

Studies in *Perenniporia* (Basidiomycota). African taxa VI. A new species and a new record of *Perenniporia* from the Ethiopian Afromontane forests

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Background and aims – This study is a part of an ongoing survey of the genus *Perenniporia* (Basidiomycota, Polyporales) in sub-Saharan Africa, and reports on several species collected in Central and Southwestern Ethiopia.

Methods – Species are described using morphology-based methods.

Key Results – *Perenniporia abyssinica* is proposed as new species. *Perenniporia globispora* is reported for the first time in Ethiopia.

Conclusion – *Perenniporia abyssinica* and *P. globispora* are reported from Central and Southwestern Ethiopia. The report of *P. globispora* constitutes the second report of the species and the first record for Ethiopia.

Key words – Basidiomycota, East Africa, Ethiopia, *Perenniporia*, Polypores, taxonomy.

INTRODUCTION

As a continuation of the revision of the genus *Perenniporia* in sub-Saharan Africa (Decock 2001, Decock & Mossebo 2001, 2002, Decock & Masuka 2003, Decock et al. 2011), several collections from Ethiopian highland forests were examined. Two species were identified, of which one was found to correspond to *Perenniporia globispora* Ipulet & Ryvardeen, originally described from Uganda (Ipulet & Ryvardeen 2005) while the second did not correspond to any of the described species (Corner 1989, Decock 2001, Decock & Mossebo 2001, 2002, Decock & Masuka 2003, Decock & Stalpers 2006, Decock et al. 2011, Gilbertson & Ryvardeen 1986, Ryvardeen & Johansen 1980, Ryvardeen & Gilbertson 1994). It is described as *Perenniporia abyssinica* sp. nov. *Perenniporia globispora* is also redescribed and illustrated.

MATERIAL AND METHODS

Material and collecting localities

The specimens were collected in Southwestern Ethiopia, between Jimma and Bonga, approx. 7°14'–7°36'N / 35°51'–36°45'E, elev. approx. 1600–2000 m, in secondary, degraded and pastured Afromontane rain forests, and in Central Ethiopia, at Wondo Genet forest, approx 7°06'N 38°37'E, elev.

ranging from 1800 to 2100 m, in dry afromontane ecosystem.

The type and original specimens are preserved at MUCL, NY and O; herbarium acronyms are from Index Herbariorum (Thiers continuously updated). MUCL original strains were isolated from basidiome tissues during field work, on malt extract agar supplemented with 2 ppm benomyl (benlate) and 50 ppm chloramphenicol, and later purified in the laboratory. Living cultures are preserved at MUCL, with duplicates at CBS.

Descriptions

Colours are described according to Kornerup & Wanscher (1981). Sections of the basidiomes were incubated for one hour at 40°C in NaOH 3% solution, then carefully dissected under a stereomicroscope and examined in NaOH 3% solution at room temperature (Decock et al. 2010). To study the staining reaction of the basidiospores and hyphae, sections of the basidiomes were examined in Melzer's reagent and lactic acid cotton blue. All microscopic measurements were done in Melzer's reagent. In presenting the size range of several microscopic elements, 5% of the measurements at each end of the range are given in parentheses when relevant. In the text, the following abbreviations are used: ave = arithmetic

