

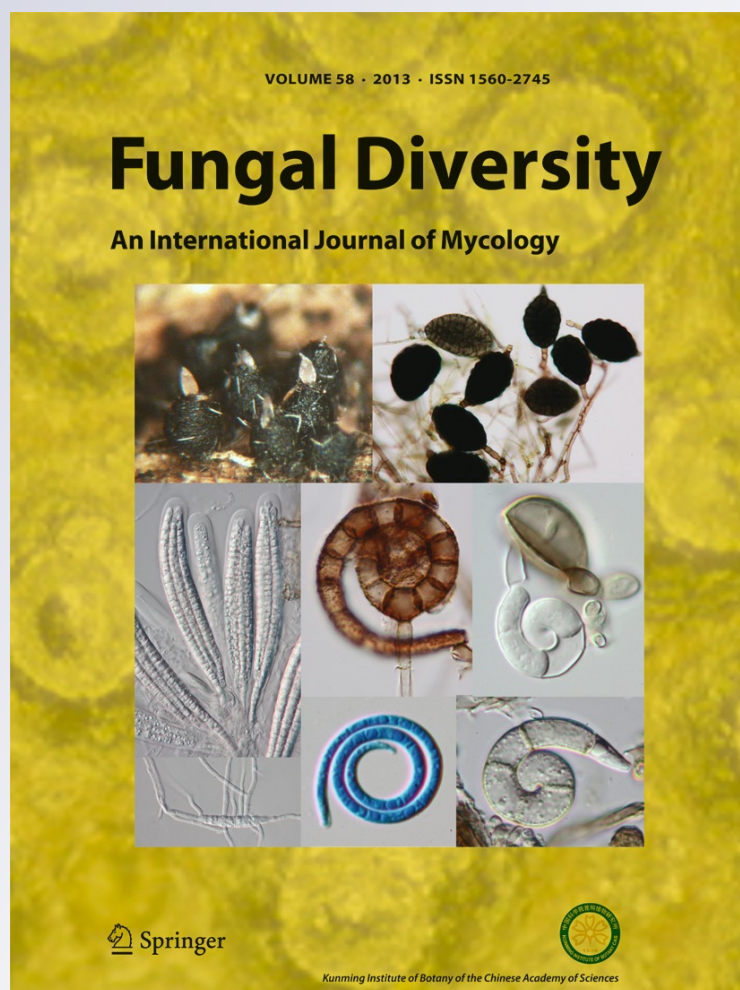
Taxonomic study of Favolus and Neofavolus gen. nov. segregated from Polyporus (Basidiomycota, Polyporales)

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Taxonomic study of *Favolus* and *Neofavolus* gen. nov. segregated from *Polyporus* (Basidiomycota, Polyporales)

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Abstract We present a taxonomic study of ‘group Favolus’ and related species in *Polyporus*. Phylogenetic analyses of nrLSU and ITS regions revealed that the infrageneric ‘group Favolus’ is divided into two main clades. Fungi within the group share laterally stipitate basidiocarps, with non-crustose stipe surfaces, and are distinguishable by the morphology of the pileus surface. One clade is characterized by species with hyaline to brown cutis, composed of hyaline to brown agglutinated generative hyphae. The other clade accommodates species with radially striate pileus, and lacks any distinct cutis of agglutinated hyphae. We propose *Neofavolus* gen. nov., typified by *N. alveolaris*, for the former

clade, and revise the genus *Favolus*, typified by *F. brasiliensis*, for the latter clade. *Neofavolus* includes *N. mikawai* and *N. cremeoalbidus* sp. nov., known only from temperate eastern Asia, in addition to *N. alveolaris*. *Favolus* includes members of the *Polyporus grammacephalus* complex, the *P. tenuiculus* complex, and *P. pseudobetulinus*. We reveal that the polypore known as ‘*P. grammacephalus*’ in Asia includes *F. acervatus* and *F. emerici* (= *P. grammacephalus*), whereas ‘*P. tenuiculus*’ includes three distinct species; *F. brasiliensis* from tropical America, and *F. spathulatus* and *F. roseus* from tropical Asia. Detailed descriptions and illustrations are provided for the accepted species in *Favolus* and *Neofavolus*.

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Introduction

Favolus Fr. was erected for *F. brasiliensis* (Fr.) Fr. by Fries (1828), and had accommodated species with fleshy basidiocarps and angular-alveolate, radially arranged pores. However, *Favolus* has been treated as a synonym of *Polyporus* Fr. by most recent mycologists (i.e. Corner 1984; Ryvarden 1991; Núñez and Ryvarden 1995a, 2001; Ryvarden and Iturriaga 2004; Silveira and Wright 2005; Drechsler-Santos et al. 2008), because many of the morphological characteristics agree with those of *Polyporus* P. Micheli ex Adans.

Polyporus is characterized by stipitate basidiocarps, a dimitic hyphal system with arboriform skeletal-binding hyphae, and cylindrical, smooth basidiospores, and its taxa characteristically cause a white rot (Gilbertson and Ryvarden 1987; Núñez and Ryvarden 1995a). The genus accommodates ecologically and macro-morphologically variable species, and Núñez and Ryvarden (1995a) divided it into six infrageneric groups based on macro-

morphological characters. One of these, ‘group Favolus’, referring to the genus *Favolus*, is characterized by the flabelliform to dimidiate pileus and the short lateral stipe without a dark crust. It included four species: *P. alveolaris* (DC.) Bondartsev & Singer, *P. grammocephalus* Berk., *P. philippinensis* Berk., and *P. tenuiculus* (P. Beauv.) Fr. (= *F. brasiliensis*, fide Ryvarden 1991) (Núñez and Ryvarden 1995a). This infrageneric group is occasionally used as subgenus *Favolus* (P. Beauv.) Fr. within the genus *Polyporus* (e.g. Singer 1986; Ryvarden and Iturriaga 2004; Drechsler-Santos et al. 2008). Ryvarden and Johansen (1980) accepted *Favolus* as a distinct genus, in part, on the basis of the incorrect assumption that *F. brasiliensis* has generative hyphae without clamp connections (Ryvarden 1991), and accommodated here *F. brasiliensis* and *F. spathulatus*.

Species included in ‘group Favolus’ are morphologically variable in pileus color, the sizes of basidiocarps, pores, and basidiospores, and the presence of clamp connections on generative hyphae. In addition to *P. grammocephalus*, *P. philippinensis*, and *P. brasiliensis* (Fr.) Corner (nom. illegit.; non *P. brasiliensis* Speg. 1889), Corner (1984) accepted *Polyporus multiplex* (Lév.) Corner (nom. illegit., non *P. multiplex* Lloyd, 1912) as a synonym of *F. spathulatus*. Corner (1984) also proposed some varieties of the above species based on features such as pileus color and pore size, and frequency of hyphal pegs. Núñez and Ryvarden (1995a, 2001) put emphasis mainly on the size and shape of pores to differentiate the species of ‘group Favolus’ and indicated many species as synonymous with *P. grammocephalus*, *P. philippinensis*, and *P. tenuiculus*, remarking that they possibly form a species complex. In addition, several new species and combinations reviving synonymous names for the above species were more recently proposed for collections from neotropical areas, but without molecular phylogenetic investigation (Ryvarden and Iturriaga 2003; Gibertoni et al. 2004; Drechsler-Santos et al. 2008).

Some *Polyporus* species excluded from group Favolus by Núñez and Ryvarden (1995a) actually resemble those in group Favolus. *Polyporus mikawai* Lloyd known from Japan and eastern and southern China (Lloyd 1915; Yasuda 1915; Hattori and Zang 1995; Dai et al. 2011; Dai 2012) was included in group Melanopus by Núñez and Ryvarden (1995a) based on an incorrect assumption. Its morphology is compatible with those in group Favolus. *Polyporus pseudobetulinus* (Murashk. ex Pilát) Thorn, Kotir. & Niemelä was accommodated in group Admirabilis (Núñez and Ryvarden 1995a), but is phylogenetically related to *P. grammocephalus* and *P. tenuiculus* (Sotome et al. 2011).

Sotome et al. (2008) revealed that *Polyporus* is a polyphyletic genus that needs reorganization into several genera using Asian isolates of *Polyporus* together with their allied genera. The genus *Polyporus* that is broadly accepted today includes six major clades with high bootstrap support.

Species within morphologically distinct genera, including *Datronia* Donk, *Pseudofavolus* Pat., and *Mycobonia* Pat. were also nested in one of these clades (Krüger and Gargas 2004; Sotome et al. 2008). In addition, one major clade comprised of ‘group Polyporellus’ (*Polyporus* and *Lentinus* Fr.) is more closely related to *Amauroderma* Murrill, *Ganoderma* P. Karst. and several other genera, than to other members of *Polyporus* (Sotome et al. 2008). Sotome et al. (2008) also showed that ‘group Favolus’ was divided into two distinct clades, and that the Asian ‘*P. alveolaris*’, ‘*P. grammocephalus*’, and ‘*P. tenuiculus*’ were comprised of some morphologically and phylogenetically distinct species.

We have conducted a taxonomic study focusing on members of ‘group Favolus’ and related species, using both phylogenetic and morphological methods of investigation. Phylogenetic relationships were inferred based on the nuclear ribosomal internal transcribed spacer (ITS) and the nuclear large-subunit (nuLSU) rRNA regions. We also examined in detail the morphological characters of voucher specimens, and determined characteristics enabling species differentiation within the two major clades, including the ‘group Favolus’ detected by Sotome et al. (2008). We describe a new genus to represent one of these major clades, and emend the genus *Favolus* to represent the other. We provide species names within these two new genera, after examination of several authentic specimens, and include detailed descriptions. Keys to accepted species are provided for the new genera.

Materials and methods

Sampling

Details of the specimens and their isolates used for phylogenetic analyses are shown in Tables 1 and 2. Scientific names of group Favolus in *Polyporus* used here mainly follow Núñez and Ryvarden (1995a). Isolates were established on PDA media from tissue of the basidiocarp, germinating spores or decayed wood. Herbaria holding specimens were abbreviated according to Holmgren et al. (1990). We also examined several type specimens of the names that were treated as synonyms or closely related species to *P. grammocephalus* and *P. tenuiculus* by Núñez and Ryvarden (1995a).

Morphological studies

The procedure for morphological observation follows Sotome et al. (2007). Color descriptions were given according to Munsell System (Color Atlas Co., Ltd.). Basidiospore measurements were made from materials mounted in Melzer’s reagent. The following abbreviations are used for

Table 1 List of species of group Favolus in *Polyporus* and their GenBank accession numbers

Isolates/Voucher specimens	Locality	Culture Bank	GenBank Accession no.	
			nucLSU	ITS
<i>Polyporus alveolaris</i>				
TUFC 14286/TUMH 50004	Tottori, Japan	FMRC	AB735948	AB735967
TUFC 14544/TUMH 50003	Tottori, Japan	FMRC	AB735949	AB735968
TUFC 14556/TUMH 50002	Nara, Japan	FMRC	AB735947	AB735969
WD2340/TFM F-21694	Ibaraki, Japan	FFPRI	AB368077 ^b	AB735970
WD2358/TFM F-27367	Chiba, Japan	FFPRI	AB368079 ^b	AB587624 ^b
<i>Polyporus grammocephalus</i>				
WD163/TFM F-14764	Kanagawa, Japan	FFPRI	AB735950	AB735971
WD2343/TFM F-21714	Okinawa, Japan	FFPRI	AB368089 ^b	AB587626 ^b
WD2350/TFM F-21697	Okinawa, Japan	FFPRI	AB735951	AB735972
WD2351/TFM F-21693	Kanagawa, Japan	FFPRI	AB368090 ^b	AB587627 ^b
WD2373/TFM F-27443	Kanagawa, Japan	FFPRI	AB368091 ^b	AB735973
WD2717/TFM F-27345	Oita, Japan	FFPRI	AB735952	AB735974
WD2379/TFM F-21715	Okinawa, Japan	FFPRI	AB587619 ^b	AB587628 ^b
<i>Polyporus tenuiculus</i>				
PEN33/TFM F-20589	Penang, Malaysia	USM	AB368099 ^b	AB735975
TENN10242/-	Costa Rica	TENN	AB368097 ^b	AB735976
WD1576/TFM F-16246	Okinawa, Japan	FFPRI	AB587622 ^b	AB587633 ^b
-/INP241452 ^a	Amazonus, Brazil	-	AB735953	AB735977
			AB735954	
Favolus sp.				
TUFC 14497/TUMH 50007	Nara, Japan	FMRC	AB735955	AB735978
TUFC 14528/TUMH 50006	Nara, Japan	FMRC	AB735956	AB735979
TUFC 14529/TUMH 50009	Nara, Japan	FMRC	AB735957	AB735980
TUFC 14541/TUMH 50008	Nara, Japan	FMRC	AB735958	AB735981

^aSpecimens used for the DNA extraction

^bSequences determined in Sotome et al. (2008) or (2011)

basidiospore measurements: L = mean basidiospore length, W = mean basidiospore width, R = the ratio of length/width of a basidiospore, r = arithmetic mean of R; (n = x/y) means x measurement of basidiospores from y specimens, IKI– means both inamyloid and indextrinoid.

Molecular techniques and phylogenetic analyses

DNA was extracted from cultured mycelia or dried specimens using DNeasy Plant Mini Kit (QIAGEN, California, USA), EZNA Fungal DNA Kit (Omega Bio-Tek, Georgia, USA) and following Hosaka and Castellano (2008). The ITS and nucLSU regions were amplified by PCR following the method described by Sotome et al. (2008, 2009b). Some of PCR products were purified using the QIAquick PCR Purification Kit (QIAGEN, California, USA). Cloning was done using the Qiagen PCR Cloning Kit (QIAGEN, California, USA), whereby the purified amplicons were ligated into the pDrive cloning vector and transformed into *E. coli* DH5 alpha cells, as specified by the manufacturer. DNA sequences were determined using a Big Dye Terminator 3.1 Cycle Sequencing Kit (Applied Biosystems, California, USA) with the ABI

3100 or ABI3130 DNA sequencer. Sequences newly generated in this study were submitted to GenBank (accession numbers AB735939–AB 735981, Tables 1 and 2).

The ITS and nucLSU sequences were initially aligned using the MAFFT version 6.864 (Katoh and Toh 2008). Dataset congruence was tested with the incongruence length difference (ILD) test (Farris et al. 1994) as implemented in PAUP* 4.0b10 ('partition-homogeneity test') (Swofford 2003). A *P*-value of <0.05 was considered statistically significant. After testing congruence, the individual gene datasets were combined and phylogenetic analyses were conducted. Maximum parsimony (MP) analysis was performed in PAUP* 4.0b10 with gaps treated as missing data. The most parsimonious trees were identified using heuristic searches with random addition sequences (1000), maxtree set to auto increase, and TBR branch swapping was employed. A bootstrap (MPBS) analysis was performed with 1000 replicates with 10 random taxon sequence additions per replicate and branch swapping set to TBR.

