Preliminary annotated checklist of Gasteromycetes in Panama

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Abstract

Based on 18 recently collected specimens, 12 herbarium specimens and extensive literature research, a preliminary checklist of the Gasteromycetes of Panama is presented. Nine species are reported for the first time for Panama: *Bovista oblongispora*, *Calostoma cinnabarinum*, *Calvatia rosacea*, *Crucibulum laeve*, *Cyathus limbatus*, *Morganella velutina*, *Mutinus argentinus*, *Radiigera taylorii* and *Sphaerobolus stellatus*. In addition, an unknown species related to *Radiigera* is recorded. Known locations and descriptions of 33 species currently known for Panama are given, together with taxonomical and nomenclatural discussions, where necessary.

Key words: tropical mycology, *Basidiomycota*

Introduction

Despite of their abundance, often striking appearance and important ecological roles of tropical fungi, the knowledge of their diversity and distribution is far from being complete. This is especially true for Gasteromycetes, since their often problematic taxonomy and nomenclature, as well as scarce general works on the topic, make this group harder to approach than many other groups of *Basidiomycota.*

For Panama, the present knowledge on fungi including Gasteromycetes has been listed by Piepenbring (2006). Garner (1956) presented the only work dealing exclusively with Panamanian and Costa Rican Gasteromycetes so far. However, detailed descriptions and localities were not presented there. Further records of Panamanian Gasteromycetes are included in fungus-floristic studies of other countries (e.g. Dennis 1970), or monographs of certain genera (e.g. Kreisel & Dring 1967, Guzmán 1970).

Materials and methods

The present treatment is based mainly on collections made by M. Piepenbring and coworkers during field work in Western Panama and mycological courses held at the Universidad Autónoma de Chiriquí, Panama. Specimens of local importance are deposited at the Herbario Nacional de Panamá (PMA), critical ones in PMA and the Botanische Staatssammlung München (M). Further specimens were obtained by loan from the herbaria of the National Fungus Collection of the U.S. Department of Agriculture (BPI), New York Botanical Garden (NY) and Oregon State University (OSC). Specimens were analysed macroscopically and microscopically using a Carl Zeiss Stemi 2000 and a Jenalab microscope. Microscopical preparates were mounted in 3% KOH or lactic acid. Spore measurements are given excluding ornamentation. Microphotographs were taken with a Sony 3 CCD-hig camara. SEM images were made at the Institute for Systematic Zoology and Evolution at FSU Jena. Species without analysed specimens are described according to literature and specimens from other areas, where available. Specimen data is given as recorded in literature, or as indicated by the Virtual Herbarium of the New York Botanical Garden.

To allow geomycological conclusions, locations in Panama and distribution data within Central America and the Caribbean (excluding Mexico, Florida and South America south of Colombia and Venezuela) are given as exactly as possible. However, only self-revised or paper-published records were taken into account. In several cases, data are problematic due to taxonomical or nomenclatural uncertainty. In these cases, a discussion of these issues follows the description.

Results

Lycoperdaceae (Agaricaceae p. p.)

Bovista longispora Kreisel

Specimen visum: **Chiriquí**: Parque Nacional Volcán Barú, Sendero de los Quetzales, alt. approx. 2500 m, 02.X.2007, M. Piepenbring with licenciatura students 4073.

Macroscopical features: Fruitbodies (Fig. 1a) globose, 1.5–2.3 cm diam. Exoperidium middle to dark brown, granulose, lapsing at maturity, then yellowish endoperidium visible. Gleba olivaceous

brown to umber. Subgleba almost absent, greyish, finely cellular, cavities less than 0.5 mm diam. White, branched rhizomorphs at base. On soil.
Microscopical features: Spores (Fig. 2a) ellipsoid to pear shaped, 4.5–6 x 2.8–3.5 µm, very weakly verruculose, as seen by light microscopy almost smooth, with short pedicel. Capillitium transition-type, up to 5.5 µm diam., without septa, with minute pores only in the upper part of the gleba.
The species is restricted to Central America and the Caribbean, it is a new record for Panama, being known to the present only from Costa Rica, Cuba, the Dominican Republic, Guadelupe and Puerto Rico (Kreisel 1967, Stevenson 1975, Minter et al. 2006, Calonge et al. 2005).

Bovista pusilla Batsch : Pers. agg
Syn.: *Lycoperdon ericetorum* Pers.

Specimina non visa: **Canal Zone**: Barro Colorado Island, G.W. Martin and A.L. Welden 7368, 7460, 8659, as *L. ericetorum* in Garner (1956).

Description based on other specimens of *B. pusilla* ss Kreisel 1967 and on literature (Kreisel 1967, Jülich 1984).
Macroscopical features: Fruitbodies globose, 0.5–1.5 cm diam. Peridium yellowish buff to light brown, smooth. Gleba brownish buff to brown. Subgleba absent. On soil in open areas.
Microscopical features: Spores 3–4 µm diam., globose, pale brown, finely warty to punctate, with short pedicel. Capillitium pale brown, transition-type, densely branched, up to 3.5 µm wide, abundantly pitted.
This species is cosmopolitan, apart from Panama (Garner 1956 as *L. ericetorum*) it is known from Colombia, Puerto Rico, Tobago and Venezuela (Kreisel 1967, Dennis 1970 (includes *Bovista polymorpha* (Vittad.) Kreisel), Stevenson 1975, Reid 1977, Minter et al. 2001). This record is given as aggregate species, incorporating *Bovista dermoxantha* (Vittad.) De Toni and *Bovista furfuracea* Pers. The scarce description does not allow for an exact determination; and the systematic relationships of the highly problematic group of *Bovista* subgen. *Globaria* are still to be revised. However, as most records in the area are determined as *B. pusilla*, the name is used here to avoid confusion. Revision of the specimen is needed to obtain an exact determination.

Calvatia cyathiformis (Bosc) Morg.

Specimina non visa: **Canal Zone**: Balboa, G.W. Martin 4167, 4217 (NY 068960).

Description based on other specimens and on literature (Jülich 1980, Kreisel 1994).
Macroscopical features: Fruitbodies globose to turbinate, up to 10 cm diam. Exoperidial surface smooth when young, cracking irregularly during ripening process. Gleba dark purple to purplish brown when ripe. Subgleba cup-shaped to flat, cellular, cream colored to purplish grey, lighter than gleba, gleba and subgleba are often separated by a diaphragm. Growing on ground, usually in grassland.
Microscopical features: Spores purplish, globose, 4–6.5 µm diam., coarsely verrucose. Capillitium violaceous brown, fragile, branched, *Lycoperdon*-type, 2.5–6 µm diam., with minute rounded pits.
The species has a worldwide distribution (Kreisel 1994) including Southern Europe (Demoulin pers. comm.). Records for Panama are published by Garner (1956) and Dennis (1970). In the vicinity of Panama, it has been recorded from Costa Rica, Colombia, Cuba, Jamaica, Puerto Rico, Trinidad and Venezuela (Dennis 1953, Dennis 1970, Kreisel 1971, Nieves-Rivera & Lodge 1998, Minter et al. 2001, Calonge et al. 2005, Calonge & Mata 2006). It is possible that this species is conspecific with *Calvatia fragilis* (Vittad.) Morgan, which is distinguished by a compact subgleba. (Kreisel 1994). Garner (1956) did obviously not discriminate between the two taxa. The numerous collections in the surrounding area make *C. cyathiformis* more probable, if both are considered as different species.

Calvatia rosacea Kreisel

Specimen visum: **Canal Zone**: Ft. Sherman area, 31.VII.1945, G.W. Martin 6137, as *Calvatia candida* (Rostk.) Hollós var *fusca* G. Cunn. (OSC 28213).
Specimen non visum: **Canal Zone**: Ft. Sherman area, G.W. Martin 6181, as *C. candida*.

