 1983, washed-up debris (incubated 5 mo), J. K. 4504. **U. S. A.:** CA, 6 Aug. 1979, J. K. 4013; Hawaii, WK, 2 Nov. 1983 (sal. 36.1‰, 26°C), J. K. 4487; WRK, 3 Nov. 1983 (sal. 34.0‰, 26°C), J. K. 4473, 4489; HK, 3 Nov. 1983 (sal. 36.6‰, 26°C), J. K. 4488; WBK, 4 Nov. 1983 (sal. 37.2‰, 26°C), J. K. 4490; HM, 9 Nov. 1983 (sal. 33.9‰, 26°C), J. K. 4491.

Other new distribution records for *A. trifurcatus*, published after 1979, are: Atlantic Ocean (Bahamas, Tobago, Trinidad: KOHLMEYER, 1980; Martinique: KOHLMEYER, 1981 a; Sierra Leone: ALEEM, 1980; Brazil: BOOTH, 1979, 1983), Black Sea (U. S. S. R.: ZELEZINSKAYA & NIKITINA, 1977; ZELEZINSKAYA, 1979 a), Indian Ocean (Sri Lanka: KOCH, 1982), Pacific Ocean (New Zealand: LINTOTT & LINTOTT, 1982; U. S. S. R.: KRYLOVA, 1980). Fig. 1 is based on my new collections and on data contained in the preceding publications, as well as the earlier compilation by KOHLMEYER & KOHLMEYER (1979). The Bay Bean *Canavalia rosea* (*Leguminosae*) is a new host for *A. trifurcatus*.

Ultrastructural studies showed that the origin of ascospore appendages is basically different in *Corollospora maritima* (type species of *Corollospora*) and

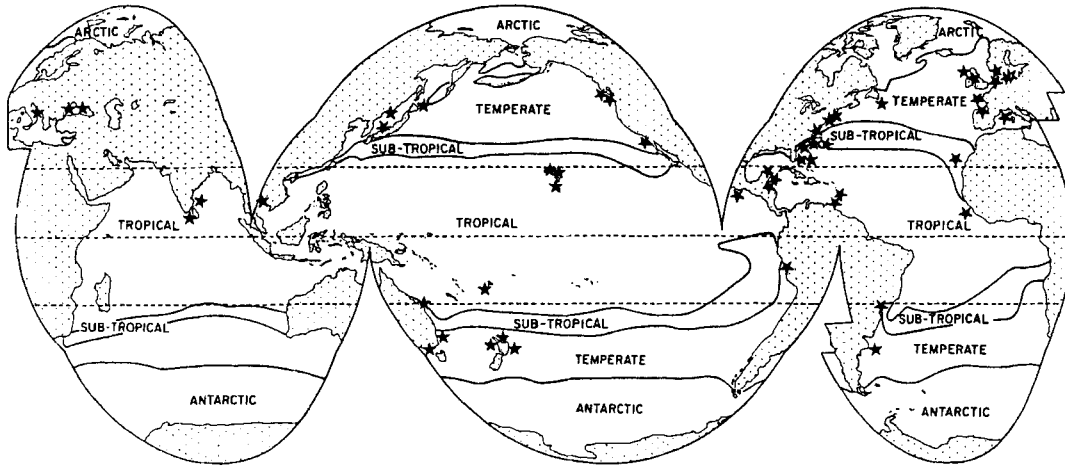


Fig. 1. Geographic distribution of the cosmopolitan Ascomycete *Arenariomyces trifurcatus*. (World map redrawn after HUGHES, 1974; with permission of the author and publisher.)

C. trifurcata (JONES *et al.*, 1983 a). Therefore, JONES *et al.* (1983 a) removed *C. trifurcata* from *Corollospora*, referred it back to *Arenariomyces* HÖHNK and designated a neotype. Although HÖHNK (1954) did not name a type species, this procedure became only a requirement after 1 Jan. 1958 according to the International Code of Botanical Nomenclature (Art. 37.1) and, therefore, *Arenariomyces* is a valid genus.

Arenariomyces triseptatus KOHLM. sp. nov. (Figs. 2 a–g, 3 a, b)

Ascocarpiis 50–120 μm diametro, globosis vel subglobosis, vel irregularibus, superficialibus vel immersis, saepe ad basem applanatis subciculatisque, ostiolatis, papillatis, coriaceis, atro-brunneis ad dilute brunneis, interdum hyphis brevis tectis, solitariis vel gregariis; **peridiis** 14–16 μm crassis, bistratis; **papillis** ad 20–23 μm altis, 16–25 μm diametro, conicis, eperiphysatis; **paraphysibus** absentibus, centris ascocarporum immaturorum cellulis pseudoparenchymaticis, hyalinis, deliquescentibus; **ascis** octosporis, ellipsoideis, unitunicatis, leptodermis, deliquescentibus ante maturitatem ascosporarum; **ascosporis** 27–34 \times 6–8.5 μm (appendicibus exclusis), cylindricis, triseptatis, ad septa constrictis, hyalinis, appendiculatis; ad apices ambos tres (rariter 4 vel 5) appendiculis subterminalibus, 18–20 μm longis, 2 μm diametro ad basem, 0.5 μm ad apicem, gracilibus, attenuatis, rigidis, curvatis; ab *A. trifurcato* differt ascosporis triseptatis. **Substratum:** algae et folia *Thalassiae* putrescentes, intra cameras foraminiferum; ascosporae in spuma ad litoros oceanorum. **Distributio:** Oceanus Atlanticus (Mexico: Quintana Roo, Yucatan).

Holotypus: J. K. 4426 a. **Isotypus:** J. K. 4426 b.

Ascocarps 50–120 μm in diameter, globose or subglobose, or irregular, superficial or immersed, often flattened at the base and seated with subicula on grains of sand or calcareous animal shells, or inside foraminiferous shells (Fig. 2 d),

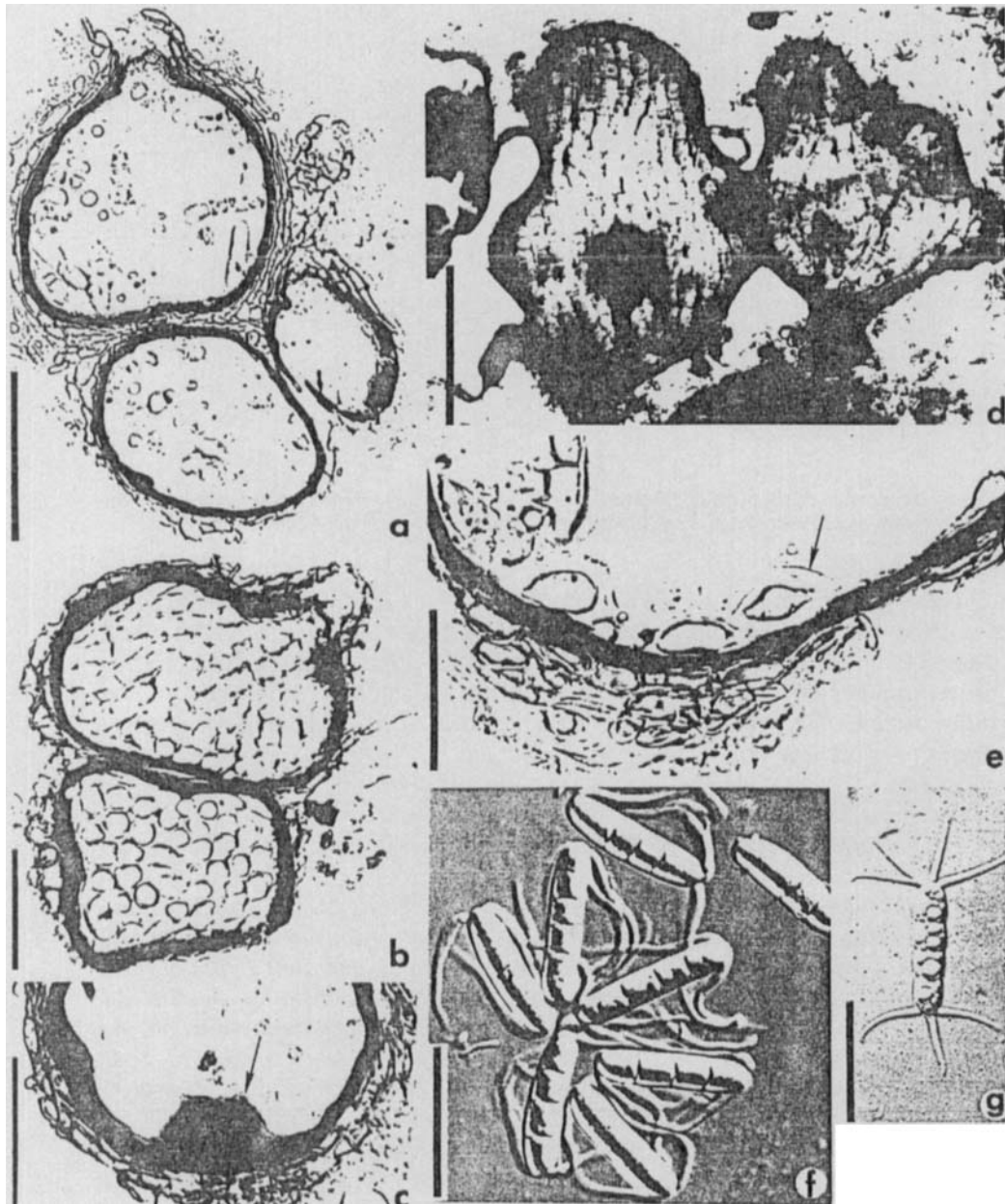


Fig. 2. *Arenariomyces triseptatus* sp. nov. a. Ascocarps, longitudinal sections (l. s. $4\ \mu\text{m}$), bar = $50\ \mu\text{m}$; b. ascocarps filled with mature ascospores (l. s. $4\ \mu\text{m}$), bar = $25\ \mu\text{m}$; c. peridium ($4\ \mu\text{m}$ section), outer layers of polygonal cells, inner dark brown layer, partly in surface view (arrow), bar = $25\ \mu\text{m}$; d. thin-walled, irregularly shaped ascocarps from foraminifer after dissolving of shell with HCl, bar = $50\ \mu\text{m}$; e. peridium section ($4\ \mu\text{m}$), hyaline cells of central pseudoparenchyma with contracted cytoplasm (arrow), bar = $20\ \mu\text{m}$; f. cluster of 8 ascospores from a dissolved ascus, bar = $25\ \mu\text{m}$; g. abnormal ascospore with 4 appendages at one end, bar = $25\ \mu\text{m}$. (f and g in Nomarski interference contrast, the others in brightfield; a, f, g from J. K. 4426; b, c, e from J. K. 4427; d from J. K. 4424.)

ostiolate, papillate, coriaceous, dark to light brown, sometimes covered by short hyphae, solitary or gregarious (Fig. 2 a–d). **Peridium** 14–16 μm thick, two-layered; wider outer layer light brown, composed of two or three layers of thin-walled, polygonal cells with wide lumina, forming a *textura angularis* (Fig. 2 a–c, e); narrow inner layer dark brown, composed of one or two layers of thick-walled, compressed cells with narrow lumina (Fig. 2 c); subicula prosenchymatous. **Papillae** up to 20–24 μm high, 16–25 μm in diameter, conical; ostiolar canal filled with small-celled pseudoparenchyma. **Pseudoparenchyma** of thin-walled polygonal cells filling the centrum of young ascocarps, deliquescing at ascospore maturity (Fig. 2 e). **Asci** eight-spored, ellipsoidal, unitunicate, thin-walled, aphysoclastic, deliquescing before ascospore maturation (Fig. 2 f). **Ascospores** 27–34 \times 6–8.5 μm (excluding appendages), cylindrical, three-septate, constricted at the septa, hyaline, appendaged; at both ends with three (rarely 4 or 5) subterminal appendages (Fig. 2 g, 3 a, b); appendages 18–20 μm long, 2 μm in diameter at the slightly swollen base, 0.5 μm at the tip, slender, attenuate, rigid, curved, attached to the side of immature spores. Differs from *A. trifurcatus* by having three-septate ascospores. **Mode of life:** Saprobic. **Substrate:** Wet rotting algae (*Sargassum* sp.) and seagrass leaves (*Thalassia testudinum*) or inside chambers of foraminifera; ascospores accumulate in foam along the shore. **Range:** Atlantic Ocean (Mexico, Quintana Roo and Yucatan). **Material examined:** Washed-up algae and seagrass leaves, ascocarps attached to shell fragments and inside tests of foraminifera, Playa San Francisco, Cozumel,

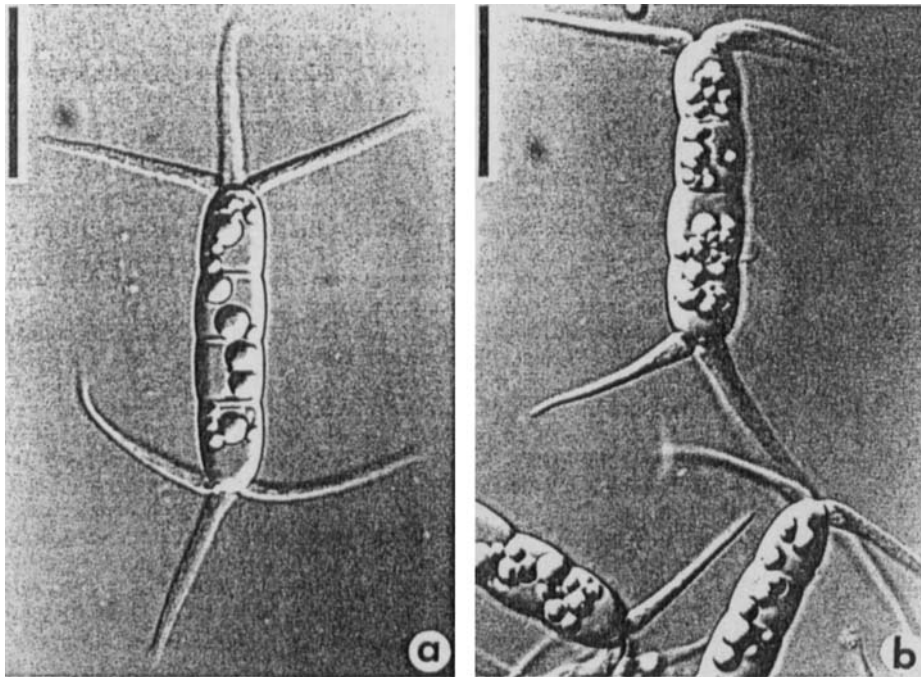


Fig. 3. *Arenariomyces triseptatus* sp. nov., ascospores. a. Three appendages at each apex, bar = 20 μm ; b. showing individual attachment of the appendages, bar = 20 μm . (Nomarski interference contrast; from J. K. 4426.)

Quintana Roo, Mexico, 20°21'30"N, 87°01'W, incubated from 28 Jan. until 23 June 1983, J. K. 4426 a (**Holotype**, NY), 4426 b (**Isotype**, IMS), fruiting in pure culture; inside foraminiferan shells, attached to detritus (fresh algae) washed up on beach at Punta Morena, east coast of Cozumel, Quintana Roo, Mexico, 20°27'N, 86°51'W, incubated from 28 Jan. until 21 June 1983, J. K. 4424; washed-up *Sargassum* sp., beach at Los Cocos, east coast of Cozumel, Quintana Roo, Mexico, 20°29'N, 86°49'W, incubated from 1 Feb. until 24 June 1983, J. K. 4427 a (NY), 4427 b (IMS); ascospores in foam along the beach, Progreso, Yucatan, Mexico, 21°16'N, 89°40'W, 21 Mar. 1970, J. K. 2683. **Etymology:** From the Latin, *triseptatus* = three-septate, in reference to the ascospores, in contrast to the one-septate ascospores of *A. trifurcatus*.

The new species is closely related to *A. trifurcatus* and differs from it mainly by the presence of three septa. The septation is consistent also in ascospores produced in pure culture J. K. 4426. Ascospores resemble those of *Torpedospora ambispinosa* KOHLM. which are shorter and have five subapical appendages at each apex. However, *Torpedospora* and *Arenariomyces* are not related because the former genus is of uncertain taxonomic position (KOHLMAYER & KOHLMAYER, 1979), whereas the latter is a member of *Halosphaeriaceae* (JONES *et al.*, 1983 a). The culture is deposited at the American Type Culture Collection (ATCC 56660).

Corollospora maritima WERDERMANN

Material: **Belize:** AA, 12 Nov. 1982, on grains of sand attached to *Sargassum* sp. washed up on beach (incubated 4 mo), J. K. 4321; CPA, 9 Nov. 1982, on detritus (incubated 4 mo), J. K. 4316; D, 27 Mar. 1983, spores in foam (sal. 31.7‰, 30°C), J. K. 4325. **Mexico:** CC, 1 Feb. 1983, spores in foam (sal. 38.3‰, 27°C), J. K. 4287; LC, 1 Feb. 1983, on bryozoan skeletons on washed-up *Sargassum* (incubated 5 mo), J. K. 4427; SC, 28 Jan. 1983, on sand grains attached to washed-up algae and seagrass leaves (incubated 5 mo), J. K. 4426; TC, 1 Feb. 1983, on crustose algae, attached to loose subtidal leaves of *Thalassia testudinum* (incubated 5 mo), J. K. 4430; BB, 31 Mar. 1982, spores in foam (sal. 36.6‰, 22°C), J. K. 4160; PB, 2 Apr. 1982, spores in foam (sal. 36.6‰, 23°C), J. K. 4157. **Australia:** HQ, 18 Aug. 1981, spores in foam (sal. 37.2‰, 22°C) and on sand grains 25–50 cm below the beach surface, J. K. 4136, 4146; WQ, 16 Aug. 1981, washed-up debris (incubated 2 yr), J. K. 4417; TNSW, 23 Aug. 1981, spores in foam (sal. 34.5‰, 13°C) and on grains of sand attached to washed-up leaves of *Posidonia australis* Hook. f. (incubated 5 mo), J. K. 4143, 4144, 4415; KV, 30 Aug. 1981, intertidal wood, J. K. 4149, 4153; LV, 2 Sept. 1981, spores in foam (sal. 35.0‰, 14°C), J. K. 4138; PV, 1 Sept. 1981, spores in foam (sal. 35.0‰, 14°C), J. K. 4137; BSA, 4 Sept. 1981, washed-up rhizomes of *P. cf. ostensfeldii* DEN HARTOG (incubated 5 mo), J. K. 4420; LSA, 6 Sept. 1981, washed-up leaves of *P. australis* and *Amphibolis* sp. (incubated 5 mo), ascocarps attached to grains of sand, bryozoan colonies and *Spirorbis* sp., J. K. 4414. **Fiji:** M, 16 Sept. 1981, spores in foam (sal. 35.5‰, 25°C), J. K. 4132; T, 19 Sept. 1981, spores in foam (sal. 35.5‰, 25°C), J. K. 4140. **New Zealand:** MN, 14 Sept. 1981, spores in foam (sal. 34‰, 14°C), J. K. 4134; PN, 11 Sept. 1981, spores in foam (sal. 35‰, 13°C), J. K. 4133. **Thailand:** P, 15 Sept. 1983, washed-up detritus (incubated 5 mo) and spores in foam (sal. 32.2‰, 32°C), J. K. 4464, 4503; R, 13 Sept. 1983, washed-up detritus (incubated 5 mo), J. K. 4504. **U. S. A.** (all spores in foam): CA, 6 Aug. 1979, J. K. 4013; Hawaii, HK, 3 Nov. 1983 (sal. 36.6‰, 26°C); WBK, 4 Nov. 1983 (sal. 37.2‰, 26°C), J. K. 4490; WK, 2 Nov. 1983 (sal. 36.1‰, 26°C), J. K. 4487; WRK, 3 Nov. 1983 (sal. 34.0‰, 26°C), J. K. 4473; HM, 9 Nov. 1983 (sal. 33.9‰, 26°C), J. K. 4491.

Corollospora maritima is ubiquitous and the most common species among the arenicolous fungi, as demonstrated again by the large number of new collecting sites in temperate and tropical zones. New locations not included in KOHLMAYER

& KOHLMAYER (1979) are in the Atlantic Ocean: Bahamas, Tobago, Trinidad and St. John (KOHLMAYER 1980), Canada (New Brunswick: MILLER & WHITNEY, 1981), Martinique (KOHLMAYER, 1981 a), Sierra Leone (ALEEM, 1980), South Africa (GORTER, 1978), Texas (KOEHN, 1979); in the Black Sea: U. S. S. R. (ZELEZINSKAYA, 1979 a; ZELEZINSKAYA & NIKITINA, 1977); in the Pacific Ocean: Easter Island (KOHLMAYER, 1981 b), Hong Kong (VRIJMOED *et al.*, 1982), New Zealand (South Island: LINTOTT & LINTOTT, 1982), U. S. S. R. (Maritime Territory: KRYLOVA, 1980). *Posidonia* spp. and *Amphibolis* are new substrates for *C. maritima*.

Corollospora pulchella KOHLM., SCHMIDT & NAIR (anamorph:
Clavariopsis bulbosa ANAST.)