The maximum likelihood (ML) trees were obtained using the PhyML 3.0 program (Guindon et al. 2010) under the GTR+I+G model that is selected as the best model of

Table 2 List of species other than group *Favolus* in *Polyporus* and their GenBank accession numbers

Species	Isolates no. (Specimen no.)	Locality	Culture Bank	GenBank Accession no.	
				nucLSU	ITS
<i>Datronia mollis</i>	WD794	Fukushima, Japan	FFPRI	AB368063 ^b	AB587623 ^b
<i>Lentinus tigrinus</i>	MUCL22821	Belgium	MUCL	AB368072 ^b	AB478881 ^b
<i>Polyporus arcularius</i>	WD2359	Ibaraki, Japan	FFPRI	AB368082 ^b	AB478875 ^b
<i>P. badius</i>	WD2341	Ibaraki, Japan	FFPRI	AB368083 ^b	AB587625 ^b
<i>P. mikawai</i>	(TFM F-27346 ^a)	Chiba, Japan	-	AB735939	AB735959
<i>P. mikawai</i>	(TFM F-27380 ^a)	Okinawa, Japan	-	AB735940	AB735960
<i>P. mikawai</i>	TUFC 14350(TFM F-27396)	Tokyo, Japan	TUFC	AB735941	AB735961
<i>P. mikawai</i>	TUFC 14359(TFM F-27416)	Kyoto, Japan	TUFC	AB735942	AB735962
<i>P. mikawai</i>	TUFC 14360(TFM F-27417)	Kyoto, Japan	TUFC	AB735943	AB735963
<i>P. mikawai</i>	TUFC 14501(TUMH 50005)	Tottori, Japan	TUFC	AB735944	AB735964
<i>P. pseudobetulinus</i>	(TRTC 51022 ^a)	Ontario, Canada	-	AB587620 ^b	AB587629 ^b
<i>P. squamosus</i>	MUCL30721	Belgium	MUCL	AB368094 ^b	AB587630 ^b
<i>P. tubaeformis</i>	WD1839	Nagano, Japan	FFPRI	AB368101 ^b	AB587634 ^b
<i>P. tuberaster</i>	WD2382	Gunma, Japan	FFPRI	AB368104 ^b	AB474086 ^b
<i>Pycnoporus cinnabarinus</i>	WD741	Hokkaido, Japan	FFPRI	AB735945	AB735965
<i>Trametes orientalis</i>	WD1660	Kanagawa, Japan	FFPRI	AB735946	AB735966

^a Specimens used for the DNA extraction

^b Sequences determined in Sotome et al. (2008), (2009a), (2009b) or (2011)

evolution for combined dataset by MrModeltest version 2.2 (Nylander 2004). Bootstrap support values (MLBT) were obtained on the basis of 1000 replicates analyzed using the same maximum likelihood procedure.

Pycnoporus cinnabarinus (Jacq.) P. Karst. and *Trametes orientalis* (Yasuda) Imazeki were used as outgroups because it is close to, but outside, *Polyporus* s.l. (Alfredo and Hibbett 2011). All trees were viewed with TreeView. 1.6.6 (<http://taxonomy.zoology.gla.ac.uk/rod/rod.html>). The alignment and MP and ML trees are deposited in TreeBase under accession number S13119.

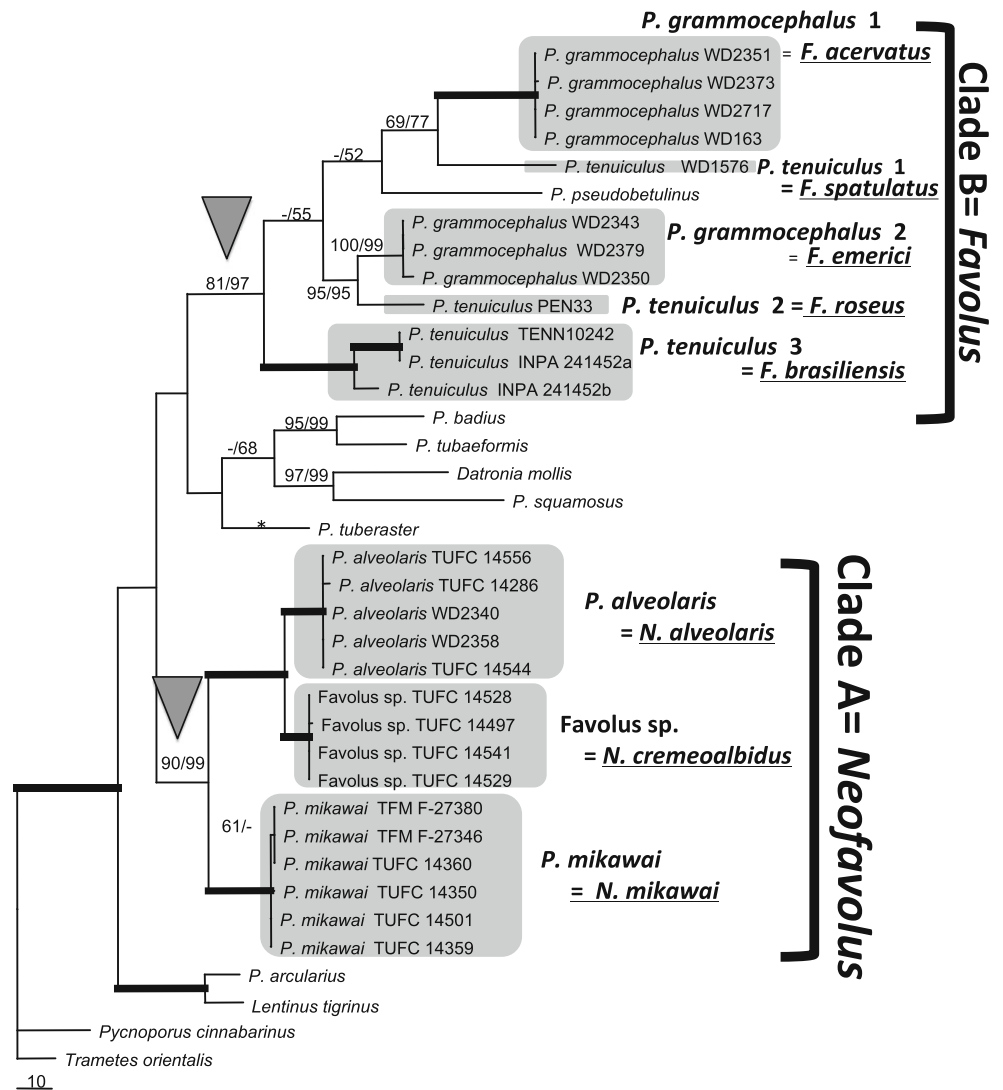
Results

Phylogenetic analysis An ILD test showed no significant incongruence between nucLSU and ITS datasets ($P=0.65$). The combined ITS and nucLSU regions had an aligned length of 1,258 characters, of which 215 characters were informative for parsimony analysis. Six trees with equal length [$L=689$, $CI=0.49$, $RI=0.79$] were constructed by the MP analysis. The MP tree and ML tree showed no inconsistency in any supported clades. The resulting topology is represented in Fig. 1.

These phylogenetic trees showed that species within 'group *Favolus*' were divided into two distinct clades: A and B. No other species used herein formed supported

clades with Clades A and B. In the MP tree, *P. tuberaster* (Jacq. ex Pers.) Fr., which was the lectotype species of *Polyporus* selected by Donk (1933) and accepted by many authors (Cunningham 1965; Singer 1986; Ryvarden 1991; Núñez and Ryvarden 1995a; Silveira and Wright 2005), was placed in the basal position of Clade A, but lacked support and its placement was incompatible with the ML analysis. Clade A, corresponding to Clade 4 in Sotome et al. (2008), was strongly supported (MPBT=90, MLBT=99), and contains three subclades represented by *P. alveolaris* (MPBT=100, MLBT=100), an undescribed species, *Favolus* sp. (MPBT=100, MLBT=100), and *P. mikawai* (MPBT=100, MLBT=100). *Polyporus mikawai* is found within a sister clade containing *P. alveolaris* and *Favolus* sp. Clade B corresponds to Clade 5 in Sotome et al. (2008), and includes the *P. grammocephalus* complex, the *P. tenuiculus* complex, and *P. pseudobetulinus* (MPBT=81, MLBT=97). The *Polyporus grammocephalus* complex and the *P. tenuiculus* complex were divided into two and three subsidiary groups, respectively. In addition, one can see that four collections of *P. grammocephalus* 1 and one collection of *P. tenuiculus* 1 (MPBT=69, MLBT=77), and three of *P. grammocephalus* 2 and one of *P. tenuiculus* 2 (MPBT=95, MLBT=95) are closely related, respectively. *Polyporus tenuiculus* sensu lato, collected from Central and southern South America, has two clone types in nucLSU and ITS regions, but formed a distinct clade (MPBT=100, MLBT=100).

Fig. 1 One of the six most parsimonious trees obtained from heuristic searches based on nucLSU and ITS regions. Bootstrap values (MP/ML) greater than 50 % are indicated above the branches. *Bold lines* show where nodes supported with 100 % MPBP and MLBP. The branch with *asterisk* indicates that its position disagrees between MP and ML analyses. *Small capitals* after Isolates number show clone sequences



Morphology of the detected clades

Fungi within Clades A and B are similar in having tough fleshy to leathery context, with short, laterally stipitate basidiocarps without a black crust on the stipe, a dimittic hyphal system with skeletal-binding hyphae and cylindrical basidiospores. They can be differentiated by the macro- and microscopical features of the pileus surface. Species in Clade A share a glabrous to scaly pileus surface, with a cutis composed of hyaline to brown, parallel and agglutinated, generative hyphae that are distinct from contextual hyphae mainly composed of non-agglutinated skeletal-binding hyphae. Members of Clade B commonly have radial lines on their pileus surface, with or without pileipellis composed of densely arranged parallel hyphae without agglutination. Among the species in Clade B, only *Polyporus pseudobetulinus* has a filmy and easily separable cutis as pileipellis, but this is composed of short cells and is easily squashable (Sotome et al. 2011) making it distinguishable from species in Clade A.

Taxonomy

On the basis of the morphological and phylogenetical investigations, we accept *Favolus* representing Clade B and *Neofavolus* gen. nov. typified with *N. alveolaris* for Clade A as two distinct genera. Descriptions of *Favolus* and *Neofavolus* species are shown below.

Neofavolus Sotome & T. Hatt., gen. nov.

Mycobank MB801926

Etymology. Neo (Lat.) new; favolus (Lat.) a genus name, referring to morphologically similar genus *Favolus*.

Basidiocarps annual, laterally to rarely centrally stipitate, occasionally substipitate. Pileus reniform to semicircular, circular in centrally stipitate specimens, surface covered with flattened scales or smooth, azonate, white to cream or brownish. Stipe cylindrical, often reduced. Context fleshy-tough to leathery in fresh condition, brittle or corky to leathery in dried condition, up to 1 cm thick. Pores large

to small, diamond shaped and radially elongated or regular. Hyphal system dimitic with generative and skeletal-binding hyphae. Generative hyphae with clamp connections. Skeletal-binding hyphae usually dominating, arboriform, hyaline, IKI–. Pileipellis present as cutis composed of hyaline to brown agglutinated and parallel generative hyphae that are distinct from contextual hyphae mainly composed of non-agglutinated skeletal-binding hyphae. Basidia clavate, 4-sterigmate. Basidiospores cylindrical, thin-walled, smooth, hyaline, IKI–.

Type species. Neofavolus alveolaris (DC.) Sotome & T. Hatt.

Neofavolus alveolaris (DC.) Sotome & T. Hatt., comb. nov. Figs. 2, 10a, 11a, and 12a

Mycobank MB801930

Basionym: *Merulius alveolaris* DC., in de Candolle & Lamarck, Fl. Franç. Edn 3:43 (1815).

Basidiocarps annual, laterally to centrally stipitate, solitary. Pileus reniform to semicircular, circular in centrally stipitate basidiocarps, applanate to conchate, 2–7 cm from the base to margin, 2.5–13 cm wide, up to 10 mm thick; surface glabrous, cream to brownish orange (10YR5–8/4–9), covered with appressed scales, scales often lost with age, then sordid white to cream, smooth, azonate; margin acute, entire. Stipe cylindrical, up to 1 cm long, up to 1.5 cm in diam. Context fleshy-tough in fresh condition, corky or brittle in dried condition, white, up to 6 mm thick. Pore surface white, cream to grayish orange (10YR8–9/4), pores radially elongated, (0.5–)0.7–7×0.5–3 mm, dissepiments thin, entire to slightly lacerate. Tubes concolorous with the pore surface, up to 6 mm deep. Hyphal system dimitic with generative hyphae and skeletal-binding hyphae. Contextual generative hyphae thin-walled, hyaline, with clamp connections, up to 4.5 µm in diam. Contextual skeletal-binding hyphae usually thick-walled, occasionally branched, interwoven, hyaline, non-dextrinoid, 3.5–5 µm in diam. at basal stalk. Tramal generative hyphae same as in context but more abundant. Tramal skeletal-binding hyphae thick-walled to solid, occasionally branched, moderately interwoven, hyaline, non-dextrinoid, 3.5–6 µm in diam. at basal, taper to 1.5 µm in diam. at apex. Pileipellis present as cutis composed of hyaline to brown, parallel and agglutinated generative hyphae covering context mainly composed of non-agglutinated and interwoven skeletal-binding hyphae. Basidia clavate, 4-sterigmate, 17.5–26×4–7 µm. Basidiospores cylindrical, hyaline, non-dextrinoid, (6.5–)7–10(–10.5)×2.5–4 µm, $L=8.29$ µm, $W=3.01$ µm, $R=2.1$ –4.3, $r=3.01$ ($n=150/4$).

Distribution Widely distributed in temperate to boreal areas of the Northern Hemisphere. Known from North America (Boulet 2003; Gilbertson and Ryvarden 1987), Central and Southern Europe (Bernicchia 2005; Ryvarden and Gilbertson 1994), East Asia (Núñez and Ryvarden 1995a, 2001; Dai 2012).

Remarks *Neofavolus alveolaris* is variable in the color of the pileus surface and the size of basidiocarps. This species is well characterized by the large sized alveoloid pores and distinct scales on the pileus surface that can be lost in old specimens.

