Biodiversity of fungi on the palm *Eleiodoxa conferta* in Sirindhorn peat swamp forest, Narathiwat, Thailand

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This study focuses on the saprobic fungi occurring on decaying palm material of *Eleiodoxa conferta* at Sirindhorn peat swamp forest, Narathiwat Province, Thailand. In this survey, 462 fungal records were made from seven field collections in May, June, September and November (2001) and February, May and November (2002). Two hundred and fifty-one records were identified to species level, 176 to generic level while 35 records were unidentified. Of the 112 taxa identified 43 (38%) were ascomycetes, 67 (60%) anamorphic fungi and 2 (2%) basidiomycetes. Different parts of *E. conferta* support differing fungi: dry (aerial) material supported 17% of the fungal records, damp (moist and on the surface of the soil) material 34.5%, while submerged wet material had the most fungal records (48.5%). The percentage abundances of fungi on different parts of *E. conferta* were petioles 53%, rachides 30% and leaves 17%. Many of the taxa collected are new to science. *Eleiodoxa conferta* has been shown to support a rich diversity of fungi that differ significantly from those on terrestrial and brackish water palms. Eight new species and one genus have been described from this palm, while 12 taxa await description.

Key words: biodiversity, habitat preference, palm fungi, peat swamp, tissue specificity

Introduction

A wide range of fungi have been documented from palms primarily from tropical locations (Hyde, 1996a,b,c; Hyde *et al*., 1997; Taylor and Hyde, 2003). Up to 1994, *ca.* 1,580 fungi had been recorded from palms including 650 ascomycetes, 270 basidiomycetes and 660 anamorphic fungi, with 75% of the fungi on palms being new records to science (Hyde *et al*., 1997).

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Anthostomella, *Astrosphaeriella*, *Capsulospora*, *Linocarpon*, *Neolinocarpon* and *Oxydothis* are common genera on terrestrial palm material (Fröhlich and Hyde, 2000; Yanna, 2001a,b; Taylor and Hyde, 2003).

Studies on palm fungal diversity have focused on saprobic terrestrial species, with fewer on endophytes and pathogens (Fröhlich and Hyde, 2000). In aquatic habitats, the brackish water palm *Nypa fruticans* has been examined for fungi with *Astrosphaeriella*, *Linocarpon* and *Oxydothis* being the most common genera (Hyde and Alias, 1999). Freshwater peat swamps are often rich in palms species but little information is available on the fungi colonizing such substrata (Shearer and Crane, 1986).

The objectives of this study were determine the fungal diversity on *Eleiodoxa conferta*; determine the diversity and distribution of fungi on different parts of *Eleiodoxa conferta*; determine the effect of dry, damp, and wet microhabitats on fungal diversity on *Eleiodoxa conferta*; compare the fungal diversity on freshwater palm, *Eleiodoxa conferta*, with those on brackish water and terrestrial palms and compare the fungal diversity on palm and other substrates from freshwater habitats.

Materials and methods

Sample collection

Eleiodoxa conferta was collected at Sirindhorn Research and Nature Study Center (Sirindhorn Peat Swamp Forest), Narathiwat Province, Thailand (See Fig. 1). Collections of *Eleiodoxa conferta* were divided into 3 parts: palm leaves, rachides and petioles, and from 3 microhabitats: wet (constantly submerged), damp (moist and on the surface of the soil), and dry (aerial part) microhabitats and then placed in plastic bags. Collections were made in May, June, September and November (2001) and February, May and November (2002). Samples were returned to the laboratory where the material was incubated in plastic boxes on sterile moist tissue. The material was kept moist and examined periodically for fungal fruiting structures, and species identified. One thousand and seventy one samples were collected over the study period: May (2001) 109 samples; June (2001) 271; September (2001) 105; November (2001) 121; February (2002) 215; May (2002) 160 and November (2002) 90.

Isolation

Single spore isolations were made from sporulating structures on material incubated in the laboratory or from fresh material when isolated in the field

Fig. 1. Sirindhorn peat swamp forest arrow the palm *Eleiodoxa conferta*.

laboratory. The isolation medium was Corn Meal Agar (CMA), with added antibiotics (Streptomycin 0.5 g/l, Penicillin G 0.5 g/l), and germinating spores transferred to Potato Dextrose Agar (PDA), and incubated at room temperature until growth was observed.

