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Marine fungi from the Bahamas Islands[a]

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Abstract

This study extends our knowledge of the marine fungi in the Bahamas Islands (Atlantic Ocean) and of subtropical mangroves in general. Ninety-two fungal taxa have been recorded from seven mangrove sites, of which 81 are new records, bringing the total number of species for the islands to 112. Fungi dominating the community were *Lulworthia grandispora*, *Kallichroma tethys*, *Leptosphaeria australiensis* and *Verruculina enalia*, all common mangrove species. The fungal community reported is, compared to that of the Atlantic Ocean, one of the least sampled locations for marine fungi. Many new taxa were encountered during the study and further ecological and taxonomical studies on the mangrove fungi of these islands are warranted.

Keywords: Atlantic Ocean; biodiversity; ecology; intertidal fungi; subtropical mangroves.

Introduction

This paper sets out to examine the occurrence of marine fungi reported from islands, especially their geographical location, and to compare mangrove fungi reported from the three oceans of the world. Hughes (1975) was of the opinion that "the marine fungi of small oceanic islands would be extremely valuable to an understanding of the ecology of the group". At that time only three studies had been undertaken: Hawaiian Islands with 27 species (Kohlmeyer 1969); Iceland with 34 species (Johnson 1968, Cavaliere 1968) and Helgoland in the North Sea with 25 species (Schaumann 1973). Since then, a number of studies have reported marine fungi from islands in the three major oceans: e.g., Pacific Ocean: Aldabra and Galapagos (Kohlmeyer and Volkmann-Kohlmeyer 1987a); Hawaii (Kohlmeyer and Volkmann-Kohlmeyer 1989); Siargao Islands, Philippines (Besituloa et al. 2002); New Zealand (Lintott and Lintott 2002); Indian Ocean: Seychelles (Hyde and Jones 1989), Sumatra Island, Indonesia (Hyde 1989); Pirotan Island and other islands, India (Borse et al. 2000, Prasannarai and Sridhar 2000–2001, Ananda and Sridhar 2003); Singapore (Tan et al. 1989, Tan 2002) and Atlantic Ocean: Saint Croix (Kohlmeyer and Volkmann-Kohlmeyer 1988).

Islands vary greatly in their size and distance from other landmasses, but what effect has this on the distribution of marine fungi? One hundred and twenty-eight and 66 marine fungi are documented for Hong Kong and Siargo Islands, respectively (Besitulo et al. 2002, Jones and Vrijmoed 2003), locations with a variety of mature, mangrove tree species. Kohlmeyer and Volkmann-Kohlmeyer (1989), however, reported only 17 species from the Hawiian Islands, and attributed this to low tree diversity (trees planted less than 25 years previously). Similarly, only 12 marine fungi were reported from Singy and South Georgia, Antarctica. A number of factors may account for this: low substrate availability, low temperature and distance from landmasses (Pugh and Jones 1986). Conversely, over 50 marine fungi have been reported for other islands: Brunei (87 species; Hyde 1988), Seychelles (63 species; Hyde 1986), Australia (65 species; Hyde 1990, Kohlmeyer and Volkmann-Kohlmeyer 1991); Andaman and Nicobar Islands, India (63 species; Chinnaraj 1993); Boracay, Philippines (50 species; Alias et al. 1999), and Singapore (50 species; Leong et al. 1991, Tan et al. 1989, Tan 2002). All these islands are either close to landmasses, with large forests, support mature trees, are species rich but are also subject to environmental effects of large landmasses (Hughes 1975). The intensity of sample collection, duration of survey, length material was incubated and seasonal effect, all affect species diversity (Jones 2000).