Material: **Belize:** AA, 12 Nov. 1982, on grains of sand attached to washed-up *Sargassum* (incubated 4 mo), J. K. 4321. **Mexico:** CC, 1 Feb. 1983, spores in foam (sal. 38.3‰, 27°C), J. K. 4287; MC, 28 Jan. 1983, on washed-up detritus (incubated 5 mo), J. K. 4424. **Australia:** HQ, 18 Aug. 1981, on grains of sand, 25–50 cm below beach surface, J. K. 4146; 16 Aug. 1981, on washed-up *Sargassum* sp. (incubated 2 yr), J. K. 4418; TNSW, 23 Aug. 1981, spores in foam (sal. 34.5‰, 13°C) and ascocarps on sand grains, attached to leaves of *Posidonia australis* (incubated 5 mo), J. K. 4143, 4415; LSA, 6 Sept. 1981, washed-up leaves of *P. australis* (incubated 5 mo), J. K. 4414. **Palau Islands:** P, 4 Mar. 1983, attached to grains of sand and on calcareous lining of shipworm tubes in driftwood, J. K. 4306. **Thailand:** P, 15 Sept. 1983, driftwood, J. K. 4452.

In addition to the new collections listed above, the teleomorph or anamorph, or both, of *C. pulchella* have been recorded from the following new locations since 1979: Atlantic Ocean: Brazil (BOOTH, 1979, 1983), Denmark (KOCH & JONES, 1983), Sierra Leone (ALEEM, 1980; ALEEM & MALIBARI, 1981), Trinidad (KOHLMAYER, 1980), U. S. A. (Virginia: KIRK & BRANDT, 1980), Indian Ocean: Sri Lanka (KOCH, 1982), Pacific Ocean: Hong Kong (VRIJMOED *et al.*, 1982), Red Sea: Saudi Arabia (ALEEM, 1978). Although *C. pulchella* is found in temperate waters, its main distribution appears to be in the tropics. *Sargassum* and *Posidonia australis* are new substrates.

Dactylospora haliotrepha (KOHLM. & KOHLM.) HAFELLNER

Material: **Belize:** MW, 8 Apr. 1983, dead prop root of *Rhizophora mangle* L. with shipworms, J. K. 4406; SI, 29 Mar. 1983, dead submerged branch of *R. mangle*, J. K. 4341; TC, 3 and 7 Mar. 1983, dead intertidal branches of *Laguncularia racemosa* and dead prop roots of *R. mangle*, often with shipworms, J. K. 4370, 4371, 4388–4390, 4398, 4401; WW, 29 Mar. 1983, dead intertidal branches of *L. racemosa* and dead tip of prop root of *R. mangle*, J. K. 4328, 4329, 4353. **Australia:** NQ, 14 Aug. 1981, dead submerged branch of *Avicennia marina* (FORSK.) VIERH. var. *resinifera* (FORST.) BAKH., J. K. 4438. **Thailand:** S, 15 Sept. 1983, dead branches under mangroves, J. K. 4463.

Other new locations of *D. haliotrepha*, published after 1979 are in the Atlantic Ocean (Trinidad, U. S. Virgin Islands [St. John]: KOHLMAYER, 1980) and the Pacific Ocean (Australia [Queensland], Mexico [Baja California]: KOHLMAYER, 1983). *Avicennia marina* var. *resinifera* and *Laguncularia racemosa* are new hosts.

Didymosphaeria enalia KOHLM.

Material: **Belize:** AA, 7 and 10 Nov. 1982, dead branch of *Laguncularia racemosa* and dead prop roots of *Rhizophora mangle* L., J. K. 4266, 4278; CPA, 7 Nov. 1982, driftwood, J. K. 4319; MA, 11 Nov. 1982, dead branches of *Batis maritima* L., J. K. 4279; TC, 3 and 7 Apr. 1983, intertidal branch and root of *L. racemosa*, dead stems of *B. maritima*, J. K. 4398–4400. **Australia:** HQ, 20 Aug. 1981, intertidal piling, J. K. 4150. **Marshall Islands:** E, 23 Aug. 1971, driftwood, J. K. 3026. **Thailand:** S, 15 Sept. 1983, stump of *Ceriops* sp., dead prop roots of *Rhizophora* sp. (?), J. K. 4449, 4457, 4465.

New distributional records for *D. enalia* published after 1979 are all in the Atlantic Ocean: Brazil (BOOTH, 1979, 1983), Martinique (KOHLMAYER, 1981 a), Sierra Leone (ALEEM, 1980), Trinidad (KOHLMAYER, 1980), United States (Texas: KOEHN, 1979; Virginia: KIRK & BRANDT, 1980). *Batis maritima*, *Cerriops* and *Laguncularia racemosa* are new hosts.

Didymosphaeria rhizophorae KOHLM. & KOHLM.

Material (all on *Rhizophora mangle*): **Belize:** A, 8 Nov. 1982, dead root, J. K. 4260; 29 Mar. 1983, dead prop roots, J. K. 4332, 4349, 4352–4354, 4356, 4358; TC, 3 and 7 Apr. 1983, dead prop roots and submerged branch, J. K. 4362, 4364, 4366, 4381, 4382, 4387, 4396, 4397. **Mexico:** JAB, 28 Mar. 1982, prop root, J. K. 4182.

New locations of *D. rhizophorae* not included in KOHLMAYER & KOHLMAYER (1979) are all in the Atlantic Ocean: Brazil (BOOTH, 1979), Bahamas and U. S. Virgin Islands (KOHLMAYER, 1980), U. S. A. (Texas: KOEHN, 1979). Except for the new record from Baja California, *D. rhizophorae* has been found only in the Atlantic, and appears to be restricted to the American continent and neighboring islands.

Halosarpheia KOHLM.

In recent years, the genus *Halosarpheia*, originally monospecific, has gained a large number of species through new descriptions and recombinations. Submicroscopical studies (JONES & MOSS, 1978; SHEARER & CRANE, 1980; JONES *et al.*, 1983 b) have shown that several species that were first included in the genera *Haligena* and *Halosphaeria* could better be assigned to *Halosarpheia* because their asci were more or less persistent and ascospore appendages developed by exudation through a pore at each apex, transforming into long filaments after release into the water. In the present paper one new species of *Halosarpheia* from the tropics is described, one new combination is made, and a key to the accepted 10 species is presented. *Halosarpheia viscosa* (I. SCHMIDT) SHEARER & CRANE (1980) is omitted in this key. The epithet *viscosa* was not validly published according to the International Code of Botanical Nomenclature (Article 37) because no type was indicated in the original description of *Halosarpheia viscosa* (SCHMIDT, 1979).

Halosarpheia abonnis KOHLM. sp. nov. (Figs. 4 a–f, 5 a–c)

Ascocarpiis 450–600 μm altis, 300–450 μm diametro, ellipsoideis, immersis, ostiolatis, papillatis, coriaceis, dilute brunneis, interdum axe principale horizontale; **peridiis** 20–45 μm crassis, bistratis, texturam angularem formantibus; strato externo cellulis subglobosis parvis, affixis ad lignum putridum; strato interno cellulis majoribus elongatis applanatisque, in pseudoparenchyma venteris transienti; **collis** 350–450 μm longis, 80–180 μm diametro, cylindricis, centralibus vel lateralibus, periphysatis; **pseudoparenchymate** cellulis leptodermis, magnis, polygonalibus, ventera ascocarporum juvenium ante originem cellularum ascogonarum complentibus, denique secedentibus et catenophyses formantibus; **ascis** 210–290 \times 30–54 μm , octosporis, clavatis, pedunculatis, unitunicatis, leptodermis, pachydermis ad apicem, persistentibus, in parte inferiore loculi insertis, successive maturescentibus, in maturitate basaliter e textura ascogena secedentibus sine ascosporas liberantibus; **ascosporis** 33–47 \times 16–22 μm (appendicibus exclusis), ellipsoideis, uniseptatis, leviter constrictis, hyalinis, appendicibus apicalibus subapicalibusque; appendicibus primo pileatis, rigidis homogenisque, 5–8 μm crassis, 16–20 μm longis, 10 μm latis, in maturitate gelatinescentibus et in filamentis delicatis transmutatis. **Substrata:** Lignum immersum Avicenniae germinantis, Conocarpi erectae, Hibisci tiliacei, Rhizophorae mangle. **Distributio:** Oceanus Atlanticus (Belize, Bermuda), Oceanus Pacificus (Mexico: Baja California; U. S. A.: Hawaii).

Holotypus: J. K. 4391 a; **Isotypus:** J. K. 4391 b.

Ascocarps 450–600 μm high, 300–450 μm in diameter, ellipsoidal, immersed, ostiolate, papillate, coriaceous, light brown, main axis sometimes horizontal with a lateral, recurved neck (Fig. 4 d). **Peridium** 20–45 μm thick, two-layered, forming a *textura angularis*; outer stratum composed of small, subglobose cells that are intimately bound to the softened, decomposing wood; inner stratum composed of larger, elongate and flattened cells that merge with the pseudoparenchyma of the centrum (Fig. 4 a, b). **Necks** 350–450 μm long, 80–180 μm in diameter, cylindrical, centrally or laterally inserted, sometimes curved and irregular; ostiolar canal periphysate (Figs. 4 d, 5 c). **Pseudoparenchyma** of thinwalled, large polygonal cells filling the centrum of young ascocarps before the development of ascogenous cells, breaking up to form catenophyses; cells of pseudoparenchyma and peridium are filled with lipid globules. **Asci** 210–290 \times 30–54 μm , eight-spored, clavate, pedunculate, unitunicate, thin-walled, thicker at the apex, persistent, apical apparatuses not observed, developing at the base of the ascocarp venter on a small-celled ascogenous tissue that is separated from the peridium by thin-walled, polygonal cells of the sterile pseudoparenchyma; asci mature successively; in squash mounts breaking off basally from the ascogenous tissue without releasing the ascospores (Fig. 4 c, e, f). **Ascospores** 33–47 \times 16–22 μm (excluding appendages), ellipsoidal, one-septate, slightly constricted at the septum, hyaline, with apical-subapical appendages (Fig. 5 a, b); one caplike, stiff and homogeneous appendage is attached to each apex and runs partially along the side of the ascospore, 5–8 μm thick, 16–20 μm long, 10 μm wide, at maturity becoming soft and scooplike, eventually transforming into a coil of delicate fibers that uncoil and form long, sticky

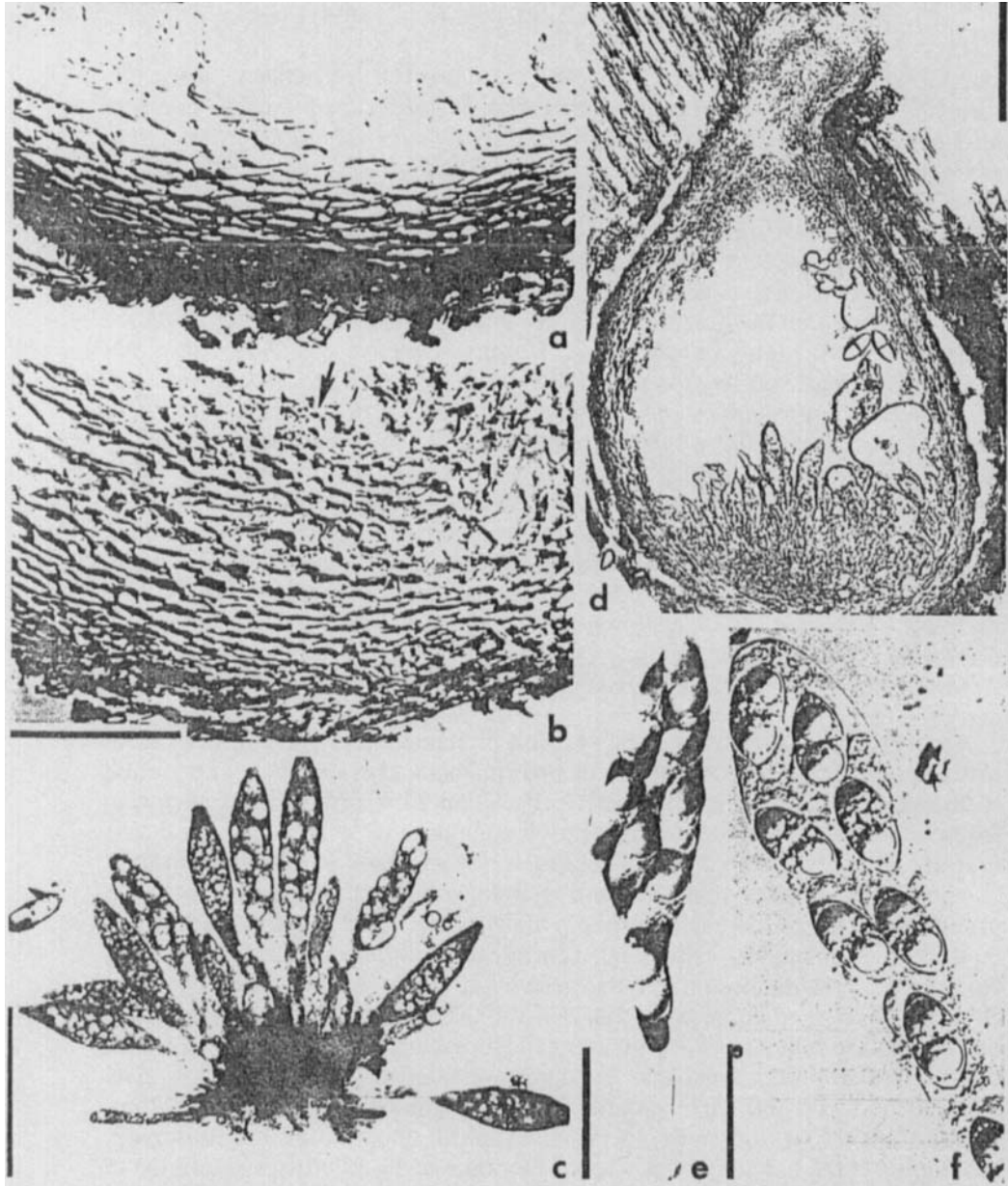


Fig. 4. *Halosarpheia abonnis* sp. nov. a. Ascocarp peridium (6 µm section), bar = 50 µm; b. peridium and ascogenous tissue (arrow), 6 µm section, bar = 50 µm; c. immature asci, stained in hematoxylin, bar = 100 µm; d. ascocarp, longitudinal section, bar = 100 µm; e. ascus, appendages stained in hematoxylin, bar = 50 µm; f. ascus with apical plate (arrow), bar = 50 µm. (c and d in brightfield, the others in Nomarski interference contrast; c and e from J. K. 3748, d from J. K. 4195; f from J. K. 4355; a and b from J. K. 4391.)

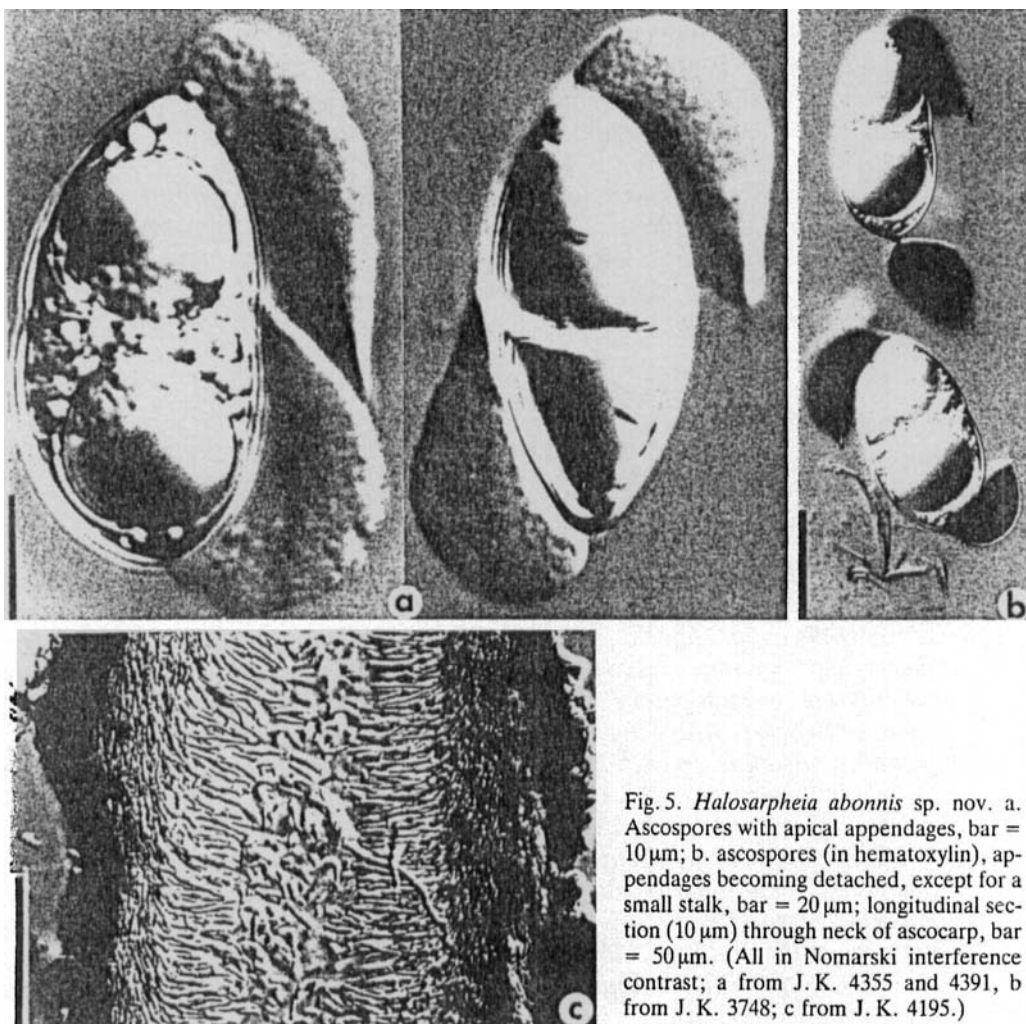


Fig. 5. *Halosarpheia abonnis* sp. nov. a. Ascospores with apical appendages, bar = 10 μ m; b. ascospores (in hematoxylin), appendages becoming detached, except for a small stalk, bar = 20 μ m; longitudinal section (10 μ m) through neck of ascocarp, bar = 50 μ m. (All in Nomarski interference contrast; a from J. K. 4355 and 4391, b from J. K. 3748; c from J. K. 4195.)

filaments, but remain attached to the ascospore apices with their bases (Fig. 5b). **Mode of life:** Saprobic. **Substrates:** Immersed wood of mangroves [*Avicennia germinans* (L.) L., *Conocarpus erecta* L., *Rhizophora mangle*], *Hibiscus tiliaceus* L., and driftwood. **Range:** Atlantic Ocean (Belize, Bermuda), Pacific Ocean (Mexico: Baja California; U. S. A.: Hawaii). **Material examined:** Tip of dead intertidal branch of *R. mangle*, together with *Hydronectria tethys* and *Leptosphaeria australiensis*, Twin Cays, Belize, 16°50'N, 88°06'W, 7 Apr. 1983, J. K. 4391 a (**Holotype**, NY), 4391 b (**Isotype**, IMS); tip of dead prop root of *R. mangle*, together with *L. australiensis*, Wee-Wee Cay, Belize, 16°45'45"N, 88°09'W, 29 Mar. 1983, J. K. 4355; driftwood and dead intertidal branch of *A. germinans*, Isla Bargo, Bahia Coyote, Baja California, Mexico 26°43'N, 111°54'30"W, 31 Mar. 1982, J. K. 4171 and 4195 (together with *L. australiensis*); wood of dead root or branch of *A. germinans*, Puerto Ballena, Isla Espiritu

Santo, Baja California, Mexico, 24°27'N, 110°20'W, 27 Mar. 1982, J. K. 4178; dead submerged branch of *C. erecta*, near Bermuda Biological Station, St. George's Island West, Bermuda, 32°20'N, 64°40'W, 17 May 1976, J. K. 3748; the following all on Oahu, Hawaii: driftwood under mangroves, together with *Dactylospora haliotrepha* and *Lulworthia* sp., Coconut Island, Kaneohe Bay, 21°25'40"N, 157°47'30"W, 24 May 1968, J. K. 2540; damaged prop root of *R. mangle*, Pearl Harbor, West Loch, 21°21'N, 158°01'W, 17 May 1968, J. K. 2558; dead branch of *H. tiliaceus*, Heeia Pond, Kaneohe Bay, 21°25'30"N, 157°48'W, 10 June 1968, J. K. 2561. **Etymology:** From Medieval Latin, *abonnis* = a kind of cap, bonnet, in reference to the ascospore appendages.

Halosarpheia abonnis was listed as *Halosarpheia* sp. III by KOHLMAYER & KOHLMAYER (1977).