Data analyses: Percentage abundance of a taxon was calculated according to the following formula:

$$\textbf{Percentage abundance of taxon A} = \frac{\text{Occurrence of taxon A} \times 100}{\text{Occurrence of all taxa}}$$

Similarity index (Magurran, 1988)

$2N / N_1 + N_2$ (comparing fungi between 2 vertical positions)
$3N / N_1 + N_2 + N_3$ (Overall: comparing fungi between 3 vertical positions)
Where,
N = Number of fungi commonly occurring at multiple levels
N_1 = total number of fungal species on level 1
N_2 = total number of fungal species on level 2
N_3 = total number of fungal species on level 3

Results

Abundance of fungi on the palm **Eleiodoxa conferta**

Four-hundred and sixty-two fungal records were made from six field collections (Table 1). One hundred and twelve taxa were collected and identified with 43 (38% all of records) ascomycetes, 67 (60%) anamorphic fungi and 2 (2%) basidiomycetes (Table 1). The most common taxa were *Cancellidium applanatum* (6.9% of all records), *Xylomyces aquaticus* (5.8%), *Astrosphaeriella* sp. (5.6%), *Stilbohypoxylon moelleri* (5.2%), *Lophiostoma frondisubmersa* (5%), *Microthyrium* sp. (5%), *Morenoina palmicola* (4.5%), *Phaeoisaria clematidis* (4.1%), *Nemania eleiodoxae* (3%), and *Jahnula appendiculata* (2.8%) (Table 1). Forty species (36% of total species) were represented by only one record and can be regarded as infrequent or rare. Twenty-three taxa remained unidentified: 6 ascomycetes, 12 hyphomycetes, 3 coelomycetes, and 2 basidiomycetes.

Abundance of fungi on palm material under different microhabitats

Percentage abundance of fungi on different parts of the *E. conferta* were as follows: dry material supported 17%, damp material 34.5%, while the wet material supported the most fungi 48.5%, with *Xylomyces aquaticus* (19 records), *Microthyrium* sp. (18), *Astrosphaeriella* sp. (15), and *Jahnula appendiculata* (12) being the most common taxa (data not shown). On dry material a few records of the following species were made: *Morenoina palmicola* (12 records), *Nemania eleiodoxae* (8), and *Capnodiastrum*/*Kamatia* sp. (5); while on damp material: *Cancellidium applanatum* (12 records), *Gaeumannomyces* sp. (6), and *Berkleasmium typhae* (5) were the most common fungi (data not shown).

Percentage coverage of fungi on different parts of the palm

The percentage coverage of fungi on different parts of *E. conferta* were petioles 53%, leaves 17%, and rachides 30%. The following species appeared exclusively or primarily on the petioles of the palm: *Stilbohypoxylon moelleri* (12 records), *Morenoina palmicola* (10), *Nemania eleiodoxae* (9), *Astrosphaeriella* sp. 4 (6), *Capnodiastrum*/*Kamatia* sp. (6), *Gaeumannomyces* sp. (6) *Coleodictyospora micronesica* (5), *Delortia palmicola* (4) and *Nawawia filiformis* (4). Fewer fungi were recorded on the palm rachides, the most common being *Phaeoisaria clematidis* (9), *Microthyrium* sp. (8 records), *Berkleasmium typhae* (6), and *Sporidesmium* sp. 1 (4). The following species were only collected once on leaf material and diversity was low *Acrocalymma*

Table 1. Abundance of fungi on the palm *Eleiodoxa conferta* at the peat swamp forest, Narathiwat (species listed in order of percentage abundance).

