



New and interesting Laboulbeniales from Panama and neighboring areas

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With 3 figures and 2 tables

Abstract: We present 33 new records of Laboulbeniales from Central American countries on hosts of the orders Blattodea, Coleoptera, and Diptera. Twenty-seven records are new for Panama. These are *Amorphomyces ophioglossae* on *Ophioglossa* sp.; *Chitonomyces hyalinus* on *Laccophilus pictus*; *Ch. simplex* on *Laccophilus fasciatus* and *L. pictus*; *Dimeromyces homophoetae* on *Capraita* sp.; *Eucantharomyces calleidae* on *Calleida aurata*; *Gloeandromyces pageanus* sp. nov. on *Trichobius dugesioides*; *G. streblae* on *Trichobius* spp.; *Herpomyces chaetophilus* on *Periplaneta americana*; *Hesperomyces virescens* on *Azya orbigera*, Brachiacanthini gen. & sp. indet., *Cycloneda sanguinea*, and *Epilachna mexicana*; *Kleidiomyces hoplandriae* on *Hoplandria* sp.; *Laboulbenia bruchii* on *Neolema* sp.; *L. coccinellidicola* sp. nov. on *Exochomus childreni* and *Exochomus* sp. 1; *L. disenochei* on *Platynus purpurellus*; *L. ecitonis* on *Ecitophya* sp.; *L. flabelliformis* on *Asphaera transversofasciata*; *L. fuliginosa* and *L. idiostoma* on *Altica bimarginata*; *L. perplexa* and *L. punctata* on *Galerita* sp.; *L. skelleyi* on *Ischyryus* sp. and *Pselaphacus sparsus*; *L. systemae* on *Systema* sp.; *L. trogacti* on *Carpelimus* sp.; *Neohaplomyces medonalis* on *Medinina* gen. & sp. indet. and *Paederinae* gen. & sp. indet.; *Nycteromyces streblidinus* on *Trichobius joblingi*; *Peyritschiella protea* on *Platydracus prasinvariegatus*; *Rhachomyces longissimus* on *Platynus lyratus*; and *Stichomyces conosomatis* on *Sepeidophilus* sp. The number of species of Laboulbeniales in Panama is raised to 78. An alphabetical parasite-host list of Panamanian Laboulbeniales is given. Additionally, the following new records are presented for neighboring areas: *Chitonomyces paradoxus* on *Laccophilus proximus* from the

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Bahamas; *Gloeandromyces nycteribiidarum* on *Trichobius yunkerii* from Costa Rica; *Herpomyces paranensis* on *Archimandrita tessellata* from Colombia and Costa Rica; *Hesperomyces palustris* on *Coleomegilla maculata* from Cuba; *Laboulbenia fallax* on *Gyretes* sp. from Trinidad; *L. flabelliformis* on *Asphaera nobilitata* from Trinidad; *L. funeralis* on *Gyrinus* sp. from Costa Rica; and *L. systemae* on *Systema basalis* from Haiti and on *S. s-littera* from Trinidad. *Archimandrita*, *Azya*, *Capraita*, *Epilachna*, *Ischyryus*, and *Trichobius* are reported as new host genera for Laboulbeniales. Illustrations are given for 16 species.

Key words: Ascomycota, Central America, ectoparasites, insect-fungus interactions, new species, taxonomy.

Introduction

Recent study of the genus *Laboulbenia* Mont. & C.P.Robin in Panama yielded five species that were for the first time reported for the country, including the newly described *L. tortilis* J.A.Bernal & R.Kirschner This study (Villarreal et al. 2010) initiated collecting insects and screening them for the presence of Laboulbeniales by local students at the Universidad Autónoma de Chiriquí (Jennifer Castillo, Betty Espinosa, Laura Gaitán, Leila Gonzalez, Katerine Gutierrez). It also initiated the collaboration of DH (Pfister Lab, Harvard University) with JB and RV (Universidad Autónoma de Chiriquí), of which this manuscript is the first physical output.

In this contribution, we provide details for 27 species of Laboulbeniales, all of which represent new records for Panama. New records of Laboulbeniales are also reported from the following countries: Bahamas, Colombia, Costa Rica, Cuba, Haiti and Trinidad and Tobago.

Most of these parasites and their hosts have been reported elsewhere in Central or South America. However, we also found thalli of *Gloeandromyces* on the bat fly *Trichobius dugesioides* Wenzel, 1966 (Diptera, Streblidae) and *Laboulbenia* Mont. & C.P.Robin on ladybirds (Coleoptera, Coccinellidae) of the genus *Exochomus* Redtenbacher, 1843. These specimens did not fit any of the descriptions in the literature available to us and thus are described as new species, *G. pageanus* and *L. coccinellidicola*.

Materials and methods

The first source for our collections were dried insect specimens at entomological collections of the American Museum of Natural History in New York (AMNH), Harvard University Museum of Comparative Zoology in Cambridge, MA (MCZ); Museo de Peces de Agua e Invertebrados (MUPADI); and Tupper Center of the Smithsonian Tropical Institute, in Ancon, Panama (STRI). DH and SJCv carefully screened insects under dissecting microscopes at 50× magnification.

Second, insects were collected in the field by all authors and students using pitfall traps, aquatic nets, entomological nets, or mistnets (for capturing bats), and by hand. Insects were stored in 70–95% ethanol for transport to the laboratory where they were screened under 50× magnification. Parasitized insects were separated from the uninfected ones and permanently stored in 95% ethanol.

Laboulbeniales thalli were transferred using a Minutem Pin (BioQuip #1208SA, Rancho Dominguez, CA) and embedded in Amann solution (Benjamin 1971) with the help of a drop of Hoyer's medium (30 g arabic gum, 200 g chloral hydrate, 16 mL glycerol, 50 mL ddH₂O), as described by Haelewaters et al. (2015b). Microscopic slides are deposited at FH (Farlow Herbarium, Harvard University),

MIUP (Museo de Invertebrados de la Universidad de Panamá), and UCH (Universidad Autónoma de Chiriquí). For Laboulbeniales removed from host specimens deposited at STRI, all "b" slides are deposited at MIUP, the other ones at FH.

Observations and measurements of fungal specimens were made at the Pfister Lab using an Olympus BX40 light microscope with Olympus XC50 digital camera and MicroSuite Special Edition software 3.1 (Soft Imaging Solutions GmbH). Images were optimized (with LEVELS and BRIGHTNESS/CONTRAST tools) and cropped in Adobe Photoshop CS Version 8.0 (San Jose, California).

Finally, fungal material was found in unidentified microscopic slides from Roland Thaxter, whose entire collection has been deposited at FH [except for co-types, which are deposited at the Muséum National d'Histoire Naturelle in Paris, France (PC)]. The examination of these slides led to the discovery of some unpublished records, which are presented and discussed in this paper.

Using the modified Extract-N-Amp Plant PCR Kit as outlined in Haelewaters et al. (2015a), we isolated DNA, amplified the ribosomal small subunit (SSU) gene, and obtained a partial sequence from *H. virescens* thalli removed from a specimen of Coccinellidae. The sequence was deposited in GenBank (KX533512).

Taxonomy

Amorphomyces ophioglossae Thaxt., Proc. Am. Acad. Arts Sci. 48: 167 (1912).

Fig. 1A

KNOWN DISTRIBUTION AND HOSTS: Described on *Ophioglossa* (?) *cava* (Sharp, 1876) from Argentina (Thaxter 1912) and since then only reported from Guatemala on an unidentified staphylinid (Thaxter 1931).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Ophioglossa* sp. (Coleoptera, Staphylinidae, Aleocharinae), Potrerillos Arriba (Chiriquí), i.2012, leg. J.Castillo & B.Espinosa, det. T.Ríos, in coll. MUPADI, D.Haelew. 1001b (FH).

REMARKS: *Amorphomyces ophioglossae* is closely related to *A. minusculus* Thaxt., which occurs on the same host genus. However, in female thalli of *A. ophioglossae* the perithecial apex is distinctly suffused with dark brown on one side (Santamaría 2000, figs 18 & 26), which is obvious in the material we obtained.

Chitonomyces hyalinus Thaxt., Mem. Am. Acad. Arts Sci. 12: 291 (1896).

≡ *Heimatomyces hyalinus* Thaxt., Proc. Am. Acad. Arts Sci. 27: 31 (1892).

= *Heimatomyces marginatus* Thaxt., Proc. Am. Acad. Arts Sci. 27: 34 (1892).

= *Chitonomyces marginatus* (Thaxt.) Thaxt., Mem. Am. Acad. Arts Sci. 12: 289 (1896).

KNOWN DISTRIBUTION AND HOSTS: *Chitonomyces hyalinus* was described [as *Heimatomyces hyalinus*] on *Laccophilus maculosus* Say, 1823 (Coleoptera, Dytiscidae, Laccophilinae) from Connecticut, U.S.A. (Thaxter 1892) and since then found only a few times on *Laccophilus* spp.: in Grenada, Trinidad (Thaxter 1924), Brazil (Rossi & Bergonzo 2008), and New York, U.S.A. (Goldmann & Weir 2012). Recently *Chitonomyces marginatus* was shown to be synonymous with *C. hyalinus* (Goldmann & Weir 2012). The former has been found on *Laccophilus* spp. and *Hydroporus spurius* LeConte, 1855 in the U.S.A. and Jamaica (Thaxter 1892, 1924).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On female *Laccophilus pictus* Laporte, 1835, NE of Santa Fe (Veraguas), Río Mulabá, 24.viii.2006, rock pools, leg. and det. D.Post, in coll. STRI (SYNOPTIC STRI-ENT 0 107 823), D.Haelew. 891a–b (FH, MIUP).

REMARKS: The observed thalli fit the description of the "morphospecies" *Ch. marginatus* (Thaxter 1896), which was synonymized with *Ch. hyalinus* (Goldmann & Weir 2012). The issues of position specificity and position-induced polymorphisms have recently received a lot of attention, especially for species occurring on aquatic hosts. Thirteen morphospecies of *Chitonomyces* Peyr. on *L. maculosus* were studied using both phylogenetic and ecological data, resulting in synonymies and the recognition of six species following the phylogenetic species concept (Goldmann & Weir 2012).

We found *Ch. hyalinus* together with *Ch. simplex* (slide D.Haelew. 891c) on the same host specimen. *Chitonomyces hyalinus* was found along the margin of the left elytron (between bristles), while *Ch. simplex* was found at the tip of the right elytron. Rossi and Bergonzo (2008) also found this combination on *Laccophilus fasciatus* in Brazil, but they also found up to five other position-specific morphospecies on this host.

Chitonomyces paradoxus (Peyr.) Thaxt., Mem. Am. Acad. Arts Sci. 12: 287 (1896).
= *Heimatomyces paradoxus* Peyr., Sitzb. k. Akad. Wissensch., Math.-naturwiss. Cl. 68: 251 (1873).
= *Heimatomyces unciger* Thaxt., Proc. Am. Acad. Arts Sci. 30: 478 (1895).
= *Chitonomyces unciger* (Thaxt.) Thaxt., Mem. Am. Acad. Arts Sci. 12: 288 (1896).
= *Chitonomyces truncatus* Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 27: 47 (1915).

KNOWN DISTRIBUTION AND HOSTS: On *Laccophilus* spp. (Coleoptera, Dytiscidae, Lacco-philinae) from many countries, in Europe, North and Central America, and Asia (Santamaría 2001). Most recently it was found on *Laccophilus hyalinus* (De Geer, 1774) in Belgium (De Kesel & Werbrouck 2008), *Laccophilus* spp. in Sweden (Huggert & Eriksson 2010), *L. maculosus* in New York, U.S.A. (Goldmann & Weir 2012), and *Laccophilus poecilus* Klug, 1834 in Turkey (Rossi 2016). *Chitonomyces truncatus*, a synonym of *Ch. paradoxus*, was described from Italy (Spegazzini 1915). Goldmann & Weir (2012) synonymized it with *Ch. unciger*, based on the combination of molecular and ecological data. *Chitonomyces unciger* was described on *L. maculosus* from Connecticut, U.S.A. (Thaxter 1895), and later found on *Laccophilus* spp. from Florida, U.S.A. and China (Thaxter 1924).

NEW RECORDS FROM CENTRAL AMERICA: BAHAMAS. On female *Laccophilus proximus* Say, 1823, West End (Grand Bahama Island), 12.v.1953, leg. E.B.Hayden, in coll. AMNH, D.Haelew. 295a (FH 00313437).

REMARKS: *Chitonomyces paradoxus* is recognized by its compact habitus, the more or less triangular cell h, and the perithecial outgrowth, which is pointed obliquely upwards and tapering distally to a rounded point. Thaxter (1924) pointed out that there is considerable morphological variation in this species, and Majewski (1994) and Santamaría (2001) described three morphological forms on the three European *Laccophilus* hosts [*L. hyalinus*, *L. minutus* (Linnaeus 1758), *L. poecilus* Klug, 1834]. However, in America (as well as in Asia) many more species serve as host to this species, which makes it hard to define its specific limits.

Chitonomyces simplex Thaxt., Mem. Am. Acad. Arts Sci. 12: 292 (1896).