Specimens examined JAPAN, Aomori Pref., Aomori, Oaza-yokouchi, S. Ito, 17 Aug 2003 (TFM F–27350); Chiba Pref., Imba-Gun, Sakae, T. Fukiharu, 13 Oct 2003 (TFM F–27367); the same place, T. Fukiharu, 13 Oct 2003 (TFM F–27368); the same place, T. Fukiharu, 13 Oct 2003 (TFM F–27369); Gunma Pref., Kiryu, Aoi-machi, T. Suda, 7 July 2004 (TFM F–27388); the same place, T. Suda, 7 July 2004 (TFM F–27389); Hokkaido Pref., Iwamizawa, Tonebetsu Natural Park, K. Sotome, 25 Sep 2004 (TFM F–27451); the same place, K. Sotome, 25 Sep 2004 (TFM F–27452); Hokkaido Pref., Muroran, Mt. Muroran, Y. Nishihara, 19 Sep 2005 (TFM F–27489); Hokkaido Pref., Rishiri Island, Kutsugata, 28 July 2007, T. Hattori (TFM F–27542); Ibaraki Pref., Tsuchiura, Shishizuka, T. Hattori, 7 June 2003 (TFM F–23201); the same place, T. Hattori, 1 Nov 2003 (TFM F–21694); Ibaraki Pref., Tsukuba, Mt. Tsukuba, K. Sotome, 12 Sep 2008 (TFM F–22558); Kanagawa Pref., Ashigarakami-gun, Matsuda, H. Sasaki, 18 May 2007 (TFM F–27522); Kanagawa Pref., Aiko, Kiyokawa, H. Sasaki, 5 July 2004 (TFM F–27406); Kanagawa Pref., Zushi, Numama, H. Sasaki, 13 June 2004 (TFM F–27390); Miyagi Pref., Sendai, Y. Ando, 28 Sep 2003 (TFM F–27353); Miyagi Pref., Sendai, Y. Ando, 23 July 2004 (TFM F–27603); Miyagi Pref., Sendai, Y. Ando, 13 Oct 2004 (TFM F–27398); Nara Pref., Kawakami, Sannokou, T. Hattori, 7 July 2010, (TUMH 50002); Saitama, Iruma, on *Machilus thunbergii* Sieb. et Zucc., Y. Higuchi, 19 June 2009 (TFM F–27640); Tottori Pref., Tottori, R. Nakano, 21 Apr 2011 (TUMH 50003); Tottori Pref., Tottori, Ochidani, E. Nagasawa, 9 Mar 2011 (TUMH 50004).

Neofavolus cremealbidus Sotome & T. Hatt., sp. nov. Figs. 3, 10b, 11b, 12b

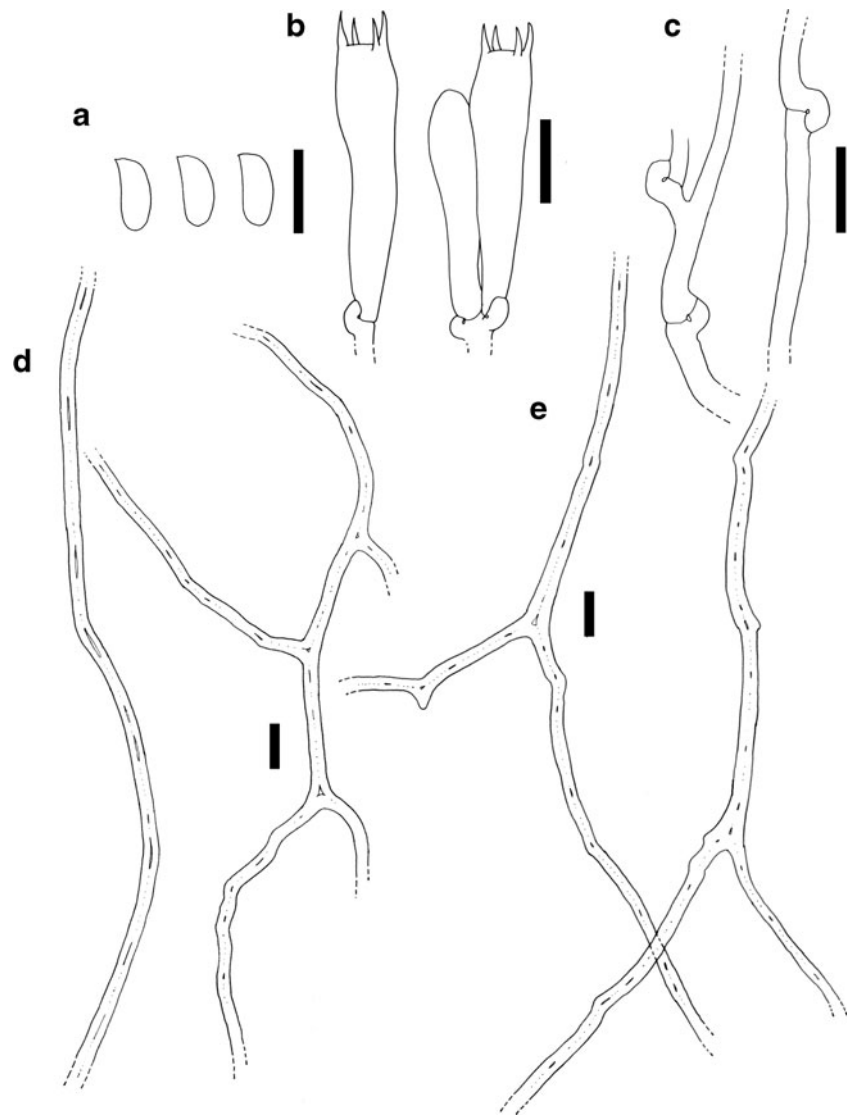
Mycobank MB801927

Holotype: Nara Pref., Kawakami, Sannokou, on hard wood, T. Hattori, 7 July 2010, (TUMH 50009).

Etymology: *Cremeus* (Lat.) cream; *albidus* (Lat.) whitish, referring to the whitish basidiocarps.

Basidiocarps annual, laterally stipitate, solitary. Pileus reniform to dimidiate, applanate, 1.5–3.5 cm from the base to margin, 2–5 cm in diam., up to 5 mm thick; surface glabrous, faintly radially striate or not, white to light brown in fresh condition, brownish orange to grayish orange (10YR6–8/4) in dried condition, azonate; margin acute, entire. Stipe cylindrical, up to 4 mm long, up to 4 mm in diam. Context fleshy-tough to leathery in fresh condition, brittle in dried condition, white, up to 2 mm thick. Pore surface white to cream (10YR9/4–6), pores angular, 2–4(5)

Fig. 2 *Neofavolus alveolaris* (TUMH 50004). **a** Basidiospores. **b** Basidia. **c** Generative hyphae from trama. **d** Skeletal-binding hyphae from context **e** Skeletal-binding hyphae from trama. Bars=10 μm



pores/mm, dissepiments thin, entire to lacerate. Tubes concolorous with the pore surface, up to 3 mm deep. Hyphal system dimitic with generative hyphae and skeletal-binding hyphae. Contextual generative hyphae thin-walled, with clamp connections, hyaline, up to 3.5 μm in diam. Contextual skeletal-binding hyphae thick-walled to solid, moderately to frequently branched, moderately to highly interwoven, hyaline, non-dextrinoid, 2.5–4 μm in diam. at basal stalk. Tramal generative hyphae same as in context but more abundant. Tramal skeletal-binding hyphae thick-walled to solid, frequently branched, highly interwoven, hyaline, non-dextrinoid, 3–4 μm in diam. at basal stalk, tapering to 1.5–2 μm in diam. Pileipellis present as cutis composed of hyaline, parallel and agglutinated generative hyphae. Basidia clavate, 18–22.5 \times 5–7.5 μm , four sterigmate. Basidiospores cylindrical, hyaline, non-dextrinoid, (7.7–)8–12 \times 3–4 μm , $L=9.52$ μm , $W=3.46$ μm , $R=2.2$ –3.3, $r=2.77$ ($n=101/2$).

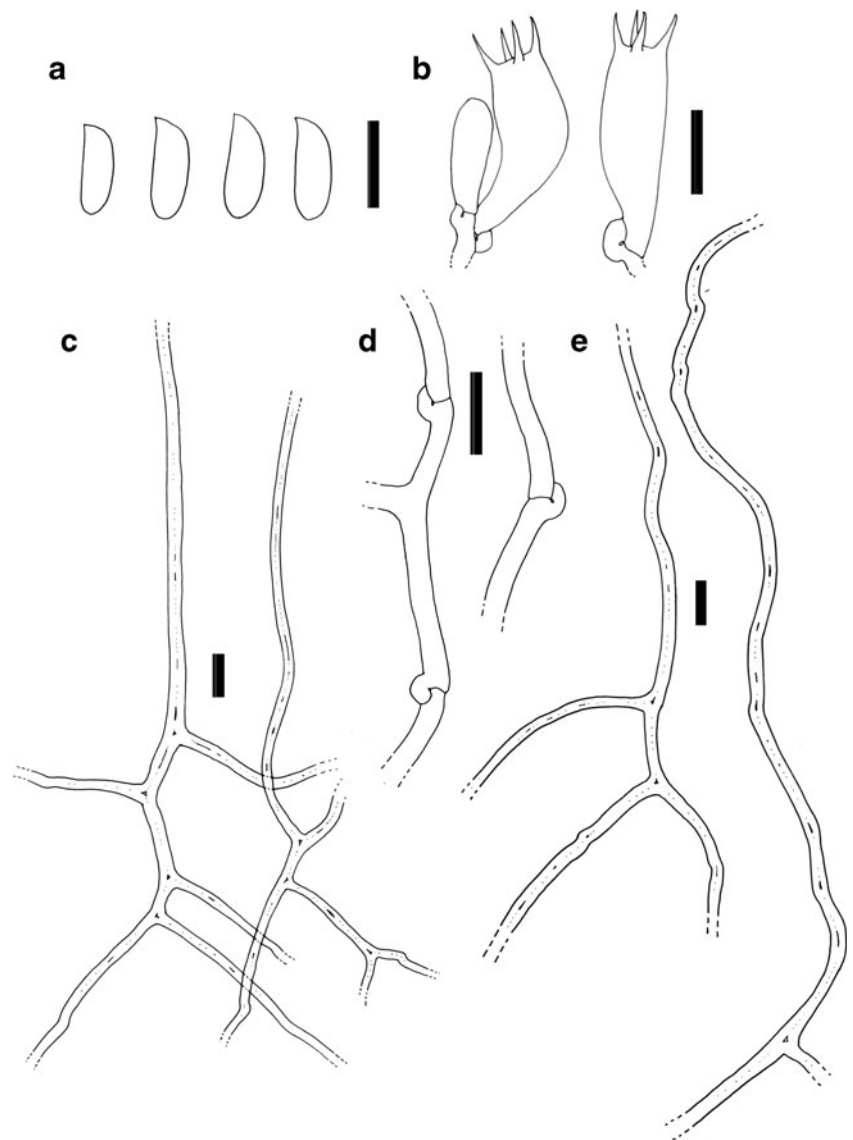
Distribution Hitherto known only from temperate areas of Japan.

Remarks This species is distinct from other *Neofavolus* spp. in its thin and pale-colored basidiocarps. *Neofavolus mikawai* occasionally has a similar cream pileus and similar sized angular pores, but differs in its thicker and less flexible context, and distinctly shorter basidia.

Other specimens examined JAPAN, Kanagawa Pref., Odawara, Iryuda, H. Sasaki, 24 June 2006 (TFM F–27496); Nara Pref., Kawakami, Sannokou, T. Hattori, 6 July 2010, (TUMH 50006); the same place, T. Hattori, 6 July 2010, (TUMH 50007); the same place, T. Hattori, 6 July 2010, (TUMH 50008).

Neofavolus mikawai (Lloyd) Sotome & T. Hatt., comb. nov. Figs. 4, 10c, 11c, 12c

Fig. 3 *Neofavolus cremeoalbidus* (TUMH 50006). **a** Basidiospores. **b** Basidia and unripe basidium. **c** Skeletal-binding hyphae from trama. **d** Generative hyphae from trama. **e** Skeletal-binding hyphae from context. **f** Generative hyphae from trama. Bars=10 μm



Mycobank MB801929

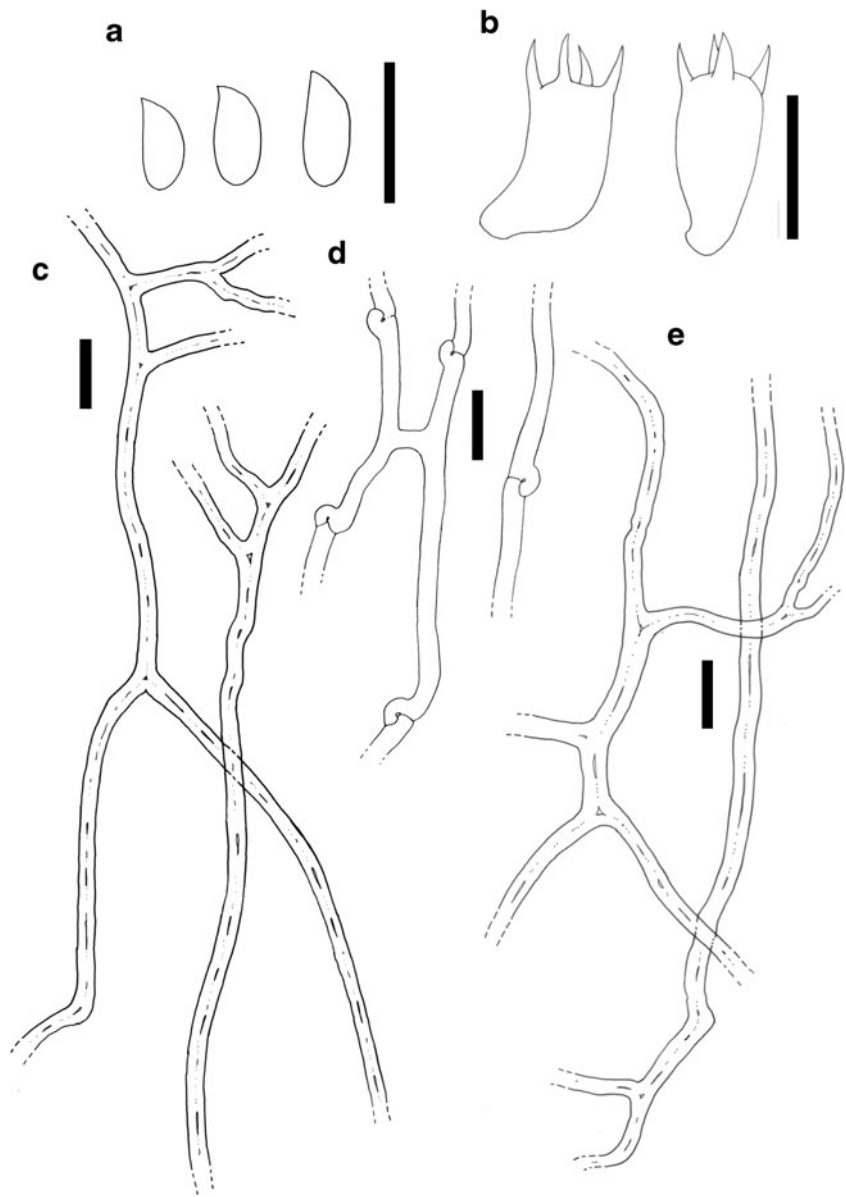
Basionym: *Polyporus mikawai* Lloyd, Mycol. Writ. 4 (Letter 54):5 (1915).

