
Pyrenomycetes of the Great Smoky Mountains National Park. III. *Cryptosphaeria*, *Eutypa* and *Eutypella* (*Diatrypaceae*)

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Five species of *Eutypa*, six species of *Eutypella*, and a single species of *Cryptosphaeria* are reported from the Great Smoky Mountains National Park. Only two of these had been recorded prior to the present study. Descriptions are provided for all of the species in these three genera now known from the Park, along with keys to the species of *Eutypa* and *Eutypella*.

Key words: *Ascomycotina*, Southern Appalachians, taxonomy, temperate forests

Introduction

Species of *Eutypa* and *Eutypella* are so difficult to differentiate that some authors (e.g. Tiffany and Gilman, 1965) have united them under the name *Eutypa*. Many of the species described as members of the two genera have been found to be conspecific, as can be seen for the long list of synonyms given for *Eutypella scoparia* (Schwein.: Fr.) Ellis & Everh. by Rappaz (1987). *Cryptosphaeria* seems to be more distinctive, but some ‘good’ species within this genus were assigned to *Eutypa* by Tiffany and Gilman (1965). The key provided by Rappaz (1987) for the genera of the *Diatrypaceae* indicates that *Cryptosphaeria* (as well as *Diatrype*, which includes some species of *Eutypa* in his treatment) is not well characterized and in urgent need of a taxonomic revision. In this paper, the genus *Eutypa* is circumscribed as including those taxa producing effuse stromata within wood and with separate ostioles at the surface. In contrast, *Cryptosphaeria* has similar stromata but with these occurring within bark tissues, while *Eutypella* is characterized by collectively erumpent clusters of perithecial beaks. The analogues in the *Valsaceae* are *Xenotypa*, *Allantoportha* and *Diaporthe*, respectively.

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Prior to the present study, four species in this group of diatrypaceous genera, *Eutypa spinosa* (Pers.: Fr.) Tul. & C. Tul., *E. sepulta* (Berk. & M.A. Curtis) Sacc., *Eutypella fraxinicola* (Cooke & Peck) Sacc., and *E. microcarpa* (Ellis & Everh.) Sacc., had been reported (Petersen, 1979) from the Great Smoky Mountains National Park (GSMNP), but *Eutypa sepulta* and *Eutypella microcarpa* are now recognized as synonyms of *Eutypella scoparia* (Rappaz, 1987). The records reported herein are based upon specimens collected during a six-week period from late March to early May 2002.

Cryptosphaeria Ces. & De Not., Comm. Soc. Critt. Ital., 1(4): 231, 1863 (nom. cons.)

Stromata widely effuse within bark tissues that are slightly elevated, usually unchanged, but sometimes discoloured or darkened, with separate, rounded or stellate ostioles at the surface. *Asci* clavate or cylindrical, 8-spored, usually with long stalks, paraphysate. *Ascospores* allantoid, hyaline or brownish.

Type species: Cryptosphaeria eunomia (Fr.) Fuckel.

There are no previous reports of *Cryptosphaeria* from the Great Smoky Mountains National Park. We found several specimens on *Fraxinus* spp. in the Cosby (Lower Mountain Cammerer Trail) and Cades Cove (Parsons Branch Road) regions of the Park that have the superficial characters of *Cryptosphaeria eunomia* (Fr.) Fuckel. Most of these specimens were sterile, but a preliminary field examination showed very small ascospores in one specimen from Cosby that are surely different from those reported for *C. eunomia*. Unfortunately, we were unable to relocate asci and ascospores in this specimen when it was examined again in the laboratory. However, we wish to call the attention of future investigators to the possible occurrence of a new species in the Park. It may be a sister species of *C. eunomia*, for which records from the United States are still under question (Rappaz, 1987).

Eutypa Tul. & C. Tul., Sel. Fung. Carp., 2: 52, 1863.

Stromata widely effuse within wood tissue causing its blackening, with separate, rounded or sulcate ostioles at the surface. *Asci* clavate or cylindrical, 8-spored, usually with long stalks, paraphysate. *Ascospores* allantoid, hyaline or yellowish.

Type species: Eutypa maura (Fr.: Fr.) Fuckel.

