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## New species and new records of *Marasmius* from Panamá

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Dennis E. Desjardin<sup>1</sup> and Clark L. Ovrebo<sup>2\*</sup>

<sup>1</sup>Department of Biology, San Francisco State University, San Francisco, California 94132

<sup>2</sup>Department of Biology, University of Central Oklahoma, Edmond, Oklahoma 73034

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Nine species of *Marasmius* from Barro Colorado Island, Panamá are treated. Three species, *Marasimius griseoradiatus*, *M. scopulatus* and *M. variabilis* are described as new. Six other species, *Marasmius helvolus*, *M. multiceps*, *M. praecox*, *M. tageticolor*, *M. tenuisetulosus* and *M. leveilleanus* are reported from Panamá for the first time. Descriptions and microscopic illustrations are provided for all but *M. leveilleanus*; photographs are provided for all taxa.

**Key words:** fungal taxonomy, marasmioid fungi, *Tricholomataceae*, tropical fungi

### Introduction

*Marasmius* species are an important agaric component of tropical ecosystems. Rolf Singer published extensively on species from the neotropics (e.g., Singer 1958, 1965a, 1976), while work is being carried out in Asia by Desjardin and co-workers (e.g. Wannathes *et al.*, 2004). Most of his neotropical collecting was carried out in South America, with only a few species described from Central America. Although he never collected in Panamá, he described or reported on species occurring there based on collections made by other workers. He described three new species from Barro Colorado Island (BCI): *Marasmius euosomus* Singer, *M. panamensis* Singer, and *M. sessililiaffinis* Singer. From other sites in Panamá he described *M. haematocephalus* var. *pseudotageticolor* Singer, *M. polycladioides* Singer, and *M. pseudominutus* Singer. Previously described species he reported from localities other than BCI are *Marasmius beniensis* Singer, *M. cladophyllus* Berkeley and *M. setulosifolius* Singer ex Singer.

In this paper we expand the knowledge of *Marasmius* in Panamá based on collecting carried out by the junior author. We describe three new species and include complete descriptions and illustrations for five other species. Three additional species were found by the junior author on BCI: *M. cladophyllus*, *M.*

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\*Corresponding author: Clark L. Ovrebo; e-mail: covrebo@ucok.edu

*haematocephalus* (Mont.) Fr., and *M. leveilleanus* (Berk.) Pat. The first two are well known neotropical species and descriptions/illustrations can be found in Singer (1976) and Pegler (1983). *Marasmius leveilleanus* was re-described by Ovrebo (1996) based on material from Costa Rica and we cite Panamanian collections and include a photograph of this taxon.

## Materials and methods

All descriptions are based from material collected on Barro Colorado Island. For more information on this site, see Buyck and Ovrebo (2002). Colour terms and notations in parentheses are those of Kornerup and Wanscher (1978) and Anonymous (1992). Microscopic observations were made by rehydrating tissues in ethanol followed by distilled water, and then mounted in 3% KOH or Melzer's reagent. Spore statistics are based on the measurement of 20 spores per collection. The following abbreviations are used for spore measurements:  $\bar{x}$  = mean length and width of 20 spores,  $Q_r$  = range of length/width quotients,  $Q_m$  = mean of length/width quotient.

## Results

### *Marasmius griseoradiatus* Desjardin & Ovrebo, **sp. nov.** (Figs. 1, 10-13)

*Etymology*: *griseus* (Latin) - grey; *radiatus* (Latin) - with radiate streaks; referring to the colour pattern of the pileus.

*Pileus* 9-20 mm diametro, convexus vel late convexus, sulcatus, glaber, striatus, cristis atro-griseis, sulcis bubalinis. *Lamellae* liberae, distantes, latae, bubalinae, griseomarginatae. *Stipes* 25-40 × 0.5 mm, cylindraceus, glaber, non-insititius, in apice bubalinus, in base rubello-brunneus. *Basidiosporae* 15-15.5 × 4 μm, fusiformes, laeves, hyalinae, inamyloideae. *Basidiola* 22-29 × 5-7 μm. *Cheilocystidia* ex elementis *M. sicco* similibus composita, 10-20 × 4-6.5 μm, clavata; setulis 2-16 × 1-1.5 μm, conicis, lutescenti-brunneis praedita. *Pleurocystidia* biformia: gloeocystidiis 31-42 × 5-7 μm, cylindaceo-flexuosis, hyalinis, atque cellulis *M. sicco* similibus, in forma eadem ac in cheilocystidiis. *Pileipellis* hymeniformis ex elementis *M. sicco* similibus composita, 10-20 × 5-8 μm, clavata; setulis 5-12 × 1-1.5 μm, conicis, hyalinis vel lutescenti-brunneis praedita. *Caulocystidia* nulla. Fibulae praesentes. *Basidiomata* foliicolae. Holotypus hic designatus: PANAMA, Barro Colorado Island, Ovrebo # 3590, 10 Aug. 1997 (PMA).

*Pileus* 9-20 mm wide, convex when young, broadly convex to nearly plane when mature, dry, dull, sulcate, glabrous, opaque, colouration striped, sulcations buff, ridges dark grey, but light grey when older, centre buff; *pileus context* immeasurably thin, odor and taste nondescript. *Lamellae* 2-3 mm wide, free, no collarium, creamy buff, dark grey-marginate, entire, not intervenose, distant (3-4 mm apart on larger basidiomes), 9-11 per basidiome; *lamellulae* generally absent, only one seen on 15 basidiomes. *Stipe* 25-40 mm long, 0.5 mm thick, equal, glabrous, buff over upper third or one-half, reddish brown below; base with golden ochre strigose mycelium.



**Figs. 1-3.** Basidiomes. 1. *Marasmius griseoradiatus* (Ovrebo 3590). 2. *Marasmius helvolus* (Ovrebo 3741). 3. *Marasmius leveilleanus* (Ovrebo 3533). Bar = 1 cm.



**Figs. 4-6.** Basidiomes. **4.** *Marasmius multiceps* (Ovrebo 3586). **5.** *Marasmius praecox* (Ovrebo 3840). **6.** *Marasmius scopulatus* (Ovrebo 3710). Bar = 1 cm.



**Figs. 7-9.** Basidiomes. 7. *Marasmius tageticolor* (Ovrebo 4040). 8. *Marasmius tenuisetulosus* (Ovrebo 3593). 9. *Marasmius variabilis* (Ovrebo 3588). Bar = 1 cm.

