Hyphomycetes from the Great Smoky Mountains National Park, including three new species

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As part of the All Taxa Biotic Inventory currently being conducted in the Great Smoky Mountains National Park, samples of woody debris in freshwater and terrestrial habitats as well as leaves and soil organic matter in terrestrial habitats were collected and studied to detect the presence of hyphomycetes. Sixty hyphomycetes are reported here, and three new species are described and illustrated. Eleven species are new records for the USA, and fifteen species are new records for the park.

Key words: anamorph, fresh water, mitosporic, systematics, wood

Introduction

An All Taxa Biotic Inventory (ATBI) is currently underway in the Great Smoky Mountains National Park (GSMNP), USA. In conjunction with a non-profit organization, Discover Life In America (DLIA), the aim of the ATBI is to inventory all life forms in the park. Goals of the ATBI are to determine: 1) what species exist in the park; 2) where the species occur in the park; and, 3) the roles species play in the park ecosystems (Sharkey, 2001).

Sharkey (2001) estimated the total number of fungi in the GSMNP to be around 20,000 species, but only about 2,250 species are currently known (Petersen, 1979). Historically, few studies on euascomycete fungi have been conducted in the park. Petersen (1962, 1963a,b), Crane (1968), and Dyko (1976) collected and described freshwater hyphomycetes from several streams in the park and nearby areas, while Dyko and Sutton (1978) studied coelomycetes from aquatic sites throughout the Appalachian Mountains. L.R.

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Hesler collected fungi in the park throughout his lifetime, and his collections are summarized in a checklist by Petersen (1979). More recently, Vasilyeva and others, (2004, 2005, 2006, 2007) collected terrestrial pyrenomycetes focusing on xylariaceous fungi from the park, while Baird *et al*. (2007) surveyed the hyphomycetes growing on bark of spruce, fir, and beech trees. Two new freshwater euascomycete fungi have recently been described from the GSMNP (Raja *et al*., 2003, 2005). To date, no studies of soil euascomycetes have been conducted in the park.

In view of the minimal knowledge concerning fungal biodiversity in the park, we carried out an inventory to determine the species richness and distribution of euascomycetes that occur in freshwater and terrestrial habitats in the GSMNP. In this paper we describe and illustrate three new species of hyphomycetes collected from freshwater and terrestrial habitats in the park. A preliminary checklist of hyphomycetes collected from these habitat types is also presented herein and compared to a recent study of hyphomycetes from bark (Baird *et al*., 2007).

Materials and methods

Study area

The GSMNP, an International Biosphere Reserve, encompasses an area of more than 2105 km^2 and spans the mountainous border between eastern Tennessee and western North Carolina. It contains some of the largest old growth forests in the eastern United States and is home to more than 1,570 species of vascular plants including 130 species of native trees (Sharkey, 2001). Five major forest types occur in the GSMNP: cove hardwood, hemlock, northern hardwood, pine-oak, and spruce-fir (Whittaker, 1956). Spruce-fir forests dominate the highest elevations, hardwood forests occur throughout the middle to upper elevations, hemlocks are scattered from the lower elevations to ca. 1300 meters, while pine-oak forests and cove hardwoods are seen at the lower elevations. Elevations range from approximately 243–2000 meters above sea level.

Sampling method (freshwater fungi)

Submerged woody debris was collected from aquatic (lotic and lentic) habitats at elevations ranging from 244–1,220 meters and transported to the laboratory in plastic bags containing moistened paper towels. Water temperature, pH, and latitude and longitude were measured and recorded in the field. Woody debris was incubated in the laboratory at room temperature (22–

25ºC) under 12/12h (light/dark) conditions in plastic boxes containing moistened paper towels. Samples were examined with a dissecting microscope immediately after collection and periodically over six months. For a detailed explanation of the collection methods refer to Shearer *et al*. (2004). New species were isolated on antibiotic water agar (AWA), and then transferred to corn meal agar (CMA), potato dextrose agar (PDA) or yeast peptone glucose starch agar (YPGS) following Shearer *et al*. (2004).

Sampling method (terrestrial fungi)

Samples of plant debris (leaves, small branches, bark and wood of deciduous trees and herbaceous plants) were collected from soil, placed into sterilized paper bags, and processed as soon as possible. Plant material was then placed into moist chambers, incubated at room temperature (22–25ºC), and examined with a stereomicroscope over a 3-week period.

Soil samples from the A_o horizon were collected using sterilized, auto-sealed polyethylene bags. The samples were treated with 5% acetic acid water solution for 10 min and plated on potato carrot agar (PCA; 20 g potatoes, 20 g carrot, 20 g agar-agar, 1 L tap water) with chloramphenicol (50 mg/L) at 25ºC, under 12/12h (light/dark) conditions, as described by Stchigel *et al*. (2001).

