
**Pyrenomycetes of the Great Smoky Mountains National Park.
V. *Annulohypoxylon* and *Hypoxylon* (*Xylariaceae*)**

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Vasilyeva, L.N., Rogers, J.D., and Miller, A.N. (2007). Pyrenomycetes of the Great Smoky Mountains National Park. V. *Annulohypoxylon* and *Hypoxylon* (*Xylariaceae*). *Fungal Diversity* 27: 231-245.

Descriptions and keys are provided for the four species of *Annulohypoxylon* and 18 species of *Hypoxylon* now known from the Great Smoky Mountains National Park in the eastern United States. Eighteen of these are new records for the Park. *H. cf. fendleri* is found in USA for the first time.

Key words: Ascomycota, Southern Appalachians, taxonomy, temperate forests, *Xylariaceae*

Introduction

As part of an inventory of the pyrenomycetes of the Great Smoky Mountains National Park (GSMNP) (Vasilyeva and Stephenson, 2004, 2005, 2006; Vasilyeva *et al.*, 2007), specimens of *Annulohypoxylon* Y.-M. Ju, J.D. Rogers & H.-M. Hsieh and *Hypoxylon* Bull. were collected throughout the park from late March to early May 2002, and in different periods in 2004-2006. These specimens are deposited in BPI, ILLS, WSP and VLA (the Institute of Biology and Soil Science, Vladivostok, Russia). Collectors are abbreviated as follows: ANM, Andrew N. Miller; JDR, Jack D. Rogers; and LNV, Larissa N. Vasilyeva. Images and an interactive key to most species can be found at: <http://mycology.sinica.edu.tw/Xylariaceae>.

Prior to the study reported herein, eight species were recorded from the GSMNP under the generic name *Hypoxylon* (Petersen, 1979). Most of them have been collected in the Park recently. However, some fungi previously identified as *Hypoxylon* have been instated in different genera. Only two

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previously reported species are currently left in the genus, namely *H. fuscum* (Pers.: Fr.) Fr. and *H. rubiginosum* (Pers.: Fr.) Fr. *H. cohaerens* (Pers.: Fr.) Fr. and *H. truncatum* (Schwein.: Fr.) J.H. Mill. are placed in the genus *Annulohypoxyton* (Ju *et al.*, 2005), while *Hypoxyton deustum* (Hoffm.: Fr.) Grev. is now *Kretzschmaria deusta* (Hoffm.: Fr.) P.M.D. Martin. The new genus *Whalleya* is based upon *Hypoxyton microplacum* (Berk. et M.A. Curtis) J.H. Mill. (Rogers *et al.*, 1997), while the old genus *Creosphaeria* was reinstated for *Hypoxyton sassafras* (Schwein.: Fr.) M.A. Curtis (Ju *et al.*, 1993). At present, 18 species of *Annulohypoxyton* and *Hypoxyton* are new records for the Park and one of them is a new record for USA. *Hypoxyton commutatum* Nitschke is considered as doubtful record, since this species is known only from the type material (Ju and Rogers, 1996).

Taxonomy

Annulohypoxyton Y.-M. Ju, J.D. Rogers & H.-M. Hsieh, *Mycologia* 97: 855 (2005).

Type species: Annulohypoxyton truncatum (Schwein.: Fr.) Y.-M. Ju, J.D. Rogers & H.-M. Hsieh.

Stromata superficial or erumpent-superficial, semiglobose, cushion-like or effuse, light or dull-colored, usually blackened with age, with ostioles always higher than the stromatal surface and often encircled with an annulate disc; pigments extracted in KOH present or absent. *Asci* cylindrical, paraphysate, with amyloid or infrequently inamyloid apical ring. *Ascospores* uniseriate, one-celled, light-brown to dark brown, with germ slits; perispores with minute thickening on convex side.

Key to species of *Annulohypoxyton* known from GSMNP

- 1. Ostioles with papillae 2
- 1. Ostioles with papillae surrounded with a more or less well-developed annulus 3
- 2. Stromata 2-4 mm diam., turbinate, caespitose, primarily on *Fagus* ***A. cohaerens***
- 2. Stromata more robust, effused-pulvinate to semiglobose, on *Betula* ***A. multiforme***
- 3. Stromata glomerate, caespitose to effused-pulvinate ***A. truncatum***
- 3. Stromata more robust, effused-pulvinate to semiglobose ***A. annulatum***

Annulohypoxyton annulatum (Schwein.: Fr.) Y.-M. Ju, J.D. Rogers & H.-M. Hsieh, *Mycologia* 97: 857 (2005). (Fig. 1)

Sphaeria annulata Schwein., *J. Acad. Nat. Sci.* 5: 11 (1825). - *S. annulata* Schwein.: Fr., *Elench. Fung.* 2: 64 (1828).