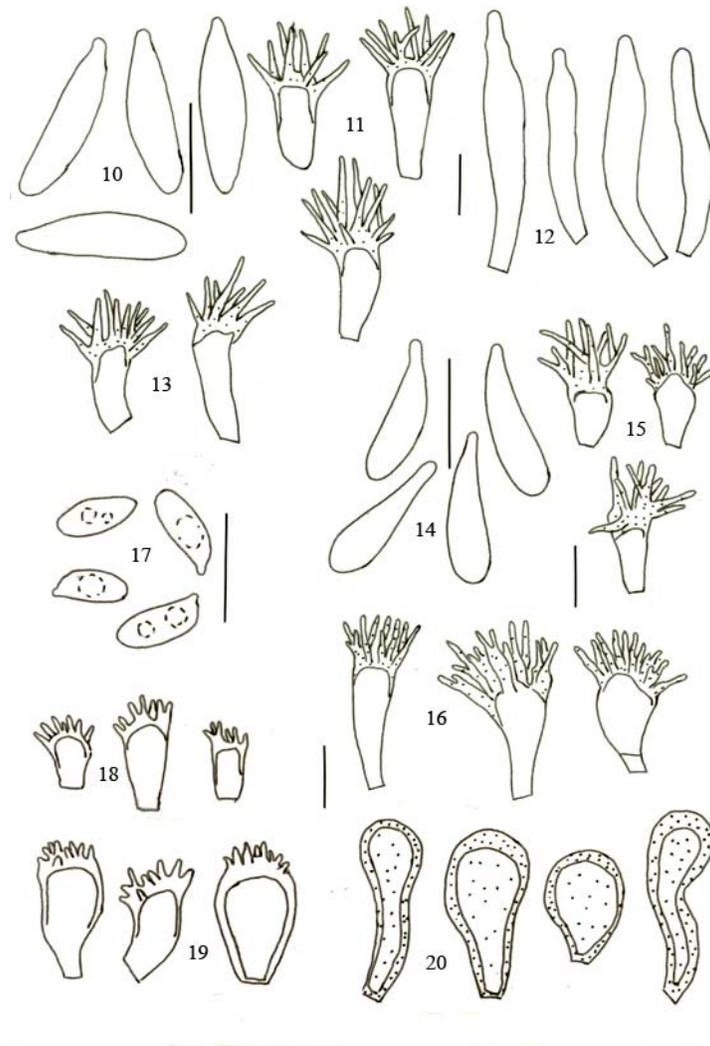
*Basidiospores* 15-15.5 × 4 μm, ( $\bar{x}$  = 15.13 × 4,  $Q_r$  = 3.75-3.88,  $Q_m$  = 3.78), narrowly fusiform in profile with adaxial face straight or slightly concave, narrowly fusiform in face view, smooth, thin-walled, hyaline, inamyloid. Mature *basidia* absent, basidioles 22-29 × 5-7 μm, ampullaceous or occasionally clavate. *Cheilocystidia* present in the form of *Siccus*-type broom cells, often extending back a short ways on the sides of the lamellae; body 10-20 × 4-6.5 μm, cylindric to clavate, hyaline to yellowish brown; setulae 2-16 μm long, 1-1.5 μm wide at base, tapered to a rounded apex, erect or with those at the side at an angle, yellowish brown. *Pleurocystidia* of two types: (1) gloeocystidia, 31-42 × 5-7 μm, translucent and without visible content, cylindric or cylindro-flexuous, geniculate, apex rounded, occasionally subcapitate, hyaline; (2) *Siccus*-type broom cells like the cheilocystidia but entirely hyaline, scattered on lamellae sides. *Hyphae of lamellar trama* subparallel to loosely interwoven, 3-5 μm wide, cylindric, hyaline, dextrinoid. *Hyphae of subhymenium* 2-3 μm wide, scarcely evident. *Pileus surface* composed of *Siccus*-type broom cells; body 10-20 × 5-8 μm, hyaline to yellowish brown; setulae 5-12 μm long, 1-1.5 μm wide at base, tapered to a rounded apex, erect, yellowish brown. *Hyphae of stipe surface* 3-3.5 μm wide, cylindric, pale yellow, without caulocystidia. *Hyphae of stipe context* 5-7 μm wide, cylindric, hyaline. *Hyphae at stipe base* 2.5-4 μm wide, cylindric, hyaline although yellowish in mass. *Clamp connections* present.

*Habit and habitat*: scattered, on leaf litter.

*Specimens examined*: PANAMA, Province of Panamá, Gatun Lake, Barro Colorado Island, Shannon Trail, 10 Aug 1997, Ovrebo 3590 (PMA, **holotype**; SFSU, **isotype**).

*Commentary*: *Marasmius griseoradiatus* forms beautiful basidiomes with a striped or star-like pileus wherein the sulcae are pallid and the area in between is grey to dark grey. The striped pattern remains in dried specimens. Micromorphologically, the species is characterised by fusiform basidiospores with mean 15.1 × 4 μm, and two types of pleurocystidia, viz., hyaline gloeocystidia and *Siccus*-type broom cells. The species belongs in sect. *Sicci* ser. *Haematocephali*. In the New World, *M. griseoradiatus* is closest to *M. montagneanus* Singer, a species known from French Guyana and Bolivia. The latter species differs in forming pilei coloured more ochraceous to golden ochraceous-brown, ferruginous, or tawny with pallid stripes (i.e., not grey), has non-marginate lamellae, only one type of pleurocystidia (gloeocystidia), and larger basidiospores in the range 14.5-21.5 × 3-4.7 μm (Singer, 1976).

The strikingly striped pileus is reminiscent of *M. lilacinoalbus* Beeli from Africa and *M. purpureostriatus* Hongo from eastern Asia. *Marasmius lilacinoalbus* differs in forming a pileus with lilac tones, in lacking pleurocystidia, and in forming larger basidiospores in the range 16-25 × 2.7-5.5



**Figs. 10-20.** Microscopic features. **10-13.** *Marasmius griseoradiatus* (Ovrebo 3590). **10.** Basidiospores. **11.** Broom cells from lamellar edge. **12.** Pleurogloeocystidia. **13.** Broom cells from pileus surface. **14-16.** *Marasmius helvolus* (Ovrebo 3741). **14.** Basidiospores. **15.** Broom cells from lamellar edge. **16.** Broom cells from pileus surface. **17-20.** *Marasmius multiceps* (Ovrebo 3479). **17.** Basidiospores. **18.** Broom cells from lamellar edge. **19.** Broom cells from pileus surface. **20.** Cells from central area of pileus surface. Bar = 10  $\mu\text{m}$ , long line is for spores, shorter line for other features.

$\mu\text{m}$  (Singer 1965b). *Marasmius purpureostriatus* differs in forming a pileus with lilac tones, a pileipellis of broadly clavate, non-setulose cells (i.e., Globulares-type cells), and larger basidiospores in the range  $19\text{-}28 \times 4\text{-}6 \mu\text{m}$  (Desjardin and Horak, 1997).