The Bahamian Islands offer a distinctly different location for the study of marine and mangrove fungi. Mangroves on these islands are small coastal strips, with fully saline water, rocky or sandy shorelines, with few mangrove tree species. Few studies have reported on marine fungi from the Bahamas, with the initial account by Meyers (1957) who listed three species: *Antennospora quadricornuata* (=*Antennospora caribbea* Meyers), *Antennospora salina* (=*Arenariomyces salina* Meyers) and *Lulworthia* sp. (=*Lulworthia medusa* var. *biscaynia* Meyers). Kohlmeyer and Kohlmeyer (1971) and Kohlmeyer (1984) recorded a further nine and 20 marine fungi, respectively, from the Bahamas, bringing the total to 31 (Table 1). The Bahamas are located in the Atlantic Ocean, an area for which few data on marine fungi are available.

Several islands in the tropical western Atlantic Ocean, have been explored for marine fungi: Martinique (Kohlmeyer 1981), Tobago, Trinidad, Saint Croix and Saint Johns, US Virgin Islands (Kohlmeyer 1980, Kohlmeyer 1984, Kohlmeyer and Volkmann-Kohlmeyer 1988) and Belize (Kohlmeyer 1984, Kohlmeyer and Volkmann-Kohlmeyer 1987b, Kohlmeyer et al. 1995); subtropics: Baha-

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Table 1 Marine fungi recorded from the Bahamas Islands before this study.

Fungi	Meyers (1957)	Kohlmeyer and Kohlmeyer (1971)	Kohlmeyer (1980)	Kohlmeyer (1984)
Ascomycota				
Antennospora quadricornuata (Cribb *et* J.W. Cribb) T.W. Johnson	√		√	
Antennospora salina (Meyers) Yusoff, E.B.G. Jones *et* S.T. Moss	√		√	
Arenariomyces trifurcatus Höhnk			√	√
Chadefaudia corallinarum (Crouan *et* Crouan) Müller *et* von Arx			√	
Corollospora lacera Linder			√	
Corollospora maritima Werderm.			√	
Dactylospora haliotrepha (Kohlm. et E. Kohlm.) Hafellner		√	√	
Etheirophora blepharospora (Kohlm. *et* E. Kohlm.) Kohlm. *et* Volkm.-Kohlm.		√	√	
Haloguignardia oceanica (Ferdinandsen *et* Winge) Kohlm.			√	
Kallichroma tethys (Kohlm. *et* E. Kohlm.) Kohlm. *et* Volkm.-Kohlm.			√	√
Leptosphaeria australiensis (Cribb *et* J.W. Cribb) G.C. Hughes		√	√	
Leptosphaeria avicenniae Kohlm. *et* E. Kohlm.		√	√	
Leptosphaeria sp.				
Lindra marinera Meyers			√	
Lindra thalassiae Orpurt, Meyers, Boral *et* Simms			√	
Lineolata rhizophorae (Kohlm. *et* E. Kohlm.) Kohlm. *et* Volkm.-Kohlm.			√	
Lulworthia grandispora Meyers		√	√	
Lulworthia sp.	√		√	
Mycosphaerella pneumatophorae Kohlm.		√	√	
Mycosphaerella salicorniae (Auersw.) Lindau			√	
Torpedospora radiata Meyers			√	
Verruculina enalia (Kohlm.) Kohlm. *et* Volkm.-Kohlm.		√	√	
Basidiomycota				
Nia vibrissa R.T. Moore *et* Meyers			√	
Mitosporic fungi				
Blodgettia confervoides Harvey			√	
Cytospora rhizophorae Kohlm. *et* E. Kohlm.		√	√	
Periconia prolifica Anastasiou			√	
Phoma sp.			√	
Rhabdospora avicenniae		√	√	
Trichocladium alopallonellum (Meyers *et* R.T. Moore) Kohlm. *et* Volkm.-Kohlm.			√	
Xylomyces sp.			√	
Zalerion varium Anastasiou			√	

