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## New records of Xylariaceae from Panama

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**Abstract:** Twenty-two species of Xylariaceae (Xylariales, Ascomycota) are presented as new records for Panama based on specimens recently collected in this country in Southern Central America: *Annulohypoxylon multiforme*, *A. truncatum*, *Biscogniauxia capnodes*, *B. philippinensis*, *Camillea stellata*, *Daldinia placentiformis*, *D. steglichii*, *Hypoxylon anthochroum*, *H. crocopeplum*, *H. fendleri*, *H. investiens*, *H. lividipigmentum*, *Kretzschmaria pavimentosa*, *K. sandvicensis*, *Nemania immersidiscus*, *Poronia oedipus*, *Whalleya microplaca*, *Xylaria anisopleura*, *X. enteroleuca*, *X. fissilis*, *X. gracillima* and *X. schweinitzii*. The number of species of Xylariaceae known for Panama thereby increases from 54 to 76 species. Some other collections correspond to new records in different provinces of Panama. Most species are rather common mostly in tropical and subtropical latitudes. *Daldinia steglichii*, however, is up to now only known for India and Papua New Guinea, *Hypoxylon lividipigmentum* only for Venezuela and Mexico, *Nemania immersidiscus* only for Guyana, Papua New Guinea and Hawaii and *Whalleya microplaca* is only known from China, Mauritius, the Philippines, the USA and Taiwan. *Camillea stellata* was recently (1989) described from Peru and since this date collected in Ecuador and Brazil. As Panama is located in a hotspot of biodiversity, many more species are still waiting for discovery.

**Key words:** Ascomycota, *Camillea stellata*, *Daldinia steglichii*, *Hypoxylon lividipigmentum*, *Nemania immersidiscus*, new records, Panama, *Whalleya microplaca*, Xylariaceae.

**Introduction:** The Xylariales with Xylariaceae as most frequently observed and species rich family are one of the best known orders within Ascomycota. Nevertheless, our knowledge about these fungi in Panama is still in a pioneer phase. Piepenbring (2006) lists 44 species of Xylariaceae in the checklist of fungi known for Panama according to literature references, mostly from Barro Colorado Island (BCI) in the former Canal Zone. In addition, Dennis (1957) mentions *Phylacia surinamensis* (Berk.) Dennis for Panama and van der Gucht (1995) *Biscogniauxia grenadensis* (J.H. Mill.) Whalley & Læssøe (as *B. grenadensis* var. *macrospora* (J.H. Mill.) Whalley & Læssøe), *Annulohypoxylon stygium* (Lév.) Y.M. Ju, J.D. Rogers & H.M. Hsieh var. *stygium* (as *Hypoxylon stygium* (Lév.) Sacc.) and *Hypoxylon subgilvum* Berk. & Broome. Six further new records of species of Xylariaceae in Panama have recently been published by Stadler et al. (2008): *Entonaema liquescens* A. Möller, *Xylaria aenea* Mont., *X. curta* Fr., *X. moelleroclavus* J.D. Rogers, Y.M. Ju & Hemmes, *X. poiteana* (Lév.) Fr. and *X. telfairii* (Berk.) Fr. *Daldinia eschscholzii* (Ehrenb.) Rehm is cited by Bitzer et al. (2008) for Panama, a fungus which probably has already been counted in the checklist as *Daldinia* sp. Thereby, 54 species of Xylariaceae are presently known for Panama. They are distributed in the following genera, followed by the respective number of species known for Panama: *Annulohypoxylon* (1), *Anthostomella* (1), *Biscogniauxia* (3), *Camillea* (7), *Daldinia* (1), *Entonaema* (1), *Hypoxylon* (10), *Kretzschmaria* (1), *Penzigia* (1), *Phylacia* (3), *Rosellinia* (1), *Xylaria* (23), and *Xylosphaera* (1).

**Materials and Methods:** Specimens were collected by A. Carmona (Carmona 2008), M. Piepenbring, students and coworkers from 2003 to 2008, mainly in Western Panama. Stromata were analyzed by stereomicroscopy, asci and ascospores by light microscopy. In preparations of *Hypoxylon* spp., 10 % KOH was added to

observe the dehiscence of the outer, gelatinous layers of ascospore walls (perispore). Literature used for identification is cited together with the respective species. Specimens are deposited at the Herbario Nacional de Panamá (PMA) and some of them also in the Herbarium of the Universidad Autónoma de Chiriquí (U.CH.) and the Botanische Staatssammlung München, Germany (M).