Hypoxylon annulatum (Schwein.: Fr.) Mont. *apud* C. Gay, Hist. Chile Bot. 7: 445 (1850).

Illustrations: Miller 1961, figs 160, 162 (as *H. truncatum* f. *marginata*).

Stromata effused-pulvinate to semiglobose, 0.5-2 cm diam., 2-4.5 mm thick, at first olivaceous-brown, at maturity blackish-brown, with coarsely papillate ostioles encircled with a convex disc 0.3-0.5 mm diam., KOH extractable pigments green or greenish. *Asci* p. sp. 70-80 × 5-6 μm, with stipes 45-55 μm long and discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* brown to dark brown, ellipsoid-inequilateral, 7.5-12 × 3.5-5 μm, with straight germ slit spore-length, perispore dehiscent in 10% KOH.

Habitat: On dead branches of *Quercus* spp.

Localities in GSMNP: Bryson City (Noland Creek Trail); Cades Cove (Anthony Creeks Trail, Rich Mountain Loop Trail, Finley Cane Trail, Turkey Pen Ridge Trail); Cataloochee (Pretty Hollow Gap Trail); Cosby (Horse Trail, Gabes Mountain Trail); Purchase Knob; Twin Creeks (ATBI plot).

Notes: This fungus is among the most common inhabitants of oak in the Park.

Annulohypoxylon cohaerens (Pers.: Fr.) Y.-M. Ju, J.D. Rogers & H.-M. Hsieh, Mycologia 97: 857 (2005). (Fig. 2)

Sphaeria cohaerens Pers., Tent. Disp. Meth. Fung.: 2 (1797). - *S. cohaerens* Pers.: Fr., Syst. Mycol. 2: 333 (1823).

Hypoxylon cohaerens (Pers.: Fr.) Fr., Summa Veget. Scand.: 384 (1849).

Illustrations: Miller 1961 figs 61, 62, 79; Granmo 1999, figs 4, 13, 38.

Stromata subglobose, flattened above, 2-4 cm diam., often constricted below, gregarious, confluent, at first brown, at maturity purplish black, with papillate ostioles; KOH-extractable pigments greenish to yellowish or without visible pigments. *Asci* p. sp. 75-85 × 5-7 μm, with stipes 50-70 μm long and discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* brown to dark brown, ellipsoid-inequilateral, 9-12 × 4-5 μm, with straight germ slit spore-length, perispore dehiscent in 10% KOH.

Habitat: On dead branches of *Fagus grandifolia* Ehrh.

Localities in GSMNP: Cades Cove (Anthony Creek Trail, Cooper Road Trail); Cosby (Gabes Mountain Trail); Cataloochee (Caldwell Fork Trail, Hemphill Bald Trail, Pretty Hollow Gap Trail); Greenbrier (Porters Creek Trail, Ramsey Cascades Trail); Purchase Knob (Hemphill Bald Trail).

Notes: This fungus is a common inhabitant of beech, often with *Hypoxylon fragiforme*.

Annulohypoxylon multiforme (Fr.: Fr.) Y.-M. Ju, J.D. Rogers & H.-M. Hsieh, Mycologia 97: 859 (2005). (Fig. 3)

Sphaeria multiforme Fr., Obs. Mycol. 1: 169 (1815). - *S. multiforme* Fr.: Fr., Syst. Mycol. 2: 334 (1823).

Hypoxylon multiforme (Fr.: Fr.) Fr., Summa Veget. Scand.: 384 (1849).

Illustrations: Miller 1961, figs 64, 80; Granmo 1999, fig. 22.

Stromata erumpent-superficial, effused-pulvinate to semiglobose, 0.5-3 cm diam., 1.5-7 mm thick, gregarious, confluent, at first rusty- or red-brown, at maturity almost black, with coarsely papillate ostioles; KOH-extractable pigment usually orange, but sometime with green tint. *Asci* p. sp. 70-80 × 5-6 μm, with stipes 70-80 μm long and discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* light brown to brown, ellipsoid-inequilateral, 8-12 × 3.5-5 μm, with straight germ slit less than spore-length, perispore dehiscent in 10% KOH.

Habitat: On dead branches of *Betula* spp.

Localities in GSMNP: Cosby (Gages Mountain Trail); Greenbrier (Porters Creek Trail); Purchase Knob.

Notes: This is a common inhabitant of birch throughout North America.

Annulohypoxylon truncatum (Schwein.: Fr.) Y.-M. Ju, J.D. Rogers & H.-M. Hsieh, Mycologia 97: 859 (2005). (Fig. 4)

Sphaeria truncata Schwein., Schrift. Nat. Ges. Leipzig 1: 44 (1822). - *S. truncata* Schwein.: Fr., Syst. Mycol. 2: 442 (1823).