mas (Meyers 1957, Kohlmeyer and Kohlmeyer 1971, Kohlmeyer 1980, Kohlmeyer 1984), and Bermuda (Kohlmeyer and Kohlmeyer 1977) and temperate locations: San Juan Island (Kohlmeyer 1961, Jones 1985, Jones et al. 1999). The Antarctic islands of Signy and South Georgia are cold-water locations with a shortage of suitable substrata for the growth of marine fungi, and they are also distant from landmasses. Only 12 species have been recorded, and this was attributed to the lack of woody substrata around the islands (Pugh and Jones 1986). How do these factors affect marine fungal diversity? Temperature plays a key role in the geographical distribution of marine fungi (Hughes 1975, Jones 2000), for example species can be exclusively or predominantly tropical: *Antennospora quadricornuata* (Cribb *et* J.W. Cribb) T.W. Johnson, *Saagaromyces abonnis* (Kohlm.) K.L. Pang *et* E.B.G. Jones; temperate: *Ceriosporopsis trullifera* (Kohlm.) P.W. Kirk, *Ondiniella torquata* (Kohlm.) E.B.G. Jones, R.G. Johnson *et* S.T. Moss; arctic: *Spathulospora antartica* Kohlm., or cosmopolitan: *Corollospora maritima* Werderm., *Lignincola laevis* Höhnk.

Therefore, it is interesting to compare marine and mangrove fungi collected in the three oceans. One hundred and six fungi have been reported from mangroves in the Atlantic Ocean, while 173 and 128 are documented for Pacific and Indian Ocean mangroves, respectively (Schmit and Shearer 2003). These authors (op. cit.) state that the higher fungal species richness in the Pacific Ocean may reflect the greater mangrove tree diversity and the more extensive sampling carried out in this region. Mangroves in subtropical locations have been researched relatively poorly in comparison to the extensive work that has been carried out in tropical mangroves (Hyde and Lee 1995, Jones 2000).

The present study was carried out to provide a broader view of the biodiversity of mangrove fungi in the Bahamian Islands, in the Atlantic Ocean and to extend our knowledge of the biodiversity of fungi in subtropical mangroves (which is still far from complete).

Materials and methods

Sampling methods for marine fungi are well documented (e.g., Jones and Hyde 1988) and will not be considered here in any detail. Drift and attached mangrove wood, drift wood, salt marsh plants, selected seaweeds and *Thalassia* leaves were collected, washed with seawater and incubated in plastic boxes for up to six weeks to encourage fungal sporulation. Samples were examined for fungi, identified and isolated into axenic culture.

The first collecting trip was a three-week cruise to various Bahamian Islands (Sweatings, Chub Cay, Little San Salvador) in September–October, 1998. The following year, a shorter cruise was made to the islands of Little San Salvador, Cunningham and Aklins. Mangroves formed a fringe community, with the exception of Chub Cay where extensive storm damage yielded good collections of fungi, due to the large quantity of damaged trees. Mangrove tree diversity was low with only four species: *Avicennia germinans* (L.) Stearn., *Conocarpus erectus* L., *Laguncularia racemosa* (L.) Gaertn. and *Rhizophora mangle* L.

The following data were calculated for each of the study sites:

Percentage occurrence of each fungus

$$= \frac{\text{Number of collections of the fungus}}{\text{Number of samples collected}} \times 100$$

Number of fungi per sample

$$= \frac{\text{Total number of fungal collections}}{\text{Number of samples collected}}$$

In Table 2, the percentage occurrence of each fungus at each site is given as well as the actual number of collections of each species. In this paper, a sample is each piece of wood collected randomly at a site, while fungal collections refer to the number of times a fungus was identified.