Fungus	Number of records	Percentage abundance
Cancellidium applanatum	32	6.9
Xylomyces aquaticus	27	5.8
Astrosphaeriella sp.*	26	5.6
Stilbohypoxylon moelleri	24	5.2
Lophiostoma frondisubmersa	23	5.0
Microthyrium sp.	23	5.0
Morenoina palmicola	21	4.5
Phaeoisaria clematidis	19	4.1
*Nemania eleiodoxae**	14	3.0
Jahnula appendiculata	13	2.8
Gaeumannomyces sp.*	12	2.6
Berkleasmium typhae	10	2.2
Nawawia filiformis	9	1.9
Capnodiastrum/ *Kamatia* sp.	9	1.9
Coleodictyospora micronesica	8	1.7
Annulatascus sp. 1	8	1.7
Astrosphaeriella sp. 4	7	1.5
Submersisphaeria palmae	7	1.5
Oxydothis rattanicola	6	1.3
*Didymobotryum biseptata**	6	1.3
Delortia palmicola	5	1.1
Septomyrothecium sp. 1	5	1.1
Sporidesmium sp.*	5	1.1
Stictis sp.	5	1.1
Brachysporiella gayana	4	0.9
Bionectria sp.	3	0.6
Custingophora undulatistipes	3	0.6
Helicomyces roseus	3	0.6
Stachybotrys albipes	3	0.6
Thozetella sp.*	3	0.6
Annulatascus velatispora	3	0.6
Dactylella sp. 1	3	0.6
Fluviatispora reticulata	3	0.6
Trichoderma sp.	3	0.6
Dactylaria flammulicornuta	3	0.6
Arthrobotrys sp.	2	0.4
Astrosphaeriella sp. 3	2	0.4
Capsulospora frondicola	2	0.4
Chlamydospore type 2	2	0.4
Chloridium sp.	2	0.4
Diplococcium asperum	2	0.4
Dischloridium sp.	2	0.4
Linocarpon sp.*	2	0.4

Table 1 continued. Abundance of fungi on the palm *Eleiodoxa conferta* at the peat swamp forest, Narathiwat (species listed in order of percentage abundance).

Fungus	Number of records	Percentage abundance
Massarina-like	2	0.4
Penicillium sp.	2	0.4
Pestalosphaeria austroamericana	2	0.4
Phialogeniculata sp.	2	0.4
Pleurophragmium sp. 1	2	0.4
Septomyrothecium sp. 2	2	0.4
Sporidesmium-like	2	0.4
Acrocalymma medicaginis	1	0.2
Anthostomella sp.*	1	0.2
Annulatuscus sp. 2 *	1	0.2
Apioclypea apiosporioides	1	0.2
Astrosphaeriella angustispora	1	0.2
Astrosphaeriella sp. 1	1	0.2
Astrosphaeriella sp. 2	1	0.2
Cancellidium-like 1	1	0.2
Cancellidium-like 2	1	0.2
*Chaetoporthe eleiodoxae**	1	0.2
Chaetopsina sp.	1	0.2
Chalara siamense	1	0.2
Chlamydospore type 1	1	0.2
Dactylaria uliginicola	1	0.2
Dactylella sp. 2	1	0.2
Diaporthe sp.	1	0.2
Gnomonia sp.	1	0.2
Goidanichiella fusiforma	1	0.2
Gonytrichum macrocladum	1	0.2
Haplographium state of *Hyaloscypha dematiicola*	1	0.2
Helicoma sp.	1	0.2
Helicosporium sp.	1	0.2
Helicoubisia coronata	1	0.2
Heteroconium sp.	1	0.2
Lophodermium sp.	1	0.2
Melanographium citri	1	0.2
Monotosporella rhizoidea	1	0.2
Munkovalsaria sp.*	1	0.2
Ophiostoma sp.	1	0.2
Orbilia sp.	1	0.2
Ornatispora sp.	1	0.2
Pleurophragmium sp. 2	1	0.2
Septomyrothecium sp. 2	1	0.2
Sporidesmium sp. 2*	1	0.2
Septomyrothecium sp. 2	1	0.2

Table 1 continued. Abundance of fungi on the palm *Eleiodoxa conferta* at the peat swamp forest, Narathiwat (species listed in order of percentage abundance).

Fungus	Number of records	Percentage abundance
Sporidesmium sp. 2*	1	0.2
Tubeufia claspisphaeria	1	0.2
Unisetosphaeria penguinoides	1	0.2
Vanakripa minutiellipsoidea	1	0.2
Verticillium sp.	1	0.2
Wiesneriomyces-like	1	0.2
Unidentified ascomycetes (6 taxa)	14	#
Unidentified basidiomycete (2 taxa)	5	#
Unidentified coelomycetes (3 taxa)	3	#
Unidentified hyphomycetes (12 taxa)	13	#
Total records	462	100
Ascomycetes	43	38
Basidiomycetes	2	2
Anamorphic fungi	67	60
Total species	**112**	**100**

* New species awaiting description
# Data not presented

sp., *Annulatascus* sp. 2, *Astrosphaeriella angustispora*, *Helicoubisia coronata*, *Lophodermium* sp., *Melanographium* sp., *Septomyrothecium* sp. 2, *Stachybotrys albipes*, and *Verticillium* sp.