Basidiocarps annual, laterally stipitate, often substipitate and attached to the substrate by a narrow base, solitary. Pileus reniform to semicircular, applanate, 1.7–6 cm from the base to margin, 2–8 cm wide, up to 5 mm thick; surface glabrous, smooth, cream to brownish orange (10YR8–9/2–8), azonate; margin acute, usually undulating. Stipe cylindrical, up to 5 mm long, up to 7 mm in diam. Context fleshy-tough in fresh condition, corky in dried condition, white in fresh condition, up to 5 mm thick. Pore surface cream (10YR9/4–6), pores angular, 3–5 pores/mm, dissepiments thin, entire to slightly lacerate. Tubes concolorous with the pore surface, up to 2 mm deep. Hyphal system dimitic with generative hyphae and skeletal-binding hyphae. Contextual generative hyphae thin-walled, hyaline, with

clamp connections, up to 3.5 μm in diam. Contextual skeletal-binding hyphae usually solid, frequently branched, highly interwoven, hyaline, non-dextrinoid, 3.5–5 μm in diam. at basal stalk. Tramal generative hyphae same as in context. Tramal skeletal-binding hyphae dominant, mostly solid, moderately branched, moderately to highly interwoven, hyaline, non-dextrinoid, 2.5–4 μm in diam. at basal stalk, tapering to 1.5–2 μm in diam. Pileipellis present as cutis composed of hyaline, parallel and agglutinated generative hyphae. Basidia clavate, 4-sterigmate, 12–16.5 \times 5–8 μm . Basidiospores cylindrical, hyaline, non-dextrinoid, 6–9.5 \times 2.3–3.6 μm , $L=7.73$ μm , $W=2.88$ μm , $R=2\text{--}3.4$, $r=2.71$ ($n=186/4$).

Distribution Known only from Japan and China (Hattori and Zang 1995; Lloyd 1915; Núñez and Ryvardeen 1995a, 2001; Cui et al. 2008; Dai et al. 2011; Wang et al. 2011).

Fig. 4 *Neofavolus mikawai* (TUMH 50005). **a** Basidiospores. **b** Basidia. **c** Skeletal-binding hyphae from context. **d** Generative hyphae from trama. **e** Skeletal-binding hyphae from trama. Bars = 10 μ m



Remarks This species can be differentiated from other *Neofavolus* spp. by its cream to brownish orange basidiocarps, glabrous pileus surface, corky context when dried, angular pores, and small clavate basidia up to 16.5 μ m long. This is known only from restricted areas of warm-temperate Japan and China. Ryvarden (1990) concluded that the holotype is an immature specimen of *Polyporus* cf. *varius*, but actually it lacks a black stipe. Núñez and Ryvarden (1995a) wrongly characterized this species as having a black crust on the stipe, and remarked a resemblance to *P. varius* (Pers.) Fr. However, *Polyporus varius* is distinct from *N. mikawai* due to its yellowish pileus surface, and stipe partly covered by a black crust.

Specimens examined CHINA, Jiangxi Prov., Yianshanzian, Zhumukung, Nature Reserve in Mt. Wuyi, alt. 800–1350 m,

Y. Abe, 4 July 1994 (TNS F–183112); the same place, alt. 800–1350 m, T. Hattori, 4 July 1994 (TNS F–183121); the same place, alt. 800–1350 m, Ji W-T, 4 July 1994 (TNS F–183122); the same place, alt. 1600 m, T. Hattori, 7 July 1994 (TNS F–183134). JAPAN, Aichi Pref., Hazu, Yokosuka, on *Castanopsis* sp., U. Matsuzaki, 10 July 1914 (ISOTYPE; TNS F–20445); Chiba Pref., Sakura, Sakurajoushi Park, K. Sotome, 12 July 2003 (TFM F–27346); Kanagawa Pref., Odawara, Iryuda, H. Sasaki, 24 June 2006 (TFM F–27500); the same place, H. Sasaki, 24 June 2006 (TFM F–27501); Osaka Pref., Mino, S. Tsujiyama, 18 July 2004 (TFM F–27416); the same place, S. Tsujiyama, 18 July 2004 (TFM F–27417); Okinawa Pref., Y. Ando, 8 May 2004 (TFM F–27380); Tokyo Pref., Hachijo Island, Y. Ando, 20 June 2004 (TFM F–27396); Tottori Pref., Tottori, Ouchidani, Y. Ando, 3 July 2011 (TUMH 50005).

Favolus Fr., Elench. Fung. 1: 44 (1828), emend. Sotome & T. Hatt.

Basidiocarps annual, laterally stipitate to substipitate or almost sessile. Pileus spathulate, reniform to dimidiate, surface glabrous or with minute hairs, occasionally with stiff tufts or spinulose scales toward the base in some species, more or less radially striate, azonate, variable in color. Stipe cylindrical to flattened or reduced. Context fleshy-tough to leathery in fresh condition, leathery to corky or brittle in dried condition. Pores large to small, regular or radially elongated. Hyphal system dimitic with generative and skeletal-binding hyphae. Generative hyphae with or without clamp connections. Skeletal-binding hyphae usually dominating, arboriform, hyaline, IKI–. Pileipellis undifferentiated, if present composed of non-agglutinated parallel hyphae, up to 50 µm thick. Basidia clavate, 4-sterigmate. Basidiospores cylindrical to navicular, thin-walled, smooth, hyaline, IKI–.

Type species. Favolus brasiliensis (Fr.) Fr.

Favolus acervatus (Lloyd) Sotome & T. Hatt., comb. nov. Figs. 5, 10d, 11d, 12d

Mycobank: MB801930

Basionym: *Polyporus acervatus* Lloyd, Mycol. Writ. 6: 1006 (1920).

= *Polyporus emerici* (Cooke) Imazeki auct. non Cooke, Imazeki: Bull. Tokyo Sci Mus. 6:95 (1943).

Basidiocarps annual, laterally stipitate to almost sessile, solitary to imbricate. Pileus reniform to dimidiate, occasionally irregular, applanate to conchate or triquetrous, 3–10.5 cm from the base to margin, 3–13.7 cm in diam., up to 1.7 cm thick; surface glabrous, radially striate, white to cream (5Y7–8/4, 10YR8/2–4) or pale yellowish gray in fresh condition, azonate; margin acute, entire, sometimes undulating. Stipe cylindrical to flattened, up to 2.5 cm long, up to 1.3 cm in diam. Context fleshy-tough, white in fresh condition, leathery to leathery-corky in dried condition, up to 1.4 cm thick. Pore surface white to cream (5Y9/4–8, 10YR9/4), pores angular, 2–4 pores/mm, dissepiments thin, entire. Tubes concolorous with the pore surface, up to 3 mm deep. Hyphal system dimitic with generative hyphae and skeletal-binding hyphae. Contextual generative hyphae thin-walled, without clamp connections, hyaline, up to 3.5 µm in diam. Contextual skeletal-binding hyphae thick-walled to solid, moderately branched, moderately interwoven, hyaline, non-dextrinoid, 3–5(6) µm in diam. at basal stalk. Tramal generative hyphae same as in context but more abundant. Tramal skeletal-binding hyphae mostly solid, moderately branched, moderately to highly interwoven, hyaline, non-dextrinoid, up to 5 µm in diam. at basal stalk. Pileipellis not well differentiated or present, then 10–50 µm thick, or composed of densely arranged parallel hyphae without agglutination. Basidia clavate, four sterigmate, 19–22 × 5–6.5 µm, Basidiospores navicular to

cylindrical, hyaline, non-dextrinoid, 7–9 × (2.3–)2.5–3.5 µm, $L=8.13$ µm, $W=2.96$ µm, $R=2.7–3.5$, $r=2.76$ ($n=173/4$).

Distribution This species was originally described from Singapore by Lloyd (1920). In Japan, this species is widely distributed in warm-temperate areas.

Remarks *Favolus acervatus* is variable in shape and size of basidiocarps, but is well characterized by its white to cream basidiocarps, angular pores, generative hyphae lacking clamp connections, and navicular to cylindrical basidiospores. Ryvarden (1990) concluded that this is a synonym of *P. grammacephalus*, after the type examination accepted by Núñez and Ryvarden (1995a, 2001). However the latter species has an orange to brown pileus surface, frequently flabelliform pileus, generative hyphae with clamp connections, and cylindrical basidiospores. The specimen of *Polyporus admirabilis* Peck cited as the voucher from Japan (TFM F–14764; Núñez and Ryvarden 1995b) represents a form of *F. acervatus* with an irregular pileus.

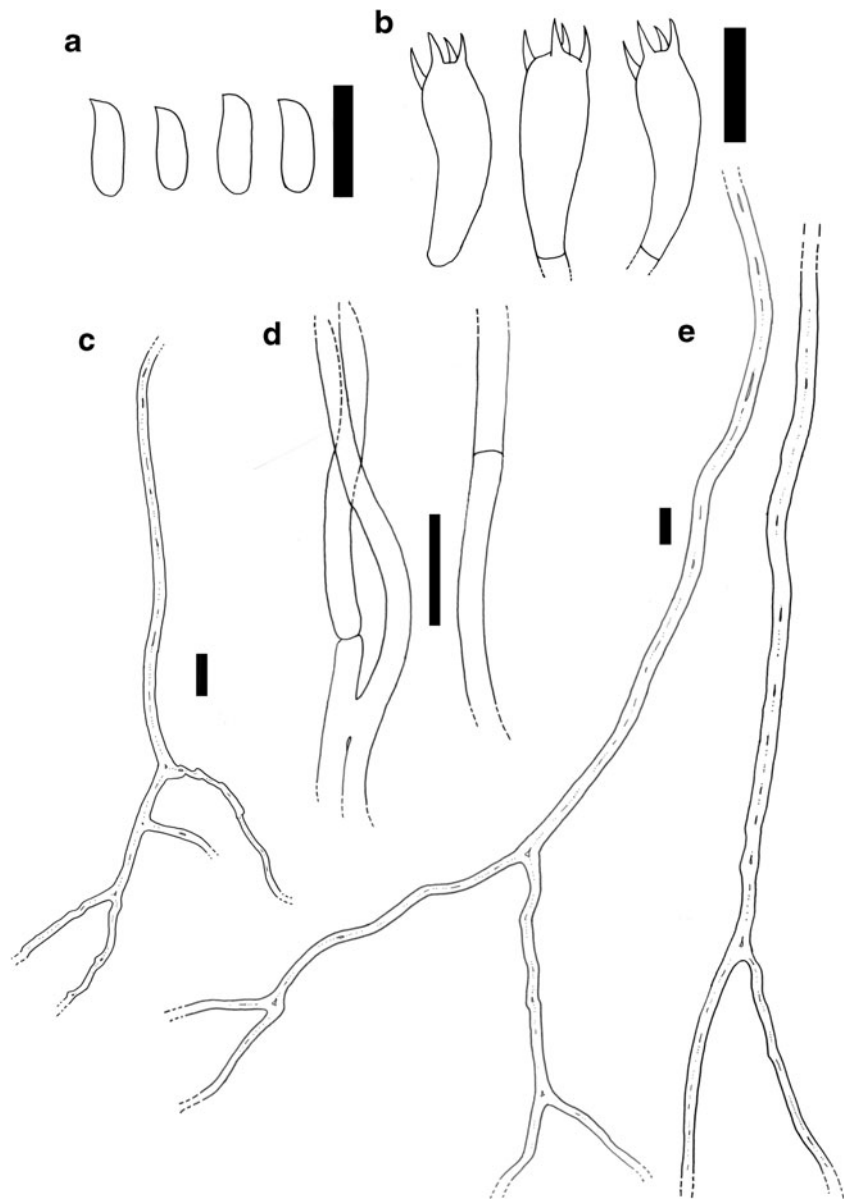
Specimens examined JAPAN, Gunma Pref., Kiryu, Hishi-machi, T. Suda, 27 June 2006 (TFM F–27553); Ibaraki Pref., Tsuchiura, Shishizuka, T. Hattori & K. Sotome, 9 July 2006 (TFM F–27504); the same place, K. Sotome, 8 July 2007 (TFM F–27539); Kanagawa Pref., Atsugi, Kanagawa Prefectural Nature Conservation Center, 27 Aug 2003 (TFM F–21693); Kanagawa Pref., Odawara, Kawasaki, Ikutaryokuchi, I. Asai, 14 June 2009 (TFM F–27636); Kanagawa Pref., R. Imazeki, July 1978 (TFM F–14764); Kanagawa Pref., Yokohama, Tomioka-Sougou Park, K. Egawa, 16 Sep 2004 (TFM F–27443); Oita Pref., Yufu, Hasama, E. Hadano & A. Hadano, 21 July 2003 (TFM F–27345); Oita Pref., Yufu, E. Hadano & A. Hadano, 2 July 2006 (TFM F–27502); Saitama Pref., Saitama, I. Asai, 30 May 2006 (TFM F–27554). SINGAPORE, T.F. Chipp, 15 Dec 1919 (HOLOTYPE; BPI US0301331).

Favolus brasiliensis (Fr.) Fr., Linnaea 5: 511 (1830). Figs. 6, 10e, 11e, 12e

Basionym: *Daedalea brasiliensis* Fr. Syst. Mycol. (Lundae) 1: 332 (1821).

