Freshwater ascomycetes: new and noteworthy species from aquatic habitats in Florida

Huzefa A. Raja1
Carol A. Shearer

Department of Plant Biology, University of Illinois, Room 265 Morrill Hall, 505 South Goodwin Avenue, Urbana, Illinois 61801

Abstract: As part of a distributional study of freshwater ascomycetes in Florida, a number of new taxa were encountered. The new taxa include six Sordariomycetes, Aniptodera megalosascorepura sp. nov., Flaminospora pulchra sp. nov., Hanliniomyces hyaloapicalis gen. et sp. nov., Lockerbria striata sp. nov., Phomatospora triseptata sp. nov. and Physalospora limnetica sp. nov., and three Dothideomycetes, Caryospora obclavata sp. nov., Lepidopterella tangerina sp. nov. and Ophiobolus shoemakeri sp. nov. These taxa are described and illustrated. Six additional species are reported from Florida for the first time; among them, two species are new reports from freshwater habitats.

Key words: lentic, lotic, saprobic fungi, submerged wood, systematics

INTRODUCTION

As part of a large-scale latitudinal distribution study of freshwater ascomycetes in North and Central America, Raja (2007) investigated the latitudinal, habitat and substrate distribution patterns of freshwater ascomycetes along the Florida Peninsula. Thus far collections from Florida have yielded one new genus (Raja et al. 2008) and four new species of freshwater ascomycetes (Raja and Shearer 2006a, b; 2007). In this paper we describe and illustrate additional new taxa from aquatic habitats in Florida.

MATERIALS AND METHODS

Collection sites.—Five sites along the Florida Peninsula were established based on latitude and presence of appropriate aquatic habitats: (i) Blackwater River State Forest (30°N), (ii) Apalachicola National Forest (29–30°N), (iii) Ocala National Forest (29°N), (iv) Big Cypress National Preserve (25–26°N) and (v) Everglades National Park (25°N). These sites comprise southern hardwoods (Blackwater River State Forest and Apalachicola National Forest in the Panhandle), temperate broadleaf evergreens (Ocala National Forest, in the central part of the peninsula) and subtropical forests (Big Cypress National Preserve and Everglades National Park, in the southern tip). In the Big Cypress and Everglades National Parks tropical hardwood hammocks predominate.

Collection methods.—Submerged woody and herbaceous debris was collected randomly from lotic and lentic habitats four times over 2 y at the five collection sites along the Florida Peninsula. Samples were placed in zippered plastic bags containing moist paper towels and transported to the lab in an insulated cooler containing ice to control heat build-up and biological activity. In the lab substrates were gently rinsed with tap water and incubated in plastic storage boxes with moistened paper towels at ambient temperatures (about 24 C) under 12/12 h (light/dark) conditions. Water temperature, pH and latitude and longitude were measured and recorded in the field and are presented in the specimen citations.

Samples were examined with a dissecting microscope within 1 wk of collection and periodically over 6–12 mo. Collectors’ names are abbreviated as: CB (Christopher Brown), JLC (J. L. Crane), ANM (Andrew N. Miller), HAR (Huzefa A. Raja), KR (Kevin Robertson), CAS (Carol A. Shearer).

Morphological study.—Ascomata were placed on a large (25 mm) cover slip on a microscope slide and opened in a drop of distilled water with fine dissecting needles and covered with a second smaller (18 mm) cover slip for microscopic examination. Material mounted on slides was preserved with glycerin (100%) or lactic acid (85%) containing azure A using the double cover glass method (Volkmann-Kohlmeier and Kohlmeier 1996). Melzer’s reagent (MEZ; 0.5 g iodine, 1.5 g IKI, 20 g chloral hydrate, 20 mL distilled water) and aqueous cotton blue was used to determine staining reactions of the ascus apical apparatus. India ink or aqueous nigrosin was added to water mounts to reveal gelatinous sheaths on or around ascospores as well as gelatinous material surrounding the paraphyses or pseudoparaphyses. Measurements were made of material mounted in water, glycerin (100%) or lactic acid containing azure A. When sufficient fruit bodies were available, single ascospore derived cultures were obtained and maintained on cornmeal agar (CMA; Difco, cornmeal agar) or peptone, yeast extract, glucose agar (PYG; 1.25 g Peptone, 1.25 g yeast extract, 3.00 g glucose, 18 g agar, 1000 mL distilled water) according to the procedures of Fallah and Shearer (2001) and Shearer et al. (2004).

Ascomata were fixed and sectioned with a modification of Huhndorf’s technique (Huhndorf 1991, Fallah and Shearer 2001). Holotype slides were deposited in the Herbarium of the University of Illinois at Urbana-Champaign (ILL). Digital micrographs were obtained with an Insight Spot RT digital camera using an Olympus microscope equipped with Nomarski interference and phase optics. Digital images...
were edited with Adobe Photoshop CS2 and assembled with Adobe InDesign CS2.

**TAXONOMY**

**New Taxa**

**Aniptodera megalostacocarpia** Raja et Shearer sp. nov.  
**Figs. 1–10**


Ascomata on wood 1060–1360 × 430–530 μm, scattered, immersed, hyaline membranous; venter large, globose, 490–650 × 485–580 μm, with a long, central, hyaline neck protruding through the surface of the wood when venter immersed (Fig. 1). Neck 540–850 × 70–80 μm, cylindrical, peripheratum (Fig. 2). Peridium composed of 2–4 layers of hyaline angular cells; cells 10–15 × 2–3 μm, of textura epidermoideae in surface view (Fig. 3). Catenophyses sparse, hyaline, septate, consisting of elongated cells, slightly constricted at the septa, ca. 70–100 μm (Fig. 4). Ascii 100–128 × 20–26 μm, (mean = 116 × 24 μm, n = 30), thin-walled, clavate, flattened at apex, tapering to a pointed pedicel, unitunicate, persistent, (Figs. 5, 6), wall thickened at the apex, ascus apex Melzer’s negative (MEZ–), staining blue in aqueous nigrosin, cytoplasm retracted below the ascus apex (Figs. 5–7); empty ascii show an apical pore where the ascospores have been discharged (Fig. 7); containing eight irregularly arranged ascospores. Ascospores 20–26 × 9–11 μm (mean = 23 × 10 μm, n = 60), 1-septate, broadly ellipsoid, thin-walled, with single large guttule in each cell, surrounded by an irregular gelatinous sheath ca. 2–5 μm wide at the ascospore apex; sheath staining in aqueous nigrosin (Figs. 8, 9), hyaline when young becoming pale brown to dark brown with age; septum becoming thicker and pigmented brown in older ascospores (Fig. 10).

**Etymology.** Greek: *megalos* = large; Latin: *ascocarpus* = fruit body of an ascomycete, in reference to the large fruit body compared to those of other described species of *Aniptodera*.

**Type.** USA. FLORIDA: Ocala National Forest, Little Lake Kerr, 29°20’57”N, 81°43’49”W, water 21 C, pH 7, on submerged decorticated woody debris, 2 Feb 2006, HAR and JLC, F91-1. (HOLOTYPE designated here, ILL40109).