≡ *Heimatomyces simplex* Thaxt., Proc. Am. Acad. Arts Sci. 27: 30 (1892).

= *Heimatomyces uncinatus* Thaxt., Proc. Am. Acad. Arts Sci. 27: 33 (1892).

= *Chitonomyces uncinatus* (Thaxt.) Thaxt., Mem. Am. Acad. Arts Sci. 12: 291 (1896).

KNOWN DISTRIBUTION AND HOSTS: Reported from *Laccophilus* spp. (Coleoptera, Dytiscidae, Laccophilinae) in Brazil, Grenada, Guatemala, Trinidad, and the U.S.A. (Thaxter 1896, 1924, Rossi & Bergonzo 2008, Goldmann & Weir 2012).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Laccophilus fasciatus* Aubé, 1838, El Copé Road, 1 km N of Pan-American Highway (Coclé), 29.viii.2006, roadside ditch, leg. and det. D.Post, in coll. STRI (SYNOPTIC STRI-ENT 0 107 818), D.Haelew. 888b (MIUP). On female *L. pictus* Laporte, 1835, NE of Santa Fe (Veraguas), Río Mulabá, 24.viii.2006, rock pools, leg. and det. D.Post, in coll. STRI (SYNOPTIC STRI-ENT 0 107 823), D.Haelew. 891c (FH).

REMARKS: Thalli of *C. simplex* were removed from the tip of the right elytron from both *L. fasciatus* and *L. pictus*. This is the growth position of the "typical" *Ch. simplex*, with which *Ch. uncinatus* was recently synonymized (Goldmann & Weir 2012). *Chitonomyces uncinatus* occurs on the left-hand side of sternites 4–5 of male host specimens only. The most distinctive feature of these two morphospecies is the curvature of the perithecium; in *Ch. simplex* the perithecium curves away from the primary appendage, in *Ch. uncinatus* it curves toward the primary appendage. Despite consistent morphological differences, both species are recognized as a single phylogenetic species (Goldmann & Weir 2012).

Dimeromyces homophoetae Thaxt., Proc. Am. Acad. Arts Sci. 50: 19 (1914).

KNOWN DISTRIBUTION AND HOSTS: Reported on *Omophoita aequinoctialis* (Linnaeus, 1758) [as *Homophoeta*] (Coleoptera, Chrysomelidae, Galerucinae) of Grenada, Guatemala, and Trinidad (Thaxter 1914), and on *Omophoita octoguttata* (Fabricius, 1775) [as *Homophoeta*] from Argentina (Spegazzini 1917).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Capraita* sp. (Coleoptera, Chrysomelidae, Galerucinae), Potrerillos Abajo (Chiriquí), N8°38'55.48"W 82°28'14.10", 648 m a.s.l., 20.vii.2016, abandoned orange plantation, leg. Y.Aguirre, J.Bernal & D.Haelewaters, det. T.Ríos, in coll. MUPADI, D.Haelew. 1105a–b (FH). Same data, D.Haelew. 1106a–b (UCH).

REMARKS: To date, 11 species of *Dimeromyces* Thaxt. on Chrysomelidae have been described (Haelewaters & Rossi 2015, Rossi et al. 2016). *Dimeromyces homophoetae* is easily distinguished from the others by the pointed terminal cell of the primary appendage of the female thallus (Thaxter 1924). *Dimeromyces bubalinus* W.Rossi et al. shares this character but has a very different perithecial tip, with symmetrically divergent, curved outgrowths (Rossi et al. 2015).

Eucantharomyces calleidae Thaxt., Proc. Am. Acad. Arts Sci. 35: 418 (1900).

Fig. 1B

KNOWN DISTRIBUTION AND HOSTS: Only known from *Calleida* spp. [misspelled as "*Callida*"] in Suriname and Venezuela (Thaxter 1908).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Calleida aurata* Motschulsky, 1864 [as *C. "anypterygioides"*] (Coleoptera, Carabidae, Harpalinae), Cerro Picacho (Panamá), N8°38'W

80°03', 800 m a.s.l., 21.vi.1992, leg. and det. H.P.Stockwell, in coll. STRI (STOCKWELL STRI-ENT 0 043 594), D.Haelew. 871a (FH).

REMARKS: *Eucantharomyces* Thaxt. currently contains 29 species (Thaxter 1895, Santamaría 2006, Rossi & Ponziani 2008). All of its members parasitize ground beetles (Coleoptera, Carabidae). For species delineation features of the compound antheridium and perithecium are used. For example, the number of antheridial cells and rows and the spore apex remnant serve as diagnostic characters, as well as details of the perithecial wall cells (e.g. with corrugations). However, despite Thaxter's (1908) suggestion that the number of antheridial cells for each row is constant, this is not a very reliable character (Santamaría 1994, 2006). *Eucantharomyces calleidae* is recognized by the structure of the base of the thallus: cells I and II of the receptacle are (sub-)equal and lie next to each other. Cell III extends downward, hence covering the posterior side of the upper half of cell II.

Gloeandromyces nycteribiidarum (Thaxt.) Thaxt., Mem. Am. Acad. Arts Sci. 16: 113 (1931). Fig. 1C

≡ *Stigmatomyces nycteribiidarum* Thaxt., Proc. Am. Acad. Arts Sci. 52: 702 (1917).

KNOWN DISTRIBUTION AND HOSTS: Described on *Megistopoda aranea* (Coquillett, 1899) [as *Pterellipsis aranea*] (Diptera, Streblidae, Trichobinae), parasitic on *Artibeus jamaicensis grenadensis* [as *A. grenadensis*] (Mammalia, Chiroptera, Phyllostomidae) from Grenada (Thaxter 1931).

NEW RECORDS FROM CENTRAL AMERICA: COSTA RICA. On male *Trichobius yunkerii* Wenzel, 1966 (Diptera, Streblidae, Trichobinae), Santa Rosa National Park (Guana-caste), 5.iii.2012, parasitic on female *Pteronotus parnellii* (Mammalia, Chiroptera, Phyllostomidae), 2012CR296, leg. and det. T.Hiller, in coll. MCZ, slide D.Haelew. 946a (FH). Same data, D.Haelew. 947a (FH).

REMARKS: *Gloeandromyces* Thaxt. includes only two species, *G. nycteribiidarum* (Thaxt.) Thaxt. and *G. streblae* (Thaxt.) Thaxt. *Gloeandromyces nycteribiidarum* was first described on a bat fly, which, however, was misidentified as a nycteribiid fly. This explains the epithet reference, while the host belongs to the family Streblidae. Because bat flies are blood-sucking ectoparasites of bats (Mammalia, Chiroptera), the Laboulbeniales parasitizing these hosts can be considered hyperparasites.

The two species in the genus *Gloeandromyces* can be differentiated based on their total length, perithecial features, and the way they attach to the host, which is by a rhizoidal haustorium in *G. nycteribiidarum* or a blackened foot in *G. streblae* (Thaxter 1931). The Costa Rican material represents the second report only for *G. nycteribiidarum*.

Gloeandromyces pageanus Haelew., sp. nov.

Fig. 1D

Mycobank number MB 819381.

DIAGNOSIS: Different from the other species in the genus by its peculiar perithecial bulbous outgrowths and finger-like projections.

TYPES: PANAMA. On female *Trichobius dugesioides* Wenzel, 1966 (Diptera, Streblidae, Trichobinae), collected in Gamboa (Colón), 26.vi.2016, parasitic on female *Trachops cirrhosus* (Mammalia, Chiroptera, Phyllostomidae), leg. R.Page et al., det. T.Hiller, D.Haelew. 1093a (HOLOTYPE, 6 mature thalli, prescutum and scutum, FH). On female *T. dugesioides*, Gamboa (Colón), 24.vi.2016, parasitic

on male *Trachops cirrhosus*, leg. R. Page et al., det. T. Hiller, D. Haelew. 1092a (PARATYPE, 1 mature thallus, prescutum, FH). Same data, D. Haelew. 1091a (PARATYPE, 1 mature thallus, right-hand side thorax, FH). On male *T. dugesioides*, Gamboa (Colón), 2.vii.2016, parasitic on *Trachops cirrhosus*, leg. R. Page et al., det. T. Hiller, D. Haelew. 1094a (PARATYPE, 4 mature thalli, right prescutum, FH). On female *T. dugesioides*, same data, D. Haelew. 1098a (PARATYPE, 1 mature thallus, thorax, FH).

ETYMOLOGY: Referring to Dr. Rachel Page (Smithsonian Tropical Research Institute), mammologist, collaborator, and Principal Investigator at the Bat Lab in Gamboa.

DESCRIPTION: THALLUS: 195–257 μm long from foot to perithecial tip. Irregularly colored reddish, darker at the basal cell of the appendage, the perithecial bulbous outgrowth, and the finger-like projections; upper part of cell III and cells VI and VII tinged with orange. RECEPTACLE: Cell I anteriorly curved, longer than broad, with divergent margins, 45–74 \times 31–44 μm (above), carrying cells II and VI. Cell II trapezoidal, slightly broader than long. Cell III isodiametrical, with rounded lower anterior margin. APPENDAGE: Basal cell 7–10 \times 11–13 μm , pentagonal, with parallel anterior and posterior margins, carrying two very short branches of dichotomously dividing cells; final cells antheridial. PERITHECIUM: Cell VI obliquely positioned between cells II and VII, broadly triangular, lower margin rounded, broader than long. Perithecium 113–139 \times 43–52 μm (not including bulbous outgrowth), obclavate, anterior margin with a short and bulbous outgrowth at lower third; halfway at the posterior side two finger-like projections obliquely directed upwards, up to 46 μm in length; neck well distinguished, upper half of posterior side with two very short bulbous outgrowths, the upper one slightly smaller and darkly pigmented; tip undifferentiated, blunt. Ascospores bicellular, 30–35 \times 3–5 μm .

REMARKS: Its perithecial bulbous outgrowth and finger-like projections separate the new species from the two known species in the genus *Gloeandromyces* (Thaxter 1917, 1931). These characteristics are stable, and have been observed in all studied specimens. *Gloeandromyces pageanus* shares with *G. streblae* a simple, blackened foot.

The host for *G. pageanus*, *Trichobius dugesioides*, is also reported for *G. streblae* in Panama. On most of the host specimens, we removed thalli of both parasite species (Table 1). *Gloeandromyces pageanus* was always found on the thorax, while *G. streblae* occurs mostly on the wings (Table 1). While *G. pageanus* seems limited to the thorax (based on the available material), *G. streblae* has no positional restrictions; we have observed this species on the thorax, legs, and wings. On one bat fly, both species co-occurred on the right prescutum. This confirms that the two taxa are separate species.

Gloeandromyces streblae (Thaxt.) Thaxt., Mem. Am. Acad. Arts Sci. 16: 113 (1931).
Fig. 1G

≡ *Stigmatomyces streblae* Thaxt., Proc. Am. Acad. Arts Sci. 52: 700 (1917).

KNOWN DISTRIBUTION AND HOSTS: Described on *Strebla wiedemanni* Kolenati, 1856 [as *S. vespertilionis*] (Diptera, Streblidae, Streblinae) from Venezuela.

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On male *Trichobius dugesioides* (Diptera, Streblidae, Trichobinae), Bohio (Panama Canal Zone), 29.ix.2013, parasitic on female *Trachops cirrhosus* (Mammalia, Chiroptera, Phyllostomidae), P_0191, leg. and det. T. Hiller, in coll. MCZ, D. Haelew. 1068a (FH). On male *Trichobius joblingi* Wenzel, 1966, Bohio (Panama Canal Zone),

Table 1. Overview of all bat fly-associated Laboulbeniales discussed in this paper, with information of bat species, bat fly species, and position on the bat fly host from where thalli were removed.