Basidiocarps annual, laterally stipitate, solitary. Pileus reniform, flabelliform to spathulate, applanate, up to 5.5 cm from the base to margin, up to 4.5 cm wide; surface glabrous, radially striate, white in fresh condition, drying cream to brownish orange (10YR6–8/4–8), azonate; margin acute, entire. Stipe cylindrical, up to 7 mm long, up to 5 mm diam. Context leathery to tough-fleshy, thin, white in fresh condition, drying brittle, cream (10YR8–9/4). Pore surface white, pores radially elongated, 2–4 mm long, 1–2 mm wide, dissepiments thin, entire or slightly lacerate. Tubes

Fig. 5 *Favolus acervatus* (TFM F-27636). **a** Basidiospores. **b** Basidia. **c** Skeletal-binding hyphae from trama. **d** Generative hyphae from trama. **e** Skeletal-binding hyphae from context. Bars=10 μm



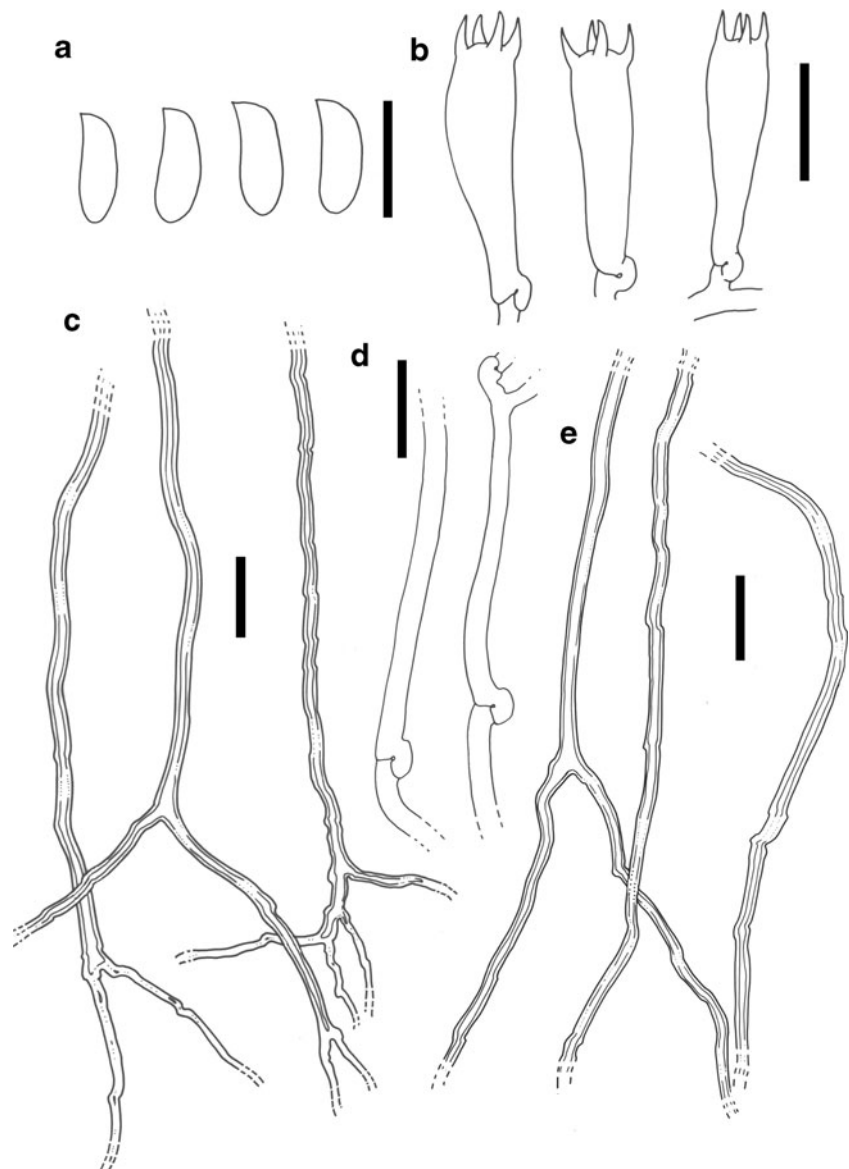
white, up to 4 mm deep. Hyphal system dimitic with generative hyphae and skeletal-binding hyphae. Contextual generative hyphae thin-walled, hyaline, with clamp connections, clamp connections abundantly seen in dried specimens, up to 4 μm in diam. Contextual skeletal-binding hyphae thick-walled to solid, occasionally to moderately branched, moderately interwoven, hyaline, non-dextrinoid, 3–5(–6.6) μm in diam. at basal stalk. Tramal generative hyphae same as in context. Tramal skeletal-binding hyphae thick-walled to solid, moderately branched, moderately to highly interwoven, hyaline, non-dextrinoid, 3.5–7 μm in diam. at basal stalk. Pileipellis not well differentiated. Basidia clavate, 4-sterigmate, 20–34 \times 6.6–8.5 μm . Basidiospores cylindrical, hyaline, non-dextrinoid, (6–)7–12 \times 2.2–4.6(–4.8) μm , $L=9.56$ μm , $W=3.53$ μm , $R=2.0$ –3.7, $r=2.75$ ($n=171/3$).

Distribution Tropical areas of Central to South America in El Salvador and Brazil.

Remarks This is quite similar to *F. spathulatus* in its white, leathery, and flexible basidiocarps with radially elongated and hexagonal pores. However, *F. brasiliensis* is distinct from *F. spathulatus* owing to its larger pores and generative hyphae with conspicuous clamp connections.

Specimens examined BRAZIL, Amazonas St., Manaus, N.K. Ishikawa, C.A.A. Cortegano & R. Vargas-Isla, 11 Mar 2011 (INPA 241446); Amazonas St., Manaus, N.K. Ishikawa & R. Vargas-Isla, 7 Apr 2011 (INPA 241447); Amazonas St., Manaus, N.K. Ishikawa & R. Vargas-Isla, 25 Apr 2011 (INPA 241453); Amazonas St., Manaus, N. Maekawa, T. Shirouzu, N.K. Ishikawa & D.L. Komura, 9

Fig. 6 *Favolus brasiliensis* (INPA 241452). **a** Basidiospores. **b** Basidia. **c** Skeletal-binding hyphae from trama. **d** Generative hyphae from trama. **e** Skeletal-binding hyphae from context. Bars=(**a**, **b**, **d**) 10 μ m; (**c**, **e**) 20 μ m



Aug 2011 (INPA 241427); Amazonas St., Manaus, D.L. Komura, N.K. Ishikawa & N. Maekawa, 9 Aug 2011 (INPA 241452). El SALVADOR, Cabañas Dep., Cinquera, Parque Ecológico Bosque de Cinquera, K. Sotome & N. Maekawa, 28 Sep 2011 (TUMH 50010); the same place, K. Sotome & N. Maekawa, 28 Sep 2011 (TUMH 50011).

Favolus emerici (Berk. ex Cooke) Imazeki, Bull. Tokyo Sci. Mus 6: 95 (1943). Figs. 7, 10f, 11f, 12f

Basionym: *Polyporus emerici* Berk. ex Cooke, Grevillea 10: 96 (1882)

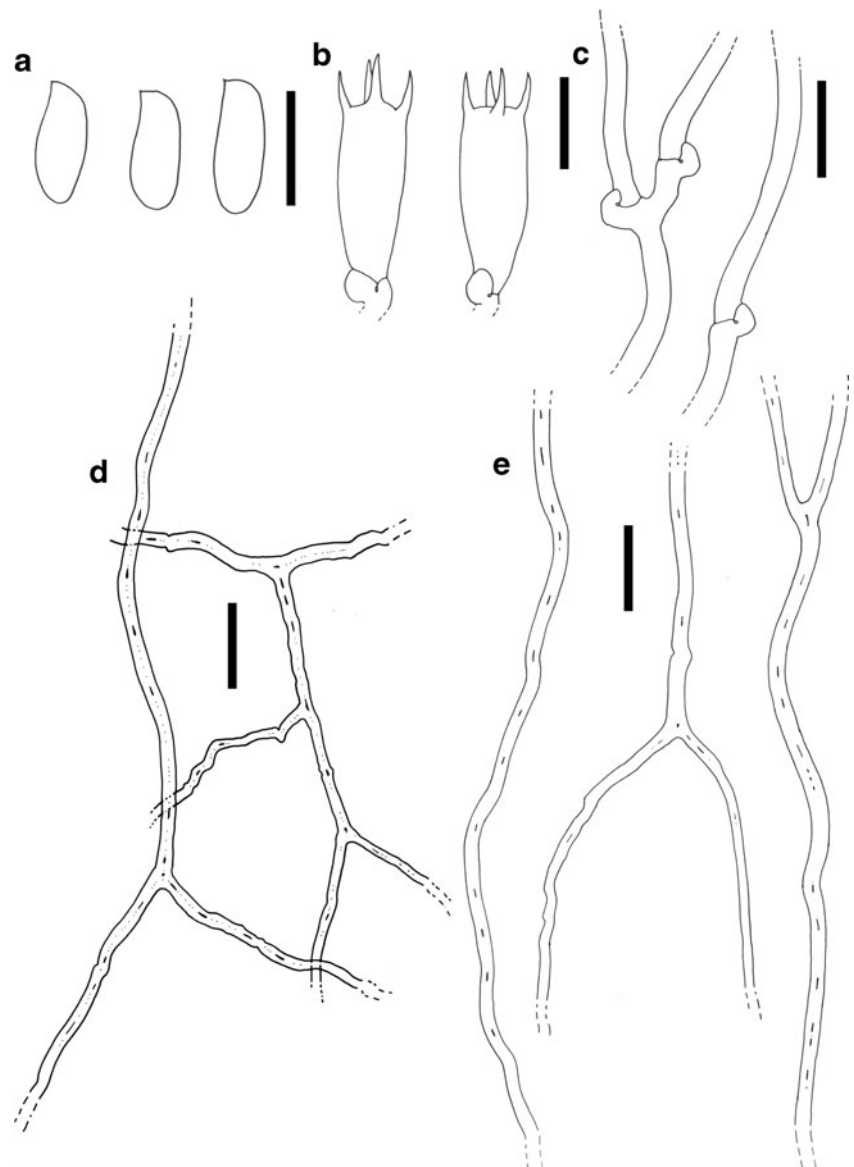
= *Polyporus grammacephalus* Berk., Hooker's J. Bot. Kew Gard. Misc. 1: 184 (1842).

= *Favolus grammacephalus* (Berk.) Imazeki, Bull. Tokyo Sci. Mus. 6: 95 (1943), nom. illegit., non *Favolus grammacephalus* Lloyd, Mycol. Writ. 7: 1271 (1924).

= *Polyporus perversus* Lloyd, Mycol. Writ. 3: 136 (1912).

Basidiocarps annual, laterally stipitate or substipitate with a contracted base, solitary to gregarious. Pileus dimidiate, flabelliform to spathulate, applanate, up to 9 cm from the base to margin, 8 cm wide, up to 12.5 mm thick; surface glabrous, radially striate, often partly scrupeose or spinulose towards the base, orange to reddish brown (5YR5–7/6–12), occasionally dark brown (5YR3–4/4), azonate; margin acute, entire. Stipe cylindrical to flattened, often indistinct, up to 2 cm long, up to 1 cm wide. Context leathery to fleshy-tough in fresh condition, white, leathery to corky in dried condition, up to 1 cm thick. Pore surface white, cream to orange (5YR5–7/6–8, 10YR7–8/8), various in color in fresh condition, pores round to angular, 2–3 to 4–5 pores/mm, various in size according to the specimens, dissepiments thin, entire. Tubes concolorous with the pore surface, up to 4 mm deep. Hyphal system dimitic with generative hyphae and skeletal-binding

Fig. 7 *Favolus emeric* (TFM F-27539). **a** Basidiospores. **b** Basidia. **c** Generative hyphae from trama. **d** Skeletal-binding hyphae from context **e** Skeletal-binding hyphae from trama. Bars=10 μ m



hyphae. Contextual generative hyphae thin-walled, hyaline, with clamp connections, up to 5 μ m in diam. Contextual skeletal-binding hyphae thick-walled to solid, frequently branched, moderately interwoven, hyaline, non-dextrinoid, up to 3–4.5 μ m in diam. at basal stalk. Tramal generative hyphae same as in context but more abundant. Tramal skeletal-binding hyphae solid, frequently branched, moderately to highly interwoven, hyaline, non-dextrinoid, 3–4.5 μ m in diam. at basal stalk. Pileipellis 10–35 μ m thick, brownish, composed of densely arranged parallel hyphae without agglutination, occasionally with minute hairs on pileus surface; hairs up to 40 μ m long, composed of thin-walled generative hyphae. Basidia clavate, 4-sterigmate, 18–24 \times 6–7.5 μ m. Basidiospores cylindrical, hyaline, non-dextrinoid, 8.1–12 \times 2.7–4.8 μ m, $L=9.87$ μ m, $W=3.78$ μ m, $R=2-3.5$, $r=2.64$ ($n=94/2$).

Distribution Widely distributed in tropical to subtropical areas of Southeast Asia and southern East Asia.

Remarks This species is characterized by its orange to brown pileus surface with distinctive radial lines, leathery to fleshy-tough context, angular pores and generative hyphae with clamp connections. Because *F. emeric* (= *P. grammocephalus*) is variable in pileus color and sizes of pores and basidiospores, a number of synonyms have been proposed for this species (Ryvarden 1984, 1990; Núñez and Ryvarden 1995a). Some may be distinct species. From our current study, this species is common in tropical to subtropical areas in Asia.

Specimens examined Australia, Queensland Sta., Brisbane, on wood (ISOTYPE of *P. emeric*; K(M)155852). CHINA, Hainan Prov., Haikon People's Park, Y.C. Dai, 1 July 2006

(IFP Dai 7799); Hainan Prov., Bawangling Nature Reserve, Y.C. Dai, 3 July 2006 (IFP Dai 7869); the same place, Y.C. Dai, 3 July 2006 (IFP Dai 7893). JAPAN, Okinawa Pref., Y. Ando, 8 May 2004 (TFM F-21697); Okinawa Pref., Iriomote Island, H. Sasaki, 23 May 2004 (TFM F-27599); Okinawa Pref., Iriomote Island, Haeki, K. Sotome, 24 Oct 2005 (TFM F-27485); the same place, K. Sotome, 24 Oct 2005 (TFM F-27486); the same place the same place, K. Sotome, 24 Oct 2005 (TFM F-21715); Okinawa Pref. Iriomote Island, Shiira River, K. Sotome 25 Oct 2005 (TFM F-21714) Okinawa Pref., Kunigami, E. Hatano, 3 June 2007 (TFM F-27531); Tokyo, Hachijo Island, H. Sasaki, 2004 (TFM F-27383). MALAYSIA, Negeri Sembilan, Pasoh Forest Reserve, T. Hattori, 1 Aug 1995 (TFM F-17438); the same place, T. Hattori, 8 Dec 1993 (TFM F-18165); the same place, T. Hattori, 21 Dec 1997 (TFM F-18263); Penang, Muka Head, T. Hattori, 21 Dec 2002 (TFM F-20609); the same place, T. Hattori, 2 Dec 2003 (TFM F-20954); Penang, Balik Pulan, T. Hattori & S. Baharuddin, 24 Dec 2002 (TFM F-20641); Penang, Teluk Bahang, T. Hattori, 1 Dec 2003 (TFM F-20934). PHILIPPINES, [HOLOTYPE of *P. grammacephalus*; K(M) 57290]. Cagayan Prov., R.C. Merrill, Aug 1909 (BPI US0305614 as *Polyporus perversus*); Laguna, Mt. Makiling, on dead wood, S. Msrquz, 16 Sep 1917 (BPI US0305611 as *Polyporus perversus*); Mindoro, R. Edano, Oct-Nov 1919 (BPI US0305613 as *Polyporus perversus*); Negros, Gimagaan Riv., 6 Jan 1904 (BPI US0305616 as *Polyporus perversus*); Negros, Co. Reyes, 25 Nov 1920 (HOLOTYPE of as *Polyporus perversus*; BPI US0255822).

