
On poroid Hymenochaetales growing on bamboos in Southern Brazil and NE Argentina

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Fomitiporia sanctichampagnatii sp. nov. is described and illustrated on the basis of a specimen growing on bamboo in Rio Grande do Sul State, Southern Brazil. The species is compared to other *Phellinus* species growing on bamboos, especially those with dextrinoid basidiospores. The new combinations *Fomitiporia spinescens* and *Fomitiporia uncinata* also are proposed. Species of *Phellinus s.l.* (Hymenochaetales) growing on bamboos in southern Brazil and NE Argentina plus those recorded elsewhere are keyed out.

Key words: Basidiomycetes, fungi, Hymenochaetales, polypores, wood-inhabiting neotropical fungi

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Introduction

Bamboos are woody perennial grasses that occur in tropical, subtropical and cool temperate (sometimes even in boreal forests), evergreen and deciduous forest worldwide. Important uses of bamboos include paper and pulp industry, fuel, food, feed, furniture, house construction and scaffolding, and making several articles of daily use. In South America, they have been cultivated or exploited from native forests to be used in gardening, building, decoration, pulping, and daily use (McClure and Smith, 1967).

Bamboos have been recorded as substrate to several wood-rotting fungi (Ryvarden and Johansen, 1980; Boidin *et al.*, 1986; Spooner and Candoussau, 1988; Petrini *et al.*, 1989; Candoussau *et al.*, 1996; Rungjindamai *et al.*, 2008). Some species of *Phellinus* Quél. s. l. (Hymenochaetales, Basidiomycota) have been found growing exclusively on bamboo indicating specificity to this substrate (Larsen and Cobb-Poullé 1990, Ryvarden 1983, 2004). Species that are able to grow on bamboo and other different substrates

were also recorded in the literature (Larsen and Cobb-Poullé, 1990; Ryvarden, 1991, 2004). All species of *Phellinus s.l.* presenting bambusicolous specificity were hitherto known from subtropical areas in South America, except *Phellinus bambusinus* (Pat.) Pat., described from Vietnam and known only from the type locality. Ryvarden (2004) has monographed the poroid Hymenochaetales for tropical South America but several rearrangements of taxa and species distribution need to be specified.

During a review of *Phellinus s. l.* taxa growing on bamboos in southern Brazil and NE Argentina, a collection characterized by a resupinate habit, large pores, hymenial setae, and dextrinoid basidiospores was studied. The dextrinoid basidiospores indicated a possible relationship with the *Fomitiporia punctata* complex. After comparison with other *Phellinus* species with dextrinoid basidiospores and occurring on bamboos or other substrates, it became evident that this collection represented an undescribed taxon, described below as *Fomitiporia sanctichampagnatii*. We propose the new combinations *Fomitiporia spinescens*

and *Fomitiporia uncinata* after revising the type material of several other bambusicolous species with dextrinoid basidiospores and present a key of *Phellinus s. l.* growing on bamboos worldwide.

Materials and methods

Materials utilized in this study have been gathered either from areas located around the town of Santa Maria (in the central region of Rio Grande do Sul State, RS, Southern Brazil) by the senior author or from field expeditions in the Nature Research and Conservation Center, Pró-Mata (São Francisco de Paula, Eastern RS), a preserved area in Dom Pedro de Alcântara (Eastern RS) and from NE Argentina in the Iguazú Falls area. Phyto-geographically, these areas pertain to the Neotropic region, Amazonic domain, Paranean and Atlantic provinces (Cabrera and Willink 1980). Additional data were obtained from previous type studies made by the authors and from the literature.

Descriptions and measurements are according to Coelho (2005) and Dai (1999). Studied specimens are deposited at ICN, PACA and BAFC herbaria. The authors of scientific names follow the new edition of *Authors of Fungal Names* (Kirk and Ansell 1992), available on the internet at (<http://www.indexfungorum.org/AuthorsOfFungalNames.htm>). Colours are according to Munsell Soil Color Charts (1994).

Results

Species recorded exclusively on bamboos are the following:

Phellinus bambusarum (Rick) M.J. Larsen, *Synopsis Fungorum* 3: 40, 1990.

(Figs 1 and 4)

≡ *Poria bambusarum* Rick, *Brot. Ser. Cienc. Nat.* 6: 146, 1937 (PACA!).

