

Some interesting Boletales (Basidiomycota) from Quintana Roo, Mexico

Algunos Boletales interesantes (Basidiomycota) de Quintana Roo, México

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RESUMEN

Antecedentes: Los Boletales se estudian ampliamente en bosques templados, pero en bosques tropicales son poco conocidos.

Objetivo: El objetivo de este trabajo es incrementar el conocimiento sobre los Boletales Tropicales de México.

Métodos: Se realizaron exploraciones micológicas entre 2014 y 2017 en el estado de Quintana Roo. Todos los especímenes se herborizaron y depositaron en el herbario "José Castillo Tovar" en el Instituto Tecnológico de Ciudad Victoria (ITCV).

Resultados y conclusiones: Se describen seis especies, de las cuales *Phlebopus brasiliensis*, *Suillus decipiens*, *Scleroderma nitidum* y *Xerocomus coccolobae* son nuevos registros para Quintana Roo. Se presenta una clave para las especies de Boletales registradas en Quintana Roo.

Palabras clave: hongos tropicales, Península de Yucatán, hongos ectomicorrícicos.

ABSTRACT

Background: Boletales are studied widely in temperate forest, but in tropical forest are little known.

Objective: The aim of this paper is to increase the knowledge of tropical Boletales from Mexico.

Methods: Mycological explorations were carried out between 2014 and 2017 in Quintana Roo state. All the specimens were herborized and deposited at mycological herbarium "José Castillo Tovar" of Instituto Tecnológico de Ciudad Victoria (ITCV).

Results and conclusions: Six species are described, and *Phlebopus brasiliensis*, *Suillus decipiens*, *Scleroderma nitidum* and *Xerocomus coccolobae* are new records from Quintana Roo. A key of species for Boletales occurring in Quintana Roo is provided.

Keywords: tropical fungi, Yucatán Peninsula, ectomycorrhizal fungi.

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INTRODUCTION

The order Boletales Gilbert was proposed for grouping all putrescent fungi with poroid hymenia (Gilbert, 1931). Currently, the Boletales includes also agaricoid, sequestrate and resupinate fungi classified in 17 families, and more than 1316 species in the world (Binder and Hibbett, 2006; García-Jiménez *et al.*, 2013). Most species of Boletales are ectomycorrhizal and grow in association with members of Pinaceae, Fagaceae, Salicaceae, Betulaceae, Fabaceae, Nyctaginaceae, and

Polygonaceae, but there are also some saprotrophic. Some Boletales have both economic and ecological importance as many species are edible (Henkel *et al.*, 2002; Ortiz-Santana *et al.*, 2007; García-Jiménez *et al.*, 2013) and they also play a central role in translocation of nutrients from soil to different hosts in the forest. Several Boletales surveys have been conducted in Central and Northern Mexico (García and Castillo, 1981; García *et al.*, 1986; Singer *et al.*, 1990, 1991, 1992; González-Velázquez and Valenzuela, 1993, 1995, 1996; García-Jiménez, 1999; García-Jiménez and Gar-

za-Ocañas, 2001; Cázares et al., 2008; García-Jiménez et al., 2013; Baroni et al., 2015). However, researchs on Boletes from tropical forest and coastal vegetation are still scarce. Only 11 species of Boletales have been recorded from Quintana Roo (Chío and Guzmán, 1982; Guzmán, 1982, 1983; Pérez-Silva et al., 1992; Singer et al., 1992; García-Jiménez, 1999; Chay-Casanova and Medel, 2000; Pompa-González et al., 2011) (Table 1). Boletales are scarce in well-established tropical dry forest from Northern Yucatan Peninsula, (Hasselquits et al., 2011), but appear to be common in disturbed vegetation from Quintana Roo according to our observations. It is possible that Boletales form mycorrhizas with some tree species characteristic from early successional vegetation stages, for example *Coccoloba spicata* Lundell and *Lysiloma latisiliquum* (L.) Benth., this process has been reported by Singer and Morello (1960). However, there are poorly explored ecosystems in southern Quintana Roo, like the lowland savanna with *Pinus caribaea* Morelet and exuberant tropical forests

near the Belize's frontier that have been recognized by mycologists as a well conserved area with a high richness of fungal species (López et al., 2011). The aim of this paper is to provide information about Boletales of Quintana Roo and set the foundations of new mycological surveys in the Mexican tropical forest.

MATERIALS AND METHODS

The explorations were made in the state of Quintana Roo, in the Yucatan Peninsula, Mexico in the year period 2014-2017 (Figure 1). The collection sites were dominated by lowland forests with *Coccoloba diversifolia* Jacq., *Gymnanthes lucida* Sw., *Chrysobalanus icaco* L., and *Gymnopodium floribundum* Rolfe; tropical forest dominated by Sapotaceae and Fabaceae, lowland savanna with *P. caribaea*, *C. diversifolia* and *G. floribundum* and disturbed vegetation with *Coccoloba* sp. and *L. latisiliquum*. Methods of Lodge et al. (2004) were followed for sampling and collecting