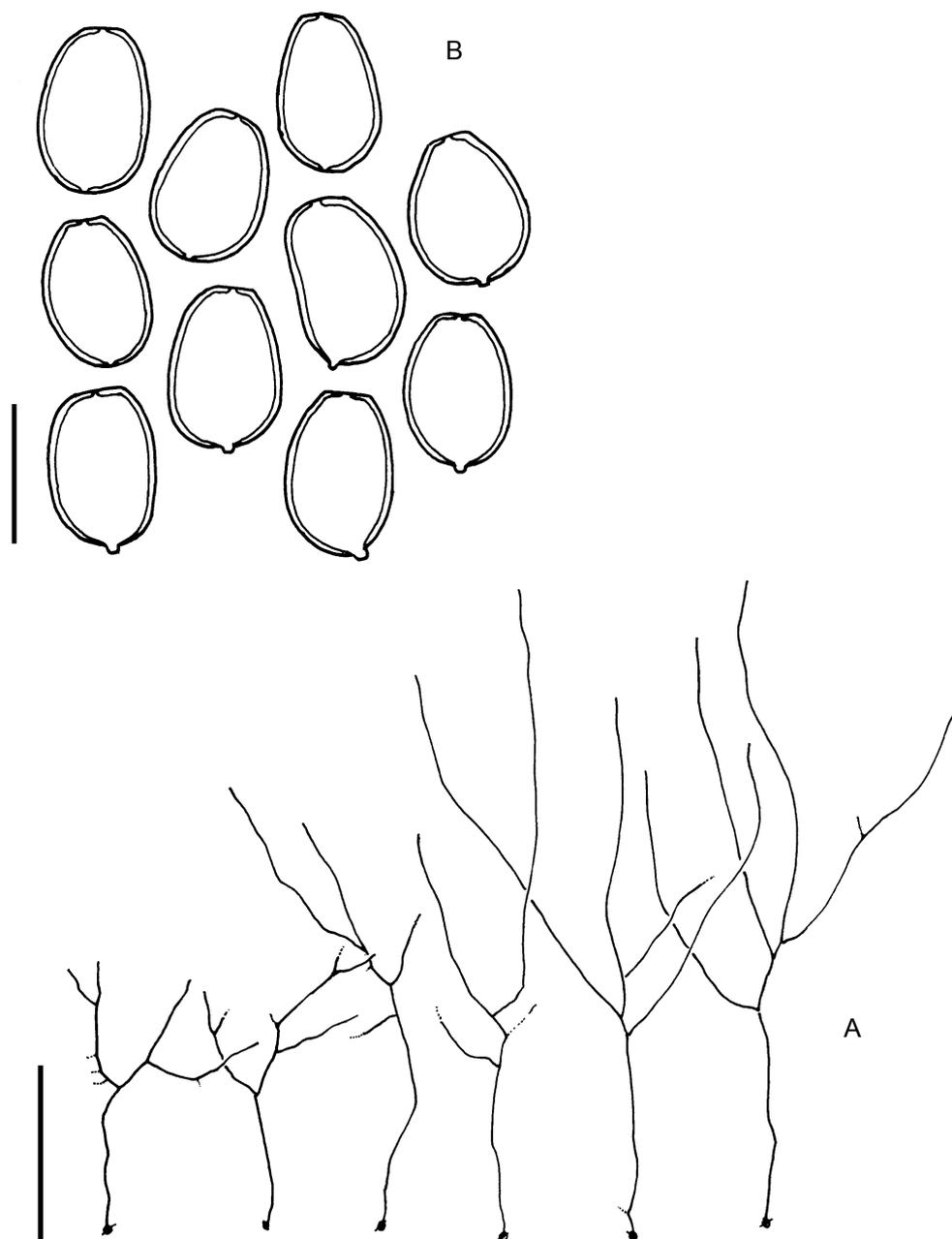


Figure 1—*Perenniporia abyssinica*: A, vegetative hyphae from the hymenophoral trama, schematic view, scale bar = 80 μm ; B, basidiospores, scale bar = 5 μm .

mean, R = the ratio of length/width of basidiospores, and ave_R = arithmetic mean of the ratio R .

RESULTS

Perenniporia abyssinica Decock & Bitew, *sp. nov.*

Basidiomata perennia, resupinata vel leviter pseudopileata, margine albo; pori albidii, rotundati (4–)5(–6)/mm, (140–)145–175(–200) μm latis; systema hypharum dimiticum, hyphae generatrices fibulatae, hyalinae; contextus hyphis skeletalibus pauciramosis, crassitunicatis, hyalinis;

trama hyphis skeletalibus laxe usque dense arboriformibus, crassitunicatis, (hyalinis), leviter dextrinoideae, stipite (25–)30–65(–70) μm longo, ramulis 1–3, crassitunicatis, laxe ramosis, usque 180 μm longis, 1.5–2.5 μm latis; basidia clavata vel pedunculata, tetrasterigmatica; basidiosporae ellipsoideae vel oblongae, cum apice truncatae, leviter crassitunicatae, adextrinoideae vel leviter dextrinoideae, (4.5–)5–6(–6.5) \times 3.5–4(–4.4) μm ($\text{ave} = 5.6 \times 3.9 \mu\text{m}$) $R = (1.2\text{--})1.3\text{--}1.6$ (–1.7) $\text{ave}_R = 1.4$; chlamydosporae nullae. – Type: Ethiopia, Southern Nations, Nationalities, and Peoples' region, Sidama Zone, Wondo Genet forest, approx. 7°06'N 38°37'E, elev. approx. 1880 m, on a dead fallen branch (10 cm diam.) on