Hypoxylon truncatum (Schwein.: Fr.) J.H. Mill., Trans. Brit. Mycol. Soc. 17: 130 (1932).

Illustrations: Miller 1961 fig. 164 (as *H. truncatum* f. *annulata*).

Stromata glomerate to effused-pulvinate, with rather prominent perithecial mounds, 0.5-1 cm diam., 0.6-2 mm thick, at first dark reddish brown, at maturity blackish brown, with papillate ostioles encircled with a disc 0.2-0.4 mm diam.; KOH-extractable pigments greenish. *Asci* p. sp. 70-90 × 5-6 μm, with stipes 70-90 μm long and discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* brown to dark brown, ellipsoid-inequilateral, 8-10.5 × 4-5 μm, with straight germ slit spore-length, perispore dehiscent in 10 % KOH.

Habitat: On dead branches of *Quercus* spp.

Localities in GSMNP: Big Creek; Greenbrier.

Notes: This fungus can be confused with *A. annulatum*. The latter fungus often is pulvinate to tent-shaped, has greenish tints, and usually lacks obvious perithecial elevations and deep conspicuous ostiolar discs. A collection made on Big Creek Trail, 5.06.2002, LNV is atypical and might represent *A. elevatidiscus* Y.-M. Ju, J. D. Rogers & H.-M. Hsieh, *A. nitens* (Ces.) Y.-M. Ju, J.D. Rogers & H.-M. Hsieh, or a new species.

Hypoxylon Bull., Hist. Champ. France: 167 (1791).

Type species: *Hypoxylon fragiforme* (Pers.: Fr.) J. Kickx f.

Stromata superficial, semiglobose, cushion-like, or effuse, bright- or dark-colored, soft or waxy, rarely carbonaceous, with umbilicate or, in several species, papillate ostioles. *Asci* cylindrical, paraphysate, usually with amyloid apical ring stained blue in iodine reagents. *Ascospores* uniseriate, one-celled, light-brown to dark-brown, often with germ slits, perispores dehiscent or indehiscent in 10% KOH, smooth or with minute or obvious ornamentation.

Key to species of *Hypoxylon* known from GSMNP

1. Ostioles papillate *H. croceum*
1. Ostioles umbilicate 2
2. Stromata lacking KOH-extractable pigments (or some greyish tinge could be observed)
..... *H. sp. ? nov. (1)*
2. Stromata having KOH-extractable pigments 3
3. KOH-extractable pigments orange, rust or dark brick 4
3. KOH-extractable pigments other than above 10
4. Stromata hemispherical to spherical 5
4. Stromata in pulvinate glomerules or effused 6
5. Ascospores (10.5)11-15 × 5-7 μm *H. fragiforme*
5. Ascospores smaller (up to 10 μm long on average) *H. howeianum*
6. Stromata in pulvinate glomerules, at first reddish or rusty, finally black with age
..... *H. sp. ? nov. (2)*
6. Stromata effused 7
7. Ascospores 10-15 × 4-6 μm (12.5 μm long on average) *H. crocopeplum*
7. Ascospores smaller (8-10 μm long on average) 8
8. Stromatal surface with vinaceous shades *H. cf. fendleri*
8. Stromatal surface without vinaceous shades 9
9. Stromata with dull-colored granules, ascospores mostly 8-12 μm long *H. rubiginosum*
9. Stromata with bright-colored granules, ascospores mostly 7-9 μm long *H. subgilvum*
10. KOH-extractable pigments greenish or olivaceous 11
10. KOH-extractable pigments yellowish to ochraceous 14
11. Stromatal surface dark reddish brown *H. macrocarpum*
11. Stromatal surface with lilac or vinaceous shades 12
12. Stromata hemispherical to spherical *H. fuscum*
12. Stromata effused 13

13. Ascospores up to 12 μm long..... *H. anthochroum*
 13. Ascospores longer than 12 μm *H. fuscopurpureum*
 14. Stromatal surface reddish shades, with white material in ostiolar pores..... *H. perforatum*
 14. Stromatal surface other shades, ostiolar pores not whitened..... 15
15. Stromata glomerate, coffee-brown..... *H. notatum*
 15. Stromatal surface with lilac or vinaceous shades..... 16
16. Stromata hemispherical to spherical..... *H. intermedium*
 16. Stromata effused..... 17
17. Stromata with distinct perithecial contours..... *H. lenormandii*
 17. Stromata with more or less immersed perithecia..... *H. cf. hypomiltum*

Hypoxyton anthochroum Berk. et Broome, J. Linn. Soc. Bot. 14: 122 (1873).