Macroscopical features: One single cut fruitbody in collection, approximately 3.7 cm in height, 4 cm in width. Exoperidium finely granulose, almost smooth, yellowish to reddish brown, withered at glebal part, remains of peridium wrinkled in lower subglebal part. Gleba yellowish brown. Subgleba somewhat darker, cellular, obscured by insect damage, subglebal cavities (Fig. 2b) are crossed by hyphae. The collection is probably immature and was made from soil.
Microscopical features: Spores yellowish hyaline, globose to ellipsoidal, 2.8–4.5 x 2.8–3.7 µm, verrucose; capillitium light brown, fragile, *Lycoperdon*-type, sparsely septated by true and false septa, branched, no pits.
This is the second record of that species worldwide, the type being from the vicinity of Macas in Ecuador at the eastern base of the Andes in the tropical rainforest zone (Kreisel 1989). The fresh color of the fruitbody in Panama is not noted by the finder, it should have been rosaceous. The

specimen has been recorded by Garner (1956), Dennis (1970) and Piepenbring (2006), in every case as *C. candida*. However, *C. candida* has a compact subgleba and is a temperate species from heaths and open land (Kreisel 1994). The related *Calvatia ochrogleba* Zeller from western USA (Oregon) has larger fruitbodies and echinulate spores; and *Calvatia rugosa* (Berk. & M.A. Curtis) D.A. Reid with pitted capillitium and compact subgleba, is a temperate to tropical species (Zeller 1947, Zeller & Smith 1964, Kreisel 1994) which has also been recorded for Cuba (Kreisel 1992) and Costa Rica (Calonge et al. 2005). The other specimen cited by Garner (1956) as *C. candida* (G.W. Martin 6181) was not analysed, it is therefore not sure whether it corresponds to *C. rosacea*.

Lycoperdon atropurpureum Vittad.
Syn.: *Lycoperdon mauryanum* Pat. ex Demoulin

Specimina non visa: **Chiriquí**: Casita Alta, G.W. Martin and A.L. Welden 8048; trail between Finca Lerida and Casita Alta, G.W. Martin and A.L. Welden 8216; Valley of Rio Chiriquí Viejo, G.W. Martin 2583, all alt. 1600–2200 m, as *L. molle* Pers. : Pers. in Garner (1956).

Description based on other specimens and on literature (Jülich 1984).
Macroscopical features: Fruitbodies capitate to almost cylindrical, 2–5.5 x 2–3 cm; exoperidium spiny, spines breaking away easily, yellowish brown to blackish, endoperidium in old specimens visible between spines, yellowish, shiny. Gleba purple brown when ripe. Subgleba yellowish to brown, chambered, cavities around 0.8 mm wide. On soil in open woods.
Microscopical features: Spores purplish, globose, 4–6 µm diam., coarsely verrucose, often mixed with sterigmal remains. Capillitium *Lycoperdon*-type, 4–8 µm diam., reddish brown, septated, with scarce small pores.
This species is distributed in warm temperate regions of the Northern hemisphere, but has apart from the Panamanian records as *L. molle* (Garner 1956, Dennis 1970) also been recorded from Costa Rica (Calonge et al. 2005, Calonge & Mata 2006) and Guatemala (Demoulin 1972, as *L. mauryanum*). *L. atropurpureum* was considered conspecific with *L. molle* when Garner (1956) wrote his article. According to his description, the gleba is dark purple and the spores are coarsely warted, therefore the records probably belong to *L. atropurpureum*. The gleba of *L. molle* is brown, sometimes with a slight purplish touch; and the spores are finely warted. Apparantly, *L. molle* is restricted to temperate regions. The specimens have to be revised in order to resolve these taxonomic problems. The exclusively American species *L. mauryanum* is considered conspecific with *L. atropurpureum* here, it has slightly smaller spores and more scarce pores in the capillitium (Demoulin 1972).

Lycoperdon perlatum Pers.

Specimina non visa: **Chiriquí**: Trail between Finca Lerida and Casita Alta, alt. 2000–2200 m, G.W. Martin 8199; Cerro Respingo, approx. 6 km NW of town of Cerro Punta, 02.VII.1975, Dumont-PA 1634 (NY 871658).

Description based on other specimens and on literature (Jülich 1984).
Macroscopical features: Fruitbodies capitate, 2–8 x 1.5–5 cm. Exoperidium white, becoming cream to brown when ripe, spiny, spines 1–2 mm long, conical, easily falling away, leaving an areolate pattern on the endoperidium, which is cream and not shiny when ripe. Gleba olive brown to grey brown. Subgleba greyish brown, lighter than gleba, chambers up to 1.2 mm diam. On soil in woods, sometimes on very decayed wood.
Microscopical features: Spores light brown, 3–4.5 µm diam., coarsely warted, often mixed with sterigmal remains. Capillitium *Lycoperdon*-type, 4–8 µm diam., yellowish brown, scarcely septate, pores of irregular size, paracapillitium abundant.
This fungus has been recorded for Panama by Garner (1965) and Dennis (1970). The cosmopolitan species has been recorded in the Central American region from Costa Rica, Cuba, the Dominican Republic, Haiti, Jamaica, Venezuela (Dennis 1953, Benjamin and Slot 1969, Dennis 1970, Rodríguez Gallart 1997, Minter et al. 2001, Calonge et al. 2005). It seems to be quite common in the region at higher altitudes.

Lycoperdon lividum Pers.
Syn.: *Lycoperdon spadiceum* Pers.

Specimina non visa: **Canal Zone**: Barro Colorado Island, G.W. Martin and A.L. Welden 8492, 8577, all as *L. spadiceum*.

Description based on other specimens and on literature (Jülich 1984).
Macroscopical features: Fruitbodies capitate, 1–4.5 x 1–3 µm. Exoperidium whitish, brownish when ripe, granular, without spines; endoperidium greyish cream, shiny. Gleba olive to umber. Subgleba brownish, chambers up to 0.5 mm diam. On soil in open, dry places.
Microscopical features: Spores 3.3–5 µm diam., finely warted, with pedicel 0.5–5 µm long, without sterigmal remains. Capillitium *Lycoperdon*-type, 4–8 µm diam., yellowish brown, seldom septate, pores small, irregular.

Apart from the Panamanian records as *L. spadiceum* (Garner 1956, Dennis 1970), this species is known only from the temperate zone, usually from dry areas. Garner (1956) gave no description of the specimens; therefore they need to be revised.

Morganella fuliginea (Berk. & M.A. Curtis) Kreisel & Dring
Syn.: *Morganella mexicana* Zeller

Specimina visa: **Chiriquí**: Bocas del Toro, El Valle, Celestine, alt. approx. 600 m, 28.IX.2005, M. Piepenbring and participants of the Mycological Workshop 3598; **Coclé**: Base of Cerro Pilon, approx. 5 km NE of El Valle, alt. approx. 670 m, 13.VI.1975, Dumont-PA 164 (NY 398742); Dumont-PA 182 (NY 398741) and Dumont-PA 190 (NY 398743); **Panamá**: 2–3 km N of Pan American Highway on El Llano-Carti road, alt. approx. 180–245 m, 29.VI.1975, Dumont-PA 1363 (NY 398738); **San Blas**: Trail from Puerto Obaldia to Darien, alt. approx. 0–90 m, 22.VI.1975, Dumont-PA 968 (NY 398740); **Veraguas**: Lower slopes of Cerro Tuté, approx. 8 km NE of Santa Fe on property of Agricultural school Alto de Piedra, alt. approx. 610 m, 19.VI.1975, Dumont-PA 763 (NY 398745) and Dumont-PA 788 (NY 398744).
Specimina non visa: **Coclé**: El Valle de Anton, alt. 600–700 m, G.W. Martin 2933, 2973, as *M. mexicana*; **Panamá**: Rio Tucuman valley, 10 km E of Juan Diaz, G.W. Martin 3180, as *M. mexicana*; **Canal Zone**: Barro Colorado Island, G.W. Martin and A.L. Welden 7329, 7923, as. *Lycoperdon subincarnatum*; Ft. Sherman area, G.W. Martin 6183, 6201, as *M. mexicana*; **Veraguas**: Along road from St. Fe to Calovebora, Atlantic slope, vicinity Rio Caleborita, approx. 16 km from St. Fe, 18.VI.1975, Dumont-PA 551 (NY 398737).