Halosarpheia ratnagiriensis PATIL & BORSE, Indian Bot. Repr., 1 : 102, 1982 (Figs. 6 a–f, 7 a–h)

Ascocarpiis 300–650 μm altis, 400–480 μm diametro, ellipsoideis, immersis, ostiolatis, papillatis, coriaceis, hyalinis hyphis tectis; **peridiis** 25–40 μm crassis, cellulis texturam angularem formantibus, in pseudoparenchyma venteris transiuntibus; **collis** circa 1 mm longis, 100–160 μm diametro, cylindricis, supra superficiem ligni apicibus albis villosisque emergentibus, centralibus vel lateralibus, periphysatis; **pseudoparenchymate** cellulis leptodermis, magnis, polygonalibus, ventera ascocarpiorum juvenum ante originem cellularum ascogonarum complentibus, denique secedentibus et catenophyses formantibus; **ascis** 250–340 \times 50–68 μm , octosporis, clavatis, pedunculatis, unitunicatis, leptodermis, pachydermis infra apicem, clavatis pedunculatis, unitunicatis, leptodermis, pachydermis infra apicem, persistentibus; disco apicale lentiforme refractivo, 3–6 μm diametro, circa 0.8 μm crasso; in parte inferiore loculi insertis, successive maturescentibus, in maturitate basaliter e textura ascogena secedentibus sine ascosporas liberantibus; **ascosporis** 48–64 (–71.5) \times 22–28 μm (appendicibus exclusis), ellipsoideis, uniseptatis, leviter constrictis, hyalinis, appendicibus grandis apicalibus subapicalibusque; appendicibus primo pileatis, rigidis homogenisque, 4–7 μm crassis, 25–34 μm longis, 16–18 μm latis, in maturitate gelatinescuntibus et in filamentis delicatis transmutatis. **Substrata:** Lignum et cortex immersum mangrovium. **Distributio:** Oceanus Atlanticus (Brazil), Oceanus Indicus (India), Oceanus Pacificus (Thailand).

Ascocarps 300–650 μm high, 400–480 μm in diameter, ellipsoidal, immersed, ostiolate, papillate, coriaceous, hyaline, covered by hyphae. **Peridium** 25–40 μm thick, cells forming a *textura angularis*, merging with the pseudoparenchyma of the centrum (Fig. 6 a). **Neck** about 1 mm long, 100–160 μm in diameter, cylindrical, emerging with whitish, fuzzy tips over the wood surface, centrally or laterally inserted; ostiolar canal periphysate. **Pseudoparenchyma** of thin-walled, large polygonal cells filling the centrum of young ascocarps, breaking up to form catenophyses. **Asci** 250–340 \times 50–68 μm , eight-spored, clavate, pedunculate, unitunicate, thin-walled, thicker below the apex, persistent; with a refractive lens-shaped, apical plate, 3–6 μm in diameter, about 0.8 μm thick (Fig. 6 c, d); developing at the base of the ascocarp venter, maturing successively (Fig. 6 b);

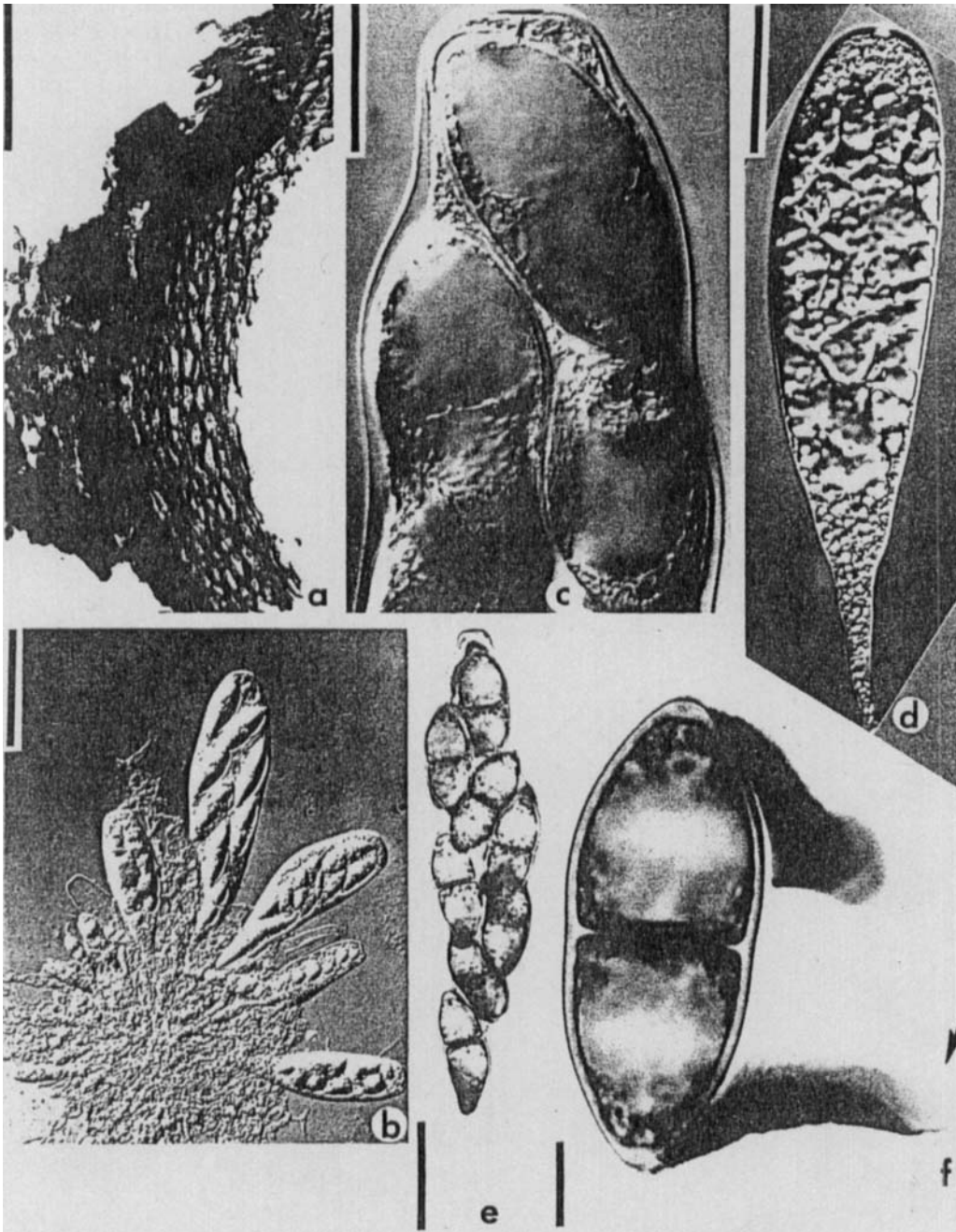


Fig. 6. *Halosarpheia ratnagiriensis* a. Ascocarp peridium (8 μm section), bar = 50 μm ; b. asci in different stages of development, bar = 100 μm ; c. tip of immature ascus (arrow = apical plate), bar = 20 μm ; d. immature ascus, bar = 50 μm ; e. mature ascus, appendages stained in methylene blue, bar = 50 μm ; f. ascospore, appendages becoming detached, tip smooth (arrow) without internal filament (methylene blue), bar = 10 μm . (a, e, f in brightfield, the others Nomarski interference contrast; a from J. K. 4458; b and d from 4460; c, e, f from J. K. 4470.)

in squash mounts breaking off basally from the ascogenous tissue without releasing the ascospores (Fig. 6e). **Ascospores** 48–64 (-71.5) \times 22–28 μm (excluding appendages), ellipsoidal, one-septate, slightly constricted at the septum, hyaline, with large apical-subapical appendages (Fig. 6f); one caplike,

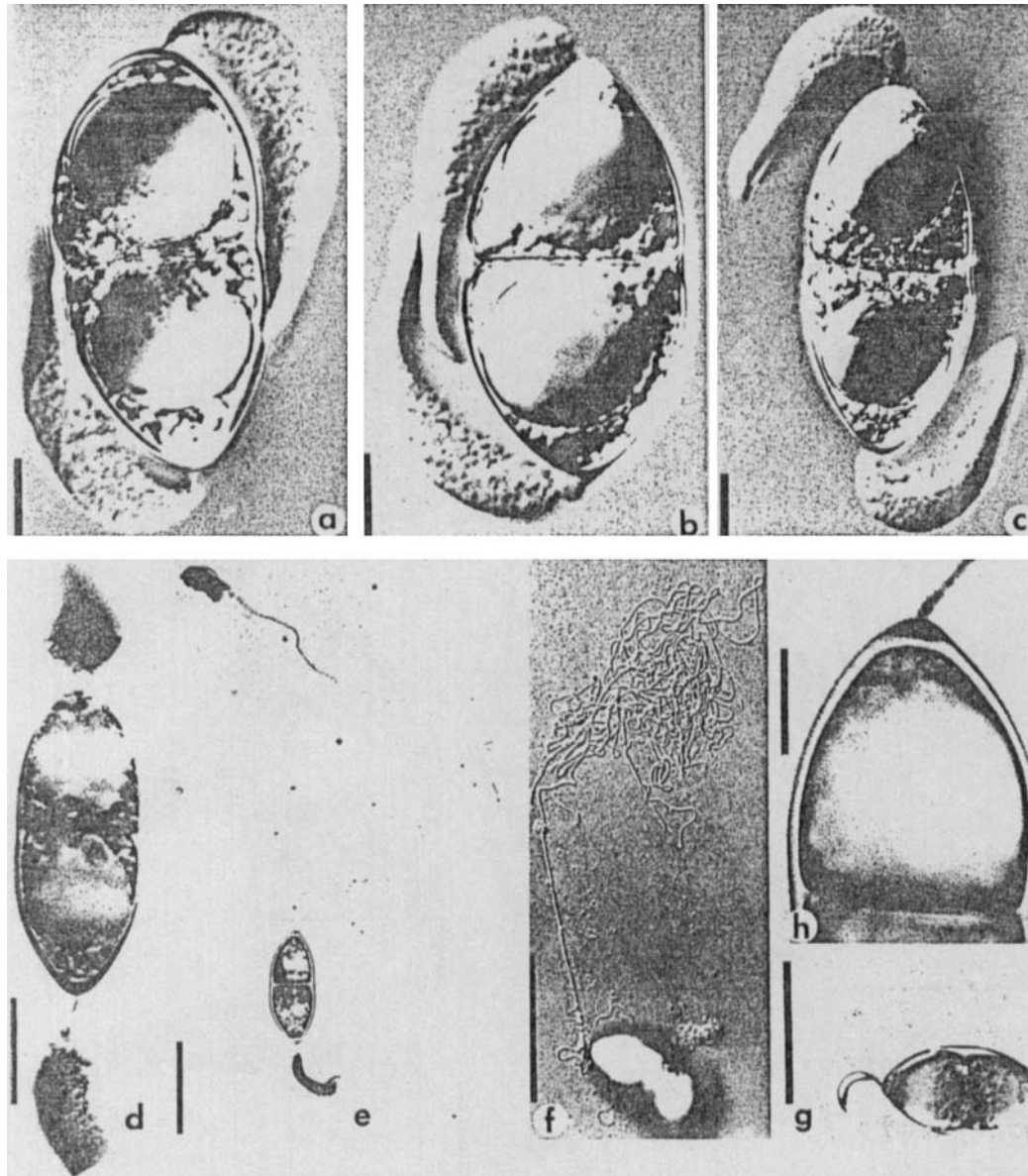


Fig. 7. *Halosarpheia ratnagiriensis*, ascospores. a–d. Appendages becoming detached and unfurling; bar 10 μm in a–c, 20 μm in d; e and f. unfurling appendages, bar = 50 μm ; g. oil droplet coming out of apical pore under pressure, bar = 50 μm ; h. dark stained area in the spore wall at the apex, appendage filament attached at tip, bar = 10 μm . (e and h in brightfield, the others in Nomarski interference contrast; d, e, g, h stained in methylene blue; a, d, e, f from J. K. 4470; b, c, g from J. K. 4460; h from J. K. 4465).

stiff and homogeneous appendage is attached to each apex and runs partially along the side of the ascospore, 4–7 μm thick, 25–34 μm long, 16–18 μm wide, at maturity becoming soft and scooplike, eventually transforming into a coil of a delicate fiber that uncoils and forms a long, sticky filament of about 0.7 μm in diameter, but remains attached to the ascospore apex with its 1 μm thick base (Fig. 7 a–h); when spores are released into water, apparently a matrix enclosing the coiled filament of the appendage dissolves and releases the filament; at this stage a refractive, spoon-shaped tip becomes visible which is smooth and does not contain any fibers (Fig. 7 c); this tip was originally attached to the side of the ascospore; appendages stain violet in DELAFIELD's hematoxylin and dark blue in methylene blue; when asci of *H. ratnagiriensis* are briefly dried on a microscope slide, rehydrated and then treated with methylene blue, the appendage matrix dissolves and the filaments are set free; all ascospores, even immature ones, are now surrounded by the filaments that fill the lumen of the ascus; ascospore appendages appear to originate by exudation from the inside of the spore; the ascospore wall is thickened at the apex (2.4–3.2 μm at the tip; 1.6 μm at the sides) and contains a faintly visible conical canal below the point of attachment of the appendage, when methylene blue is applied; this canal appears to connect the filament with the lumen of the ascospore (Fig. 7 h); under pressure oil globules are pressed out through the tip of the spore, indicating the presence of a preformed pore (Fig. 7 g). **Mode of life:** Saprobic. **Substrates:** Immersed wood and bark of mangroves (*Rhizophora* sp.?). **Range:** Atlantic Ocean (Brazil), Indian Ocean (India), Pacific Ocean (Thailand). **Material examined:** The following collections from the same mangal, along a channel, Bang Sai near Chon Buri, Chon Buri Province, Thailand, 13°20'N, 100°55'E, 15 Sept. 1983, in submerged wood and bark of mangroves (*Rhizophora* sp.), J. K. 4460, 4458, 4465, 4467, 4470; in submerged branch of a mangrove, Bay of São Vicente near Santos, Estado de São Paulo, Brazil, 24°S, 46°25'W, 31 March 1963, leg. R. H. RIMPAU, J. K. 1617. A paper by S. D. PATIL & B. D. BORSE (Indian Bot. Reporter, 1: 102–106, 1982) describing *H. ratnagiriensis* came to my attention after the present paper went to press, containing the description of the same species. The diagnosis is retained herewith because it adds information to PATIL & BORSE's description.

Halosarpheia fibrosa KOHLM. & KOHLM.

Material: **Belize:** MW, 8 Apr. 1983, damaged pneumatophores of *Laguncularia racemosa*, J. K. 4409; WW, 29 Mar. 1983; intertidal branch of *L. racemosa*, J. K. 4331. **Australia:** NQ, 14 Aug. 1981, intertidal branch, J. K. 4147.

Laguncularia racemosa is a new host.

Halosarpheia marina (A. B. CRIBB & J. W. CRIBB) KOHLM. comb. nov.
(Fig. 8 a–d)

Basionym: *Gnomonia marina* CRIBB & CRIBB, Univ. Queensland Pap. Dep. Bot. 3: 100, Pl. 3, Figs. 3 & 4, 1956.

Material: Root of *Avicennia marina* var. *resinifera*, Redcliffe, Queensland, Australia, 27°15'S, 153°04'E, 3 Dec. 1955, type material, slide No. 80 of A. B. CRIBB, (Fig. 8 a, b, d); unidentified wood

(probably mangrove), Pago Pago, American Samoa, 14°22'S, 170°39'W, 1 Dec. 1963, Cruise CHG-69, U. S. B. C. F. Honolulu, comm. R. A. BARKLEY, J. K. 1688; prop root of *Rhizophora mangle*, Buttonwood Creek near Flamingo, Florida, U. S. A., 25°09'N, 80°55'W, 9 Jan. 1964, J. K. 1711 b; prop root of *R. racemosa* MEYER, Mesurado River near Monrovia, Liberia, 6°18'N, 10°49'W, 28 Feb. 1965, J. K. 1823.

This species with appendaged ascospores does not fit in the genus *Gnomonia* where it was placed originally (MONOD, 1983). A reexamination of permanent slides and comparison with other species of *Halosarpheia* suggests a close relationship to the members of this genus, and a transfer is proposed herewith. MONOD (1983) states that *G. marina* belongs to *Lentescospora* LINDER, which, however, is a *nomen dubium* (KOHLMAYER & KOHLMAYER, 1979). A full description of *H. marina* is found in KOHLMAYER & KOHLMAYER (1979, under *Gnomonia marina*). As in most other species of *Halosarpheia*, *H. marina* has more or less persistent asci with an apical plate (Fig. 8 a), catenophyses and apical, cap-like ascospore appendages that detach from the spore, become ladle-like (Fig. 8 c, d), and finally unfurl into long filaments.

Halosarpheia retorquens SHEARER & CRANE

Material: U. S. A.: Hawaii, HBM, 9 Nov. 1983, submerged branch of *Hibiscus tiliaceus* in brackish lagoon and intertidal branch on open shore, J. K. 4478, 4484.

In addition to the accepted 10 species of *Halosarpheia*, other species are probably extant, as indicated by unidentifiable representatives of this genus in several collections. The species of *Halosarpheia* are distinguished by ascospore characters, especially septation, length, diameter, as well as location and size of appendages.

Key to the species of *Halosarpheia*

1. Ascospores one-septate, or becoming three-septate at maturity 2
- 1'. Ascospores consistently four- or more-septate 8
2. Ascospores becoming three- (or four-)septate *H. bentotensis* KOCH
- 2'. Ascospores consistently one-septate 3
3. Ascospore diameter less than 13 μm 4
- 3'. Ascospore diameter over 13 μm 5
4. Ascospore appendages lateral, hamate *H. retorquens* SHEARER & CRANE
- 4'. Ascospore appendages apical, semiglobose *H. marina*
(CRIBB & CRIBB) KOHLM.
5. Ascospores 48–64 μm long *H. ratnagiriensis*
- 5'. Ascospores shorter 6
6. Ascospore appendages large (5–8 μm thick, 16 μm or longer), subapical . . .
H. abonnis sp. nov.
- 6'. Ascospore appendages small (up to 5 μm thick, shorter than 15 μm), apical 7

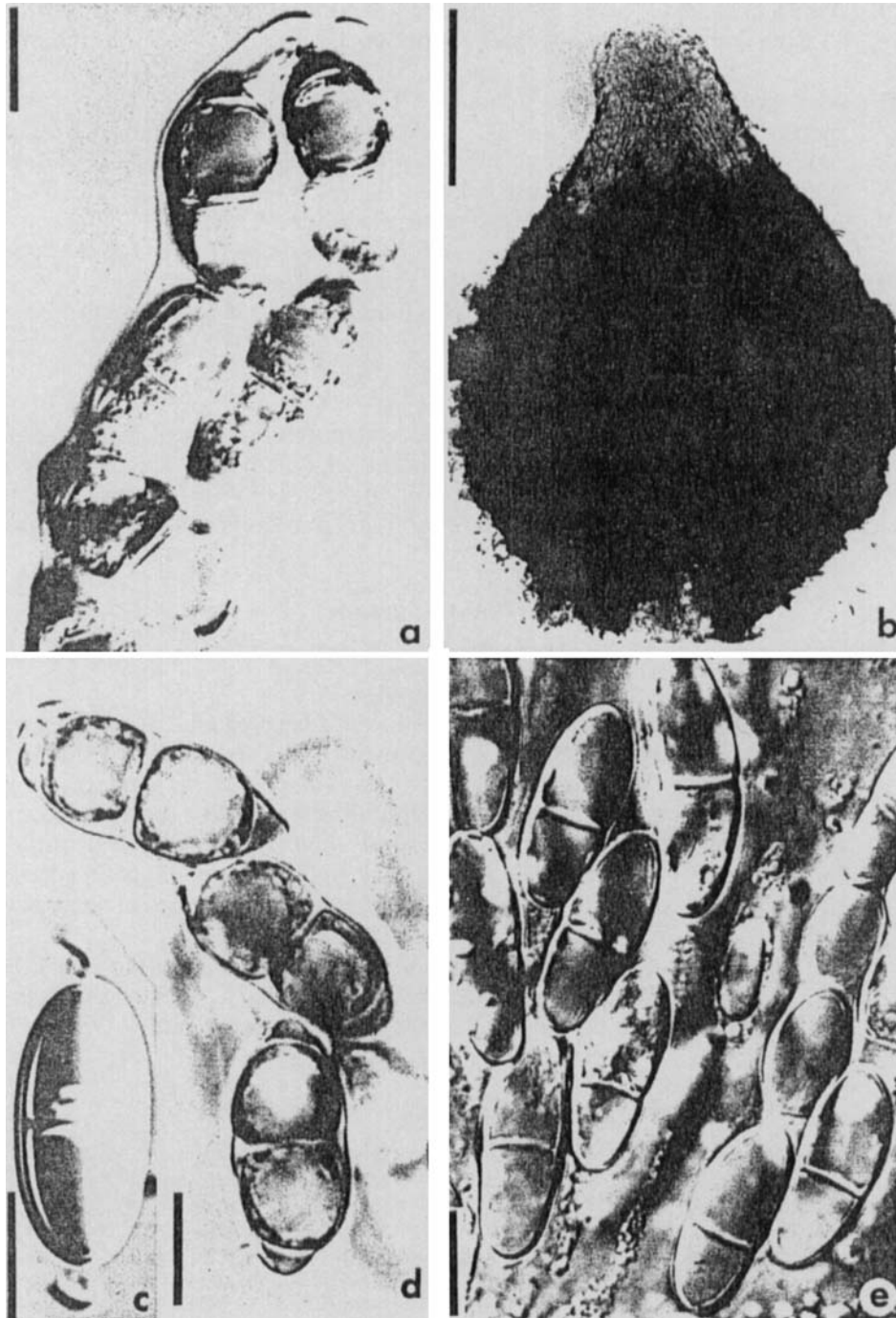


Fig. 8. a-d. *Halosarpheia marina*. a. Ascus tip with apical plate and pore, bar = 10 μ m; b. ascocarp, bar = 100 μ m; c. ascospore with unfurling appendages, bar = 10 μ m; d. ascospores with apical caps, bar = 10 μ m; e. *Hydronectria tethys* var. *glabra* var. nov., smooth ascospores, bar = 10 μ m. (b and c in brightfield, the others Nomarski interference contrast; a, b and d type slide No. 80 of A. B. CRIBB of *Gnomonia marina*; c from J. K. 1688; e from J. K. 4463.)