Stromata effused-pulvinate, with lilac or vinaceous shades, red granules beneath the surface and greenish KOH-extractable pigments. *Asci* cylindrical, sp. p. 60-70 \times 5-7 μm , with stipes 40-50 μm long and small apical ring bluing in Melzer's iodine reagent. *Ascospores* brown, 9-12 \times 4-5 μm , perispore dehiscent in 10% KOH.

Habitat: On wood of deciduous trees.

Localities in GSMNP: Big Creek (Baxter Creek Trail); Cataloochee (Pretty Hollow Gap Trail); Greenbrier.

Notes: This species differs from *H. fendleri* (as it is in present collections) only in stromatal pigments. It is previously known from Pennsylvania and Louisiana in North America (Ju and Rogers, 1996).

***Hypoxyton* sp. ?nov. (1)**

Stromata effused-pulvinate, at times with rather prominent perithecial mounds, surface different shades of cacao, some parts even whitish, light brown granules beneath surface and between perithecia, without apparent KOH-extractable pigments (or slightly grey pigment). *Asci* cylindrical, sp. p. 70-80 \times 6-7 μm , with stipes 30-40 μm long and apical ring bluing in Melzer's iodine reagent. *Ascospores* brown, 8-12 \times 4.5-5 μm , perispore dehiscent in 10% KOH.

Habitat: On bark of a deciduous tree.

Localities in GSMNP: Twin Creeks (Twin Creeks Trail).

Notes: This might represent a new species. We prefer to see additional collections before making a decision.

Hypoxyton croceum J.H. Mill., Mycologia 25: 323 (1933).

Illustrations: Miller 1961, figs 73, 74, 86.

Stromata mostly glomerate, with conspicuous perithecial mounds, surface fuscous when aged, dark brown tissue beneath surface and between perithecia,

with KOH-extractable pigments greyish yellow or greenish brown. Asci sp. p. 70-90 × 6-7 μm, with stipes 30-50 μm long and discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* 9-12(13.5) × 4-5 μm, perispore indehiscent in 10 % KOH.

Habitat: On log.

Localities in GSMNP: Smokemont (Bradley Fork Trail).

Notes: This species occurs in eastern United States (Georgia, North Carolina, Ohio, Tennessee) and seems to prefer the rotten wood of *Liriodendron tulipifera* L. (Ju and Rogers, 1996). This is the only *Hypoxylon* species from the Park with papillate ostioles.

Hypoxylon crocoveplum Berk. et M.A. Curtis *apud* Berk., *Grevillea* 4: 49 (1875). (Fig. 5)

Illustrations: Miller 1961, fig. 27.

Stromata effused-pulvinate, surface fulvous or apricot, orange red granules beneath surface and between perithecia, with KOH-extractable pigments orange. *Asci* sp. p. 70-90 × 6-8 μm, with stipes 80-130 μm long and discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* (10)12-15 × 5-7 μm, perispore dehiscent in 10% KOH.

Habitat: On wood of different deciduous trees.

Localities in GSMNP: Big Creek (Baxter Creek Trail); Cades Cove (Anthony Creek Trail, Laurel Creek Road); Cosby; Elkmont (Little River Trail); Greenbrier (Ramsey Cascades Trail); Oconaluftee (Mingus Creek Trail); Sugarlands (Sugarlands Nature Trail).

Hypoxylon cf. fendleri Berk. *apud* Cooke, *Grevillea* 11: 132 (1883).

Stromata effused-pulvinate, with lilac or vinaceous shades, rust granules beneath the surface and dark rust KOH-extractable pigments. *Asci* cylindrical, sp. p. 60-70 × 5-7 μm, with stipes 40-50 μm long and small apical ring bluing in Melzer's iodine reagent. *Ascospores* brown, 9-12 × 4-5 μm, perispore dehiscent in 10% KOH.

Habitat: On wood of deciduous trees.

Localities in GSMNP: Big Creek (Baxter Creek Trail); Cosby (Maddron Bald Trail); Twin Creeks.

Notes: This species is common throughout the tropics (Ju and Rogers, 1996), but has not been reported in USA before.

Hypoxylon fragiforme (Pers.: Fr.) J. Kickx f., *Fl. Crypt. Env. Louvain*: 116 (1835). (Fig. 6)

Sphaeria fragiformis Pers., *Ann. Bot.* 11: 21 (1794). - *S. fragiformis* Pers.: Fr., *Syst. Mycol.* 2: 332 (1823).

Perisphaeria fragiforme (Pers.: Fr.) Gray, Nat. Arr. Brit. Pl. 1: 513 (1821).

Stromatosphaeria fragiformis (Pers.: Fr.) Grev., Scot. Crypt. Gl. 3: Pl. 136 (1825).