≡ *Phellinus bambusarum* (Rick) M.J. Larsen, *Synopsis Fungorum* 3: 40, 1990.

= *Phellinus garuhapensis* J.E. Wright & Blumenf., *Mycotaxon* 21:420, 1984 (BAFC!).

= *Phellinus rickianus* J.E. Wright & J.R. Deschamps, *Mycotaxon* 21: 414, 1984.

Wright and Deschamps (in Wright and Blumenfeld 1984) incorrectly assigned the name *Phellinus rickianus* to specimens from

NE Argentina that they thought corresponded to *Poria bambusarum* Rick. They provided a new name because they incorrectly thought that their placement in *Phellinus* was preoccupied by *Phellinus bambusinus*, which is not the case, and the name turned out to be superfluous. Specimens upon which the name was given, though, do not correspond to the type of *P. bambusarum*, but to *Ph. uncinatus* Rajchenb. *Phellinus garuhapensis*, known only from the type material, is an immature specimen of *Poria bambusarum*, as already stated by Rajchenberg and De Meijer (1990), but Ryvarden (2004) recognized it as an independent taxon following Wright and Blumenfeld (1986).

This species is found in NE Argentina and Southern Brazil, Rio Grande do Sul, Santa Catarina, and Paraná states (Gerber and Loguercio-Leite 2000, Rajchenberg 1987b, Rajchenberg and De Meijer 1990, Rick 1960). For a description, see Larsen and Cobb-Poulsen (1990). This species is clearly related to *Fomitiporia* by its globose to subglobose dextrinoid basidiospores, but its recombination into the genus is being studied by different authors (Loguercio-Leite, Univ. Fed. Santa Catarina, pers. com.).

Materials examined: ARGENTINA, Misiones, Garuhapé, leg. C. Gómez and R.T. Guerrero, VI.1965 (BAFC 29452, **holotype** of *Phellinus garuhapensis*). BRAZIL, Paraná State, Parque Marumbi, leg. A. de Meijer, 06.II.1993, N°. 2448, on culm of bamboo, *Guadua* sp. (ICN 139046); Rio Grande do Sul State, São Leopoldo, 1932 (Fungi Rickiani 18570, PACA, **lectotype** of *Poria bambusarum*); Santa Maria, Distrito de Boca do Monte, FEPAGRO, leg. G. Coelho, 26.III.2003, N° GC 382-7, on bamboo (ICN 139047); Dom Pedro de Alcântara, Mato da Cova Funda, leg. G. Coelho *et al.*, 20.V.2005, probably on *Merostachys multiramea* (ICN 139048); São Francisco de Paula, Potreiro Velho, Pró-Mata, Três Forquilhas trail, leg. G. Coelho *et al.*, 10.VI.2005, on bamboo (ICN 139049); 11.VI.2005, on bamboo (ICN 139050); on bamboo (ICN 139051).

Fomitiporia sanctichampagnatii G. Coelho, R. M. Silveira & Rajchenb., **sp. nov.**

(Figs 2 and 3)