7. Ascospores up to 32.5 μm (rarely 35.5 μm) long, diameter up to 17.5 μm (rarely 20 μm); a temperate species *H. trullifera* (KOHLM.) JONES *et al.*
- 7'. Ascospores 32–44 μm long, diameter 18–24 μm ; a tropical or subtropical species *H. fibrosa* KOHLM. & KOHLM.
8. Ascospore appendages at one apex only. *H. cincinnatula* SHEARER & CRANE
- 8'. Ascospore appendages at both apices 9
9. Ascospores predominantly five-septate, diameter over 10 μm *H. spartinae* (JONES) SHEARER & CRANE
- 9'. Ascospores predominantly eleven-septate, diameter less than 10 μm *H. viscidula* (KOHLM.) SHEARER & CRANE

Halosphaeria LINDER

Based on submicroscopic investigations of ascospore ontogeny of *Halosphaeria* species JONES & MOSS (1978, 1980) and JONES *et al.* (1984) have assigned most of the species formerly included in this genus (KOHLMAYER & KOHLMAYER, 1979) to other genera. In the following only three species from tropical waters are listed.

Halosphaeria galerita (TUBAKI) SCHMIDT

Material: U. S. A.: Hawaii, HBM, 9 Nov. 1983, intertidal wood (probably *Hibiscus tiliaceus*), J. K. 4483.

The ascospore ontogeny of this species has not been examined and it is not known if the apical caps originate as outgrowths of the spores as they do in *H. appendiculata*, type species of the genus (JONES *et al.*, 1984). Appendages of *H. galerita* consist of amorphous material surrounding fibrils (TUBAKI, 1968; KOHLMAYER & KOHLMAYER, 1968; *sub Lentescospora submarina* LINDER), apparently similar to appendages of *H. appendiculata*. The generic placement of *H. galerita* is uncertain until submicroscopic studies determine the origin of ascospore appendages.

New records are from Brazil (BOOTH, 1979, 1983), Canada (Hudson Bay: BOOTH, 1981; New Brunswick: MILLER & WHITNEY, 1981) and Texas (KOEHN, 1979). Thus, *H. galerita* occurs from Arctic waters to the tropics.

Halosphaeria quadricornuta CRIBB & CRIBB

Material: Belize: AA, 7 and 10 Nov. 1982, submerged dead tree and driftwood, J. K. 4252, 4257; CB, 28 Mar. and 1 Apr. 1983, intertidal wood and subtidal wood (6 m deep) with shipworms, J. K. 4326, 4359 (leg. G. HENDLER); CC, 4 Apr. 1983, old tree trunk in the surf on top of the reef, J. K. 4369; SI, 29 Mar. 1983, subtidal wood with *Limnoria* sp. and teredinids under *Rhizophora*, J. K. 4335, 4338; TC, 3 Apr. 1983, subtidal bamboo under mangroves, J. K. 4373. Mexico: CC, 1 Feb. 1983, ascospore in foam (sal. 38.3‰, 27°C), J. K. 4287; TC, 1 Feb. 1983, subtidal wood (3 m deep), J. K. 4294; JB, 4 Apr. 1982, driftwood, J. K. 4172. Australia: HQ, 17 Aug. 1981, subtidal wood with *Limnoria* sp. in a tidal pool, J. K. 4210. Fiji: B, 22 Sept. 1981, intertidal wood from shipwreck, J. K. 4213; M, 17 Sept. 1981, subtidal wood (1.5 m deep) with shipworms and *Limnoria*, J. K. 4205. Thailand: P, 15 Sept. 1983, driftwood with shipworms, J. K. 4451, 4503; R, 13 Sept. 1983, driftwood (incubated 5 mo), J. K. 4504. U. S. A.: Hawaii, HBM, 9 Nov. 1983, intertidal wood (*Hibiscus tiliaceus* ?), J. K. 4483; WK, 2 Nov. 1983, intertidal wood, J. K. 4474.

Ascocarps of *H. quadricornuta* occur often on, in, or under calcareous linings of empty shipworm tubes. This affinity to calcareous material of teredinid tunnels has been noted before (KOHLMAYER, 1969 a). It is likely that hyphae of *H. quadricornuta* decompose the organic matrix of the calcium carbonate, thereby making the lining brittle, however, no enzymatic studies on this question have been made thus far.

JONES & MOSS (1980) and JONES *et al.* (1984) separate *H. quadricornuta* from *Halosphaeria* and include it in *Antennospora*. These authors found that ascospore appendages in both, *H. appendiculata* (type species of *Halosphaeria*) and *H. quadricornuta* arise as outgrowths of the spore. In both species, the appendage is connected by an isthmus of electron-dense material to the mesosporium, and an episporium is absent at the region of attachment. In my opinion, the differences between the two species are not significant enough to warrant a separation on the generic level, and I prefer to keep *H. quadricornuta* in *Halosphaeria* at this time.

New geographic locations of *H. quadricornuta* are Brazil (BOOTH, 1979, 1983), Ghana (FURTADO & JONES, 1980), Hong Kong (VRIJMOED *et al.*, 1982), Sri Lanka (KOCH, 1982), St. John (U. S. Virgin Islands) and Tobago (KOHLMAYER, 1980).

Halosphaeria salina (MEYERS) KOHLM.

Material: **Belize:** AA, 7, 10 and 12 Nov. 1982, intertidal and subtidal wood, trunk of palm, J. K. 4252, 4255, 4258, 4270, 4422; CB, 28 Mar. 1983, intertidal wood with shipworms, J. K. 4326; CC, 4 Apr. 1983, old tree trunk in surf on the reef, J. K. 4369; D, 27 Mar. 1983, intertidal roots of dead tree (incubated 11 mo), J. K. 4496; MA, 11 Nov. 1982, subtidal wood with teredinids and *Limnoria* sp., J. K. 4253; RA, 12 Nov. 1982, dead runners of *Canavalia rosea* among pneumatophores of *Avicennia germinans* (incubated 4 mo), J. K. 4313; WW, 29 Mar. 1983, subtidal bamboo among *Thalassia testudinum*, J. K. 4334. **Mexico:** C, 29 Jan. 1983, intertidal tree trunk with shipworms, J. K. 4300; LC, 1 Feb. 1983, driftwood, J. K. 4297 (fruiting culture ATCC 56661); MC, 28 Jan. 1983, washed-up detritus (algae, wood; incubated 5 mo), J. K. 4424; PC, 27 Jan. 1983, intertidal tree trunk, J. K. 4288; TC, 1 Feb. 1983, subtidal bamboo (incubated 5 mo), J. K. 4429. **Marshall Islands:** E, 23 Aug. 1971, driftwood with woodborers, J. K. 3027. **Thailand** (both on washed-up wood, incubated 5 mo): P, 15 Sept. 1983, J. K. 4503; R, 13 Sept. 1983, J. K. 4504. **U. S. A.:** Hawaii, WK, 2 Nov. 1983, intertidal wood, J. K. 4476.

Like *Halosphaeria quadricornuta*, *H. salina* occurs often in or under the calcareous lining of empty shipworm tubes.

Ascospore appendages stain a deep purple in DELAFIELD's hematoxylin. They appear to originate as outgrowths of the spore, not by separation of an outer wall layer. Appendages are attached to the spore by a broad base, they taper to a fine point and are channeled on the outside, appearing crescent-shaped in optical section. My observations with light microscopy indicate that *H. salina* is better placed in *Halosphaeria* than in *Remispora*. Submicroscopic studies have to demonstrate details of the ontogeny of ascospores and appendages.

New distribution records of *H. salina*, not listed by KOHLMAYER & KOHLMAYER (1979), are in the Atlantic Ocean: Brazil (BOOTH, 1979, 1983), Martinique (KOHLMAYER, 1981 a), Sierra Leone (ALEEM, 1980), Trinidad & Tobago (KOHLMAYER, 1980), in the Indian Ocean: Sri Lanka (KOCH, 1982), and in the Pacific Ocean: Easter Island (KOHLMAYER, 1981 b) and Hong Kong (VRIJMOED *et al.*,

1982). *Halosphaeria salina* is a characteristic tropical fungus that has been collected exclusively in tropical and subtropical regions. It is a frequently occurring species, although not as common as *H. quadricornuta*. *Canavalia rosea* is a new host.

Halosphaeriopsis mediosetigera (CRIBB & CRIBB) JOHNSON
[anamorph: *Trichocladium achrasporum* (MEYERS & MOORE) DIXON]

Material: **U. S. S. R.:** Yalta, Crimea, Black Sea, 12 July 1975, driftwood (incubated one mo), J. K. 3667. **Belize:** AA, 10 Nov. 1982, subtidal plywood, J. K. 4255. **Australia:** TNSW, 23 Aug. 1981, ascospores in foam (sal. 34.5‰, 13°C), J. K. 4143; LV, 2 Sept. 1981, ascospores in foam (sal. 35‰, 14°C), J. K. 4138. **Fiji:** T, 19 Sept. 1981, conidia on dead roots of *Hibiscus* sp. (?) and dead prop roots of *Bruguiera gymnorhiza* (L.) LAMK., J. K. 4207, 4244. **New Zealand:** PN, 11 Sept. 1981, ascospores in foam (sal. 35‰, 13°C), J. K. 4133. **U. S. A.:** Hawaii, HBM, 9 Nov. 1983, intertidal wood (*Hibiscus tiliaceus* ?), J. K. 4481; CA, 12 Aug. 1979, driftwood (incubated 11 mo), J. K. 4075.

The frequent occurrence of ascospores of *H. mediosetigera* in foam along the seashore, together with the spores of typical arenicolous fungi such as *Arenariomyces trifurcatus* and *Corollospora maritima*, is surprising. The foam at these collecting sites in Australia and New Zealand contained propagules of up to 10 marine Ascomycetes and Deuteromycetes, among them *Halosphaeria torquata* KOHLM., another species not found before in the foam. The only other report of *H. mediosetigera* collected in foam is from the Black Sea (ZELEZINSKAYA, 1979 a).

Halosphaeriopsis mediosetigera, in its anamorphic and teleomorphic state, is one of the most frequently collected marine fungi. Although this species is ubiquitous, most of the records are from temperate waters (HUGHES, 1974; KOHLMAYER & KOHLMAYER, 1979). In culture *H. mediosetigera* grows between about 10 and 34°C, has an optimum at 25°C, and does not develop at all at 5 and 35°C (HENNINGSSON, 1978). This broad growth range may explain the occurrence of the species in temperate as well as in tropical regions.

New distribution records of *H. mediosetigera* are in the Atlantic Ocean: Brazil (BOOTH, 1979, 1983), Canada (Hudson Bay: BOOTH, 1981; New Brunswick: MILLER & WHITNEY, 1981; Nova Scotia: BOLAND & GRUND, 1979), Sierra Leone (ALEEM, 1980), South Africa (GORTER, 1978), Trinidad (KOHLMAYER, 1980); in the Indian Ocean: Sri Lanka (KOCH, 1982); in the Mediterranean: Italy (MONTEMARTINI, 1979); in the Pacific Ocean: Easter Island (KOHLMAYER, 1981 b), Hong Kong (VRIJMOED *et al.*, 1982), New Zealand (LINTOTT & LINTOTT, 1982). *Bruguiera gymnorhiza* is a new host for *H. mediosetigera*.

Hydronectria tethys KOHLM. & KOHLM. (Fig. 9)

Material: **Belize:** MW, 8 Apr. 1983, dead branch and prop roots of *Rhizophora mangle*, J. K. 4403, 4404, 4407; SI, 29 Mar. 1983, dead prop roots of *R. mangle*, J. K. 4342, 4343; TC, 3 and 7 Apr. 1983, dead intertidal branch of *Laguncularia racemosa*, dead prop roots and branches of *R. mangle*, J. K. 4363, 4366, 4375, 4381, 4382, 4385, 4386, 4388, 4391, 4396, 4398; TR, 8 Apr. 1983, dead prop root of *R. mangle*, J. K. 4392; WW, 29 Mar. 1983, dead prop roots of *R. mangle*, J. K. 4332, 4340, 4353. **Mexico:** TC, 1 Feb. 1983, dead tip of intertidal branch of *Conocarpus erecta*, J. K. 4289. **Fiji:** T, 19

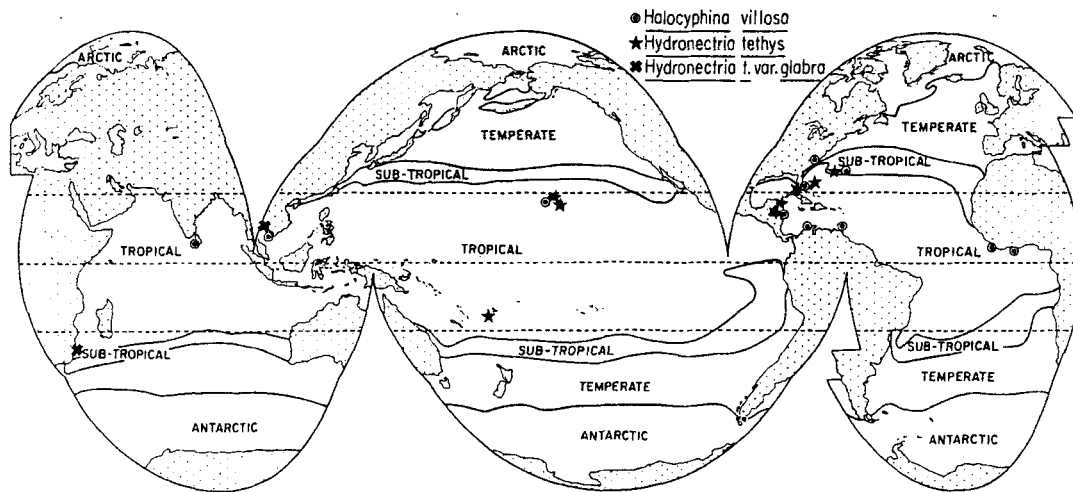


Fig. 9. Geographic distribution of the cosmopolitan Ascomycetes *Hydronectria tethys* and *H. t. var. glabra*, and the Basidiomycete *Halocyphina villosa*. (World map redrawn after HUGHES, 1974; with permission of the author and publisher.)

Sept. 1981, dead root of *Hibiscus* sp. (?) and dead prop roots of *Bruguiera gymnorhiza*, J. K. 4207, 4244. U.S.A.: Hawaii, HBM, 9 Nov. 1983, intertidal wood (probably *Hibiscus tiliaceus*), J. K. 4486.

The only new reports of *H. tethys* after 1979 are by KOHLMAYER (1980) from the Bahamas and St. John (U. S. Virgin Islands). This species occurs exclusively in tropical and subtropical waters (Fig. 9). Ascospores in collections of a *Hydronectria* from Thailand lack the longitudinal ridges found in *H. tethys*. Also material from South Africa had smooth spores and it was speculated that the ridges may disappear in senescent ascospores (KOHLMAYER & KOHLMAYER, 1971). This is not the case, as shown in the well-preserved Thai collections. Since the fungus from Thailand and South Africa is identical with *H. tethys* in all characters except for the ascospore walls, it is described in the following as a new variety. *Bruguiera gymnorhiza* and *Laguncularia racemosa* are new hosts of *H. tethys*.

Hydronectria tethys KOHLM. & KOHLM. var. *glabra* KOHLM. var. nov.
(Fig. 8 e, 9)

Varietas habitu cum Hydronectria tethys var. *tethys* optime congruens, sed differt ascosporis glabris; **ascosporis:** 17–24 (–27) × 8–10 μm, ovoideis, uniseptatis, glabris; **substratum:** lignum putridum; **distributio:** Oceanus Indicus (Africa australis), Oceanus Pacificus (Thailand).

Holotypus: J. K. 4463 a; **Isotypus:** 4463 b.

The variety agrees in habit with *H. tethys* var. *tethys*, but differs in the smooth ascospores. **Ascospores** 17–24 (–27) × 8–10 μm, ovoid, one-septate, smooth (Fig. 8 e). **Mode of life:** Saprobic. **Substrate:** Decomposing wood of mangroves.

Range: Indian Ocean (South Africa); Pacific Ocean (Thailand) (Fig. 9). **Material examined:** Unidentified dead branch under mangroves, Bang Sai near Chon Buri, Chon Buri Province, Thailand, 13°20'N, 100°55'E, 15 Sept. 1983, J. K. 4463 a (**Holotype**, NY), 4463 b (**Isotype**, IMS); dead prop root, same location, J. K. 4467 (**Paratype**, IMS); submerged branch with barnacles under mangroves, Durban Harbor, Natal, South Africa, 30°S, 31°E, 1 Feb. 1969, leg. F. J. SCHWARTZ, J. BALLARD & G. MITCHELL, J. K. 2633 (**Paratype**, IMS; this collection was listed by KOHLMAYER & KOHLMAYER, 1971, as *H. tethys*). **Etymology:** From the Latin *glabrus* = smooth, being free of unevenness, in reference to the smooth ascospores.

Keissleriella blepharospora KOHLM. & KOHLM.

Material: Belize: AA, 12 Nov. 1982, dead prop root of *Rhizophora mangle*, J. K. 4251; MW, 8 Apr. 1983, damaged seedling with roots of *R. mangle*, J. K. 4402.

Recently published new locations are in the Atlantic Ocean (Trinidad, St. John [U. S. Virgin Islands]: KOHLMAYER, 1980), and in the Pacific Ocean (Peru and Fiji: KOHLMAYER, 1980, 1983).

Leptosphaeria australiensis (CRIBB & CRIBB) HUGHES

Material: Belize: A, 8 Nov. 1982, wooden core of pneumatophore of *Avicennia germinans*, J. K. 4272; AA, 10 Nov. 1982, dead submerged root of *Conocarpus erecta* (incubated 4 mo), J. K. 4314; MW, 8 Apr. 1983, dead branches of *Rhizophora mangle*, and denuded stem of *Batis maritima*, J. K. 4407, 4408, 4411; SI, 29 Mar. 1983, dead branches and prop roots of *R. mangle*, J. K. 4336, 4341, 4343, 4348, 4350; SW, 30 Mar. and 6 Apr. 1983, damaged pneumatophores of *A. germinans*, J. K. 4344, 4378; TC, 3 and 7 Apr. 1983, dead branches and prop roots of *R. mangle*, dead stem of *B. maritima*, J. K. 4363–4366, 4371, 4375, 4387, 4390, 4391, 4397, 4399; TR, 8 Apr. 1983, prop root of *R. mangle* and pneumatophores of *A. germinans*, J. K. 4392, 4393; WW, 29 Mar. 1983, dead branch of *Laguncularia racemosa* and dead prop roots of *R. mangle*, J. K. 4329, 4340, 4351, 4354, 4355, 4357. Mexico: BB, 31 Mar. 1982, pneumatophores and submerged branch of *A. germinans*, J. K. 4183, 4184, 4194, 4195; EB, 27 Mar. 1982, root or branch of *A. germinans*, J. K. 4177; JAB, 28 Mar. 1982, prop roots of *R. mangle*, J. K. 4173, 4175, 4188; PC, 27 Jan. 1983, intertidal tree trunk, J. K. 4288; TC, 1 Feb. 1983, intertidal branch of *C. erecta* and subtidal wood, J. K. 4286, 4293, 4302. Australia: TNSW, 23 Aug. 1981, dead *Avicennia marina* var. *resinifera*, J. K. 4224, 4440; WQ, 15 Aug. 1981, prop roots of *Rhizophora stylosa* GRIFF. and pneumatophore of *A. marina*, J. K. 4211, 4222, 4247. Fiji: S, 20 Sept. 1981, submerged branch of *Rhizophora* sp., J. K. 4225; T, 19 Sept. 1981, dead roots of *Hibiscus* sp. (?) and *Cocos nucifera* L., J. K. 4207, 4208. U. S. A.: Hawaii, HBM, 9 Nov. 1983, intertidal wood (*H. tiliaceus* ?), J. K. 4482; WK, 2 Nov. 1983, intertidal wood, J. K. 4476.

New distribution records from the literature are all in the Atlantic Ocean: Brazil (BOOTH, 1979), Martinique (KOHLMAYER, 1981 a), Sierra Leone (ALEEM, 1980), and St. John, U. S. Virgin Islands (KOHLMAYER, 1980). The long list of my new collections further supports the view that *L. australiensis* is one of the most frequent marine fungi in mangrove habitats (KOHLMAYER, 1969 b). New hosts for *L. australiensis* are *Batis maritima*, *Cocos nucifera*, *Laguncularia racemosa* and *Rhizophora stylosa*.

Leptosphaeria avicenniae KOHLM. & KOHLM.

Material: **Belize**: CP, 8 Apr. 1983, in bark of pneumatophores of *Avicennia germinans*, J. K. 4394; SW, 6 Apr. 1983, same host, J. K. 4377; TC, 3 Apr. 1983, same host, J. K. 4380.

Ascocarps in collections J. K. 4377 and 4394 developed next to conidiomata of *Rhabdospora avicenniae*. This association was observed before (KOHLMAYER & KOHLMAYER, 1971) and the possibility discussed that *R. avicenniae* represents the anamorph of the Ascomycete. Culture experiments have to substantiate this assumption.