Illustrations: Miller 1961 figs 1, 34; Granmo 1999, figs 7, 14; Dämon *et al.* 2000, fig. 9.

Stromata hemispherical to spherical, with conspicuous perithecial mounds, about 0.5-1 cm diam., with rust or dark brick surface, orange-red granules beneath, and orange KOH-extractable pigments. *Asci* cylindrical, sp. p. 80-90 × 6-8 µm, with stipes up to 90 µm and discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* brown, ellipsoid-inequilateral, (10.5)11-15 × 5-7 µm, perispore dehiscent in 10% KOH.

Habitat: On dead branches of *Fagus grandifolia* Ehrh.

Localities in GSMNP: Cades Cove (Parsons Branch Road); Greenbrier (Porters Creek Trail).

Notes: This species is found throughout the range of beech in North America.

Hypoxylon fuscopurpureum (Schwein.: Fr.) M.A. Curtis, Geol. Nat. Hist. Surv. North Carolina 3: 140 (1867).

Sphaeria fuscopurpurea Schwein., J. Acad. Nat. Sci. Philad. 5: 16 (1825). - *S. fuscopurpurea* Schwein.: Fr., Syst. Mycol. Index: 165 (1832).

Illustrations: Miller 1961, fig. 21 (as *Hypoxylon vogesiacum* var. *microspora*).

Stromata effused-pulvinate, with lilac or vinaceous shades, dull reddish granules beneath the surface and greenish olivaceous KOH-extractable pigments. *Asci* cylindrical, sp. p. 80-90 × 8-10 µm, with stipes 50-60 µm long and discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* brown, 12-15 × 5-7 µm, perispore indehiscent in 10% KOH.

Habitat: On wood of a deciduous tree.

Localities in GSMNP: Greenbrier Cove (Whaley Cemetery Trail).

Hypoxylon fuscum (Pers.: Fr.) Fr., Summa Veget. Scand.: 384 (1849).

(Fig. 7)

Sphaeria fusca Pers., Ann. Bot. (Usteri) 11: 22 (1794). - *S. fusca* Pers.: Fr., Syst. Mycol. 2: 332 (1823).

Peripherostoma fuscum (Pers.) Gray, Nat. Arr. Brit. Plant. 1: 513 (1821).

Stromatosphaeria fusca (Pers.: Fr.) Grev., Fl. Edin.: 356 (1824).

Illustrations: Miller 1961, fig. 5; Granmo 1999, figs 8, 15, 39; Dämon *et al.* 2000, fig. 9.

Stromata usually hemispherical to pulvinate, about 3-7 mm diam., sometimes confluent, surface vinaceous brown to purplish, at first covered with a thin pruinose layer, dull orange or dull reddish brown granules beneath surface and between perithecia, with KOH-extractable pigments greenish-

olivaceous. *Asci* cylindrical, sp. p. $80-110 \times 6-9 \mu\text{m}$, with stipes up to $90 \mu\text{m}$ and discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* brown, ellipsoid-inequilateral, $11-16 \times 5-7 \mu\text{m}$, perispore dehiscent in 10% KOH.

Habitat: On *Alnus serrulata* (Aiton) Willd. and *Betula* sp.

Localities in GSMNP: Cades Cove (Appalachian Trail, Fodge Creek Road, Parsons Branch Road); Cosby (Snake Den Ridge Trail); Purchase Knob (Hemphill Bald Trail).

Hypoxylon howeianum Peck, Ann. Rep. New York State Mus. 24: 98 (1871).

(Fig. 8)

Illustrations: Miller 1961, fig. 2; Granmo 1999, figs 11, 17, 37; Dämon *et al.* 2000, fig. 9.

Stromata superficial on bark, sessile, hemispherical or sometimes crowded and tending to coalesce becoming irregular, rust or dark brick, with a rather smooth surface, red granules beneath, orange or brick KOH-extractable pigments and satiny black entostroma. *Asci* cylindrical, sp. p. $50-70 \times 5-6 \mu\text{m}$, with stipes $40-60 \mu\text{m}$ long and discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* uniseriate, inequilaterally elliptical, light to dark brown, $6-9 \times 3-3.5 \mu\text{m}$.

Habitat: On various deciduous trees.

Localities in GSMNP: Cades Cove (Turkey Pen Ridge Trail); Chimney Tops (picnic area); Cosby (Lower Mt. Cammerer Trail, Low Hap Trail, Snake Den Ridge Trail); Greenbrier (Porters Creek Trail); Sugarlands Visitor Center (Nature Trail).

Notes: This species resembles *H. fragiforme*, but has a smaller ascospore range and a wider host range.

Hypoxylon cf. hypomiltum Mont., Ann. Sci. Nat. Bot., ser. 2, 13: 356 (1840).