Results

Table 2 lists the percentage occurrence and the number of collections of the fungi recorded during the two cruises. Ninety-two taxa (76 ascomycetes, 16 mitosporic) were identified from 757 fungal occurrences in 611 samples collected at seven mangrove sites (Table 2). Twenty-eight and 49 fungi were unique to the 1998 and 1999 samples, respectively, while 14 species were recorded in both years. Fungal species richness recorded from the sites studied ranged from 14 to 36. In spite of the sample size, the highest and lowest number of species recorded was from Little San Salvador Island: 36, 14, respectively in 1999, 1998. The dominant species collected at each site varied, e.g., *Kallichroma tethys* (28.8%), *Anthostomella* sp. (27.3%), *Verruculina enalia* (19.6%) and *Lulworthia grandispora* (77.1%) were the dominant species in samples from Chub Cay, Little San Salvador, Cunningham Lake and Acklins Lake, respectively. The number of fungi per sample varied from 0.9 (unnamed island) to 1.9 (Acklins Island), with an average of 1.2 for all seven sites.

The most common fungus was *Lulworthia grandispora*, with an overall frequency of occurrence of 13.7% and other common fungi included: *Kallichroma tethys* (10%), *Leptosphaeria australiensis* (8.5%) and *Verruculina enalia* (9.5%).

Discussion

Previous records of marine fungi in the Atlantic Ocean indicated low species richness (Schmit and Shearer 2004). However in our study, 92 fungi were recorded from seven mangrove stands, where only 31 taxa had been reported previously from the Bahamas, bringing the total for the islands to 112. The 92 fungi reported in this study represent the highest number of marine fungi ever recorded from locations in the Atlantic Ocean.

The richness of fungi recorded in this study is comparable to those recorded from tropical mangroves, e.g., 128 fungi from Hong Kong (Jones and Vrijmoed 2003), 95 fungi recorded from Brunei (Hyde 1988), 91 fungi from Udyavara, India (Maria and Sridhar 2003, Sridhar 2004), 88 species from Godavari and Krishna deltas, India (Sarma and Vittal 2001), 82 species from Malaysia (Jones and Kuthubutheen 1989) and higher than those recorded from subtropical locations, e.g., 22 species from Bermuda (Kohlmeyer and Kohlmeyer 1977); and tropical locations, e.g., 63 fungi from Andaman and Nicobar Islands, India (Chinnaraj 1993), 46 fungi from Belize (Kohlmeyer and Volkmann-Kohlmeyer 1987b), 67 species from Mauritius (Poonyth et al. 1999) and 63 species from Seychelles (Hyde and Jones 1989). The number of marine fungi recovered from any location is dependent on the frequency, intensity and number of samples examined.

There were marked differences in the fungal communities recorded on the two cruises, with *Lulworthia grandispora* widely collected in 1999, but collected only once in 1998. Of the 63 fungi recorded on the second cruise, 49 were not recorded on the first, indicating that further collections may yield more taxa. Ten discomycetes were collected in 1999, including *Dactylospora haliotrepha*, *D. mangrovei*, and a *Patellaria* sp., a group poorly represented in the marine environment (Seutrong and Jones 2004). The fungi collected are typical mangrove species, including many bitunicate ascomycetes, which favour an intertidal habitat where they can actively eject their ascospores.

Although a number of typical mangrove fungi were collected on these cruises, many species were noticeably absent e.g., *Aigialus grandis* Kohlm. *et* S. Schatz, *Cirre-*

Table 2 Fungi recorded on intertidal wood collected from Bahamian mangroves.