With the aid of a dissecting microscope, sporulating fungi were located on natural substrates or isolation media. Fruiting structures were removed, placed in a drop of distilled water and covered with a coverslip for examination with the compound microscope. Measurements were made of material mounted in distilled water, lactic acid containing azure A, or glycerin. A minimum of 30 measurements was taken for all morphological structures. Images of micromorphological characters were captured with a QImaging QColor 3 digital camera mounted on either a Leica MZ7.5 dissecting microscope with a Schott KL1500 fiber optics light source or an Olympus BX51 compound microscope using differential interference or phase contrast microscopy. Images were processed using Adobe Photoshop 7.0 (Adobe Systems Inc., Mountain View, California). Lactic acid containing azure A or glycerin was used to preserve slide preparations using the double cover glass method (Volkmann-Kohlmeyer and Kohlmeyer, 1996). Permanent slides and air-dried specimens are deposited in the Illinois Natural History Survey Mycological Collections (ILLS) or in the Mycological Herbarium of the University of Illinois Urbana Champaign (ILL). Abbreviations of collectors' names are: ANM, Andrew N. Miller; AMS, Alberto M. Stchigel; JC, Jinx Campbell.

Results

A total of 60 hyphomycetes were collected (Table 1). Eleven species are new records for the USA (indicated by * in Table 1), and fifteen species are new records for the GSMNP (indicated by **bold** in Table 1). Fourteen species were found on wood both in freshwater and terrestrial habitats. No overlap in species composition occurred between species reported from wood (either freshwater or terrestrial) and soil. Three new species of hyphomycetes are described and illustrated herein (Figs 1-24).

Table 1. Hyphomycetes from the Great Smoky Mountains National Park and the habitats in which they occur (new records for the GSMNP are shown in **bold**; new records for USA are indicated by *).

Fungus Name	Freshwater Wood	Terrestrial Wood/Leaves	Terrestrial Soil
Acrogenospora sphaerocephala (Berk. & Broome) M.B. Ellis	+	+	
Alysidiopsis prolificans* Stchigel, A.N. Mill. & J.L. Crane		+	
Arthrobotrys cfr. *superba*	+		
Bactrodesmium abruptum (Berk. & Broome) E.W. Mason & S. Hughes	+		
Bactrodesmium longisporum M.B. Ellis	+		
Bactrodesmium pallidum M.B. Ellis	+		
Berkleasmium concinnum (Berk.) Moore	+	+	
Brachydesmiella biseptata G. Arnaud ex S. Hughes	+		
Brachydesmiella orientalis* (V.G. Roa & de Hoog) Goh	+		
Brachysporium obovatum Keissl. anamorph of *Cryptodelphia obovata* Réblová & Seifert	+	+	
Brachysporium pendulisporum S. Hughes anamorph of *Cryptodelphia pendulispora* Réblová & Seifert	+		
Canalisporium pulchrum* (Hol.-Jech. & Mercado) Nawawi & Kuthub	+		
Candelabrum brocchiatum Tubaki	+	+	
Casaresia sphagnorum Frag.	+		
Chaetospermum cfr. *camelliae*	+		
Cheiromyces lignicola* Wai H. Ho, K.D. Hyde & Hodgkiss	+		
Cladorrhinum sp.			+
Cordana abramovii Seman & Davydkina	+		
Cordana pauciseptata Preuss		+	
Corniculariella spina (Berk. & Rav.) di Cosmo		+	
Corynespora curvispora* Stchigel, A.N. Mill. & J.L. Crane		+	
Cacumisporium sigmoideum Mercado & R.F. Castañeda	+		
***Dactylaria hyalotunicata* K.M. Tsui, Goh & K.D. Hyde**	+		

Table 1 continued. Hyphomycetes from the Great Smoky Mountains National Park and the habitats in which they occur (new records for the GSMNP are shown in **bold**; new records for USA are indicated by *).