*Marasmius helvolus* Berk., Hooker's J. Bot. Kew Gard. Misc. 8: 136. 1856

(Figs. 2, 14-16)

*Pileus* 16-35 mm wide, convex when young, broadly convex to plane when mature, sulcate, dry, dull, rugulose at the centre, medium brown (5YR3/4) overall, not discolouring; context immeasurably thin, odor and taste nondescript. *Lamellae* 1.5-4 mm wide, deeply adnexed, not attached to collarium, greyish cinnamon buff, brownish marginate but visible only with lens, distant (lamellae and lamellulae 3-4 mm apart), not intervenose, 9-11 through-lamellae present; lamellulae present and in several tiers. *Stipe* 15-30 mm long, 1-1.5 mm thick, terete, equal, glabrous, dark brown overall with apex buff to cinnamon buff, hollow. White mycelial pad on substrate.

*Basidiospores*  $11.5-13 \times 3-4 \mu\text{m}$  ( $\bar{x} = 12.5 \times 3.5$ ,  $Q_r = 3.43-3.71$ ,  $Q_m = 3.59$ ), in profile fusoid with suprahilar depression to suballantoid, bowling-pin shaped in face view, smooth, thin-walled, hyaline, inamyloid. *Basidia*  $27-34 \times 6-6.5 \mu\text{m}$ , clavate, 4-sterigmate. *Cheilocystidia* of Siccus-type broom cells; body  $11.5-14 \times 5.5-7 \mu\text{m}$ , clavate, hyaline; setulae  $2-8 \mu\text{m}$  long,  $1 \mu\text{m}$  wide, cylindric, apex rounded, somewhat contorted and bumpy, erect or oblique, light yellowish brown. *Hyphae of lamellar trama*  $4-8 \mu\text{m}$  wide, interwoven, cylindric, with yellowish extracellular oil bodies, dextrinoid. *Hyphae of subhymenium*  $2-3 \mu\text{m}$  wide, cylindric. *Pileus surface* composed of Siccus-type broom cells; body  $13-25 \mu\text{m}$  long,  $7-9 \mu\text{m}$  wide, clavate, hyaline; setulae up to  $7 \mu\text{m}$  long,  $1 \mu\text{m}$  wide, equal or tapered only slightly to apex, somewhat contorted or bumpy, erect, golden brown. *Hyphae of pileus trama*  $4-9 \mu\text{m}$  wide, hyaline, dextrinoid. *Hyphae of stipe surface*  $3-4 \mu\text{m}$  wide, appressed, slightly thick-walled, hyaline to pale yellow. *Hyphae of stipe trama*  $3-8 \mu\text{m}$  wide, cylindric, hyaline. *Clamp connections* present.

*Habit and habitat*: Scattered, on large twigs.

*Specimens examined*: PANAMA, Province of Panamá, Gatun Lake, Barro Colorado Island, Barbour-Lathrop Trail, 12 Aug 1999, Ovrebo 3741 (CSU, SFSU, PMA).

*Commentary*: *Marasmius helvolus* is characterised by a brown pileus lacking orange, red or olive tones, basidiospores in the range  $11-15 \times 3-4 \mu\text{m}$ , inconsistent pleurocystidial development, and the absence of caulocystidia. Singer (1976) stated that the species "has somewhat inconstant cystidial characters" although he indicated that pleurocystidia are usually present. Hence, Singer included the species in sect. *Sicci*, subsect. *Siccini*, ser. *Haematocephali* (species with pleurocystidia) but he also included it in the key to ser. *Leonini* (species without pleurocystidia). Singer (1976) reported the species from Brazil (type locality), Ecuador and Bolivia. Pegler (1983) reported *M. helvolus* from Guadeloupe and Trinidad, and indicated that the species usually lacks pleurocystidia or they are "very occasionally present and then inconspicuous." The specimen reported here from Panama lacks obvious

pleurocystidia but in every other way is indistinguishable from *M. helvolus sensu* Singer.

*Marasmius leveilleanus* (Berk.) Pat. (Fig. 3)

*Habit and habitat:* Scattered, on sticks and woody debris.

*Specimens examined:* PANAMA, Province of Panamá, Gatun Lake, Barro Colorado Island, Van Tyne Trail, at base of "Big Tree," 19 May 1997, Ovrebo 3505; 26 May 1997, Ovrebo 3533; 17 May 2000, Ovrebo 3834 (all CSU, PMA).

*Commentary:* For complete description and illustrations of microscopic features, see Ovrebo (1996).

*Marasmius multiceps* Berk. & M.A. Curtis, J. Linn. Soc., Bot. 10: 298. (1869)  
(Figs. 4, 17-20)

*Pileus* 3-10 mm wide, broadly convex when young, plane at maturity, depressed at centre and with papilla, sulcate, dry, glabrous, light buff, papilla brown to black. *Lamellae* up to 1.5-2 mm wide, attached to a collarium, 11-15 per basidiocarp, distant, light buff, not discolourous, lamellulae absent. *Stipe* 6-23 mm long, 0.3 mm thick, wiry, smooth, brownish black to black, buff at apex, insititious. *Rhizomorphs* black, thin (< 0.5  $\mu\text{m}$ ), wiry, branching, aerial or forming a loose mesh on log; numerous basidiomes arise from a common rhizomorph.

*Basidiospores* 6.5-7.5  $\times$  3-3.5  $\mu\text{m}$  ( $\bar{x}$  = 6.94  $\times$  3.03,  $Q_r$  = 2.14-2.5,  $Q_m$  = 2.29), elliptic in profile and face view, adaxial face often slightly flattened, smooth, thin-walled, hyaline, inamyloid. *Basidia and basidioles* 16-24  $\times$  4-6  $\mu\text{m}$ , 4-spored, clavate, basidioles fusoid, hyaline. *Cheilocystidia* present in the form of broom cells; body 10-17  $\times$  5-10  $\mu\text{m}$ , clavate, hyaline; setulae 1-3  $\mu\text{m}$  long 1  $\mu\text{m}$  wide, erect or oblique, apex rounded, hyaline. *Hyphae of lamellar trama* subinterwoven, 3-7  $\mu\text{m}$  wide, hyaline, slowly and weakly dextrinoid. *Hyphae of subhymenium* 2-2.5  $\mu\text{m}$  wide, hyaline. *Pileus surface* a hymeniform layer and composed of two cell-types: (1) cells on the margin and scattered at centre of Siccus-type broom cells; body 13-24  $\times$  7-12  $\mu\text{m}$ , hyaline but in mass pale yellow; setulae 1-4  $\mu\text{m}$  long, 1  $\mu\text{m}$  wide, erect or oblique, apex rounded, hyaline; (2) cells at centre and extending a short way on margin without setulae, 18-30  $\times$  8-12  $\mu\text{m}$ , thick-walled (2  $\mu\text{m}$ ), smooth, yellowish brown to dark brown, cells at very centre forming blackish brown layer as seen under lower magnification. *Hyphae of stipe surface* 3-5  $\mu\text{m}$  wide, thick-walled, smooth, brownish black. *Caulocystidia* absent. *Clamp connections* present.