New records of *L. avicenniae* are all located in the Atlantic Ocean: Bahamas (Great Abaco: KOHLMAYER, 1980), Brazil (BOOTH, 1979), Martinique (KOHLMAYER, 1981 a), Sierra Leone (ALEEM, 1980). Although *Avicennia* species occur throughout the tropics, *L. avicenniae* has been collected exclusively in the Atlantic Ocean (see also KOHLMAYER & KOHLMAYER, 1979).

Lignincola laevis HÖHNK, Veröff. Inst. Meeresforsch. Bremerhaven 3:216, 1955

Material: **Belize**: AA, 10 Nov. 1982, dead intertidal branch of *Laguncularia racemosa*, J. K. 4266. **Australia**: TNSW, 23 Aug. 1981, damaged pneumatophore of *Avicennia marina* var. *resinifera*, J. K. 4440. **Thailand**: P, washed-up driftwood (incubated 5 mo), J. K. 4503; S, 15 Sept. 1983, dead branch and prop roots of *Rhizophora* sp. (?), J. K. 4459 (fruiting in culture; ATCC 56662), 4461, 4462; a dried pure culture of J. K. 4459 is deposited in the New York Botanical Garden (NY) and designated as **Neotype**, because no type material of HÖHNK's species is available. **U. S. A.**: Hawaii, HBM, 9 Nov. 1983, submerged dead branch of *Hibiscus tiliaceus*, J. K. 4478.

Other new distribution records of *L. laevis*, published after 1979 are from the Atlantic Ocean in Bermuda and Trinidad (KOHLMAYER, 1980), Brazil (BOOTH, 1983), Canada (Nova Scotia: BOLAND & GRUND, 1979), Denmark (KOCH & JONES, 1983), Martinique (KOHLMAYER, 1981 a), Sierra Leone (ALEEM, 1980), U. S. A. (Virginia: KIRK & BRANDT, 1980; KIRK & SCHATZ, 1980); from the Mediterranean in Italy (FURTADO & JONES, 1980); from the Pacific Ocean in Australia (Queensland, New South Wales: KOHLMAYER, 1983), Easter Island (KOHLMAYER, 1981 b), and Hong Kong (VRIJMOED *et al.*, 1982). All the new data confirm that *L. laevis* is a cosmopolitan fungus that occurs equally in temperate and tropical waters (KOHLMAYER, 1983). *Avicennia marina* var. *resinifera* and *Laguncularia racemosa* are new hosts of *L. laevis*.

Lignincola longirostris (CRIBB & CRIBB) KOHLM. comb. nov. (Fig. 10 a)

Basionym: *Gnomonia longirostris* CRIBB & CRIBB, Pap. Univ. Queensland, Dept. Bot., 3: 101, 1956.

Material: **Hawaii**: HBM, 9 Nov. 1983, submersed dead branches of *Hibiscus tiliaceus* in a lagoon (sal. 2.2–12.0‰) and intertidal branches (probably *H. tiliaceus*) along open shore (sal. 36.1‰), J. K. 4478, 4480, 4481, 4484.

Gnomonia is a genus of *Diaporthaceae*, characterized by refractive apical rings in the asci (MÜLLER & v. ARX, 1962, 1973). Examination of type material

of *G. longirostris* (KOHLMAYER & KOHLMAYER, 1979) and of the new Hawaiian collections showed that this species does not belong in *Gnomonia*, but rather in *Halosphaeriaceae*. The closest genus is *Lignicola* and a transfer is proposed herewith. Immature ascocarps in the new material contain a thin-walled pseudoparenchyma which develops into deliquescing catenophyses. The asci are thin-walled with a refractive apex and an inconspicuous pore (Fig. 10 a).

A recent collection of *L. longirostris* was made by KOEHN & GARRISON (1981) on leaves of *Avicennia germinans* in Texas. *Hibiscus tiliaceus* is also a new host.

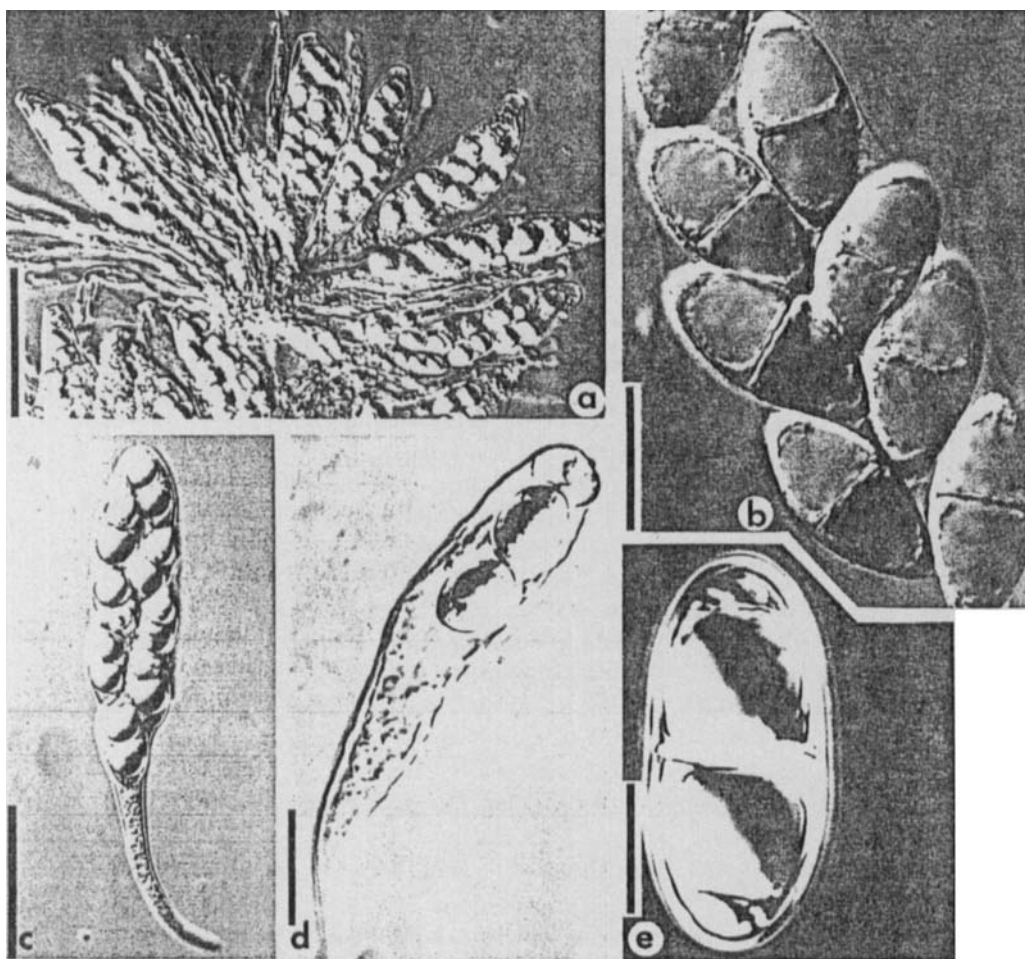


Fig. 10. a. *Lignicola longirostris*, asci, bar = 50 μ m; b-e. *L. tropica* sp. nov.; b. ascospores, bar = 20 μ m; c. mature ascus, bar = 50 μ m; d. ascus tip showing apical pore, bar = 20 μ m; e. ascospore, bar = 10 μ m. (Nomarski interference contrast; a from J. K. 4480; b and c from J. K. 4431; d from J. K. 4338; e from J. K. 4288.)

Lignicola tropica KOHLM. sp. nov. (Figs. 10 b–e, 11 a–d)

Ascocarpiis 325–375 μm altis, 250–350 μm diametro, subglobosis ad ellipsoideis, immersis vel fere superficialibus, ostiolatis, papillatis, coriaceis, dilute ad atro-brunneis, solitariis vel gregariis; **peridiis** 30–40 μm crassis, tristratis; strato externo 2–4 μm crasso, atro-brunneo, hyphis ad substratus affixis; strato medio 15–20 μm crasso, dilute brunneo, cellulis luminibus parvis, texturam epidermoideam formantibus; strato interno 15–20 μm crasso, hyalino, cellulis luminibus majoribus, texturam angularem formantibus, in pseudoparenchyma venteris transienti; **papillis** vel collis 175–400 \times 80–150 μm , cylindricis, saepe irregularibus, curvatis vel inflatis, periphysatis; **pseudoparenchymate** cellulis leptodermis, ventera ascocarpiorum juvenium complentibus, denique secedentibus et catenophyses formantibus; **ascis** 130–200 \times 24–34 μm , octosporis, clavatis, pedunculatis, unitunicatis, leptodermis, aphysoclasticis, truncatis, refractivis pertusisque ad apicem, semi-persistentibus, in parte inferiore loculi insertis; **ascosporis** 22–36 \times 12–16 μm , ellipsoideis, uniseptatis (rariter eseptatis), leviter vel non constrictis, hyalinis, inornatis. **Substratum:** lignum putridum submarinum. **Distributio:** Oceanus Atlanticus (Belize; Mexico: Quintana Roo).

Holotypus: J. K. 4431 a; *Isotypus:* J. K. 4431 b.

Ascocarps 325–375 μm high, 250–350 μm in diameter, subglobose to ellipsoidal, immersed or almost superficial, ostiolate, papillate, coriaceous, light to dark brown, solitary or gregarious (Fig. 11 a, c). **Peridium** 30–40 μm thick, three-layered; outer layer 2–4 μm thick, dark brown with hyphae attached to the substrate; middle layer 15–20 μm thick, light brown, composed of irregularly interwoven cells with small lumina, forming a *textura epidermoidea*; inner layer 15–20 μm thick, hyaline, composed of cells with large lumina, forming a *textura angularis*, merging into the pseudoparenchyma of the centrum. **Papillae** or necks 175–400 \times 80–150 μm , cylindrical, or often irregularly shaped, curved or inflated; ostiolar canal periphysate (Fig. 11 b). **Pseudoparenchyma** of thin-walled cells filling centrum of young ascocarps (Fig. 11 c); eventually breaking up into catenophyses. **Asci** 130–200 \times 24–34 μm , eight-spored, clavate, pedunculate, truncate above, unitunicate, thin-walled, aphysoclastic, refractive at the apex and with a pore, semi-persistent, developing at the base of the ascocarpial centrum (Fig. 10 c, d, 11 c, d). **Ascospores** 22–36 \times 12–16 μm , ellipsoidal, one-septate (rarely non-septate), slightly or not constricted at the septum, hyaline, without appendages (Fig. 10 b, e). **Mode of life:** Saprobic. **Substrate:** Subtidal wood. **Range:** Atlantic Ocean (Mexico: Quintana Roo; Belize). **Material examined:** Submerged wood in shallow water of open shore, Punta Tormentos, west coast of Cozumel, Quintana Roo, Mexico, 20°25'45"N, 87°01'W, incubated from 1 Feb. until 29 June 1983, J. K. 4431 a (**Holotype**, NY), 4431 b (**Isotype**, IMS); submerged branch with attached leaf of *Thalassia testudinum*, same location in a land-locked lagoon, sal. 2.2‰, J. K. 4305; dead, submerged tree trunk under mangroves, harbor near hotel "El Presidente", south of San Miguel de Cozumel, island of Cozumel, Quintana Roo, Mexico, 20°27'N, 87°W, 27 Jan. 1983, sal. 31.2‰, temp. 31°C, J. K. 4288; subtidal wood with shipworms and *Limnoria* under *Rhizophora mangle*, Stewart Island, Belize, 16°46'N, 88°10'W, 29 Mar. 1983, J. K. 4337 (incubated until 4 May 1983), J. K. 4338. **Etymology:**

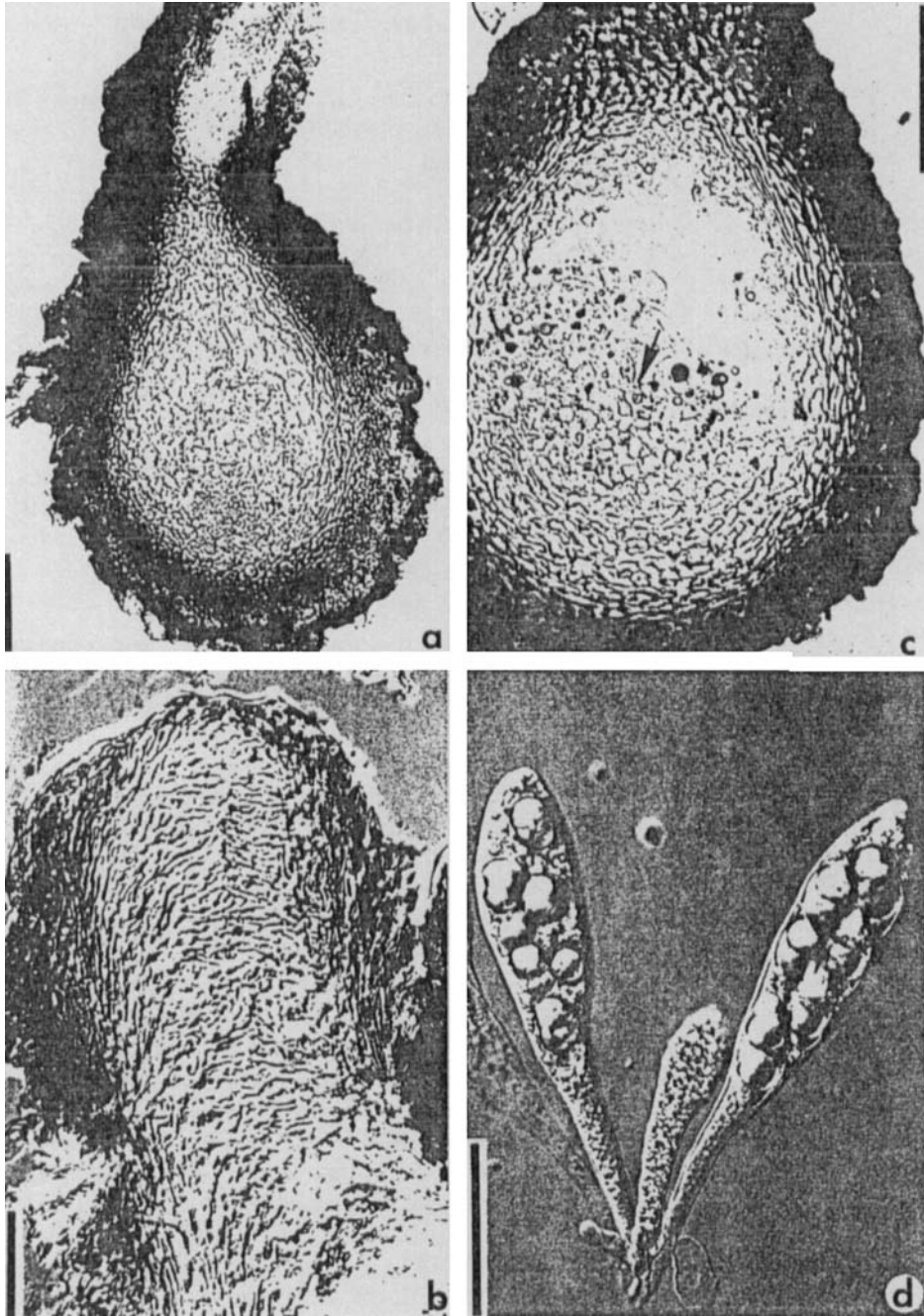


Fig. 11. *Lignicola tropica* sp. nov., from J. K. 4431. a. Ascocarp, longitudinal section (l. s. $14\ \mu\text{m}$), bar = $50\ \mu\text{m}$; b. neck (l. s. $8\ \mu\text{m}$), canal filled with periphyses, bar = $25\ \mu\text{m}$; c. immature ascocarp (l. s. $8\ \mu\text{m}$), with ascogenous tissue (arrow), bar = $50\ \mu\text{m}$; d. immature asci, bar = $50\ \mu\text{m}$. (a and c in brightfield, b and d Nomarski interference contrast.)

From the Latin *tropicus* = tropical, in reference to the occurrence in tropical waters, in contrast to the temperate species *L. laevis*.

Lignincola tropica occurs on the same substrate together with several mostly tropical marine fungi, e. g., *Halosphaeria quadricornuta*, *H. salina*, *Humicola alopallonella*, *Leptosphaeria australiensis*, and *Periconia prolifica*.

Lignincola tropica is assigned to *Halosphaeriaceae* and *Lignincola* with reservation. The pseudoparenchymatous centrum and thin-walled asci are characters of *Halosphaeriaceae*, however the typical members of this family have early dissolving asci, whereas asci in *L. tropica* are semi-persistent and have a refractive apex with a pore. The ascospore release has not been observed. The new species appears to be intermediate between the monotypic genera *Nais* and *Lignincola*, both with catenophyses and ascospores lacking appendages. Whereas asci in *Nais* are early deliquescent, they are semi-persistent in *Lignincola*, where they become detached at the base and are released into the water while still enclosing the ascospores. *Lignincola longirostris* is another species closely related to *L. tropica*, however with smaller asci (50–80 × 17–21 µm) and ascospores (13–19.5 × 4–7.5 µm).

Lindra WILSON

Representatives of the genus *Lindra* are frequently encountered during investigations on tropical marine fungi. Ascospores are regularly found in sea foam, and ascocarps develop on incubated detritus from the shore, especially on leaves of sea grasses. In addition to *L. marinera* and *L. thalassiae* a closely related fungus occurred in collections from Belize and Mexico. This fungus is described below as *L. thalassiae* var. *crassa* and compared in Table 1 with similar taxa. Ascospore dimensions are at present the main characters used to distinguish the different species and varieties of *Lindra*. An anamorph (*Anguillospora marina* NAKAGIRI & TUBAKI) is known only for *L. obtusa* (NAKAGIRI & TUBAKI, 1983). Because of overlap in spore lengths between *L. thalassiae* and *L. marinera* (Table 1), it is sometimes impossible to assign collections to either species with certainty. Unless other distinguishing characters will be found, it may be

Table 1. Comparison of *Lindra* species.

Taxa	Ascospore			Source of Data
	Dimensions (in µm)	Approximate Mean of Length	Septa	
<i>L. thalassiae</i> var. <i>thalassiae</i>	215–310(–345) × 4–8	270	14–26	J. K. 4132, 4281, 4282, 4317, 4322, 4327, 4426, 4427, 4430
<i>L. thalassiae</i> var. <i>crassa</i>	320–520 × 8–10	410	15–23	J. K. 4287, 4321, 4424, 4428
<i>L. marinera</i>	180–250(–270) × 4–6.5	210	12–18	J. K. 2683, 3751, 3821, 3822, 4291, 4308, 4325
<i>L. obtusa</i>	182.5–250(–313) × 2.3–3.2(–3.8)	?	9–16(–21)	NAKAGIRI & TUBAKI, 1983
<i>L. inflata</i>	212–411 × 4–6	290	30–50	WILSON, 1956

preferable to consider *L. marinera* a variety of *L. thalassiae*, but no change is proposed at this time.

Lindra marinera MEYERS

Material: **Belize:** AA, 10 Nov. 1982, ascospores in foam (sal. 36.6‰, 31°C), J. K. 4291; D, 27 Mar. 1983, ascospores in foam (sal. 31.7‰, 30°C) and washed-up leaves of *Thalassia testudinum* (incubated 11 mo), J. K. 4325, 4497. **Bermuda:** Whalebone Bay, St. George's Island, 19 May 1976, ascospores in foam, J. K. 3751 (in the same collection also *Lindra thalassiae*; KOHLMAYER & KOHLMAYER, 1977). **Palau Islands:** P, 4 Mar. 1983, leaf of *Thalassia testudinum* (?), J. K. 4308 (also fruiting pure culture).

Ascospores from the natural habitat measure 185–235 × 4–6 μm, in culture on glucose-yeast extract-seawater agar 210–250 (–270) × 5–6.5 μm.

New records of *L. marinera* are from the Bahamas (Great Abaco), Tobago, and St. John in the U. S. Virgin Islands (KOHLMAYER, 1980).

Lindra thalassiae ORPURT et al.

Material: **Belize:** AA, 10 Nov. 1982, washed-up leaves of *Thalassia testudinum* (incubated 4 mo), J. K. 4317, 4322 (fruiting culture ATCC 56664); 12 Nov. 1982, ascospores in foam (sal. 38.3‰, 30°C), J. K. 4282; CB, 2 Apr. 1983, in shells of Foraminifera, and other calcareous substrates attached to *T. testudinum* leaves buried 25 cm deep in the intertidal zone (incubated 11 mo), J. K. 4499; same location, 28 Apr. 1983, dead tips of attached leaves of *T. testudinum*, damaged during exposure at low tides, J. K. 4327 (also fruiting pure culture); MA, 11 and 12 Nov. 1982, ascospores in foam (sal. 36.1‰, 30 and 26°C), J. K. 4281, 4283. **Mexico:** CB, 29 Mar. 1982, ascospores in foam (sal. 34.5‰, 24°C), J. K. 4159; LC, 1 Feb. 1983, ascocarps in empty bryozoan skeletons on washed-up *Sargassum* sp. (incubated 4.5 mo), J. K. 4427; SC, 28 Jan. 1983, ascocarp inside fragment of a calcareous alga (?), attached to washed-up algae and seagrass leaves (incubated 5 mo), J. K. 4426; TC, 1 Feb. 1983, subtidal loose leaves of *T. testudinum* (incubated 5 mo), J. K. 4430. **Fiji:** M, 16 Sept. 1981, ascospores in foam (sal. 35.5‰, 25°C), J. K. 4132.