Some fungi were found on all parts of the palm: e.g. *Astrosphaeriella* sp., *Cancellidium applanatum*, *Lophiostoma frondisubmersa*, *Microthyrium* sp., *Nawawia filiformis*, and *Xylomyces aquaticus*. Saprobes found under every microhabitat included: *Nemania eleiodoxae*, *Astrosphaeriella* sp. 4, *Berkleasmium typhae*, *Capnodiastrum/Kamatia* sp., *Coleodictyospora micronesica*, *Delortia palmicola*, *Gaeumannomyces* sp., *Morenoina palmicola*, *Phaeoisaria clematidis*, and *Stilbohypoxylon moelleri*.

Fungi that were recorded equally on petioles and rachides include *Annulatascus velatispora*, *Astrosphaeriella* sp. 4, Basidiomycete 1, *Berkleasmium typhae*, *Coleodictyospora micronesica*, *Custingophora undulatistipes*, *Didymobotryum biseptata*, *Gaeumannomyces* sp., *Helicomyces roseus*, *Jahnula appendiculata*, *Morenoina palmicola*, *Oxydothis rattanicola*, *Phaeoisaria clematidis*, *Stilbohypoxylon moelleri*, *Submersisphaeria palmae*, and *Thozetella* sp.

Discussion

The results presented raise a number of questions with respect to the diversity of fungi on the palm *E. conferta*. Are the species recorded unique to the peat swamp forest and how similar is the fungal community to that on terrestrial palms?

Are the fungi on* Eleiodoxa conferta *different to those on terrestrial palms?

Ascomycetes are common on *Eleiodoxa conferta* as in the terrestrial palms *Oraniopsis appendiculata* and *Livistona australis* (Taylor and Hyde, 2003) with *Astrosphaeriella* species common to all three. However, genera such as *Arecomyces*, *Linocarpon* and *Oxydothis*, generally common on terrestrial palms, were not a dominant group on *E. conferta*. Similar differences were observed with the fungi *Brachysporiella*, *Linocarpon*, *Oxydothis* and *Trichoderma* common fungi on the palm *Oncosperma horridum* (Yanna *et al*., 2001a), but rarely found on *E. conferta*.

Comparisons of ten most dominant fungi on terrestrial palms and *E. conferta* showed little overlap in species (data not show). A variety of factors may account for the differences observed, habitats, host-specificity, location, temperature, and rainfall (Fröhlich and Hyde, 2000; Taylor and Hyde, 2003).

Fungi common to palms are often non-specific in their host species associations. However, not only are cases of host species specificity notable (e.g. *Oxydothis alexandrarum* is commonly collected on, and thus far exclusive to *Archontophoenix alexandrae*), but also differences in the composition of assemblages of different palms has been noted (Yanna *et al*., 2001a,b; Taylor and Hyde, 2003). At which level specificity occurs, e.g. host genus, subtribe, tribe, subfamily, is not yet obvious, but should become apparent as the mycota of more palm hosts are systemically investigated.

***Comparison of fungi colonizing the brackish water palm* Nypa fruticans *with* Eleiodoxa conferta**

Nypa fruticans is a palm that grows in brackish water and extends into freshwater zones and the fungi colonizing it have been well documented by Hyde (1992), Hyde and Alias (1999) and Hyde *et al*. (1999). Sixty-four fungi have been recorded on *Nypa* from Brunei, Malaysia and Thailand, and the ten most common species collected in Brunei are listed in Table 2. Pilantanapak (2003) and Pilantanapak *et al*. (2005) have undertaken a quantitative study of the fungi growing on *Nypa* in Kamnanyiam, Samut Songkhram, Thailand and reported a wide variety of species. Some were present at a high frequency of occurrence: *Aniptodera nypae* (14%), *Astrosphaeriella striataspora* (26.4%), *Trichocladium nypicola* (34.8%), *Helicorhoidion nypicola* (34%), *Linocarpon nipae* (30.8%), *Oxydothis nypae* (26.8%), while others occurred at a lower

Table 2. Ten most common fungi on *Nypa fruticans* in Brunei (Hyde, 1992) and *Eleiodoxa conferta*.