**Known distribution.** USA (FL).

**Comments.** The genus *Aniptodera* Shearer and Miller is characterized as having membranous, light colored ascomata, presence of catenophyses, apically thickened persistent ascii with a distinct pore and subapical retraction of cytoplasm, and hyaline, 1-septate ascospores without appendages (Shearer and Miller 1977). *Aniptodera* species with ascospore appendages were reported later in the literature (Shearer and Kane 1980a, Shearer 1989, Hyde 1992a, Hyde et al 1999, Campbell et al 2003). *Aniptodera megalostacocarpia* fits well within the concept of the genus with respect to ascomal, ascus and ascospore morphology (Figs. 1, 5, 6, 8). *Aniptodera megalostacocarpia* differs distinctly from other species in the genus because it has the largest ascomata (1060–1360 × 430–530 μm) (Fig. 1). In addition ascospores are surrounded by an irregular mucilaginous sheath (Figs. 8, 9). The mucilaginous sheath however cannot be seen when the ascospores are fixed in glycerin or lactic acid. Older ascospores of *A. megalostacocarpia* are pale brown and the septum is darkened (Fig. 10); these characters are not observed in other species of *Aniptodera* (Shearer 1989, Volkman-Kohlmeyer and Kohlmeyer 1994, Hyde et al 1999).

*Aniptodera megalostacocarpia* is similar to *Phaeonectrilla lignicola* R.A. Eaton & E.B.G. Jones (Eaton and Jones 1970), which is characterized by having hyaline to pale brown globose ascomata with a long periph- ystate neck, clavate asci and hyaline ascospores with germ pores that become gray to brown at maturity. *Aniptodera megalostacocarpia* however differs from *P. lignicola* in having a larger ascoma and in ascospore morphology. Ascospores of *P. lignicola* possess a germ pore at each end, a feature not seen in ascospores of *A. megalostacocarpia*. In addition Hyde et al (1999) reported polar appendages in *P. lignicola* from specimens collected in Mauritius but ascospores of *A. megalostacocarpia* do not have apical appendages.

**Flammispora pulchra** Raja et Shearer sp. nov.  
**Figs. 11–18**


Ascomata on wood 200–210 × 184–188 μm, solitary, scattered, superficial or partially immersed, black, ostiolate with a small neck (Fig. 11). Neck 50
Figs. 1–10. *Aniptodera megalosascocarpa* from the holotype. 1. Hyaline, membranous, ascomata on wood, note discharged ascospores around the neck. 2. Periphysate neck. 3. Peridium of *textura epidermoidea* in surface view. 4. Catenophyses. 5. Ascus showing retraction of cytoplasm at apex. 6. Ascus showing thickened wall of the apex. 7. Ascus containing one ascospore, arrow indicates ascus apical pore and apical thickening. 8, 9. Ascospores showing irregular gelatinous sheath. 10. Mature pale brown ascospores with thickened and darkened septum. Bars: 1 = 1 mm, 2–10 = 20 μm.
× 20 μm, conical, periphyses not seen (Fig. 11). Peridium ca. 12–20 μm wide, in longitudinal section 4–5 cell layers wide; inner layers of hyaline elongated cells, outer layers of pseudoparenchymatic cells with brown walls (Fig. 12). Physes not seen. Asci 52–107 × 12–18 μm, clavate or fusiform, with a short stalk, thin-walled (Fig. 13), separating from the ascogenous hyphae, deliquescent, with eight tetraseriate or irregularly arranged ascospores (Figs. 13, 14). Ascospores 25–30 × 4–5 μm (mean = 28 × 4 μm, n = 30), narrow, fusiform or cylindrical, hyaline, 3-septate, sometimes 5-septate (Figs. 15, 16), with a flame shaped appendage protruding through a rod shaped structure 2–3 μm wide at the base of the ascospore (Figs. 15, 16); appendage 10–15 μm long, ca. 2–3 μm wide, staining in aqueous nigrosin (Figs. 17, 18).

**Etymology.** From Latin feminine of *F. pulchra.*


**Known distribution.** USA (FL).

**Comments.** The genus *Flammispora,* typified by *F. bioteca* U. Pinruan et al, was found originally on submerged leaves of the peat swamp palm, *Licuala longicalycata* Furt. in Thailand (Pinruan et al 2004). This genus is characterized by immersed to semi-immersed, coriaceous ascomata; paraphyses absent; 8-spored, clavate to cylindroclavate, deliquescent asc; and hyaline, 5-septate ascospores with a flame shaped basal gelatinous appendage.

The new species from Florida was found on submerged decorticated woody debris in a lake in Ocala National Forest. The Florida material agrees in all respects with the protolog of *F. bioteca,* the type species of the genus, but differs as follows. The ascomata are immersed to semi-immersed as in the protolog, but medial longitudinal sections through the ascoma revealed a small papilla (Fig. 11), a feature not present in *F. bioteca.* The ascospores of the new species are smaller (25–30 × 4–5 μm) and mostly 3-septate (Figs. 17, 18), versus the larger (47.5–55 × 5–6.5 μm), 5-septate ascospores of *F. bioteca* (Pinruan et al 2004). *Flammispora pulchra* also differs from *F. bioteca* in substrate (*F. pulchra* was found on woody debris, while *F. bioteca* was found on herbaceous debris) and habitat (*F. pulchra* occurred in a lake, but *F. bioteca* was reported from a peat swamp).

**Hanliniomyces** Raja et Shearer gen. nov.


**Etymology.** Named in honor of Dr Richard T. Hanlin for his outstanding contributions to ascomycete systematics.

Ascomata scattered, partially immersed to superficial, black, ostiolate, with a cylindrical, periphysate neck; venter globose to subglobose, membranous. Peridium composed of pseudoparenchymatic cells, of textura angularis in surface view. Paraphyses wide at the base, tapering toward the apex, septate, slightly constricted at the septa. Asci ununiticate, narrowly fusoid, with or without a stalk, with a refractive, nonamyloid apical apparatus, containing eight uniticrate to overlapping biseriate ascospores. Ascospores ellipsoid, asetate and hyaline when young, becoming 3-septate and brown with age, surrounded by a gelatinous sheath.