Because ascospore characters are the main features to distinguish species and varieties of *Lindra*, ascospore sizes of ascocarps developed on the natural substrate were compared with those grown in pure cultures on agar. Combined dimensions from collections J. K. 4317, 4322 and 4327 are 214–310 × 6–8 μm in ascospores from the original material, in contrast to 220–300 × (4.5–) 6–7 μm in spores from culture. This comparison indicates that ascospore size is a reliable character that remains constant also when *L. thalassiae* is grown in artificial culture.

New locations of *L. thalassiae* in addition to the data listed above, are Great Abaco (Bahamas) and Martinique (KOHLMAYER, 1980, 1981 a). A report of the species (spores in foam) from the Sea of Japan (U. S. S. R.: KRYLOVA, 1980) is doubtful because the location is temperate, whereas *L. thalassiae* is restricted to tropical and subtropical waters.

Lindra thalassiae ORPURT, MEYERS, BORAL & SIMMS var. *crassa*
KOHLM. var. nov. (Fig. 12 a–f)

Proprietatibus ascocarporum et ascorum ut in L. thalassiae var. thalassiae; ascosporis 320–(410)–520 × 8–10 μm, filiformibus, apicaliter attenuatis ad 2.5–3 μm, incurvatis, 15–23-septatis, non vel vix constrictis ad septa, hyalinis.

Substrata: *Sargassum* sp. et conchae foraminiferae. **Distributio:** Oceanus Atlanticus (Belize; Mexico: Quintana Roo).

Holotypus: J. K. 4321 a; **Isotypus:** J. K. 4321 b.

Features of ascocarps (Fig. 12 a, b) and asci as in *L. thalassiae* var. *thalassiae*. **Ascospores** 320-(410)-520 × 8–10 μm, filiform, tapering towards both apices,

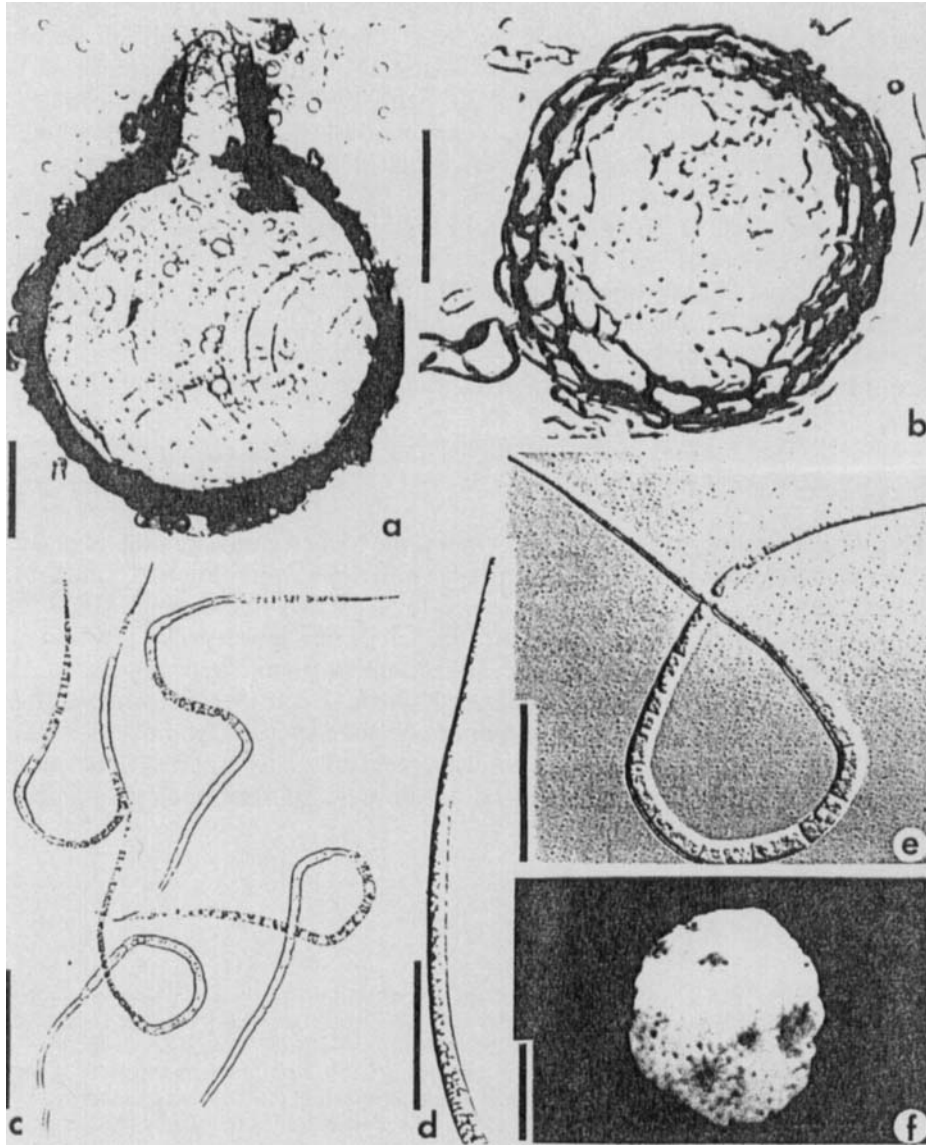


Fig. 12. *Lindra thalassiae* var. *crassa* var. nov. a. Ascocarp, longitudinal section (l. s. 6 μm), bar = 25 μm; b. immature ascocarp (l. s. 8 μm) from pure culture, pseudoparenchyma in the centrum, bar = 20 μm; c. ascospores, bar = 100 μm; d. tip of ascospore, bar = 50 μm; e. ascospore, bar = 50 μm; f. ascocarps appearing as dark shadows in a foraminiferan shell, bar = 500 μm. (d and e in Nomarski interference contrast, the others in brightfield; e from J. K. 4424; f from J. K. 4428; the others from J. K. 4321.)

2.5–3 µm in diameter at the apex, curved, 15–23-septate, not or barely constricted at the septa, hyaline (Fig. 12 c–e). **Mode of life:** Saprobic. **Substrates:** Air vesicles and leaves of *Sargassum* sp. and shells of foraminifera (Fig. 12 f). **Range:** Atlantic Ocean (Belize; Mexico: Quintana Roo). **Material examined:** In vesicles and leaves of washed-up *Sargassum* from the highwater mark, north of Punta Azul, Ambergris Cay, Belize, 18°05'N, 87°52'W, incubated from 12 Nov. 1982 until 18 Mar. 1983, J. K. 4321 a (**Holotype**, NY), 4321 b (**Isotype**, IMS), also pure culture, ATCC 56663; on shell fragments on washed-up detritus (*Thalassia* leaves, algae, etc.), Man-of-War Cay, Belize, 16°53'N, 88°06'15"W, incubated from 8 Apr. 1983 until 20 Feb. 1984, J. K. 4502; in shells of foraminifera and zooecia of bryzoa, and/or mollusk shell fragments attached to washed-up algae and seagrass leaves, beach at Castillo Real, east coast of Cozumel, Quintana Roo, Mexico, 20°31'N, 86°47'W, incubated from 1 Feb. until 28 June 1983, J. K. 4428; spores in foam, same location as No. 4428, sal. 38.3‰, 27 °C, 1 Feb. 1983, J. K. 4287; in shell fragments attached to washed-up algae, beach at Punta Morena, east coast of Cozumel, Quintana Roo, Mexico, 20°27'N, 86°51'W, incubated from 28 Jan. until 21 June 1983, J. K. 4424. **Etymology:** From the Latin *crassus* = thick, in reference to the ascospores that are thicker and longer than those of *L. thalassiae* var. *thalassiae*.

Lulworthia SUTHERLAND

This difficult genus, found frequently in marine and estuarine habitats is in need of a revision (KOHLMAYER & KOHLMAYER, 1979). The delimitation of *Lulworthia* into *L. kniepii*, *L. lindroidea*, *L. medusa* (ELL. & EVERH.) CRIBB & CRIBB and three varieties of *L. medusa* (BOOTH, 1983) does not appear to be justified nor practical, because, in my experience, collections with spore lengths between 110 and 500 µm cannot be readily separated. Also, I consider *L. fucicola* (type species of the genus) and *L. grandispora* to be good species. At the present time I recognize and include in the following key only such species that can be distinctly identified by characters of ascospores, substrates or geographical distribution.

Lulworthia grandispora MEYERS

Material: **Belize:** A, 8 Nov. 1982, ascocarps superficial or partly embedded in bark of pneumatophore of *Avicennia germinans*, J. K. 4272; TR, 8 Apr. 1983, damaged roots and pneumatophores of *A. germinans*, J. K. 4393. **Mexico:** JAB, 28 Mar. 1982, prop roots of *Rhizophora mangle*, J. K. 4173, 4190. **Fiji:** M, 17 Sept. 1981, in bark of washed-up seedling of *R. mangle*, J. K. 4220; T, 19 Sept. 1981, in bark of damaged prop root of *Bruguiera gymnorrhiza*, J. K. 4230. **U. S. A.:** Hawaii, HBM, 9 Nov. 1983, ascocarps half immersed in submerged dead branch of *Hibiscus tiliaceus*, J. K. 4478.

Ascospore dimensions in the new material measure 500–720 × 4–6 µm, falling well within the range of earlier collections (KOHLMAYER & KOHLMAYER, 1979). Other new locations of *L. grandispora* are in the Atlantic Ocean: Ghana (FURTADO & JONES, 1980), Trinidad (KOHLMAYER, 1980), U. S. A. (Virginia:

KIRK & BRANDT, 1980) and Pacific Ocean: Peru (KOHLMAYER, 1980). All collections have been made in tropical and subtropical regions, therefore, a record of *L. grandispora* in the Mediterranean (Italy: FURTADO & JONES, 1980) appears doubtful. *Avicennia germinans*, *Bruguiera gymnorrhiza* and *Hibiscus tiliaceus* are new hosts.

BOOTH (1983) considers *L. grandispora* to be synonymous with *L. medusa* var. *apiculata* (JOHNSON) BOOTH, a position that I cannot share. Ascospores in BOOTH's (1983) collections of *L. m.* var. *apiculata* are 300–(505–750)–875 µm long, therefore, it is possible that two different taxa are involved. I include in *L. grandispora* only collections with spores longer than 500 µm.

Lulworthia kniepii KOHLM.

Material: **Mexico:** BCB, 1 Apr. 1982, in crustose coralline alga (*Lithophyllum* sp. ?), J. K. 4167; EB, 27 Mar. 1982, empty ascocarps in crustose coralline alga, J. K. 4166 (positive identification impossible because of senescent material).

Ascocarps in J. K. 4167 are well preserved and the ascospore dimensions fall within the range of earlier collections: 210–220 × 4 µm, apical chambers 6 × 2.5 µm.

Lulworthia kniepii KOHLM. var. *curalii* KOHLM. var. nov. (Fig. 13 a–c)

Proprietatibus ascocarporum et ascorum ut in L. kniepii var. *kniepii*; **ascosporis** 120–180 × 4–5 (–6) µm (*cameras apicales includentes*), *filiformibus, rectis, rariter leviter curvatis, hyalinis, ad extrema utrinque camera conica, 6–8 µm longa, 2.5–3 µm diametro, ad apicem acuta, mucum includentum*. **Hospes:** *Paragoniolithon solubile* (FOSLIE & HOWE) SETCHELL & MASON. **Distributio:** *Oceanus Atlanticus* (Belize). *Holotypus:* J. K. 4379.

Features of ascocarps and asci (Fig. 13 a) as in *L. kniepii* var. *kniepii*. **Ascospores** 120–180 × 4–5 (–6) µm (including apical chambers), filamentous, straight, rarely somewhat curved, hyaline, tapering at each end into an elongate, conical process or apical chamber (Fig. 13 b); processes 6–8 µm long, 2.5–3 µm diameter at the base, acute, filled with mucus that is released through an apical pore. **Mode of life:** Parasitic. **Host:** *Paragoniolithon solubile* (identified by Dr. R. S. STENECK). **Range:** Atlantic Ocean (Belize). **Material examined:** Crustose red alga (*P. solubile*) covering submerged corals, Curlew Cay, Belize, 16°47'N, 88°05'W, 6 Apr. 1983, J. K. 4379 (**Holotype**, IMS). **Etymology:** From the Latin *curalium* = coral, in reference to the habitat, viz. coral reefs.

The new variety differs from *L. kniepii* var. *kniepii* by the shorter ascospores. The key for the identification of *Lulworthia* taxa (p. 363) may serve to separate the variety *curalii* from other species of the genus. The large ascocarps of *L. k.* var. *curalii* are deeply embedded in the host (Fig. 13 c) and are visible from the outside only as dark zones within greenish, senescent areas of the alga. Decalcification of infected host tissues in 5% HCl for 12 h permits isolation of ascocarps that remain unaffected by this treatment.

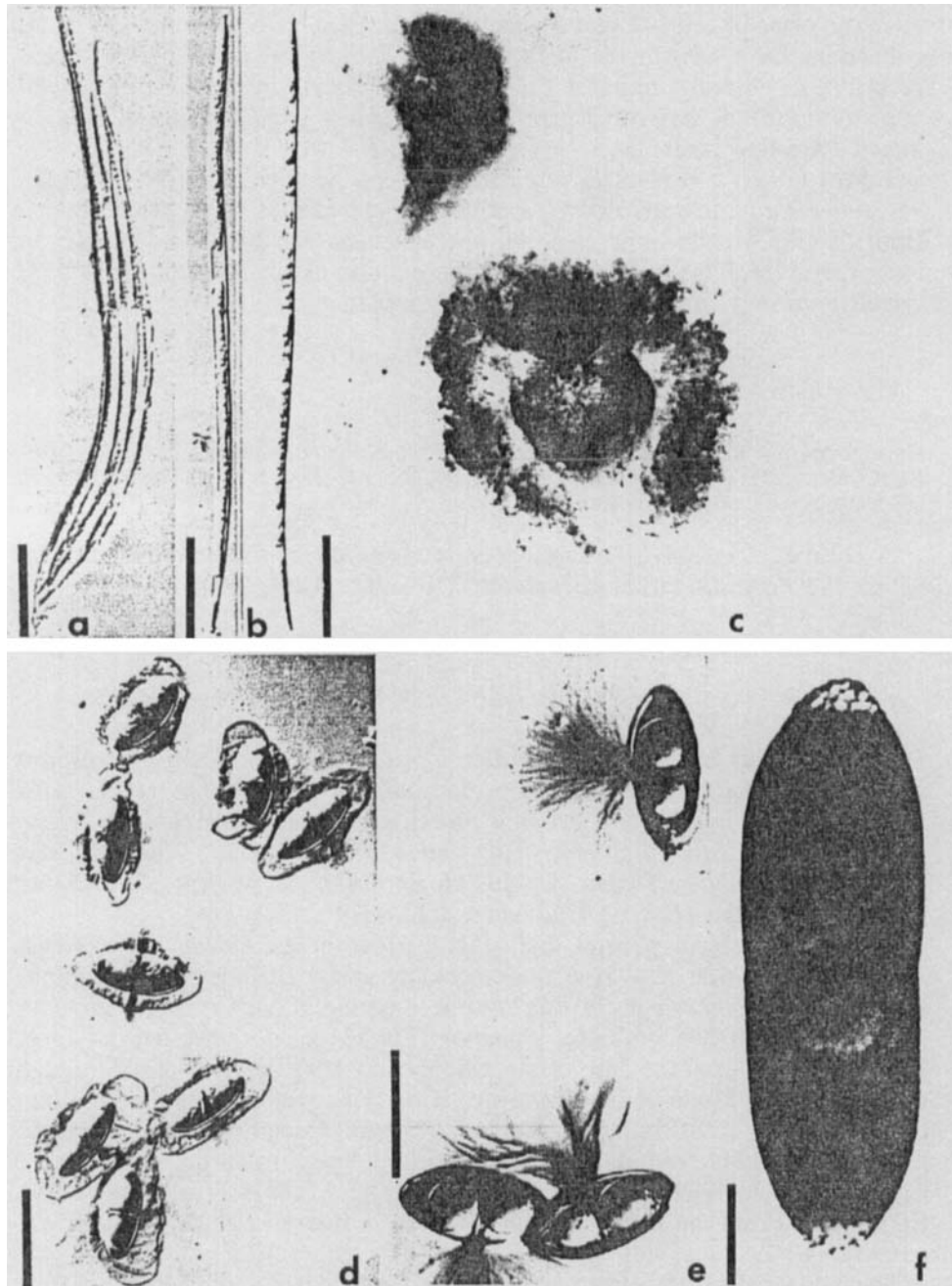


Fig. 13. a–c. *Lulworthia kniepii* var. *curalii* var. nov. a. Ascus, bar = 25 μ m; b. ascospores, bar = 25 μ m; c. hole in *Paragoniolithon solubile*, left by ascocarp, surrounded by dark hyphae, bar = 750 μ m; d and e. *Nimbo- spora effusa*, ascospores, bar in d = 25 μ m, in e = 20 μ m; f. *Savoryella paucispora*, ascospore, apical cells verruculose, bar = 10 μ m. (c close-up photograph, the others Nomarski interference contrast; a–c from J. K. 4379; d from J. K. 2575; e from J. K. 4483; f from J. K. 4478.)

Lulworthia sp.

Material: **Belize:** AA, 10 and 12 Nov. 1982, dead intertidal branches of *Conocarpus erecta* and *Laguncularia racemosa*, attached leaves of *Thalassia testudinum* (incubated 4 mo), J. K. 4259, 4266, 4312; MW, 8 Apr. 1983, dead branches and prop roots of *Rhizophora mangle*, damaged pneumatophores of *Avicennia germinans* and *L. racemosa*, J. K. 4404, 4408–4410; SW, 30 Mar. and 6 Apr. 1983, pneumatophores of *A. germinans*, J. K. 4344, 4378; TC, 3 Apr. 1983, dead prop root of *R. mangle*, J. K. 4376; TR, 8 Apr. 1983, damaged pneumatophores of *A. germinans*, J. K. 4393; WW, 29 Mar. 1983, intertidal branch and peg roots of *L. racemosa*, J. K. 4330, 4331. **Mexico:** BB, 31 Mar. 1982, washed-up pneumatophore of *A. germinans*, J. K. 4174; JB, 4 Apr. 1982, subtidal wood (2.5 m deep), J. K. 4161; PC, 27 Jan. 1983, intertidal branch, J. K. 4298. **Australia:** HQ, 17 Aug. 1981, subtidal wood, J. K. 4210. **Fiji:** M, 17 Sept. 1981, subtidal wood and washed-up seedling of *R. mangle*, J. K. 4206, 4220; S, 20 Sept. 1981, dead young plant and washed-up seedling of *R. mangle*, J. K. 4216, 4219. **Thailand:** S, 15 Sept. 1983, twigs and dead prop root under mangroves, J. K. 4454, 4461.

Ascospores in these collections range from 200 to 500 μm , therefore, they belong to species that cannot be identified at this time (KOHLMAYER & KOHLMAYER, 1979). New collections of unidentified *Lulworthia* spp. in tropical waters are in the Atlantic Ocean: Martinique (KOHLMAYER, 1981 a), Tobago, Trinidad and St. John, U. S. Virgin Islands (KOHLMAYER, 1980), in the Indian Ocean: Sri Lanka (KOCH, 1982), and in the Pacific Ocean: Easter Island (KOHLMAYER, 1981 b) and Hong Kong (VRIJMOED *et al.*, 1982).

Key to the species of *Lulworthia*

1. Ascospores without apical mucus-filled chambers, septate . . . *Lindra* spp.
(see Table 1)
- 1'. Ascospores with such apical chambers, septate or non-septate 2
2. Ascospores septate 3
- 2'. Ascospores non-septate 4
3. Ascospores longer than 400 μm . . . *Lu. lignoarenaria* KOCH & JONES (1984)
- 3'. Ascospores shorter than 250 μm *Lu. lindroidea* KOHLM.
4. Ascospores 500 μm or longer; species on mangroves and wood in tropics and subtropics *Lu. grandispora* MEYERS
- 4'. Ascospores shorter; tropical or temperate species 5
5. Ascospore length usually 110 μm or less, a temperate species . . . *Lu. fucicola*
SUTHERLAND
- 5'. Ascospores longer than 110 μm 6
6. Parasitic in calcified Rhodophyta 7
- 6'. Saprobic in other substrates *Lulworthia* sp.
7. Ascospores 200 μm or longer *Lu. kniepii* KOHLM.
- 7'. Ascospores 180 μm or shorter *Lu. k.* var. *curalii* KOHLM.

Mycosphaerella pneumatophorae KOHLM.

Material (all in pneumatophores of *Avicennia germinans*, on 8 Apr. 1983): **Belize:** CP, J. K. 4394; MW, J. K. 4410; TR, J. K. 4393.

This host-specific fungus is infrequently collected, appears to be restricted to the Atlantic Ocean, and was reported after 1979 only by KOHLMAYER (1980) from St. John (U. S. Virgin Islands).

Mycosphaerella salicorniae (AUERSW.) PETRAK

Material (all in *Salicornia* sp.): **Belize**: MA, 11 Nov. 1982, J. K. 4280. **Mexico**: JAB, 28 Mar. 1982, J. K. 4200.