Stromata effuse pulvinate, surface vinaceous brown, dull rusty brown granules immediately beneath surface and between perithecia, with KOH-extractable pigments luteous. *Asci* cylindrical, sp. p. $50-60 \times 5-6 \mu\text{m}$, with stipes $50-60 \mu\text{m}$ and apical ring bluing in Melzer's iodine reagent. *Ascospores* uniseriate, light brown to brown, $7-9 \times 3-4 \mu\text{m}$, perispore dehiscent in 10% KOH.

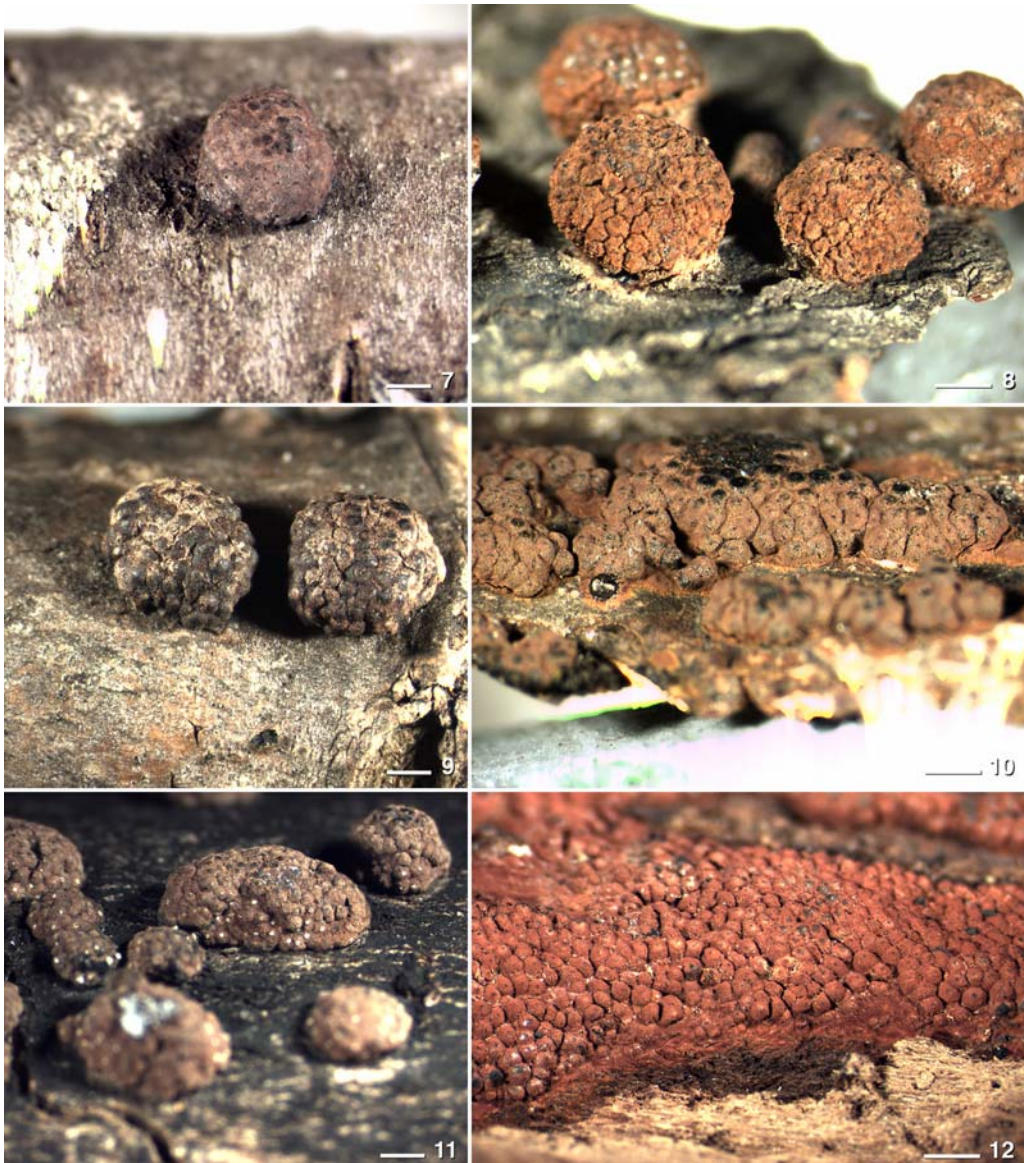
Habitat: On fallen branches of a deciduous tree.

Localities in GSMNP: Greenbrier (Porters Creek Road).

Notes: This species has not been commonly encountered in North America; it is basically a tropical species (Ju and Rogers, 1996).