Fungi	1998								1999						Total	
	Sweatings		Chub Cay		Little San Salvador		Other coll.		Little San Salvador		Cunningham Lake		Acklins Lake			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Ascomycota																
Aigialus sp.	1	1.4	–	–	–	–	–	–	–	–	–	–	–	–	1	0.2
Antennospora salina (Meyers) Yusoff, E.B.G. Jones *et* S.T. Moss	–	–	–	–	–	–	-	–	–	–	11	9.7	–	–	11	1.8
Anthostomella sp. 1	1	1.4	1	1	1	2.3	2	3.3	–	–	–	–	–	–	5	0.8
Anthostomella sp. 2	–	–	–	–	12	27.3	–	–	–	–	–	–	–	–	12	2
Anthostomella sp. 3	–	–	–	–	–	–	–	–	8	7	2	1.8	–	–	10	1.6
Anthostomella sp. 4	–	–	–	–	–	–	–	–	12	10.4	–	–	–	–	12	2
Astrosphaeriella mangrovei (Kohlm. *et* Vittal) Aptroot *et* K.D. Hyde	1	1.4	–	–	–	–	–	–	–	–	–	–	–	–	1	0.2
Belizeana sp.	–	–	–	–	–	–	–	–	–	–	–	–	4	3.8	4	0.7
Caryospora sp.	–	–	–	–	–	–	–	–	1	0.9	–	–	–	–	1	0.2
Caryosporella rhizophorae Kohlm.	–	–	14	13.5	–	–	–	–	–	–	–	–	–	–	14	2.3
Cryptovalsa mangrovei Abdel-Wahab *et* Inderb.	–	–	–	–	–	–	–	–	1	0.9	–	–	1	1	2	0.3
Cryptovalsa sp. 1	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	0.2
Dactylospora haliotrepha (Kohlm. *et* E. Kohlm.) Hafellner	–	–	4	3.8	1	2.3	–	–	1	0.9	–	–	–	–	6	1
Dactylospora mangrovei E.B.G. Jones, Alias, Abdel-Wahab *et* S.Y. Hsieh	–	–	–	–	–	–	–	–	–	–	2	1.8	1	1	3	0.5
Dactylospora sp.	–	–	–	–	–	–	–	–	–	–	–	–	4	3.8	4	0.7
Decorospora gaudefroyi (Patouillard) Inderb., Kohlm. *et* Volkm.-Kohlm.	–	–	–	–	–	–	–	–	–	–	–	–	5	4.8	5	0.8
Diatrypella sp.	–	–	–	–	–	–	–	–	4	3.5	–	–	–	–	4	0.7
Eutypa bathurstensis K.D. Hyde *et* Rappaz	10	14.3	2	1.9	1	2.3	6	10	–	–	–	–	–	–	19	3.1
Eutypa sp. 1	1	1.4	7	6.7	1	2.3	–	–	–	–	–	–	–	–	9	1.5
Eutypa sp. 2	–	–	–	–	9	20.5	5	8.3	–	–	–	–	–	–	14	2.3
Eutypa sp. 3	–	–	–	–	–	–	–	–	3	2.6	–	–	–	–	3	0.5
Eutypa sp. 4	–	–	–	–	–	–	–	–	5	4.3	–	–	–	–	5	0.8
Eutypella sp.	–	–	–	–	–	–	–	–	1	0.9	–	–	–	–	1	0.2
Hapsidascus sp.	–	–	–	–	–	–	–	–	–	–	2	1.8	–	–	2	0.3
Hypophloeda rhizospora K.D. Hyde *et* E.B.G. Jones	2	2.8	–	–	–	–	–	–	–	–	–	–	–	–	2	0.3
Hysterium sp. 1	–	–	–	–	–	–	–	–	–	–	12	10.6	–	–	12	2
Hysterium sp. 2	–	–	–	–	–	–	–	–	–	–	–	–	5	4.8	5	0.8
Julella avicenniae (Borse) K.D. Hyde	–	–	–	–	–	–	–	–	2	1.7	–	–	–	–	2	0.3
Kallichroma glabrum (Kohlm.) Kohlm. *et* Volkm.-Kohlm.	–	–	–	–	–	–	–	–	3	2.6	–	–	–	–	3	0.5

(Table 2 continued)