**Type species.** *Hanliniomyces hyaloapicalis*}

**Hanliniomyces hyaloapicalis** Raja et Shearer sp. nov. Figs. 19–28


Ascomata 340–380 × 160–190 μm, scattered, partially immersed to superficial, venter globose to subglobose, 115–160 × 100–130 μm, membranous, black, ostiolate, with a neck (Figs. 19, 22). Neck 125–160 × 25–30 μm, cylindricum, black at the base, lighter toward the apex, periphysate (Fig. 20). Peridium 8–12 μm wide, composed of 4 or 5 layers of pseudoparenchymatic cells, textura angularis in surface view, amorphous, dark material deposited on the outer cell walls, inner layer of hyaline, elongated and compressed cells, ca. 10–15 × 2–4 μm wide (Fig. 21).
Paraphyses 120–150 μm long, 5–10 μm wide at the base, tapering to ca. 2–3 μm wide at the apex, septate, slightly constricted at the septr (Fig. 23). Ascii 130–160 × 18–20 μm, unitunicate, narrowly fusoid, with or without a stalk, ascus apical ring MEZ negative, staining blue in aqueous nigrin, with eight uniseriate to biseriate overlapping ascospores (Fig. 24a, b). Ascospores 28–36 × 9–12 μm, (mean = 32 × 10 μm, n = 40), ellipsoidal, aseptate, multiguttulate and hyaline when young, becoming 3-septate and brown with age, surrounded by an irregular gelatinous sheath that stains in aqueous nigrin (Figs. 25–28).

Colonies on PYG agar grown at 25 C, dark gray-black, effuse. Aerial mycelium hyaline to black, septate. Immersed mycelium composed of branched, septate, black hyphae. No anamorph observed.

Etymology. From Latin hyalo = hyaline, and apicalis = apical, referring to the hyaline apex of the ascocarpic neck.

TYPE. USA. FLORIDA: Big Cypress National Preserve, Cypress Swamp Loop Road 5, 25°45′45″N, 80°55′09″W, water 30 C, pH 6, on submerged partially decorticated woody debris, 15 Jul 2006, HAR and JLC, F37-3. (HOLO-TYPE designated here, ILL40116).

Additional specimens examined. Blackwater River State Forest, Penny Creek, 30°45′05″N, 86°46′54″W, water 23 C, pH 6.6, on submerged decorticated woody debris, 10 Jul 2004, HAR and CB, F37-1; Blackwater River, north end at Kennedy Bridge, 30°56′01″N, 86°44′07″W, water 11 C, pH 5.5, on submerged decorticated woody debris, 11 Feb 2006, HAR and JLC, F37-2.

Known distribution. USA (FL).

Comments. Hanliniomyces is similar to Lentomitella Höhnel (Höhnel 1905, Rébolová 2006) in the morphology of the ascomata, peridium and paraphyses and in the shape of the ascospores. In addition asci of both Hanliniomyces and Lentomitella are similar in that they possess a refractive nonamyloid apical ring. However, despite these similarities, Hanliniomyces differs from Lentomitella in that it has a black ascomal neck with a hyaline apex rather than an entirely black neck and narrowly fusoid rather than cylindrical-clavate asci. The young ascospores of Hanliniomyces are smooth-walled, aseptate and surrounded by a gelatinous sheath but become brown and septate at maturity, whereas ascospores of Lentomitella are longitudinally striated, aseptate or septate, do not possess a gelatinous sheath and are hyaline throughout their development. In addition the genus Lentomitella is associated with a Phaeoisaria-like anamorph, but no anamorph was observed in culture for Hanliniomyces.

Hanliniomyces also is morphologically closely related to Xylomelasma Rébolová (Rébolová 2006) in having dematiaceous hyphae in culture; dark, nonstromatic perithecial ascomata with a cylindrical neck, a two-layered peridial wall with dark cells on the outside and hyaline cells on the inside; paraphyses that are broad at the base and taper toward the apex; asci that have a refractive nonamyloid apical annulus; and ellipsoidal ascospores that are hyaline and aseptate when young but become brown and septate at maturity. Hanliniomyces however differs from Xylomelasma in having an ascomal neck with a hyaline apex compared to a dark neck and a peridial wall of textura angularis as opposed to textura prismatica. Hanliniomyces has a narrowly fusoid ascus with a long stalk, but Xylomelasma has a cylindrical ascus with a short stalk. In addition a gelatinous sheath surrounds the ascospores of Hanliniomyces but an ascospore sheath does not occur in Xylomelasma.

Furthermore Hanliniomyces differs from both Lentomitella and Xylomelasma in its habitat. Lentomitella and Xylomelasma species have been reported from wood in terrestrial habitats, whereas Hanliniomyces was collected on submerged woody debris from lotic and lentic habitats.

Hanliniomyces hyaloapicalis also is similar to Physalospora citogerminans Kohlm., Volkm.-Kohl. & O.E. Erikss. (Kohlmeyer et al. 1995) with respect to ascomal, ascus and ascospore morphology. In addition older ascospores of both H. hyaloapicalis and P. citogerminans become 3-septate. Ascospores of the genus Physalospora usually are not 3-septate, and this feature has not been reported in previously described species of Physalospora (von Arx and Müller 1954, Barr 1970, Scheuer 1988, Nograshe 1990). Hanliniomyces hyaloapicalis, however differs from P. citogerminans in having a dark neck with a hyaline apex and ascospores that do not germinate in contact with freshwater. The two species also differ in their ascomal and ascus dimensions, which suggests that they are not conspecific. In addition the two species differ in the type of habitat in which they occur. Hanliniomyces hyaloapicalis occurred on submerged woody debris in freshwater habitats in Florida, whereas P. citogerminans has been reported from Juncus roemerianus Scheele in a salt marsh in North Carolina (Kohlmeyer et al. 1995). It is plausible that P. citogerminans could be transferred to the genus Hanliniomyces in the future; however molecular data would be useful to confirm the relationship of the two taxa.

We establish Hanliniomyces as a new genus closely allied to Lentomitella and Xylomelasma. Using nuclear large ribosomal RNA subunit gene sequence data Rébolová (2006) placed Lentomitella, and Xylomelasma in the Sordariomycetes incert. sed. We also place Hanliniomyces provisionally within the Sordariomycetes incert. sed. pending phylogenetic analyses.

Lockera striata Raja et Shearer sp. nov. Figs. 29–38

Ascomata 500–620 × 400–480 μm, cleistothecialia, glo-
Ascomata 500–620 × 400–480 μm, scattered, globose to subglobose, tapering to a stalk at the base, superficial with base immersed in the substrate, cleistothecial, dark brown to black, membranous, rupturing and wearing away at maturity (Figs. 29, 30, 31). Peridium 15–20 μm wide, areolate in surface view, in medial longitudinal section composed of two layers, an outer dark brown amorphous region and an inner hyaline region of short angular cells (Fig. 32). Paraphyses abundant, simple or branched, narrow, ca. 2 μm wide, filiform, septate, hyaline, immersed in gel matrix (Fig. 33). Asci 140–170 × 20–24 μm, unitunicate, cylindrical, with a narrow short pedicel, with eight uniseriate ascospores (Figs. 34, 35). Ascospores 20–24 × 14–18 μm, 1-celled, subglobose, obovate or oval, hyaline when young (Fig. 36) becoming dark brown with age, without germ pores or slits, ascospore wall thinner at apices, warted (Fig. 37), surrounded by a hyaline, gelatinous sheath ca. 3–5 μm wide; sheath not staining in aqueous nigrosin or India ink stained; striations radiating from ascospore wall (Figs. 35, 38).