Nypa fruticans	***Eleiodoxa conferta***
Linocarpon appendiculatum	*Cancellidium applanatum*
Astrosphaeriella striataspora	*Xylomyces aquaticus*
Oxydothis nypae	*Astrosphaeriella* sp.*
Lignincola laevis	*Stilbohypoxylon moelleri*
Linocarpon nipae	*Lophiostoma frondisubmersa*
Lulworthia grandispora	*Microthyrium* sp.
Halocyphina villosa	*Morenoina palmicola*
Helicascus nypae	*Phaeoisaria clematidis*
Fasciatispora nypae	*Nemania eleiodoxae**
Carinispora nypae	*Jahnula appendiculata*
Ascomycetes = 9 species	Ascomycetes = 7 species
Basidiomycetes = 1 species	Anamorphic fungi = 3 species
Total = 10 species	Total = 10 species

* New species awaiting description

frequency: *Lulworthia grandispora* (3.6%), *Neolinocarpon globosicarpum* (4%), *Aniptodera limnetica* (6%), *Dictyosporium elegans* (6.3%), and *Lignincola laevis* (8.8%). Some species were present at a very low frequency and included: *Linocarpon appendiculatum* and *Cirrenalia pygmea*.

A comparison of the fungi colonizing *Eleiodoxa conferta* with *Nypa fruticans* shows that there are few species/genera in common: *Astrosphaeriella*, *Linocarpon* and *Oxydothis*. However, the genera *Carinispora*, *Fasciatispora*, *Halocyphina*, *Helicascus*, *Lignincola* and *Lulworthia*, which are common on *Nypa,* have not been recorded on *E. conferta* (Table 2). These genera are more commonly found on substrata in marine habitats (Poonyth *et al.*, 1999) and may require sodium chloride for growth, while those on *E. conferta* may not be salt tolerant. The latter may be more tolerant to acidic waters, while marine fungi tend to occur in more alkaline waters.

Comparison of fungi on **Eleiodoxa conferta** *with freshwater fungi*

Fungi occurring on *Eleiodoxa conferta* in a peat swamp can be compared with those on different substrata in freshwater streams and rivers (Table 3). Common fungi in freshwater habitats include: *Aquaticola*, *Aniptodera*, *Dictyochaeta*, *Dictyosporium*, *Helicomyces*, *Savoryella* and *Sporoschisma* (Ho *et al.*, 1999a, b; Sivichai *et al.*, 2000; Luo *et al.*, 2004; Tsui *et al.*, 2004) but these genera are not common or even reported on *E. conferta*, and these differences can be attributed to habitat and the substrata sampled. Nevertheless,

Table 3. Ten most common fungi on wood in freshwater habitats in Hong Kong and Thailand. (Ho *et al*., 2001, 2002; Sivichai, 1999)

Machilus velutina **Natural wood Hong Kong**	***Dipterocarpus alatus*** **Natural wood Thailand**	***Pinus velutina*** **Natural wood Hong Kong**
Savoryella lignicola	*Helicomyces roseus*	*Massarina ingoldiana*
Aniptodera chesapeakensis	*Trematosphaeria* sp.	*Sporoschisma nigroseptatum*
Sporoschisma floriformis	Sporodochial	*Spirosphaera floriformis*
Aquaticola rhomboida	*Dictyochaeta* sp.	*Aniptodera chesapeakensis*
Dictyosporium elegans	*Ophioceras dolichostomum*	*Lophiostoma bipolare*
Lophiostoma ingoldianum	Discomycete	*Aquaticola rhomboida*
Xylomyces chlamydosporus	*Bombardia* sp.	*Dictyosporium elegans*
Dictyosporium digitatum	Unidentified ascomycete	*Dictyosporium digitatum*
Cercophora appalachianensis	Pycnidial fungus 1	*Sporoschisma uniseptatum*
Kameshwaromyces globosus	*Tubeufia cylindrothecia*	*Savoryella lignicola*

Submerged test block ***Dipterocarpus alatus*** **Thailand**	**Submerged test block** ***Xylia dolabriformis*** **Thailand**
Trematosphaeria sp.	*Savoryella aquatica*
Unidentified ascomycete	*Trematosphaeria* sp.
Helicomyces roseus	*Biflagellospora gracilis*
Anthostomella aquatica	*Helicomyces roseus*
Sporodochial	*Dactylaria* sp.
Unidentified hyphomycete	*Scutisporus brunneus*
Dactylaria sp.	*Volutella* sp.
Ellisembia brachypus	*Dictyochaeta* sp.
Pycnidial fungus 1	*Ellisembia opaca*
Discomycete species	*Biflagellospora papillata*

fungi on *E. conferta* such as *Cancellidium applanatum*, *Xylomyces aquaticus*, *Phaeoisaria clematidis* and *Nawawia filiformis* were also found on other substrata in freshwater habitats but at a lower frequency than the fungi mentioned above.