### Results: New records of Xylariaceae from Panama

*Annulohypoxylon multiforme* (Fr.: Fr.) Y.M. Ju, J.D. Rogers & H.M. Hsieh var.

#### *multiforme*

Fig. 1.

For further figures and description see Ju & Rogers (1996: 218, as *Hypoxylon multiforme* (Fr.: Fr.) Fr.).

Specimen examined: **Panama. Chiriquí:** Volcán Barú National Park, Sendero los Quetzales, alt. ca. 2500 m, 20.X.2007, M. Piepenbring with Licenciatura students 4070 (M-0140918, PMA). On dead wood, maybe *Alnus acuminata* Kunth – the only species of Betulaceae in the area.

*A. multiforme* prefers wood of Betulaceae in temperate regions as substrate but can occasionally occur on other hosts. It is mainly known from temperate regions of the Northern hemisphere. The present new record for Panama might be the most southern one.

*Annulohypoxylon thouarsianum* (Lév.) Y.M. Ju, J.D. Rogers & H.M. Hsieh var.

#### *thouarsianum*

For figures and description see Ju & Rogers (1996: 227, as *Hypoxylon thouarsianum* (Lév.) C.G. Lloyd).

Specimen examined: **Chiriquí:** Cerro Punta, Finca Alto los Reyes, alt. c. 2500 m,

25.VIII.2007, R. Ríos & A. Gracia, in herb. M. Piepenbring 3954 (M-0140914, PMA). On dead angiosperm wood. This collection is the typical *A. thouarsianum* with spores 20-23 x 5-5.5 µm.

This widely distributed species is already known for Panama as *Hypoxylon thouarsianum* by Dennis (1970). It is reported here for the first time for the province Chiriquí.

***Annulohypoxylon thouarsianum* (Lév.)**

Y.M. Ju, J.D. Rogers & H.M. Hsieh var. ***macrosporum*** (F. San Martín, Y.M. Ju & J.D. Rogers) Y.M. Ju, J.D. Rogers & H.M. Hsieh

For figures and description see Ju & Rogers (1996: 228, as *Hypoxylon thouarsianum* (Lév.) C.G. Lloyd var. *macrosporum* F. San Martín et al.).

Specimen examined: **Panama. Chiriquí:** Volcán Barú National Park, Sendero los Quetzales, alt. c. 2000-2450 m, 15.II.2003, M. Piepenbring & R. Kirschner 3152, det. J.M. Ju (M-0140923, PMA). On dead angiosperm wood.

The variety *macrosporum* is reported here for the first time for Panama.

***Annulohypoxylon truncatum* (Schwein.: Fr.) Y.M. Ju, J.D. Rogers & H.M. Hsieh Fig. 2.**

For further figures and description see Ju & Rogers (1996: 229, as *Hypoxylon truncatum* (Schwein.: Fr.) J.H. Miller).

Specimen examined: **Panama. Chiriquí:** Volcán Barú National Park, Sendero los Quetzales, Boquete side, 8.III.2007, M. Piepenbring et al. 3889 (M-0140921, PMA). On dead branch of *Quercus* sp. fallen down from the canopy.

*A. truncatum* is associated with wood of *Quercus* spp. and is known from the United States and Mexico (Ju & Rogers 1996). It is not sure whether it also occurs on other continents,

because this species has often been confused with *Annulohypoxylon annulatum* (Schwein.: Fr.) Y.M. Ju, J.D. Rogers & H.M. Hsieh.

***Biscogniauxia capnodes* (Berk.) Y.M. Ju & J.D. Rogers, in Ju, Rogers, San Martín & Granmo var. *capnodes***

For figures and description see Ju et al. (1998: 23) and Carmona (2008: 42).

Specimen examined: **Panama. Chiriquí:** Boquete, Bajo Mono, alt. c. 1679 m, 15.XI.2006, on dead bark, A.L. Carmona 4 (PMA). On dead angiosperm wood.