Macroscopical features: Fruitbodies (Fig. 1b) globose, 1–2 cm diam. Exoperidium brown to blackish brown, rough, no distinct spines. Gleba light brown. Sterile base compact, very scarce or absent, yellowish. Branched white rhizomorphs on base. On more or less decayed wood in rain forest and degraded rain forest.
Microscopical features: Peridium (Fig. 2c) composed of chains of irregular cells, no setae visible. Spores (Fig. 2d) globose, 3.2–4 µm diam., yellowish hyaline, spinulose, Spines up to 0.5 µm long. Capillitium absent, paracapillitium (Fig. 2d) abundant, hyaline, septate and branched, up to 5.5 µm diam., threads joined and interwoven by glebal membranes.
Records of this species from Panama are given by Garner (1956, as *M. mexicana*), Dennis (1970), Stevenson (1975) and Piepenbring (2006). It has a Central and South American distribution. In the vicinity of Panama, it has been collected in Colombia, Costa Rica, Cuba, Dominica, the Dominican Republic, Grenada, Guadeloupe, Puerto Rico, Trinidad and Tobago and Venezuela (Baker and Dale

1951, Dennis 1953, 1970, Garner 1956, Kreisel & Dring 1967, Kreisel 1971, Ponce de León 1971, Morales et al. 1974, Stevenson 1975, Suárez & Wright 1996, Minter et al. 2001, Calonge et al. 2005). As quoted by Ponce de León (1971), *M. mexicana* has been included into this species, therefore the collections referred to this species are cited here. Some of the specimens listed in Garner (1956) as *M. subincarnata* (G.W. Martin 7329 and 7923) were included into *M. fuliginea* by Ponce de León (1979). Since the latter did not mention the other collections of this species collected by G.W. Martin, these are referred to as *M. subincarnata* here (see below). However, none of these problematic collections could be analysed within the scope of this project.

Morganella cf. *subincarnata* (Peck) Kreisel & Dring
Syn.: *Lycoperdon subincarnatum* Peck

Specimina non visa: **Canal Zone**: Barro Colorado Island, G.W. Martin 3157, G.W. Martin and A.L. Welden 7692, 7788, 7790, 7873, 8490, 8521, 8624; E of Arraijin, G.W. Martin and A.L. Welden 8377a; Rio Sardinella, G.W. Martin and A.L. Welden 7542; **Panamá**: 10–12 km N of Pan American highway on El Llano-Carti-Road, 28.VI.1975, Dumont-PA 1293 (NY 888670), 2–3 km N of Pan American highway on El Llano-Carti-Road, 29.VI.1975, Dumont-PA 1421 (NY 888671).

Description based on other specimens and on literature (Kreisel & Dring 1967, Ponce de León 1971).
Macroscopical features: Fruitbodies globose to short pyriform, 2–4 cm diam. Exoperidium reddish brown, spiny, spines often connivent, breaking away at maturity, endoperidium then becoming visible, yellowish brown, relatively stout, pitted like a thimble or a golf-ball. Gleba olive when mature. Subgleba cellular, cream to brownish, occupying one quarter to one third of the fruitbody. White, branched rhizomorphs at base. Lignicolous.
Microscopical features: Exoperidium composed of chains of irregular rounded cells, without setae. Spores 4–5 µm diam., yellowish hyaline, verrucose, sometimes with short pedicel. Capillitium absent, paracapillitium abundant, hyaline, septate and branched, up to 6.5 µm diam., threads joined and interwoven by glebal membranes.
This species has a predominantly North American distribution and is also known from some localities in Southern Europe according to Kreisel & Dring (1967) and Ponce de León (1971). For Panama, the species is recorded in Garner (1956) as *L. subincarnatum*. Only the cited records, one collection cited in Garner (1956) from Costa Rica (G.W. Martin and A.L. Welden 8277), and a further record from Costa Rica (Calonge & Mata 2006) are known from Central America, collections from Florida (Ponce de León 1971) turned out to be *Morganella velutina* (Berk. :

Massee) Kreisel & Dring (Morales and Kimbrough 1981). Concerning other species of *Morganella* with pitted endoperidium, *Morganella costaricensis* M.I. Morales with smooth spores (Morales et al. 1974, Suárez & Wright 1996) and *Morganella compacta* (G. Cunn.) Kreisel & Dring with large peridial spines (Kreisel & Dring 1967) are recorded for Costa Rica (Morales et al. 1974, Calonge et al. 2005, Calonge & Mata 2006) and might be found in Panama. Ponce de León (1971) determined some of the collections by G.W. Martin as *M. fuliginea*. These specimens could not be examined, and are filed under *M. fuliginea*. The other collections are treated under *M. subincarnata*. All these records need to be revised to prove the existence of this species in Central America.

Morganella velutina (Berk. ex Massee) Kreisel & Dring

Specimina visa: **Chiriquí**: Cerro Respingo, approx. 6 km NW of Town of Cerro Punta, alt. approx. 2300 m, 02.VII.1975, Dumont-PA 1667 (NY 398739) as *M. fuliginea*; Parque Internacional de la Amistad, Sendero de la Cascada, alt. approx. 2350 m, 02.IX.2007, M. Piepenbring with licenciatura students 3970.

Macroscopical features: Fruitbodies (Fig. 1c) 1–2 (–3) cm diam., globose. Exoperidium brown to violet when fresh, brown when dry, densely velutinous, velvety to the touch at least when dry. Gleba light brown. Subgleba scarce or lacking, compact. Lignicolous, often on thin branches.
Microscopical features: Exoperidium (Fig. 2e) composed of thick walled clavate setae up to 130 µm in length, visible even under hand lens. Spores (Fig. 2f) globose, 3.5–4 µm diam., yellowish hyaline, echinulate, spines up to 1 µm long. Capillitium absent, paracapillitium abundant, hyaline, septate, branched, joined and interwoven by glebal membranes.
This species has a Central and South American distribution like *M. fuliginea*, but seems to be more rare. It is often found at higher altitudes. This is the first record for Panama. In the vicinity it is known from Costa Rica and Venezuela (Kreisel & Dring 1967, Dennis 1970, Ponce de León 1971, Morales et al. 1974, Suárez & Wright 1996, Calonge et al. 2005).

Vascellum pratense (Pers. : Pers.) Kreisel
Syn.: *Lycoperdon pratense* Pers. : Pers.
Lycoperdon depressum Bonord.
Lycoperdon curtisii Berk.
Vascellum curtisii (Berk.) Kreisel
Vascellum subpratense (Lloyd) Ponce de León

Specimina non visa: **Chiriquí**: Llanos de Volcán, alt. 1250–1300 m, G.W. Martin 2051, as *L. curtisii*; **Coclé**: Valle de Anton, alt. 600–700 m, G.W. Martin 2927, as *L. curtisii*.

Description based on other specimens and on literature (Jülich 1984, Kreisel 1993).
Macroscopical features: Fruitbodies globose to turbinate, 2.5–6 cm diam. Exoperidium consists of 1 mm long, often connivent spines on upper part and irregular granules below, whitish to cream, brown when old, endoperidium grey brown, fragile. Gleba olive brown. Subgleba bowl-like, dark brown when ripe, then darker as gleba, chambers up to 1.5 mm diam., a parchment-like diaphram separates gleba and subgleba. On meadows and open land.
Microscopical features: Spores globose, 3–4.5 µm diam., finely verrucose to almost smooth. Capillitium scarce, only close to the diaphragm, red brown, up to 5 µm diam., without pores, paracapillitium abundant, hyaline, 3–8 µm diam., scarcely branched, septate.
This species has been recorded repeatedly from Panama as *L. curtisii* (Garner 1956, Dennis 1970). The common cosmopolitan fungus has also been recorded from Costa Rica, Cuba, Puerto Rico, Trinidad and Venezuela (Dennis 1953, 1970, Garner 1956, Minter et al. 2001, Calonge et al. 2005). Small American specimens with little subgleba and persistent white spines have been recorded usually as *V. curtisii* (Ponce de León 1970, Kreisel 1993). However, there is little reason to do so, since collections of *V. pratense* show, depending on the conditions of growth, extreme variability including the range of features of *V. curtisii* (M. Gube, unpubl.). The genus *Vascellum* should be included into *Lycoperdon* based on morphological (Reid 1977, M. Gube, unpubl.) and molecular systematic data (Jeppson & Larsson 2008, M. Gube, unpubl.).

Sclerodermataceae

Calostoma cinnabarinum Desv.

Specimen visum: **Chiriquí**: Parque Internacional de La Amistad, Cerro Picacho, alt. approx. 2600 m, 25.IX.2007, M. Piepenbring, T. Hofmann, E. Moreno 4013.