*Habit and habitat:* Gregarious and numerous (often hundreds), arising from black, common, branching rhizomorphs, the rhizomorphs extend over stumps or logs.

*Material examined:* PANAMA, Province of Panamá, Gatun Lake, Barro Colorado Island: Schneirla Trail, 16 May 1997, Ovrebo, 3479 (CSU, PMA); Shannon Trail, 17 May 1997, Ovrebo 3486 (CSU, SFSU, PMA) & 1 Aug 1999, Ovrebo 3692 (CSU, PMA); trail from Van Tyne to "Big Tree," 9 Aug, 1997, Ovrebo 3586 (CSU, PMA).

*Commentary:* *Marasmius multiceps* was described originally from Cuba, and was made the type species for the new genus *Polymarasmius* by Murrill (1915). *Polymarasmius* was established for species with numerous basidiomes arising from a common rhizomorph. A second species, *Polymarasmius submulticeps* Murrill (1915: 286), was described from British Honduras, and both were accepted by Singer (1976) as conspecific and placed in *Marasmius* sect. *Marasmius* subsect. *Marasmius*. The latter subsection is populated by species with Rotalis-type broom cells. The Panamá specimens reported herein form Siccus-type broom cells, but the apical setulae are very short, divergent, and somewhat suggestive of Rotalis-type cells. In a type study of *M. multiceps* by Dennis (1951), he reports the setulae on pileipellis broom cells as 1-4  $\mu\text{m}$  long, and he illustrates them (Fig. 11) as being apical and of the Siccus-type. In addition, in a type study by Pegler (1987), he illustrates the pileipellis broom cells (Fig. 4V) as Siccus-type cells. Clearly, the broom cells on the type specimen of *M. multiceps* as documented by Dennis and Pegler are identical to those of the Panama specimens reported herein and are of the Siccus-type. Accordingly, *M. multiceps* should be included in sect. *Marasmius* subsect. *Sicciformis* (= subsect. *Penicillati sensu* Singer, 1976).

Distinctive features of *M. multiceps* include small, white pilei with dark brown central papilla, white collariate lamellae, and black, glabrous and insititious stipes that arise directly from black rhizomorphs with numerous basidiomes on a common rhizomorph. The species is widespread in Central America.

*Marasmius praecox* Singer, Sydowia 12: 140. 1959 (Figs. 5, 21-23)

*Pileus* 5-10 mm wide, hemispheric to convex, depressed to subumbilicate at the centre, sulcate from disk to edge, not tuberculate but occasionally bumpy, glabrous, fulvous-reddish brown (7-8EF8, 2.5 YR3/6), centre often the lightest; context immeasurably thin, odor absent, taste nondescript. *Lamellae* 1.5 mm wide, attached to a collarium, off-white, dark reddish brown marginate, subdistant (10-12 per basidiome), lamellulae absent, not intervenose. *Stipe* 17-33 mm long, .3 mm thick, thin, wiry, off-white to light tan, glabrous, insititious; rhizomorphs seen on substrate but basidiomes attached to wood.

*Basidiospores* 8-11  $\times$  5-6  $\mu\text{m}$  ( $\bar{x}$  = 9.8  $\times$  5.48,  $Q_r$  = 1.6-1.9,  $Q_m$  = 1.79), elliptical in profile and face view, smooth, thin-walled, inamyloid. *Basidia* 25-31  $\times$  7.5-9  $\mu\text{m}$ , 4-sterigmate, clavate. *Cheilocystidia* present in the form of



**Figs. 21-27.** Microscopic features. **21-23.** *Marasmius praecox* (Ovrebo 3840). **21.** Basidiospores. **22.** Broom cells from lamellar edge. **23.** Broom cells from pileus surface. **24-27.** *Marasmius scopulatus* (Ovrebo 3573). **24.** Basidiospores. **25.** Hymenial setae and brooms cells from lamellar sides. **26.** Broom cells from lamellar edge. **27.** Broom cells and seta from pileus surface. Bar = 10  $\mu\text{m}$ , long line is for spores, shorter line for other features.

Siccus-type broom cells; body 14-19 × 7-9 µm, clavate, hyaline to pale amber; setulae mostly 3-5 µm long, tapered to a rounded apex, 1-1.5 µm wide at base, erect, melleous. *Pleurocystidia* absent. *Hyphae of lamellar trama* 3-7 µm wide, subparallel, hyaline, non-dextrinoid. *Hyphae of subhymenium* 3-4 µm wide, interwoven, hyaline. *Pileus surface* composed of Siccus-type broom cells; body 12-20 × 7-10(-12) µm, clavate, often flared at the apex, often branched, wall thickened on upper portion, amber; setulae 2-5 µm long, 1-1.5 µm wide at the base, erect, cylindric or tapering to the apex, apex round, brown. *Hyphae of pileus trama* 4-8 µm wide, hyaline, non-dextrinoid. *Hyphae of stipe surface* 2-4 µm wide, appressed, cylindric, hyaline. *Hyphae of stipe trama* 4-8 µm wide, hyaline, non-dextrinoid. *Caulocystidia* absent. *Clamp connections* present.

*Habit and habitat*: gregarious, on log.

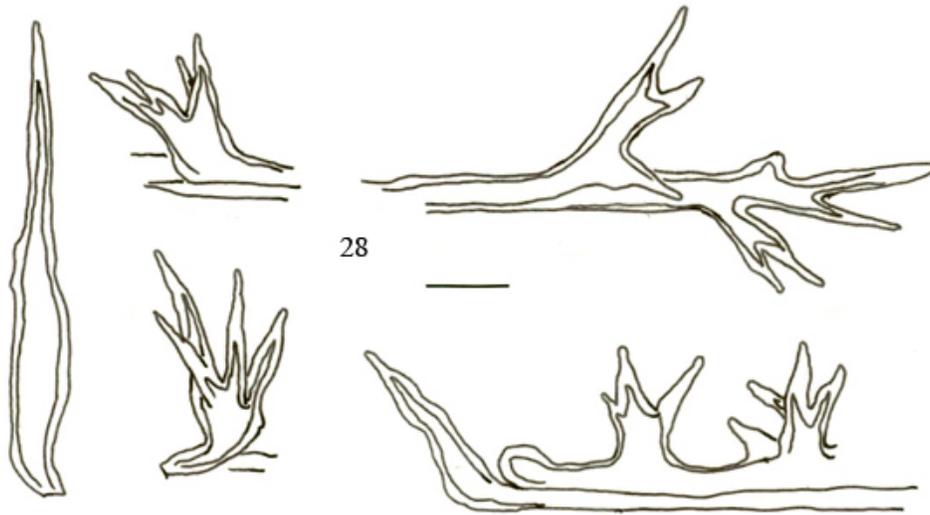
*Material examined*: PANAMA. Province of Panamá Gatun, Lake Barro Colorado Island, Balboa Trail, 18 May 2000, Ovrebo 3840 (CSU, SFSU, PMA).