Figs 1-6. Stromata of species of *Annulohypoxyton* and *Hypoxyton* known from the GSMNP. **1.** *Annulohypoxyton annulatum*. **2.** *Annulohypoxyton cohaerens*. **3.** *Annulohypoxyton multiforme*. **4.** *Annulohypoxyton truncatum*. **5.** *Hypoxyton crocopeplum*. **6.** *Hypoxyton fragiforme*. Bars = 1 mm.



Figs 7-12. Stromata of species of *Hypoxylon* known from the GSMNP. 7. *Hypoxylon fuscum*. 8. *Hypoxylon howeianum*. 9. *Hypoxylon intermedium*. 10. *Hypoxylon lenormandii*. 11. *Hypoxylon perforatum*. 12. *Hypoxylon rubiginosum*. Bars = 1 mm.

Hypoxylon intermedium (Schwein.: Fr.) Y.-M. Ju & J.D. Rogers, Revision of the genus *Hypoxylon*: 133 (1996). (Fig. 9)

Illustrations: Miller 1961, figs 3, 36 (as *H. argillaceum*)

Stromata hemispherical to spherical, 2-4 mm diam., surface greyish-vinaceous, dark brown granules beneath surface, with KOH-extractable pigments yellow or greenish-yellow. *Asci* cylindrical, sp. p. 100-120 × 12-15 μm, with stipes up to 100 μm and apical ring reduced and not bluing in Melzer's iodine reagent or lacking. *Ascospores* uniseriate, dark brown, 15-20 × 7-9 μm, perispore dehiscent in 10% KOH.

Habitat: On *Fraxinus* spp.

Localities in GSMNP: Cosby (Lower Mt. Cammerer Trail); Purchase Knob.

Notes: This seems to be a rare fungus in North America.

Hypoxylon lenormandii Berk. et M. A. Curtis *apud* Berk., J. Linn. Soc. Bot. 10: 385 (1869). (Fig. 10)

Illustrations: Miller 1961, figs 8, 39 (as *H. oodes*).

Stromata glomerate or effused-pulvinate, with conspicuous perithecial mounds or almost free perithecia united by a thin stromatal tissue, surface fuscous or brown vinaceous, with KOH-extractable pigments fulvous to ochraceous. *Asci* cylindrical, sp. p. 80-100 × 6-9 μm, with stipes 50-70 μm and discoid apical ring lightly bluing in Melzer's iodine reagent. *Ascospores* uniseriate, ellipsoid-inequilateral, brown to dark brown, 10-15 × 4-6.5 μm, perispore dehiscent in 10% KOH.

Habitat: On wood of a deciduous tree.

Localities in GSMNP: Chimney Tops.

Notes: This species resembles *Rosellinia* in the conspicuous perithecioid stromata (Ju and Rogers, 1996).

Hypoxylon cf. macrocarpum Pouzar, Ceska Mykol. 32: 19 (1978).

Stromata effused-pulvinate, surface dark reddish brown, with inconspicuous or conspicuous perithecial mounds, dull rusty granules beneath the surface and olivaceous KOH-extractable pigments. *Asci* cylindrical, sp. p. 65-75 × 6-7 μm, with stipes 70-80 μm and apical ring bluing in Melzer's iodine reagent. *Ascospores* uniseriate, ellipsoid-inequilateral, brown to dark brown, 10-12 × 4.5-5 μm, perispore dehiscent in 10% KOH.

Habitat: On *Fraxinus* sp.

Localities in GSMNP: Greenbrier (Old Settlers Trail).

Notes: This species has previously been known only from Canada and Indiana in eastern North America (Ju and Rogers, 1996).

Hypoxylon notatum Berk. et M.A. Curtis *apud* Berk., Grevillea 4: 50 (1875).

Illustrations: Miller 1961, figs 6, 7, 38.

Stromata glomerate, coffee-brown, with pale circular areas at the tops of very prominent perithecial elevations, with KOH-extractable pigments yellow or greenish yellow. *Asci* cylindrical, p. sp. 80-100 × 8-10 μm, with stipes up to 35 μm long and apical ring reduced and not bluing in Melzer's iodine reagent or lacking. *Ascospores* dark brown, ellipsoid-inequilateral, 12-15 × 6-7.5 μm, with perispore dehiscent in 10% KOH.

Habitat: On dead branches of *Quercus* spp.

Localities in GSMNP: Cades Cove (Parsons Branch Road); Chimney Tops.

Notes: This species has previously been known from Louisiana and South Carolina in USA (Ju and Rogers, 1996).

Hypoxylon perforatum (Schwein.: Fr.) Fr., Summa Veget. Scand.: 384 (1849).
(Fig. 11)

Sphaeria perforata Schwein., Shrift. Nat. Ges. Leipzig 1: 31 (1822). - *S. perforata* Schwein.: Fr., Syst. Mycol. 2: 340 (1823).