Fungus Name	Freshwater Wood	Terrestrial Wood/Leaves	Terrestrial Soil
Dactylaria tunicata* Goh & K.D. Hyde	+		
Dactylaria sp.			+
***Delortia palmicola* Pat.**	+		
Dendryphiopsis atra (Corda) S. Hughes	+	+	
Desertella fumimontarum* Raja & Shearer	+		
Dichobotrys abundans Hennebert			+
Dictyosporium elegans Corda	+		
Ellisembia adscendens (Berk.) Subram.	+		
Endophragmia sp.		+	
Epicoccum nigrum Link			+
Geomyces pannorum var. *pannorum* (Link) Sigler & J.W. Carmich.			+
Helicoma dennisii M.B. Ellis	+	+	
Helicoma perelegans Thaxt. ex Linder	+		
Helicomyces roseus Link		+	
Helicoön gigantisporum* Goh & K.D. Hyde	+	+	
Helicosporium gigasporum* K.M. Tsui, Goh, K.D. Hyde & Hodgkiss	+	+	
Hyphozyma sp.			+
Lecythophora sp.			+
Melanocephala australiensis (G.W. Beaton & M.B. Ellis) S. Hughes	+		
Monodictys sp.		+	
Monotosporella setosa Berk. & M.A. Curtis	+	+	
***Neta patuxentica* Shearer & J.L. Crane**	+		
Periconia sp.		+	
Phaeoisaria sp.		+	
Phialographium sp.		+	
Pithomyces chartarum (Berk. & M.A. Curtis) M.B. Ellis			+
Pleurothecium recurvatum (Berk.) S. Hughes	+	+	
Pseudospiropsis sp.	+	+	
Spadicoides obovata (Cooke & Ellis) S. Hughes		+	
Sporidesmiella hyalosperma (Corda) P.M. Kirk. var. *hyalosperma*	+		
Sporoschisma juvenile Boud.	+		
Sporoschisma mirabile Berk. & S. Hughes	+	+	
Sporoschisma saccardoi Mason & S. Hughes	+	+	
Sporoschisma sp.		+	
***Xylomyces chlamydosporus* Goos, R.D. Brooks & Lamore**	+		
Xylomyces elegans* Goh, W.H. Ho, K.D. Hyde & K.M. Tsui	+		
Zanclospora novae-zelandiae* S. Hughes & W.B. Kendr.	+	+	

Taxonomy

Alysidiopsis prolificans Stchigel, A.N. Mill. & J.L. Crane, **sp. nov.** (Figs 1-7) MycoBank: 510818.

Etymology: From Latin 'prolificus', referring to the successive proliferations of the conidiophore.

Coloniae restrictae, nigrae, hirsutae. Mycelium superficiale, ex hyphis ramosis, septatis, pallide brunneis vel atrobrunneis, laevibus, 5-12 µm crassis compositum. Coniodiophora macronematosa, erecta vel flexuosa, ramosa secus longitudinem ad apicem irregulariter, parietibus crassis, atrobrunnea vel nigrae, 6-12 septata, 200-2000 µm longa, 8-15 µm crassa ad basim, ramis 50-300 µm longis. Cellulae conidiogenae monoblasticae vel polyblasticae, in conidiophoris incorporatae, laterales vel terminales. Conidia in catenas ramosas lateraliter vel terminaliter et ramos conidiophorae formata, sicca, sphaerica, limonifomia vel irregularia, laevia, non septata, hyalina, pallide vel atrobrunnea in basalis positionis, ad denticulos truncates interdum protrusos apicalis, basales et laterals, 8-25 × 7-15 µm.

Colonies restricted, black, hairy. Mycelium mostly superficial, formed of irregularly branched, septate, pale brown to dark brown, smooth hyphae; 5–12 µm wide. Conidiophores macronematous, erect to flexuous, irregularly branched along the length and at the tip, thick-walled, dark brown to black, 6–12 septate, 200–2000 µm long, 8–15 µm wide at the base, branches 50–300 µm long. Conidiogenous cells mono and polyblastic, integrated, lateral and terminal. Conidia formed in simple and branched chains, terminally and laterally on the conidiophore and its branches, dry, spherical, limoniform or irregular, smooth, non-septate, hyaline, but pale to dark brown when close to the conidiophore or branch main axis, basal, lateral or terminal on protruding truncate denticles (2–6 µm wide), 8–25 × 7–15 µm.