Bat host	Bat fly host	Position on bat fly	D.Haelew. #	Parasite species	Country
<i>Pteronotus parnellii</i>	<i>Trichobius yunkerii</i>	mouth parts	946a	<i>Gloeandromyces nycteribidiarum</i>	Costa Rica
<i>Pteronotus parnellii</i>	<i>Trichobius yunkerii</i>	ventral head	947a	<i>Gloeandromyces nycteribidiarum</i>	Costa Rica
<i>Carollia perspicillata</i>	<i>Trichobius joblongi</i>	left protibia	1066a	<i>Nycteromyces streblidinus</i>	Panama
<i>Pteronotus parnellii</i>	<i>Trichobius yunkerii</i>	left wing	1067a	<i>Gloeandromyces streblae</i>	Panama
<i>Trachops cirrhosus</i>	<i>Trichobius dugesioides</i>	right mesofemur	1068a	<i>Gloeandromyces streblae</i>	Panama
<i>Carollia perspicillata</i>	<i>Trichobius joblingi</i>	wings	1071a	<i>Gloeandromyces streblae</i>	Panama
		head & left metafemur	1071b	<i>Nycteromyces streblidinus</i>	
<i>Carollia castanea</i>	<i>Trichobius joblingi</i>	left profemur	1088a	<i>Gloeandromyces streblae</i>	Panama
				<i>Nycteromyces streblidinus</i>	
<i>Trachops cirrhosus</i>	<i>Trichobius dugesioides</i>	right-hand side thorax	1091a	<i>Gloeandromyces pageanus</i>	Panama
		lateral margin right wing	1091c	<i>Gloeandromyces streblae</i>	
<i>Trachops cirrhosus</i>	<i>Trichobius dugesioides</i>	prescutum	1092a	<i>Gloeandromyces pageanus</i>	Panama
<i>Trachops cirrhosus</i>	<i>Trichobius dugesioides</i>	prescutum & scutum	1093a	<i>Gloeandromyces pageanus</i>	Panama
		lateral margin right wing	1093c	<i>Gloeandromyces streblae</i>	
<i>Trachops cirrhosus</i>	<i>Trichobius dugesioides</i>	right prescutum	1094a	<i>Gloeandromyces pageanus</i>	Panama
				<i>Gloeandromyces streblae</i>	
<i>Trachops cirrhosus</i>	<i>Trichobius dugesioides</i>	thorax	1098a	<i>Gloeandromyces pageanus</i>	Panama

2015, parasitic on female *Carollia perspicillata* (Mammalia, Chiroptera, Phyllostomidae), P_3935, leg. and det. T.Hiller, in coll. MCZ, D.Haelew. 1071a (FH). On female *Trichobius yunkerii* Wenzel, 1966, Isla Barro Colorado (Panamá Oeste), 19.iv.2014, parasitic on female *Pteronotus parnellii* (Mammalia, Chiroptera, Phyllostomidae), WP1_344, leg. and det. T.Hiller, in coll. MCZ, D.Haelew. 1067a (FH). On male *T. joblingi*, Gamboa (Colón), 13.vi.2016, parasitic on male *Carollia castanea* (Mammalia, Chiroptera, Phyllostomidae), leg. R.Page et al., det. T.Hiller, D.Haelew. 1088a (FH). On female *T. dugesioides*, Gamboa (Colón), 24.vi.2016, parasitic on male *Trachops cirrhosus*, leg. R.Page et al., det. T.Hiller, D.Haelew. 1091c (FH). On female *T. dugesioides*, Gamboa (Colón), 26.vi.2016, parasitic on female *Trachops cirrhosus*, leg. R.Page et al., det. T.Hiller, D.Haelew. 1093c (FH). On male *T. dugesioides*, Gamboa (Colón), 2.vii.2016, parasitic on *Trachops cirrhosus*, leg. R.Page et al., det. T.Hiller, D.Haelew. 1094a (FH).

REMARKS: The material from Panama represents only the second report for this species. When Thaxter (1917) described *G. streblae*, he did not mention a bat host species. However, *S. wiedemanni* typically parasitizes the common vampire bat *Desmodus rotundus* (Mammalia, Chiroptera, Phyllostomidae) (Dick 2013). The host species for *G. streblae* belong to two subfamilies: Streblinae (*Strebla*) and Trichobinae (*Trichobius*). This seems to suggest a less strict host relationship for this species. More data are required to understand the host specificity dynamics for this and other species infecting bat flies.

Herpomyces chaetophilus Thaxt., Proc. Am. Acad. Arts Sci. 38: 12 (1902).

KNOWN DISTRIBUTION AND HOSTS: On *Periplaneta* spp. (Blattodea, Blattidae, Blattinae) in "the Amazon", Mauritius, Peninsular Malaysia, and Zanzibar (Thaxter 1902, 1931, Sugiyama & Mochizuka 1979). Only recently the fungus was discovered on *Periplaneta americana* (Linnaeus, 1758) in Massachusetts, U.S.A. (Wang et al. 2016a).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Periplaneta americana*, Bágala (Chiriquí), ix.2012, leg. Y.Saldaña, det. R.Santanach, in coll. MUPADI, D.Haelew. 932a (UCH). On *P. americana*, Gamboa (Colón), 183 Harding Avenue, N 9°06'58.64", W 79°41'52.89", 15.vii.2016, apartment floor, leg. and det. D.Haelewaters, in coll. MUPADI, D.Haelew. 1097a (FH).

REMARKS: *Herpomyces chaetophilus* is easily distinguished from other species in the same genus for the following characters: (1) its solitary perithecium, with the tip bending anteriorly and (2) the absence of a cellular upgrowth (or "shell-like shield"; Thaxter 1908) at the base of the perithecium.

This record is the first for Central America. *Herpomyces chaetophilus* is now known from North, Central, and South America, Africa, and Asia. Wang et al. (2016a) hypothesized that *H. chaetophilus* was somehow introduced with *P. americana* to the United States, most likely after Thaxter's time, who did not record it from North America during his extensive studies. In the light of the recent records from Massachusetts, U.S.A. (Wang et al. 2016a) and Panama (this paper) it will be interesting to demonstrate routes of invasion by performing population genetics.

Herpomyces paranensis Thaxt., Proc. Am. Acad. Arts Sci. 38: 19 (1902). Fig. 1E

KNOWN DISTRIBUTION AND HOSTS: *Herpomyces paranensis* was described on *Blaberus* sp. [as *Blabera*] from Brazil, and since then only found in Mexico on another unidentified species of *Blaberus* Serville, 1831 (Thaxter 1902, 1908).

NEW RECORDS FROM CENTRAL AMERICA: COLOMBIA. On *Archimandrita tessellata* Rehn, 1903 (Blattodea, Blaberidae, Blaberinae), no locality, 3.vi.1889, leg. Sleight, det. Bacon, in coll. AMNH, D.Haelew. 615a (FH). COSTA RICA. On *A. tessellata*, Santa Rosa National Park (Guanacaste), xi.2012, leg. A.R.Deans, det. L.M.Roth, in coll. MCZ, D.Haelew. 609c (FH).

REMARKS: This marks the first record of this fungus after more than a century. *Archimandrita* Saussure, 1893 is a new host genus for this fungus. It belongs to the same subfamily (Blaberinae) as *Blaberus*. This implies that the host specificity of *H. paranensis* is not restricted to genus but (at least) to subfamily.

Hesperomyces palustris W.Rossi & A.Weir, Fungal Biol. 117: 812 (2013). Fig. 1F

KNOWN DISTRIBUTION AND HOSTS: Only known from *Coleomegilla maculata* (DeGeer, 1775) (Coleoptera, Coccinellidae, Coccinellinae) in Ecuador (holotype) and Costa Rica (Goldmann et al. 2013).

NEW RECORDS FROM CENTRAL AMERICA: CUBA. On *C. maculata*, Viñales (Pinar del Río), 27–31.1951, leg. P.Vaurie, det. G.H.Dieke, in coll. AMNH, D.Haelew. 379a–b (FH).

REMARKS: *Hesperomyces coleomegillae* W.Rossi & A.Weir and *H. palustris* were recently described as two phylogenetic species, each with two morphospecies on precise positions of the host body (= position specificity; Goldmann et al. 2013). Both species are the only ones of about 2,100 described species of Laboulbeniales for which molecular analyses were used to back up the morphological observations.

Hesperomyces palustris has two morphotypes, one on the legs and one on the margins of the elytra. Our material was collected from the margin of the right elytron and is consistent with the morphotype description from this area.

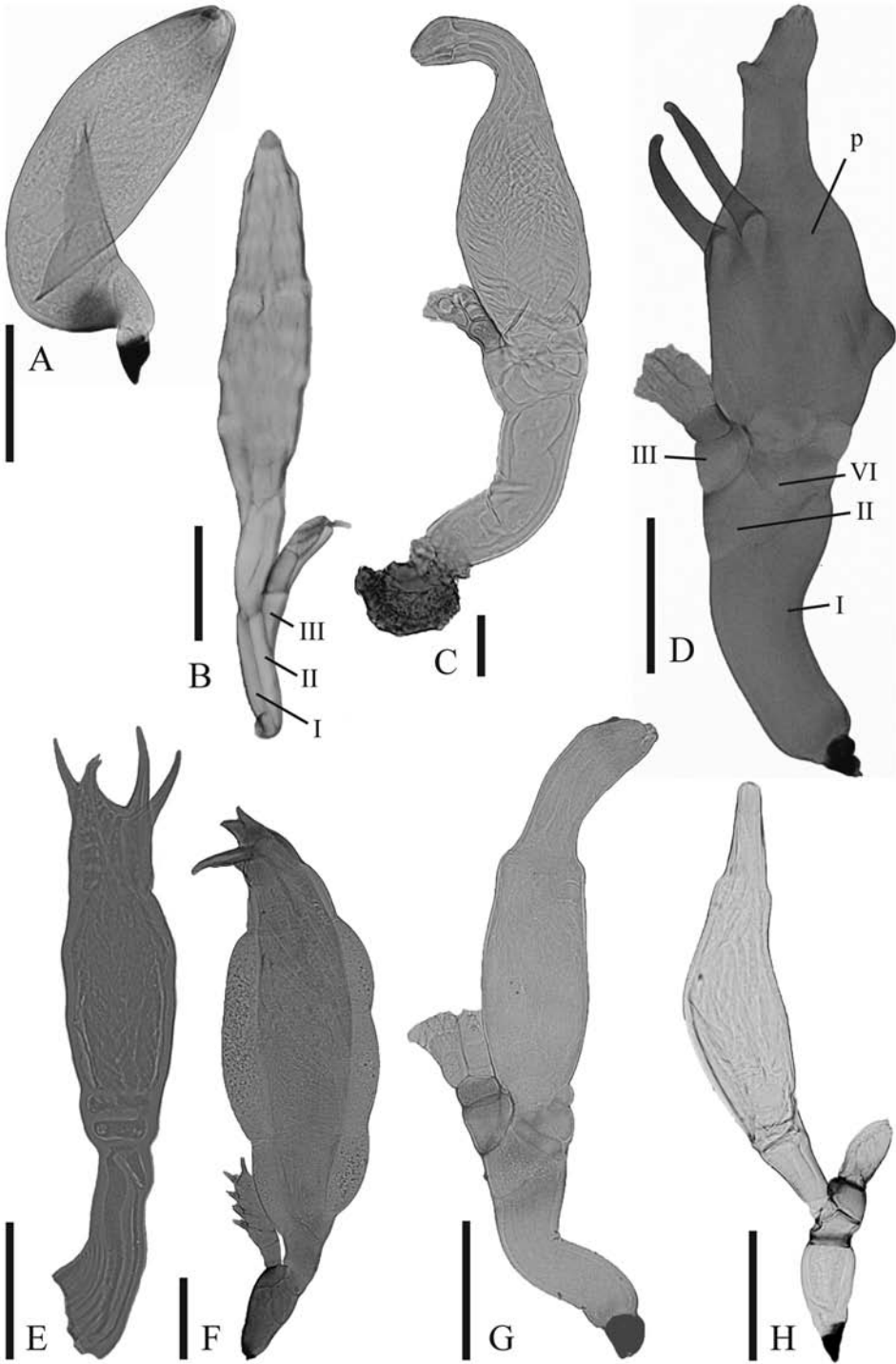
Hesperomyces virescens Thaxt., Proc. Am. Acad. Arts Sci. 25: 264 (1891).

≡ *Stigmatomyces virescens* (Thaxt.) Thaxt., Proc. Am. Acad. Arts Sci. 29: 106 (1894).

KNOWN DISTRIBUTION AND HOSTS: Described on *Chilocorus stigma* (Say, 1835) [as *C. bivulnerus*] (Coccinellidae, Coccinellinae, Chilocorinae) from California, U.S.A. It is a widespread species known from all continents except Antarctica, hosted by several genera of Coccinellidae (Santamaría et al. 1991, Ceryngier et al. 2012). Most recent records were found on the globally invasive *Harmonia axyridis* (Pallas, 1773) in Argentina, Austria, Canada, France, Slovakia, and South Africa (Haelewaters et al. 2017).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Epilachna mexicana* (Guérin-Ménéville, 1842) (Coleoptera, Coccinellidae, Epilachninae), Volcán (Chiriquí), N8°47'23.47"W 82°38'44.93", 20.vii.2015, leg. J.Bernal & S.Verhaeghen, det. D.Haelewaters, in coll. MCZ, D.Haelew. 930a (FH). On *Azya orbigera* Mulsant, 1850 (Coleoptera, Coccinellidae, Coccidulinae), Potrerillos Abajo (Chiriquí), N8°38'55.48"W 82°28'14.10", 648 m a.s.l., 19.vii.2015, abandoned orange plantation, leg. M.Fuentes, L.Gonzalez, D.Haelewaters, R.Villarreal & S.Verhaeghen, det. D.Haelewaters, in coll. MCZ, D.Haelew. 925a (FH). Same data, 20.vii.2016, leg. Y.Aguirre, J.Bernal & D.Haelewaters, det. D.Haelewaters, in coll. MUPADI, D.Haelew. 1103a (FH). Same data, D.Haelew. 1104a (FH). Same data, 21.vii.2016, leg. J.Bernal, L.Gonzalez, M.Fuentes, J.Trejos & R.Villarreal, det. D.Haelewaters, in coll. MUPADI, D.Haelew. 1109a (FH). On Brachiacanthini gen. & sp. indet. (Coleoptera, Coccinellidae, Scymninae), 6 km S of Ipetí (Panamá), 350 m a.s.l., 8.xi.1992, leg. A.R.Gillogly, det. R.G.Boothe, in coll. STRI (STOCKWELL STRI-ENT 0 059 403), D.Haelew. 881a (FH). On *Cycloneda sanguinea* (Linnaeus, 1763) (Coleoptera, Coccinellidae, Coccinellinae), Volcán, Urbanización La Florida (Chiriquí), N8°47'23.47"W 82°38'44.93", 20.vii.2015, leg. J.Bernal & S.Verhaeghen, det. D.Haelewaters, in coll. MCZ, isolate D.Haelew. 929a.