Description of mature features taken from literature (Massee 1888, Liu 1984)
Macroscopical features: Single immature fruitbody in collection 2.8 cm in height, head globose, 1.3 cm diam., pseudostipe 20 x 10 mm. Mature fruitbodies up to 4 cm in height. Pseudostipe and outer peridium gelatinous, hyaline, inner peridium bright red; peristome with 4–7 lobes. Gleba white to pale ochraceous. Growing on soil, probably mycorrhizal (Watling 2006).
Microscopical features: Immature spores (Fig. 2g) hyaline to yellowish, broad oval, 9–12 x 6.7–8

µm, mature spores pale ochraceous, 12–20 x 6,3–10 µm moderately to strongly pitted depending on degree of maturity.
The species is pantropically distributed, it is known from Costa Rica and Guatemala (Sharp 1948, Calonge et al. 2005) as well. This is the first record of this species for Panama.

Scleroderma cepa Pers.

Specimen non visum: **Chiriquí**: Casita Alta, alt. 2000–2200 m, G.W. Martin and A.L. Welden 8207.

Description based on other specimens and on literature (Guzmán 1970, Jülich 1984).
Macroscopical features: Fruitbody globose, 3–4 cm diam. Peridium thick, stout, yellowish to brown, smooth or irregulary cracked. Gleba dark greyish black. On soil, mycorrhizal.
Microscopical features: Spores globose, 9–15 µm diam., spiny, spines 1–1.5 µm long, not connected at base. Peridium thick, peridial hyphae rarely with clamps.
This fungus is distributed predominantly in the Northern hemisphere, but apart from the Panamanian records (Garner 1956, Dennis 1970), collections in the region are also known from Costa Rica and Cuba (Guzmán 1970, Calonge et al. 2005). Since the cited specimen is immature (Garner 1956), the record is not absolutely certain.

Scleroderma sinnamariense Mont.
Syn.: *Scleroderma chrysastrum* G.W. Martin

Specimina non visa: **Canal Zone**: Barro Colorado Island, G.W. Martin and A.L. Welden 7367 (type of *S. chrysastrum)*, 7472, 7696 (paratypes of *S. chrysastrum*); Miller trail, Ovrebo 3602, in Herb. SCZ (Smithsonian Tropical Research Institute, Balboa, Panama).

Description based on other specimens and literature (Guzmán 1970, Guzmán & Ovrebo 2000).
Macroscopical features: Fruitbodies globose, substipitate, up to 4.5 (–9) cm diam.; Peridium bright yellow when young, outside turning yellowish brown to brownish black in maturity; base, peridial interior and rhizomorphs always yellowish, smooth to warty due to cracking. Gleba dark grey to almost black. On soil, mycorrhizal.
Microscopical features: Spores globose, 5–8.5 µm diam., spiny, spines 0.5–1.5 µm long, reticulate at base, sometimes inconspicious.
This fungus is known from Central and South America and Australasia. It has been recorded for Panama by Martin (1954, as *S. chrysastrum*), Garner (1956, as *S. chrysastrum*), Dennis (1970 as *S.*

chrysastrum), Guzmán (1970), Guzmán & Ovrebo (2000) and Guzmán et al. (2004a). In the region it is also recorded for Costa Rica (Guzmán & Ovrebo 2000).

Scleroderma stellatum Berk.
Syn.: *Scleroderma echinatum* (Petri) Guzmán
Caloderma petrianum E. Fisch.

Specimina non visa: **Canal Zone**: Barro Colorado Island, Dodge (in Herb BPI); Barro Colorado Island, Miller Trail, Ovrebo 3603, 3638, in Herb SCZ and XAL (Instituto de Ecologia, Xalapa, Mexico); Barro Colorado Island, Latham trail, Ovrebo 4049, in Herb SCZ; Cerro San Bastarda, G.W. Martin and A.L. Welden 7508; Ft. Sherman, G.W. Martin and A.L. Welden 8708; **Colón**: E of Colón, G.W. Martin 6009; **San Blas**: Port Obaldia, Vitter 5717, in Herb. BPI.

Description based on literature (Guzmán 1970, Guzmán et al. 2004).
Macroscopical features: Fruitbodies globose or subglobose, sessile or short stipitate, up to 4,5 cm diam. Peridium reddish brown to dark brown, yellow near the base, with pyramidal scales up to 1,5 mm high, smaller near the base. Gleba dark purple to brownish violet when ripe. On soil, mycorrhizal.
Microscopical features: Spores 4–6 µm diam., spiny, spines up to 1.5 µm long, partly (when ripe) connected at base. Peridium 500 µm thick, clamps rare.
Records for Panama are given by Garner (1956, as *C. petrianum*), Dennis (1970, as *C. petrianum* and *S. stellatum*) and Guzmán et al. (2004a). The pantropical fungus is in the region also known from Barbados, Cuba, Puerto Rico and Venezuela (Dennis 1970, Guzmán 1970, Kreisel 1971, Minter et al. 2001, Guzmán et al. 2004a). The synonymisation of *S. stellatum* and *S. echinatum* (Guzmán et al. 2004) is
followed here, but has been doubted by some (Demoulin pers comm.).

Veligaster nitidum (Berk.) Guzmán & Tapia
Syn.: *Scleroderma verrucosum* (Bull.) Pers. p.p.
Scleroderma tenerum Berk. & M.A. Curtis

Specimina visa: **Chiriquí**: Rio Serena, carretera a Piedra Candela, alt. approx. 1400 m, 08.X.2005, M. Piepenbring 3633; Cerro Punta, Finca Alto los Reyes, alt. approx. 2500 m, 25.VIII.2007, leg: R. Rios, A. Gracia, in Herb. M. Piepenbring 3951.
Specimina non visa: **Canal Zone**:Barro Colorado Island, G.W. Martin and A.L. Welden 8594;

Chiriquí: Casita Alta, alt. 2000–2200 m, G.W. Martin and A.L. Welden 8113, 8167; Trail from Casita Alta to Finca Lerida, altitude 1600–2000 m, G.W. Martin and A.L. Welden 8206, 8208; Upper valley of the Rio Chiriquí Viejo, altitude 1600–1800 m, G.W. Martin 2080, 2081, 2089, 2183, 2206, 2207, 2208, 2209, 2210, 2222, 2327, 2412, 2492, 2503, 2528, 2549, 2665, 2674, 2709.

Macroscopical features: Fruitbodies 4–8 cm in height (Fig. 1d), capitate, with pseudostipe 2.5–6 x 0.5–1.5 cm and globose "head" with 1.5–3.5 cm diam. Peridium verrucose, verrucae dark brown, irregular, 0,5–1 mm diam. on top, getting gradually smaller below, peridium in between light brown to beige. Gleba grey to dark grey. On soil, mycorrhizal.
Microscopical features: Spores (Fig. 2h) globose, 6.5–9.5 µm diam., densely spiny, spines up to 2.5 µm long, not connected at base. Peridium thin, hyphae without clamps.
This common pantropical fungus is recorded for Panama by Garner (1956, as *S. verrucosum*), Dennis (1970, as *S. tenerum* and *S. verrucosum*) Guzmán (1970, as *S. verrucosum*) and Guzmán & Ovrebo (2000). In the region it is also known from Costa Rica, Cuba, Jamaica, Venezuela and the Virgin Islands (Dennis 1953, Dennis 1970, Kreisel 1971, Calonge et al. 2005, Guzmán & Ovrebo 2000, Minter et al. 2001, Guzmán et al. 2004). The species causes a lot of taxonomic uncertainty, since it has been listed as *S. verrucosum* (Garner 1956, Dennis 1970, Guzmán 1970, Calonge et al. 2005), as *S. tenerum* (Dennis 1953, Dennis 1970, Kreisel 1971) and as *V. nitidum* (Guzmán & Tapia 1995, Guzmán & Ovrebo 2000, Guzmán et al. 2004a). According to Guzmán & Tapia (1995), *V. nitidum* differs from *Scleroderma verrucosum* in having a long pseudostipe, subgelatinous patches at the upper pseudostipe, and smaller spores. However, the revised collections and some descriptions in literature (e.g. Guzmán & Ovrebo 2000), show not all of these features. Several features can be found in other species clearly situated within *Scleroderma* (Demoulin & Dring 1975). Judging from molecular phylogenetics, at least *Veligaster columnaris* (Berk. & Broome) Guzmán is to be transferred into *Scleroderma* (Binder and Bresinsky 2002). Yet, a recombination would require thorough analysis of the complete material, and so could not be included in this study. *Scleroderma areolatum* Ehrenb. (Syn.: *Scleroderma lycoperdoides* Schwein.) is rather similar, but differs by considerably larger spores (12–20 µm diam.), a shorter stipe (up to 2 cm) and regular, dark brown peridial verrucae (Guzmán 1970, Jülich 1984).