*Commentary*: *Marasmius praecox* is characterised by lignicolous basidiomes with a small, orange-rufous to terra cotta or reddish brown pileus that often has a paler umbilicus, by distant and broad, collariate lamellae with reddish brown margin, by a wiry, light umber, glabrous, insititious stipe, and by relatively broad basidiospores (in the range 4.5-6.5 µm). The species belongs in sect. *Marasmius* subsect. *Sicciformis* where it is phenetically similar to *M. ruforotula* Singer. The latter species differs only subtly from *M. praecox* by the formation of narrower basidiospores (in the range 3.5-4.5 µm; Holotype FH!). Prior to this report of *M. praecox* from Panamá, the species was known only from Argentina, where Singer (1976) has described several distinct forms varying in pileus colouration. The Panamanian specimen differs slightly from the Argentina material in having basidiomes with more reddish brown pilei (not orange-rufous) that lack a central black spot, and in forming paler stipes (light tan versus light umber to black).

***Marasmius scopulatus* Desjardin & Ovrebo, sp. nov.** (Figs. 6, 24-28)

*Etymology*: *scopulatus* (Latin) - like a broom or brush, referring to the numerous broom cells and setae on the lamellar sides.

*Pileus* 9-30 mm diametro, convexus vel late convexus, sulcatus, ruguloso-umbonatus, glaber, ferruginescens. *Lamellae* adnexae, distantes, latae, bubalinae, rubromarginatae. *Stipes* 30-60 × 1-1.5 mm, cylindraceus, glaber, non-insititius, in apice bubalinus vel luteus, in base brunneus. *Basidiosporae* 8.5-10 × 3.5-4 µm, fusiformes, laeves, hyalinae, inamyloideae. *Basidia* 27-32 × 5-6 µm, 4-spora. *Pleurocystidia* et cheilocystidiaque e setis atque cellulis *M. sicco* similibus composita; setis 38-60 × 4-6 µm, aculeatis, crasso-tunicatis, aurantiaco-brunneis, cellulis *M. sicco* similibus versiformibus, 12-17 × 4-7 µm, clavatis, eae setulis apicalibus paucis vel numerosis, 6-23 × 2.5-3 µm, conicis, crasso-tunicatis, aurantiaco-brunneis praeditae. *Pileipellis* hymeniformis ex elementis *M. sicco* similibus composita, atque setis sparsis, cystidiis hymenialibus similibus. *Caulocystidia* ex elementis sparsis *M. sicco*



**Fig. 28.** Microscopic features, *Marasmius scopulatus* (Ovrebø 3573). Elements from the stipe surface. Bar = 10  $\mu$ m.

similibus, setisque composita. *Fibulae* praesentes. *Basidiomata* lignicolae. Holotypus hic designatus: PANAMA, Barro Colorado Island, Ovrebø # 3573, 8 Aug. 1997 (PMA).

*Pileus* 9-30 mm wide, convex when young, expanding to broadly convex, dry, dull, opaque, sulcate, ridges rounded, centre often with a low, rounded, rugulose umbo, light to medium dull rusty brown overall (between 2.5YR4/8 and 10YR4/8, 6-7D8, between 7E8 and 8E8); context immeasurably thin, buff, odor and taste nondescript. *Lamellae* 1-4 mm wide, deeply adnexed, buff, edge reddish brown, entire, distant (lamellae and lamellulae 2-5 mm apart on largest basidiomes), not intervenose; lamellulae present and in numerous tiers. *Stipe* 30-60 mm long, 1-1.5 mm thick, equal, glabrous, buff over upper half with dull yellow transition zone and brown over lower half, hollow; yellowish strigose mycelium at base, substrate with yellowish buff mycelium. *Chemical colour reactions*: 3% KOH - no reaction.

*Basidiospores* white in deposit;  $8.5-10 \times 3.5-4 \mu\text{m}$  ( $\bar{x} = 9.2 \times 3.7$ ,  $Q_r = 2.25-2.86$ ,  $Q_m = 2.49$ ), fusiform in profile and often with a suprahilar depression, fusiform to bowling-pin shaped in face view, smooth, thin-walled, hyaline, inamyloid. *Basidia and basidioles*  $27-32 \times 5-6 \mu\text{m}$ , 4-sterigmate, basidia clavate, basidioles fusoid, hyaline. *Hymenial cystidia* in the form of Siccus-type broom cells, elements that are transitional between broom cells, and setae, all present on sides and edges, densely clustered on edge. *Setae* 38-60  $\mu\text{m}$  long, 4-6  $\mu\text{m}$  wide at base, aculeate with a subacute apex, occasionally with short branches, thick-walled (1  $\mu\text{m}$  thick at base), orange-brown. *Transitional broom cells* mainly with 2 or 3 to many long setulae; body 12-17  $\times$  4-7  $\mu\text{m}$ , clavate or cylindric, orange-brown; setulae 6-23  $\mu\text{m}$  long, up to 3

$\mu\text{m}$  wide at base, tapered to a subacute apex, erect or angled, orange brown, these cells generally not extending beyond the basidial layer. *Siccus-type broom cells* with consistently shorter setulae present on edge; body  $7\text{-}15 \times 5\text{-}8 \mu\text{m}$ ; setulae up to  $7 \mu\text{m}$  long,  $1 \mu\text{m}$  wide at base, erect, orange brown, all setulae not distinctly dextrinoid. *Hyphae of lamellar trama* interwoven,  $3\text{-}6 \mu\text{m}$  wide, hyaline, dextrinoid. *Pileus surface* a hymeniform layer of *Siccus-type broom cells* with scattered setae; body  $10\text{-}18 \times 5\text{-}8 \mu\text{m}$  cylindrical or clavatae; setulae up to  $10 \mu\text{m}$  long,  $2 \mu\text{m}$  wide at base, tapered to a subacute apex, erect, orange brown; setae like hymenial setae. *Hyphae of stipe surface*  $3\text{-}4 \mu\text{m}$  wide, cylindrical, yellowish brown. *Caulocystidia* present in form of broom cells and setae; setae  $25\text{-}55 \mu\text{m}$  long,  $4\text{-}8 \mu\text{m}$  wide at base, some broom cells lacking a body, and setula-like extensions also arising from thick-walled recumbent hyphae. *Hyphae of stipe context* parallel,  $4\text{-}8 \mu\text{m}$  wide, hyaline, dextrinoid. *Clamp connections* present.

*Habit and habitat:* gregarious on log.

*Material examined:* PANANA. Province of Panamá: Gatun Lake, Barro Colorado Island, Wheeler Trail, 8 Aug 1997, Ovrebo 3573 (PMA, **holotype**; SFSU, **isotype**), Ovrebo 3574 (CSU, PMA); 4 Aug 1999, Ovrebo 3710 (CSU, PMA).