Fig. 1. A. *Amorphomyces ophioglossae* (D.Haelew. 1001b). B. *Eucantharomyces calleidae* (D.Haelew. 871a), with cells I, II, and III of the receptacle labeled. C. *Gloeandromyces nycteribiidarum* (D.Haelew. 947a). D. *Gloeandromyces pageanus* sp. nov. (D.Haelew. 1092a), with indication of cells I, II, III, VI, and the perithecium (p). E. *Herpomyces paranensis* (D.Haelew. 609c). F. *Hesperomyces palustris* (D.Haelew. 379b). G. *Gloeandromyces streblae* (D.Haelew. 1096a). H. *Neohaplomyces medonalis* (D.Haelew. 895a). Scale bars = 50 µm.



REMARKS: *Hesperomyces virescens* was already known from many representatives of three subfamilies within Coccinellidae: Chilocorinae, Coccinellinae, and Scymninae. The new findings from Panama add two subfamilies to the host range of *H. virescens*: Coccidulinae (*Azya orbigera*) and Epilachninae (*Epilachna mexicana*). The observed infection prevalence of *H. virescens* on *A. orbigera* was 4.5% in 2015 (18–19 Jul, $n = 110$). We went back to Potrerillos Abajo in 2016, and collected 4 specimens of *A. orbigera* infected with *H. virescens*, marking a prevalence of 12.2% (19–21 Jul, $n = 41$). However, thallus density on *A. orbigera* is extremely low, with 1–3 thalli per host specimen.

An SSU rDNA sequence (isolate D.Haelew. 929a) from thalli removed from *C. sanguinea* is available in GenBank with accession number KX533512. It is 99–100% similar (100% query cover) to publicly available sequences of *H. virescens* from *Cheilomenes propinqua* (Mulsant, 1850), *H. axyridis*, and *Olla v-nigrum* (Mulsant, 1866), confirming its identity as *H. virescens*. Not enough thalli were available on this host specimen to also make microscope slides.

Kleidiomyces hoplandriae Thaxt., Proc. Am. Acad. Arts Sci. 25: 264 (1891).

KNOWN DISTRIBUTION AND HOSTS: Reported on *Hoplandria* spp. (Coleoptera, Staphylinidae, Aleocharinae) from Ecuador, Grenada, and Trinidad (type) (Thaxter 1931, Bernardi et al. 2014).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Hoplandria* sp., Gamboa (Colón), Pipeline Road KM7, 20.v-11.vi.1996, leg. S.Lingafelter, det. J.S.Ashe, in coll. STRI (SYNOPTIC STRI-ENT 0 108 324), D.Haelew. 910a–b (FH, MIUP).

REMARKS: *Kleidiomyces hoplandriae* was described on *Hoplandria "carinicollis"*, which "appear[s] not to be valid" according to Frank (1982). Also the host for the Ecuadorian material, *Hoplandria "rossii"*, seems an undescribed species. Both species names cannot be found in the Zoological Record (<http://www.organismnames.com/>).

Laboulbenia bruchii (Speg.) Thaxt., Proc. Am. Acad. Arts Sci. 50: 23 (1914).

Fig. 3A

≡ *Sphaleromyces bruchii* Speg., An. Mus. Nac. Hist. Nat. Buenos Aires 23: 195 (1912).

KNOWN DISTRIBUTION AND HOSTS: Reported in many countries in the Americas on species of the genera *Lema* Fabricius, 1798 and *Neolema* Monrós, 1951 (Coleoptera, Chrysomelidae, Criocerinae). Currently it is known in Argentina, Brazil, Ecuador, French Guiana, Guatemala, Mexico, and Trinidad (Spegazzini 1912, Thaxter 1914, Proaño Castro & Rossi 2008). Recently, De Kesel et al. (2011) reported *L. bruchii* for the first time on the African continent (in Togo).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Neolema* sp., La Reserva Forestal de Fortuna (Chiriquí), 9.i.2016, close to dam, leg. J.Bernal, D.Haelewaters, T.Ríos & R.Villarreal, det. T.Ríos, in coll. MUPADI, D.Haelew. 986a (UCH). Same data, D.Haelew. 987a–b (FH).

REMARKS: This species is recognized primarily by its cell IV forming a protrusion, which grows besides and slightly beyond the insertion cell. In this characteristic *L. bruchii* is allied to *L. bilobata* Haelew. & W.Rossi, *L. macarthurii* Balazuc [formerly

L. papuana Thaxt.], and *L. rhinoceralis* Thaxt. All four species have hosts in the Criocerinae subfamily (*Lema*, *Neolema*). However, *L. bilobata* is obviously completely different because of the monstrous growth of cell VI (Haelewaters & Rossi 2015). The perithecium of *L. rhinoceralis* carries two short apical horn-like projections (Thaxter 1914), which are absent in *L. bruchii*. Thaxter (1914) wrote about *L. macarthurii*: "This species is so closely related to *L. bruchii* that I have hesitated to separate it specifically, and it may prove to be merely a well marked variety when a large series becomes available for examination".

Also *Laboulbenia hottentotae* Thaxt. occurs on insects of the genus *Lema* (in Zanzibar). However, the thallus is always typically anteriorly curved and its cell IV does not form a protrusion (Thaxter 1914).

***Laboulbenia coccinellidicola* Haelew., sp. nov.**

Fig. 2A–C

Mycobank number MB 819382.

DIAGNOSIS: Separated from other species of *Laboulbenia* by (1) the crenulation on the anterior margin of the receptacle up to cell VII, (2) the punctation pattern of cells II through VII, (3) its simple inner and outer appendages, (4) the presence of a single antheridium, and (5) Coccinellidae as hosts.

TYPES: PANAMA. On *Exochomus childreni* Mulsant, 1850 (Coleoptera, Coccinellidae, Chillocorinae), collected in Reserva Forestal De Fortuna (Chiriquí), "Cont. Div. Trail", 1300 m a.s.l., 18.i.1992, leg. H.P.Stockwell, det. T.Ríos, in coll. STRI (STOCKWELL STRI-ENT 0 059 457), D.Haelew. 885b (HOLOTYPE, 1 mature thallus, right elytron, MIUP); ISOTYPES D.Haelew. 885a (1 mature thallus, margin elytral tips, FH), 885c (1 submature and 1 mature thallus, left elytron, FH), and 885d (1 mature thallus, left elytron, FH). On *Exochomus* sp. 1, Parque Nacional Darién (Darién), N7°45.5' W77°41', 460 m a.s.l., 3–9.vi.1996, leg. H.P.Stockwell, det. T.Ríos, in coll. STRI (STOCKWELL STRI-ENT 0 059 297), PARATYPES D.Haelew. 878a (4 mature thalli, right elytron, FH) and 878b (1 submature and 8 mature thalli, left elytron, FH). On *E. childreni*, La Mesa (Coclé), N8°37' W80°07', 850 m a.s.l., 3.ii.1997, leg. H.P.Stockwell, det. T.Ríos, in coll. STRI (STOCKWELL STRI-ENT 0 059 299), PARATYPE D.Haelew. 879a (1 juvenile thallus, tip of elytra, FH). On *Exochomus* sp. 1, El Valle (Coclé), 750 m a.s.l., 17.v.1973, leg. H.P.Stockwell, det. T.Ríos, in coll. STRI (STOCKWELL STRI-ENT 0 059 343), PARATYPE D.Haelew. 880a (4 juvenile thalli, right elytron, FH). On *Exochomus* sp. 1, Reserva Natural Punta Patiño (Darién), N8°16'W 78°18', 0–50 m a.s.l., 12.xii.2004, leg. D.M.Windsor, det. T.Ríos, in coll. STRI (STOCKWELL STRI-ENT 0 070 120), PARATYPE D.Haelew. 884a (4 juvenile thalli, right elytron, FH).

ETYMOLOGY: Referring to the host family Coccinellidae, since this is the first report of the genus *Laboulbenia* on this beetle family.

DESCRIPTION: THALLUS: 183 µm long from foot to perithecial tip, straight; cell I, cell V, and the perithecial tip hyaline to light brown colored, the rest of the thallus irregularly brown, with the posterior margin of cells III and IV and the anterior margin of the perithecial venter very dark brown. Anterior margin of the foot and of cells I, II, VI, and VII crenulated. Cells II through VII punctate. RECEPTACLE: Cell I rectangular, up to 2× longer than broad, 27 × 16 µm. Cell II longer than broad, with divergent margins, septum II–VI strongly oblique. Cells III and IV of similar length, rectangular, 1.5 × longer than broad. Cell V: at the inner-upper corner of cell IV, septum IV–V oblique, strongly curved. Insertion cell: very dark, thickest in the middle, marking a strong constriction at the posterior margin. APPENDAGE: Outer appendage consisting of a

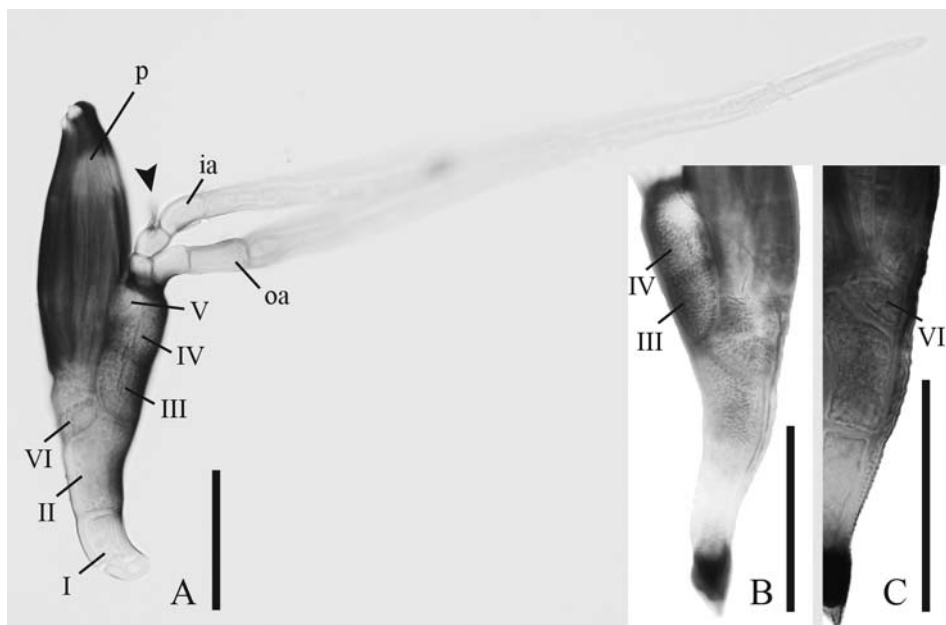


Fig. 2. A–C. *Laboulbenia coccinellidicola* sp. nov. A. Mature thallus (D.Haelew. 878a), with indication of receptacle cells I through V, the basal cell of the perithecium (VI), the perithecium itself (p), the inner appendage (ia) with the single antheridium (arrowhead), and the outer appendage (oa). B. Detail of punctation on cells II through VII (D.Haelew. 878b). C. Detail showing crenulation at anterior margin of receptacle up to cell VII (D.Haelew. 878c). Scale bars = 50 μ m.

simple branch, up to 294 μ m, composed of cells gradually more elongate; basal cell rectangular, strongly curved posteriorly, $19 \times 8 \mu$ m. Inner appendage consisting of a simple branch, up to 173 μ m, similar to the outer appendage but shorter, bearing a single, short antheridium at the anterior side of the suprabasal cell; basal cell squarish, less than half as long than basal cell of outer appendage. PERITHECIUM: Cell VI obliquely positioned, slightly broader than long, $10\text{--}14 \times 14\text{--}17 \mu$ m. Perithecium $91\text{--}120 \times 24\text{--}32 \mu$ m, elongate, nearly symmetrical except for the anteriorly curved apex, with prominent and rounded posterior lips, both of which subtend a conspicuous papilla; posterior pre-ostiolar spot very conspicuous, black, opaque.

REMARKS: The genus *Laboulbenia* is the largest genus of Laboulbeniales. Over 600 species have been described – Dictionary of the Fungi mentions 593 species (Kirk et al. 2008), and 30 new species were described since 2010 alone (Villarreal et al. 2010, Rossi 2011, Rossi & Kirk-Spriggs 2011, De Kesel & Haelewaters 2014, Haelewaters & Yaakop 2014, Haelewaters & Rossi 2015, Rossi et al. 2015, 2016, Wang et al. 2016b). *Laboulbenia* has a very wide host range, however *L. coccinellidicola* is the first species on Coccinellidae. Thus far, this family was only known to host species in the genus *Hesperomyces* Thaxt.

The combination of the ornamentation of the basal part of the thallus (crenulation of anterior cell margins and receptacular punctation), the simple inner and outer appendages, and the single antheridium make this a well-distinguished species.