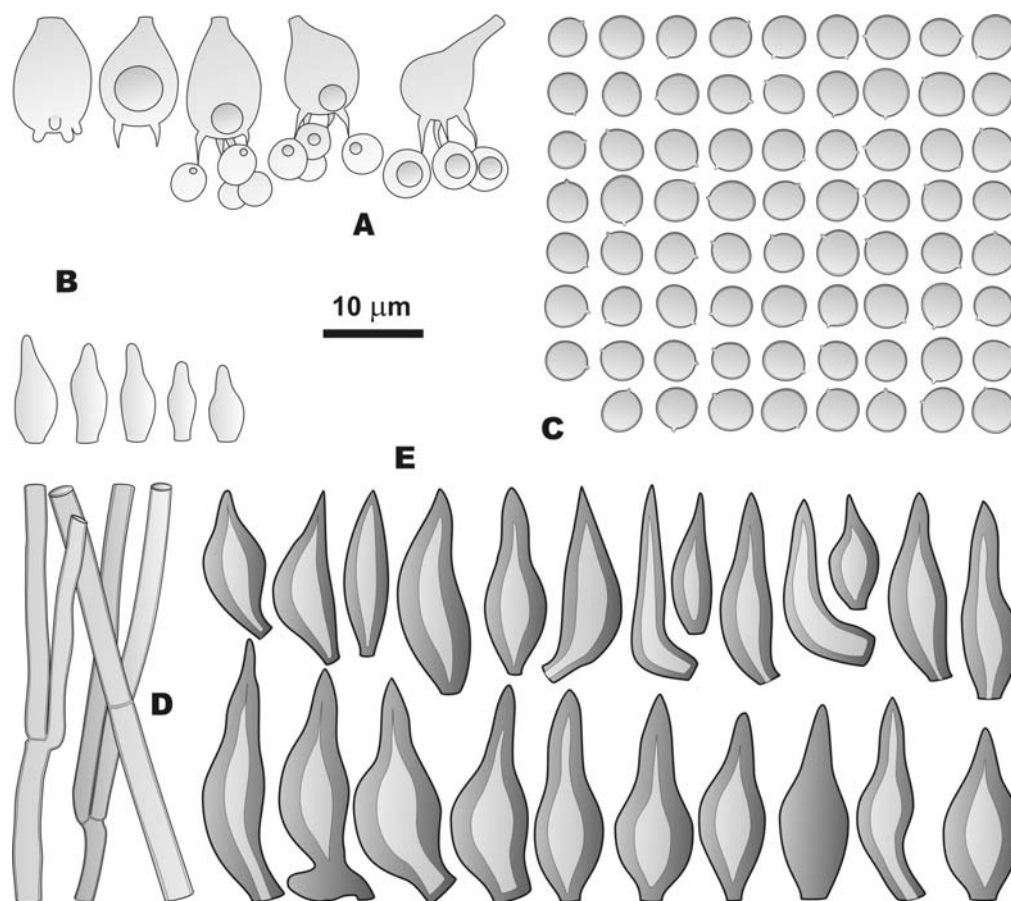


Fig. 1. *Phellinus bambusarum* (drawn from ICN 139050). A. Basidia. B. Cystidioles. C. Basidiospores. D. Generative hyphae from trama. E. Hymenial setae.

*Basidiomata resupinata, ochraceo-brunnea; margine pallidiore, sterile, villosa; poris rotundis, (2-)3-4(-5) per mm. Systema hypharum dimiticum hyphis skeletalibus raro septatis, crassitunicatis, ferrugineis, (2-)2.4-2.8(-3.6) μm latis; hyphis generatoriis tenuitunicatis, hyalinis vel pallido-luteis, septatis, (1.6-)1.8-2.8(-3.6) μm latis. Hymenium setis ochraceo-ferrugineis vel fusco-nigris, lanceolatis vel ventricosis, apicibus acuminatis, (12-)16.8-32(-40) \times (2.4-)4.4-8(-9.2) μm ; sporis globosis vel subglobosis, hyalinis vel pallido-luteis, dextrinoideis, crassitunicatis, (4.4-)5.2-6.4(-6.8) \times (4.4-)4.8-5.8(-6.4) μm . Proxima *Phellinus bambusarum*, sed poris, sporis et setis magnis distincta.*

Typus speciei hic designatus: Brasilia meridionalis, prov. Rio Grande do Sul, prope São Francisco de Paula, Potreiro Velho in Pró-Mata 10.VI.2005 Gilberto Coelho et alii legit, in Herbario ICN conservatur, No. 139044, ad culmo putrido bambusae.

Etymologia: Nomen speciei in memoriam clarissimi Sancti Marcellini Champagnatii dedicavi.

Basidiome annual, resupinate, up to 130 mm long, 16 mm wide, and 1 mm thick. *Pore surface* golden-yellow to ferruginous-brown or cinnamon-brown (6/6-6/8 10YR, 5/4-5/8); pores round to polygonal, (2-)3-4(-5) per mm, $P_m = 3.6$, $n = 64/1$; dissepiments velutinous; margin paler than the pore surface or similar, velutinous. *Context* ferruginous brown (6/6-6/8 10YR to 5/4-5/8), homogeneous, 1 mm thick. Tube layer concolorous with context, up to 1 mm long.