*Commentary:* The presence of setae and broom cells on the sides of the lamellae are a distinctive feature of this species. Their presence places this species in sect. *Sicci*, subsect. *Siccini*, ser. *Spinulosi* (Clemençon) Desjardin. Singer (1958) described provisionally *M. setulosifolius* from sterile material collected in Panamá. Later, Singer (1965a) formally described the species based on additional specimens collected in Bolivia, and chose a specimen from Bolivia as the type. *Marasmius setulosifolius* was described as having thick-walled, melleous to brownish broom cells on the sides of the lamellae with few, spreading apical setulae up to  $24 \mu\text{m}$  long, very similar to those of *M. scopulatus*. However, no setae were reported on the lamellae or in the pileipellis, and accordingly, Singer (1976) placed the species in ser. *Haematocephali*. In addition, *M. setulosifolius* differs in forming an umbilicate pileus and narrower lamellae. *Marasmius scopulatus* is similar to the following setae-bearing species. *Marasmius echinatulus* Singer differs in forming close, non-marginate lamellae and lacks setae on the lamellar sides. *Marasmius flammans* Berk. is a poorly known species with unknown basidiospore features that differs from *M. scopulatus* in forming orange-fulvous pilei, has non-marginate lamellae, and hyaline to stramineous hymenial setae. *Marasmius cohaerens* (Pers.: Fr.) Cooke & Quél. and its varieties differ in forming more numerous and broader lamellae, and more numerous and broader setae on lamellar, pileus and stipe surfaces.

*Marasmius tageticolor* Berk., Hook. J. Bot. 8: 136. 1856 (Figs. 7, 29-31)

*Pileus* 10-17(-30) mm wide, convex to broadly convex, depressed at centre or not, glabrous, sulcate, colouration striped, ridges beet red (11-12E-F7, 11-12E8), sulcations light buff. *Lamellae* up to 2(-4) mm wide, free, edge or outer half white, beet red near pileus, entire, distant, 8-10 per basidiome; lamellulae present but not between all lamellae, not intervenose. *Stipe* 30-40 mm long, 1 mm wide, equal, glabrous, dull, beet red to dull brown. *Basal mycelium* cottony, buff.

*Basidiospores* 17-19 × 3.5-4 μm ( $\bar{x}$  = 18.1 × 3.7,  $Q_r$  = 4.63-5.14,  $Q_m$  = 4.9), elongate, narrowly fusoid in profile and often with suprahilar depression, in face view narrowing toward hilar appendage, smooth, thin-walled, inamyloid. *Basidia* 26-30 × 7-8 μm, clavate, 4-sterigmate, hyaline. *Pleurocystidia* absent. *Cheilocystidia* present in the form of Siccus-type broom cells, but occurring intermittently; body 12-18 × 6-7 (10) μm, cylindric to clavate, hyaline; setulae 4-8 μm long, up to 1.5 μm at base, tapered to a subacute apex, angled or running parallel to one another, hyaline, dextrinoid. *Hyphae of subhymenium* 2-3 μm wide, interwoven. *Hyphae of lamellar trama* subparallel, 3-8 μm wide, hyaline, dextrinoid. *Pileus surface* a hymeniform layer of Siccus-type broom cells; body 10-15 × 5-7 μm, clavate, hyaline; setulae 2-5(7) μm long, tapered to a rounded apex, melleous, slightly dextrinoid. *Hyphae of pileus trama* 3-8 μm wide, hyaline, dextrinoid. *Hyphae of stipe surface* 2-3 μm wide, appressed, cylindric, hyaline; caulocystidia lacking. *Hyphae of stipe trama* 3-6 μm wide, hyaline, dextrinoid. *Clamp connections* present but not conspicuous.

*Habit and habitat*: scattered, on *Heliconia* debris.

*Specimens examined*: PANAMA. Province of Panamá: Gatun Lake, Barro Colorado Island, Station Compound, 6 Aug 2001, Ovrebo 4040 (CSU, SFSU, PMA).

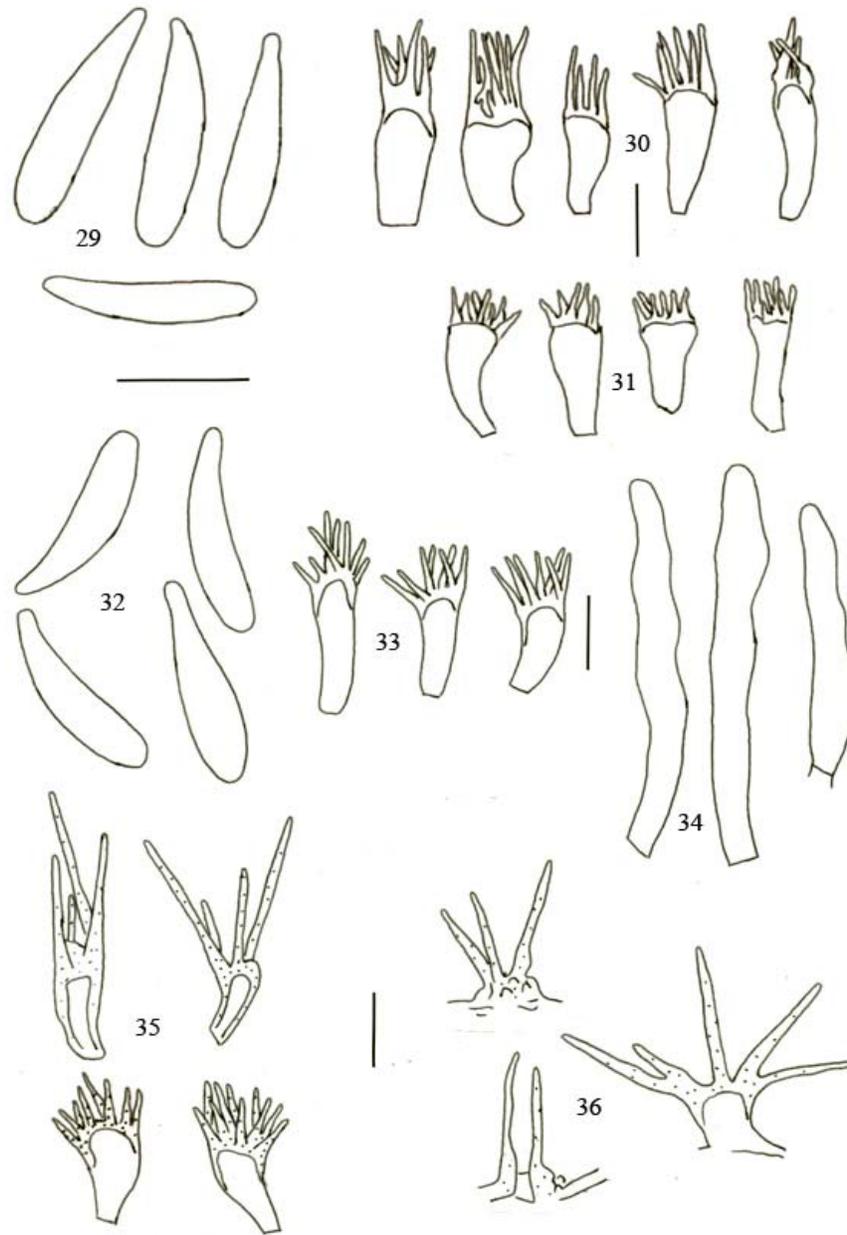
*Commentary*: *Marasmius tageticolor* is a striking species because of the striped, red-coloured pileus. It was described from Brazil and also recorded from Mexico and Venezuela (Singer, 1976). The species belongs in section *Sicci*, subsect. *Siccini*, ser. *Leonini*.