The host of both collections was growing under, or next to, *Avicennia germinans*. *Mycosphaerella salicorniae*, a cosmopolitan species (KOHLMAYER & KOHLMAYER, 1979), has been reported recently only from the Bahamas (Great Abaco) and the Yucatan province of Mexico (KOHLMAYER, 1980).

Nimbospora effusa KOCH (Fig. 13 d, e)

Material: **U. S. A.**: Hawaii, H, 25 June 1968, driftwood, J. K. 2575; HBM, 9 Nov. 1983, intertidal wood (*Hibiscus tiliaceus* ?), J. K. 4483.

This species was recently described by KOCH (1982) from Sri Lanka and is known so far only from the Indian and Pacific Ocean. The ascospore appendages are most striking and consist of an excentric gelatinous sheath enclosing a bunch of lateral strands (Fig. 13 d, e). The Hawaiian ascospores measure 19–24 × 9–10.5 μm, therefore agreeing with the type description. The sheath dissolves when spores are treated with methylene blue, while the lateral strands and the spore itself turn blue. Violamin and DELAFIELD's hematoxylin stain the sheath violet and the strands a darker color.

Savoryella paucispora (CRIBB & CRIBB) KOCH (Fig. 13 f)

Material: **U. S. A.**: Hawaii, HBM, 9 Nov. 1983, submerged dead branch of *Hibiscus tiliaceus*, J. K. 4478.

This species, originally described as a *Leptosphaeria* by CRIBB & CRIBB (1960) from Australia (Queensland), was recently discovered in the Indian Ocean (Sri Lanka) by KOCH (1982) and reported from Hong Kong by VRIJMOED *et al.* (1982). Ascospore sizes differ somewhat but overlap in the different collections (CRIBB & CRIBB: 36–50 × 13–16.5 μm; KOCH: 44–60 × 12–16 μm; KOHLMAYER: 46–67 × 17–20 μm). The apical cells are inconspicuously verruculose (Fig. 13 f) in the Hawaiian material, a feature not reported from the other collections. *Hibiscus tiliaceus* is a new host.

Torpedospora radiata MEYERS (Fig. 14)

Material: **Belize**: AA, 10 Nov. 1982, intertidal branch and dead eroding runners of *Canavalia rosea* (incubated 4 mo), J. K. 4256 (fruiting culture ATCC 56665), 4315; MA, 11 Nov. 1982, ascospores in scum (sal. 36.1‰, 30 °C), J. K. 4283; RA, 12 Nov. 1982, dead runners of *C. rosea* among pneumatophores of *Avicennia germinans* (incubated 4 mo), J. K. 4313; SW, 6 Apr. 1983, wooden core of pneumatophore of *A. germinans*, J. K. 4378; TC, 3 Apr. 1983, subtidal wood, J. K. 4361. **Mexico**: CC, intertidal wood in tidal pool, J. K. 4301; X, 29 Jan. 1983, intertidal wood, J. K. 4295. **Hawaii**: HBM, 9 Nov. 1983, submerged dead branch of *Hibiscus tiliaceus* and intertidal wood (*H. tiliaceus* ?), J. K. 4478, 4481; WK, 2 Nov. 1983, intertidal wood, J. K. 4474, 4475; WM, 6 Nov. 1983, intertidal branch, J. K. 4477.

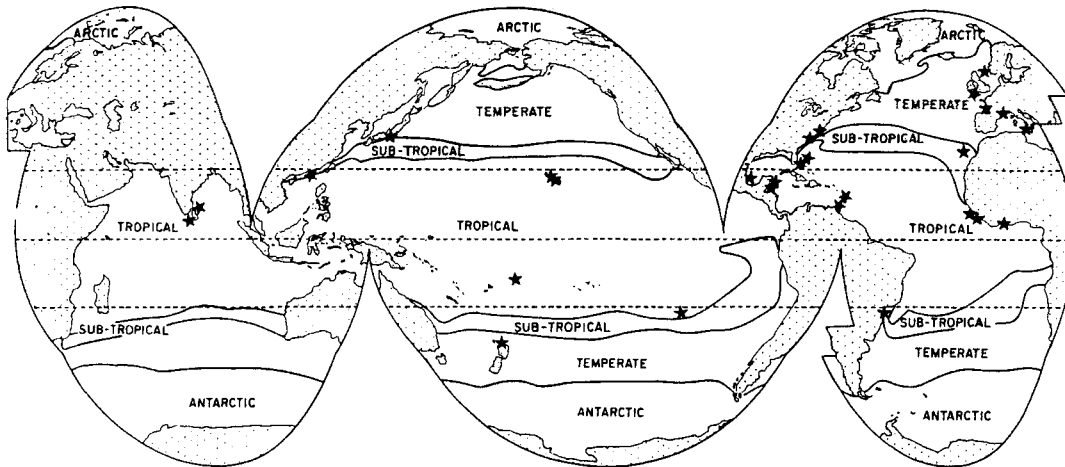


Fig. 14. Geographic distribution of the cosmopolitan Ascomycete *Torpedospora radiata*. (World map redrawn after HUGHES, 1974; with permission of the author and publisher.)

New locations of *T. radiata* are in the Atlantic Ocean: Bahamas, Martinique, St. John (U. S. Virgin Islands), and Tobago (KOHLMAYER, 1980, 1981 a), Brazil (BOOTH, 1979, 1983), Sierra Leone (ALEEM, 1980), and U. S. A. (Virginia: KIRK & BRANDT, 1980), in the Indian Ocean: Sri Lanka (KOCH, 1982), and in the Pacific Ocean: Easter Island (KOHLMAYER, 1981 b) and Hong Kong (VRIJMOED *et al.*, 1982). Although *T. radiata* is occasionally found in temperate waters, *e. g.* New Zealand (North Island) and Norway (JONES *et al.*, 1972), the major distribution appears to be in subtropical and tropical regions (Fig. 14). *Canavalia rosea* and *Hibiscus tiliaceus* are new hosts.

Trematosphaeria lignatilis KOHLM. sp. nov. (Figs. 15 a–d, 16 a–g)

Ascocarpiis 340–670 μm altis, 350–600 μm diametro, obpyriformibus, aliquantum lateraliter compressis, omnino immersis, ostiolatis, papillatis, carbonaceis ad coriaceis, nigris, gregariis; **peridiis** 40–50 μm crassis, bistratis; strato externo 20–30 μm crasso, cellulis irregulariter hyphoideis, particulis putridis ligni vel corticis mixtis; strato interno 16–20 μm crasso, cellulis applanatis, texturam angularem formantibus, guttulis olei in luminibus, pigmento atro in parietibus cellularum; **rostris** 250–460 μm longis, 160–280 μm diametro, irregulariter cylindricis; canale ostioli 90 μm diametro, reticulo hypharum subtilium hyalinarumque, hyphis in matrice gelatinosa inclusis; pariete canalis materia nigra incrustato; **pseudoparaphysibus** 1.5–3.5 μm diametro, plus minusve parallelis eramosisque inter ascos, trabeculatis (ramosis anastomosantibusque) supra ascos et in filamentibus periphysoideis ostioli transientibus, in matrice gelatinosa inclusis; **ascis** 230–290 \times 28–37 μm , octosporis, cylindricis, pedunculatis, pachydermaticis, fissitunicatis, disco apicale inconspicuo, saepe excentrico, textura ascogena basale exorientibus; **ascosporis** 51–80 \times 14–20 (–22) μm biseriatis, fusiformibus, quin-

queseptatis, ad septum medium leviter constrictis, hyalinis rariter dilute luteis, laevibus, multiguttulatis. Substratum: lignum et cortex immersum Lagunculariae racemosae et Rhizophorae mangle. Distributio: Oceanus Atlanticus (Belize).

Holotypus: J. K. 4365 a; Isotypus: J. K. 4365 b.

Ascocarps 340–670 μm high, 350–600 μm in diameter, obpyriform, somewhat compressed laterally, completely immersed, ostiolate, papillate, carbonaceous to coriaceous, black, gregarious (Fig. 15 a). **Peridium** 40–50 μm thick, two-layered; outer stratum 20–30 μm thick, composed of irregular hyphoid cells mixed with decomposing wood or bark particles; inner stratum 16–20 μm thick, composed of flattened cells, forming a *textura angularis*, with oil droplets in the

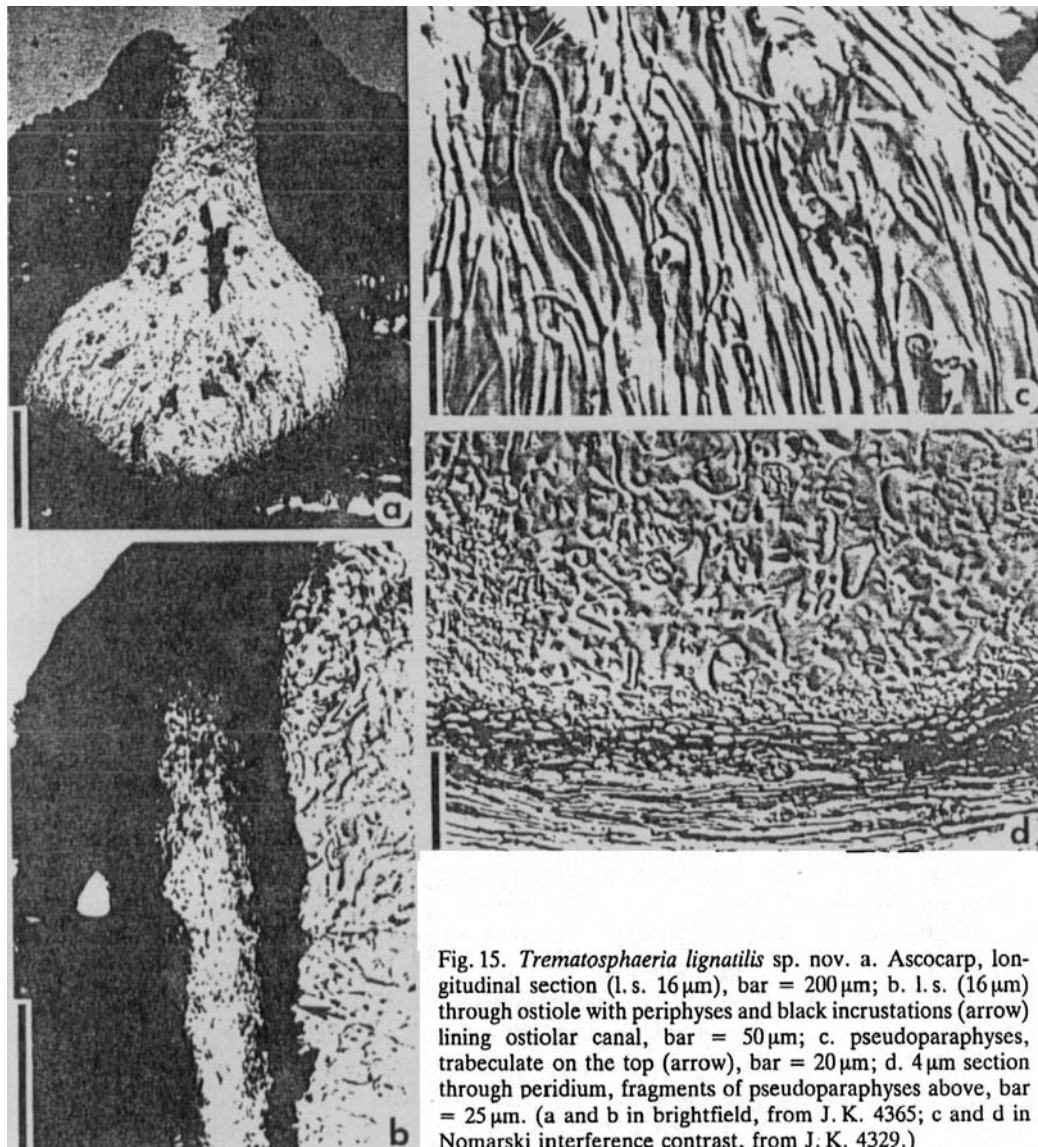


Fig. 15. *Trematosphaeria lignatilis* sp. nov. a. Ascocarp, longitudinal section (l. s. 16 μm), bar = 200 μm ; b. l. s. (16 μm) through ostiole with periphyses and black incrustations (arrow) lining ostiolar canal, bar = 50 μm ; c. pseudoparaphyses, trabeculate on the top (arrow), bar = 20 μm ; d. 4 μm section through peridium, fragments of pseudoparaphyses above, bar = 25 μm . (a and b in brightfield, from J. K. 4365; c and d in Nomarski interference contrast, from J. K. 4329.)

lumina and black pigment deposits in the cell walls (Fig. 15 d). **Neck** 250–460 μm long, 160–280 μm in diameter, irregularly cylindrical; ostiolar canal 90 μm in diameter, filled with a network of thin, hyaline hyphae, embedded in a gelatinous matrix, black incrustations lining the sides of the canal (Fig. 15 b). **Pseudoparaphyses** 1.5–3.5 μm in diameter, more or less parallel between the asci and unbranched (Fig. 16 f), becoming trabeculate (branched and anastomosing) above the asci (Fig. 15 c) and merging with the periphysoid filaments in the ostiolar canal, embedded in a gelatinous matrix which often adheres to asci in squash mounts (Fig. 16 a, b). **Asci** 230–290 \times 28–37 μm , eight-spored, cylindrical, pedunculate, thick-walled (Fig. 16 a, b), fissitunicate (Fig. 16 c, d), with an inconspicuous, often eccentric apical plate (Fig. 16 g), not blueing in IKI; arising from a basal ascogenous tissue. **Ascospores** 51–80 \times 14–20 (–22) μm , biseriate, fusiform, five-septate, slightly constricted at the central septum, less so at the others, hyaline, rarely pale yellowish, smooth-walled, filled with many oil droplets (Fig. 16 e, f). **Mode of life:** Saprobic. **Substrates:** Immersed wood and bark of mangroves (*Laguncularia racemosa*, *Rhizophora mangle*). **Range:** Atlantic Ocean (Belize). **Material examined:** Dead tip of prop root of *Rhizophora mangle*, Twin Cays, Belize, 16°50'N, 88°06'W, 3 Apr. 1983, J. K. 4365 a (**Holotype**, NY), 4365 b (**Isotype**, IMS); submerged dead branch of *R. mangle*, same location, 7 Apr. 1983, J. K. 4390; submerged dead branch of *R. mangle*, Man-of-War Cay, Belize, 16°53'N, 88°06'15"W, 8 Apr. 1983, J. K. 4407; dead intertidal branches of *Laguncularia racemosa*, Wee-Wee Cay, Belize, 16°45'45"N, 88°09'W, 29 Mar. 1983, J. K. 4329, 4331, 4421. **Etymology:** From the Latin *lignatilis* = growing on wood, indicating its place of growth.

The key to the *Loculoascomycetes* by BARR (1979) leads to *Melanommataceae* (order *Melanommatales*; BARR, 1983). Among the genera listed in this family (BARR, 1979), *Trematosphaeria* FCKL. appears to be the closest one to accommodate the new species from Belize. Also VON ARX & MÜLLER's (1975) treatise supports the inclusion of the new species in *Trematosphaeria*. HOLM (1957) circumscribes this genus and 10 species. SAMUELS & MÜLLER (1979) discuss the relationship of *Melanomma* to *Trematosphaeria* and conclude that the type species are congeneric, however, without merging them at that time. Until now, two *Trematosphaeria* species are known from the marine environment, namely, *T. britzelmayriana* and *T. mangrovis* (KOHLMAYER & KOHLMAYER, 1979). The first species has a temperate distribution and four- to ten-septate ascospores, whereas the second is tropical and has three-septate ascospores.

A collection from India, identified as *Leptosphaeria albopunctata* (RAGU KUMAR, 1973) is possibly identical with *T. lignatilis*. The former resembles *T. lignatilis* superficially, however, ascospores of *L. albopunctata* are pale yellow to light brown, up to seven-septate, maximally 55 μm in length and 15 μm in diameter. Furthermore, *L. albopunctata* appears to be restricted to temperate waters and occurs predominantly on herbs, whereas *T. lignatilis* is a tropical fungus on mangroves.

When a dried branch of *Rhizophora mangle* (J. K. 4407) bearing *T. lignatilis* was rehydrated in seawater for several hours, blotted and observed under a dissecting microscope, asci were ejected from the ascocarps (Fig. 16 d). Asci become detached at the base, they swell and elongate by apical fracture of the

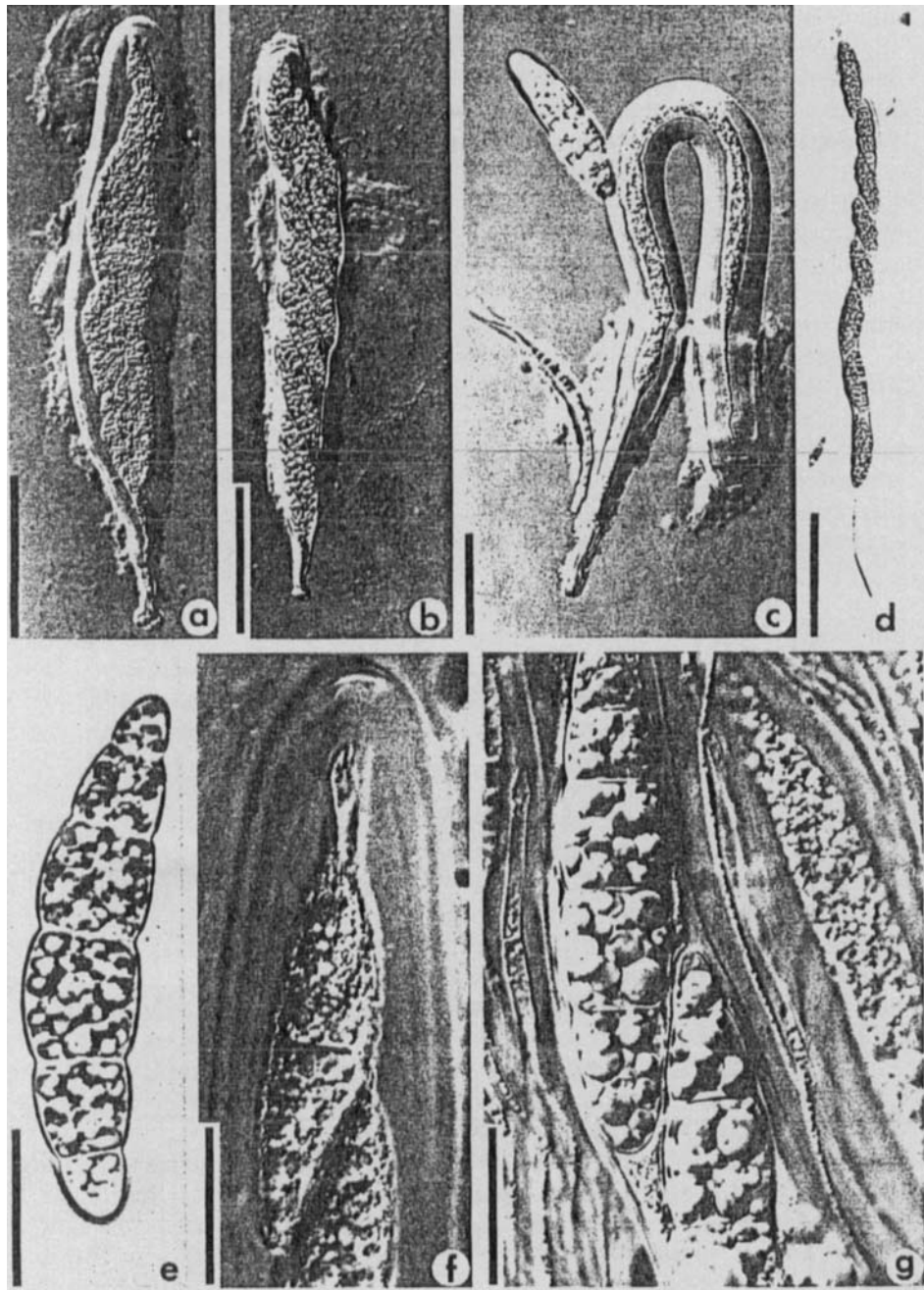


Fig. 16. *Trematosphaeria lignatilis* sp. nov. a-d. Asci; a. immature, bar = 50 μ m; b. mature, remains of pseudoparaphyses adhering, bar = 75 μ m; c. immature, ectoascus ruptured, bar = 25 μ m; d. mature, ejected on wood surface, ectoascus ruptured, endoascus expanded, bar = 100 μ m; e. ascospore, bar = 20 μ m; f. ascus tip with apical plate, bar = 20 μ m; g. asci and pseudoparaphyses, bar = 20 μ m. (d and e in brightfield, others in Nomarski interference contrast; c-e from J. K. 4407, others from J. K. 4421.)

ectoascus and are forced out of the ostiole by the pressure of the pseudoparaphyses. It has to be proven that this type of dispersal occurs in the natural habitat, but such mechanism of forceful ejection would be advantageous for an Ascomycete growing on wood in the intertidal zone, where it is exposed to alternating wetting and drying.

2. Basidiomycetes

Halocyphina villosa KOHLM. & KOHLM.