**Etymology.** From Latin *striatus* meaning marked with striae, referring to the appearance of the ascospore sheath.

**Type.** USA. FLORIDA: Blackwater River State Forest, Horns Creek Swamp, 30°46′31″N, 86°54′43″W, water 30 C, pH 6, on submerged partially decorticated woody debris, 10 Jul 2004, HAR and CB, F24-1 (HOLOTYPE designated here, ILL40118).

**Additional specimens examined.** USA. FLORIDA: Apalachicola National Forest, Andrew Lake near Silver Lake Recreation Area, 30°24′09″N, 84°24′27″W, water 33 C, pH 6.5, on submerged partially decorticated woody debris, 13 Jul 2004, HAR and CB, F24-2. MISSISSIPPI: Big Black River at Mississippi 19, east of West, Holmes County, 33°11′38″N, 89°46′14″W, water 7 C, pH 5.5, on submerged decorticated woody debris, 27 Dec 1993, JLC and CAS, A247-F; Edge of Wolf River at I-10 in Harrison County, 30°21′25″N, 89°17′12″W, water 24 C, pH 6.5, on submerged decorticated woody debris, 16 Jun 1997, KR, A247-2.

**Known distribution.** USA (FL, MS).

**Comments.** The genus *Lockerbia* K.D. Hyde, typified by *L. palmicola* K.D. Hyde, originally was found on a terrestrial palm rachis in a rainforest in Queensland, Australia (Hyde 1993). *Lockerbia* is characterized by superficial, cleistothecial, membranous, thin-walled ascocoma; 8-spored, apically rounded, cylindrical, unitunicate asci; and brown, limoniform or oval, thick-walled, minutely pitted ascospores with a hyaline sheath.

We collected *L. striata* from submerged decorticated woody debris in a creek as well as on an unidentified piece of herbaceous debris in a lake. During a geographically broader survey of freshwater ascomycetes, we also found *L. striata* on submerged decorticated wood in two lotic habitats in Mississippi. *Lockerbia striata* agrees in most respects with the protolog of *Lockerbia* but differs from the type species, *L. palmicola*, in these ways: the ascocoma are large and cleistothecial (Figs. 29, 30), as in the original protolog, but the medial longitudinal section through the ascocoma of *L. striata* reveals a stalk-like structure (Fig. 31) that anchors the base of the cleistothecium to its substrate much like a puffball. This structure was not reported for *L. palmicola*. The ascospores of *L. striata* are warted (Figs. 32, 37), whereas those of *L. palmicola* are minutely pitted. In addition the ascospores of *L. striata* are surrounded by a hyaline, striated, gelatinous sheath ca. 3–5 μm wide and having a definite form (Figs. 35, 37, 38), while those of *L. palmicola* are surrounded by a hyaline mucilaginous sheath (see Figs. 9–11 in Hyde 1993) lacking a definite form and striations.

**Phomatospora triseptata** Raja et Shearer sp. nov. Figs. 39–47


Ascocoma on wood 290–400 × 190–340 μm, subglobose, scattered to gregarious, immersed in the substrate, membranous, brown, ostiolate, with a neck (Figs. 39, 40). Neck 180–230 × 60–70 μm, central, cylindricum, covered with black, amorphous material around the upper region (Fig. 41), periphysate; periphyses hyaline, short, filiform. Peridium 15–20 μm wide, composed of 5–10 layers of hyaline to brown pseudoparenchymatic cells; cells darker toward
Figs. 39–47. Phomatospora triseptata from the holotype. 39. Ascomata immersed in wood. 40. Medial longitudinal section through ascoma. 41. Periphysate neck, note darkened area composed of amorphous material around the apex of the neck. 42. Peridium. 43. Ascus with apical ring, in water. 44. Ascus with overlapping uniseriate ascospores. 45. Paraphyses. 46. Ascospore with filamentous apical appendages, and narrow gelatinous sheath, in water. 47. Ascospores fixed in glycerin showing longitudinal striations. Bars: 39 = 50 μm, 40 = 100 μm, 41–47 = 20 μm.
the inside and lighter toward the outside (Fig. 42). Paraphyses numerous, filamentous, septe, broad at the base and tapering toward the apex, branched, ca. 3–4 μm wide (Fig. 45). Asci 134–164 × 10–12 μm, unitunicate, cylindrical, pedicellate, thin-walled, with a small refractive apical ring; apical ring staining blue in aqueous cotton blue, MEZ negative, elongating in water, with eight overlapping uniseriate ascospores (Figs. 43, 44). Ascospores 18–20 × 7–8 μm (mean = 19 × 7 μm, n = 30), ellipsoidal with slightly flattened apices, 3-septate, with bipolar gelatinous caps ca. 3–7 μm long; appendages staining in aqueous nigrosin; the middle and lower half of the ascospore surrounded by a narrow gelatinous sheath (Fig. 46); wall longitudinally striate, appendages and sheath not visible in glycerin or lactic acid (Fig. 47).

*Ethymology.* From Latin *triseptatus* = three septate, referring to the three septate ascospores.

**TYPE.** USA. FLORIDA: Big Cypress National Preserve, Cypress Swamp Loop Road 2, 25°45′36″N, 81°02′07″W, water 25 C, pH 8, on submerged soft, decorticated woody debris, 22 Mar 2005, HAR, ANM and JLC, F67-1. (HOLOTYPE designated here, ILL40114).

**Known distribution.** USA (FL).

**Comments.** Fallah and Shearer (1998) examined the type specimen of the genus *Phomatospora* Sacc., *P. berkeleyi* Sacc., and described it as having immersed, light brown, membranous ascomata, ascoma with a short periphysate base, which is thick and dark around the ostiole; cylindrical asci with a small chitinous refractive apical ring, which stains blue in cotton blue; and single-celled, hyaline, longitudinally striate ascospores with bipolar gelatinous caps. The specimen collected from Florida agrees in most respects with the type of *Phomatospora*. *Phomatospora triseptata* differs from the type and 20 other species of *Phomatospora* (Kirk et al 2001) in having an ascospore with a long, cylindrical neck (Fig. 39) and consistently 3-septate ascospores, which are slightly flattened at the apices and equipped with both bipolar gelatinous appendages as well as a gelatinous sheath (Fig. 46). *Phomatospora bellaminuta* Kohlm., Volkm.-Kohl., & O.E. Erikss. (Kohlmeier et al 1995) also has a long neck and bipolar appendages but differs from *P. triseptata* in having smaller, one-celled ascospores and no gelatinous sheath. In addition *P. bellaminuta* was isolated from a marine habitat on *Juncus roemarianus* Scheele, whereas *P. triseptata* was found on a piece of submerged wood in freshwater. Multiseptate ascospores occur in *P. radegundensis* Scheuer (Scheuer 1988) and *P. admontensis* Nograsek (Nograsek and Matzer 1991) but *P. triseptata* differs from these two species in ascospore morphology and ecological habitat.