*Marasmius tenuisetulosus* (Singer) Singer, Fl. Neotropica 17: 220. 1976

(Figs. 8, 32-36)

= *Marasmius grandisetulosus* var. *tenuisetulosus* Singer, Bull. Jard. Bot. État 34: 380. 1964.

*Pileus* 13-40 mm wide, convex when young, broadly convex to plane when mature, dry, dull, weakly translucent-striate to disc, shallowly sulcate to disc, centre smooth or rugulose, disc dull dark brown, elsewhere dull brownish ochre (5 YR 4/6 - 7.5 YR 4/6, 7.5 YR 5/8, 6E8), often with a frosted sheen to surface (spores?), context immeasurably thin, buff to brown, odor slightly



**Figs. 29-36.** Microscopic features. **29-31.** *Marasmius tageticolor* (Ovrebo 4040). **29.** Basidiospores. **30.** Broom cells from lamellar edge. **31.** Broom cells from pileus surface. **32-36.** *Marasmius tenuisetulosus* (Ovrebo 3593). **32.** Basidiospores. **33.** Broom cells from lamellar edge. **34.** Pleurogloeocystidia. **35.** Broom cells from pileus surface. **36.** Elements from stipe surface. Bar = 10  $\mu$ m, long line is for spores, shorter line for other features.

fragrant, taste nondescript, perhaps a little potato-like. *Lamellae* 2.5-4 mm wide, adnexed, dull yellowish buff, not discolouring, not marginate, entire, subdistant (lamellae and lamellulae 1-2 mm apart), not intervenose but occasionally rugulose, lamellulae abundant and of varying lengths. *Stipe* 15-70 mm long, 1-2.5 mm thick, equal, glabrous, dark brown overall, occasionally buff at the apex, hollow; base with ochre mycelium. *Chemical colour reactions*: 3% KOH - no reaction.

*Basidiopores* 15-16(-17) × 3.5-4.5 μm ( $\bar{x}$  = 15.36 × 4.04,  $Q_r$  = 3.33-4.29,  $Q_m$  = 3.81), fusoid with adaxial face straight or slightly concave and then somewhat allantoid, fusoid or somewhat bowling-pin shaped in face view, smooth, thin-walled, hyaline. *Basidia and basidioles* 20-30 × 4-8 μm; basidia clavate and 4-sterigmate, basidioles fusoid, hyaline. *Cheilocystidia* present in the form of Siccus-type broom cells; body 12-16 × 5-6 μm, hyaline; setulae 3-13 μm long, 1-1.5 μm wide at base, tapered to a rounded apex, hyaline to melleous. *Pleurocystidia* gloeocystidioid, 35- 60 × 5-7 μm, cylindric, cylindro-flexuous or slightly geniculate, without distinctive content but translucent, hyaline. *Hyphae of lamellar trama* 4-8 μm wide, subparallel to slightly interwoven, hyaline, dextrinoid. *Hyphae of subhymenium* 2-3 μm wide, cylindric, hyaline. *Pileus surface* a hymeniform layer of Siccus-type broom cells; body 8-12 × 5-6.5 μm, hyaline; setulae on most cells 2-8 μm long, 1 μm wide at base, tapered to a rounded apex, some cells with setulae 15-30 μm long, 1-1.5 μm wide at base, all setulae yellowish brown. *Hyphae of stipe surface* 2-4 μm wide, cylindric, smooth, ochre-brown. *Caulocystidia* present at apex and scattered to rare elsewhere on stipe; body poorly developed or appearing collapsed; setulae mainly 18-25 μm long, 1-2 μm wide at base, erect or angled, occasionally rosette-like appearance, yellowish brown. *Hyphae of stipe trama* 3-8 μm wide, cylindric, hyaline. *Clamp connections* present.

*Habit and habitat*: scattered to gregarious, on wood debris, twigs or log.

*Specimens examined*: PANAMA. Province of Panamá, Gatun Lake, Barro Colorado Island, Shannon Trail, 10 Aug 1997, Ovrebo 3593 (CSU, SFSU, PMA); Barbour Lathrop Trail, 2 Aug 1999, Ovrebo 3703 (CSU, PMA); Buena Vista Peninsula, 16 Aug 1999, Ovrebo 3753 (CSU, PMA).

*Commentary*: *Marasmius tenuisetulosus* was described originally from Zaire, Africa, as a variety of *M. grandisetulosus* Singer, differentiated from the type variety by having broom cell setulae with narrower bases (1-1.7 μm vs. 1.8-4.5 μm diam; Singer, 1964). Upon collecting material from northern coastal Colombia (Buenaventura), Singer elevated the variety to species rank and expanded the range of the species to the New World. We have not studied the type specimen from Africa, but our material from Panamá matches the specimen from Colombia quite nicely, differing only subtly in forming slightly

shorter basidiospores. Whether the New World and Old World populations are conspecific cannot be evaluated at present.

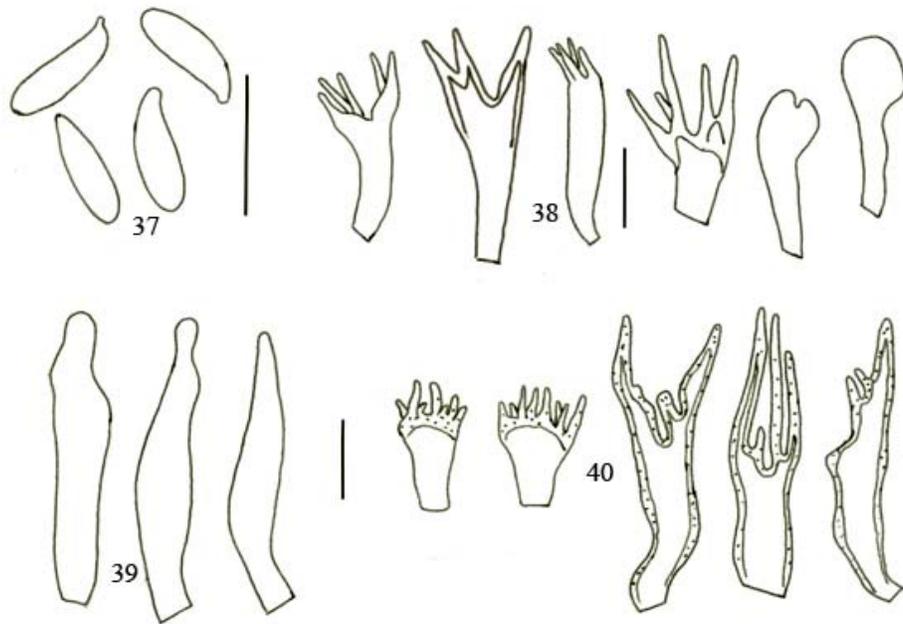
***Marasmius variabilis* Desjardin & Ovrebo, sp. nov.** (Figs. 9, 37-40)

*Etymology:* *variabilis* (Latin) - variable, referring to the versiform cheilocystidia and pileipellis broom cells.