Fungi	1998								1999						Total	
	Sweatings		Chub Cay		Little San Salvador		Other coll.		Little San Salvador		Cunningham Lake		Acklins Lake			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Kallichroma tethys (Kohlm. *et* E. Kohlm.) Kohlm. *et* Volkm.-Kohlm.	14	20	30	28.8	7	15.9	10	16.7	–	–	–	–	–	–	61	10
Kirschsteiniothelia maritima (Linder) D. Hawksw.	–	–	–	–	–	–	–	–	–	–	1	0.9	–	–	1	0.2
Leptosphaeria australiensis (Cribb *et* J.W. Cribb) G.C. Hughes	14	20	11	10.6	2	4.5	19	31.7	3	2.6	–	–	3	2.9	52	8.5
Leptosphaeria avicenniae Kohlm. *et* E. Kohlm.	–	–	–	–	–	–	–	–	1	0.9	–	–	–	–	1	0.2
Leptosphaeria sp.	–	–	–	–	1	2.3	1	1.7	–	–	–	–	–	–	2	0.3
Lineolata rhizophorae (Kohlm. *et* E. Kohlm.) Kohlm. *et* Volkm.-Kohlm.	2	2.8	13	12.5	1	2.3	1	1.7	5	4.3	–	–	3	2.9	25	4.1
Lophiostoma sp.	–	–	–	–	–	–	–	–	3	2.6	–	–	2	1.9	5	0.8
Lulworthia grandispora Meyers	–	–	–	–	–	–	1	1.7	1	0.9	1	0.9	81	77.1	84	13.7
Massarina acrostichi K.D. Hyde	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	0.2
Massarina armatispora K.D. Hyde, Vrijmoed, Chinnaraj *et* E.B.G. Jones	–	–	2	1.9	–	–	–	–	–	–	–	–	1	1	3	0.5
Massarina lacertensis Kohlm. *et* Volkm.-Kohlm.	2	2.8	–	–	–	–	–	–	–	–	–	–	–	–	2	0.3
Massarina thalassiae Kohlm. *et* Volkm.-Kohlm.	–	–	1	1	–	–	–	–	–	–	10	8.8	8	7.6	19	3.1
Massarina sp. 1	2	2.8	–	–	–	–	–	–	–	–	–	–	–	–	2	0.3
Massarina sp. 2	–	–	–	–	–	–	1	1.7	–	–	–	–	–	–	1	0.2
Massarina sp. 3	–	–	–	–	–	–	–	–	–	–	3	2.7	–	–	3	0.5
Massarina sp. 4	–	–	–	–	–	–	–	–	–	–	2	1.8	–	–	2	0.3
Melaspilea mangrovei Vrijmoed, K.D. Hyde *et* E.B.G. Jones	1	1.4	3	2.9	3	6.8	2	3.3	3	2.6	–	–	–	–	12	2
Mauritiana sp.	1	1.4	–	–	–	–	1	1.7	1	0.9	4	3.5	5	4.8	12	2
Nemania maritima Ju *et* Rogers	–	–	–	–	–	–	–	–	2	1.7	–	–	–	–	2	0.3
Patellaria sp.	–	–	–	–	–	–	–	–	1	0.9	–	–	2	1.9	3	0.5
Phaeosphaeria sp.	–	–	–	–	–	–	–	–	6	5.2	–	–	6	5.7	12	2
Pleospora sp.	1	1.4	–	–	–	–	–	–	–	–	1	0.9	2	1.9	4	0.7
Pyrenographa xylographoides Aptroot	5	7.1	13	12.5	5	11.4	–	–	14	12.2	–	–	3	2.9	40	6.5
Quintaria lignatilis (Kohlm.) Kohlm. *et* Volkm.-Kohlm.	1	1.4	1	1	–	–	–	–	–	–	–	–	–	–	2	0.3
Saccardoella mangrovei K.D. Hyde	–	–	–	–	–	–	–	–	1	0.9	–	–	–	–	1	0.2
Saccardoella sp. 1	–	–	–	–	–	–	–	–	1	0.9	–	–	–	–	1	0.2
Saccardoella sp. 2	1	1.4	1	1	–	–	–	–	3	2.6	5	4.4	1	1	11	1.8
Saagaromyces abonnis (Kohlm.) K.L. Pang *et* E.B.G. Jones	–	–	2	1.9	–	–	–	–	–	–	–	–	–	–	2	0.3
Saagaromyces ratnagiriensis (Patil *et* Borse) K.L. Pang *et* E.B.G. Jones	–	–	–	–	–	–	1	1.7	–	–	–	–	–	–	1	0.2