Most species of *Phomatospora* have been reported as saprobic on herbaceous substrates, as well as on old ascomycete stromata (Barr 1994, Yuan and Mohammed 1997). Other than *P. triseptata*, only one other species, *P. aquatica* Minoura & T. Muroi, has been reported from wood. *Phomatospora aquatica* was described from balsa wood submerged in a pond in Japan (Minoura and Muroi 1978).

*Phomatospora triseptata* is the fifth species to be reported from a freshwater habitat. Four other species, *P. aquatica*, *P. berkeleyi*, *P. muskellungensis* Fallah and Shearer and *P. striatigera* Scheuer have been reported previously from freshwater (http://fungi.life.uiuc.edu/). *Phomatospora triseptata* was collected only once, and we were unable to isolate this species in axenic culture. Whether an anamorph is associated with this fungus remains unknown.

**Physalospora limnetica** Raja et Shearer sp. nov.  
Figs. 48–58


Ascomata 470–490 × 400–450 μm, scattered, immersed to partially immersed, becoming erumpent, ostiolate, globose to subglobose, membranous, dark brown to black, papillate (Fig. 48). Papillae 80–100 × 100–130 μm, conical, wall of papillae composed of dark brown outwardly diverging hyphae, periphysate; paraphyses thin-walled, hyaline, septate (Fig. 49). Peridium 20–30 μm wide, composed of five to six layers of elongated pseudoparenchymatic cells; dark toward the outside, pale brown to hyaline toward the inside; cells ca. 10–15 × 2–4 μm (Fig. 50). Paraphyses abundant, simple, septate, immersed in a gel matrix, broad at the base and narrowing toward the apex, extending above the asci, tips of the paraphyses staining blue in aqueous nigrosin (Fig. 51). Asci 145–190 × 16–20 μm, cilindro-clavate, uniseriati, with a small bipartite, nonamyloid apical ring that stains blue in aqueous nigrosin; ascus flattened at the apex,
tapering to a short stalk at the base, with eight overlapping uniseriate ascospores (Figs. 52, 53, 54). Ascospores 18–22 × 9–14 μm, aseptate, rhomboid when young, becoming subglobose to oval when mature, hyaline, multiguttulate, surrounded by a gelatinous sheath ca. 3–4 μm wide, staining blue in aqueous nigrosin, enlarging in water to ca. 10–15 μm wide (Figs. 55–58).

Colonies on CMA hyaline, producing a pink pigment that diffuses into the surrounding agar. Aerial mycelium white, floccose, immersed hyphae creamy yellow; composed of branched, septate, hyaline hyphae.

**Etymology.** From Greek *limn* meaning standing water, referring to the habitat of the fungus.

**TYPE.** USA. FLORIDA: Apalachicola National Forest, Camel Pond, 30°16′36″N, 84°59′20″W, water 33 C, pH 5.5, on submerged herbaceous debris, 10 Jul 2006, HAR and JLC, F108-1. (HOLOTYPE designated here, ILL40115).

**Known distribution.** USA (FL).

**Comments.** _Physalospora_ Niessl was established in 1876 and contains 30 species (Kirk et al 2001) that are found on living and dead leaves or sometimes on twigs of angiosperms (Hanlin 1990). The genus, based on _P. alpestris_ Niessl, is characterized as having immersed _obclavati_, _pedunculati_, _octospori_. *Ascosporae* 30–40 × 11–15 μm, late, ellipsoidae vel biconicae, crystallinae, uniseptatae, constrictae sed perraro 1-septo prope apicibus, brunneae, circuminicteae tumica tenui, gelatinosa.

Ascomata on wood 290–320 × 290–340 μm, black, carbonaceous, scattered, partially immersed, erupting from the substrate, broadly conical, ostiolar, papillate (Fig. 59). *Papilla* 50 × 80 μm, short, broadly cylindrical; periphyses not seen. Peridium 40–45 μm thick; textura angularis in surface view; in longitudinal section composed of two layers; inner layer of pseudoparenchymatic cells 5–10 × 3–5 μm, outer layer of black carbonaceous material (Fig. 60). Pseudoparaphyses trabeculate, branched and anastomosing (Fig. 61). *Asci* 115–160 × 32–50 μm (mean = 140 × 39 μm, _n_ = 25), basitunicate, fissionsunicate, obclavate and broadly rounded at the apex (Figs. 62, 63), pedicellate, ectoausic splitting at the ascus apex, endoausic thick-walled (Fig. 64), with a broad ocular chamber 13 × 12 μm (Figs. 65, 66), with eight ascospores, uniseriate at the apex and base and irregularly arranged in the middle (Figs. 62, 63). Ascospores 30–40 × 11–15 μm (mean = 34.5 × 13 μm, _n_ = 30), broadly ellipsoidae vel bicornicae (Figs. 68, 69), hyaline to pale green, becoming dark reddish brown at maturity, forming acicular crystals in glycerin or lactic acid, deeply constricted at the midseptum, slightly constricted below the apices; upper cell wider than basal cell, cells with one large guttule and several small ones; surface roughened (Fig. 67); surrounded by a thin gelatinous sheath (Fig. 69); sheath invisible in glycerin or lactic acid, 1-septate, but occasionally additional septa also seen near the tips of the ascospores (Fig. 70).

**Etymology.** From Latin _oblavatus_ in reference to the shape of the ascus.

**TYPE.** USA. FLORIDA: Apalachicola National Forest, Whitehead Lake, 30°09′54″N, 84°40′30″W, water 29 C, pH 7.5, on submerged decorticated woody debris, 13 Jul 2004, HAR and CB, F79-1. (HOLOTYPE designated here, ILL40110).

**Known distribution.** USA (FL).

**Comments.** Following Barr (1979, 1990) our fungus from Florida belongs to the genus _Caryospora_ de Not., typified by _Caryospora putaminum_ (Schw. Ex Fr.) de Not. (Massariaceae Winter). This genus is characterized as having large, dull black, erumpent ascomata with a papilla; few oblong or inflated, 1-, 2- or 8-spored...
Figs. 59–70. *Caryospora obclavata* from the holotype. 59. Longitudinal section through ascoma. 60. Peridium. 61. Trabeculate pseudoparaphyses. 62. Young ascii; note thick-walled apex. 63. Ascus with eight irregularly arranged ascospores. 64. Fissitunicate ascus, arrow indicates area where endoascus extends from ectoascus. 65. Endoascus showing apical chamber. 66. Endoascus with thickened apex showing ocular chamber. 67. Rough-walled ascospores. 68. Mature ascospore. 69. Ascospore showing thin gelatinous sheath. 70. Mature ascospores showing additional septa within endoascus. Bars: 59 = 50 μm, 60–70 = 20 μm.
asci; rich reddish brown, rough walled, ellipsoidal ascospores usually constricted at the midseptum and surrounded by a narrow gelatinous sheath. *Caryospora obclavata* differs from other species in the genus in having smaller ascomata, thick-walled, obclavate asci, as well as broadly ellipsoidal, biconic ascospores. Seven species currently are recognized in the genus *Caryospora* (Barr 1979, 1990; Hawksworth 1982; Abdel-Wahab and Jones 2000). The species from Florida is most similar to *C. putaminum* (Schw. ex. Fr.) de Not (Barr 1979) in that the ascospores of both species have a median septum and thin-walled secondary septa, with a constriction at the midseptum and rough walls. *Caryospora obclavata*, however, differs from *C. putaminum* in the number of ascospores per ascus, ascus shape and size, absence of a wide gelatinous sheath surrounding the ascospores, and the nature of its habitat. The asci of *C. obclavata* are narrow (32–50 μm) versus the wider asci (50–70 μm) of *C. putaminum* (Barr 1979). In addition, *C. obclavata* always has eight ascospores per ascus (Figs. 63, 64), whereas asci in *C. putaminum* usually have 1–4 ascospores per ascus (Jeffers 1940, Barr 1979). The ascospores of *C. obclavata* are surrounded by a narrow gelatinous sheath (Fig. 69), whereas a wide gelatinous sheath is reported for *C. putaminum* (Barr 1979). *Caryospora obclavata* was found on submerged woody debris from a Florida lake, whereas *C. putaminum* originally was collected from endocarps of *Prunus persica* L. (peach) in a terrestrial habitat (Jeffers 1940, Barr 1979).