*Pileus* 9-20 mm diametro, convexus vel planus, sulcatulatus, glaber, cremeo-bubalinus. *Lamellae* adnexae, subdistantes, mediocriter latus, bubalinus, immarginatus. *Stipes* 16-60 × 1 mm, cylindraceus, glaber, non-insititius, in apice bubalinus, in medio lutescenti-brunneus, in base brunneus. *Basidiosporae* 8-9 × 2.5-3 μm, angustae, ellipsoideae, laeves, hyalinae, inamyloideae. *Basidia* 21-28 × 5-6 μm, 4-spora. *Pleurocystidia* 20-40 × 6-8 μm, fusoida vel clavato-subcapitata, hyalina. *Cheilocystidia* versiformia, 15-30 × 5-9 μm, setulis nullis vel paucis vel numerosis, 3-10 × 1-2 μm, obtusis vel acutis, hyalinis. *Pileipellis* hymeniformis ex elementis *M. sicco* similibus composita, setulis variis cellulisque setaceis praedita; setulis 2-20 × 1-2 μm, conicis, hyalinis vel aureo-brunneis; setis 22-40 × 3-7 μm, crasso-tunicatis, aureo-brunneis. *Caulocystidia* nulla. *Fibulae* praesentes. *Basidiomata* lignicolae foliicolaeque. Holotypus hic designatus: PANAMA, Barro Colorado Island, Ovrebo # 3588, 9 Aug. 1997 (PMA).

*Pileus* 9-20 mm wide, convex when young, expanding to broadly convex to plane, very slightly sulcate, translucent-striate to centre, flesh-creamy buff (5A2), darkest at centre, not discolouring, context thin, less than 1 mm thick, buff, odor and taste distinctive but nondescript. *Lamellae* 1-2.5 mm wide, adnexed, light buff, not discolouring, subdistant (lamellae and longer lamellulae 1-1.5 mm apart on largest carpophores), not intervenose but rugulose-pitted as seen with 10X lens, occasionally forked, lamellulae present and in varying lengths. *Stipe* 16-60 mm long, 1 mm thick, equal, glabrous, buff at apex, with a yellowish brown transition zone and brown over the lower third or half, hollow; base with golden strigose mycelium. Pale yellow mycelium on substrate. *Chemical colour reactions:* 3% KOH - no reaction.

*Basidiospores* white in deposit; 8-9 × 2.5-3 μm ( $\bar{x}$  = 8.35 × 2.88,  $Q_r$  = 2.67-3.2,  $Q_m$  = 2.92), narrowly elliptic in profile and face view, smooth, thin-walled, hyaline, inamyloid. *Basidia* 21-28 × 5-6 μm, 4-sterigmate, clavate, hyaline. *Pleurocystidia* gloeocystidoid, 20-40 × 6-8 μm, cylindric, fusoid or clavate often with a subcapitate apex, smooth, thin-walled, without distinctive contents but slightly translucent, hyaline. *Cheilocystidia* present, with or without setulae; body including the cells without setulae 15-30 × 5-9 μm, clavate or cylindric; setulae when present few to numerous, 3-10 μm long, 1-2 μm wide at the base, tapered to a rounded apex, erect or angled, hyaline; cystidia without setulae swollen at the apex and often with bumps or bulges. *Hyphae of lamellar trama* 3-11 μm wide, subparallel, hyaline, dextrinoid. *Pileus surface* a hymenium of Siccus-type broom cells of three types based on setulae length: (1) setulae 2-5 μm long, 1 μm wide at base, tapered to a rounded apex, golden brown; body 9-15 μm × 4.5-6 μm, clavate, hyaline; (2)



**Figs. 37-40.** Microscopic features, *Marasmius variabilis* (Ovrebo 3588). 37. Basidiospores. 38. Cells from lamellar edge. 39. Pleuro-gloeocystidia. 40. Elements from the pileus surface. Bar = 10  $\mu\text{m}$ , long line is for spores, shorter line for other features.

setulae 5-20  $\mu\text{m}$  long, 1-2  $\mu\text{m}$  wide at base, tapered to a rounded apex, erect, golden brown; body 11-15  $\times$  7  $\mu\text{m}$ , thick-walled, golden brown, the cells with shorter setulae the dominant type; (3) setoid cells without a distinct body, 22-40  $\times$  3-7  $\mu\text{m}$ , golden brown. *Stipe surface* without broom cells; surface hyphae 3-5  $\mu\text{m}$ , cylindric, thin-walled, pale yellow. *Hyphae of stipe trama* 3-9  $\mu\text{m}$  wide, hyaline, thin-walled. *Clamp connections* present.

*Habit and habitat:* gregarious, on log and leaf litter.

*Material examined:* PANAMA. Province of Panamá, Gatun Lake, Barro Colorado Island, Fausto Trail, 9 Aug 1997, Ovrebo 3588 (PMA, **holotype**; SFSU, **isotype**).

*Commentary:* This new species belongs in sect. *Sicci*, subsect. *Siccini*, ser. *Haematocephali*. It is characterised by basidiomes with creamy-buff to nearly white pilei, subdistant and non-marginate lamellae, glabrous stipe, relatively small basidiospores, numerous pleurogloeocystidia, and versiform cheilocystidia and pileipellis broom cells. The most striking feature of the species is the variability in cheilocystidia morphology. In *M. variabilis*, the cheilocystidia range from typical *Siccus*-type broom cells to irregularly clavate and non-setulose cells. Few known *Marasmius* species develop both broom cells and non-setulose cystidia on the lamellae edge. *Marasmius flosculus*

Berk. described from New Ireland (Papua New Guinea) differs in forming tiny (up to 3 mm diam), umber pilei and larger basidiospores (16-19 × 4.5-5.2 μm; Desjardin and Horak 1997). *Marasmius anisocystidiatus* Antonín, Desjardin & Gsell, described from a greenhouse in Zürich, Switzerland, differs in forming darker pigmented pilei, fewer lamellae, and larger basidiospores (16-20 × 4.5-6 μm; Antonín *et al.*, 1992).

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