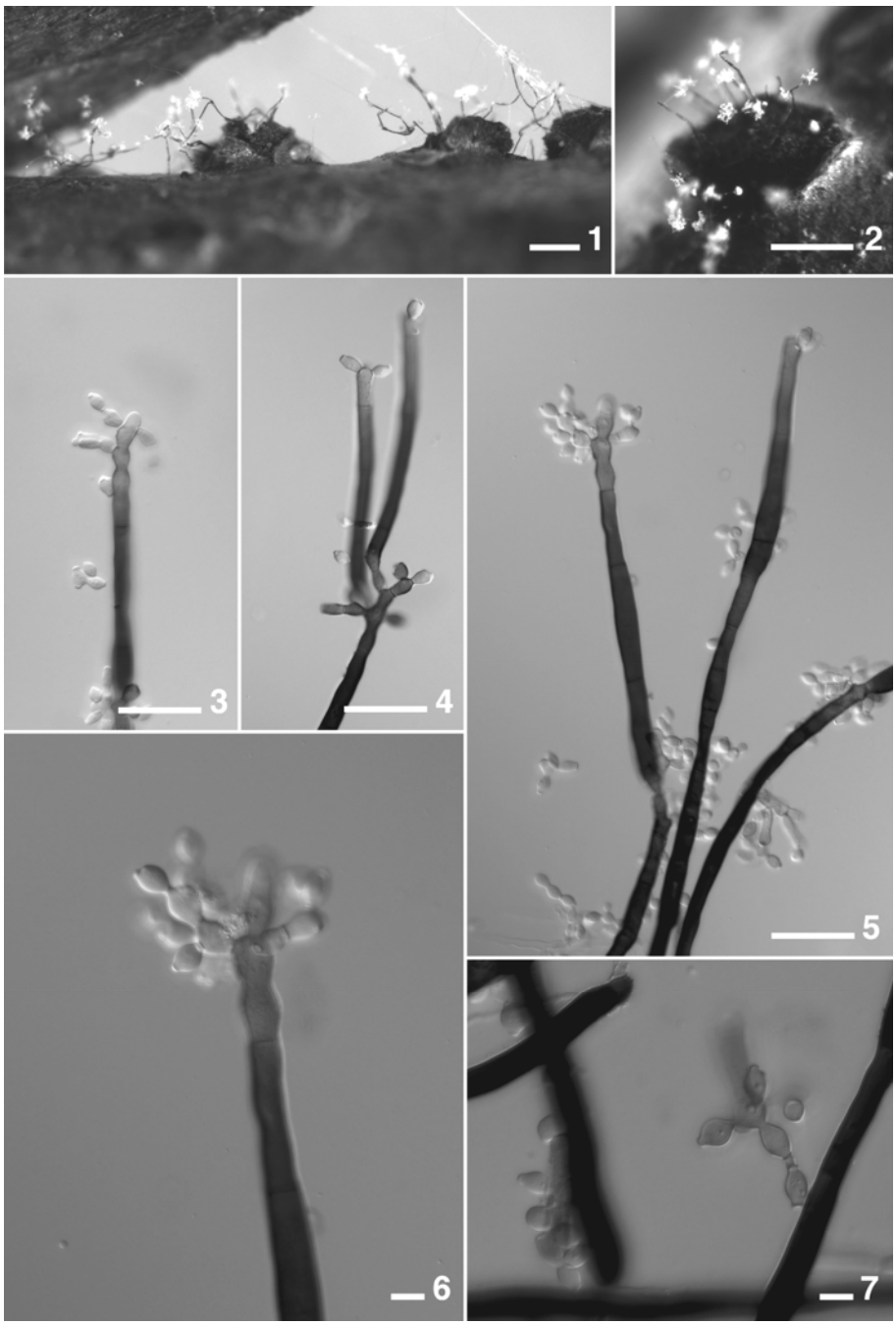
Teleomorph: not observed.

Habitat: on dead, corticated twigs of a deciduous tree on the forest floor.

Known distribution: USA (Tennessee).

Material examined: USA (Tennessee), Sevier Co., Great Smoky Mountains National Park, Alum Cave Trail, 35˚ 37' 43.1"N, 83˚ 27' 3.7"W, 1173 m elev., 14-July-2005, on dead, corticated twigs of a deciduous tree, A.N. Miller & A.M. Stchigel, ANM 573 **(ILLS 58191, holotype**).

Notes: *Alysidiopsis* was erected by Sutton (1973) to accommodate *A. pipsissewae* B. Sutton, a taxon collected in Canada growing on peduncular hairs of *Chimpalla umbellata* var. *occidentalis*. At present three other species have been described: *A. foliicola* R.F. Castañeda & G.R.W. Arnold (Arnold and Castañeda, 1986), *A. lignicola* Mercado, Figueras & Mena (1996), and *A. yunnanensis* Y.L. Guo & X.L. Liu (1992). All of them have been found growing on plant debris, mainly on dead leaves. *Alysidiopsis prolificans* resembles the type species, *A. pipsissewae*, in having conidia with a protuberant, truncate hilum, and an irregular pattern of branching at the apex of



Figs 1-7. *Alysidiopsis prolificans* (from holotype). **1-2.** Colonies on natural substrate (wood). **3-7.** Conidia and conidiophores mounted in water. Scale bars: 1,2 = 500 µm, 3-5 = 50 µm, 6,7 = 10 µm.

the conidiophores. *Alysidiopsis prolificans* has larger conidiophores (200–2000 µm long *vs*. 120–170 µm long in *A. pipsissewae*) that are flexuous and profusely branched (erect, rarely branched in *A. pipsissewae*), and possess mostly hyaline conidia without a dark protuberant hilum.

Corynespora curvispora Stchigel, A.N. Mill. & J.L. Crane, **sp. nov**.
MycoBank: 510819. (Figs 8-13)

Etymology: From Latin 'curvus-' and from greek '-sporos', referring to the curved conidia.