Laboulbenia disenochi Thaxt., Proc. Am. Acad. Arts Sci. 38: 34 (1902). Fig. 3B

KNOWN DISTRIBUTION AND HOSTS: Described from several species of *Blackburnia* Sharp, 1878 (Coleoptera, Carabidae, Platyninae) in Hawaii (Thaxter 1902). Colla (1926) also reported it from an unidentified carabid on the Canary Islands but this record is doubtful (Arndt & Santamaría 2004). Thaxter (1902) lists as hosts: *Blackburnia optata* (Sharp, 1903) [as *Brosconymus*, misspelled as "*Brosconegneus*"] and *B. agonoides* (Sharp, 1903), *B. fracta* (Sharp, 1903), and *B. sulcipennis* [all as *Disenochus*].

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Platynus purpurellus* Liebherr, 1992 (Coleoptera, Carabidae, Platyninae), Parque Internacional La Amistad (Chiriquí), Sendero Panamá Verde, 14.i.2016, under bark of logs, leg. D.Haelewaters, det. T.Ríos, in coll. MUPADI, D.Haelew. 1004a–b (FH).

REMARKS: *Laboulbenia disenochi* parasitizes *Platynus purpurellus* in Panama, which is an extension to the known host range. Both host genera *Blackburnia* and *Platynus* Bonelli, 1810 belong to the subtribe Platynina sensu stricto within the Platynini tribe (Coleoptera, Carabidae, Platyninae).

The most obvious observable difference from the type series (illustrated in Thaxter 1908) is the well-distinguished tip of the perithecium. However, the placement of cell V, the blackening of the perithecial tip (and the hyaline area around the ostiole), and the darkened branches of the appendage are illustrative of *L. disenochi*.

Laboulbenia ecitonis G.Blum, Centbl. Bakt. ParasitKde, Abt. II 62: 301 (1924).

Fig. 3E

KNOWN DISTRIBUTION AND HOSTS: Reported from Brazil (type), Costa Rica, and Ecuador. Hosts are diverse, including *Eciton* Latreille, 1804 ants (Hymenoptera, Formicidae), *Sternocoelopsis* [misspelled as *Stenocobelopsis* in Blum (1924) and Thaxter (1931)] *auricomus* Reichensperger, 1923 (Coleoptera, Histeridae), *Ecitophya gracillima* Mann, 1925 (Coleoptera, Staphylinidae, Aleocharinae), and uropodid mites (Acari, Mesostigmata, Uropodidae) (Blum 1924, Reichensperger 1935, Rossi 1991).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Ecitophya* sp. (Coleoptera, Staphylinidae, Aleocharinae), Cana Biological Station (Darién), N7°45'18"W77°41'6", 500–550 m a.s.l., 3.vi.1996, army ant column, leg. J.S.Ashe & R.Brooks, det. J.S.Ashe, in coll. STRI (SYNOPTIC STRI-ENT 0 108 232), D.Haelew. 903a–c (MIUP). Same data, in coll. STRI (SYNOPTIC STRI-ENT 0 108 233), D.Haelew. 904a–d (FH).

REMARKS: *Laboulbenia ecitonis* is a plurivorous species that occurs on phylogenetically unrelated hosts. Other examples are *Laboulbenia polyxena* W.Rossi et al. (Rossi et al. 2016) and *Rickia berlesiana* (Bacc.) Paoli (Thaxter 1931). While most Laboulbeniales are strictly host specific, the explanation for this phenomenon lies in the fact that these unrelated hosts occupy the same ecological niche (e.g. ant nests), in which opportunities exist for Laboulbeniales to become transmitted from one host to another (De Kesel & Haelewaters 2014, Pfliegler et al. 2016, Rossi 2011). Such opportunities

can ultimately lead to speciation through reproductive isolation. Examples for this are *Laboulbenia littoralis* De Kesel & Haelew. and *L. slackensis* Cépède & F.Picard, which are morphologically closely related but have phylogenetically diverse hosts (De Kesel & Haelewaters 2014).

Our material follows the description for *L. ecitonis* well. In all thalli observed, cells II–VI of the receptacle are dark colored, as in the Ecuadorian thalli described by Rossi (1991). Pigmentation, however, is not a good parameter for species delineation.

Laboulbenia fallax Thaxt., Proc. Am. Acad. Arts Sci. 35: 176 (1899).

KNOWN DISTRIBUTION AND HOSTS: Known on species of *Gyretes* Brullé, 1835 (Coleoptera, Gyridae, Gyridinae) from the "Amazon River", Brazil, and Panama only (Thaxter 1899).

NEW RECORDS FROM CENTRAL AMERICA: TRINIDAD. On *Gyretes* sp., Verdant Vale (Tunapuna-Piarco), no date, no collector, Thaxter No. 2912, slide 10301 (FH). On *Gyretes* sp., Sangre Grande, no date, no collector, Thaxter No. 2886, slide 10302 (FH).

REMARKS: Thaxter designated slide FH 2912 as the "type" but he never published it formally. This might have been part of the intended sixth volume of his monograph. The monstrous development of cell V, resulting in an elongated lobe along the posterior margin of the perithecium is characteristic for a few species only: *L. fallax*, *L. rotundata* Thaxt., and *L. satanas* Balazuc, all parasitizing members of Gyridae. *Laboulbenia satanas* carries horn-like outgrowths at its perithecial apex (Balazuc 1973), while the apex in *L. fallax* is undifferentiated. As for *L. rotundata*, this species is deeply darkened, contrary to *L. fallax*, and possesses two minute, tooth-like projections at the perithecial tip (Thaxter 1905, 1908).

Laboulbenia flabelliformis K.Sugiy. & T.Majewski, Trans. Mycol. Soc. Japan 28: 127 (1987).

KNOWN DISTRIBUTION AND HOSTS: Described on *Alticini* sp. (Coleoptera, Chrysomelidae, Galerucinae) from Peru (Sugiyama & Majewski 1987) and since then unreported.

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Asphaera transversofasciata* (Jacoby, 1880) (Coleoptera, Chrysomelidae, Galerucinae), Bugaba (Chiriquí), no date, no collector, Thaxter No. 1773, in coll. MCZ, slides 10505 and 10506 (FH). TRINIDAD. On *Asphaera nobilitata* Fabricius, 1787 (Coleoptera, Chrysomelidae, Galerucinae), Port of Spain, 1913, no collector, Thaxter No. 2472, slides 10501 through 10504 (FH).

REMARKS: This species is recognized by the following characteristics: (1) cells III and IV of the receptacle are undivided, (2) cell V is free from the perithecium, and (3) the appendage bears very long branchlets. The record from Trinidad is a confirmation of the personal communication by R.K.Benjamin in Sugiyama & Majewski (1987). Although he never formally described this fungus, Thaxter had tentatively named it "*Laboulbenia asphaerae*" on his slide mounts, after the host genus.

Laboulbenia fuliginosa Thaxt., Proc. Am. Acad. Arts Sci. 50: 28 (1914). Fig. 3D

KNOWN DISTRIBUTION AND HOSTS: Only known from the original description on *Altica* sp. [as *Haltica*] (Coleoptera, Chrysomelidae, Galerucinae) from Cuba, Guatemala, Haiti, and Jamaica (Thaxter 1914).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Altica bimarginata* Say, 1824, Boquete, Parque Internacional La Amistad (Chiriquí), Sendero Los Quetzales, 13.xii.2015, leg. K.Castillo, det. T.Ríos, in coll. MUPADI, D.Haelew. 974a (FH). Same data, D.Haelew. 981a-c (UCH). Same data, D.Haelew. 972c (FH) and 972f (UCH).

REMARKS: *Laboulbenia fuliginosa* was portrayed as a "very ordinary looking species" by Thaxter (1914). We agree that there are very few outstanding morphological characters to describe this species. Most diagnostic features are: (1) cells IV and V are equal in length, (2) insertion cell marks a strong constriction on the posterior margin of the thallus, and (3) the basal cell of the outer appendage separated from its outermost branch by an oblique black septum. In the 25 thalli that we studied, the outermost branch of the outer appendage was always broken above the darkened septum, which apparently is typical for this species (Thaxter 1914).

Laboulbenia funeralis Thaxt., Proc. Am. Acad. Arts Sci. 48: 208 (1912).

KNOWN DISTRIBUTION AND HOSTS: Described on *Gyrinus* sp. (Coleoptera, Gyrinidae, Gyrininae) from Argentina. It has been reported on species of the genus *Gyrinus* Geoffroy, 1762 and its subgenus *Neogyrinus* Hatch, 1925 in Bolivia, Brazil, Ecuador, Paraguay, and the U.S.A. (Balazuc 1971, Weir & Rossi 2001, Proaño Castro & Rossi 2008, Rossi & Bergonzo 2008).

NEW RECORDS FROM CENTRAL AMERICA: COSTA RICA. On *Gyrinus* sp., Cartago, 1910, no collector, Thaxter No. 2039, slide 10118 (FH).

REMARKS: This new finding fills the gap between the North American and South American records.

Laboulbenia idiostoma Thaxt., Proc. Am. Acad. Arts Sci. 50: 28 (1914). Fig. 3C

KNOWN DISTRIBUTION AND HOSTS: Described on *Macroaltica* [as *Haltica*] *jamaicensis* (Fabricius, 1792) (Coleoptera, Chrysomelidae, Galerucinae) from Haiti (Thaxter 1914) and subsequently reported on *Altica* spp. in India, Indonesia (Bali), Japan, Malaysian Borneo, Peninsular Malaysia, Sierra Leone, and Thailand (Balazuc 1988, Kauk & Mukerji 1995).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Altica bimarginata* Say, 1824 (Coleoptera, Chrysomelidae, Galerucinae), Boquete, Parque Internacional La Amistad (Chiriquí), Sendero Los Quetzales, 13.xii.2015, leg. K.Castillo, det. T.Ríos, in coll. MUPADI, D.Haelew. 972b (FH).

REMARKS: Diagnostic for *L. idiostoma* are (1) cell IV, which is large, bending the insertion cell and appendages inwards, and (2) the perithecium with two distinctive rounded apical lobes (Thaxter 1914). Also characteristic for this species is the position on the host body; thalli are restricted to the antennae (Thaxter 1914, Kaur & Mukerji 1995). The thalli on slide D.Haelew. 972b were removed from the right antenna.

The host insect bearing *L. idiostoma* was also infected with *L. fuliginosa* on its pronotum (D.Haelew. 972c) and left elytron (D.Haelew. 972f).

Laboulbenia perplexa Thaxt., Proc. Am. Acad. Arts Sci. 38: 49 (1902). Fig. 3F

KNOWN DISTRIBUTION AND HOSTS: Described on *Galerita* (*Galerita*) *carbonaria* Mannerheim, 1837 (Coleoptera, Carabidae, Harpalinae) from Brazil and not reported since.

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Galerita* sp., Potrerillos Arriba (Chiriquí), 23.ii.2011, leg. J.Castillo & B.Espinosa, det. T.Ríos, in coll. MUPADI, D.Haelew. 999a–b (FH). Same data, D.Haelew. 1230a–b (FH).

REMARKS: This is the second report of this species after over a hundred years. *Laboulbenia perplexa* has a series of morphological characters that clearly separate it from other species. The color pattern is unambiguous: cell I of the receptacle, the (short) basal cells of the perithecium, and the perithecial tip are hyaline, contrasting to the rest of the thallus, which is colored orange-brown. Also other features make this a peculiar species: cell II is short and pentagonal, with two oblique upper septa, separating it from cells III and VI. Septa III–IV and IV–V are positioned very obliquely and nearly parallel. The appendages are composed of three branches, one arising from the outer basal cell, two from either side of the inner basal cell. The perithecium is erect and has slightly spiraled wall cells.

Closely related species are *L. fusiformis* Thaxt., *L. punctata* Thaxt., and *L. subpunctata* Thaxt., all of which occur on *Galerita* spp. in Central and South America. *Laboulbenia fusiformis* has a punctate perithecium and is much larger than *L. perplexa*. Thaxter (1908) reported a total length of 1.65 mm for *L. fusiformis* (compared to 500 µm for *L. perplexa*). Other differences between these two species are the much more elongate receptacle and the color pattern (Thaxter 1908: Plate LXIV, fig. 4). Among other differences, *L. punctata* and *L. subpunctata* have a punctate perithecium, with dark, rounded to irregular spots up to its entire length in the case of the former, or only in the lower half in the case of the latter.

The Brazilian host specimen from which the type collection of *L. perplexa* was removed (Thaxter No. 960), was also host for *L. fusiformis* and *L. subpunctata*. As positions on the host body are given: for *L. fusiformis* prosternum, for *L. perplexa* prothorax and elytra, and for *L. subpunctata* head and prothorax (dorsal and ventral) (Thaxter 1908). We observed a double infection on our Panamanian host specimen: thalli of *L. perplexa* were removed from the pronotum (D.Haelew. 999b) and the left mesofemur (D.Haelew. 999a), while *L. punctata* thalli were removed from the clypeus (D.Haelew. 999c).