TABLE 1. Boletales of Quintana Roo, Mexico

TAXA	HABITAT	REFERENCE
Boletaceae		
<i>Boletellus cubensis</i> (Berk. & M.A. Curtis) Singer	Urban Gardens, disturbed vegetation	Singer et al. (1993)
<i>Octaviania ciquroensis</i> Guzmán	Tropical forest	Guzmán (1982)
<i>Pulveroboletus aberrans</i> Heinem. & Gooss.-Font.	Tropical forest	Guzmán (1983)
<i>Xerocomus caeruleonigrescens</i> Pegler	Tropical forest	García-Jiménez (1999)
<i>Xerocomus coccolobae</i> Pegler	Coastal vegetation, urban gardens	This work
<i>Xerocomus cuneipes</i> Pegler	Tropical forest	García-Jiménez, 1999
Boletinellaceae		
<i>Phlebopus brasiliensis</i> Singer	Lowland forest, disturbed vegetation	This work
<i>Phlebopus colossus</i> (R. Heim) Singer	Tropical forest	Guzmán (1983)
<i>Gyrodon intermedius</i> (Pat.) Singer	Tropical forest	Chío and Guzmán (1982)
Sclerodermataceae		
<i>Scleroderma albidum</i> Pat. & Trab.	Tropical forest	Pérez-Silva et al. (1992)
<i>Scleroderma areolatum</i> Ehrenb	Tropical forest	Pérez-Silva et al. (1992)
<i>Scleroderma bermudense</i> Coker	Tropical forest, urban gardens	Guzmán et al. (2013)
<i>Scleroderma nitidum</i> Berk.	Lowland forest, disturbed vegetation	This work
<i>Scleroderma sinnamariense</i> Mont.	Tropical forest	Pompa-González et al. (2011)
Suillaceae		
<i>Suillus decipiens</i> (Peck) Kuntze	Pine savanna	This work

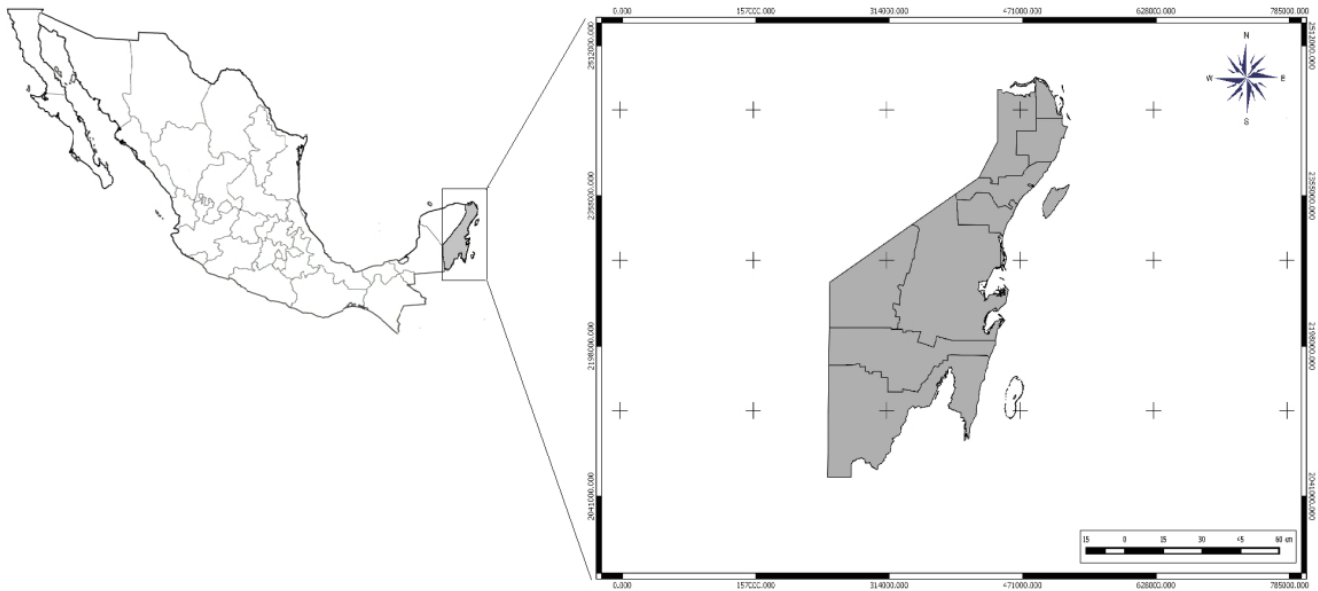


FIGURE 1. State of Quintana Roo in the Yucatán Peninsula, Southern Mexico.

macrofungi. Hand-cut sections were mounted in KOH 5% for microscopical descriptions of the species. The handbook of color of Kornerup and Wanscher (1978) was used for identifying color of basidiomata. A key of Boletales species occurring in Quintana Roo is given. The specimens were deposited at the "José Castillo Tovar" herbarium in the Instituto Tecnológico de Ciudad Victoria (ITCV).

RESULTS

Six species belonging to four families (Boletaceae, Boletinellaceae, Sclerodermataceae and Suillaceae) were studied. A taxonomic description, discussion and illustrations are provided for each species (Figures 2 and 3). All records except *Boletellus cubensis* (Berk. & M.A. Curtis) Singer and *Scleroderma bermudense* Coker are new records from Quintana Roo. Most of the species were registered in disturbed vegetation, lowland forest or urban gardens.