Coloniae nigrae, pilosae, in substratum crescentia. Mycelium ex hyphis ramosis, septatis, laevis, pallide brunneis vel brunneis, 2-5 µm crassis compositum. Conidiophora macronematosa, mononematosa, erecta, recta vel flexuosa, simplica, atrobrunnea, 6-10 septata, cylindrical**,** laevia, interdum usque 2-5 proliferationes successivas, cylindricas**,** elongascentiae, usque ad 150 µm longa, 5.5-7.5 µm crassa. Cellulae conidiogenae monotreticae, determinatae, terminales, in conidiophoris integratae. Conidia singula vel 2-5 in catenulam singulam conjucta, primo in apice conidiophori et dein proliferationis cujusque successivae oriunda, paulo curvata vel curvata, obclavata, laevia, straminea vel medio brunnea, parietivus crassis, 5-10 distoseptata, cellulis singularibus luminibus deminutis, 40-250 µm longa, 10-12 µm crassa, basi truncata, atrobrunnei vel nigra, 2.5-6.5 µm lata.

Colonies on natural substrate black, hairy. Mycelium composed of branched, septate, smooth, pale brown to brown, 2–5 µm wide hyphae. Conidiophores macronematous, mononematous, arising singly, erect, straight or slightly flexuous, simple, dark brown, 6–10 septate, cylindrical, smooth, occasionally showing 2–5 succesive proliferations up to 150 µm long, 5.5–7.5 µm wide. Conidiogenous cells monotretic, usually determinate (except where proliferation occurs), terminal, incorporated in the conidiophores or conidia. Conidia formed singly or in unbranched dry chains of 2–5 through a pore at the apex of the conidiophore or successive conidia, slightly curved or curved, narrowly obclavate and slender toward the apex, smooth, straw-colored to mid brown, thick-walled, 5–10 distoseptate, individual cells with greatly reduced lumina, 40–250 µm long, 10–12 µm wide at the middle of the conidia, 2.5–6.5 µm wide at the truncate, dark brown to blackish base.

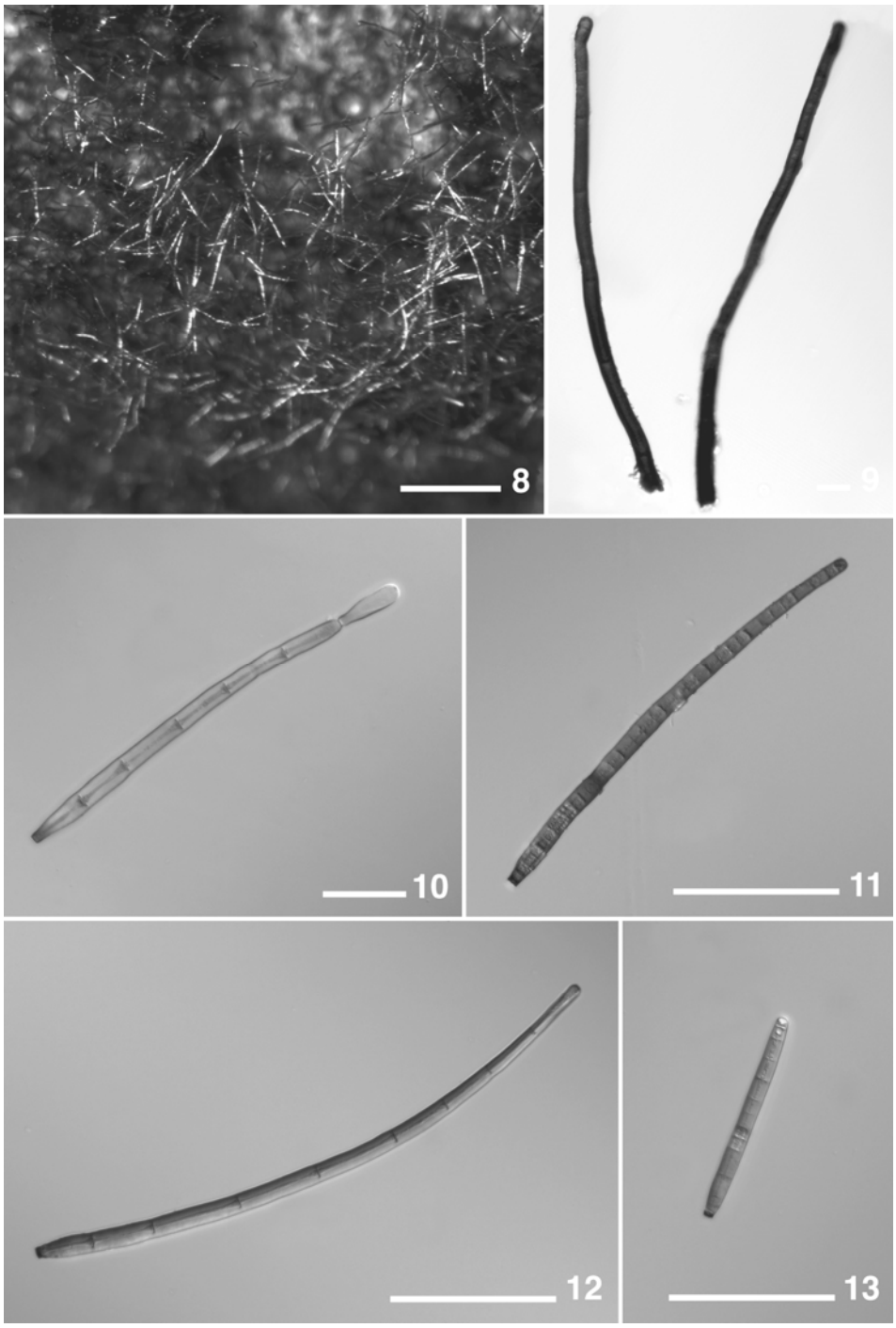
Teleomorph: not observed.