This species is cited here for the first time for Panama. It is known from many countries all around the world (Ju et al. 1998).

***Biscogniauxia philippinensis* (Ricker) Whalley & Læssøe, in Whalley, Læssøe & Kile var. *philippinensis***

For figures and description see Ju et al. (1998: 45) and Carmona (2008: 45).

Specimen examined: **Panama. Chiriquí:** David, alt. ca. 35 m., 26.II.2007, A.L. Carmona 48 (PMA). On dead angiosperm wood.

This species is cited here for the first time for Panama. It is widely distributed in the tropics and subtropics, known for example from Mexico, Guyana, Philippines and Taiwan (Ju et al. 1998).

***Camillea cyclisca* (Mont.) Læssøe, J.D. Rogers & Whalley**

For figures and description see Læssøe et al. (1989: 128).

Specimen examined: **Panama. Chiriquí:** Corr. Dolega, Los Algarrobos, Quebrada de Los Algarrobos, alt. c. 140 m, 15.II.2007, M. Piepenbring & F. Beyhl 3877 (M-0140941,

PMA). On dead wood of *Acacia collinsii* Saff. (Fabaceae).

This species is already known for Panama by Dennis (1970, as *Hypoxylon cycliscum* Mont.). It is reported here for the first time for the province Chiriquí. This species is known for several countries of the neotropics (Læssøe et al. 1989).

***Camillea stellata*** Læssøe, J.D. Rogers & Whalley. **Fig. 3.**

For further figures and description see Læssøe et al. (1989: 144).

Specimen examined: **Panama. Chiriquí:** Corr. Dolega, Los Algarrobos, border of Río Majagua, alt. c. 110 m, 17.IX.2008, M. Piepenbring & O. Cáceres 4587 (M-0141082, PMA). On dead angiosperm wood.

This species is cited here for the first time for Panama. It was described from Peru by Læssøe et al. (1989) and since this date was collected in Ecuador and Brazil (T. Læssøe pers. comm.).

***Daldinia placentiformis*** (Berk. & M.A. Curtis, in Berk.) Theiss.

For figures and descriptions see Ju and Rogers (1996: 168), Hsieh et al. (2005) and Carmona (2008: 77).

Specimen examined: **Panama. Chiriquí:** Renacimiento, Santa Clara, alt. ca. 1400 m, 28.X.2006, A.L. Carmona 25 (PMA). On dead angiosperm wood.

This species is widely distributed in the tropics and subtropics (Ju and Rogers 1996) and cited here for the first time for Panama.

***Daldinia steglichii*** M. Stadler, M. Baumgartner & Wollw.

For figures and descriptions see Stadler et al. (2001: 183) and Carmona (2008: 54).

Specimen examined: **Panama. Chiriquí:** Boquete, Bajo Mono, alt. ca. 1679 m, 16.XI.2006, A.L. Carmona 35 (PMA). On dead angiosperm wood.

This species is up to now only known from India and Papua New Guinea (Stadler et al. 2001). It is reported here for the first time for Panama and for America.

***Hypoxylon anthochroum*** Berk. & Broome, species complex

For figures and description see Ju & Rogers (1996: 88).

Specimen examined: **Panama. Chiriquí:** Dolega, Los Algarrobos, The Alemana's House, alt. ca. 150 m, 26.XII.2006, M. Piepenbring 3826 (M-0140934, PMA). On dead branch of *Ocotea veraguensis* (Meisn.) Metz (Lauraceae).

This species is known from many countries of the neotropics as well as from tropical and subtropical countries all around the world (Ju & Rogers 1996) and cited here for the first time for Panama. This collection keys out to *H. anthochroum* in the key published by Ju and Rogers (1996) but this taxon is likely to be a complex of species in need of elucidation.

***Hypoxylon crocopeplum*** Berk. & M.A. Curtis, in Berk.

For figures and description see Ju & Rogers (1996: 103).

Specimen examined: **Panama. Chiriquí:** Alanje, Playa La Barqueta, close to the sea, 19.II.2003, M. Piepenbring & R. Kirschner 3177, det. J.M. Ju (M-0140902, PMA). On dead angiosperm wood.

This species is widely distributed in tropical and subtropical regions (Ju & Rogers 1996). It is cited here for the first time for Panama.