(Table 2 continued)

Fungi	1998								1999						Total	
	Sweatings		Chub Cay		Little San Salvador		Other coll.		Little San Salvador		Cunningham Lake		Acklins Lake			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Swampomyces armeniacus Kohlm. *et* Volkm.-Kohlm.	2	2.8	5	4.8	2	4.5	5	8.3	–	–	–	–	2	1.9	16	2.6
Swampomyces triseptatus K.D. Hyde *et* Nakagiri	–	–	–	–	–	–	2	3.3	4	3.5	–	–	3	2.9	9	1.5
Swampomyces sp.	–	–	–	–	–	–	–	–	5	4.3	1	0.9	–	–	6	1
Trematosphaeria mangrovis Kohlm.	–	–	1	1	–	–	1	1.7	–	–	–	–	–	–	2	0.3
Torpedospora radiata Meyers	–	–	–	–	–	–	1	1.7	–	–	–	–	–	–	1	0.2
Valsa sp.	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	0.2
Verruculina enalia (Kohlm.) Kohlm. *et* Volkm.-Kohlm.	–	–	2	1.9	–	–	–	–	–	–	56	49.6	–	–	58	9.5
Ascomycete no. 1	1	1.4	–	–	–	–	–	–	–	–	–	–	–	–	1	0.2
Ascomycete no. 2	–	–	–	–	–	–	–	–	8	7	–	–	3	2.9	11	1.8
Ascomycete no. 3	1	1.4	–	–	–	–	–	–	–	–	–	–	–	–	1	0.2
Ascomycete no. 4	–	–	–	–	–	–	–	–	–	–	–	–	12	11.4	12	2
Discomycete no. 1	–	–	–	–	–	–	–	–	1	0.9	–	–	–	–	1	0.2
Discomycete no. 2	–	–	–	–	–	–	–	–	3	2.6	–	–	–	–	3	0.5
Discomycete no. 3	–	–	–	–	–	–	–	–	2	1.7	–	–	–	–	2	0.3
Discomycete no. 4	–	–	–	–	–	–	–	–	3	2.6	–	–	–	–	3	0.5
Discomycete no. 5	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	0.2
Discomycete no. 6	–	–	–	–	–	–	–	–	–	–	–	–	5	4.8	5	0.8
Stromatic bitunicate ascomycete	–	–	–	–	–	–	–	–	–	–	–	–	10	9.5	10	1.6
Mitosporic fungi																
Cirrenalia basiminuta Raghuk. *et* Zainal	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	0.2
Cirrenalia tropicalis Kohlm.	–	–	–	–	–	–	1	1.7	–	–	–	–	–	–	1	0.2
Cladosporium sp.	–	–	–	–	–	–	–	–	–	–	5	4.4	–	–	5	0.8
Dendryphiella salina (Sutherland) Pugh *et* Nicot	–	–	1	1	–	–	–	–	–	–	–	–	–	–	1	0.2
Macrophoma sp.	–	–	1	1	–	–	–	–	–	–	–	–	–	–	1	0.2
Phoma sp. 1	1	1.4	20	19.2	3	6.8	–	–	–	–	–	–	–	–	24	3.9
Phoma sp. 2	–	–	–	–	–	–	1	1.7	–	–	–	–	–	–	1	0.2
Phoma sp. 3	–	–	–	–	–	–	–	–	9	7.8	–	–	4	3.8	13	2.1
Rhabdospora avicenniae Kohlm. *et* E. Kohlm.	1	1.4	–	–	–	–	–	–	–	–	–	–	–	–	1	0.2
Rhabdospora sp.	–	–	–	–	–	–	–	–	–	–	–	–	3	2.9	3	0.5
Torula sp.	–	–	–	–	–	–	–	–	–	–	–	–	3	2.9	3	0.5
Coelomycete no. 1	1	1.4	–	–	–	–	–	–	–	–	–	–	–	–	1	0.2
Coelomycete no. 2	1	1.4	–	–	–	–	–	–	–	–	–	–	–	–	1	0.2
Coelomycete no. 3	–	–	–	–	–	–	–	–	7	6.1	–	–	8	7.6	15	2.5