Hyphal system dimitic. *Subicular skeletal hyphae* interwoven, thick-walled, with a wide lumen, (2-)2.4-2.8(-3.6) μm diam., $D_m = 2.7$, $n = 63/1$. *Subicular generative hyphae* rarely present, thin-walled, simple-septate, hyaline to pale yellow in KOH, (1.8-)2-2.8(-3.6) μm diam., $D_m = 2.3$, $n = 61/1$. *Tramal skeletal hyphae* thick-walled, with a wide lumen to subsolid, ferruginous brown in KOH, (2-)2.4-2.8(-3.6) μm diam., $D_m = 2.6$, $n = 61/1$. *Tramal generative hyphae* simple-septate, hyaline to pale yellow in KOH, branched, thin-walled. (1.6-)1.8-2.4(-2.8) μm diam., $D_m = 2.2$, $n = 42/1$.

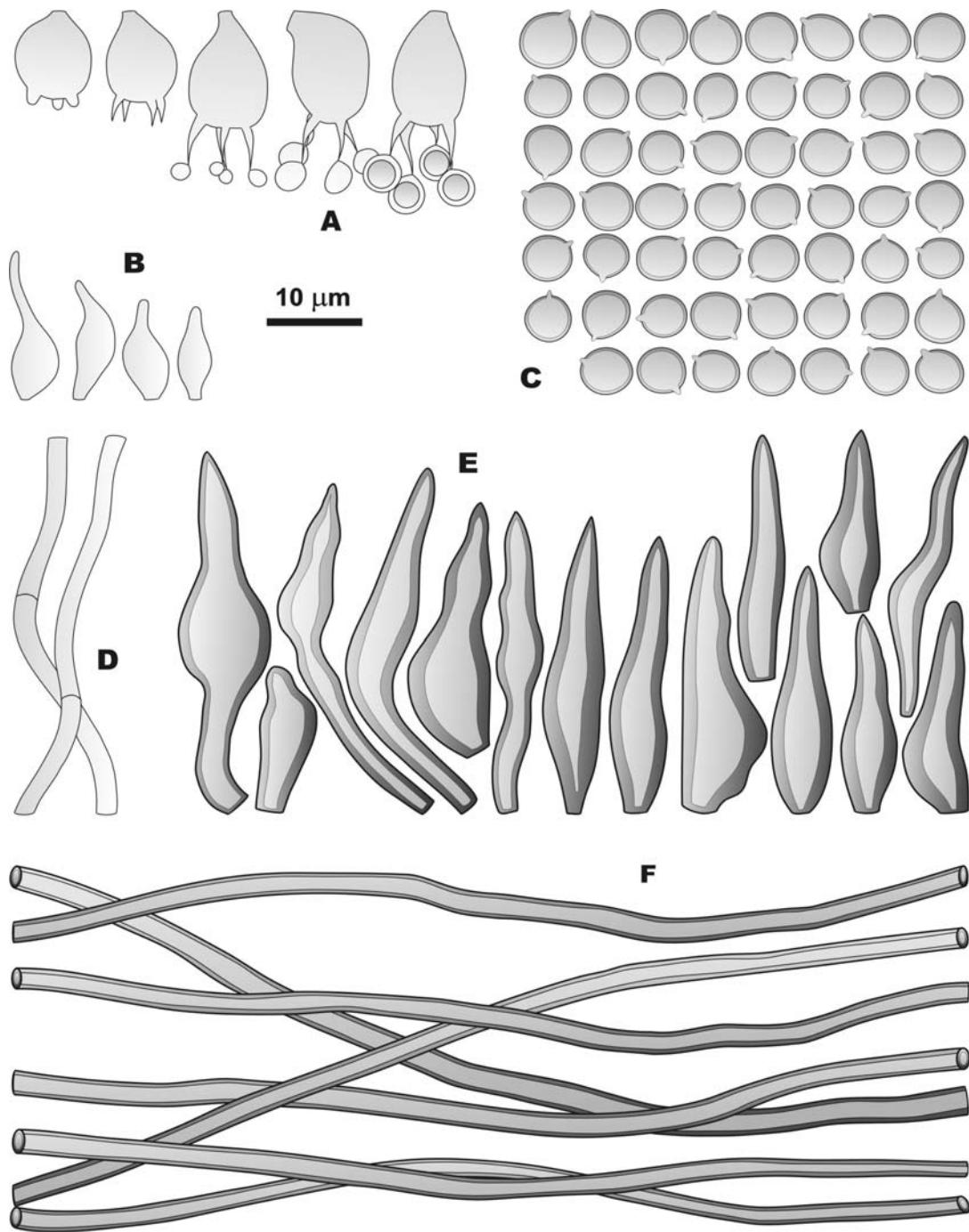


Fig. 2. *Fomitiporia sanctichampagnatii* (drawn from ICN 139044). A. Basidia. B. Cystidioles. C. Basidiospores. D. Generative hyphae from trama. E. Hymenial setae. F. Skeletal hyphae from subiculum.