Material: **Belize:** MW, 8 Apr. 1983, dead prop roots and branch of *Rhizophora mangle*, J. K. 4403, 4404, 4406, 4408; SI, 29 Mar. 1983, same substrate, J. K. 4339, 4348; TC, 7 Apr. 1983, same substrate, J. K. 4385; WW, 29 Mar. 1983, intertidal branch of *Laguncularia racemosa* and prop root of *R. mangle*, J. K. 4331, 4351. **Thailand:** S, 15 Sept. 1983, stump of *Ceriops* sp., J. K. 4449. **Trinidad:** Caroni Swamp, 10°35'N, 61°28'W, 25 Oct. 1976, submerged branch of *R. mangle*, J. K. 3981.

The superficially growing basidiocarps of *H. villosa* and *Nia vibrissa* are susceptible to being washed off their substrates by water currents. Therefore, they are usually found inside hollow branches and prop roots, or on the walls of empty shipworm tunnels.

Halocyphina villosa is restricted to tropical and subtropical waters (Fig. 9). New collecting sites from the literature are in the Atlantic Ocean: Colombia (KUPKA *et al.*, 1981), Ghana (FURTADO & JONES, 1980) and in the Indian Ocean: Sri Lanka (KOCH, 1982). *Ceriops* sp. and *Laguncularia racemosa* are new hosts.

Nia vibrissa MOORE & MEYERS

Material: **Belize:** D, 27 Mar. 1983, basidiospores in foam (sal. 31.7‰, 30°C), J. K. 4325; MW, 8 Apr. 1983, tips of dead branch and prop root with shipworms, next to *Bostrychia tenella* (VAHL) J. AGARDH (det. S. FREDERICQ), J. K. 4405, 4408. **Mexico:** CC, 1 Feb. 1983, basidiospores in foam (sal. 38.3‰, 27°C), J. K. 4287. **U.S.A.:** Hawaii, WK, 2 Nov. 1983, along walls of empty teredinid tunnels, on intertidal branch, J. K. 4474; CA, 6 Aug. 1979, basidiospores in foam, J. K. 4013.

Nia vibrissa is a cosmopolitan species (KOHLMAYER, 1983) with easily detachable basidiocarps that develop mostly in protected areas, *e. g.* under loose bark of mangrove roots or in empty shipworm tunnels. New collecting sites are in the Atlantic Ocean: Bahamas (Great Abaco: KOHLMAYER, 1980), Ghana (FURTADO & JONES, 1980), Martinique (KOHLMAYER, 1981a), South Africa (GORTER, 1978); in the Baltic Sea: Denmark (KOCH & JONES, 1983); in the Black Sea: U. S. S. R. (ZELEZINSKAYA, 1979b); in the Mediterranean: Italy (MONTEMARTINI, 1979); in the Pacific Ocean: Australia (N. S. W., Queensld., South Austr., Vict.) and Fiji (KOHLMAYER, 1983).

3. Deuteromycetes

Cirrenalia pygmea KOHLM.

Material: **Fiji:** T, 19 Sept. 1981, on wood of dead prop root of *Bruguiera gymnorhiza*, J. K. 4245. **Thailand:** S, 15 Sept. 1983, in tube of a dead prop root (*Rhizophora* sp. ?), J. K. 4458 (also fruiting pure culture).

A *Cirrenalia* sp. from Kenya (J. K. 4127, leg. Mrs. W. REUSCH) has greyish-blue to black conidia and may also belong to *C. pygmea*. New distributional records of *C. pygmea* are from the Atlantic Ocean: Brazil (BOOTH, 1979), Sierra Leone (ALEEM, 1980; ALEEM & MALIBARI, 1981), Trinidad (KOHLMAYER, 1980), and Indian Ocean: Sri Lanka (KOCH, 1982). *Bruguiera gymnorrhiza* is a new host.

Cytospora rhizophorae KOHLM. & KOHLM.

Material (all in *Rhizophora mangle*): **Belize**: D, 27 Mar. 1983, washed-up seedling, J. K. 4324; SW, 30 Mar. 1983, dead seedling, J. K. 4345; TC, 3 Apr. 1983, dead prop root, J. K. 4384. **Mexico**: MC, 28 Jan. 1983, washed-up seedling, J. K. 4425. An additional collection from Mexico (PC, J. K. 4298) is assigned to *C. rhizophorae* with reservation because the conidia are 2–2.5 µm in diameter, therefore wider than in the type and other material (1.1–1.5 µm).

Other new records of *C. rhizophorae*, published recently, are in Sierra Leone (ALEEM, 1980; ALEEM & MALIBARI, 1981), and in Trinidad and St. John, U. S. Virgin Islands (KOHLMAYER, 1980).

Humicola alopallonella MEYERS & MOORE

Material: **Belize**: AA, 10 Nov. 1982, dead intertidal root of *Conocarpus erecta*, J. K. 4254; MA, 7 Nov. 1982, same substrate, J. K. 4277; SI, 29 Mar. 1983, subtidal wood and bamboo (incubated 1 mo), J. K. 4337, 4338. **Mexico**: X, 29 Jan. 1983, intertidal wood, J. K. 4295. **Marshall Islands**: E, 23 Aug. 1971, driftwood, J. K. 3026. **Thailand**: P, 15 Sept. 1983, driftwood, J. K. 4451.

Humicola alopallonella is one of the most widely distributed and common *Deuteromycetes*, as evidenced by the long list of geographic locations and numerous literature dealing with this species (KOHLMAYER & KOHLMAYER, 1979). Additional collections are in the Atlantic Ocean: Bahamas (Great Abaco: KOHLMAYER, 1980), Brazil (BOOTH, 1979), Canada (New Brunswick: MILLER & WHITNEY, 1981; Nova Scotia: BOLAND & GRUND, 1979), Denmark (KOCH & JONES, 1983; REES *et al.*, 1979), Ghana (FURTADO & JONES, 1980), U. S. A. (Virginia: KIRK & BRANDT, 1980; KIRK & SCHATZ, 1980), U. S. Virgin Islands (St. John: KOHLMAYER, 1980); in the Baltic: Denmark (KOCH & JONES, 1983); in the Pacific Ocean: Australia (Queensland: KENDRICK *et al.*, 1982), Hong Kong (VRIJMOED *et al.*, 1982); in the Indian Ocean: Sri Lanka (KOCH, 1982). *Conocarpus erecta* is a new host.

Periconia prolifica ANAST. [anamorph of *Halosphaeria cucullata* (KOHLM.) KOHLM.]

Material: **Belize**: AA, 10 Nov. 1982, intertidal dead branches of *Conocarpus erecta* and *Laguncularia racemosa*, J. K. 4259, 4266; CPA, 9 Nov. 1982, dead submerged branch and pneumatophore of *L. racemosa*, J. K. 4264, 4268. **Mexico**: PC, 2 Feb. 1983, subtidal branch (incubated 5 mo), J. K. 4432. **Australia**: HQ, 16 Aug. 1981, intertidal wood (incubated), J. K. 4226, 4228. **Thailand**: P, 15 Sept. 1983, driftwood, J. K. 4450–4452; S, 15 Sept. 1983, submersed twigs under mangroves, J. K. 4454. **U. S. A.**: Hawaii, HBM, 9 Nov. 1983, submersed dead branch of *Hibiscus tiliaceus*, J. K. 4478.

This study and recent publications confirm again that the anamorph of *Halosphaeria cucullata* is more frequently found than the teleomorph and restricted to tropical and subtropical areas (KOHLMAYER & KOHLMAYER, 1971, 1979; HUGHES, 1974; VRIJMOED *et al.*, 1982). *Periconia prolifica* was recently reported in the Atlantic Ocean from the Bahamas (Great Abaco: KOHLMAYER, 1980), Ghana (FURTADO & JONES, 1980), Martinique (KOHLMAYER, 1981 a), Sierra Leone (ALEEM, 1980; ALEEM & MALIBARI, 1981), U. S. A. (Virginia: KIRK & BRANDT, 1980; KIRK & SCHATZ, 1980), in the Pacific Ocean from Hong Kong (VRIJMOED *et al.*, 1982), and in the Red Sea from Saudi Arabia (ALEEM, 1978). A putative record of *P. prolifica* in foam from the Black Sea (ZELEZINSKAYA, 1979 c) needs to be confirmed. New hosts are *Conocarpus erecta*, *Hibiscus tiliaceus* and *Laguncularia racemosa*.

Rhabdospora avicenniae KOHLM. & KOHLM.

Material (all in pneumatophores of *Avicennia germinans*): **Belize**: CP, 8 Apr. 1983, J. K. 4394; MA, 11 Nov. 1982, J. K. 4273; SW, 6 Apr. 1983, J. K. 4377; TR, 8 Apr. 1983 (incubated 2 mo), J. K. 4393. **Mexico**: BB, 31 Mar. 1982, J. K. 4184.

The material from Mexico represents the first record of *R. avicenniae* from the Pacific Ocean, since earlier collections have been made exclusively in the Atlantic Ocean (KOHLMAYER & KOHLMAYER, 1979). Conidia in collections J. K. 4184 and 4273 are up to 16 µm long, and in J. K. 4393 (after two months of incubation) even up to 20 µm. A similar effect of development of longer conidia in stored material was observed earlier (KOHLMAYER & KOHLMAYER, 1971).

Varicosporina ramulosa MEYERS & KOHLM.

Material (all conidia in foam, except J. K. 4427): **Belize**: AA, 10 Nov. 1982, (sal. 36.6‰, 31°C), J. K. 4291; D, 27 Mar. 1983, (sal 31.7‰, 30°C), J. K. 4325. **Mexico**: CC, 1 Feb. 1983, (sal. 38.3‰, 27°C), J. K. 4287; LC, 1 Feb. 1983, washed-up *Sargassum* sp. (incubated 5 mo), J. K. 4427. **U. S. A.**: Hawaii, HM, 9 Nov. 1983, (sal. 33.9‰, 26°C), J. K. 4491.

Earlier geographical records of *V. ramulosa* have been plotted on a map by BOYD & KOHLMAYER (1982) who also studied the effects of temperature on development in culture and found maximum growth at 35 and 40°C. The thermophilic reaction of *V. ramulosa in vitro* explains its restriction to tropical and subtropical waters.

Zalerion cfr. *varium* ANAST.

Material: **Belize**: AA, 10 Nov. 1982, on a shell fragment, attached to intertidal dead roots of *Cocos nucifera*, J. K. 4267. **Palau Islands**: P, 4 Mar. 1983, driftwood, J. K. 4306.

This species is difficult to identify because of the polymorphic nature of its conidia. Even when conidia of the type material are compared with other collections it is not always possible to identify the new specimens with certainty

(KOHLMAYER & KOHLMAYER, 1979). Therefore, I refrain from listing all the putative new records of *Z. varium* from the literature. Ideally, voucher specimens of all collections identified as *Z. varium* need to be compared among each other and with the type and the variability of conidia in culture should be established.

Discussion

1. Mycogeography

The distribution of marine fungi has not been explored as actively in the tropics as in temperate areas. Among the 203 filamentous higher marine fungi listed by KOHLMAYER & KOHLMAYER (1979), there are 32 found exclusively in the tropics and 25 cosmopolitan species. When 8 newly described tropical species (KOHLMAYER, 1980, 1981 a; SHEARER & CRANE, 1980; KOCH, 1982) and the new ones of this paper are added, a total of 73 taxa are known at the present time from the tropics and subtropics. This number comprises about one third of all described higher marine fungi. The balance is expected to change in favor of tropical fungi, when research in tropical habitats will intensify in the future. Discoveries of new species are expected in particular in the mangal, where many hosts have never been studied for the occurrence of fungi.

As demonstrated in Table 2, the number of cosmopolitan species is much smaller (23 %) than that of exclusively tropical and subtropical fungi (77 %). Since *in vitro* experiments have shown that marine fungi grow best at a temperature range corresponding to their observed natural temperature regime (BOYD & KOHLMAYER, 1982), it can be expected that the cosmopolitan species have a wider temperature tolerance than the tropical species, which show optimal growths around 35 and 40 °C. Distribution maps of cosmopolitan species, *e. g.*, *Arenariomyces trifurcatus* (Fig. 1) and *Torpedospora radiata* (Fig. 14), indicate the lack of data in certain areas of the globe. The Arctic and Antarctic zones have not been explored at all for marine fungi, except for some parasites on algae (*e. g.*, *Spathulospora antarctica* KOHLM.). Also, the Indian Ocean and the southern coasts of the South American and African continents have rarely been studied.

Most of the 47 species and varieties listed in the present paper occurred in Belize (36 taxa = 77 %), where 18 days of intensive collecting were spent. But even two days of collecting in the mangal and on the shores of Thailand yielded 16 species (34 %). Not counted are a number of unidentified species that await future description. These examples show that it required more than two weeks of collecting in the tropical Atlantic to find about half of all 73 known tropical marine fungi, whereas results were obtained faster in the South Pacific, possibly because of the greater variety of host plants (CHAPMAN, 1976). Almost all species collected in Belize, Fiji, Mexico and Thailand are new records for these areas.

2. Hosts or substrates

All fungi treated above were either identified immediately after collecting with their natural substrates, or the host specimens were incubated in sterile collect-

ing bags for several months and fungal species identified thereafter. Common terrestrial molds, such as *Penicillium* spp., rarely developed during incubation on the seagrasses or mangrove roots, and only recognized marine fungi (KOHLMAYER & KOHLMAYER, 1979) were included in this study. When other collecting methods are used, e. g. plating out of mangrove mud or beach sand, almost all species isolated are terrestrial molds (e. g., CHOWDHERY & RAI, 1980; RAI *et al.*, 1969; DUNN & BAKER, 1983) the role of which in this habitat is unknown.

Table 2. Geographical groups of higher marine fungi occurring in the tropics.

Exclusively Tropical & Subtropical		Cosmopolitan
	Ascomycetes	
? <i>Aniptodera chesapeakensis</i>		<i>Arenariomyces trifurcatus</i>
? <i>Arenariomyces triseptatus</i>		<i>Corollospora maritima</i>
<i>Dactylospora haliotrepha</i>		<i>C. pulchella</i>
<i>Didymosphaeria enalia</i>		<i>Halosphaeria galerita</i>
<i>D. rhizophorae</i>		<i>Halosphaeriopsis mediosetigera</i>
? <i>Halosarpheia abonnis</i>		<i>Lignincola laevis</i>
<i>H. fibrosa</i>		<i>Mycosphaerella salicorniae</i>
<i>H. marina</i>		<i>Torpedospora radiata</i>
? <i>H. ratnagiriensis</i>		
? <i>H. retorquens</i>		
? <i>Halosphaeria quadricornuta</i>		
<i>H. salina</i>		
<i>Hydronectria tethys</i>		
<i>H. tethys</i> var. <i>glabra</i>		
<i>Keissleriella blepharospora</i>		
<i>Leptosphaeria australiensis</i>		
<i>L. avicenniae</i>		
? <i>Lignincola longirostris</i>		
<i>L. tropica</i>		
<i>Lindra marinera</i>		
<i>L. thalassiae</i>		
<i>L. thalassiae</i> var. <i>crassa</i>		
<i>Lulworthia grandispora</i>		
<i>L. kniepii</i>		
<i>L. kniepii</i> var. <i>curalii</i>		
? <i>Lulworthia</i> sp.		
<i>Mycosphaerella pneumatophorae</i>		
? <i>Nimbospora effusa</i>		
<i>Savoryella paucispora</i>		
? <i>Trematosphaeria lignatilis</i>		
	Basidiomycetes	
<i>Halocyphina villosa</i>		<i>Nia vibrissa</i>
	Deuteromycetes	
<i>Cirrenalia pygmaea</i>		<i>Humicola alopallonella</i>
<i>Cytospora rhizophorae</i>		<i>Zalerion varium</i>
<i>Periconia prolifica</i> (anamorph of <i>Halosphaeria cucullata</i>)		
<i>Rhabdospora avicenniae</i>		
<i>Varicosporina ramulosa</i>		

? = insufficient data, but tropical distribution is indicated

With few exceptions, the fungi of this treatise are saprobes living on dead or damaged parts of submerged mangrove roots, branches or trunks, or on washed-up sea grasses and algae of sandy beaches. Possible parasites are *Cytospora rhizophorae* in seedlings, prop roots and branches of *Rhizophora mangle*, and *Lulworthia kniepii* and the variety *curalii* in crustose coralline algae. However, the pathogenicity of these fungi has not been established experimentally, and they may be perthophytes, living on tissues killed by other causes.

New hosts, not investigated before for the occurrence of marine fungi, are *Amphibolis* sp., *Batis maritima*, *Bruguiera gymnorhiza*, *Canavalia rosea*, *Ceriops* sp., *Laguncularia racemosa*, *Posidonia australis*, *Rhizophora stylosa*, and the coralline *Paragoniolithon solubile*. Other substrates collected for this study, but known to inhabit marine fungi (KOHLMAYER & KOHLMAYER, 1979), are *Avicennia germinans*, *A. marina* var. *resinifera*, *Cocos nucifera*, *Conocarpus erecta*, *Hibiscus tiliaceus*, *Rhizophora mangle*, *R. racemosa*, *Salicornia* sp., *Sargassum* sp., and *Thalassia testudinum*. Representatives of this last group are new hosts for a number of fungi. Collecting of fungi among the over 100 species of mangroves in the eastern mangal will undoubtedly result in a considerable increase in the number of tropical marine fungi and in the recognition of new host plants.

Ascocarps of arenicolous marine fungi are mostly attached to grains of sand or calcareous shells. In some cases, ascocarps can also be embedded in the calcium carbonate substrate of animal shells (KOHLMAYER & KOHLMAYER, 1979) or inside calcified green algae (*Halimeda* sp.; KOHLMAYER, 1980). Particularly interesting are the discoveries of ascocarps of the new taxa *Arenariomyces triseptatus* (J. K. 4426) and *Lindra thalassiae* var. *crassa* (J. K. 4424, 4428) inside shells of foraminifera, *i. e.* substrates not known to be attacked by higher marine fungi. Up to 30 fungal fruiting bodies develop in the chambers of the Protozoa (Fig. 12f) and take up their irregular shape (Fig. 2d). Treatment in dilute acid (5% HCl) dissolves the calcium carbonate, revealing the dark ascocarps that are almost invisible in untreated shells. Only the ostioles of the fruiting bodies can be seen as dark dots in the white shells. Most probably, the organic membrane of foraminifera (remaining after HCl-treatment) serves as a nutrient for the developing ascocarps. The membrane consists of a proteinaceous mucopolysaccharide called tectin. Other substrates of special interest are empty zoecia of bryozoa that harbour fruiting bodies of *L. thalassiae* (J. K. 4427) and *L. t.* var. *crassa* (J. K. 4428). The latter occurs also inside unidentified calcareous shell fragments (J. K. 4424). Obviously, the ascocarps are well protected inside the hard substrates until the ascospores mature, which are released to the outside through the ostiole or by the eventual fragmenting of the substrate during wave action. The development of ascocarps of intertidal fungi inside hard substrates appears to be an adaptation to the environment of shifting sand grains. Fruit bodies of *A. triseptatus*, *L. thalassiae* and *L. t.* var. *crassa* are not as thick-walled and resistant to pressure as those of *Corollospora* species which are often found attached to the outside of shells or other hard substrates in sandy beaches.

Although no quantitative data are available on the growth of fungi in the mangal, the number of fruiting bodies and the variety of species appear to be greatest in eutrophic habitats, *e. g.* Man-of-War Cay in Belize. This island is a

rookery of frigate and other birds, and prop roots of *Rhizophora mangle*, pneumatophores of *Avicennia germinans* and *Laguncularia racemosa*, and fallen branches under the trees are covered with bird excrements. Especially basidiocarps of *Halocyphina villosa* and *Nia vibrissa*, and ascocarps of *Hydronectria tethys* occur in great numbers in this habitat.

Summary

Filamentous higher marine fungi were collected in the tropics and subtropics (Australia, Belize, Hawaii, Fiji, Marshall Islands, Mexico, New Zealand, Palau, Thailand) to study the mycogeography of this group. Almost all collections represent new distribution records for the fungi in these countries. The worldwide distribution is plotted on maps for *Arenariomyces trifurcatus*, *Halocyphina villosa*, *Hydronectria tethys*, *H. t.* var. *glabra*, and *Torpedospora radiata*. This study updates the treatise of KOHLMAYER & KOHLMAYER (1979) concerning the geographical distribution of marine fungi in the tropics.

Of a total of 73 marine fungi known to occur in tropical and subtropical waters, 47 taxa were collected in the course of this investigation (38 *Ascomycetes*, 2 *Basidiomycetes*, 7 *Deuteromycetes*). The *Ascomycetes* include 4 new species in the genera *Arenariomyces*, *Halosarpheia*, *Lignincola* and *Trematosphaeria*, 3 new varieties in *Hydronectria*, *Lindra* and *Lulworthia*, and 2 new combinations in *Halosarpheia* and *Lignincola*. Keys for the identification of species and varieties of *Halosarpheia* and *Lulworthia* are supplied.

The majority of the species are saprobes from submerged parts of mangroves or from detritus in sandy beaches. New hosts for marine fungi belong to the genera of spermatophytes *Amphibolis*, *Batis*, *Bruguiera*, *Canavalia*, *Ceriops*, *Laguncularia*, *Posidonia* and *Rhizophora*, and to the crustose red alga *Paragoniolithon*. Substrates not known to be attacked by marine fungi are shells of foraminifera that enclose ascocarps of *Arenariomyces triseptatus* and *Lindra thalassiae* var. *crassa*.

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