Why are fungi more abundant on wet palm material?

Wet palm material was found to support more fungal records than damp or dry material. A number of factors may account for this: a water logged substratum, and the acidity of the water. Most fungi require a high relative humidity for spore infection, spore germination, growth, and reproduction (Magan and Lacey, 1984). A further factor that may account for this is the acidic nature of the water in the peat swamp forest (pH 3-6 depending on season). pH has been shown to affect the growth of fungi for example some prefer alkaline conditions for growth: urea or ammonia fungi; fungi in tree holes (Hilton and Mill, 1986; Kladwang *et al*., 2003). Preference for acidic conditions for the growth is more widely documented (Sabine and Eleanora, 2000).

Webster (1956) examined the moisture content of erect stems of the terrestrial grass *Dactylis* and showed that the atmosphere around the basal parts was often saturated with water up to about 10 cm above soil level. There was a steep decline in moisture content with increasing height above the soil level. As the stems of most grasses remain erect, the decline in the humidity gradient is marked (Dix and Webster, 1995; Van Ryckegem and Verbeken, 2005a,b). However, they found that some fungi were better able to colonize the upper internodes, with a lower humidity, than those confined to the lower regions of the grass. This could account for the variation in fungal communities on different parts of the grass with low or high moisture contents and may account for the vertical distribution of fungi on such a substratum. Similarly distinct zonation of fungi with height above water has been reported for the brackish water marsh grasses *Spartina* and *Juncus roemarianus* (Gessner and Kohlmeyer, 1976; Kohlmeyer and Volkmann-Kohlmeyer, 2002) and the marine angiosperms e.g. *Posidonia oceanica* and *Cymodocea nodosa* (Cuomo *et al*., 1982). This has been attributed to the salinity of the water and degree of drying out of the aerial portions of the grasses.

Why are fungi more abundant on petioles of the palm?

Fungi were more prevalent on palm petioles (53%) than on the rachides (30%) and leaves (17%) and this may be accounted for by their anatomical structure. Leaves contain mainly parenchymatous cells that are thin-walled, with chloroplasts and rich in starch, while rachides and petioles have more sclerenchyma associated with the vascular bundles. Thus, the thicker cell walls may yield more nutrients for the sustained growth of fungi, in particular cellulose.

As with the grasses (Dix and Webster, 1995; Van Ryckegem and Verbeken, 2005a,b), there is a gradation in the water content of various parts of the palm. The base of the palm (petiole) is generally submerged or in contact with the peat swamp water and is therefore either waterlogged or high in moisture content and thus more suitable for fungal colonization. Petioles also contain vascular bundles that may take up water and retain moisture for a longer time (Fisher *et al*., 2002). The aerial dried palm leaves contain less moisture and are subject to a more rapid drying out than the rachides and petioles.

Tissue-specificity has been widely observed (e.g. in infructescences of *Protea* sp.: Lee *et al*., 2005) and possible reasons for tissue-specificity, or recurrence, has been suggested for saprobic microfungi from palms (Fröhlich and Hyde, 2000; Yanna *et al*., 2001a,b). Palm petioles are more robust in terms of structure than leaves and do not decompose as rapidly, thus allowing time for a more complex fungal population to form and for a succession of different fungi to develop (Fröhlich and Hyde, 1999). Furthermore, endophytes have been shown to be tissue-recurrent (Kumar and Hyde, 2004) and therefore may account for tissue recurrent saprobes if they change lifestyles at plant senescence.

In conclusion, the peat swamp palm *Eleiodoxa conferta* has been shown to support a rich fungal diversity comprising few dominant species and many rare species. This type of distribution is typical of other biodiversity studies that significantly differ from those on terrestrial and brackish water palms. This diversity is reflected in the number of new taxa described (*Chalara siamense*, *Custingophora undulatistipes*, *Dactylaria flammulicornuta*, *Dactylaria palmae*, *Dactylaria uliginicola*, *Goidanichiella fusiforma*, *Submersisphaeria palmae*, *Unisetosphaeria penguinoides* and *Vanakripa minutiellipsoidea*) while others await study and description (Hyde *et al*., 2002; McKenzie *et al*., 2002; Pinnoi *et al*., 2003a,b, 2004).

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