Nidulariaceae

Crucibulum laeve (Huds.) Kambly

Specimina visa: **Chiriquí**: Parque Internacional de La Amistad, Cerro Picacho, alt. approx. 2350 m,

23.II.2004, M. Piepenbring, R. Rincon et al. 3385; Parque Internacional de la Amistad, sendero de La Cascada, alt. approx. 2300–2500 m , 04.III.2003, M. Piepenbring, R. Kirschner et al. 3205; Parque Internacional de la Amistad, Sendero de la Cascada, Mirador, alt. approx. 2450 m, 02.IX.2007, M. Piepenbring with licenciatura students 3966.

Macroscopical features: Fruitbodies (Fig. 1e) inverse conical to urn shaped, 4–13 x 3–7 mm, reddish brown, hairy, not plicate. Peridioles whitish brown, with funiculus. On soil or rotten woody debris.
Microscopical features: Spores (Fig. 2i) elliptical, 6.5–12.3 x 4–5.3 µm, smooth, hyaline, thickwalled. Peridium one-layered, hairs spiny, reddish brown.
This is the first record of this cosmopolitan fungus in Panama. It has also been recorded in Costa Rica, the Dominican Republic and Venezuela (Dennis 1970, Minter et al. 2001, Calonge & Mata 2006, Calonge et al. 2005).

Cyathus limbatus Tul.

Specimen visum: **Chiriquí**: Parque Nacional Volcán Barú, Sendero de los Quetzales, alt. approx. 1920–2450 m, 21.VIII.2003, M. Piepenbring, H. Lezcano, D. Rodríguez 3325.

Macroscopical features: Fruitbodies inverse conical, 6–10 x 3–8 mm, dark brown, hairy externally, externally and internally plicate, ridges 0.75–1 mm apart. Peridioles silvery blackish, with funiculus. On soil.
Microscopical features: Spores (Fig. 2j) elliptical, (15–)20–25 x 9.2–15, hyaline, thickwalled. Peridium three-layered.
A pantropical fungus, recorded also from Costa Rica, Cuba, Trinidad and Tobago and Venezuela (Baker and Dale 1951, Dennis 1970, Reid 1977, Minter et al. 2001, Calonge et al. 2005). This is the first record for Panama.

Cyathus poeppigii Tul. & C. Tul.

Specimen visum: **Chiriquí**: Distr. Dolega, Corr. Dolega, Potrerillos Arriba, Brazo de Cochea, Camino a la Finca los Limones de R. Espinosa, alt. approx. 1100 m, 01.XI.2007, M. Piepenbring and R. Espinosa 4088.
Specimina non visa: **Canal Zone**: Barro Colorado Island, G.W. Martin and A.L. Welden 7158, 7262, 7296, 7430, 7441, 7484, 7580, 7622, 7856; Summit, G.W. Martin 2871, 2875; **Chiriquí**:

valley of the upper Rio Chiriquí Viejo, alt. approx. 1600–1800 m, G.W. Martin 2114, 2500; **Coclé**: Valle Chiquita, 7 km S of El Valle de Anton, alt. approx. 500–600 m, G.W. Martin 3001.

Spore size from literature (Brodie 1975).
Macroscopical features: Fruitbodies (Fig. 1f) 6–8 x 4–6 mm, dark reddish brown, black in age, inverse conical, deeply plicate outside and inside, ridges 0.5 mm apart. Peridioles black, shiny, with funiculus. On soil, plant debris, rotten wood.
Microscopical features: Spores elliptical, 30–42 x 20–28 µm, hyaline, thickwalled. Peridium formed by three layers.
Records of this fungus from Panama can be found in Garner (1956) and Dennis (1970). This common pantropical species has also been recorded in Colombia, Cuba, Puerto Rico, Trinidad and Tobago and Venezuela (Baker and Dale 1951, Dennis 1970, Brodie 1975, Stevenson 1975). Specimen 4088 had no spores in its peridioles; but as the other features fit it is placed here. However, it cannot be excluded that it is an abnormal collection of *C. limbatus*.

Cyathus stercoreus (Schwein.) De Toni

Specimen non visum: **Canal Zone**: Summit, G.W. Martin and A.L. Welden 8257.

Description from other specimens and literature (Brodie 1975).
Macroscopical features: Fruitbodies 5–15 x 4–8 mm, funnel shaped, not plicate, outside yellowish to blackish brown, tomentose when young, inside blue-grey; peridioles black, lenticulate, with funiculus; coprophilous or on manured soil.
Microscopical features: Spores subglobose to ovoid, 25–40 x 20–25 µm, hyaline, thickwalled; Peridium tree-layered.
The fungus is worldwide distributed. For Panama it has been recorded by Garner (1956), Dennis (1970) and Piepenbring (2006). In the region it is also known from Colombia, Costa Rica, Cuba, the Dominican Republic, Puerto Rico and Venezuela (Garner 1956, Dennis 1970, Stevenson 1975, Arnold 1985, Minter et al. 2001, Calonge et al. 2005).

Mycocalia reticulata (Petch) J.T. Palmer
Syn.: *Nidularia reticulata* Petch

Specimen non visum: **Canal Zone**: Balboa, G.W. Martin 3985, as *N. reticulata.*

Description from literature (Martin 1939a, Cejp & Palmer 1963).
Macroscopical features: Fruitbodies globose, up to 2 mm diam., first white, then brownish; Peridium thin, gelatinous, withering quickly; Peridioles solitary to several, lens-shaped, reticulate, yellowish brown, without funiculus; on plant debris.
Microscopical features: Peridiole cortex hyphae branched, tapering, main hyphae up to 20 µm in diam., spores hyaline, thickwalled, cylindrical, 8.5–9.5 x 4.5–5.5 µm; peridioles 450–550 x 200 µm; peridial wall consists of branched, apiculate, thickwalled hyphae, main axis up to 20 µm diam.
This cosmopolitan tropical species is in Central America only known from Panama so far. It has been recorded by Martin (1939a, as *N. reticulata*), Cejp & Palmer (1963), Dennis (1970, as *N. reticulata*), and Brodie (1975).

Sphaerobolaceae

Sphaerobolus stellatus Tode

Specimen visum: **Chiriquí**: Dolega, Los Algarrobos, below Casa de la Alemana, alt. approx. 145m, 14.VIII.2005, M. Piepenbring 3488.

Macroscopical features: Fruitbodies (Fig. 3a) globose, up to 2.5 mm diam. Peridium with whitish exterior, splitting open stellately with 8–10 teeth, exposing the yellow interior layer and the greenish-brown peridiole, inner peridial layers evert to eject the peridiole. On dung (usually cattle) or rarely plant debris.
Microscopical features: Spores elliptical, smooth, 8.7–9 x 4.7–5.5 µm.
A cosmopolitan species, apparently more common in temperate regions (Geml et al. 2005). Known also from the Dominican Republic, Puerto Rico, Trinidad and Tobago and Venezuela (Baker and Dale 1951, Dennis 1953, 1970, Stevenson 1975). This is the first record of this species from Panama.

Phallaceae

Mutinus argentinus Speg.

Specimen visum: **Chiriquí**: Dolega, Los Algarrobos, way to Las Gonzales, alt. approx. 140 m, 05.X.2005, M. Piepenbring and students of the UNACHI 3615.

Macroscopical features: Fruitbodies up to 9 x 0.8–0.9 cm, growing out of yellowish white egg measuring 15–20 x 13–15 mm which forms a gelatinous volva after stretching of the cellular receptaculum. Fertile portion of receptaculum up to one quarter of total length, bright red, covered with olivaceous, pungent spore mass; infertile part pale pink, lighter in the lower part. With white rhizomorphs. On soil, often under species of *Bambusoideae*.
Microscopical features: Spores (Fig. 2k) cylindrical, greenish hyaline, 3.5–5 x 0.8–1.5 µm, smooth.
A pantropical fungus frequently collected in Central America, in Costa Rica, Cuba, the Dominican Republic, Puerto Rico, Trinidad and Tobago (Baker and Dale 1951, Dennis 1953, 1970, Kreisel 1971, Reid 1977, Sáenz & Nassar 1980, Lodge 1984, Arnold 1985, Calonge et al. 2005). This is a new record for Panama.
Mutinus bambusinus (Zoll.) E. Fisch. might eventually be regarded as synonym of *M. argentinus*, and most of the records cited above are referring to *M. bambusinus*. The distinguishing features of *M. bambusinus* are a longer fertile portion, sterile tip of the fruitbody, and receptacular chambers opening to the exterior (Dring & Rose 1977, Reid 1977).