Most species of *Caryospora* have been reported from a variety of substrates such as wood, stems and fruit endocarps in terrestrial habitats. *Caryospora obclavata* is the third species to be reported from a freshwater habitat. Two other *Caryospora* species, *C. minima* Jeffers and *C. callicarpa* (Currey) Nitschke ex Fuckel, also have been reported from freshwater (Cai et al. 2006). These two species however originally were described from terrestrial habitats (Jeffers 1940, Currey 1859). Another species, *C. australiensis* Abdel-Wahab and E.B.G. Jones, was described from marine driftwood (Abdel-Wahab and Jones 2000).

**Lepidopterella tangerina** Raja et Shearer sp. nov.

(Figs. 71–80)


Ascomata on wood 120–190 × 230–300 μm, cleistothecial, scattered to gregarious, superficial to partially immersed, globose to subglobose, appearing as raised dome-shaped structures on the substrate (Figs. 71, 72). Peridium 8–10 μm wide, textura angularis in surface view, in median longitudinal section composed of an outer dark brown amorphous layer and an inner hyaline region of 2–3 layers of elongated, thin-walled, angular cells (Fig. 73). Pseudoparaphyses sparse, hyaline, septate (Fig. 74), not covered in gel. Asci 78–130 × 40–58 μm, (mean = 106 × 50 μm, n = 20), produced successively on ascogenous hyphae, then separating from the ascogenous hyphae, globose to subglobose, thick-walled and broadly rounded at the apex, with a short pedicel, containing eight irregularly arranged ascospores (Figs. 75, 76), fissitunicate, ectoascus rupturing at the apex to release the endoascus; endoascus extend-
ing to ca. 90–150 μm long; cytoplasm of dischargingendoascus finely granular, with granules delimiting spheres (Fig. 77). Ascospores 16–19 μm long at the septum and 30–35 μm wide at the broadest point (mean = 18 × 32 μm, n = 40), papillose to broadly reniform, 1-septate, bi- to multi-guttulate, orange to light orange-brown, smooth-walled (Figs. 78, 79, 80).

Colonies on PYG agar hyaline to dark greenish brown. Center of the colony composed of aerial, hyaline hyphae and immersed, brown hyphae; mycelium toward the periphery dark green to brown, slightly thick walled, immersed, and effuse; no anamorph observed.

Etymology. From Latin tangerinus = orange, referring to the orange ascospores.

TYPE. USA. FLORIDA: Blackwater River State Forest, Blackwater River, north end, at Kennedy Bridge, 30°56′01″N, 86°44′07″W, water 11 C, pH 5, on submerged corticated woody debris, 11 Feb 2006, HAR and JLC, F118-1. (HOLOTYPE designated here, ILL40112).

Known distribution. USA (FL).

Comments. The characteristics of L. tangerina fit within the concept of the genus Lepidopterella Shearer & J.L. Crane (Shearer and Crane 1980b). Lepidopterella tangerina however differs from the type of the genus, L. palustris Shearer & J.L. Crane, in ascospore morphology and size. The ascospores of L. tangerina are broadly reniform and shorter at the midseptum (17–19 μm) (Figs. 78–80) compared to the ascospores of L. palustris, which are deeply constricted in proportion to the overall spore morphology (butterfly shaped) and consistently longer at the midseptum (18–25 μm) (Shearer and Crane 1980b). The midseptum of the ascospore is darkened in L. palustris but not in L. tangerina (Fig. 79). In addition mature ascospores of L. palustris are darker than those of L. tangerina.

Ophiobolus shoemakeri Raja et Shearer sp. nov.

(Figs. 81–88)


Ascomata 540–580 × 295–300 μm, scattered, superficial to partially immersed, black, coriaceous; venter elongated globose to broadly ellipsoidal, ostiolate; ostiole ca. 15–20 μm wide, with a neck (Fig. 81). Neck 140–160 × 80–100 μm, cylindric, truncate, periphysate (Fig. 82). Peridium ca. 40–50 μm wide, glabrous, composed of two layers; outer layer of dark brown cells interspersed with amorphous black material; inner layer of 8–10 rows of thin-walled, hyaline, elongated, angular cells; cells 13–18 × 2–3 μm (Fig. 83). Pseudoparaphyses ca. 2 μm wide, hyaline, septe, constricted at the septa, in a gel matrix (Fig. 84). Asci 200–300 × 12–20 μm, fissitunicate, long, cylindrical, apex rounded, tapering to a short stalk, with eight ascospores in a single fascicle (Fig. 85). Ascospores 230–270 × 4–6 μm, parallel, arranged in a spirally twisted fascicle at the base of the ascus, hyaline to pale yellow, long-cylindrical, sclecosporous, slightly rounded toward the apex and tapering toward the base, 25–30 septe, multiguttulate at first (Fig. 86), then with a single guttule in each cell, surrounded by a narrow gelatinous sheath, sheath staining in aqueous nigrosin, invisible in glycerin or lactic acid (Figs. 87, 88).

Colonies on PYG agar gray; reverse side black. Mycelium composed of branched, septate, dark hyphae; no anamorph observed.

Etymology. Named in honor of Dr Robert A. Shoemaker for his early work on the genus Ophiobolus, as well as his outstanding contributions to the taxonomy and systematics of the Dothideomycetes.


Known distribution. USA (FL).

Comments. Ophiobolus Riess, based on Ophiobolus acuminatus (Sow. ex Fr.) Duby (Leptosphaeriaceae Barr), is characterized by its solitary to clustered ascomata, immersed to erumpent, spherical to obpyriform, brown to black, with a conical papilla; numerous, long-cylindrical, fissitunicate ascii; and multisep-tate, yellow to brown sclecosporous ascospores (Shoemaker 1976, Walker 1980). The characteristics of O. shoemakeri fit within the concept of the genus Ophiobolus.