Description of species

Boletellus cubensis (Berk. & M.A. Curtis) Singer, *Farlowia* 2(1): 127 (1945)

Figures 2 A, 3 A-D

Pileus 30-60 mm, convex, areolated, covered with greyish tomentose cracks (30C6), being more conspicuous on the center, background whitish or pastel red (9A4) to dull red (9B4) or greyish green tints (30C6), dry

texture, appendiculate, with veil rests projecting from margin. Tubes yellowish, 5 mm long, not bruising. Pores angular, radially arranged, up to 1 mm diameter, yellowish (30A7), adnate, not bruising. Stipe 81-120 × 7-9 mm, solid, with a bulbous base, fully covered by greyish (30C6) conspicuous scales, background color white but reddish (9A4) at the apex. Context 9 mm to the disk, whitish, not bruising. Odor and taste indistinct. Basidiospores 13.2-21.6 × 6.3-8.1 μm (L=17.6 W=7.21, Q=2.42, N=30) fusoid or subfusoid, with suprahilar depression, longitudinally winged, with transverse striation, light brown and yellow in KOH. Basidia 26.1-35.4 × 12.0-17.0 μm, clavate, hyaline in KOH, four-spored, thin walled. Pleurocystidia 50.0-62.5 × 9.0-14.0 μm, ventricose, fusoid, hyaline in KOH, thin-walled. Cheilocystidia 48.0-58.5 × 9.0-14.0 μm, ventricose, fusoid or rostrate, hyaline in KOH, sometimes with incrustated pigments, thin-walled. Hymenophoral trama bilateral with a medium strata and lateral strata composed by cylindrical hyphae 2.9-5.7 μm, hyaline to pale yellowish in KOH, thin-walled. Pileipellis composed by interwoven cylindrical hyphae, yellowish color with terminal cells, 27.7-61.9 × 5.0-9.4 μm, clavate, cylindrical. Stipitipellis composed by caulocystidia 20.0-61.3 × 10.2-15.0 μm, clavate or ventricose, hyaline in KOH.

Studied material: Quintana Roo: Othon P. Blanco, Laguna Guerrero village, *de la Fuente 47*, October 26, 2014 (ITCV). Chetumal, *García and López 5471*, January 15,



FIGURE 2. Studied species. A. *Boletellus cubensis*, B. *Xerocomus coccolobae*, C. *Phlebopus brasiliensis*, D. *Scleroderma bermudense*, E. *Scleroderma nitidum*, F. *Suillus decipiens*.

1988 (ITCV). Bacalar, Bacalar city, *de la Fuente and Barboza* 197, October 19, 2015 (ITCV).

Distribution: Mexico, Belize, Costa Rica, Cuba (Ortiz-Santana *et al.*, 2007), Martinique, and Guadeloupe (Pegler, 1983). This species was described from Quintana Roo by Singer *et al.* (1992).

Discussion: This species can be recognized by the areolated pileus and the grey scales on the stipe. Recent collections from different localities were performed. The material agrees with those described by Ortiz-Santana *et al.* (2007). *Boletellus cubensis* can be often found on secondary forest and on road edges, it might form mycorrhizas with Polygonaceae and Sapotaceae. Pileus with appendiculate margin was considered by Pegler (1983), but was not described by Singer *et al.* (1992) nor Ortiz-Santana *et al.* (2007).

Xerocomus coccolobae Pegler, Kew Bull. Addit. Ser. 9: 576 (1983)

Figures 2 B, 3 E-H

Pileus 41-59 mm, convex, brown color (7F8), dry, minutely tomentose, sometimes cracked showing pale brown context (5A3), entire margin. Tubes 3-8 mm, yellowish (30A7), decurrent, not separating when cutting, bruising greenish blue when injured. Pores angulose, wide (>1.5 mm), yellowish (30A7), bruising blue when injured. Stipe 40-59 × 4-6 mm, solid, fibrous, slender, pale brown (5B4) whitish near the base. Context 7-12mm whitish bruising pale yellow at pileus, blue near the tubes and pinkish red near the base of stipe. Odor and taste fungoid. Yellowish basal mycelial present.

Basidiospores 10.0-13.0 × 4.8-6.0 μm (L=11.60, W=5.13, Q=2.25, N=30), fusiform to subfusiform, with suprahilar depression, thin walled, olive brown in KOH. Basidia 24.0-30.5 × 10.5-13.7 μm, clavate, four-spored, with granular content. Pleurocystidia 60.0-94.0 × 7.5-10.0 μm, ventricose, hyaline in KOH, thin-walled. Cheilocystidia 39.0-60.0 × 10.2-15.0 μm, ventricose, sometimes rostrate, hyaline in KOH, thin-walled. Hymenophoral trama bilateral, xerocomoid, with a medium strata and lateral strata composed cylindrical hyphae 2.5-12.0 μm diameter. Pileipellis composed by erected chains of globose or elongated cells, with terminal cells 26.3-42.7 × 7.3-11.5 μm, clavate, ventricose or cylindrical, hyaline in KOH, thin-walled. Caulocystidia 26-35 × 11-14 μm, cylindrical, clavate or fusoid, hyaline, thin-walled.