Habitat: on dead herbaceous stems of an unidentified plant on the forest floor.

Known distribution: USA (Tennessee).

Material examined: USA (Tennessee), Sevier Co., Great Smoky Mountains National Park, Greenbrier, Porters Creek Trail, 35˚ 41' 49.7"N, 83˚ 23' 18.5"W, 518 m elev., 10-July-2005, on dead herbaceous stems of an unidentified plant, A.N. Miller & A.M. Stchigel, ANM 484 **(ILLS 58190, holotype**).

Notes: *Corynespora* was erected by Güssow (1906) in order to accommodate *C. mazei* (syn. *C. cassiicola* (Berk. & Curtis) Weir). The genus



Figs 8-13. *Corynespora curvispora* (from holotype). **8.** Colonies on natural substrate (wood). **9.** Conidiophores. **10-13.** Conidia. Scale bars: 8 = 500 µm, 9,10 = 10 µm, 11-13 = 50 µm.

currently encompasses approximately 100 species of mostly saprobic fungi, although some (e.g. *C. cassiicola*) occur as plant parasites. Our specimen is morphologically similar to *C. matuszakii* Morgan-Jones (1988), *C. citricola* M.B. Ellis (1957), and *C. viticis* Y.L. Guo (1984). *Corynespora curvispora* produces conidia of a similar size as in *C. matuszakii*, but they are broader than those in *C. citricola* and *C. viticis*. However, *C. curvispora* can be differentiated from *C. matuszakii* by the conidial morphology. *Corynespora curvispora* produces slightly curved to curved conidia (straight, cylindrical in *C. matuszakii*), with a darker area at the base (absent in *C. matuszakii*) and with a reduced lumina (practically absent in *C. matuszakii*).

Desertella fumimontarum Raja and Shearer, **sp. nov.** (Figs 14-24)
MycoBank: 510820.

Etymology: From Latin fumi = smoky, montan = mountain, meaning of the Smoky Mountains