Key to species of *Eutypa* known from the GSMNP

1. Stromata strongly echinulate, with protruding sulcate perithecial beaks.....2
1. Stromata thin, similar in appearance to black patches slightly elevated above the wood surface3
2. Ascospores 4-6 μm long..... *E. limaeformis*
2. Ascospores 8-10 μm long..... *E. spinosa*
3. Ostioles non-sulcate..... *E. rivulosa*
3. Ostioles sulcate..... *E. velutina*

Eutypa denigrata (Schwein.) Ellis & Everh., North Amer. Pyren.: 506, 1892.

(Fig. 1)

Habitat: On wood of *Rhododendron maximum* L.

Locality in GSMNP: Cades Cove.

Our identification of this species is tentative and for this reason it was not included in the key. The species was reported from Pennsylvania on the same host plant, and the description of crust-like stromata in wood and with perithecia that are white inside (Ellis and Everhart, 1892) corresponds very well to the specimen we collected. However, we did not observe asci and ascospores, and there are no data about them in the literature either. Rappaz (1987) listed the name of this species among the rejected diatrypaceous fungi on the basis of the fact that the asci are bitunicate. However, the 'bitunicate' rather than 'unitunicate' nature of asci has been used as a characteristic for members of the *Diatrypaceae* (Romero and Minter, 1988) and even considered as an evidence for the ordinal separation of this family (order *Diatrypales*). Consequently, *Eutypa denigrata* might represent a good diatrypaceous species when somebody can describe and measure its asci and ascospores and compare the latter with those of other species.

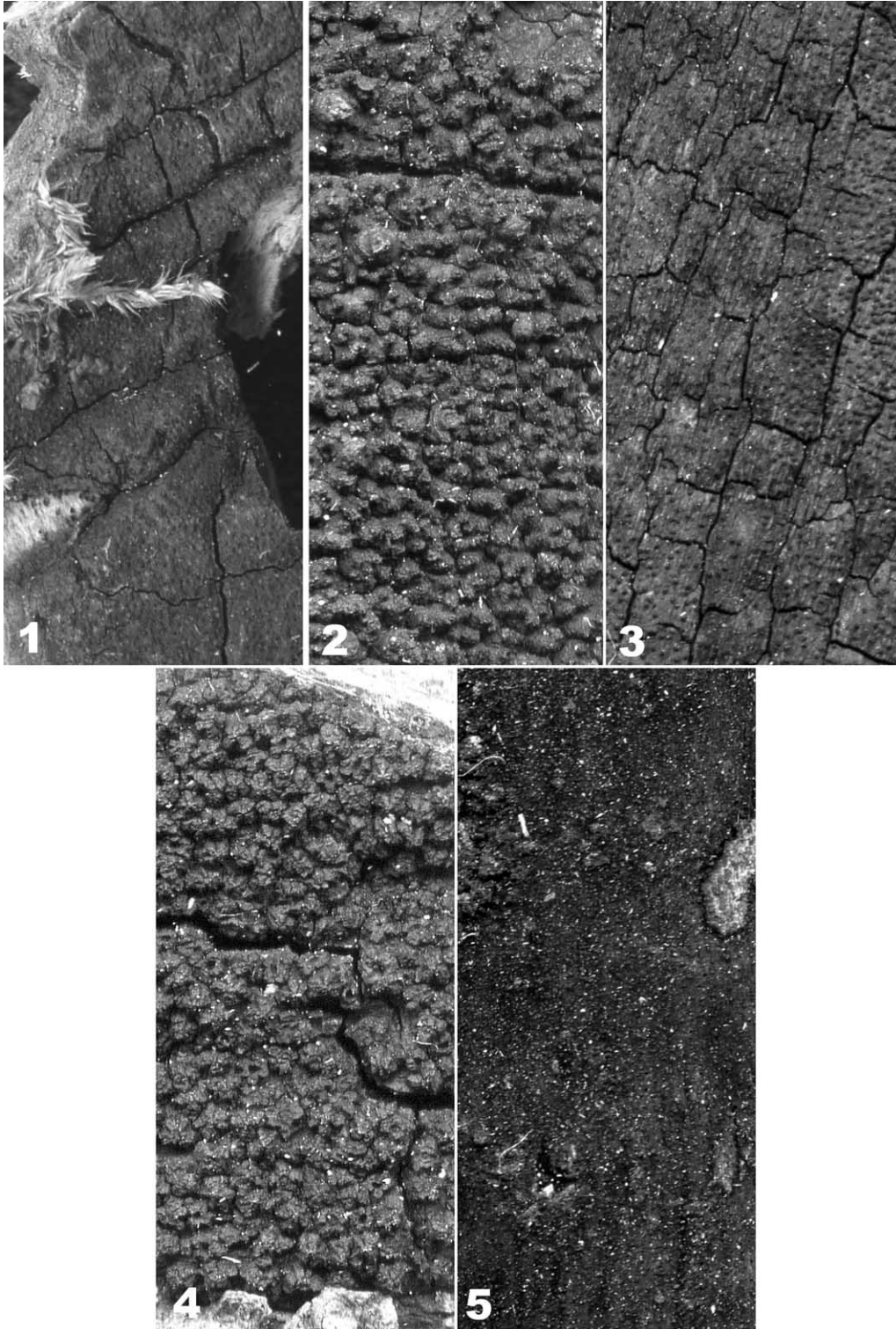
Eutypa limaeformis (Schwein.) Cooke, Grevillea, 6: 144, 1878. (Fig. 2)