Studied material: Quintana Roo: Othon P. Blanco, gardens of Instituto Tecnológico de Chetumal (ITCh), *de la Fuente* 37, October 14, 2014 (ITCV). Chetumal, Boulevard Bahía, *de la Fuente* 41, November 30, 2014 (ITCV). Santa Helena village, *de la Fuente* 254, January 08, 2017 (ITCV).

Distribution: Martinica and Mexico (Veracruz and Yucatan) (Pegler, 1983; García-Jiménez, 1999).

Discussion: This species can be recognized by the wide pores, the brown stipe and the slender, whitish stipe. Our description agrees with Pegler (1983) and García-Jiménez (1999). This is one of the tropical species in America. The original description from Martinica Island in the Lesser Antilles agrees with the material examined from Veracruz and Yucatan. This species might grow at coastal zones on the East and on the Caribbean zone in Mexico associated with *C. spicata* and *C. uvifera*, as described by Pegler (1983).

Phlebopus brasiliensis Singer in Singer, Araujo & Ivory, Beih. Nova Hedwigia 77: 43 (1983)

Figures 2 C, 3 I-L

Pileus reaching 60 mm, convex, dark brown to brown (5F3-5D8), dry texture, minutely tomentose, sometimes minutely cracked when dry, with projecting margin, pale brown and entire. Tubes 4 mm, adnate, light cream color (5A2-5A3) not bruising. Pores small (< 1mm), cream to pale yellow to cream (5A2-5A3), rounded, not bruising. Stipe 21 × 30 mm, solid, with bulbous base, cream at the apex (5A2), dark brown at the base (5F4), dry, smooth, slightly bruising orange when injured. Context whitish to cream to pale brown (5A2) irregularly bruising brown when cut. Odor and flavour indistinct.

Spores 4.5-7.0 × 3.5-5.5 μm (L=6.20, W=4.56, Q=1.35, N=30) ovate, smooth, thin-walled, light brown in KOH. Basidia 16.0-24.5 × 7.0-10.0 μm, clavate, four-spored, hyaline in KOH. Cheilocystidia 27.5-49.2 × 1.2-13.8 μm, clavate, fusoid with short neck, not abundant, hyaline in KOH, thin-walled. Hymenophoral trama bilateral, with medium strata and lateral strata composed by cylindrical hyphae 3.5-7.5 μm diameter, hyaline to pale yellowish in KOH, gelatinized. Pileipellis composed by interwoven trichodermium of hyaline yellowish in KOH hyphae, reaching 8.0 μm diameter, with terminal cells, 35.6-62.2 × 6.0-8.5 μm, cylindrical, with rounded, lanceolated apex, with clamp connections at base. Stipitipellis with interwoven, hyaline in KOH, thin-walled hyphae, with terminal cells, 38.5-43.0 × 6.0-12.0 μm diameter, cylindrical.