Hymenial setae scattered, absent in some sections, variable in form, straight to ventricose, sometimes with a long incurved base arising among tramal hyphae, with an acute apex, ferruginous brown to dark brown in KOH, (12-)16.8-32(-40) x (2.4-)4.4-8(-9.2) μm , $L_m \times W_m = 24.3 \pm 6.47 \times 5.8 \pm 1.54$, $Q_r = 1.67-10.00$, $Q_m = 4.47 \pm 2.03$, $n = 64/1$. *Basidia* barrel to club-shaped to globose, 4-sterigmate, (8-)8.8-12(-17.6) x (6.5-)7.2-9.2(-11.2) μm , $L_m \times W_m = 11.01 \times 8.08$, $Q_r = 1.00-$

2.58, $Q_m = 1.38$, $n = 65/1$. *Basidiospores* thick-walled, hyaline to pale yellow in KOH, globose to subglobose, (4.4-)5.2-6.4(-6.8) x (4.4-)4.8-5.8(-6.4) μm , $L_m \times W_m = 5.4 \pm 0.38 \times 5.17 \pm 0.39$, $Q_r = 1.00-1.17$, $Q_m = 1.05 \pm 0.04$, $n = 63/1$, with a discrete apiculum, dextrinoid, cyanophilous. *Cystidioles* present, ventricose, thin-walled, (8-)9.6-16(-20) x (2-)2.4-4.4(-5.6) μm , $L_m \times W_m = 12.2 \times 3.59$, $Q_r = 2.18-6.29$, $Q_m = 3.43$, $n = 52/1$.



Figs 3-6. Basidiomes of *Phellinus s. l.* on bamboos. 3. *Fomitiporia sanctichampagnatii* (ICN 139044). 4. *Phellinus bambusarum* (ICN 139050). 5. *Fomitiporia spinescens* (ICN 139054). 6. *Fuscoporia ferrea* (ICN 139086). Scale bars = 1 cm.

Substrate: on rotten bamboo.

Materials examined: BRAZIL, Rio Grande do Sul, São Francisco de Paula, Potreiro Velho, Pró-Mata, Três Forquilhas trail, leg. G. Coelho *et al.*, 10.VI.2005, on bamboo (ICN 139044, **holotype**); 01.VI.2006, on bamboo (ICN 139201); on bamboo (ICN 139202); on bamboo (ICN 139203).

Remarks: *Fomitiporia sanctichampagnatii* presents a unique combination of features, including: the largest pores (2-5/mm) from the group; setae somewhat variable in form, from subulate to ventricose or straight, but usually they are thicker at the base and taper evenly towards the tip, (12-)16.8-32(-40) x (2.4-)4.4-8(-9.2) μm ; and basidiospores measuring (4.4-)5.2-6.4(-6.8) x (4.4-)4.8-5.8(-6.4) μm .

Fomitiporia sanctichampagnatii (Figs 2 and 3, Table 1) is similar to *Phellinus bambusarum* (Figs 1 and 4, Table 1), but the latter differs by its shorter and ventricose setae, smaller basidiospores (4-5 x 3.5-4.5 μm), and smaller pores (6-10/mm) – the pores being the smallest among bambusicolous species of *Fomitiporia*.

Two additional species growing on bamboos and presenting medium-sized pores (4-6/mm) are *Phellinus spinescens* J.E. Wright & G. Coelho (Fig. 5, table 1) and *P. uncinatus* Rajchenb. (Table 1); the former is unique by its long ventricose setae with subapical

spine processes and the latter differs by its characteristic uncinata setae.