Phallus indusiatus Vent. : Pers.
Syn.: *Dictyophora indusiata* (Vent. : Pers.) Desv.

Specimen visum: **Chiriquí**: Dolega, Las Algarrobos, way to Las Gonzales, alt. approx. 140 m, 13.IX.2005, M. Piepenbring and participants of Mycological Workshop 3543.

Macroscopical features: Fruitbodies up to 25 x 2.5 cm, growing out of white egg forming a gelatinous volva after stretching of the cellular receptaculum. Fertile portion of receptaculum up to 3.5–5 cm, covered with blackish green, pungent smelling spore mass; absolute top sterile, basal receptaculum white to pinkish, chambered, hollow, well developed indusium hanging from fertile part, sometimes to the ground. With white rhizomorphs. On soil.
Microscopical features: Spores (Fig. 2l) greenish hyaline, elliptical, 2.5–3 x 1–2 µm, smooth.
The species has a worldwide distribution in tropical to warm temperate regions. Panamanian records can be found in Standley (1933, as *Dictyophora duplicata* (Bosc) E.Fisch.), Weston (1933, as *D. duplicata*), Dennis (1970, as *D. indusiata*) and Piepenbring (2006, as *Phallus duplicatus* Bosc). It is known also from Colombia, Costa Rica, Cuba, the Dominican Republic, Puerto Rico, Trinidad and Tobago and Venezuela (Baker and Dale 1951, Dennis 1953, 1970, Kreisel 1971, Stevenson 1975, Sáenz & Nassar 1980, Lodge 1984, Minter et al. 2001, Calonge et al. 2005, Vasco-Palacios et al. 2005). The temperate American species *P. duplicatus* has a much smaller indusium. The collections of Weston and Standley refer doubtless to the tropical *P. indusiatus*.

Staheliomyces cinctus E. Fisch.

Specimen non visum: **Canal Zone**: Barro Colorado Island, Fairchild trail, alt. approx. 26–145 m, 11.VIII.1997, PMA 1860.

Description based on literature (Sáenz & Nassar 1982, Leite et al. 2007).
Macroscopical features: receptacle up to 20 cm in height, growing from "egg", fertile portion in upper half, constricted, covered with yellowish brown, smelling, mucilaginose spore mass, sterile part below and above fertile portion white, chambered.
Microscopical features: spores long ellipsoidal, 2.5–3 × 1.2 × 1.5 µm, smooth, hyaline
This species is recorded for Panama by Stevens (1930), Dennis (1970), Piepenbring (2006) and Leite et al. (2007). The fungus is restricted to tropical Central and South America, in the region it is also known from Costa Rica (Dennis 1970, Sáenz & Nassar 1980, Calonge et al. 2005, Leite et al. 2007).

Geastraceae

Geastrum javanicum (Lév.) Ponce de León
Syn.: *Geastrum velutinum* Morg.

Specimina non visa: **Canal Zone**: Barro Colorado Island, G.W. Martin and A.L. Welden 7156, 7643, 7651, all as *G. velutinum.*

Description from literature (Ponce de León 1968, Herrera et al. 2005).
Macroscopical features: Fruitbodies developing from a mycelial subiculum, 2–5 cm diam. when open. Exoperidium light brown outwards, dark brown inwards, with two usually separating fibrous layers, splitting in 6–8 rays, outer layer often getting attached firmly to the substrate, inner layer always free; endoperidium sessile, dark brown; peristome fimbriate, concolorous or brighter. Gleba dark brown. On soil or wood.
Microscopical features: Spores globose, brown, 2.5–4 µm, spiny. Capillitium 4–5 µm diam., branched at the ends.
Panamanian records of the fungus are given by Garner (1956) and Dennis (1953, 1970), all as *G. velutinum*. It is a tropical species with worldwide distribution, known from Costa Rica, Cuba, the Dominican Republic, Guadeloupe, Puerto Rico, Trinidad and Tobago, and Venezuela (Dennis 1953,

1970, Stevenson 1975, Reid 1977, Minter et al. 2001, Calonge et al. 2005). It may easily be taken for *G. schweinitzii*, which has an unbranched capillitium and non-separating layers of the endoperidium, and *G. saccatum*, which has no subiculum and non-separating endoperidial layers (Ponce de León 1968, Reid 1977, Calonge et al. 2005, Herrera et al. 2005). The identity of *G. velutinum* and *G. javanicum* is doubtful (Demoulin pers. comm.), but an emendation of this group would be needed to reject it.

Geastrum cf. *rufescens* Pers.
Syn.: *Geastrum schaefferi* Vittad.
Geastrum vulgatum Vittad.

Specimen non visum: **Canal Zone**: E of Arraiján, G.W. Martin and A.L. Welden 8381.

Description from other specimens and literature (Dörfelt 1985, Sunhede 1989).
Macroscopical features: Fruitbodies (2–) 5–16 cm diam. when open. Exoperidium outwards whitisch brown with rose tints, inwards flesh brown, reddening when bruised, splitting in 4–10 flat rays, endoperidium 1–4 cm diam., grey brown, sessile or subsessile; peristome fimbriate, concolorous. Gleba dark brown. On soil.
Microscopical features: Spores globose, 4.5–6 µm diam., verrucose, brown. Capillitium brown, straight, up to 9 µm diam.
The species is common in temperate regions, it is known from Panama (Garner 1956, Dennis 1970), and has also been recorded in Costa Rica (Calonge et al. 2005). Garner (1956) and Dennis (1970) cite the record as *G. rufescens*, but assume conspecifity with *G. fimbriatum* Fr. Both species are known from the region, *G. fimbriatum* has been recorded from Cuba (Ponce de León 1946). More recent studies (Pouzar 1971, Dörfelt & Müller-Uri 1984) clarify the matter, both species are to be considered independent. Here the name *G. rufescens* is used for the collection, since the description in Dennis (1970) points towards this species in the present opinion. However, the specimen should be revised to clarify the identification.

Geastrum saccatum Fr.

Specimen visum: **Chiriquí**: Volcán, Humedales Lagunas de Volcán, 20.IX.2005, M. Piepenbring and participants of Mycogical Workshop 3574.
Specimina non visa: **Canal Zone**: Barro Colorado Island, G.W. Martin and A.L. Welden 7096, 7172, 7705, 7884.

Macroscopical features: Fruitbodies 2–5 cm diam when open. Exoperidium light brown inwards and outwards, splitting with 5–8 recurved rays, endoperidium sessile, grayish brown, 0.5–2.5 cm diam.; peristome (Fig. 3b) fimbriate, distinct bright "court". Gleba dark brown. On soil.
Microscopical features: Spores globose, 3.2–4 µm, spinulose, spines up to 0.5 µm long. Capillitium straight, brown, up to 6 µm diam., unbranched, narrow lumen, incrusted.
This subcosmopolitan species is reported for Panama by Garner (1956). It is quite common in the region it has been recorded for Colombia, Costa Rica, Cuba, the Dominican Republic, Jamaica, Puerto Rico, Trinidad and Tobago (Ponce de León 1946, Dennis 1953, 1970, Stevenson 1975, Reid 1977, Lodge 1984, Guzmán et al. 2004b, Calonge et al. 2005, Vasco-Palacios 2005). Minter et al. (2001) synonymize *G. fimbriatum* with *G. saccatum*, therefore the records there cannot be taken for certain.

Geastrum schweinitzii (Berk. & Curt.) Zeller
Syn.: *Geaster mirabile* Mont.

Specimina non visa: **Canal Zone**: Balboa, G.W. Martin 2891; Barro Colorado Island, G.W. Martin and A.L. Welden 7184.