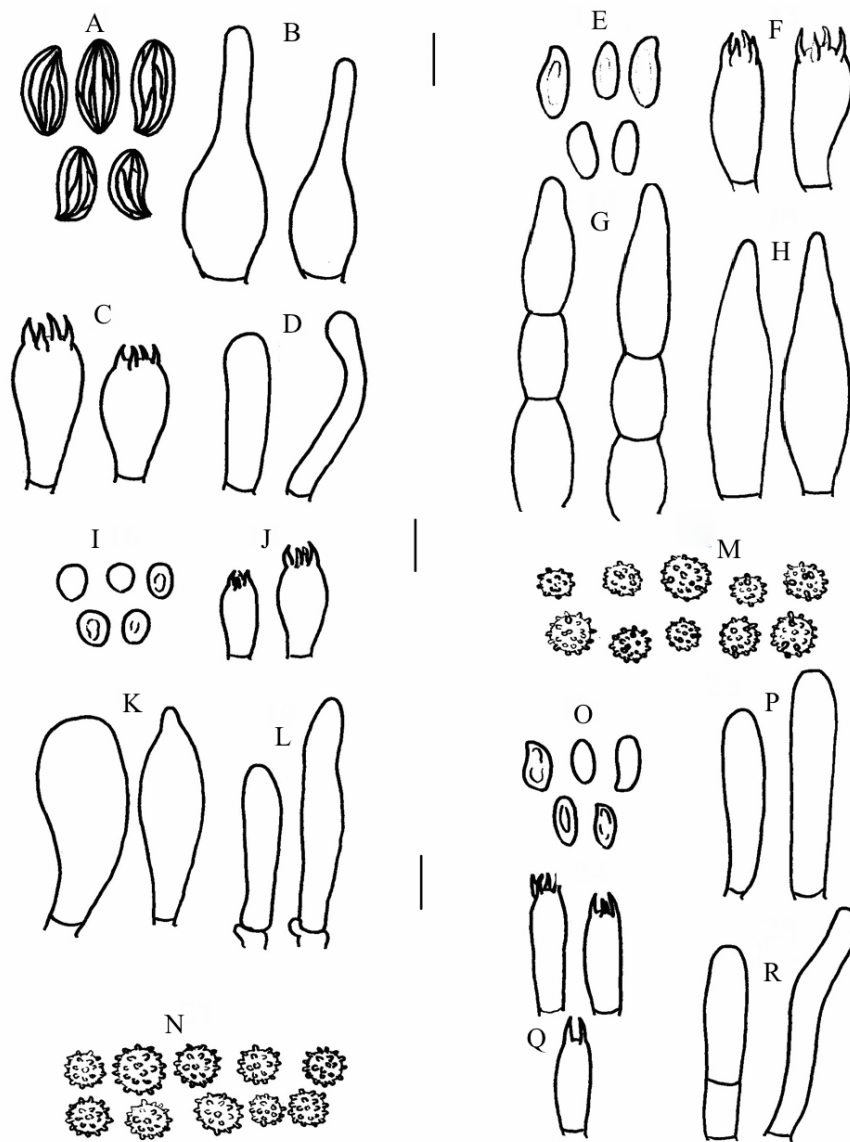


FIGURE 3. Microscopical features. A-D: *Boletellus cubensis*. A. Basidiospores, B. Cheilocystidia, C. Basidia, D. Elements of pileipellis. E-H: *Xerocomus coccolobae*. E. Basidiospores, F. Basidia, G. Elements of pileipellis, H. Cheilocystidia. I-L: *Phlebopus brasiliensis*. I. Basidiospores, J. Basidia, K. Cheilocystidia, L. Elements of pileipellis. M: *Scleroderma bermudense*. Basidiospores. N: *Scleroderma nitidum*. Basidiospores. O-R: *Suillus decipiens*. O. Basidiospores, P. Cheilocystidia, Q. Basidia, R. Elements of pileipellis. Scale bar: 10 μ m.

Studied material: Quintana Roo: Felipe Carrillo Puerto, Señor village, in lowland forest, *de la Fuente and Francisco Chan 46*, October 10, 2014 (ITCV). Chiapas: Unión Juárez, *Guzmán 30774*, October 18, 1997 (ITCV). Distribution known: Mexico (Chiapas, Jalisco and Veracruz) and Brazil (Singer *et al.*, 1983; García-Jiménez and Garza-Ocañas, 2011).

Discussion: This species can be recognized in field by the dark brown pileus, the small rounded pores and the bulbous stipe. The material agrees with the described by García-Jiménez (1999) and Singer *et al.* (1983), but with wider cheilocystidia. Singer *et al.* (1983) reported mucronate to fusoid cheilocystidia, meanwhile García-Jiménez

(1999) reported clavate cheilocystidia. Our material has both cheilocystidia shapes. Guzmán (1983) recorded *P. colossus* in Quintana Roo, that species differs in the context bruising blue when cut and the pileus size, being *P. colossus* bigger. *Phlebopus mexicanus* Cifuentes, Cappello, T. J. Baroni & B. Ortiz is similar tropical species, but it differs in the bluish reaction when cut (Baroni *et al.*, 2015).

Scleroderma bermudense Coker, *Mycologia* 31(5): 624 (1939)

Figures 2 D, 3 M

Basidiomata 15-30 mm, subhypogeous, sessile, with peridium whitish to pale greenish (30D8) or pale brown

(5E5), covered by conspicuous dry scales or cracks. Stelliform when mature, showing to 4-7 branches. Context whitish to brownish. Dusty gleba, dark gray (5F1) in young basidiomata to purplish to brown (5E4) in immature specimens. Whitish color rizomorphs are presents.

Basidiospores $6.6-8.9 \times 6.2-8.2 \mu\text{m}$ (L=5.95, W=5.60, Q=1.06, N=30), echinulated, with a poor developed reticulum, $1.0 \mu\text{m}$ long, thick walled ($1.0 \mu\text{m}$), light green in KOH. Basidia no observed. Peridium composed by interwoven, hyaline, thick walled hyphae, $3.0-5.0 \mu\text{m}$ diameter, with rounded apex. Clamp connections presents. Studied material: Quintana Roo: Othón P. Blanco, Chetumal on urban gardens, *de la Fuente 43*, September 30, 2014 (ITCV). Laguna Guerrero village on lowland forest, *de la Fuente 264*, January 11, 2017 (ITCV). Luis Echeverría village, on coastal vegetation, *de la Fuente 295*, January 17, 2017 (ITCV).

Distribution: Mexico and Caribbean countries (Guzmán *et al.*, 2013).

Discussion: *Scleroderma bermudense* can be recognized by the stelliform dehiscent basidioma. It is a very common species that can grow forming mycorrhizas with *Coccoloba* species, mainly *C. spicata* on urban gardens and *C. uvifera* in sand dunes and coastal vegetation. Our description agrees with Guzmán *et al.* (2013), being our material bigger and with peridium that does not brush red color when bruised. *Scleroderma albidum* Pat. & Trab. is a similar species, but has bigger spores and lacks clamp connections. *Scleroderma sinnamariense* Mont., another similar species, shows a sulfur yellow peridium context and a poor developed pseudostipe (Guzmán, 1970). Those species have been previously recorded from northern Quintana Roo (Pompa-González *et al.*, 2011). Guzmán (1983) recorded *S. sinnamariense* Mont. and *S. stellatum* Berk. from Quintana Roo; those materials belong to *S. bermudense* according to Guzmán *et al.* (2013).