Stromata widely effuse, black, strongly echinulate due to prominent, piramidal, 4-sulcate perithecial beaks. *Asci* p. sp. 25-30 \times 5-6 μm . *Ascospores* 4-6 μm long.

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

Localities in GSMNP: Cosby (Hen Wallow Falls); Cades Cove (Cooper Road Trail, Crib Gap Trail); Bryson City.

Notes: The name *Eutypa limaeformis* often has been listed as a synonym of *Eutypa spinosa* (Pers.: Fr.) Tul. & C. Tul. These two species have the same appearance of 'echinulate' stromata beset with very prominent, piramidal, 4-sulcate perithecial beaks. Judging from descriptions of *E. spinosa* in the



Figs. 1-5. Stromata of species of *Eutypa* known from GSMNP. **1.** *E. cf. denigrata*. **2.** *E. limaeformis*. **3.** *E. rivulosa*. **4.** *E. spinosa*. **5.** *E. velutina*.

literature, it has ascospores $8-10 \times 2 \mu\text{m}$ (Winter, 1887; Ellis and Everhart, 1892; Tiffany and Gilman, 1965) or $9-11 \times 3 \mu\text{m}$ (Berlese, 1900). This could be a good difference from our specimens of *E. limaeformis* but Rappaz (1987) indicates very similar ranges of ascospores for both species: $4.2-8 \times 1.5-2 \mu\text{m}$ for *E. limaeformis* and $5.5-9 \times (1.5)1.8-2.2 \mu\text{m}$ for *E. spinosa*. The latter range surely deviates from all descriptions of the latter species.

Rappaz (1987) distinguished *E. limaeformis* and *E. spinosa* on the basis that the latter has large perithecia (up to 1 mm diam.). Indeed, there are such specimens from the Great Smoky Mountains National Park that possess such perithecia (even up to 1.5 mm) which form a remarkable palisade layer at a cross section. In our opinion, these species could be distinguished at once on the basis of their appearance: *E. limaeformis* is similar to *Xenotypha aterrima* (Fr.) Petr. in the habit as it is illustrated at the photograph in Pirozynsky's (1974, figs. 2, 5) work, while *E. spinosa* has thick crust-like stromata that are coarse because of prominent ostioles.

The distribution of *Eutypa limaeformis* seems to be similar to that of *Diatrype atlantica* Lar. N. Vassiljeva in eastern North America (see Vasilyeva and Stephenson, 2004) and corresponds roughly to the fragment of ancient Tertiary floras. This kind of distribution in ascomycetous fungi requires further observations. That territory is well known to be involved in the disjunct distribution of the same or sister species between eastern Asia and eastern North America. So far, only a few papers (e.g. Hongo and Yokoyama, 1978; Wu and Mueller, 1997) on fungal species have discussed such a pattern in biogeographical relationships

Eutypa rivulosa (Schwein.) Ellis & Everh., North Amer. Pyren., p. 503, 1892. (Fig. 3)

Stromata widely effuse, immersed in the wood which is slightly elevated and blackened, with wrinkled or cracked surface and separate, rounded ostioles. *Asci* $30-35 \times 5-7 \mu\text{m}$. *Ascospores* $6-8 \mu\text{m}$ long.