Thaxter (1908) doubted about the separation of *L. fusiformis* and *L. perplexa*. The above-mentioned differences between these two species may be part of the morphological plasticity or could even be (partly) due to nutritional gain from growing on different positions. Molecular data will be needed to solve this issue.

Laboulbenia punctata Thaxt., Proc. Am. Acad. Arts Sci. 35: 197 (1899). Fig. 3G

KNOWN DISTRIBUTION AND HOSTS: Described on *Galerita* sp. (Coleoptera, Carabidae, Harpalinae) from Venezuela and "South America". It has been reported on *Galerita* (*Galerita*) *moritzi* Mannerheim, 1837 in Colombia (Thaxter 1908) and on *Galerita* sp. in Argentina (Thaxter 1912).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Galerita* sp., Potrerillos Arriba (Chiriquí), 23.ii.2011, leg. J.Castillo & B.Espinosa, det. T.Ríos, in coll. MUPADI, D.Haelew. 999c (FH).

REMARKS: The most distinctive character of this species is the punctation of the perithecium. Also *L. subpunctata* also has a perithecium with dark spots, but only in the

lower fifth of rarely the lower half. In *L. punctata*, the spots are present through halfway of the perithecium or more. Another, more subtle, difference lies in the antheridia, which are elongate and straight in *L. punctata* while short and bent in *L. subpunctata*. Our material agrees with Thaxter's (1908) description and drawing of *L. punctata*.

Thaxter (1899, 1908) mentions the head as position of *L. punctata* on the host body. This corresponds to the position of thalli on our Panamanian host specimen (clypeus).

Laboulbenia skelleyi W.Rossi & Bergonzo, *Aliso* 26: 6 (2008).

KNOWN DISTRIBUTION AND HOSTS: Described on *Pselaphacus rubricatus* (Herbst, 1799) (Coleoptera, Erotylidae, Tritominae) from Brazil (Rossi & Bergonzo 2008), and found on other species in *Pselaphacus* Percheron, 1835 in Costa Rica and Ecuador (Barragán et al. 2013).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Pselaphacus sparsus* Guerin, 1956 (Coleoptera, Erotylidae, Tritominae), David, campus of Universidad Autónoma de Chiriquí (Chiriquí), N8°38'55.48" W82°28'14.10", 648 m a.s.l., 26.vii.2016, Botanical Garden, leg. R.Villarreal & participants of workshop "Hongos Asociados a Insectos", det. T.Ríos, in coll. MUPADI, D.Haelew. 1115a (UCH). Same data, D.Haelew. 1116a–b (FH). On *Ischyryus* sp. (Coleoptera, Erotylidae, Tritominae), Humedales las Lagunas de Volcan (Chiriquí), 27.vii.2016, leg. R.Villarreal & participants of workshop "Hongos Asociados a Insectos", det. T.Ríos, in coll. MUPADI, D.Haelew. 1118a (UCH).

REMARKS: Seven species of *Laboulbenia* are reported from Erotylidae: *L. encaustis* K.Sugiy. & T.Majewski, *L. erotylidarum* Haelew., *L. mycotreti* W.Rossi, *L. nesitidis* Balazuc (Balazuc 1975), *L. parvula* Thaxt. (but see discussion in Haelewaters & Yaakop 2014), *L. scaphidomorphi* Speg., and *L. skelleyi* (Colla 1926, Haelewaters & Yaakop 2014, Rossi 2011, Rossi & Bergonzo 2008, Spegazzini 1915, Sugiyama & Majewski 1987). Our material unmistakably belongs to *L. skelleyi*. The single outer appendage and forked inner appendage (above its suprabasal cells) in combination with the blackened perithecial tip and hyaline apex separate this species from the other ones on erotylid hosts.

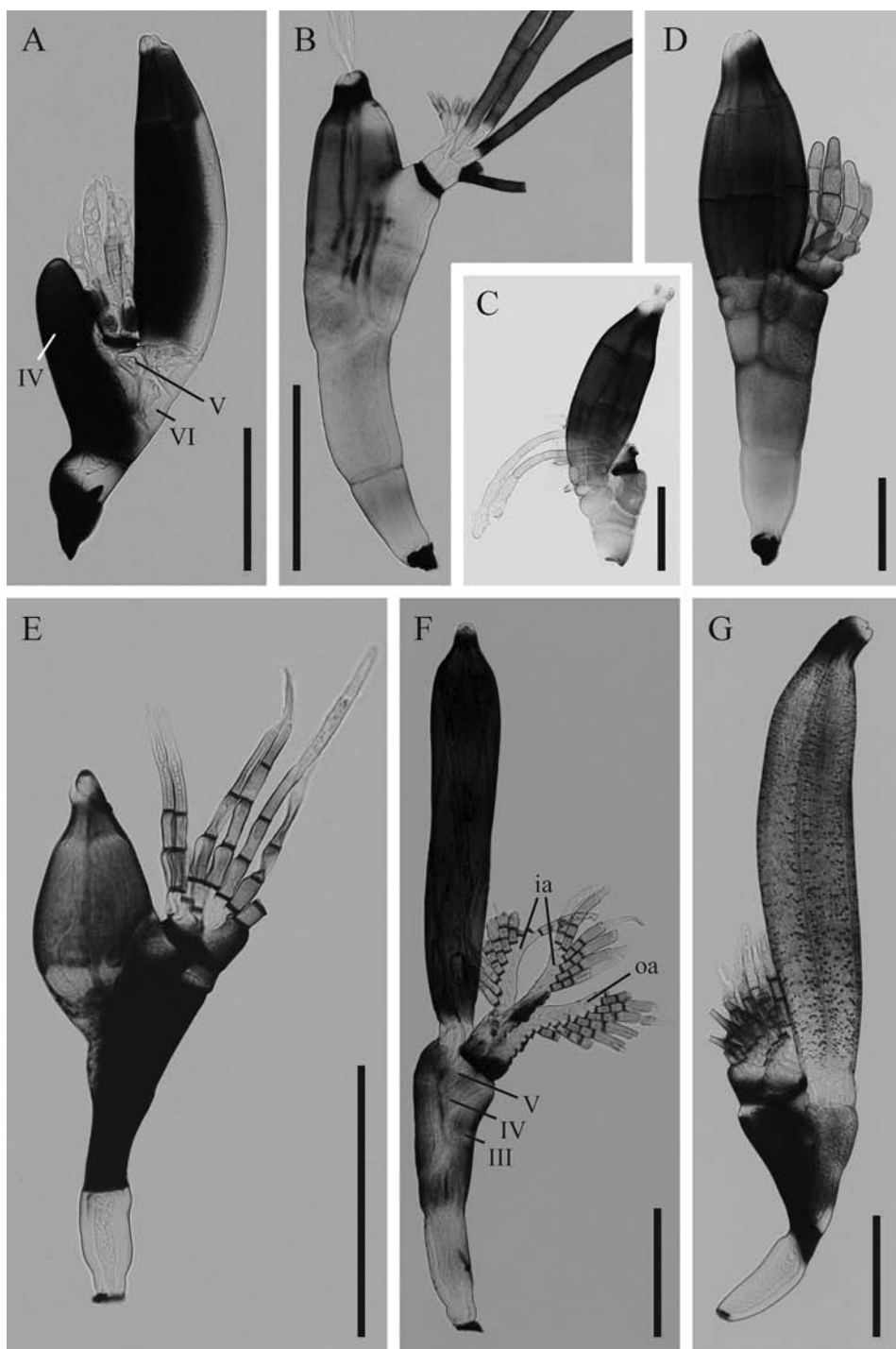
In the thalli from Panama, receptacle cells I and II are distinctly crenulated at the anterior margin. Even the youngest thalli among our studied material showed this crenulation. This feature is also observable in the Brazilian material (Rossi & Bergonzo: fig. 21)

The host genus from Humedales las Lagunas de Volcan, *Ischyryus* Lacordaire, 1842, belongs in the same subfamily as the only other known host genus for this parasite (*Pselaphacus*). *Ischyryus* represents a new host genus for Laboulbeniales.

Laboulbenia systemae Speg., *An. Mus. Nac. Hist. Nat. Buenos Aires* 29: 568 (1917).

KNOWN DISTRIBUTION AND HOSTS: Described on *Systema testaceovittata* (Clark, 1865) (Coleoptera, Chrysomelidae, Galerucinae) from Argentina (Spegazzini 1917), and since then only reported on *S. s-littera* (Linnaeus, 1758) from Bolivia and Brazil (Weir & Rossi 2001, Rossi & Bergonzo 2008).

NEW RECORDS FROM CENTRAL AMERICA: HAITI. On *Systema basalis* J.DuVal, 1856 (Coleoptera, Chrysomelidae, Galerucinae), 1913, leg. W.M.Mann, Thaxter No. 2489, slide 10671 (FH). Same data, Thaxter No. 2490, slide 10672 (FH). PANAMA. On *Systema* sp., Potrerillos Abajo (Chiriquí), N8°38'55.48"W82°28'14.10", 648 m a.s.l., 6.i.2016, abandoned orange plantation, leg. J.Bernal,



D.Haelewaters & R.Villarreal, det. T.Ríos, in coll. MUPADI, D.Haelew. 997a–b (FH) and 997c (UCH). On *Galerucinae* sp. (Coleoptera, Chrysomelidae), Isla Barro Colorado (Panamá Oeste), N9°9'53.01"W79°50'11.25", 1.vii.2015, high grasses, leg. D.Haelewaters & S.J.C.Verhaeghen, det. D.Haelewaters, in coll. MCZ, TRINIDAD. On *Systema s-littera*, Port of Spain, 1913, no collector, Thaxter No. 2469C, slide 10661 (FH).

REMARKS: *Laboulbenia systemae* is closely related to *L. homophoetae* (Speg.) Thaxt. and *L. sima* W.Rossi et al., both of which occur on Chrysomelidae. Specifically, *L. homophoetae* is reported from different genera in the *Alticini* and *Galerucini* tribes (Galerucinae), but *L. sima* was only recently described on *Phyllotrupes* sp. (Galerucinae, Alticini) (Haelewaters & Rossi 2015, Rossi et al. 2016).

The three species share the following characters: (1) cells III and IV are undivided and (2) the general structure of the appendages. *Laboulbenia sima* is easily separated based on the perithecial apex with large, spreading lips (Rossi et al. 2016). *Laboulbenia systemae* differs from *L. homophoetae* in its less slender habitus and spindle-shaped perithecium with spiraled wall cells. Thaxter (1914) stressed the morphological plasticity of *L. homophoetae*. It is possible that *L. homophoetae* and *L. systemae* are conspecific, as previously suggested by Weir & Rossi (2001) and Rossi & Bergonzo (2008).

Laboulbenia trogacti W.Rossi, Mycologia, 103: 193 (2011).

KNOWN DISTRIBUTION AND HOSTS: *Laboulbenia trogacti* is only known from the type collection in Ecuador, on *Trogactus* spp. (Coleoptera, Staphylinidae, Oxytelinae).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Carpelimus* sp. (Coleoptera, Staphylinidae, Oxytelinae), Río Caldera (Chiriquí), N8°38'55.0"W 82°23'52.1", 360 ± 13 m a.s.l., 30.xii.2011, leg. and det. Y.Aguirre, in coll. MUPADI, D.Haelew. 982a (FH). Same data, D.Haelew. 988a (UCH).

REMARKS: Many specimens of *Carpelimus* sp. were collected at the banks of Río Caldera (Aguirre & Bernal 2014); out of 102 individuals, only two bore *Laboulbeniales* thalli.

Although slide D.Haelew. 988a consisted of a single juvenile thallus only, we were able to easily identify it based on the following characters (Rossi 2011): (1) cells I and II are typically long and slender; (2) cells IV and V are separated by a vertical septum, and cell V is slightly darker; and (3) the basal portion of the outer appendage consists of two superimposed cells separated by an oblique septum. Especially the latter feature is unique in the genus *Laboulbenia* and thus diagnostic for *L. trogacti*. The thalli on slide D.Haelew. 982a are different in general habitus. They remind closely of *L. trogacti*, however with the perithecium being strictly ovoid, abruptly narrowing to the distinctive, asymmetrical tip, ending in two rounded lips, the posterior of which is more prominent and carries a small tooth. Conforming to the

Fig. 3. Different species of *Laboulbenia*. A. *L. bruchii* (D.Haelew. 987a), with indication of cell IV forming a protrusion, cell V, and the basal cell of the perithecium (VI). B. *L. disenochoi* (D.Haelew. 1004b). C. *L. idiosstoma* (D.Haelew. 972b). D. *L. fuliginosa* (D.Haelew. 972c). E. *L. ecitonis* (D.Haelew. 904b). F. *L. perplexa* (D.Haelew. 1230b), with indication of cells III, IV, and V, the inner appendage (ia), and the outer appendage (oa). G. *L. punctata* (D.Haelew. 999c) with typically punctated perithecium. Scale bars: A, C, D = 50 µm; B, E–G = 100 µm.

description by Rossi (2011), the posterior lip is subtended by a small blackish area, but in the Panamanian material there is also a darker region at the anterior side, although smaller and less profound.

Neohaplomyces medonalis R.K.Benj., El Aliso 3: 190 (1955).