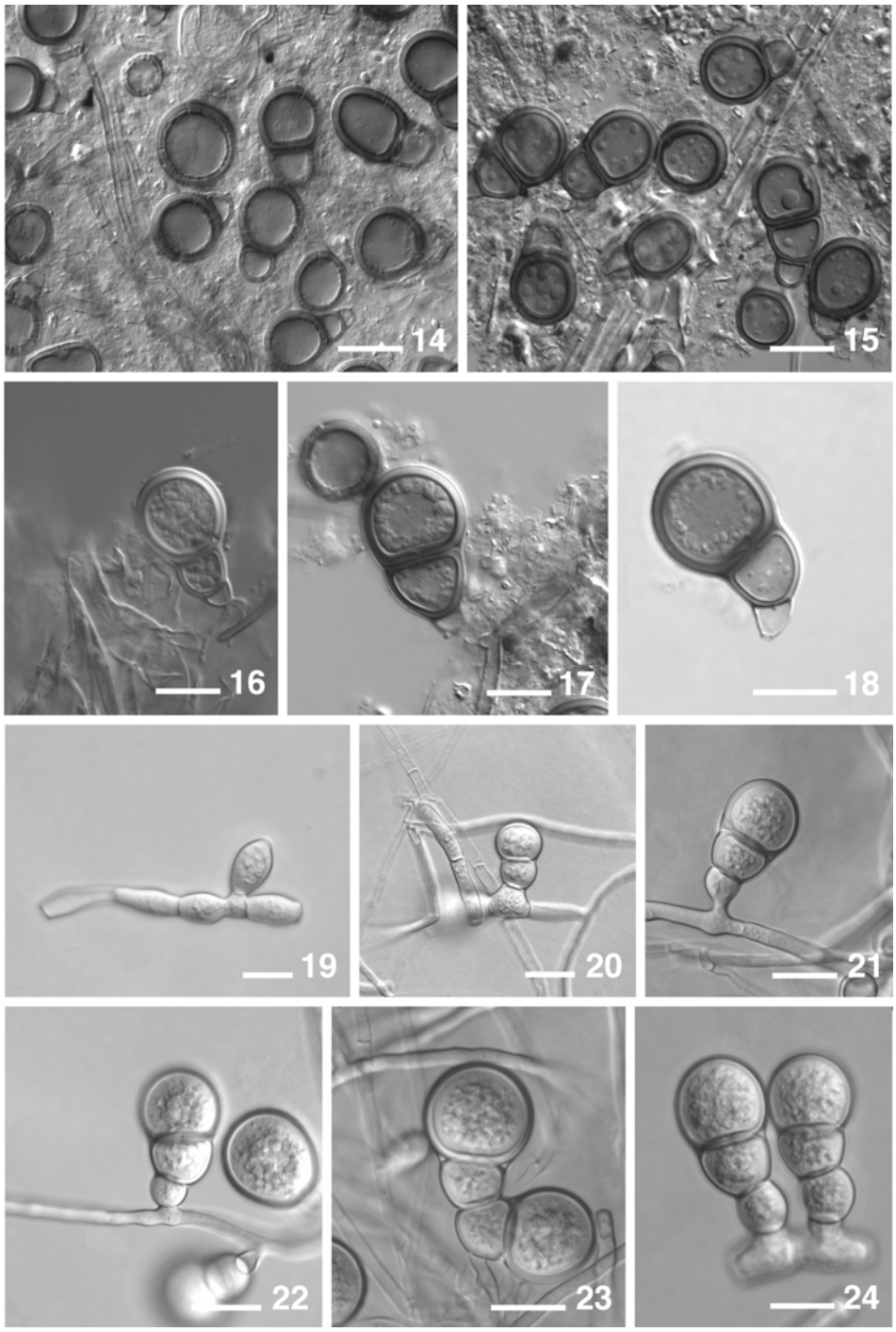
Coloniae in lignum substratum hyalinum vel pallide auurantiobrunnea; hyphis septatis, 3-4 µm latus. Conidiophoris absentibis. Cellulae conidiogenae integratae, terminale monoblasticae. Conidia solitaria, hyalina vel aurantiobrunnea, 1-3 µm septa, 32-38 × 16-28 µm; cellulae apicale 21-26 µm latis, quam basali celluli 9-17 µm lati, globosa vel subglobosa, paula constricta septata, inferne truncatis 2-3 µm latus. Secessio rhexolytica.

Colonies on wood hyaline to light golden brown; hyphae septate 3–4 µm wide. *Conidiophores* absent. *Conidiogenous cells* integrated or terminal on the hyphae, monoblastic. *Conidiogenesis* holoblastic. *Conidia* mostly solitary, pale golden brown, 1–3 septate, 32–38 × 16–28 µm (width at the mid septum); apical cell 21–26 µm wide, basal cell 9–17 µm wide, globose to subglobose, slightly constricted at the septa, densely cytoplasmic, thick-walled; conidial wall 2–3 µm wide. *Conidial secession* rhexolytic.

Colonies on yeast peptone glucose starch agar (YPGS) hyaline to pale yellow, texture becoming wool-like with age. *Mycelium* immersed to superficial, composed of branched, septate, hyaline to subhyaline hyphae, 4–8 µm wide. *Conidia* 1–3 septate, thick-walled, wall 3 µm thick, developing holoblastically from a lateral bud on the vegetative hyphae, which gives rise to a conidium directly; conidia 1-3 septate; conidial length variable ca. 19–34 µm long; apical cells globose to subglobose; subtending basal cells generally frustroid, decreasing in diameter. In some instances, conidia are produced from laterally elongating hyphae and are 20–22 × 8–9 µm. In older cultures, hyphae form tightly coiled structures at successive intervals, these coiled hyphae produce up to 4–6 conidia holoblastically, in no apparent order.

Teleomorph: not observed.

Habitat: on submerged wood in a river.



Figs 14-24. *Desertella fumimontarum* (from holotype). **14-18.** Conidia from submerged wood. **19-24.** Conidial ontogeny from culture grown on YPGS. Scale bars: = 10 µm.

Known distribution: USA (Tennessee).

Material examined: USA (TENESSEE), Sevier Co., Great Smoky Mountains National Park, Clingmans Dome, Walker Camp Prong, 35° 37' 27"N, 83° 25' 00"W, water temperature 25 C, pH 5, 20-July-2000, on submerged, corticated wood, JC, H013-1, ATCC MYA-4171, (ILL, slides made from cultures of holotype specimen, **holotype**).