Habitat: On dead decorticated wood.

Localities in GSMNP: Cosby (Snake Den Ridge Trail); Cades Cove (Crib Gap Trail); Purchase Knob (Hemphill Bald Trail).

Notes: Prior to the present study, this species was known only from Pennsylvania (Ellis and Everhart, 1892; Rappaz, 1987). It was said to be quite similar to and hardly distinguishable from *Eutypa lata* (Pers.: Fr.) Tul. & C. Tul. The key provided by Rappaz (1987) separates *E. rivulosa* and *E. lata* on the basis of ascospore length. The former species has ascospores less than 8

µm long on average, while the latter has ascospores more than 8 µm long. The appearance of stromata, especially in the specimen collected near Purchase Knob, is very similar to that of *Eutypa lata* as illustrated by Rappaz (1987, Pl. 9E).

Eutypa spinosa (Pers.: Fr.) Tul. & C. Tul., Sel. Fung. Carol., 2: 59, 1863.

(Fig. 4)

Illustrations: Berlese, 1900, tab. LIII; Tiffany, Gilman, 1965, figs. 25-26, 31.

Stromata widely effuse, forming a black crust 2-4 mm thick, coarse due to large, pyramidal, deeply 4-sulcate perithecial beaks; perithecia large, up to 1.5 mm high. *Asci* 35-40 × 5-7 µm. *Ascospores* 8-10 µm long.

Habitat: On dead fallen trees.

Localities in GSMNP: Cosby (Low Gap Trail, Snake Den Ridge Trail); Cades Cove (Anthony Creek Trail); Cataloochee (Pretty Hollow Gap Trail); Purchase Knob (Hemphill Bald Trail).

Eutypa velutina (Wallr.) Sacc., Atti Soc. Venet.-Trent. Sci. Nat., 4: 116, 1875.

(Fig. 5)

Illustration: Berlese, 1900, Tab. LII, fig. 1.

Stromata widely effuse, immersed in the wood that is slightly elevated and blackened, covered by a layer of black hyphae at the surface, with separate and sulcate ostioles. *Asci* p. sp. 28-33 × 5-7 µm. *Ascospores* 5-8 µm long.

Habitat: On dead branches of a deciduous tree.

Locality in GSMNP: Cosby (Low Gap Trail).

Notes: Ellis and Everhart (1892) reported this species on *Quercus* from Pennsylvania and listed *Sphaeria mela* Schwein. as a synonym. It was *Eutypa mela* (Schwein.) Cooke that is restricted to *Quercus* spp. (Rappaz, 1987), while true *Eutypa velutina* seemed to be wanting in American mycological literature. Rappaz (1987) listed this name as a synonym of *Eutypa lata* (Pers.) Tul. & C. Tul. var. *aceri* F. Rappaz, but we consider it to be a separate species whose stromata are easily recognizable due to characteristic filter of black hyphae at the surface.

Eutypella (Nitschke) Sacc., Atti Soc. Ven. Trent. Sci. Nat., 4: 80, 1875 (nom. cons.)

Valsa subgenus *Eutypella* Nitschke, Pyr. Germ., p. 163, 1867.

Stromata erumpent from bark as crowded perithecial beaks, mostly sulcate, sometimes rounded, usually without ectostromatic disc but united below by a common tissue that sometimes strongly developed and causing the

appearance of pulvinate prickly globules. *Asci* clavate, 8-spored, with long stalks. *Ascospores* allantoid, hyaline or yellowish.

Type species: Eutypella cerviculata (Fr.) Sacc.

Key to the species of *Eutypella* known from GSMNP

- 1. Ascospores 3-4 μm long, often strongly curved *E. scoparia*
- 1. Ascospores larger 2
- 2. Ascospores 5-8 μm long 3
- 2. Ascospores larger 4
- 3. Stromata comparatively large, pustules up to 6-7 mm, even larger when confluent, do not cause the blackening of host tissues *E. cerviculata*
- 3. Stromata much smaller, pustules up 2.5-3 mm, with few perithecial beaks, arranged in long rows and causing the blackening of host tissue *E. leaiana*
- 4. Ascospores 8-10 μm long in average *E. fraxinicola*
- 4. Ascospores 10-14 μm long in average 5
- 5. Stromata confluent into large effuse-pulvinate groups, with short perithecial beaks and sulcate ostioles at the surface *E. leprosa*
- 5. Stromata with typical clusters of elongated perithecial beaks *E. vitis*

Eutypella cerviculata (Fr.: Fr.) Sacc., Atti Soc. Vent. Trent. Sci., Nat., 4: 116, 1875. (Fig. 6)

Illustration: Berlese, 1900, Tab. LXXXVII.