Scleroderma nitidum Berk., Hooker's J. Bot. Kew Gard. Misc. 6: 173 (1854)

Figures 2 E, 3 N

Basidiomata 7-14 mm, globose to subglobose, subhypogeous, sometimes with a short pseudostipe, up to 2 mm long. Peridium thin and fragile, pale brown (5A3), densely covered by minutely dark brown scales (5D8), being more conspicuous and big near the base or pseudostipe. Apical pore present, reaching 3 mm in diameter never stelliform. Context cream to brown-

ish. Gleba greyish and compact in young specimens, olive brown and powdery in mature basidiomata with yellowish to whitish veins. Odor and taste rubbery.

Basidiospores $6.0-8.5 \times 5.0-7.5 \mu\text{m}$ (L=7.18, W=6.81, Q=1.05, N=30), echinulated, without reticulum, thin-walled, light brown to yellowish in KOH. Basidia no observed. Peridium composed by interwoven, hyaline, thin-walled hyphae, reaching $7.0 \mu\text{m}$ without clamp connections. Scales hyphae $11.0-25.0 \times 6.0-12.0 \mu\text{m}$, globose to subglobose, hyaline, collapsed, yellowish to brownish in KOH. Studied material: Quintana Roo: Othón P. Blanco, Laguna Guerrero village, on lowland forest under *C. diversifolia* and *G. floribundum*, *de la Fuente 271*, January 11, 2017 (ITCV).

Distribution: Mexico (Campeche), Costa Rica, Cuba, and Nepal (Guzmán *et al.*, 2013).

Discussion: This species can be recognized by the dark patches in the peridium, the subhypogeous habit and the rubbery smell. Our description agrees with Guzmán *et al.* (2013). This species seems to form mycorrhizas with *Coccoloba* or *Gymnopodium* trees; they have a great diversity of mycorrhizal fungi (Bandala and Montoya, 2015). *Scleroderma nitidum* seems to prefer lowland forest, growing near paths and disturbed vegetation. *Scleroderma nitidum* was considered in a different genus as *Veligaster nitidum* (Berk.) Guzmán & Tapia due to the blackish patches around the apex of the pseudostipe, but was later reconsidered by Guzmán *et al.* (2013) as synonym of *Scleroderma*.

Suillus decipiens (Peck) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 535 (1898)

Figures 2 F, 3 O-R

Pileus 15-70 mm, convex to applanate, covered of fibrilous scales, cinnamon brown (5C8), slightly more conspicuous at disc, background pallid orange to pale brown (5A4), dry texture, entire margin covering hymenophore in young basidiomata. Tubes subdecurrent, yellowish, 4-6 mm long, not bruising. Pores angular, boletinoid, yellowish to pale brown (5A3-5A4), not bruising. Stipe 30-70 \times 10-12 mm, solid, equal or sometimes with clavate base, without glandular dots, peach color at apex (6B7) orange at the base (5C7), dry texture, smooth. Basal mycelia present, orange color. Ring present only in young basidiomata. Context 7-12 mm, pale brown, not bruising. Odor and taste fungoid. Spores $7.8-8.9 \times 3.2-4.0 \mu\text{m}$ (L=9.57, W=4.03, Q=2.37, N=30), fusiform to subfusiform, smooth, with suprahi-

lar depression, thin walled, light brown in KOH. Basidia $19.7\text{-}25 \times 5\text{-}6.7 \mu\text{m}$, clavate, four-spored, hyaline in KOH. Pleurocystidia $27.2\text{-}44.9 \times 6.1\text{-}7 \mu\text{m}$, abundant, cylindrical or almost capitated, hyaline or with yellowish brown granular content in KOH, thin-walled. Cheilocystidia with similar size and shape to pleurocystidia. Hymenophoral trama bilateral, with medium strata and lateral strata composed by cylindrical and inflate hyphae $2.0\text{-}8.0 \mu\text{m}$, with incrustated elements and brown contents in KOH, thin-walled. Pileipellis composed by erect hyphae, forming chains with lanceolate or cylindrical terminal cells, $37.7\text{-}52.1 \times 9.1\text{-}14.8 \mu\text{m}$, hyaline or sometimes with yellowish intracellular content in KOH. Stipitipellis composed by caulocystidia $24\text{-}54 \times 6\text{-}9 \mu\text{m}$, clavate, with yellowish and brown content in KOH, thin-walled. Studied material: Quintana Roo: Othon P. Blanco, Jaguactal savanna, *de la Fuente 51*, September 10, 2014 (ITCV); *de la Fuente 290*, January 17, 2017 (ITCV).