Notes: The genus *Desertella* Mouchacca was established for a single species *Desertella globulifera* Mouchacca, isolated from ferrugenous desert soil in Egypt (Mouchacca, 1979). The genus is defined by its ochre cultures, hyaline, morphologically varied conidia, and absence of differentiated conidiophores. Although conidiogenesis is identical, the conidia of *D. fumimontarum* are smaller with narrower walls than those of *D. globulifera* (40–60 × 42–64 µm, conidial wall 4–8 µm wide versus 32–38 × 16–28 µm, conidial wall 3 µm thick, in the former respectively). The two species also differ in their ecological habitat. *Desertella fumimontarum* was isolated from submerged wood in a river in the GSMNP (USA), whereas, *D. globulifera* was isolated from arid soils in Egypt.

The conidial ontogeny of *D. fumimontarum* was observed from material grown on YPGS. The colonies reach a size of 5–6 mm within 2–3 weeks, and conidial production begins toward the end of the second week. Conidia are produced holoblastically on tips of hyphae, which are formed as blown-out ends from the mycelium (Figs 19–21). Conidia produced in culture vary more in morphology than those produced on the natural substrate. Sessile 1-septate conidia form directly on the hyphae, but in most cases the hyphae elongate considerably to ca. 100–125 µm, and then give rise to conidia that may be 2 or 3 septate (Figs 22-24). Conidia detach by a rupture in the basal cell, which leaves a hyaline and thin-walled remnant at the base of the conidia. In older cultures, the hyphae coil and sporulation occurs on the coils of the hyphal cells. The lack of pigment in the mycelium and spore walls in *Desertella*, distinguishes it from dematiaceous hyphomycete genera such as *Acremoniula* Cif., *Allescheriella* Henn., *Humicola* Traaen, *Trichocladium* Harz and *Culcitalna* Meyers & R.T. Moore (Mouchacca, 1979).

Desertella fumimontarum was tested for the production of qualitative extracellular enzymes in vitro and was found positive for cellulase, endoglucanase, beta-glucosidase, xylanase, amylase, and polygalacturonase (Simonis *et al*., unpubl. data). *Desertella fumimontarum* was found only once during our survey in the GSMNP and was isolated from a submerged piece of wood that was covered with sediment. It is not certain at this time whether *D. fumimontarum* is truly an aquatic species, or whether its presence in water was simply fortuitous.

Discussion

Eight out of the 60 hyphomycetes collected from the GSMNP have been reported previously only from the Austral/Asian tropics and subtropics. The presence in the GSMNP of species previously considered tropical (Hyde *et al*., 1997; Tsui *et al*., 2000) is an interesting finding. According to Wong *et al*. (1998), tropical freshwater fungi do not grow well in low temperatures and thus are absent in streams in temperate regions. This is not true for the eight so called "tropical species", *Brachydesmiella orientalis, Canalisporium pulchrum, Cheiromyces lignicola, Dactylaria hyalotunicata, Dactylaria tunicata, Helicoön gigantisporum, Helicosporium gigasporum,* and *Xylomyces elegans*, that we have collected from the GSMNP where water temperatures reach 0ºC in winter. Similarity in the mycota between eastern North America (GSMNP) and eastern Asia (Austral/Asian tropics) is noteworthy and has been reported previously for other groups of fungi (Wu and Mueller, 1997).

Fourteen species occurred in both freshwater and terrestrial habitats (Table 1). Whether they maintain sporulating populations in water or rely on continuous importation from terrestrial habitats is not yet known. *Casaresia sphagnorum* and *Canalisporium pulchrum* have been reported only from freshwater habitats thus far (Perrott, 1960; Webster *et al*., 1993; Nawawi and Kuthubutheen, 1989; Goh *et al*., 1998; Ferrer and Shearer, 2005; Goh and Hyde, 1996) and may be truly aquatic taxa. Species in genera such as *Arthrobotrys, Dictyosporium,* and *Ellisembia* (Tabe 1) were reported only from freshwater habitats in our study, but since these taxa also have been previously reported from terrestrial habitats (Wang, 2001), they can be classified as immigrant species to freshwater habitats sensu Park (1972). Although *Candelabrum brocchiatum* and *Helicoön gigantisporum* are aeroaquatic species, they were reported in our study from wood in both terrestrial and freshwater habitats.

Even though we found an overlap in species composition between hyphomycetes collected from wood in terrestrial and freshwater habitats in the GSMNP (Table 1), the species composition of hyphomycetes collected from bark of beech, fir, and hemlock in the GSMNP (Baird *et al*., 2007) was completely different from that found on wood in terrestrial and freshwater habitats. The single exception was *Epicoccum nigrum* (≡ *E. purpurascens)*, which occurs as an ubiquitous saprobic fungus (Kiffer and Morelet, 2000). This observed difference in mycobiotas is most likely due to differences in the substrates (i.e. bark versus decorticated wood).

This paper presents a preliminary report of our continuing study of the euascomycetes in the GSMNP. Additional collections in various habitats,

encompassing additional substrate types is required to better understand the species composition and distribution patterns of hyphomycetes throughout the park.

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