Stromata comparatively large, pustules up to 6-7 mm, even larger when confluent, do not cause the blackening of host tissues, beaks deeply sulcate. *Asci* p. sp. 30-40 \times 5-7 μm . *Ascospores* 6-8 μm long.

Habitat: On dead branches of *Betula* sp.

Localities in GSMNP: Alum Cave Bluffs Trail; Cosby (Maddron Bald Trail); Balsam Mountain (Flat Creek Trail).

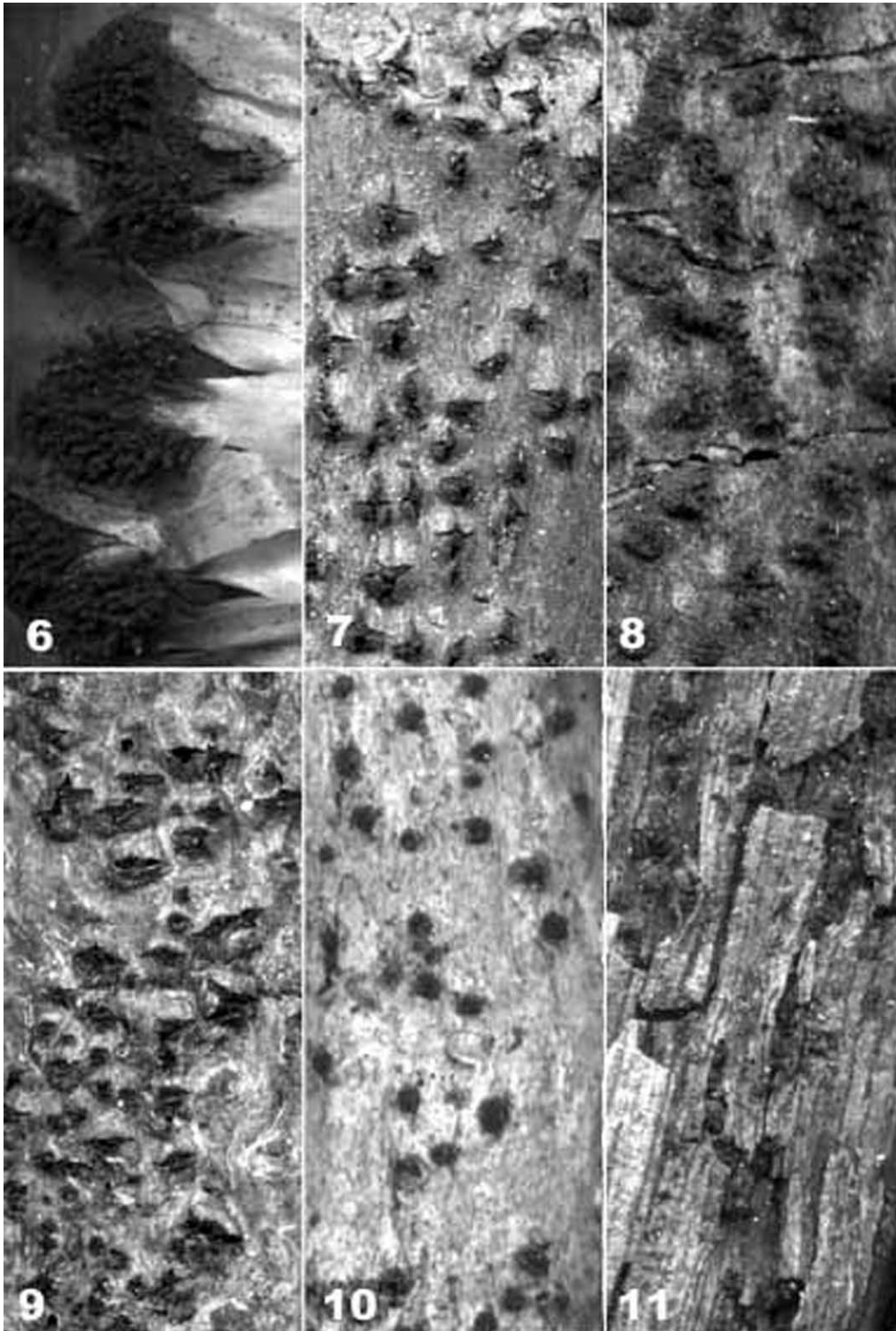
Eutypella fraxinicola (Cooke & Peck) Sacc., Syll. Fung., 1: 154, 1882. (Fig. 7)