Favolus roseus Lloyd, Mycol. Writ. 7: 1157 (1922). Figs. 8, 10g, 11g, 12g

Basidiocarps annual, laterally stipitate, solitary. Pileus reniform to semicircular, applanate, up to 3.5 cm from the base to margin, up to 4 cm in diam., up to 4 mm thick; surface glabrous, tessellate, faintly striate with radial lines, yellowish orange (10YR8/8) in fresh condition, azonate; margin acute, entire or slightly lacerate. Stipe up to 2 mm long, up to 1 mm thick. Context fleshy-leathery, white in fresh condition, leathery and cream (10YR9/4) in dried condition, up to 1 mm thick. Pore surface yellowish orange to brownish orange (10YR6/8) in fresh condition, pores radially elongated, 1–3×0.5–2 mm, dissepiments thin, entire. Tubes concolorous with the pore surface, up to 1.5 mm deep. Hyphal system dimitic with generative hyphae and skeletal-binding hyphae. Contextual generative hyphae thin-walled, hyaline, with clamp connections, up to 5 µm in diam. Contextual skeletal-binding hyphae thick-walled, moderately branched, interwoven, hyaline, non-dextrinoid, 3–5.5(–6) µm in diam. at basal stalk. Tramal generative hyphae same as in context. Tramal skeletal-binding hyphae dominant, solid, moderately

branched, highly interwoven, hyaline, non-dextrinoid, 3–4.5 µm in diam. Pileipellis not well differentiated. Basidia clavate, 4-sterigmate, 18–23.8×4.5–7 µm. Basidiospores cylindrical, hyaline, non-dextrinoid, 7–12×2.4–4.2 µm, $L=8.98$ µm, $W=3.37$ µm, $R=2-3.8$, $r=2.71$ ($n=40/1$).

Distribution Known from tropical areas of Southeast Asia in Singapore as type locality and Malaysia.

Remarks Small basidiocarps with grayish orange to yellowish orange pileus surface, and large and radially elongated pores clearly differentiate this species from other *Favolus* spp. This species has been considered as a synonym of *Polyporus tenuiculus* (Ryvarden 1989), but our study reveals that *P. tenuiculus* sensu lato comprises at least three species. We accept *F. roseus* as a distinct species, considering its phylogenetic and morphological characters. The holotype of *P. tenuiculus* seems to be inaccessible, and this must remain an ambiguous name.

Specimens examined MALAYSIA, Negeri Sembilan, Pasoh Forest Reserve, T. Hattori, 1 Aug 1995 (TFM F-17429); the same place, T. Hattori, 5 Dec 1995 (TFM F-17568); Penang, A. Yamada, 15 Nov 2005 (TUMH 50012; Penang, Muka Head, T. Hattori & S. Baharuddin, 20 Dec 2002 (TFM F-20589); the same place, T. Hattori, 2 Dec 2003 (TFM F-20963); Penang, Teluk Bahang, T. Hattori & S. Baharuddin, 12 Dec 2002 (TFM F-20465); SINGAPORE, Singapore Botanic Gardens, E. M. Burkill, 30 Dec 1913 (HOLOTYPE; BPI US0323125).

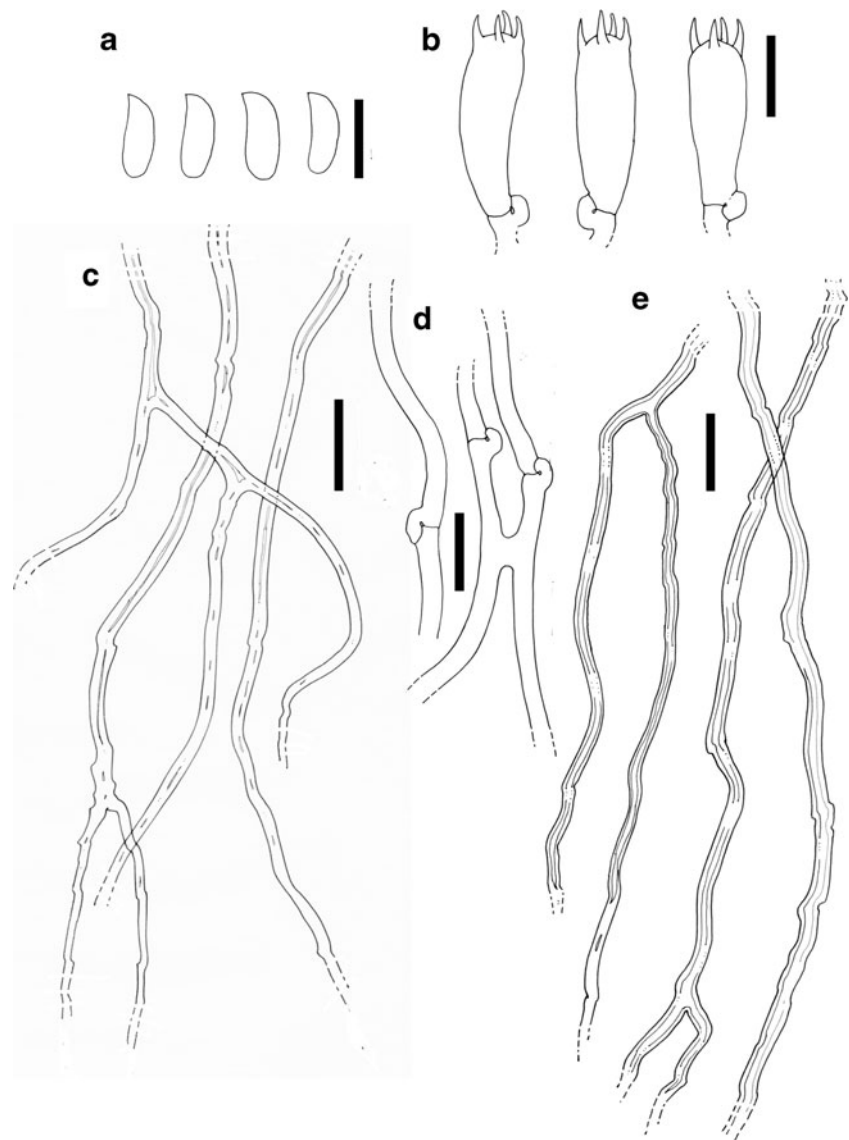
Favolus spathulatus (Jungh.) Lév., Anns Sci. Nat. Bot. sér. 3 2: 203 (1844). Figs. 9, 10h, 11h, 12h

Basionym: *Laschia spathulata* Jungh., Praem. Fl. Crypt. Java (Batavia): 75 (1838).

= *Favolus moluccensis* Mont., Anns Sci. Nat. Bot., sér. 2: 20: 365 (1843)

Basidiocarps annual, laterally stipitate, gregarious, occasionally several pilei arise from common base. Pileus flabelliform, spathulate to dimidiate, applanate to conchate, up to 3.5 cm from the base to margin, up to 5 cm wide; surface glabrous, radially striate, white in fresh condition, drying fulvous to umber (10YR5–6/4–12), azonate; margin acute, entire. Stipe cylindrical, up to 1.2 cm long, up to 2 mm in diam. Context leathery to tough-fleshy, thin and flexible, white in fresh condition, drying brittle. Pore surface white, pores radially elongated, up to 1.5 mm long, 0.5 mm wide, dissepiments thin, entire to dentate. Tubes white. Hyphal system dimitic with generative hyphae and skeletal-binding hyphae. Contextual generative hyphae thin-walled, hyaline, without clamp connections, up to 3.5 µm in diam. Contextual skeletal-binding hyphae thick-walled to solid,

Fig. 8 *Favolus roseus* (TMF F-20963). **a** Basidiospores. **b** Basidia. **c** Skeletal-binding hyphae from trama. **d** Generative hyphae from trama. **e** Skeletal-binding hyphae from context. Bars=(**a, b, d**) 10 μm ; (**c, e**) 20 μm



occasionally to moderately branched, moderately interwoven, hyaline, non-dextrinoid, 2.5–5 μm in diam. at basal stalk. Tramal generative hyphae same as in context. Tramal skeletal-binding hyphae thick-walled to solid, moderately branched, moderately to highly interwoven, hyaline, non-dextrinoid, up to 4 μm in diam. at basal stalk. Pileipellis not well differentiated. Basidia clavate, 4-sterigmate, up to 21×4.8 μm . Basidiospores cylindrical, hyaline, non-dextrinoid, $(5.3\text{--}5.5\text{--}8.7 \times 2\text{--}3.5$ μm , $L=6.66$ μm , $W=2.68$ μm , $R=1.9\text{--}3.4$, $r=2.5$ ($n=146/3$).

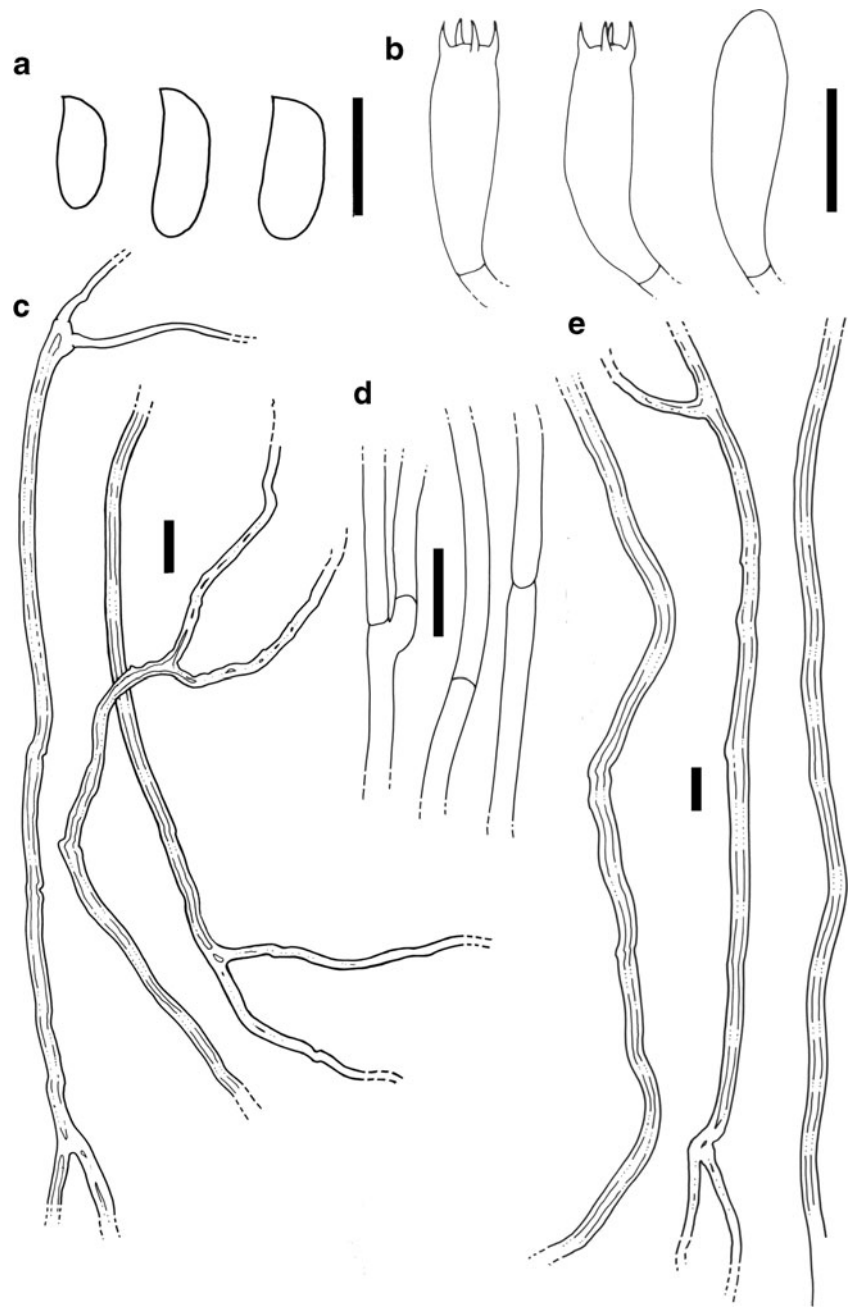
Distribution Widespread in Southeast Asia and southern East Asia.

Remarks *Favolus spathulatus* was originally described from Java, and is well characterized by its white, leathery, and flexible basidiocarps with radially elongated pores and

simple, septate, generative hyphae. *Favolus brasiliensis* is quite similar but has entire and larger pores measuring $2\text{--}4 \times 1\text{--}2$ mm, and generative hyphae with clamp connections at all septa.

Specimens examined JAPAN, Okinawa, Y. Ando, 23 Apr 2005 (TFM F-27457); Okinawa, Ishigaki Island, Omoto, E. Hatano, 19 May 2007 (TFM F-27525); Okinawa, Ishigaki Island, Mt. Omotodake, T. Hattori 6 Jun 2012 (TUMH 50121); Okinawa, Iriomote Island, T. Hattori, M. Izawa & K. Sotome (TFM F-27484); Okinawa Pref., Iriomote Island, Funaura, 14 Sep 1991 (TFM F-16246); Okinawa Pref., Iriomote Island, Shiira River, K. Sotome 25 Oct 2005 (TFM F-21713); Okinawa Pref., Kunigami, H. Sasaki, 3 June 2007 (TFM F-27529); the same place, H. Sasaki, 3 June 2007 (TFM F-27530); Okinawa Pref., Kunigami, Nishimedake, H. Hattori, 20 Feb 2008 (TFM F-27584);

Fig. 9 *Favolus spathulatus* (TMF F-24245). **a** Basidiospores. **b** Basidia and unripe basidium. **c** Skeletal-binding hyphae from trama. **d** Generative hyphae from trama. **e** Skeletal-binding hyphae from context. Bars=10 μ m



Okinawa Pref., Kunigami, Yonahadake, Y. Ando, 21 Apr 2005 (TFM F-27459); the same place, Y. Ando, 21 Apr 2005 (TFM F-27460); Tokyo, Hachijo Island, H. Sasaki, 2 July 2005 (TFM F-27471). INDONESIA, Molucca Sea, Ternate Island (PC, HOLOTYPE of *Favolus moluccensis*). MALAYSIA, Negeri Sembilan, Pasoh Forest Reserve, T. Hattori, 2 Dec 1995 (TFM F-17545); the same place, T. Hattori, 30 Jul 1995 (TFM F-17403); Penang, Muka Head, T. Hattori & S. Baharuddin, 21 Dec 2002 (TFM F-20609).