***Hypoxylon fendleri*** Berk. ex Cooke

For figures and descriptions see Ju & Rogers (1996: 113) and Carmona (2008: 57).

Specimens examined: **Panama. Chiriquí:**

Renacimiento, Santa Clara, alt. ca. 1400 m,

28.X.2006, A.L. Carmona 26. **Chiriquí:**

(ibidem), 31.I.2007, A.L. Carmona 47.

**Chiriquí:** Corr. Dolega, Los Algarrobos, valley of the Rio Majagua, alt. ca. 140 m, 13.IX.2005, R. Mangelsdorff RMP 305 (M-0140932, PMA). On dead angiosperm wood.

*H. fendleri* is common throughout the tropics (Ju & Rogers 1996) and cited here for the first time for Panama.

***Hypoxylon haematostroma*** Mont.

**Figs. 4-5.**

For further figures and description see Ju & Rogers (1996: 126).

Specimen examined: **Panama. Panamá:**

Soberania National Park, Sendero el Charco,

19.XI.2005, M. Piepenbring with Maestria

students of the University of Panama 3686, det.

M. Stadler & J. Fournier (M-0140938, PMA).

**Chiriquí:** Corr. Dolega, Los Algarrobos, valley of the Rio Majagua, alt. ca. 130 m, 1.XI.2008, M. Piepenbring 4564 (U.CH.). On dead angiosperm wood.

This species is already known from BCI (Colon province) in Panama by Standley (1933) and from Chiriquí by Bitzer et al. (2008). It is reported here for the first time for the province Panama. This species is widely distributed in the tropics and subtropics.

***Hypoxylon investiens*** (Schwein.) M.A.

Curtis.

**Fig. 6.**

For further figures and descriptions see Ju & Rogers (1996: 134) and Carmona (2008: 64).

Specimens examined: **Panama. Chiriquí:**

David, alt. ca. 35 m, 29.X.2006, A.L. Carmona

28. **Chiriquí:** Corr. Dolega, Los Algarrobos, on

the way to the Majagua river, alt. ca. 140 m,

11.VIII.2007, M. Piepenbring with Licenciatura

students 3905 (M-0140916, PMA). Chorchá, alt.

ca. 270 m, 26.VIII.2008, M. Piepenbring & R.

Mangelsdorff 4507 (U.CH.). On dead

angiosperm wood.

This species is widely distributed in the tropics and subtropics (Ju & Rogers 1996) and cited here for the first time for Panama.

***Hypoxylon lividipigmentum*** F. San Martín,

Y.M. Ju & J.D. Rogers, in Ju & Rogers

For figures and descriptions see Ju & Rogers (1996: 145) and Carmona (2008: 67).

Specimen examined: **Panama. Chiriquí:**

David, alt. ca. 35 m, 26.I.2007, A.L. Carmona 54

(PMA). On dead angiosperm wood.

This species is up to now only known from Venezuela and Mexico (Ju & Rogers 1996) and cited here for the first time for Panama.

***Kretzschmaria pavimentosa*** (Ces.) P.M.D.

Martin

For figures and description see Rogers & Ju (1998: 364).

Specimen examined: **Panama. Chiriquí:**

Boquete, close to entrance of the Volcán Barú

National Park, forest of María Amoruso,

27.VIII.2005, M. Piepenbring 3515 (M-0140937, PMA). On dead angiosperm wood.

This species is widely distributed in the tropics and subtropics (Rogers & Ju 1998) and cited here for the first time for Panama.

***Kretzschmaria sandvicensis*** (Reichardt)  
J.D. Rogers & Y.M. Ju **Fig. 7.**

For further figures and description see Rogers & Ju (1998: 366).

Specimen examined: **Panama. Chiriquí:** Chorcha, on the way up to the Meseta de Chorcha, alt. c. 270 m, 26.VIII.2008, M. Piepenbring & R. Mangelsdorff 4514 (M-0141083, PMA). On dead angiosperm wood.

This species is widely distributed in the tropics and subtropics (Rogers & Ju 1998) and cited here for the first time for Panama.

***Nemania immersidiscus*** van der Gucht,  
Y.M. Ju & J.D. Rogers

For figures and description see Ju & Rogers (2002: 97).