The ascospores of our specimen were carefully compared with other species in the genus because ascospores seem to provide useful key morphological
Figs. 81–88. *Ophiobolus shoemakeri* from the holotype. 81. Ascoma on herbaceous substrate. 82. Longitudinal section through ascoma. 83. Peridium. 84. Cellular pseudoparaphyses in gel matrix. 85. Asci. 86. Ascospores fixed in glycerin; note ascospores rounded at the apex and tapering toward the base. 87, 88. Ascospores stained in aqueous nigrosin; note arrows showing narrow gelatinous sheath surrounding entire ascospore. Bars: 81 = 200 μm; 82–85, 87, 88 = 20 μm; 86 = 50 μm.
characters to delineate species within *Ophiobolus* (Shoemaker 1976). Ascospores of the Florida specimen are similar to those of *O. lonicerae* Fabre in that they are >20 septate and are broad at the apex and taper gradually toward the base (Shoemaker 1976, Fig. 30). However *O. shoemakeri* differs from *O. lonicerae* in that the ascospores of *O. shoemakeri* have a narrow gelatinous sheath surrounding the ascospore (Figs. 87, 88), a character absent in *O. lonicerae*. In addition the two species also differ in their ecological habitat. *Ophiobolus shoemakeri* was collected from submerged unidentified herbaceous debris from lentic habitats in Florida, whereas *O. lonicerae* originally was described from *Lonicera hispidula* (Lindl.) Douglas ex Torr. & A. Gray (Caprifoliaceae) in a terrestrial habitat in California.

In addition to *O. shoemakeri* three other *Ophiobolus* species, *O. gracilis* (Niessl) E. Mueller, *O. herpotrichus* (Fries) Sacc. and *O. typhae* Feltgen, have been reported from freshwater (http://fungi.life.uiuc.edu/). These taxa differ from *O. shoemakeri* in the size and septation of the ascospores, as well as in ascomal morphology. None of the aforementioned species collected from fresh water possess a gelatinous ascospore sheath as in *O. shoemakeri*. Another species, *O. australiensis* Johnson & Sparrow, was reported from an aquatic habitat on dead roots of *Avicennia marina* (Forssk.) Vierh var. *resinifera* (G. Forst.) Bakh. from Queensland, Australia. Kohlmeyer and Kohlmeyer (1979) think *O. australiensis* might not belong in the genus because it lacks septate ascospores and pseudoparaphyses.

*Ophiobolus shoemakeri* was tested for the production of extracellular enzymes in vitro and was found positive for cellulase, endoglucanase, beta-glucosidase, xylanase, laccase, amylase, pectic lyase, and polygalacturonase (Simonis, Raja, Shearer unpubl), suggesting it has the potential to decay herbaceous substrates in freshwater. Although positive for xylanase *O. shoemakeri* was negative for the production of the lignin modifying enzymes, peroxidase and tyrosinase, and it did not cause soft-rot in balsa wood. The forgoing results are interesting because most of the species of *Ophiobolus* have been isolated from herbaceous substrates. It is plausible that lack of lignin modifying enzymes and ability to form soft-rot cavities might prevent species of *Ophiobolus* from being competitive on woody substrates. More species in the genus should be tested for production of extracellular enzymes to determine whether additional herbaceous species lack lignin-modifying enzymes.

**NEW RECORDS**

(For descriptions and illustrations see Raja 2007, http://fungi.life.uiuc.edu/)


Known distribution. Brunei, Hong Kong, Philippines, USA (FL).

Comments. The specimens from Florida fit well within the concept of Aniptodera and are similar to A. inflatiascigera K.M. Tsui, K.D. Hyde & I.J. Hodgkiss (Tsui et al. 1997). Aniptodera inflatiascigera can be distinguished from other members of the genus by its characteristic ascus, which inflates in water on release from the ascomata. Apical appendages were not observed in the Florida specimens but were reported for the type specimen (Tsui et al. 1997). If the ballooning of the ascus in water is disregarded, the thick-walled ascospores of A. inflatiascigera resemble those of A. limnetica Shearer (Shearer 1989). Aniptodera inflatiascigera however has larger asci and ascospores compared to A. limnetica.

Aniptodera inflatiascigera was found from central and south Florida on submerged decorticated woody debris as well as herbaceous debris from lentic habitats. These collections are the first reports from North America. In earlier studies this fungus was reported from submerged decorticated wood in lotic habitats in the paleotropics (Tsui et al. 1997, Hyde et al. 1999, Tsui et al. 2000, 2001).


Known distribution. Australia, Brunei, Hong Kong, Malaysia, Seychelles, South Africa, USA (FL, IL, NC, NH), Venezuela.

Comments. Annulatascus velatisporus K.D. Hyde (Hyde 1992b) is the type species of the genus Annulatascus K.D. Hyde, and the family Annulatascaceae (Wong et al. 1998). Populations of this species from Florida agree well in all aspects with the protolog of A. velatisporus (Hyde 1992b). Hyde (1992b) in the original description of the genus mentioned the ascospore sheath as being thin and irregular. The morphology of the ascospore sheath was redescribed and illustrated with TEM and SEM by Wong et al. (1999). The Florida material agrees with the description and illustrations of Wong et al. (1999) in that the ascospores are surrounded by a mucilaginous sheath, which is condensed at first but later becomes wide and spreads in water and is sticky.

Annulatascus velatisporus has been reported widely from lotic habitats on submerged decorticated woody debris from temperate and tropical latitudes (http://www.life.uiuc.edu/fungi/). We have collected this species from four of the five collection sites within Florida at water temperatures of 21–37 C and at pH (5–)6–8(–8.7). It also occurs in both lotic and lentic habitats and on submerged woody debris and palm rachis. These reports suggest that A. velatisporus is a warm-water generalist species with respect to the substrates and habitats it colonizes.

Specimens examined. USA. FLORIDA: Apalachicola National Forest, Camel Pond, 30°16′36″N, 84°59′20″W, water 33 C, pH 5, on submerged herbaceous debris, 10 Jul 2006, HAR and JLC, F11-6.

Known distribution. Brunei, USA (FL).

Comments. The fungus collected from Florida is morphologically similar in almost all respects to the protolog of A. appendiculata (Fryar and Hyde 2004). The specimen collected from Florida however has a hyaline, peripherysate neck, a character not reported for the type species (Fryar and Hyde 2004). The asci of A. appendiculata were described as persistent; asci from the Florida material although present at first, start to deliquesce after a few minutes in water. The ascospores of A. appendiculata appear to be surrounded by gelatinous material because the ascospores seem to be equally apart from each other; staining with India ink or nigrosin however does not seem to indicate the presence of a gelatinous sheath. The Florida specimen of A. appendiculata occurred on a piece of unidentified herbaceous debris in a freshwater lake, whereas the type specimen was reported from submerged wood in brackish water and seawater from Brunei. This species is reported from North America and freshwater for the first time.