Hypoxylon rubiginosum (Pers.: Fr.) Fr. var. *perforatum* (Schwein.: Fr.) L.E. Petrini, Mycol. Helvetica 1: 531 (1986).

Stromata effused-pulvinate, pulvinate to hemispherical, 2-4 mm diam. or up to 25 mm long, surface reddish shades, with white material in the ostiolar openings, dark brown granules beneath surface and between perithecia, with KOH-extractable pigments greenish-yellow. *Asci* cylindrical, p. sp. 60-80 × 6-8 μm, with stipes up to 50 μm long and discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* brown, ellipsoid-inequilateral, 9-13 × 4-6 μm, with perispore dehiscent in 10% KOH.

Habitat: On various deciduous trees.

Localities in GSMNP: Big Creek (Baxter Creek Trail); Cades Cove (Finley Cane Trail, Gum Swamp); Cosby; Cataloochee (Pretty Hollow Gap Trail); Greenbrier (Ramsey Cascades Trail); Oconaluftee (ATBI plot in the vicinity of Cherokee); Twin Creeks.

Notes: This is a common species in the Park. It is usually "spotted" with white perithecial ostioles.

***Hypoxylon* sp. ?nov. (2)**

Stromata in pulvinate glomerules, occasionally coalescing, surface uneven from strongly projecting perithecial elevations, at first reddish or rusty, finally black with age, red granules beneath surface and between perithecia, with KOH-extractable pigments orange or brick. *Asci* sp. p. 60-75 × 5-6 μm, with stipes 25-30 μm long and small apical ring faintly bluing in Melzer's

iodine reagent. *Ascospores* brown, 8-12 × 4.5-5 µm, perispore dehiscent in 10% KOH.

Habitat: On *Carpinus* sp.

Localities in GSMNP: Twin Creeks (Twin Creeks Trail).

Notes: This fungus seems close to *H. commutatum* Nitschke which is known only from type material from Germany (Ju and Rogers, 1996). It thus seems premature to equate our collection with this rare taxon or to erect a new species. Additional material needs to be studied before a determination can be made.

Hypoxylon rubiginosum (Pers.: Fr.) Fr., Summa Veget. Scand.: 384 (1849).
(Fig. 12)

Sphaeria rubiginosa Pers., Obs. Mycol. 1: 69 (1796). - *S. rubiginosa* Pers.: Fr., Syst. Mycol. 2: 340 (1823).

Illustrations: Ju and Rogers 1996, figs 6A, B.

Stromata effused, surface dark chestnut, but with reddish shades, dull reddish granules beneath the surface and bright brick KOH-extractable pigment. *Asci* cylindrical, p. sp. 70-80 × 5-6 µm, with stipes 40-50 µm discoid apical ring bluing in Melzer's iodine reagent. *Ascospores* brown, ellipsoid-inequilateral, 8-12 × 4-4.5 µm, perispore dehiscent in 10% KOH.

Habitat: On wood of deciduous trees.

Localities in GSMNP: Big Creek (Baxter Creek Trail); Cades Cove (Anthony Creek Trail, Finley Cane Trail); Cosby (Low Gap Trail, Horse Trail); Elkmont (Little River Trail).

Notes: Almost every *Hypoxylon* species with red tones in the stromata has been called *H. rubiginosum* at one time or another. The concept of Ju and Rogers (1996) is much more restricted than that of Miller (1961).

Hypoxylon subgilvum Berk. et Broome, J. Linn. Soc. Bot. 14: 120 (1873).

Stromata effused-pulvinate, surface dark brick or fuscous, with red granules immediately beneath surface and between perithecia, orange or brick KOH-extractable pigments. *Asci* cylindrical, sp. p. 50-65 × 5-6 µm, with stipes 35-45 µm long and small apical ring bluing in Melzer's iodine reagent. *Ascospores* light brown, slightly inequilateral, 7-9 × 3-4.5 µm, perispore dehiscent in 10% KOH.

Habitat: On bark of a deciduous tree (*Aesculus*?).

Localities in GSMNP: Big Creek (Baxter Creek Trail).

Notes: This species was already collected near Knoxville (Tennessee), i.e. very close to GSMNP. It is also known from Louisiana in USA (Ju, Rogers, 1996).

Acknowledgements

Our appreciation is expressed to Edgar B. Lickey (University of Tennessee-Knoxville) for his help with host identifications. Financial support for this study was provided by a NATO Foundation Award (Ref. #978557) to LNV, a National Science Foundation Grant to ANM (DEB-0515558) and Discover Life in America Grants to ANM (DLIA 2005-11) and LNV (DLIA 2006-04).

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(Received 17 January 2007; accepted 15 July 2007)