Some species of *Fomitiporia* with a resupinate habit are microscopically similar to *F. sanctichampagnatii*, such as *Fomitiporia sublaevigata* (Cleland & Rodway) Y.C. Dai and *Fomitiporia pseudopunctata* (A. David *et al.*) Fiasson, however, they both differ by having perennial basidiomes and different biogeography/ecological requirements (e.g. substrate specificity). *Fomitiporia sublaevigata* also differs by having smaller pores (5-7/mm), larger basidiospores (6.5-7 x 5-6 μm), and ventricose to subulate setae that are 21-30(-42) x 4.5-8.5 μm (Buchanan and Ryvarden 1993). *Fomitiporia pseudopunctata* (A. David *et al.*) Fiasson has larger spores (6.5-7.5 x 5.5-7 μm), smaller pores (6-8/mm), thicker and ventricose setae (15-28 x 7-10 μm , Ryvarden and Gilbertson 1994), and so far it is restricted to Southern Europe and Eastern Africa (Decock *et al.* 2005). *Phellinus sonorensis* (Gilb.) has comparable basidiospores (5.0-5.5 x 4.5-5.0 μm), but smaller pores (5-7/mm). Its setae are ventricose with a long and slender apical portion (35.0-55.0 x 5.0-8.0 μm), and it is restricted so far to North America (Gilbertson and Ryvarden 1987, Valenzuela and Chacón-Jiménez 1991).

Table 1. Comparison of *Fomitiporia* species with setae collected on bamboos.

Species	<i>P. bambusarum</i> ICN 139050/ ³ / ²	<i>F. sanctichampagnatii</i> ICN 139044	<i>F. spinescens</i> ICN 139054/ 97790 ⁴	<i>F. uncinata</i> BAFC 24090/29836 ¹
Spores, µm	4.5 x 3.5-4.5 3.2-5.2 ³ / 5 in diam. ²	4.5-7 x 4.5-6.5	5.5-7 x 5-6.5 5.2-8 x 4.8-6.8 ⁴	5-6.5 x 4.5-6 5.5-7 x 5-6.5 ¹
$L_m \times W_m$	4.4 ± 0.20 x 4.27 ± 0.15	5.4 ± 0.38 x 5.17 ± 0.39	6.30 ± 0.36 x 5.66 ± 0.21 6.18 ± 0.38 x 5.37 ± 0.31 ⁴	5.60 ± 0.43 x 5.28 ± 0.44
Q_m, Q_r	1.00-1.13, 1.04	1.00-1.17, 1.05;	1.01-1.23, 1.11 1.03-1.46, 1.16 ⁴	1.00-1.25, 1.07
Setae, µm	11-27x3.6-8.4 16-20 x 5-7 ²	12-40 x 2.4-9.2	22-51 x 7-10 25.6- 52 x 4.4-8.8 ⁴	13.-30 x 7-15
$L_m \times W_m$	18.3 ± 3.16 x 6.41 ± 1.00	24.3 ± 6.47 x 5.80 ± 1.54	37.8 ± 8.40 x 8.40 ± 0.86 37.3 ± 6.46 x 6.58 ± 1.09 ⁴	23.2 ± 3.16 x 11.83 ± 1.57
Q_m, Q_r	1.90-4.40, 2.90	1.67-10.0, 4.47;	2.54-5.74, 4.51 3.20-9.00, 5.84 ⁴	1.31-3.22, 2.00
Pores/mm	7-10/6-8 ³ /7-8 ²	2-5	4-6/3-7 ⁴	5-8/4-6 ¹
P_m	7.92	3.62	5.00/ 5.59 ⁴	6.42

¹Rajchenberg 1987a, ²Rajchenberg 1987b (holotype), ³Wright and Blumenfeld 1984 (as *P. garuhapensis*), ⁴Coelho and Wright 1996.

Fomitiporia spinescens (J.E. Wright & G. Coelho) G. Coelho, Guerrero & Rajchenb., **comb.nov.** (Fig. 5)

≡ *Phellinus spinescens* J.E. Wright & G. Coelho, Mycotaxon 59: 384, 1996 (ICN!, BAFC!).

The species was initially described from NE Argentina as an addendum in Larsen and Cobb-Poullé's (1990) monograph on *Phellinus*, as *Phellinus. spinescens* Wright, Mycotaxon (Inpress), a Latin diagnosis and valid type designation were missing. As the original collection had been lost, the species was subsequently formally described from Southern Brazil (Coelho and Wright 1996). It is characterized by ventricose setae with a long, spinulated apex, and globose, thick-walled, dextrinoid basidiospores.