Fig. 1H

KNOWN DISTRIBUTION AND HOSTS: Described on *Medon* sp. (Coleoptera, Staphylinidae, Paederinae) from California (holotype) and Arizona, U.S.A. (Benjamin 1955) and since then found on *Medon* spp. in Greece, Spain, and Turkey and on *Thinocharis* sp. (Coleoptera, Staphylinidae, Paederinae) in Madagascar (Santamaría & Girbal 1987, Santamaría & Rossi 1999).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Medonina* gen. & sp. indet. (Coleoptera, Staphylinidae, Paederinae), 20 km N of Gualaca (Chiriquí), N8°39'0"W82°12'0", 1200 m a.s.l., 10.vi.1995, leg. R.Anderson, det. A.Newton & M.Thayer, in coll. STRI (SYNOPTIC STRI-ENT 0 108 079), D.Haelew. 897a–b (FH). On Paederinae gen. & sp. indet. (Coleoptera, Staphylinidae), Cana Biological Station (Darién), N7°45'18"W 77°41'6", 530 m a.s.l., 9.xi.1996, leg. J.S.Ashe & R.Brooks, det. J.S.Ashe, in coll. STRI (SYNOPTIC STRI-ENT 0 108 056), D.Haelew. 895a (FH).

REMARKS: Based on the available material (1 mature and several immature thalli), we believe the fungus belongs to *N. medonalis*. The only noticeable differences with the description in Benjamin (1955) are the perithecium (not inflated below the middle) and the number of rows of antheridial cells (3). *Neohaplomyces cubensis* R.K.Benj. is distinctly smaller in total length, its cell I is narrower than cell II, and its perithecium is posteriorly colored brown immediately below the apex. *Neohaplomyces neomedonalis* R.K.Benj. is different from the other two species in the genus in its cell I, which forms a typical protuberance at the upper posterior corner, and the antheridium with its nearly vertical rows of antheridial cells.

Nycteromyces streblidinus Thaxt., Proc. Am. Acad. Arts Sci. 52: 654 (1917).

KNOWN DISTRIBUTION AND HOSTS: Described on *Strebla wiedemanni* Kolenati, 1856 [as *S. vespertilionis*] (Diptera, Streblidae, Streblinae) from Venezuela (Thaxter 1917).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On male *Trichobius joblingi* Wenzel, 1966 (Diptera, Streblidae, Trichobinae), Bohio (Panama Canal Zone), 2015, parasitic on female *Carollia perspicillata* (Mammalia, Chiroptera, Phyllostomidae), P_3949, leg. and det. T.Hiller, in coll. MCZ, D.Haelew. 1066a (FH). On male *T. joblingi*, Bohio (Panama Canal Zone), 2015, parasitic on female *Carollia perspicillata*, P_3935, leg. and det. T.Hiller, in coll. MCZ, D.Haelew. 1071b (FH). On male *T. joblingi*, Gamboa (Colón), 13.vi.2016, parasitic on male *Carollia castanea* (Mammalia, Chiroptera, Phyllostomidae), leg. R.Page et al., det. T.Hiller, D.Haelew. 1088a (FH).

REMARKS: The genus *Nycteromyces* Thaxt. is monotypic, with a single species *N. streblidinus* that was described in 1917 and has not been reported since that time. The material from Panama extends the known host range of *Nycteromyces* to the streblid subfamily Trichobinae.

Nycteromyces bears a superficial resemblance to *Polyandromyces* Thaxt. Both genera are dioecious, with separate male and female thalli, and monotypic. However, both the male and female thalli of *Nycteromyces* are clearly distinguished from *Polyandromyces coptosomatis* Thaxt. The male thallus carries multiple antheridia in a unilateral row and ends with a dome-shaped cell, which holds a pointed tooth. The female thallus is

a reduced form compared to *Polyandromyces*, with the receptacle consisting of two cells only, the second of which carries both the perithecium and appendage.

Two specimens of *T. joblongi* carried a double infection with *Gloeandromyces streblae* (Table 1). For slide D.Haelew. 1071b, thalli of *N. streblidinus* were removed from the head and left metafemur, while those of *G. streblae* were taken from the wings. For slide D.Haelew. 1088a, thalli of both species were removed from the left profemur. We found both species co-occurring on *T. joblongi* collected from *Carollia* bats in multiple occasions (Haelewaters et al. unpublished records). It could be that the roosting habits of these bats facilitate spore transmission of Laboulbeniales (*sensu* Patterson et al. 2007).

Peyritschiella protea Thaxt., Proc. Am. Acad. Arts Sci. 35: 427 (1900).

KNOWN DISTRIBUTION AND HOSTS: *Peyritschiella protea* is widespread in Europe but less common on other continents, with reports in Algeria (Maire 1920), Tibet (Lee et al. 2006), and the U.S.A. (Thaxter 1908, Haelewaters et al. 2015b). Hosts are *Anotylus* Thomson, 1859; *Bledius* Samouelle, 1819; *Manda* Blackwelder, 1952; *Oxytelus* Gravenhorst, 1802; *Planeustomus* Jacquelin du Val, 1857; *Styloxys* Gozis, 1886 (Coleoptera, Staphylinidae, Oxytelinae); and *Philonthus* Stephens, 1829 (Coleoptera, Staphylinidae, Staphylininae).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Platydracus prasinvariegatus* (Bernhauer, 1921) (Coleoptera, Staphylinidae, Staphylininae), Isla Barro Colorado (Panamá Oeste), *Atta colombica* external debris pile, 12.x.1998, leg. K.Buchard, WR 2460 (FI).

REMARKS: The genus *Platydracus* Thomson 1858 has been mentioned as host for *Rhachomyces philonthinus* Thaxt. (Balazuc 1982), but not for *P. protea*. This represents the first report of this fungus in Central America.

Rhachomyces longissimus (Thaxt.) Thaxt., Mem. Am. Acad. Arts Sci. 12: 361 (1896).

≡ *Acanthomyces longissimus* Thaxt., Proc. Am. Acad. Arts Sci. 28: 176 (1893).

= *Rhachomyces mattirolói* Colla, Mem. Reale Accad. Naz. Lincei, Cl. Sci. Fis. 6: 188 (1926).

KNOWN DISTRIBUTION AND HOSTS: Described on *Dyscolus* [as *Colpodes*] *evanescens* (Bates, 1882) (Coleoptera, Carabidae, Platyninae) from Guatemala (Thaxter 1896). Since then found in Colombia on *Dyscolus* [as *Colpodes*] *reflexus* (Chaudoir, 1859) (Thaxter 1908); in Costa Rica [as *R. mattirolói*] on an unidentified carabid from Costa Rica (Colla 1926); in Cuba on *Platynus medius* (Darlington, 1937) (Balazuc 1977); in Ecuador on *Dyscolus* (*Hydrodyscolus*) *asphaltinus* (Chaudoir, 1878), *D. purpuratus* Reiche, 1842, and *D. subviolaceus* (Chaudoir, 1842); in Jamaica on *Platynus cinchonae* (Darlington, 1934) (Proaño Castro & Rossi 2008); and in Mexico on *Mexisphodrus profundus* Barr, 1966 (Vigna Taglianti & Rossi, 1998).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Platynus lyratus* (Chaudoir, 1879), Boquete, Parque Internacional La Amistad (Chiriquí), Sendero Los Quetzales, 13.xii.2015, leg. K.Castillo, det. T.Ríos, in coll. MUPADI, D.Haelew. 975b (FH) and 975c (UCH).

REMARKS: A number of different host genera have been reported for *R. longissimus*: *Dyscolus* Dejean, 1831, *Platynus* Bonelli, 1810, and *Mexisphodrus* Barr, 1965. However, all three belong to the same subtribe Platynina *sensu stricto* within the

Platynini tribe (Coleoptera, Carabidae, Platyninae), suggesting a high degree of host specificity of this fungus.

The Panamanian host specimen carried a double infection with *Laboulbenia* sp. (slide D.Haelew. 975a). A single juvenile thallus of *Laboulbenia* sp. was found on the prosternum, while the thalli of *R. longissimus* were removed from sternites and the left metafemur and -tibia. Also in the Ecuadorian material double infections were found with *L. flagellata* Peyr. (Proaño Castro & Rossi 2008).

Rhachomyces longissimus is the second-largest species of the Laboulbeniales (Santamaría et al. 2016). In the original description, Thaxter (1893) mentions that the receptacle slightly exceeds 1 mm in length. Later, he refers to it as the largest species of the genus with a length up to 2 mm (Thaxter 1908). Colla (1926) even reports a thallus of 3.5 mm [as *R. mattirolói*]. The largest species of the order is *Laboulbenia kunkelii* (Giard) Thaxt., which measures between 2 and 4 mm in total length (Giard 1892, Sugiyama and Phanichapol 1984).

Stichomyces conosomatis Thaxt., Proc. Am. Acad. Arts Sci. 37: 38 (1901).

= *Stichomyces europaeus* T.Majewski, Acta Mycol. 9: 121 (1973).

KNOWN DISTRIBUTION AND HOSTS: *Stichomyces conosomatis* is a widespread species that is largely restricted to beetles in the genus *Sepedophilus* Gistel, 1856 (Coleoptera, Staphylinidae, Tachyporinae), with reports from various European countries (Belgium, Great Britain, Greece, Italy, The Netherlands, Poland, and Spain), Africa (Algeria), America (Ecuador, the U.S.A.), and Asia (Japan) (Bernardi et al. 2014, Castaldo et al. 2004, Haelewaters et al. 2012, 2015b, Majewski 2008). The parasite is also known from Portugal on *Speonemadus algarvensis* Reboleira et al. (Coleoptera, Leiodidae, Cholevinae) (Reboleira et al. 2017).

NEW RECORDS FROM CENTRAL AMERICA: PANAMA. On *Sepedophilus* sp., Tierras Altas District, 27.7 km W of Volcán (Chiriquí), N8°51'48"W82°44'36", 17.vi.1996, Finca Hartmann, leg. J.S.Ashe & R.Brooks, det. J.S.Ashe, in coll. STRI (SYNOPTIC STRI-ENT 0 108 276), D.Haelew. 908a (FH).

REMARKS: Until the discovery of the fungus on the cholevine beetle *Speonemadus algarvensis*, this fungus had only been reported on *Sepedophilus* spp. The Portugese record, however, came from a cave, which may account for the unusual host. Just like in ant nests and salt marshes, phylogenetically unrelated hosts can come into close contact in subterranean caves and provide opportunities for Laboulbeniales parasites to transmit from one to the other host (= host shift, De Kesel & Haelewaters 2014).

Discussion

In this contribution, we provide details for 27 species, all of which represent new records for Panama. We reveal the presence of the following genera in Panama for the first time: *Amorphomyces* Thaxt., *Chitonomyces*, *Gloeandromyces*, *Neohaplomyces* R.K.Benj., *Nycteromyces*, and *Stichomyces* Thaxt. With these new records, the total number of the Laboulbeniales in Panama rises to 78, of which 40 are species of *Laboulbenia* (Table 2). This updated number of Laboulbeniales reported from Panama is still rather low.

Table 2. Parasite-host list of Panamanian Laboulbeniales.