Specimen examined: **Panama. Chiriquí:** Corr. Dolega, Los Algarrobos, close to Cervecería, alt. c. 160 m, 31.V.2008, M. Piepenbring & Licenciatura students 4280 (M-0141084, PMA). On dead angiosperm wood.

This species is known for Guyana, Papua New Guinea and Hawaii and most likely has a pantropical distribution. It is cited here for the first time for Panama.

***Phylacia poculiformis*** (Mont.) Mont.

For figures and description see Rodrigues & Samuels (1989: 292).

Specimen examined: **Panama. Chiriquí:** Bugaba, Concepción, close to houses, alt. ca. 20 m, 23.II.2003, M. Piepenbring & R. Kirschner 3182, det. J.M. Ju (M-0140940, PMA). On dead angiosperm wood.

This species is already known for Panama by Standley (1933). It is reported here for the first time for the province Chiriquí. This species is distributed in the tropics and subtropics of the New World.

***Poronia oedipus*** (Mont.) Mont. **Fig. 8.**

For further figures and description see Dennis (1957: 307).

Specimen examined: **Panama. Chiriquí:** Corr. Dolega, Los Algarrobos, close to Río Majagua, alt. c. 100 m, 19.V.2008, M. Piepenbring & J. del Carmen 4247 (PMA). Los Algarrobos, The Alemana's House, alt. ca. 150 m, 25.X.2008, M. Piepenbring 4553 (M-0141085). On old cow dung.

This species is widely distributed in tropical and subtropical regions all around the world. It is apparently most frequent in the neotropics. It is cited here for the first time for Panama.

***Whalleya microplaca*** (Berk. & M.A. Curtis)  
J.D. Rogers, Y.M. Ju, & F. San Martín

For figures and descriptions see Rogers et al. (1997: 48 and citations therein) and Carmona (2008: 48, as *Biscogniauxia* sp.).

Specimen examined: **Panama. Chiriquí:** Boquete, Bajo Mono, alt. ca. 1679 m, 15.VI.2006, A.L. Carmona 5, det. J.M. Ju (PMA). On dead angiosperm wood.

This species is up to now only known from China, Mauritius, the Philippines and the U.S.A.

(Rogers et al. 1997) as well as from Taiwan (Ju & Rogers 1999). This is the first record of *W. microplaca* from Panama and from the neotropics.

***Xylaria anisopleura*** (Mont.) Fr.

For figures and descriptions see Dennis (1956: 439), van der Gucht (1995: 336), Ju & Rogers (1999: 394) and Carmona (2008: 102).

Specimen examined: **Panama. Chiriquí:** Boquete, Bajo Mono, alt. c. 1680 m, 27.X.2006, A.L. Carmona 21 (PMA). On dead angiosperm wood.

*X. anisopleura* is distributed all over the tropics and subtropics (van der Gucht 1995) and cited here for the first time for Panama.

***Xylaria berkeleyi*** Mont., in Cooke

For figures and description see Dennis (1956: 424).

Specimen examined: **Panama. Chiriquí:** Volcán Barú National Park, Sendero los Quetzales, alt. 2000-2450 m, 15.II.2003, M. Piepenbring & R. Kirschner 3148, det. J.M. Ju (M-0140926, PMA). On dead angiosperm wood.

This species is known from French Guiana (Dennis 1956), Venezuela (Rogers et al. 1988) and from Panama from BCI by Standley (1933). It is reported here for the first time for the province Chiriquí.

***Xylaria enteroleuca*** (Speg.) P.M.D. Martin

**Fig. 9.**

For further figures and description see Callan & Rogers (1990).

Specimen examined: **Panama. Chiriquí:** La Amistad International Park, Sendero de la Cascada, alt. ca. 2150 m, 2.IX.2007, M.

Piepenbring with Licenciatura students 3976 (M-0140917, PMA). On dead angiosperm wood.

This species has a pantropical distribution and is cited here for the first time for Panama. It is a penzigoid *Xylaria*, most likely conspecific with or very closely related to *X. berteri* (Callan & Rogers 1990), from which it slightly differs in having ascospores with more broadly rounded ends (Ju & Rogers 1999).