Distribution: USA, Mexico (Chiapas), Belize, Costa Rica, Nicaragua Dominican Republic, and Cuba (Singer *et al.*, 1983; García-Jiménez, 1999, Ortíz-Santana *et al.*, 2007). Discussion: This species can be recognized by the fibrilous brown scales, the absence of glandular dots in the stipe and by growing under Pinaceae species. Our material agrees with the descriptions provided by Singer *et al.* (1983), García-Jiménez (1999) and Ortíz-Santana *et al.* (2007). This species is similar to *S. salmonicolor* (Frost) Halling, but differs from *S. decipiens* in the lacking of glandular dot and squamose pileus. Other related species is *S. tomentosus* Singer, but this species had a bluish reaction when injured. The three species occur in pine savanna in Belize (Ortíz-Santana *et al.*, 2007), but only *S. decipiens* has been recorded in Jaguactal savanna in Quintana Roo. This is a common species under *P. caribaea* in the Jaguacatal savanna and also in Belize (Kropp, 2001).

Key to Boletales species occurring in Quintana Roo

- 1a. Basidiome pileate-stipitated 7
- 2a. Gleba chambered, whitish to pale brownish *Octaviania cigroensis*
- 2b. Gleba dusty, never chambered 3
- 3a. Clamp connections present 4
- 3b. Clamp connections absent 5
- 4a. Context sulfur yellow *Scleroderma sinnamariense*
- 4b. Context whitish to brownish *Scleroderma bermudense*
- 5a. Basidiospores $13\text{-}18 \mu\text{m}$ diameter *Scleroderma albidum*
- 5b. Basidiospores smaller than $13\text{-}18 \mu\text{m}$ diameter 6
- 6a. Basidiospores ($9\text{-}10\text{-}15\text{-}18$) μm diameter *Scleroderma areolatum*
- 6b. Basidiospores ($6\text{-}7\text{-}11$) μm diameter *Scleroderma nitidum*
- 7a. Pileus powdery *Pulveroboletus aberrans*
- 7b. Pileus never powdery 8
- 8a. Stipe thick and with bulbous base 9
- 8b. Stipe slender without bulbous base 10
- 9a. Pileus large, over 100 mm, bruising blue *Phlebopus colossus*
- 9b. Pileus smaller, never bruising blue *Phlebopus brasiliensis*
- 10a. Spores ornamented 11
- 10b. Spores smooth 14
- 11a. Spore surface longitudinally ridged *Boletellus cubensis*
- 11b. Spore surface bacillated 12
- 12a. Stipe context bruising pale red *Xerocomus coccolobae*
- 12b. Stipe context bruising blue 13
- 13a. Pileus with olivaceous and reddish tones *Xerocomus caerulonigrescens*
- 13b. Pileus with yellowish and pinkish tones *Xerocomus cuneipes*
- 14a. Spores ovate *Gyrodon intermedius*
- 14b. Spores fusoid *Suillus decipiens*

CONCLUSION

Boletales diversity is scarce when compared with other fungal groups in Quintana Roo like Agaricales or Polyporales. Nevertheless some interesting species can be found mostly associated with Polygonaceae trees. The lowland forest and urban gardens show an interesting diversity of Boletales species, growing associated with *Coccoloba* trees. We suggest continuing with the taxonomic studies in tropical Boletales. We also suggest more ecological and taxonomic studies in the pine savanna due the importance of the mycorrhizal fungi in this threatened pine population.