Favolus pseudobetulinus (Murashk. ex Pilát) Sotome & T. Hatt., comb. nov.
Mycobank MB801931

Basionym: *Ungulina pseudobetulina* Murashk. ex Pilát, in Kavina & Pilát, Atlas Champ. l'Europe (Praha) 3: 123 (1937).

A detailed description for this species was provided by Sotome et al. (2011).

Other authentic specimens examined

Favolus glandulosus Lloyd, Mycol. Writ. 7: 1156 (1922).

Basidiocarps laterally stipitate. Pileus dimidiate to reniform, applanate, up to 6 cm long, up to 8 cm wide; surface glabrous, radially striate, partly scrupose or spinulose towards

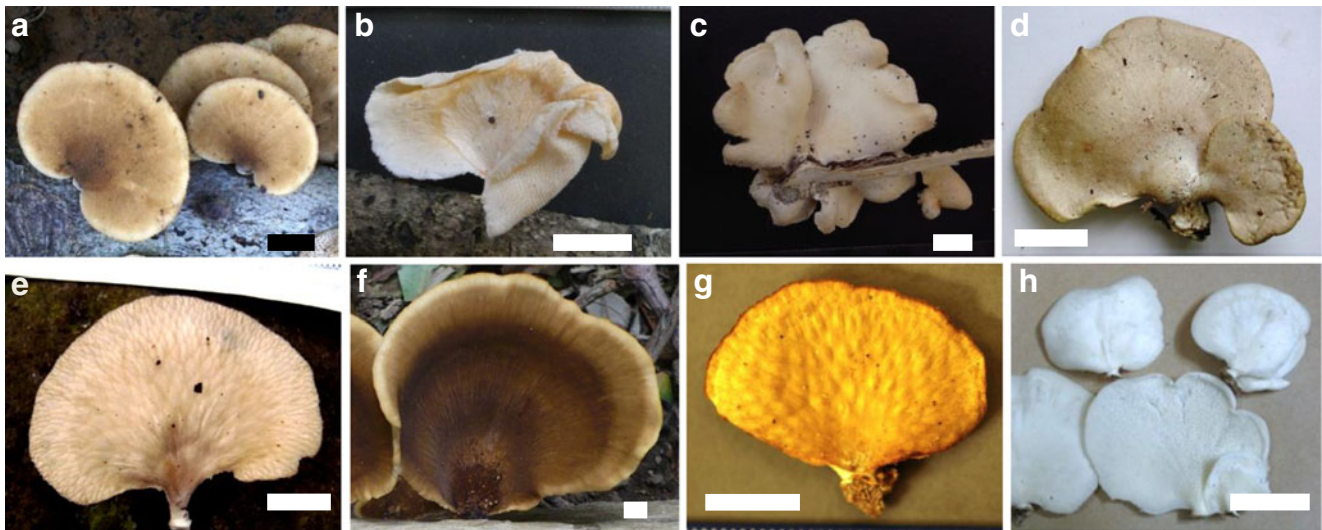


Fig. 10 Basidiocarp(s) of *Neofavolus* and *Favolus* species. **a** *N. alveolaris* (TFM F-22558). **b** *N. cremeoalbidus* (TUMH 50009). **c** *N. mikawai* (TUMH 50005). **d** *F. acervatus* (TFM F-21693). **e** *F. brasiliensis*

(TUMH 50011). **f** *F. emerici* (TFM F- 21714). **g** *F. roseus* (TMF F-50012). **h**: *F. spathulatus* (TUMH 50121). Bars=1 cm

the base, sienna (10YR5–7/10, 5YR 3/2–4), azonate. Stipe up to 8 mm long, up to 10 mm in diam. Context leathery. Pore surface fulvous to ochraceous (10YR6–7/4–8, 5YR 3/2–4), pores radially elongated, 1–2 mm long, 0.5–1 mm wide, dissepiments thin, entire. Tubes up to 2 mm. Hyphal system dimitic. Contextual generative hyphae not seen. Contextual and tramal skeletal-binding hyphae solid, frequently branched, moderately to highly interwoven, hyaline, non-dextrinoid, 4–5 µm in diam. at basal stalk. Tramal generative hyphae not seen. Basidia not seen. Basidiospores not seen.

Remarks The holotype consists of only small pieces of basidiocarps, but the radially striate pileus surface, radially elongated

pores and leathery context are identical to those of *P. philippinensis*. Our conclusion agrees with that of Ryvarden (1989).

Specimens examined PHILIPPINES, Antique Prov., Panay, R. C. McGregor, May-Aug 1918 (BPI US0323081); Copeland (HOLOTYPE; BPI US0323083; E. D. Merrill (BPI US 0323082). MALAYSIA, British North Borneo, M. Ramos, Sep-Dec 1920 (BPI US023084).

Favolus lagunae Lloyd, Mycol. Writ. 7: 1157 (1922).

Basidiocarps laterally stipitate. Pileus dimidiate, appanate to conchate, up to 1.8 cm in diam.; surface glabrous, cream (10YR8–9/4), azonate. Context brittle in dried condition, thin.

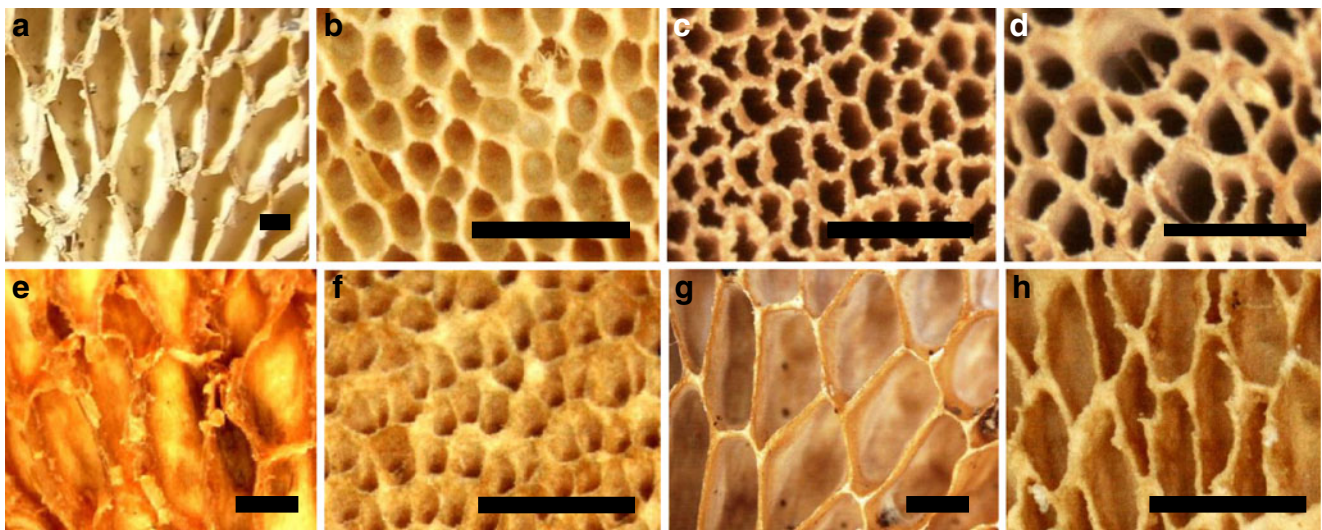


Fig. 11 Pores of *Neofavolus* and *Favolus* species. **a** *N. alveolaris* (TFM F-22558). **b** *N. cremeoalbidus* (TUMH 50006). **c** *N. mikawai* (TUMH 50005). **d** *F. acervatus* (TFM F-27636). **e** *F. brasiliensis*

(INPA 241452). **f** *F. emerici* (TFM F-27539). **g** *F. roseus* (TMF F-20963). **h** *F. spathulatus* (TFM F-24245). Bars=1 mm

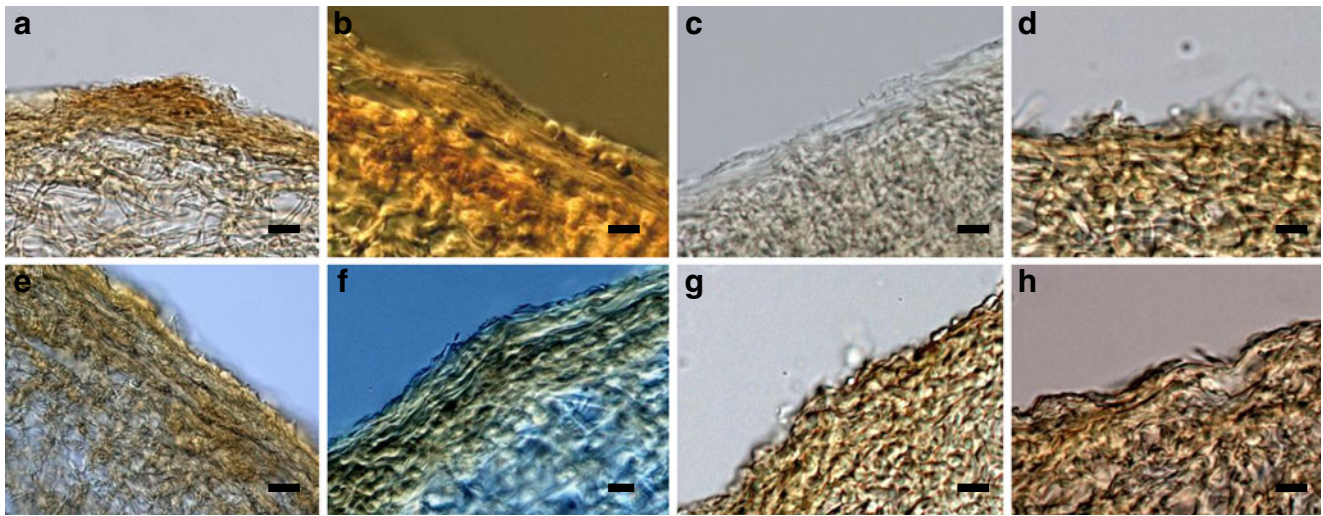


Fig. 12 Microscopic character on the pileus surface of *Neofavolus* and *Favolus* species. **a** *N. alveolaris* (TFM F-22558). **b** *N. cremeoalbidus* (TUMH 50006). **c** *N. mikawai* (TUMH 50005). **d** *F. acervatus* (TFM

F-27636). **e** *F. brasiliensis* (INPA 241452). **f** *F. emerici* (TFM F-27539). **g** *F. roseus* (TMF F-20963). **h** *F. spathulatus* (TFM F-24245). Bars=10 μ m

Pores radially elongated, up to 1.5 mm long, dissepiments thin. Tubes up to 3 mm. Hyphal system dimitic. Tramal generative hyphae thin-walled, hyaline, with clamp connections, up to 5 μ m in diam. Tramal skeletal-binding hyphae thick-walled to solid, moderately branched, hyaline, non-dextrinoid, up to 7 μ m in diam. at basal stalk.

Remarks Ryvar den (1989) concluded that this is synonymous with *P. philippinensis*, with similar laterally stipitate basidiocarps lacking a black crust and large and elongated pores. However, its brittle basidiocarps lacking radial lines on the pileus surface and wide generative hyphae with large and conspicuous clamp connections do not agree with other species of *Favolus*. At the moment this must remain *Polyporus* sp.

Specimen examined PHILIPPINES, Los Banos Laguna, on *Vitex* sp., A. Reyes, 25 Nov 1920 (HOLOTYPE; BPI US0255822).

Favolus samoensis Lloyd, Mycol. Writ. 7: 1194 (1923).

Basidiocarps laterally stipitate. Pileus dimidiate, applanate, up to 6.5 cm from base to margin; surface glabrous, radially striate, sienna (10YR5–6/8), azonate; margin rolled in drying, entire. Stipe up to 1 cm in diam. Context fibrous-brittle. Pore surface sienna (10YR5–6/8), pores angular to radially elongated, 1–2 \times 0.5–1 mm, dissepiments thin, lacperate. Hyphal system dimitic. Tramal skeletal-binding hyphae thick-walled, hyaline, non-dextrinoid, up to 6 μ m in diam. at basal stalk. Tramal generative hyphae thin-walled, hyaline, with clamp connections, up to 2(–2.5) μ m in diam. Basidiospores not seen.

Remarks Ryvar den (1989) treated this as a synonym of *P. philippinensis*, but the fibrous and brittle context, smaller pores up to 2 \times 1 mm, more loosely interwoven skeletal-binding hyphae are different from those of *P. philippinensis*. We leave this as *P. cf. philippinensis*.

Specimens examined SAMOA, C.G. Lloyd, Jan 1900 (BPI US0322934); C.G. Lloyd, 1904–1905 (BPI US0322933).

Favolus scabrolineatus Lloyd, Mycol. Writ. 7: 1157 (1922).

Basidiocarps laterally stipitate. Pileus flabelliform, applanate, 3.2 cm wide; surface glabrous, radially striate, fawn (10YR6–7/4), azonate. Pore surface ochraceous (10YR6–7/8), pores radially elongated, 2.5–4 mm long, 0.5–1 mm wide, dissepiments thin, entire. Tubes up to 2 mm. Hyphal system dimitic. Contextual generative hyphae not seen. Tramal skeletal-binding hyphae solid, frequently branched, moderately to highly interwoven, hyaline, non-dextrinoid, up to 4(–6) μ m in diam. at basal stalk. Tramal generative hyphae not seen. Basidia not seen. Basidiospores not seen.

Remarks The pileus surface is damaged, but the holotype represents *P. philippinensis* as noted by Ryvar den (1989).

Specimen examined PHILIPPINES, Luzon, Mt. Makiling, on dead wood of *Leucaena glauca*, A. Reyes, 25 Nov 1920 (HOLOTYPE; BPI US03323126).

Polyporus areosus Lloyd, Mycol. Writ. 7: 1155 (1922).

All specimens examined were moldy and in poor condition. Its small and laterally stipitate basidiocarps, small and radially elongated pores, and thin and dentate dissepiments

are similar to those of *F. spathulatus*. We leave this as *F. cf. spathulatus*.

Specimens examined PHILIPPINES, Bataan Prov. Luzon, Lamao River, E. B. Copeland, 1 Feb 1904 (HOLOTYPE; BPI US0302026); Negros Prov., Gimagaan River, E. B. Copeland, 6 Jan 1904 (BPI US0302025); E. B. Copeland (BPI US0302024).

Polyporus fuscolineatus Berk. & Broome, Trans. Linn. Soc. London, Bot. Ser. 2 1: 401 (1879).