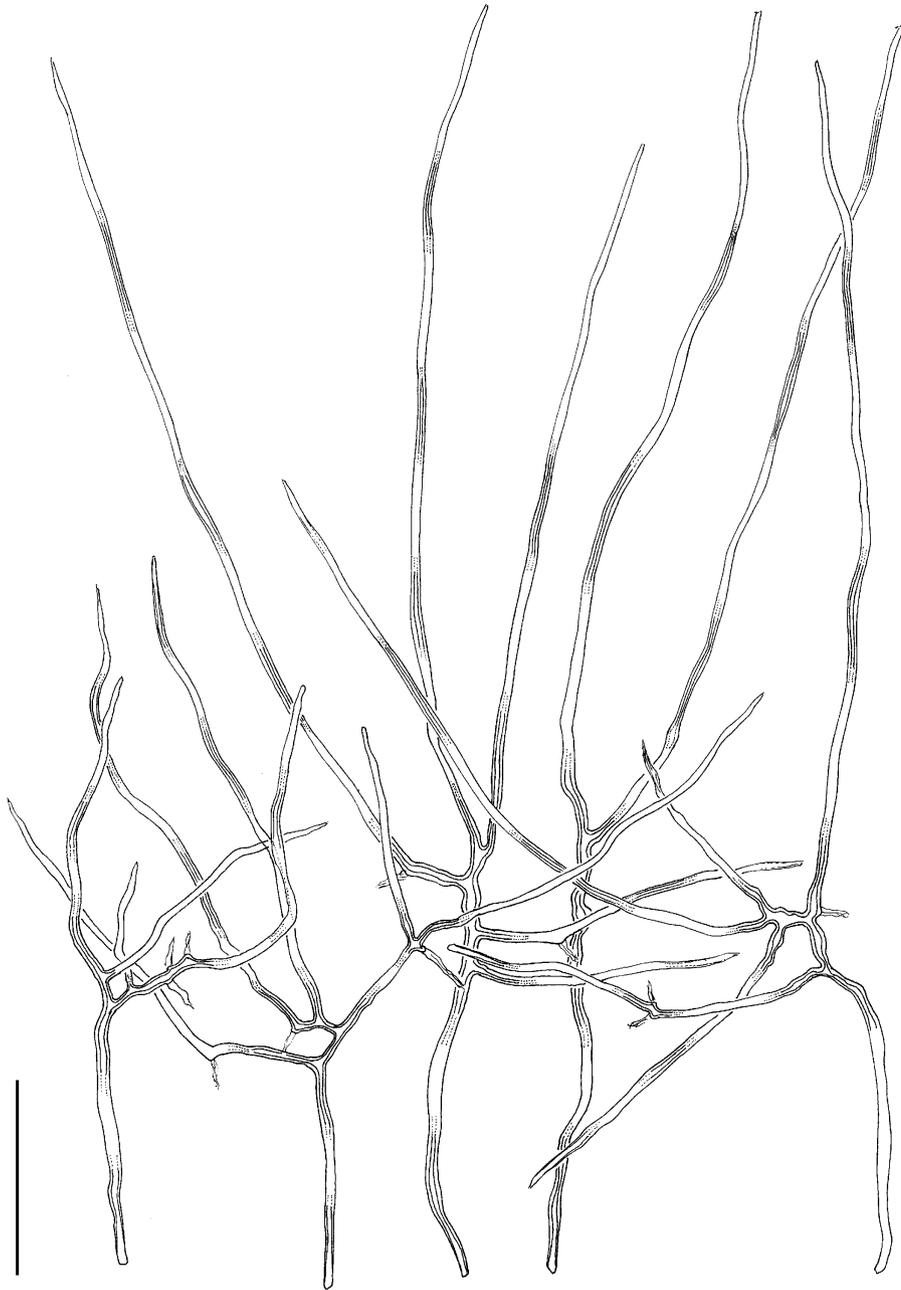


Figure 2 – *Perenniporia abyssinica*: vegetative hyphae from the hymenophoral trama. Scale bar = 50 μ m.

the soil, 29 Oct. 2002, C. Decock & A. Bitew ET-02-01, in herbarium MUCL 44215 (holo-: MUCL; iso-: NY; culture ex-holotype MUCL 44215 and CBS). Mycobank number: MB564697.

Basidiomes perennial, mostly resupinate, separable, fragments up to 100 mm long \times 40 mm wide but the complete basidiomes probably more extended, the margin occasionally slightly reflexed, then forming narrow pseudopilei, projecting up to 5 mm, 30 mm wide, up to 2 mm thick, the upper surface roughly concentrically sulcate, with 2–3 narrow bands, glabrous, dull, mainly light brown [6(C–D)6, 6E(6–7)], caramel, cinnamon to cocoa brown], the extreme growing margin white when fresh, drying whitish to greyish

orange; **margin of resupinate part** well delimited, rounded, white when fresh, drying whitish to greyish white, bruising greyish orange (5B3), or when aged, discolouring to cinnamon brown (6D6); **abhymenial surface** with mycelial sheets (xylostromata), mainly light brown (6D6, cinnamon); **po**re surface even, white when fresh, drying white to greyish white, bruising or aging greyish orange (5B3) to light brown (6D6, pale cinnamon); **po**res even, round to angular, occasionally elongated, rectangular, (4–)5(–6)/mm, (140–)145–175(–200) μ m in diam. (ave = 159 μ m); **dissepiments** thick, with free hyphal ends and embedded rhomboid crystals, 25–70 μ m thick (ave = 42.5 μ m); **co**ntext reduced to a thin line, < 1 mm thick, up to 1 mm in the pseudopilei, greyish orange (5B3), light, with a corky consistency and a fibrous texture;

tube layers stratified, with up to 4 layers, in total 7 mm thick, each layer 1–2 mm thick, pale corky when fresh, drying corky, the older tubes with white streaks, with a (hard) corky consistency, a fibrous texture.