Illustration: Berlese, 1900, Tab. LXXVII, fig. 1.

Stromata valsoid, densely aggregated, with polystichous perithecia at cross section and black line deeply in wood, erumpent with clusters of short beaks that are sulcate at the top. *Asci* p. sp. 30-35 \times 6-8 μm . *Ascospores* 8-10 \times 1.5-2 μm long.

Habitat: On dead branches of *Fraxinus* sp.

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



Figs. 6-11. Stromata of species of *Eutyrella* known from GSMNP. **6.** *E. cerviculata*. **7.** *E. fraxinicola*. **8.** *E. leaiana*. **9.** *E. leprosa*. **10.** *E. scoparia*. **11.** *E. vitis*.

Notes: This species was reported for the Great Smoky Mountains National Park by Petersen (1979). Its name was once listed among synonyms of *Eutypa ludibunda* Sacc. (Tiffany and Gilman, 1965), i.e., *Eutypella leprosa* (Fr.) Berl., or *E. juglandicola* (Schwein.: Fr.) Ellis & Everh. (Rappaz, 1987). This confusion may be caused by the fact that *Fraxinus* spp. support two species of *Eutypella*. These species are difficult for the delimitation if one takes into account that *E. juglandicola* in Rappaz's treatment has ascospores $7-11 \times 2-2.5 \mu\text{m}$, asci $30-45 \times 5-7 \mu\text{m}$, while many authors (Saccardo, 1882; Winter, 1887; Berlese, 1900) give ascospores $10-12 \times 2 \mu\text{m}$ or $10-13 \times 2.5-3 \mu\text{m}$ for *E. leprosa*. Some specimens of the latter species from the Smoky Mountains National Park have precisely such ascospores and asci. In our opinion, two species on *Fraxinus* spp. could be recognized by their stromata that are confluent in large pulvinate aggregations and white inside in *E. leprosa*, while ascospores differ in average size (see key).

For the time being, we are inclined to consider more narrow concepts of *Eutypella* species that appear to be rather limited in host range (cf. notes under *E. leaiana* and *E. vitis*) except for *E. scoparia*, but even the latter was supposed to consist of two entities.

Eutypella leaiana (Berk.) Sacc., Syll. Fung., 1: 155, 1882. (Fig. 8)

Illustration: Berlese, 1900, tab. LXXXVI.

Stromata rather small, pustules up 2.5-3 mm, with few and finely sulcate beaks, arranged in long rows and causing the blackening of host tissue. *Asci* p. sp. $30-40 \times 5-7 \mu\text{m}$. *Ascospores* 5-7 μm long.

Habitat: On dead branches of *Carpinus caroliniana* Walter.

Localities in GSMNP: Bryson City (Loop Trail).

Notes: *Eutypella leaiana* was listed as synonymous with *Eutypella cerviculata* by Rappaz (1987). It has the same ascospore size as the latter species but stromata in the specimen are smaller and similar to those in *E. scoparia* causing the same blackening of the bark tissues. Ellis and Everhart (1892) reported *E. leaiana* for Ohio and the Carolinas and indicated that the ostioles are umbilicate (i.e. non-sulcate) but finely grooved. The latter feature may be interpreted as finely sulcate.

Eutypella leprosa (Fr.) Berl., Icon. Fung., 3: 74, 1900. (Fig. 9)

Illustration: Berlese, 1900, Tab. XCI, fig. 2.