Species	Host species	Province	Reference
1 <i>Amorphomyces ophioglossae</i> Thaxt.	<i>Ophioglossa</i> sp.	Chiriquí	This paper
2 <i>Chitonomyces hyalinus</i> Thaxt.	<i>Laccophilus pictus</i>	Veraguas	This paper
3 <i>Chitonomyces simplex</i> Thaxt.	<i>Laccophilus pictus</i>	Veraguas	This paper
	<i>Laccophilus fasciatus</i>	Coclé	This paper
4 <i>Dimeromyces aulacophorae</i> Thaxt.	" <i>Plataxantha</i> sp."		Thaxter 1908
5 <i>Dimeromyces homophoetae</i> Thaxt.	<i>Capraita</i> sp.	Chiriquí	This paper
6 <i>Eucantharomyces calleidae</i> Thaxt.	<i>Calleida aurata</i> [as <i>C. "anypterygioides"</i>]	Panamá	This paper
7 <i>Eucantharomyces euprocti</i> Thaxt.	<i>Euproctus quadrim</i>	Chiriquí	Thaxter 1900
8 <i>Gloeandromyces pageanus</i> Haelew.	<i>Trichobius dugesioides</i>	Colón	This paper
9 <i>Gloeandromyces streblae</i> (Thaxt.) Thaxt.	<i>Trichobius dugesioides</i>	Panama Canal	This paper
	<i>Trichobius joblongi</i>	Zone Panama Canal	This paper
	<i>Trichobius yunker</i>	Zone Panamá Oeste	This paper
10 <i>Herpomyces chaetophilus</i> Thaxt.	<i>Periplaneta americana</i>	Chiriquí	This paper
	<i>Periplaneta americana</i>	Colón	This paper
11 <i>Herpomyces periplanetae</i> Thaxt.	<i>Periplaneta</i> sp.	Panamá	Thaxter 1902
	<i>Periplaneta americana</i>	Panamá	Haelewaters unpublished
	<i>Periplaneta australasiae</i>	Panamá	Haelewaters unpublished
12 <i>Herpomyces tricuspидatus</i> Thaxt.	"Large winged roach"		Thaxter 1902
13 <i>Hesperomyces coccinelloides</i> (Thaxt.) Thaxt.	<i>Scymnus tardus</i>	Panamá Oeste	Thaxter 1931
14 <i>Hesperomyces virescens</i> Thaxt.	<i>Azya orbigera</i>	Chiriquí	This paper
	<i>Epilachna mexicana</i>	Chiriquí	This paper
	Brachiacanthini gen. & sp. indet.	Panamá	This paper
	<i>Cycloneda sanguinea</i>	Chiriquí	This paper
15 <i>Histeridomyces acriti</i> Thaxt.	<i>Acritus</i> near <i>simpliculus</i>	Panamá Oeste	Thaxter 1931
16 <i>Ilytheomyces elegans</i> Thaxt.	<i>Ilythea</i> sp.	Bocas del Toro	Thaxter 1917, 1931
17 <i>Ilytheomyces lingulatus</i> Thaxt.	<i>Ilythea</i> sp.	Bocas del Toro	Thaxter 1917, 1931
18 <i>Ilytheomyces major</i> Thaxt.	<i>Ilythea</i> sp.	Bocas del Toro	Thaxter 1917, 1931
19 <i>Ilytheomyces manubriolatus</i> Thaxt.	<i>Ilythea</i> sp.	Bocas del Toro	Thaxter 1917, 1931
20 <i>Ilytheomyces panamensis</i> Thaxt.	<i>Ilythea</i> sp.	Bocas del Toro	Thaxter 1917, 1931
21 <i>Kleidiomyces furcillatus</i> (Thaxt.) Thaxt.	<i>Aleochara repetita</i>	Panamá	Thaxter 1901 [as <i>Monoico- myces furcilla- tus</i>], 1908, 1931
22 <i>Kleidiomyces hoplandriae</i> Thaxt.	<i>Hoplandria</i> sp.	Colón	This paper
23 <i>Laboulbenia anchonoderi</i> Thaxt.	<i>Anchonoderus subaeneus</i>	Chiriquí	Thaxter 1899, 1908
24 <i>Laboulbenia bruchii</i> (Speg.) Thaxt.	<i>Neolema</i> sp.	Chiriquí	This paper
25 <i>Laboulbenia catascopi</i> Thaxt.	<i>Catascopus fascialis</i>		Thaxter 1908
	<i>Callida quadrispora</i>	Chiriquí	Thaxter 1908

26	<i>Laboulbenia cephaloleiarum</i> Balazuc & Demaux	<i>Cephaloleia</i> sp.		Balazuc 1988
27	<i>Laboulbenia chiriquensis</i> Thaxt.	<i>Callida scintillans</i>	Chiriquí	Thaxter 1899, 1908
28	<i>Laboulbenia coccinellidicola</i> Haelew.	<i>Exochomus childreni</i>	Chiriquí	This paper
			Coclé	This paper
		<i>Exochomus</i> sp. 1	Coclé	This paper
			Darién	This paper
29	<i>Laboulbenia colpodis</i> Thaxt.	<i>Colpodes chiriquinus</i>	Chiriquí	Thaxter 1899, 1908
30	<i>Laboulbenia coptoderae</i> Thaxt.	<i>Coptodera championi</i>		Thaxter 1893, 1896
31	<i>Laboulbenia crispata</i> Thaxt.	<i>Hippelates</i> sp.	Bocas del Toro	Thaxter 1917
32	<i>Laboulbenia cristata</i> Thaxt.	<i>Paedereus luridiventris</i>	Chiriquí	Thaxter 1908
33	<i>Laboulbenia decipiens</i> Thaxt.	<i>Galerita</i> sp.	Chiriquí	Villarreal et al. 2010
34	<i>Laboulbenia disenochi</i> Thaxt.	<i>Platynus purpurellus</i>	Chiriquí	This paper
35	<i>Laboulbenia drakei</i> R.K.Benj.	<i>Rhagovelia</i> sp.	Panama Canal Zone	Benjamin 1967
36	<i>Laboulbenia drepanalis</i> Thaxt.	<i>Gyretes acutangulus</i>	Chiriquí	Thaxter 1899, 1908
37	<i>Laboulbenia ecitonis</i> Blum	<i>Ecitophya</i> sp.	Darién	This paper
		<i>Ecitophya</i> sp.	Darién	This paper
38	<i>Laboulbenia fallax</i> Thaxt.	<i>Gyretes acutangulus</i>	Chiriquí	Thaxter 1899, 1908
39	<i>Laboulbenia flabelliformis</i> K.Sugiy. & T.Majewski	<i>Asphaera transversofasciata</i>	Chiriquí	This paper
40	<i>Laboulbenia flagellata</i> Peyr.	<i>Coptodera championi</i>	Chiriquí	Thaxter 1908
		<i>Platynus</i> spp.	Chiriquí	Villarreal et al. 2010
41	<i>Laboulbenia fuliginosa</i> Thaxt.	<i>Altica bimarginata</i>	Chiriquí	This paper
42	<i>Laboulbenia guerinii</i> C.P.Robin	<i>Gyretes acutangulus</i>	Chiriquí	Thaxter 1908
43	<i>Laboulbenia idiostoma</i> Thaxt.	<i>Altica bimarginata</i>	Chiriquí	This paper
44	<i>Laboulbenia metrionae</i> Balazuc	<i>Agroiconota judaica</i>		Balazuc 1978
45	<i>Laboulbenia mexicana</i> Thaxt.	<i>Galerita americana</i>	Chiriquí	Thaxter 1908
46	<i>Laboulbenia minima</i> Thaxt.	<i>Calleida aurata</i> [as <i>C. onypterigioides</i>]	Chiriquí	Thaxter 1908
		<i>Calleida pallidipennis</i>		Thaxter 1893, 1896, 1902
47	<i>Laboulbenia pachytelis</i> Thaxt.	<i>Pachyteles seriatoporus</i>	Chiriquí	Thaxter 1908
48	<i>Laboulbenia perplexa</i> Thaxt.	<i>Galerita</i> sp.	Chiriquí	This paper
49	<i>Laboulbenia philonthi</i> Thaxt.	<i>Philonthus</i> sp.		Haelewaters et al. 2015b
50	<i>Laboulbenia polyphaga</i> Thaxt.	<i>Bradycellus circumdatus</i>	Chiriquí	Thaxter 1908
51	<i>Laboulbenia pseudomasei</i> Thaxt. [as <i>pseudomasci</i>]	<i>Platynus</i> spp.	Chiriquí	Villarreal et al. 2010
52	<i>Laboulbenia punctata</i> Thaxt.	<i>Galerita</i> sp.	Chiriquí	This paper
53	<i>Laboulbenia rhagoveliae</i> R.K.Benj.	<i>Rhagovelia uncinata</i>	Panama Canal Zone	Benjamin 1967
54	<i>Laboulbenia rigida</i> Thaxt.	<i>Platynus</i> sp.	Chiriquí	Villarreal et al. 2010
55	<i>Laboulbenia scaphidomorphi</i> Speg.	<i>Scaphidomorphus bosci</i>		Spegazzini 1915

56	<i>Laboulbenia skellei</i> W.Rossi & Bergonzo	<i>Ischyryus</i> sp.	Chiriquí	This paper
		<i>Pselaphacus sparsus</i>	Chiriquí	This paper
57	<i>Laboulbenia subpunctata</i> Thaxt.	<i>Galerita</i> sp.	Chiriquí	Villarreal et al. 2010
		<i>Galeritini</i> gen. & sp. indet.	Panamá Oeste	Haelewaters unpublished
58	<i>Laboulbenia systemae</i> Speg.	<i>Systema</i> sp.	Chiriquí	This paper
59	<i>Laboulbenia tenera</i> T.Majewski	<i>Paratrechus</i> sp.	Chiriquí	Villarreal et al. 2010
		<i>Platynus</i> sp.	Chiriquí	Villarreal et al. 2010
60	<i>Laboulbenia tortilis</i> J.A.Bernal & R.Kirschner	<i>Platynus</i> sp.	Chiriquí	Villarreal et al. 2010
61	<i>Laboulbenia trogacti</i> W.Rossi	<i>Carpelimus</i> sp.	Chiriquí	This paper
		<i>Carpelimus</i> sp.	Chiriquí	This paper
62	<i>Laboulbenia usingeri</i> R.K.Benj.	<i>Rhagovelia uncinata</i>	Panama Canal Zone	Benjamin 1967
63	<i>Mimeomyces atropurpureus</i> (Thaxt.) Thaxt.	<i>Quedius graciliventris</i>	Chiriquí	Thaxter 1900, 1908 [as <i>Sphaleromyces atropurpureus</i>]
		<i>Quedius basiventris</i>	Chiriquí	Thaxter 1900, 1908 [as <i>Sphaleromyces atropurpureus</i>]
64	<i>Mimeomyces chiriquensis</i> (Thaxt.) Thaxt.	<i>Quedius flavicaudus</i>	Chiriquí	Thaxter 1901, 1908 [as <i>Sphaleromyces chiriquensis</i>]
				This paper
65	<i>Neohaplomyces neomedonalis</i> R.K.Benj.	<i>Paederinae</i> gen. & sp. indet.	Darién	
		<i>Medonina</i> gen. & sp. indet.	Chiriquí	This paper
66	<i>Nycteromyces streblidinus</i> Thaxt.	<i>Trichobius joblongi</i>	Panama Canal Zone	This paper
67	<i>Peyritschiella lampropygi</i> Thaxt.	<i>Lampropygius analis</i>	Chiriquí	Thaxter 1931
68	<i>Peyritschiella protea</i> Thaxt.	<i>Platydracus prasinvariegatus</i>	Panamá Oeste	This paper
69	<i>Peyritschiella vulgata</i> (Thaxt.) I.I.Tav.	<i>Philonthus flavolimbatus</i>		Thaxter 1900, 1908 [as <i>Dichomyces vulgatus</i>]
				This paper
70	<i>Rhachomyces longissimus</i> (Thaxt.) Thaxt.	<i>Platynus lyratus</i>	Chiriquí	
71	<i>Rickia nutans</i> Thaxt.	"Large passaloid beetle"		Thaxter 1926
72	<i>Stemmatomyces panamensis</i> Thaxt.	<i>Aeolus</i> sp.	Panamá Oeste	Thaxter 1931
73	<i>Stichomyces conosomatis</i> Thaxt.	<i>Sepedophilus</i> sp.	Chiriquí	This paper
74	<i>Stigmatomyces caribbeus</i> Thaxt.	<i>Discocerina</i> sp.	Bocas del Toro	Thaxter 1917
75	<i>Stigmatomyces constrictus</i> Thaxt.	<i>Oscinis</i> sp.	Bocas del Toro	Thaxter 1917, 1931
		<i>Siphonella</i> sp.	Bocas del Toro	Thaxter 1917, 1931
76	<i>Stigmatomyces drapetis</i> Thaxt.	<i>Drapetis rectinerva</i>	Bocas del Toro	Thaxter 1917, 1931
77	<i>Stigmatomyces ochtheroideae</i> Thaxt.	<i>Ochtheroidea</i> sp.	Bocas del Toro	Thaxter 1931
78	<i>Stigmatomyces recurvatus</i> Thaxt.	<i>Paralimna ciliata</i>	Bocas del Toro	Thaxter 1931

In comparison, both in Brazil and Ecuador more than 100 species of Laboulbeniales have been reported (Rossi & Bergonzo 2008, Rossi et al. 2016). However, as mentioned before in exploratory papers in both tropical and temperate regions, presently low numbers of records represent the interest of investigators, rather than the true diversity. Examples are Bolivia (< 50 species, Weir & Rossi 2001), French Guyana (25 species, Rossi & Ponziani 2008), The Netherlands (40 species, Haelewaters et al. 2012), and many countries on the African continent.

We report the presence of *Laboulbenia perplexa* in Panama, a morphologically very striking species (Fig. 3F). While it does not occur on a rare host genus (*Galerita* Fabricius, 1801), the Panamanian record is only the second – after Thaxter’s (1902) type from Brazil. In this contribution, we also present other records of species that have not been observed by laboulbeniologists for a hundred years or more: *Dimeromyces homophoetae* (last reported in 1917), *Eucantharomyces calleidae* (1908), *Herpomyces paramensis* (1908), *Laboulbenia fallax* (1899), *L. fuliginosa* (1914), and *L. punctata* (1912).

A special case are the Laboulbeniales described on bat flies (Diptera, Hippoboscoidea, Nycteribiidae and Streblidae). These flies are specialized ectoparasites of bats that live on the fur and on wing membranes where they suck blood from their host. Bat flies are hosts to three genera of Laboulbeniales: *Arthrorhynchus* Kolenati (limited to the Eastern Hemisphere, on Nycteribiidae) and the neotropical genera *Gloeandromyces* and *Nycteromyces* (on Streblidae). Until the records presented in this paper, only the type collection was known of the species in *Gloeandromyces* and *Nycteromyces*. However, many more records from different countries and descriptions of new species are awaiting publication (Haelewaters, unpublished). These data provide a new exciting direction for Laboulbeniales research, with the formulation and testing of hypotheses about parasitism, host specificity, speciation, and population dynamics.

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