Specimens examined. USA. FLORIDA: Blackwater River State Forest, Bone Creek, 30°44′19″N, 86°46′29″W, water 25 C, pH 6.7, on submerged decorticated woody debris, 10 Jul 2004, HAR and CB, F11-5; Horns Creek swampy area, 30°46′31″N, 86°54′43″W, water 30 C, pH 6, on submerged decorticated woody debris, 10 Jul 2004, HAR and CB, F11-7; Apalachicola National Forest, unnamed lake east of Lost Lake, 30°21′48″N, 84°22′56″W, water 35 C, pH 7.3, on submerged decorticated woody debris, 13 Jul 2004, HAR and CB, F11-1; Andrew Lake, 30°24′09″N, 84°24′27″W, water 33 C, pH 6.5, on submerged decorticated woody debris, 13 Jul 2004, HAR and CB, F11-2; Rowletts Creek, 30°03′32″N, 85°01′11″W, water 35 C, pH 5, on submerged decorticated woody debris, 10 Jul 2006, HAR and JLC, F11-8; Camel Pond, 30°16′36″N, 84°59′20″W, water 33 C, pH 5, on submerged, decorticated woody debris, 10 Jul 2006, HAR and JLC, F11-9. Ocala National Forest, Mary Lake, 29°04′23″N, 81°49′57″W, water 33 C, pH 5, on submerged decorticated woody debris, 10 Jul 2006, HAR and CB, F11-3; 16 Jul 2006, HAR and JLC, F11-10; Fore Lake, 29°16′17″N, 81°55′03″W, water 37 C, pH 6.6, on submerged decorticated woody debris, 16 Jul 2004, HAR and CB, F11-4.

Known distribution. Brunei, Papua New Guinea, USA (FL).

Comments. Currently three species are accepted in the genus Fluviatispora K.D. Hyde (Hyde 1994, Fryar and Hyde 2004). Following Fryar and Hyde (2004) the species from Florida best fits the description of F. reticulata K.D. Hyde (Hyde 1994). The ascospores of the specimen from Florida are slightly longer and narrower (20–25 × 8–12 μm) than those of the type species (17–23 × 10–13 μm) (Hyde 1994). In addition the ascospores of the Florida material are biguttulate, as opposed to a single large eccentric guttule reported in the type species (Hyde 1994).

We have collected F. reticulata nine times from three of the five collection sites in northern and central Florida in lotic and lentic habitats. It occurred during the summer in two successive years at water temperatures of 25–37 C and at pH 5–7, only on woody substrates. This species is reported from North America for the first time.

Lepidopterella palustris Shearer & J.L. Crane, Trans-
actions of the British Mycological Society 75(2):194.
1980b.

Specimens examined. USA. FLORIDA: Apalachicola Na-
ional Forest, Owls Creek Backwater Swamp, 30°03'31"N, 85°01'11"W, water 30 C, pH 7.8, on submerged decorticat-

Known distribution. USA (FL, IL).

Comments. The specimens from Florida fit well
within the genus Lepidopterella and agree well with the
description of L. palustris, the type species of the
genus (Shearer and Crane 1980b). This genus has
butterfly-shape ascosporae and globose to subglobose
asci, which show fissitunicate dehiscence when left in
water for few minutes. Although fissitunicate dehiscence
occurs in this fungus, the ascosporae are not
forcefully discharged from the endoascus, (Shearer and
Crane 1980, Raja pers obs) instead the endoascus
wall deliquesces to release the ascosporae.

Lepidopterella palustris originally was described
from a cypress swamp in southern Illinois (Shearer
and Crane, 1980b). Thus far this species has not been
reported elsewhere from temperate and tropical
iuuc.edu/fungi/). Shearer and Crane (1980b) sug-
gested that this fungus is probably a warm water
species. Our collections from Florida add support to
their premise because the fungus from Florida was
collected only in the summer at water temperatures of
25–30 C.

ACKNOWLEDGMENTS

We appreciate the many constructive comments provided by
associate editor David Geiser and two anonymous reviewers,
which greatly improved this paper. We thank Dr J.L. Crane,
Dr Kevin Robertson, Dr Andrew N. Miller and Christopher
Brown for their assistance with collecting. We appreciate the
efforts of the rangers at Blackwater River State Forest,
Apalachicola National Forest and Ocala National Forest for
permission to collect within the forests. We are grateful for
the aid of the superintendent of Big Cypress National
Preserve and Everglades National Park for providing
permits to collect aquatic fungi. This manuscript is based
on work supported by the National Science Foundation and
National Institutes of Health under (NSF Grant No. DEB
03-16496 and NIH Grant No. R01GM-60600). Support from
these agencies is gratefully acknowledged. Any opinions,
findings and conclusions or recommendations expressed in
this publication are those of the authors and do not
necessarily reflect the views of the National Science
Foundation and National Institutes of Health. This work
represents a portion of a thesis (HAR) in partial fulfillment
of the requirements for the doctoral degree at the Graduate
College of the University of Illinois at Urbana-Champaign.

LITERATURE CITED

Abdel-Wahab MA, Jones EBG. 2000. Three new marine
ascomycetes from driftwood in Australian sand dunes.
Mycoscience 41:379–388.

Barr ME. 1970. Some amerosporous ascomycetes on

Mycotaxon 9:17–37.

———. 1989. The genus Chaetomastia (Decapriaceae) in

(Loculoascomycetes). New York Botanical Garden
Series II Part 13:129.


fungi. Fungal Diversity Press. Fungal Diversity Research
Series 18:261.

Campbell J, Anderson JL, Shearer CA. 2003. Systematics of
Halosphaeria based on morphological and molecular
data. Mycologia 95:530–552.

Currey F. 1859. Synopsis of the simple Sphaeriaceae of the

Eaton RA, Jones EBG. 1970. New fungi on timber from

Fallah PM, Shearer CA. 1998. Freshwater Ascomycetes:
Phomatospora spp. from lakes in Wisconsin. Mycologia

———. 2001. Freshwater ascomycetes: new or
noteworthy species from north temperate lakes in

Diversity Press Research Series, 393.

Fryar SC, Hyde KD. 2004. New species and genera of
ascomycetes from fresh and brackish water in Brunei:
Ayria appendiculata and Sungaica bactrodesmiella
gen. et sp. nov., Fluviatispora boothi, Torrentiopsis
crassiparietis and T. fusiformis spp. nov. Crypt Mycol 25:
245–260.

Hanlin RT. 1990. Combined Keys to Illustrated Genera of
Ascomycetes Volumes I & II. St Paul, Minnesota:
American Phytopathological Society.

Hawksworth DL. 1982. A new species of Caryospora from


herbarium speciemens for light microscopy. Mycologia
83:520–524.


———. 1992b. Tropical Australian freshwater fungi II.
Annulatuscus velatispora gen. et sp. nov., A. bipolaris sp.
nov. and Nais aquatica sp. nov. (Ascomycetes). Aust

———. 1992c. Intertidal mangrove fungi from the west
coast of Mexico, including one new genus and two new

———. 1993. Fungi from palms X. Lockerbia palmicola, a