(Table 2 continued)

Fungi	1998								1999						Total	
	Sweatings		Chub Cay		Little San Salvador		Other coll.		Little San Salvador		Cunningham Lake		Acklins Lake			
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Hyphomycete no. 1	–	–	–	–	–	–	–	–	1	0.9	–	–	–	–	1	0.2
Hyphomycete no. 2	–	–	–	–	–	–	–	–	2	1.7	–	–	–	–	2	0.3
Number of samples examined	70		104		44		60		115		113		105		611	
Number of fungal collections	68		135		49		61		131		118		195		757	
Number of fungi per sample	1		1.3		1.1		0.9		1.1		1		1.9		1.2	
Total number of fungi	24		21		14		18		36		16		33		92	

#: number of fungal collections; %: frequency of occurrence.

nalia pygmea Kohlm., *Halocyphina villosa* Kohlm., *Halorosellinia oceanica* Whalley, E.B.G. Jones, K.D. Hyde *et* Laessøe, *Halosarpheia fibrosa* Kohlm. *et* E. Kohlm. and *Lignincola laevis*, to list but a few, all common fungi on mangrove wood in the tropics (Jones and Alias 1997). However, the richness of the Diatrypaceae was high, with a number of species not previously recorded from this habitat.

Schmit and Shearer (2004) reported marine fungi from 14 locations in the Atlantic Ocean, including the Bahamas, with taxonomic richness ranging from 12–47 (mean of 25.6). This is considerably lower than the mean of 42.9 (12–64) and 44 (17–87) for the Indian and Pacific Oceans, respectively (Schmit and Shearer 2004). However, they did not advance arguments to account for these differences, beyond noting that old world mangroves are richer in plant species than new world mangroves. There are other factors that warrant consideration. In our opinion, the paucity and intensity of collections may well be significant in explaining the lower Atlantic Ocean figures. Some were short collecting visits resulting in the collection of few taxa. However, for the more intensively collected locations Belize, and Florida, much higher numbers of marine fungi were noted, 46, 47, respectively (Schmit and Shearer 2004).

Mangrove tree species in the Atlantic Ocean are few and they often form fringe communities. For example, only four tree species are found in Bahamian mangroves. However, the present study shows that with more intensive collecting, a wider range of fungi can be found, as more samples, different substrata and different areas are sampled. A number of taxa await further characterisation and description as new species, especially *Anthostomella* species and members of the Diatrypaceae.

Although many mangrove tree species have been sampled for mangrove fungi, there is a paucity of data on others, e.g., *Conocarpus erectus* L., *Ceriops tagal* (Perr.) C.B. Rob. Gaertn., *Laguncularia racemosa* (L.) Gaertn., with 11, 12 and 21 fungi reported from them, respectively (Sarma and Hyde 2001, Schmit and Shearer 2004), and further studies are warranted. Some 116 plant species occur in mangroves, yet few of these have been examined for fungi (Tomlinson 1986, Schmit and Shearer 2004). Future studies are required to focus on sampling protocols, with an emphasis on the exposure of named mangrove tree samples of equal dimension and over different exposure periods, so that their effect on fungal diversity can be evaluated (Alias and Jones 2000a,b). Such an experimental approach will help to resolve ecological issues (Sarma and Hyde 2001, Schmit and Shearer 2004), but may not yield the full range of fungi present in the ecosystem, as fewer species are generally recorded by baiting techniques (Tan et al. 1989, Leong et al. 1991).

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