Description from other specimens and literature (Ponce de León 1968).
Macroscopical features: Fruitbodies developing from a mycelial subiculum, 2–5 cm diam. when open. Exoperidium brown outwards, tomentose, lighter brown inwards, splitting in 6–7 rays, endoperidium light grey-brown, 1–1.5 cm diam. peristome fimbriate. Gleba dark brown. On wood and woody debris.
Microscopical features: spores brown, globose, 3–3.5 µm diam., echinulate, spines up to 0.5 µm high. Capillitium brown, up to 6 µm diam., unbranched.
This is a relatively common pantropical species, which has been recorded for Panama by Standley (1933, as *G. mirabile*), Weston (1933, as *G. mirabile*), Garner (1956), Ponce de León (1968, incl var. *stipitatum* (Solms) P. Ponce) and Dennis (1970). It is also known from Costa Rica, Cuba, the Dominican Republic, Jamaica, Puerto Rico, Trinidad and Venezuela (Ponce de León 1946, 1968, Dennis 1953, 1970, Stevenson 1975, Lodge 1984, Minter et al. 2001, Calonge et al. 2005, Calonge & Mata 2006).

Geastrum triplex Jungh.
Syn. *Geastrum indicum* (Klotzsch) Rauschert

Specimina non visa: **Canal Zone**: Barro Colorado Island, G.W. Martin and A.L. Welden 7471, 8686.

Description from other specimens and literature (Dörfelt 1985, Sunhede 1989).
Macroscopical features: Fruitbodies 5–20 cm diam. when open. Exoperidium with irregular light and dark brown patches on the outer surface, radially cracking, lighter brown inwards, but getting much darker when withering, splitting into 4–8 recurved rays, the inner portion of the pseudoparenchymatic layer often separates from the fibrillose layer, often forming a collar around the endoperidium; endoperidium 1.5–4 cm diam., light brown; peristome fimbriate, with bright or dark "court". Gleba dark brown. Growing on soil.
Microscopical features: Spores globose, brown, 4.5–5.5 µm diam., echinulate, spines up to 1 µm long. Capillitium brown, up to 7 µm diam.
The fungus has been recorded for Panama by Garner (1956) and Piepenbring (2006). This cosmopolitan species has also been recorded from Costa Rica, Cuba, the Dominican Republic, Puerto Rico, Trinidad and Tobago, and Venezuela (Dennis 1970, Reid 1977, Minter et al. 2001, Calonge et al. 2005). Specimens without collar may easily be taken for *G. saccatum*, which is usually much smaller and also has smaller spores.

Radiigera cf. *taylorii* (Lloyd) Zeller

Specimen visum: **Chiriquí**: Cerro Punta, Finca Alto los Reyes, alt. approx. 2500 m, 25.VIII.2007, R. Rios and A. Gracia in Herb. M. Piepenbring 3955.

Features of ripe fruitbody were taken from literature (Domínguez de Toledo and Castellano 1996).
Macroscopical features: Fruitbodies (Fig. 3c) (1.5–) 3–4 cm diam., globose to subglobose, yellowish brown, Peridium 3–4 layered, outwards smooth to velutinous. Gleba white when young, darkening to grayish brown while ripening, distinct columella. On soil.
Microscopical features: immature specimen M. Piepenbring 3955: spores globose, 2–3 µm diam, finely verrucose, capillitium hyaline, 6–8 mm diam, lumen narrow; ripe spores globose, finely verrucose, brown; ripe Capillitium pale brown, 4 µm diam., not septate.
This species is known from Mexico and the USA (Dominquez de Toledo and Castellano 1996), this is the first record for Panama. Since the specimen is immature, the identification is not absolutely certain. Judging from spore size and the smooth peridium without debris, *R. taylorii* seems the only possibility.

Radiigera sp.

Specimen visum: **Canal Zone**: Jardin Botanico Summit, alt. approx. 70 m, 13.II.2003, M. Piepenbring and R. Kirschner 3136.

Macroscopical features: Fruitbodies (Figs. 3d, 3e) globose, 15–18 mm diam. Peridium white when fresh, brownish when dry, outwards slightly rough,.with beak-like structure on top (3.5 x 2 mm); thick peridium composed of four layers, inner layer easily separating. Gleba dark brown, no columella. Lignicolous (found on frond axils of *Elaeis oleifera*).
Microscopical features: Spores globose (Figs. 2m, 2n), 3.7–4.2 µm, verrucose, brown. Capillitium (Fig. 2n) hyphae up to 7 µm diam, brown, thickwalled, unbranched, growing radially outwards.
A probably new species with close relationships to *Radiigera* and *Geastrum*. It might even be an unopened *Geastrum*, but the growth on woody substrate excludes most species, the smoothness of the outer peridium as well. Also, no peristome was distinguishable despite the beak-like structure atop. The heterogeneous genus *Radiigera* should be revised molecularly and anatomically. It probably will have to be included in *Geastrum*.

Incertae sedis

Lycogalopsis solmsii E. Fisch.

Specimina visa: **Chiriquí**: Corr. Dolega, Los Algarrobos, cerca de la Casa de la Alemana, alt. approx. 150 m, 22.VII.2007, M. Piepenbring 3934; **Canal Zone**: Balboa, Missouri Botanical Garden Tropical Station, 20.VII.1935, G.W. Martin 2896 (BPI 736359); Barro Colorado Island, 24.VIII.1952, G.W. Martin and A.L. Welden 8694 (BPI 736358); Ft. Sherman area, 22.VII.1945, G.W. Martin 6104 (BPI 736360).
Specimina non visa: **Canal Zone**: Barro Colorado Island, G.W. Martin and A.L. Welden 7053, 7083, 7136, 7356, 7398, 7459; Ft. Sherman area, G.W. Martin 6026, 6095, 6104.

Macroscopical features: Fruitbodies (Fig. 3f) 3–15 mm diam., on a more or less developed white mycelial subiculum. Peridium whitish, fragile, no defined opening. Gleba white to yellowish white. lignicolous in moist forests.
Microscopical features: Spores (Fig. 2o) irregularly globose, 1.8–3 µm diam., verrucose, yellowish hyaline. Basidia more or less persistent, spindle- to club-shaped, bearing up to 6 spores each.

Capillitial threads (Fig. 2o) hyaline, in bundles, septate, with clamps, unbranched, lumen lacking or scarcely visible, 1–1.5 µm diam., often incrusted with debris.

Records for Panama are included in Martin (1939b), Dennis (1953, 1970), Stevenson (1975), Reid (1977) and Piepenbring (2006). This pantropical species is relatively common in the Central American region, it is known from Colombia, Costa Rica, Cuba, Honduras, Martinique, Puerto Rico, Trinidad and Tobago and Venezuela (Martin 1939b, Dennis 1953, 1970, Kreisel 1971, Stevenson 1975, Reid 1977, Lodge 1984, Guzmán et al. 2004b, Calonge et al. 2005, specimens BPI 736356, 736357). Its systematic position is unknown. Because of its glebal anatomy, however, it is probably to be placed next to the Geastraceae.

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PLATE 1: 1a *Calvatia rosacea* OSC 28213, exsiccated specimen; 1b *Morganella fuliginea* M. Piepenbring 3598, fresh specimen; 1c *Morganella velutina* M. Piepenbring 3970, fresh specimen; 1d *Veligaster nitidum* M. Piepenbring 3633, exsiccated specimen; 1e *Crucibulum laeve* fresh specimen M. Piepenbring 3205; 1f *Cyathus poeppigii* M. Piepenbring 4088, fresh specimen.