Stromata numerous, white inside, confluent into large effuse-pulvinate groups elevating the bark, usually unchanged but sometimes blackened;

ostioles sulcate at the surface. *Asci* p. sp. 30-50 × 6-9 μm. *Ascospores* (8)10-14(16) × 2.5-3(4) μm.

Habitat: On dead branches of deciduous trees (?*Aesculus*, *Fraxinus*, and *Tilia*).

Locality in GSMNP: Twin Creeks; Cosby (Low Gap Trail); Cades Cove (Scott Mountain Trail, Finley Cane Trail).

Notes: The specimen on *Tilia* sp. has ascospores 12-16.5 × 3-4 μm and corresponds to *E. brunaudiana* Sacc. in Berlese's (1900) treatment (14-18 × 3.5-4 μm), but the latter name can be found among the synonyms listed for *E. leprosa* (Rappaz, 1987).

Eutypella scoparia (Schwein.: Fr.) Ellis & Everh., North Amer. Pyren., p. 495, 1892. (Fig. 10)

Illustration: Berlese, 1900, Tab. CII, fig. 2.

Stromata numerous, densely aggregated, often blackening the host tissues, with elongated clusters of perithecial beaks. *Asci* p. sp. 14-17 × 4-4.5 μm. *Ascospores* 3-4 μm long, strongly curved.

Habitat: On dead branches of *Robinia pseudoacacia* L.

Localities in GSMNP: Cades Cove (Loop Road); Bryson City (Noland Creek Trail, Loop Trail).

Notes: This species had been reported from the GSMNP before and identified as *Eutypella microcarpa* (Ellis & Everh.) Sacc. (Petersen, 1979). Ellis and Everhart (1892) indicated five species with similar stromata and very tiny and strongly curved ascospores, namely *E. scoparia*, *E. deusta* (Ellis & Everh.) Ellis & Everh., *E. glandulosa* (Cooke) Ellis & Everh., *E. microcarpa*, *E. capillata* (Ellis & Everh.) Sacc., for North America, all on different host plants and almost all in the eastern United States. Rappaz (1987) synonymized the names of these species except for *E. glandulosa* but listed *Valsa clavulata* Cooke as a synonym of *E. scoparia* while *V. clavulata* was cited as a synonym of *E. glandulosa* by Ellis and Everhart (1892). Strangely enough, Rappaz (1987) illustrated ascospores of *E. scoparia* as very moderately curved and recognized another species with strongly curved ascospores, namely *E. curvispora* (Starb.) F. Rappaz. It seems that the latter name should be synonymous with *E. scoparia* taking Ellis and Everhart's treatment into account. Probably, Rappaz's concept of *E. scoparia* is too broad (very long list of synonyms) and includes entities with two kinds of ascospores.

Eutypella vitis (Schwein.: Fr.) Ellis & Ever., North Amer. Pyren., p. 490, 1892. (Fig. 11)

Sphaeria vitis Schwein., Schrift. Nat. Ges. Leipzig, 1: 39, 1822.

Sphaeria vitis Schwein.: Fr., Syst. Mycol., 2: 401, 1823.

Valsa vitis (Schwein.: Fr.) M.A. Curtis, Geol. Nat. Hist. Surv. North Carol., 3: 142, 1867.

Diatrype vitis (Schwein.: Fr.) Berk., Grevillea, 4: 96, 1876.

Engizostoma vitis (Schwein.: Fr.) Kuntze, Rev. Gen. Pl., 3(2): 475, 1898.

Illustration: Berlese, 1900, tab. LXXIX.

Stromata numerous, densely aggregated, with elongated clusters of perithecial beaks. *Asci* p. sp. 30-40 × 6-8 μm. *Ascospores* 10-14 × 2-2.5 μm.

Habitat: On dead stems of *Vitis* spp.

Localities in GSMNP: Cosby.

Notes: Rappaz (1987) listed this species as a synonym of *Eutypella aequilinearis* (Schwein.: Fr.) Starb. and indicated the length of the ascospores as 6.5-10.5 μm for the latter species, while *E. vitis* is characterized by larger ascospores that are more than 10 μm long on average and sometimes up to 14 μm long (Ellis and Everhart, 1892; Glawe and Jacobs, 1987). This species seems to be restricted to the eastern United States in North America (Farr *et al.*, 1989), as is the case for many other diatrypaceous fungi.

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