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REFERENCES

- Bandala, V.M., L. Montoya, 2015. *Gymnopodium floribundum* Trees (Polygonaceae) Harbor a diverse ectomycorrhizal fungal community in the tropical deciduous forest of Southeastern Mexico. *Research & Reviews: Journal of Botanical Sciences* 4: 73-75.
- Baroni, J.T., J. Cifuentes, B. Ortiz-Santana, S. Capello, 2015. A new species of *Phlebopus* (Boletales, Basidiomycota) from Mexico. *North American Fungi* 10: 1-13.
- Binder, M., D.S. Hibbett, 2006. Molecular systematics and biological diversification of Boletales. *Mycologia* 98: 971-981.
- Cázares, E., G. Guevara, J. García, J. Trappe, 2008. *Melanogaster minyosporus* sp. nov., a new sequestrate member of the Boletales from Mexico. *Revista Mexicana de Micología* 28: 67-69.
- Chay-Casanova, J., R. Medel, 2000. Hongos citados para el jardín botánico y zonas adyacentes. In: Sánchez, O., G. Islebe. (eds.), *El Jardín Botánico Dr. Alfredo Barrera Marín. Fundamentos y estudio portuarios y porcícolas*. CONABIO/ECOSUR, Mexico city. Pp. 115-124.
- Chío, R., G. Guzmán, 1982. Los hongos de la península de Yucatán I. Las especies de macromicetos conocidas. *Biotica* 7: 385-398.
- García, J., J. Castillo, 1981. Las especies de Boletáceos y Gonfidáceos conocidas en Nuevo León. *Boletín de la Sociedad Mexicana de Micología* 15: 121-197.
- García, J., G. Gaona, J. Castillo, G. Guzmán, 1986. Nuevos registros de Boletáceos en México. *Revista Mexicana de Micología* 2: 343-366.
- García-Jiménez, J., 1999. Estudio sobre la taxonomía, ecología y distribución de algunos hongos de la familia Boletaceae (Basidiomycetes, Agaricales) de México. Tesis de Maestría, Universidad Autónoma de Nuevo León, Linares, Nuevo León.
- García-Jiménez, J., F. Garza-Ocañas, 2001. Conocimiento de los hongos de la familia Boletaceae de México. *Ciencia UANL* 4: 336-343.
- García-Jiménez, J., R. Singer, E. Estrada, F. Garza-Ocañas, R. Valenzuela, 2013. Dos especies nuevas del género *Boletus* (Boletales: Agaricomycetes) en México. *Revista Mexicana de Biodiversidad* 84: 152-162.
- Gilbert, J.E., 1931. *Les Bolets*, in *les livres du Mycologue*. Vol. 3. Le François, Paris.
- González-Velázquez, A., R. Valenzuela, 1993. Los Boletáceos y Gonfidáceos del Estado de México I. *Revista Mexicana de Micología* 9: 35-46.
- González-Velázquez, A., R. Valenzuela, 1995. A new species of *Boletellus* (Basidiomycotina, Agaricales: Boletales) from Mexico. *Mycotaxon* 55: 399-404.
- González-Velázquez A., R. Valenzuela, 1996. Los boletáceos y gonfidáceos del Estado de México II. *Anales de la Escuela Nacional de Ciencias Biológicas* 41: 119-196.
- Guzmán, G., 1970. Monografía del género *Scleroderma* Pers. emend. Fr. (Fungi-Basidiomycetes). *Darwiniana* 16: 233-401.
- Guzmán, G., 1982. New species of fungi from the Yucatán Peninsula. *Mycotaxon* 16: 249-261.
- Guzmán, G., 1983. Los Hongos de la Península de Yucatán II. Nuevas exploraciones y adiciones micológicas. *Biotica* 8: 71-87.
- Guzmán, G., A. Cortés-Pérez, L. Guzmán-Dávalos, F. Ramírez-Guillén, M.R. Sánchez-Jácome, 2013. An emendation of *Scleroderma*, new records, and review of the known species in Mexico. *Revista Mexicana de Biodiversidad* 84: 173-191.
- Hasselquits, N.J., G.W. Douhan, M.F. Allen, 2011. First report of the ectomycorrhizal status of Boletes on the Northern Yucatan Peninsula, Mexico determined using isotopic methods. *Mycorrhiza* 21: 465-471.
- Henkel, T.W., J. Terborgh, R.J. Vilgalys, 2002. Ectomycorrhizal fungi and their leguminous hosts in the Pakaraima Mountains of Guyana. *Mycological Research* 106: 515-531.
- Kropp, B.R., 2001. Familiar faces in unfamiliar places: mycorrhizal fungi associated with Caribbean pine. *Mycologist* 15: 137-140.
- Kornerup, A., J.H. Wanscher, 1978. *Methuen handbook of color*. Eyre Methuen, London.
- Lodge D.J., J.F. Ammirati, T.E. O'Dell, G. Müller, 2004. Collecting and describing macrofungi. In: Müller G., G. Bills, M. Foster. (eds.), *Biodiversity of fungi inventory and monitoring methods*. Elsevier Academic Press, California. Pp. 128-153.
- López C.Y., G. Guevara-Guerrero, J. Alonso-Riverol, 2011. Hongos macromicetos. In: Pozo, C., N. Armijo, S. Calmé. (eds.), *Riqueza biológica de Quintana Roo*. Gobierno del Estado de Quintana Roo, México. Pp. 24-29.
- Ortiz-Santana, B., D.J. Lodge, T.J. Baroni, E.E. Both, 2007. Boletes from Belize and the Dominican Republic. *Fungal Diversity* 27: 247-416.
- Pegler, D.N., 1983. *Agaric flora of the Lesser Antilles*. Marston Book Services Limited, London.
- Pérez-Silva, E., T. Herrera, R. Valenzuela, 1992. Hongos macromicetos de la Península de Yucatán. In: Navarro, L.D. (ed.), *Diversidad biológica en la Reserva de la Biósfera de Sian Ka'an, Quintana Roo, México*. Vol II. CIQROO, México. Pp. 13-22.
- Pompa-González, A., C.E. Aguirre-Acosta, A.V. Encalada-Oliva, A. De Anda-Jáuregui, J. Cifuentes-Blanco, R. Valenzuela-Garza, 2011. Los macromicetos del jardín botánico de ECOSUR "Dr.

- Alfredo Barrera Marín" Puerto Morelos, Quintana Roo. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Ciudad de México.
- Singer, R., I. Araujo, M.H. Ivory, 1983. Ectotrophically mycorrhizal fungi of the neotropical lowlands, especially central Amazonia. *Nova Hedwigia*, Beihefte 77: 7-335.
- Singer, R., J. García, L.D. Gómez, 1990. The Boletinae of Mexico and Central America I & II. *Nova Hedwigia*, Beihefte 98: 1-70.
- Singer, R., J. García, L.D. Gómez, 1991. The Boletinae of Mexico and Central America III. *Nova Hedwigia*, Beihefte 102: 1-97.
- Singer, R., J. García J, L.D. Gómez, 1992. The Boletinae of Mexico and Central America IV. *Nova Hedwigia*, Beihefte 105: 1-47.
- Singer, R., T.H. Morello, 1960. Ectotrophic forest tree mycorrhizae and forest communities. *Ecology* 41: 549-551.