Basidiocarps laterally stipitate. Pileus reniform, convex, up to 8.7 cm from the base to margin, 14 cm wide; surface glabrous, radially striate, ochraceous (10YR6–7/8), azonate; margin acute, entire. Stipe 1.5 cm long. Context felty. Pore surface brownish orange (10YR4/4), pores angular, 1–2/mm, various in size, dissepiments thin, slightly lacerate. Tubes concolorous with context. Hyphal system dimitic. Contextual skeletal-binding hyphae thick-walled to solid, branched, hyaline, non-dextrinoid, up to 5 µm in diam. at basal stalk. Tramal generative hyphae thin-walled, hyaline, with clamp connections, up to 4 µm in diam. (in KOH). Tramal skeletal-binding hyphae up to 5 µm in diam. at basal stalk. Tramal generative hyphae with clamp connections. Basidiospores sparse, cylindrical, hyaline, non-dextrinoid, 10–12×3–5 µm.

Remarks Ryvar den (1984) concluded that this was a synonym of *P. grammocephalus* (= *F. emeric*i). However, it is quite different from *P. grammocephalus*, as is shown by the lighter colored and convex pileus lacking a distinct radial line on the surface. We leave this as *P. cf. grammocephalus*.

Specimen examined AUSTRALIA, Queensland Sta., Brisbane, (ISOTYPE; K(M) 155853.)

Polyporus libum Berk., J. Linn. Soc., Bot. 13: 163 (1873).

Specimen damaged, only pores remaining. Pore surface dark brown (10YR4/4), pores angular, 2–3/mm, dissepiments thin, almost entire. Hyphal system dimitic. Tramal generative hyphae thin-walled, hyaline, with clamp connections, up to 4 µm in diam. Tramal skeletal-binding hyphae thick-walled to solid, moderately to frequently branched, hyaline, non-dextrinoid, up to 6.5 µm in diam. at basal stalk. Basidiospores not seen.

Remarks Cunningham (1965) noted the holotype had ‘only pores left’, and treated it as conspecific with *P. grammocephalus* (= *F. emeric*i) probably because of its pore size being similar to that in his description of ‘*P. grammocephalus*’. His conclusion was followed by Ryvar den (1984) and Núñez and Ryvar den (1995a). We leave this as a dubious species because of the poor condition of the holotype.

Specimen examined AUSTRALIA, New South Wales, Tweed River, W.R. Guilfoyle. [HOLOTYPE; K(M) 60282].

Polyporus platotis Berk. & Broome, Trans. Linn. Soc. London, Bot., Ser. 2 1: 401 (1879).

Basidiocarps laterally stipitate. Pileus plane-infundibuliform according to the original description, up to 5.5 cm from the base to margin; surface glabrous, radially striate, reddish brown (5YR4–5/8), azonate; margin obtuse, entire, irregularly wavy. Stipe up to 2.8 cm long. Pore surface reddish brown (5YR3–4/4–8), pores round to angular, 3–5 pores/mm, dissepiments thin (to partly thick), slightly lacerate. Tubes concolorous with context. Hyphal system dimitic. Contextual skeletal-binding hyphae thick-walled to solid, frequently branched, hyaline, non-dextrinoid, up to 4.5 µm in diam. at basal stalk. Tramal generative hyphae thin-walled, hyaline, with clamp connections, up to 3.5 µm in diam. (in KOH). Tramal skeletal-binding hyphae up to 3 µm in diam. at basal stalk. Basidiospores sparse, cylindrical, hyaline, non-dextrinoid, ca 7.5×3 µm.

Remarks Ryvar den (1984) concluded that this was a synonym of *P. grammocephalus* (= *F. emeric*i). Its reddish pileus surface and round to angular pores are similar to some specimens of *F. emeric*i examined here (e.g. TFM F–21697). However, its obtuse, entire, and irregularly wavy pileus margin is quite distinctive from *F. emeric*i. We therefore leave this as *F. cf. emeric*i.

Specimen examined AUSTRALIA, Brisbane, on wood, F.M. Bailey 32 (ex herb. Broome) [ISOTYPE; K(M) 155850].

Polyporus philippinensis Berk., J. Bot. Lond 1: 148 (1842).

Basidiocarps laterally stipitate. Pileus dimidiate to reniform, applanate, up to 4.8 cm long, up to 2 cm thick; surface glabrous, radially striate, partly scrupose or spinulose towards the base, brownish orange (10YR6–7/6–8), azonate. Stipe up to 1.9 cm long, up to 1.9 cm in diam. Context drying leathery. Pore surface brownish orange (10YR6–7/4–8), pores radially elongated, 1–4 mm long, 0.5–1.5 mm wide, dissepiments thin, entire to dentate. Tubes up to 2 mm. Hyphal system dimitic. Contextual generative hyphae not seen. Contextual and tramal skeletal-binding hyphae solid, frequently branched, moderately to highly interwoven, hyaline, non-dextrinoid, up to 5 µm in diam. at basal stalk. Tramal generative hyphae with clamp connections. Basidia not seen. Basidiospores not seen.

Remarks This is widely accepted as a distinct species, and is differentiated from others by the brownish orange pileus, leathery context, and large angular and elongated pores.

Favolus brasiliensis, *F. roseus* and *F. spathulatus* also have radially elongated pores, but the present species is characterized by the corky-leathery context, darker colored pileus surface, and larger basidiocarps. This is morphologically similar to *F. emerici* except for pore shape and size. This is probably a distinct species of *Favolus*, but the epithet *philippinensis* cannot be combined with *Favolus* because it has been used by ‘*F. philippinensis* Berk., London Jour. Bot. 1: 148 (1842)’.

Specimen examined PHILIPPINES, Cumming (ex herb. Berkeley) (HOLOTYPE; K(M) 60286).

Other species possibly included in the genus *Favolus*

Polyporus albostipes Ryvar den & Iturr., Mycologia 95: 1071 (2003).

Polyporus biskeletalis Corner, Beih. Nova Hedwigia 78: 57 (1984).

Polyporus elongoporus Drechsler-Santos & Ryvar den, Syn. Fung. 25: 39 (2008).

Polyporus ianthinus Gibertoni & Ryvar den, in Gibertoni, Ryvar den & Cavalcanti, Syn. Fung. 18: 53 (2004).

Polyporus subpurpurascens (Murrill) Ryvar den, Mycotaxon 23: 181 (1985).

Discussion

Favolus and *Neofavolus* share similar laterally stipitate basidiocarps lacking any black crust on the stipe surface, dimitic hyphal systems with skeletal-binding hyphae, and similar cylindrical basidiospores. Sotome et al. (2008) revealed two distinct clades within *Polyporus* s.l. corresponding to *Favolus* and *Neofavolus*, but could not identify morphological differences between these two clades. In our present study, we investigated additional samples from various regions, and revealed that characters on the pileus surface clearly distinguish the clades. Species of *Neofavolus* are characterized by a glabrous pileus with or without scales, and pileipellis as a cutis composed of parallel and agglutinated generative hyphae covering the context. In contrast, *Favolus* species, except for *F. pseudobetulinus*, have radially striate surfaces to their pileus, and their pileipellis is undifferentiated, or present but composed of non-agglutinated, dense hyphae.

Anatomical characteristics of the pileus surface have been emphasized in the classification of many agaric genera. Similar characteristics have also been used for some polypores. *Amauroderma* and *Ganoderma* species and/or subgenera, for example, can be characterized by the structures of the cortex or cuticle on the pileus surface, such as those

composed of a palisade of clavate cells (palisadoderm and interwoven hyphae (trichoderm), etc. (Imazeki 1939; Furtado 1981; Corner 1983). *Echinochaete* D.A. Reid, a genus related to *Polyporus*, has similar laterally stipitate basidiocarps, but can be differentiated from *Polyporus* by the setoid elements on the pileus surface (Sotome et al. 2008). However, there are few additional polypore genera in which the pileipellis structure has been examined in detail. Macro- and microscopic characteristics of the pileus surface are likely to be significant in adaptation to differing environmental conditions, and could possibly be correlated with phylogenetics in polypore classification.

Among the six accepted species in *Favolus*, only *F. pseudobetulinus* is found in boreal areas and has basidiocarps with an easily separable and filmy cutis composed of loose and short-celled hyphae on the pileus surface. It shares with some of other *Favolus* spp. more or less laterally-stipitate basidiocarps, and a fleshy and tough context. The other five species are mainly distributed in tropical areas, and pileus size and context texture are important for their species characterization, in addition to pore size and shape, and presence of clamp connections on generative hyphae.

Favolus acervatus and *F. emerici* (= *P. grammacephalus*) form similar medium-sized basidiocarps (up to 13 cm in width), have a leathery to fleshy-tough context, and regular and medium-sized pores (2–3 to 4–5 pores/mm); these have been considered a single species in recent publications (Núñez and Ryvar den 1995a). However, these species are phylogenetically and morphologically distinct, and easily discriminated by pileus color and occurrence of clamp connections on generative hyphae. Imazeki (1943) has accepted these species under the name *F. grammacephalus* (Berk.) Imazeki (nom. illegit., non *F. grammacephalus* Lloyd) for *F. emerici*, and *F. emerici* for *F. acervatus*.

Favolus brasiliensis, *F. roseus*, and *F. spathulatus* share a small-sized pileus and radially elongated pores, but can be differentiated by pileus surface color, pore shape and size, and presence of clamp connections on generative hyphae. The above three species have been treated as synonyms of *P. tenuiculus* described from Nigeria, and characterized by white to cream basidiocarps with hexagonal to radially elongated pores (Núñez and Ryvar den 1995a); however the holotype of *P. tenuiculus* seems to be inaccessible. Härkönen et al. (2003) showed that there are at least two members of the *P. tenuiculus* complex in Tanzania; ‘*P. moluccensis*’ with angular pores, and ‘*P. tenuiculus*’ with elongated pores. This suggested that multiple species of the *P. tenuiculus* complex are found in Africa, and thus we prefer to leave ‘*P. tenuiculus*’ as an ambiguous name until a study of the type can be made. ‘*Polyporus moluccensis*’ sensu Härkönen et al. is distinct from the above three species in its small and regular pores. ‘*Polyporus tenuiculus*’ sensu Härkönen et al. is similar to *F. spathulatus* in having

elongated pores measuring 1–2 pores/mm, but may have a larger and thicker pileus and/or darker pileus surface than *F. spathulatus*, judging by the photograph in Härkönen et al. (2003). Our study of herbarium specimens including holotypes indicates that there is a strong possibility that there are additional species of *Favolus* in tropical areas.

In contrast to *Favolus*, all three known species of *Neofavolus* are known from temperate regions and unknown from the tropics. *Neofavolus alveolaris*, the type species, is widely distributed in the temperate areas of the northern hemisphere, while the other two species are hitherto known only from limited areas of eastern Asia. *Neofavolus cremeoalbidus* resembles *N. mikawai* in having similar cream basidiocarps with angular pores, but is distinct in its thinner context and longer basidia. Despite the morphological resemblance to *N. mikawai*, the phylogenetics reveal that *N. cremeoalbidus* is more closely related to *N. alveolaris*. *N. alveolaris* is easily differentiated from the others by its distinctly larger and radially elongated pores, and scaly pileus surface. Thus, the macro-morphology of the pileus surface, the size of pores, consistency of the context, and size of basidia, are important for species characterization within *Neofavolus*.

Keys to the accepted species of *Favolus* and *Neofavolus* are provided below.

A Key to species of *Favolus* (including other species possibly included in the genus)

1. Pileus covered by thin, filmy and easily separable cutis. Known from boreal areas in North America (Thorn et al. 1990; Boulet 2003), Eurasian Continent (Bondartsev 1953; Domański et al. 1967; Thorn et al. 1990; Dai 2012) and Japan (Sotome et al. 2011) *F. pseudobetulinus*
1. Pileus lacking filmy and separable cutis. Distributed in tropical to warm temperate areas.....2
2. Pileus surface white in fresh condition; context leathery-fleshy in fresh condition, up to 2 mm thick at the base.....3
2. Pileus darker, cream, orange to brown or purplish; context fleshy-tough to leathery, often thicker.....6
3. Pileus surface with hydroid protuberances. Known from Brazil (Corner 1984)..... *P. biskeletalis*
3. Pileus surface almost smooth.....4
4. Pores round, 6–7/mm. Known from Venezuela (Ryvarden and Iturriaga 2003)..... *P. albostipes*
4. Pores radially elongated.....5
5. Pores 2–4×1–2 mm; generative hyphae with clamp connections. Known from tropical areas in Central to South America..... *F. brasiliensis*
5. Pores up to 1.5 mm long, up to 0.5 mm wide; generative hyphae without clamp connections. Known from

- subtropical to tropical areas in East to Southeast Asia..... *F. spathulatus*
6. Pores round to angular, 2–3/mm or smaller.....7
6. Pores angular to elongated, 1–3/mm or larger.....9
7. Generative hyphae without clamp connections; pileus surface cream to pale yellowish gray; pores white to cream, angular, 2–4/mm. Known from Singapore and warm temperate areas in Japan..... *F. acervatus*
7. Generative hyphae with clamp connections.....8
8. Pileus surface orange to brown, occasionally dark brown; pores round to angular, 2–5/mm; basidiospores 10–14.8 µm long. Known from tropical to subtropical areas of Southeast and East Asia..... *F. emerici*
8. Pileus surface vinaceous to brown; pores round, 5–6/mm, basidiospores 5–6 µm long. Known from Guyana and Brazil (Gibbertoni et al. 2004)..... *P. ianthinus*
9. Basidiocarps centrally stipitate; pileus surface purplish to bay, finely areolate; pores angular, 1–1.5 mm in diam. Known from Jamaica (Ryvarden 1985)..... *P. subpurpurascens*
9. Basidiocarps laterally stipitate; pileus surface light orange to light brown.....10
10. Pileus up to 5 cm wide; pileus surface grayish orange to yellowish orange, glabrous and tessellate; pores radially elongated, 1–3×0.5–2 mm; context thin, up to 1 mm thick. Known from Singapore and Malaysia..... *F. roseus*
10. Pileus up to 10 cm wide; pileus surface pale ochraceous to tan, often scrupose; pores angular to elongated, 1–3×0.5–1 mm; context up to 2 mm thick (Ryvarden and Johansen 1980). Known from Southeast Asia..... *P. philippinensis*

A Key to species of *Neofavolus*

1. Pores white, cream to grayish orange (10YR8–9/4–4), radially elongated, (0.5–)0.7–7×0.5–3 mm; Pileus surface covered by appressed scales. Known from temperate areas of the Northern Hemisphere..... *N. alveolaris*
1. Pores angular and smaller.....2
2. Context brittle-leathery in dried condition; pores angular, 2–4(5)/mm; basidia clavate, 18–22.5×5–7.5 µm. Known from temperate areas in Japan..... *N. cremeoalbidus*
2. Context corky in dried condition; pores cream, angular, 3–5/mm; basidia clavate, 12–16.5×5–8 µm. Known from temperate areas in China and Japan..... *N. mikawai*

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