Materials examined: BRAZIL, Rio Grande do Sul, SANTA MARIA, Itaara, Parque Pinhal, leg. G. Coelho, 09.IX.1992, N° GC 29-9, on bamboo (ICN 97790, **holotype**, BAFC 33581, **isotype**); 05.X.1992, N° GC 31-5, on bamboo (ICN 97791); N° GC 31-6, on bamboo (ICN 97792); N° GC 31-9, on bamboo (ICN 97793); 06.IV.1993, N° GC 38-8, on bamboo (ICN 97794); N° GC 38-11, on bamboo (ICN 97795); 03.VI.1993, N° GC 42-6, on bamboo (ICN 97796); 03.X.1993, N° GC 48-3, on bamboo (ICN 97797); N° GC 48-7, on bamboo (ICN 97798); 12.II.1995, GC 66-1, on bamboo (ICN 139054).

Fomitiporia uncinata (Rajchenb.) G. Coelho, Guerrero & Rajchenb., **comb. nov.**

≡ *Phellinus uncinatus* Rajchenb. Mycotaxon 28: 114, 1987 (BAFC!).

Diagnostic characters of this species from Argentina are its uncinata setae and the

globose, thick-walled, dextrinoid basidiospores (Rajchenberg 1987a).

Materials examined: Argentina, Misiones, Iguazú Nat'l Park, leg. R. Singer & A.P.L. Digilio, 26.II.1949, M-76, on *Chusquea* (BAFC 24049); Macuco path, leg. D. Job & M. Rajchenberg, 6.IV.1984, M-3608, on *Bambusa* (BAFC 29836; **holotype**); leg. D. Job, 27.IX.1984 (BAFC 30296).

Other *Phellinus s. l.* species that are recorded on bamboos, but also on other substrates are: *Fomitiporia punctata* (P. Karst.) Murrill, *Fuscoporia contigua* (Pers.: Fr.) G. Cunn., *F. gilva* (Schwein.: Fr.) T. Wagner & M. Fisch., *F. ferrea* (Pers.: Fr.) G. Cunn. (Fig. 6), and *F. ferruginosa* (Schrad.: Fr.) Murrill. All the species of *Phellinus s. l.* growing on bamboos were collected in Santa Maria (Brazil), except *Fomitiporia uncinata* from Argentina and *Phellinus bambusinus* from Viet Nam.

Key to known species of *Phellinus s. l.* growing on bamboos

- 1a. Basidiospores dextrinoid, thick-walled, globose 2
- 1b. Basidiospores non-dextrinoid, thin-walled, ellipsoid to cylindrical 6
- 2a. Setae lacking *Fomitiporia punctata*
- 2b. Setae present 3
- 3a. Setae with an uncinata apex.....

-*Fomitiporia uncinata*
 3b. Setae with a straight apex 4
- 4a. Setae with apical spinules, 27-51 x 7-10
 μm*Fomitiporia spinescens*
 4b. Setae without apical spinules 5
- 5a. Pores 7-10/ mm, basidiospores 4-5 x 3.5-
 4.5 μm , setae 11-27 x 3.6-8.4 μm , L_m x
 W_m = 18.3 x 6.41, basidiome annual to
 perennial.....*Phellinus bambusarum*
 5b. Pores 2-5/ mm, basidiospores 4.5-7 x 4.5-
 6.5 μm , setae 12-40 x 2.4-9.2 μm , L_m x
 W_m = 24.3 x 5.8, basidiome annual.....
*Fomitiporia sanctichampagnatii*
- 6a. Contextual setae present 7
 6b. Contextual setae absent..... 8
- 7a. Pores 2-3/ mm.....*Fuscoporia contigua*
 7b. Pores 7-9/ mm.....*Fuscoporia ferruginosa*
- 8a. Basidiospores cylindrical.....
*Fuscoporia ferrea*
 8b. Basidiospores ellipsoid 9
- 9a. Basidiospores oblong-ellipsoid.....
*Fuscoporia gilva*
 9b. Basidiospores broad-ellipsoid to obovoid..
*Phellinus bambusinus*

Discussion

All of the species so far recorded exclusively on bamboos in South America belong to the *Fomitiporia punctata* complex and present a resupinate habit. Based on the works of Fiasson and Niemelä (1984), Fischer (1996) and Wagner and Fischer (2001, 2002), who segregated this complex from the rest of *Phellinus s.l.* on morphological and molecular grounds, we have incorporated some bamboo-sicolous taxa in the genus *Fomitiporia* Murrill. Decock *et al.* (2005) also had keyed out these taxa along with *Fomitiporia* species recognizing their affinities.

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