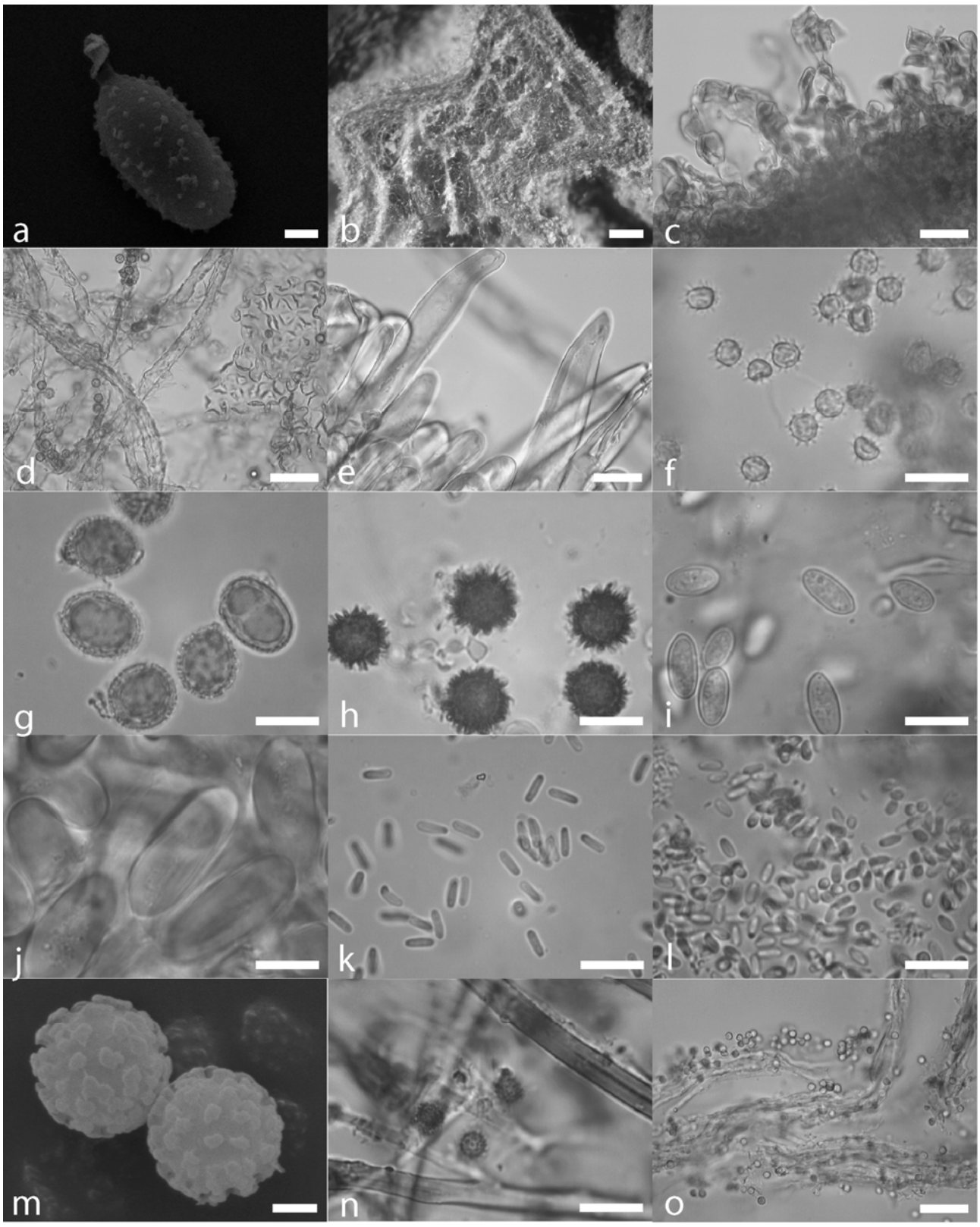

PLATE 2: 2a *Bovista longispora* M. Piepenbring 4073, SEM image of spore, scale 1 µm; 2b *Calvatia rosacea* OSC 28213, subgleba, cavities with crossing hyphae, scale 250 µm; 2c *Morganella fuliginea* NY 398740, exoperidial isodiametric elements, scale 20 µm; 2d *Morganella fuliginea* M. Piepenbring 3598, spores and paracapillitium with glebal membranes, scale 20 µm; 2e *Morganella velutina* NY 398739, exoperidial thickwalled setae, scale 20 µm; 2f *Morganella velutina* NY 398739, spinulose spores, scale 10 µm; 2g *Calostoma cinnabarinum* M. Piepenbring 4013, spores, scale 10 µm; 2h *Veligaster nitidum* M. Piepenbring 3633, spores, scale 10 µm; 2i, *Crucibulum laeve* M. Piepenbring 3966, spores, scale 10 µm; 2j *Cyathus limbatus* M. Piepenbring 3325, spores, scale 10 µm; 2k *Mutinus argentinus* M. Piepenbring 3615, spores, scale 10 µm; 2l *Phallus indusiatus* M. Piepenbring 3543, spores, scale 10 µm; 2m *Radiigera* sp. M. Piepenbring 3136, SEM image of spores, scale 1 µm; 2n *Radiigera* sp. M. Piepenbring 3136, spores and capillitium, scale 10 µm; 2o *Lycogalopsis solmsii* M. Piepenbring 3934, spores and capillitium, scale 20 µm.

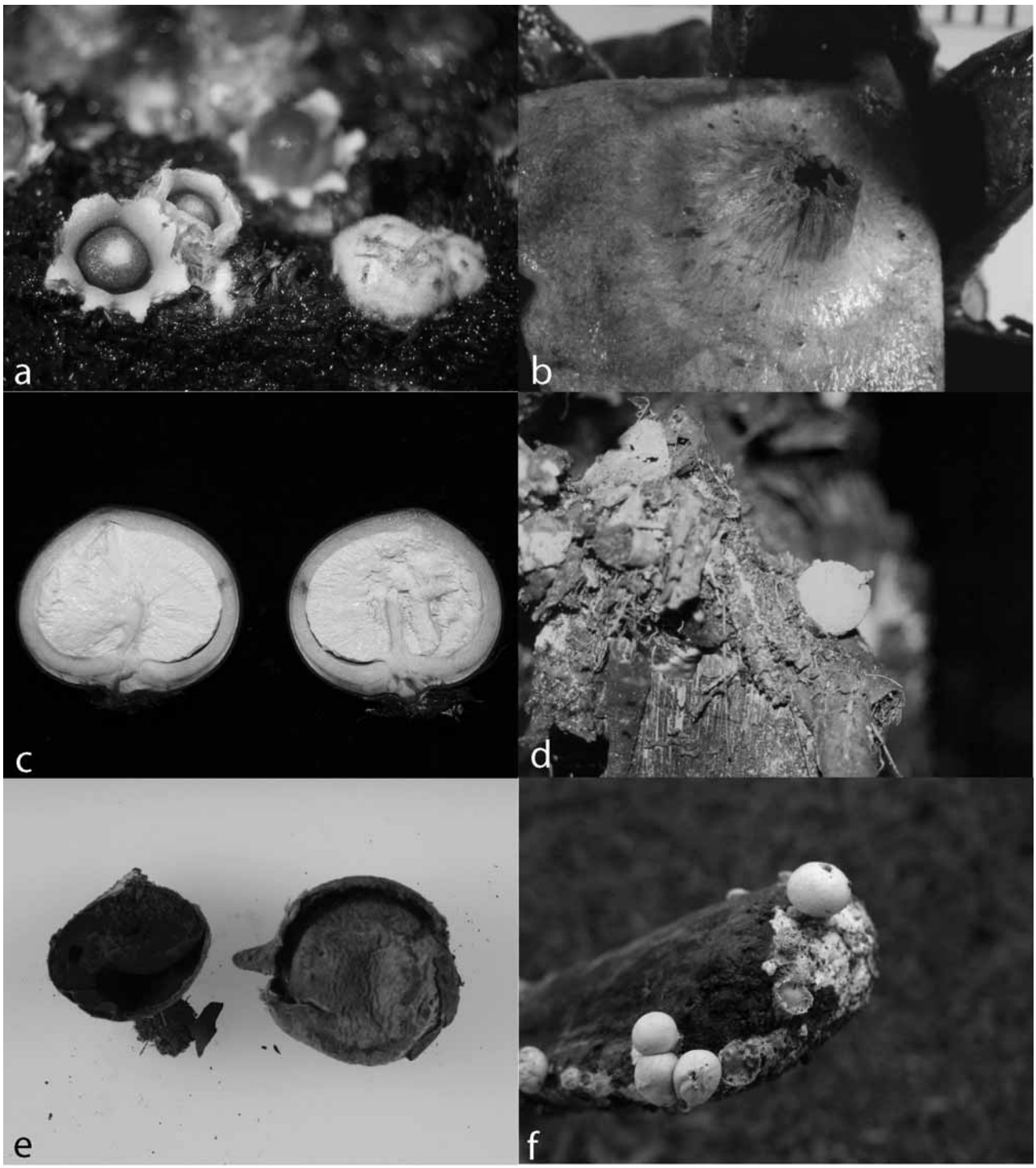

PLATE 3: 3a *Sphaerobolus stellatus* M. Piepenbring 3488, fresh specimen; 3b *Geastrum saccatum* M. Piepenbring 3547, endoperidium with fimbriate mouth and distinct "court"; 3c *Radiigera taylorii* fresh specimen M. Piepenbring 3955; 3d *Radiigera* sp. M. Piepenbring 3136, fresh specimen, 3e *Radiigera* sp. M. Piepenbring 3136, exsiccated specimen; 3f *Lycogalopsis solmsii* M. Piepenbring 3934, fresh specimen.