***Xylaria fissilis*** Ces.

**Fig. 10.**

For further figures and description see Ju & Rogers (1999: 404).

Specimens examined: **Panama. Chiriquí:** Las Nubes, Alto Chiquero, west of the ANAM house, alt. c. 1770 m, 26.VIII.2007, M. Piepenbring with Licenciatura students 3946 (M-0140908, PMA). On dead angiosperm wood. **Chiriquí:** Volcán Barú National Park, Sendero los Quetzales, alt. c. 2500 m, 20.X.2007, M. Piepenbring with Licenciatura students 4066 (M-0140920, PMA). On dead angiosperm wood.

This species is known from Malaysia and Taiwan (Ju & Rogers 1999) as well as from Martinique and Guadeloupe (FWI, unpublished data) and cited here for the first time for Panama. Its apparently worldwide distribution is still poorly documented.

***Xylaria gracillima*** (Fr.) Fr.

For figures and description see van der Gucht (1995: 364).

Specimen examined: **Panama. Chiriquí:** Volcán Barú National Park, Sendero los Quetzales, 19.XI.2005, M. Piepenbring and students, MP 3685 (PMA). On dead angiosperm wood.

This species is widely distributed in the tropics and subtropics all around the world (van der

Gucht 1995) and cited here for the first time for Panama. The species concept has been interpreted in various senses. The material examined fits the concepts of San Martín & Rogers (1989) and van der Gucht (1995).

***Xylaria schweinitzii*** Berk. & M.A. Curtis

**Fig. 11.**

For further figures and descriptions see Dennis (1956), van der Gucht (1995: 380) and Carmona (2008: 112).

Specimens examined: **Panama. Chiriquí:** Renacimiento, Santa Clara, alt. ca. 1400 m, 28.X.2006, A.L. Carmona 27 (PMA). On dead angiosperm wood. **Chiriquí:** Fortuna, close to Quijada de Diablo, alt. ca. 1240 m, 22.IX.2007, M. Piepenbring & T. Hofmann 4000 (M-0140915, PMA). On dead angiosperm wood. **Veraguas:** Distrito Santa Fe, first arm of Río Santa María, Alto de Piedra, alt. 600-750 m, 30.IX.2007, M. Piepenbring, A. Carrizo & G. González 4037 (M-0140919, PMA). On dead angiosperm wood.

*X. schweinitzii* is a relatively common species in Panama but cited here for the first time for Panama. It is pantropically distributed (van der Gucht 1995).

**Discussion:** The field work realized during the last few years results in 22 new records of Xylariaceae for Panama, *Annulohypoxylon* (2 species), *Biscogniauxia* (2), *Camillea* (1), *Daldinia* (2), *Hypoxylon* (5), *Kretzschmaria* (2), *Nemania* (1), *Poronia* (1), *Whalleya* (1) and *Xylaria* (5), increasing the current knowledge of Xylariaceae in Panama to 76 species. Some other species are reported for the first time for the provinces Chiriquí or Panamá.

The field work realized by A. Carmona from 2006 to 2007 yielded specimens corresponding to 21 different species, of which 17 (81 %) were new to Panama in 2008 (Carmona 2008). This

value is very high and reflects the lack of data on fungi of Xylariaceae in Panama.

The present investigation has been realized mainly in the province of Chiriquí in Western Panama. Many more species of Xylariaceae will be discovered in this and other parts of this country, because of the high diversity of plants and ecosystems. Intensive fieldwork has still to be done in order to know all the species existing in Panama. More collecting and taxonomic studies are still badly needed to understand the diversity, ecology and distribution of tropical Xylariaceae.

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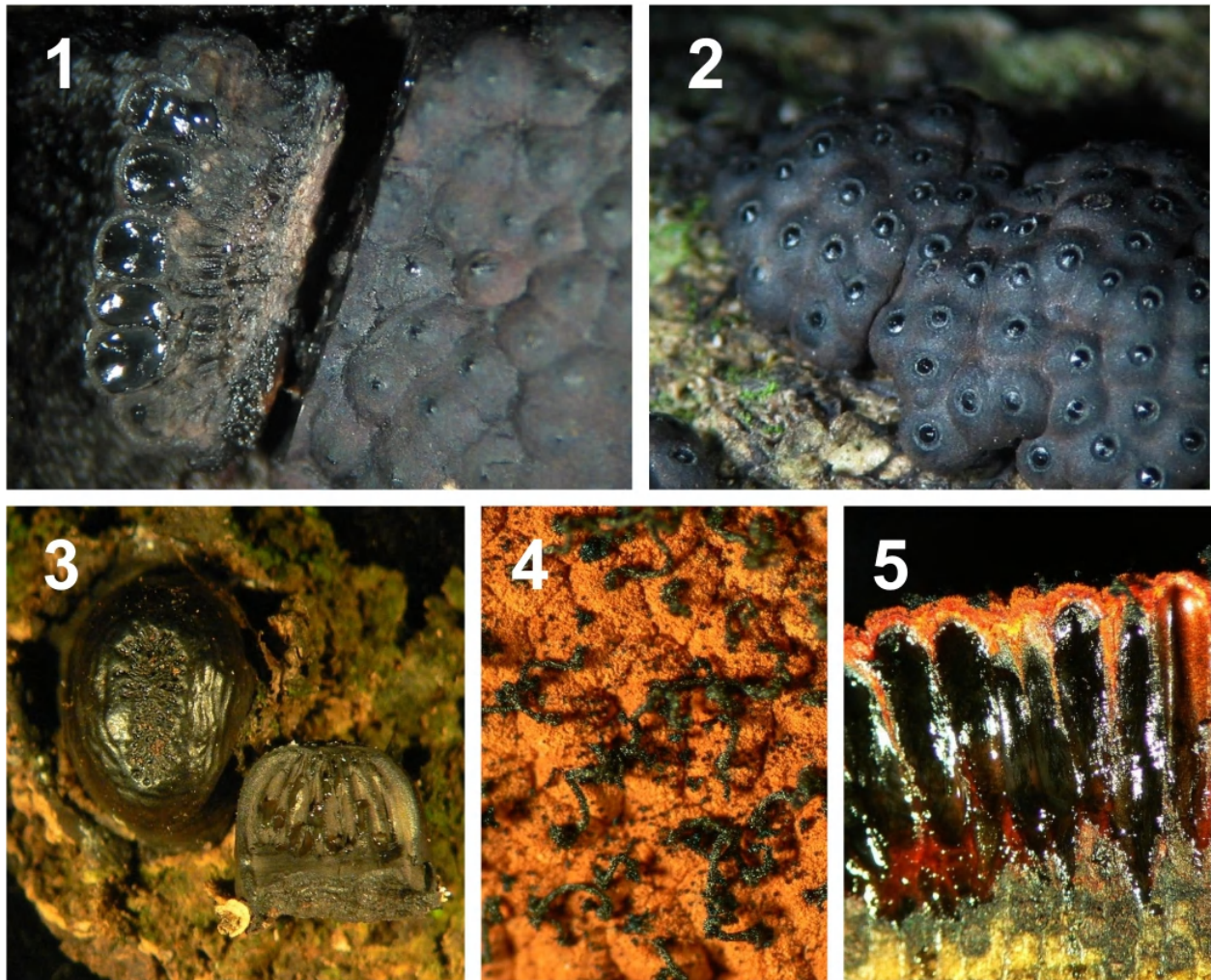
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Species of Xylariaceae in the field in Panama. **Fig. 1.** *Annulohypoxyton multiforme* var. *multiforme* (MP 4070). **Fig. 2.** *Annulohypoxyton truncatum* (MP 3889). **Fig. 3.** *Camillea stellata* (MP 4587). Figs. 4-5. *Hypoxyton haematostroma* (MP 4564). **Fig. 4.** Top view. **Fig. 5.** View of longitudinal section.





Species of Xylariaceae in the field in Panama. **Fig. 6.** *Hypoxylon investiens* (MP 4507). **Fig. 7.** *Kretzschmaria sandvicensis* (MP 4514). **Fig. 8.** *Poronia oedipus* (MP 4247). **Fig. 9.** *Xylaria enteroleuca* (MP 3976). **Fig. 10.** *Xylaria fissilis* (MP 3946). **Fig. 11.** *Xylaria schweinitzii* (MP 4000).