Hyphal system dimitic; generative hyphae hyaline, thin- to slightly thick-walled, clamped, and sparingly branched, 1.5–2.8 μm wide; vegetative hyphae clamped at the basal septum, (hyaline), slightly dextrinoid, the reaction more marked at the hyphal ends in the dissepiments, and cyanophilous; in the subiculum laxly branched with long skeletal-like apical segments; in the hymenophoral trama with a marked arboriform branching pattern, then with a short to medium basal stalk (25–)30–65(–70) μm long (ave = 48 μm), widening from 1.5–2.2 μm wide at the basal septum (ave = 1.7 μm) to 2.2–3.5 μm at the branching point, occasionally locally inflated up to 4.5 μm , straight to locally geniculate then sometimes with short aborted processes, and 1–2(–3) apical branches, sometimes with 1–2 short subapical processes, the branches straight to slightly sinuous, mainly unbranched, occasionally with lateral aborted processes, thick-walled but with an open lumen, 1.5–2.5 μm wide (ave = 1.9 μm), measured up to 160 μm long, ending thin-walled; old tubes filled with narrow, 1.0–1.5 μm wide, much branched vegetative hyphae.

Basidia mostly collapsed, pear-shaped to pedunculate, with four sterigmata; basidiospores ellipsoid to oblong-ellipsoid, thick-walled, with a truncate apex bearing an apical germ pore, hyaline, not to moderately dextrinoid, cyanophilous, (4.5–)5–6 (–6.5) \times (3.5–)3.5–4(–4.4), (ave = 5.6 \times 3.9 μm), R (1.2–)1.3–1.6(–1.7), $ave_R = 1.4$; cystidia and chlamydospores absent. Type of rot: white rot (presence of laccases positive when tested with syringaldazine; Harkin & Obst 1974). Figs 1–2.

Substrate – Dead wood of unidentified angiosperm.

Distribution – Known from a single locality in highlands of Ethiopia.

Perenniporia globispora Ipulet & Ryvardeen

Synopsis fungorum 20: 94. 2005 (Ipulet & Ryvardeen 2005).

Basidiomes seasonal, resupinate, effused, adnate but margin separating from the substrate on drying and curving up, extending up to 80 mm long \times 40 mm wide, < 0.2 mm thick at the extreme margin to 0.5–3.0 mm thick in the centre; margin narrow, effused or forming larger sterile patches when growing on debris, white to faintly pinkish when fresh; pore surface even, white with a faint pinkish tint when fresh, drying whitish, greyish white, faintly flesh-coloured to very pale greyish orange [(4–5)A(6–7), (4–5)B2, 5C3], bruising brownish orange [6(C–D)5]; pores even, round to angular, (4–)5–6(–7)/mm, (90–)90–140(–165) μm wide (ave = 114 μm), or slightly elongated; dissepiments thin, 20–50 (–60) (ave = 34.5 μm), entire, brittle when dried, with free hyphal ends; tube layer unique, with a (soft) corky consistency, a slightly fibrous texture when fresh, hard and brittle when dried, up to 2.8 mm thick, white, whitish, or very pale greyish orange when fresh, drying pale greyish orange close to the subiculum then darker, greyish orange [6(B–D)(6–7),

caramel, reddish golden]; subiculum thin, to 200 μm thick, whitish when fresh, pale greyish orange when dried.

Hyphal system dimitic, both in the context and the trama of the tubes; generative hyphae difficult to find, hyaline, sparsely branched, clamped, 1.5–3.0 μm diam.; vegetative hyphae hyaline, strongly dextrinoid, cyanophilous; in the subiculum laxly branched with long skeletal-like apical segments; in the hymenophoral trama, heavily branched, with a well-marked arboriform branching pattern, with stalk arising from generative hyphae and clamped at the basal septum, short to medium (30–)40–100 μm long (ave = 63 μm), widening from 2.5–3.5 μm wide at the basal septum (ave = 2.9 μm) to 2.8–4 μm wide (ave = 3.2 μm) at the apical branching point, thick-walled but not solid, straight to geniculate then frequently with small, lateral aborted processes, and 1–3 levels of branches, either lateral, sub-apical or apical, measuring up to 160 μm long, then skeletal-like, straight to sinuous, thick-walled but not solid, and ending thin-walled (very occasionally with secondary septa), 2–3.2(–3.5) μm wide (ave = 2.7 μm) in the main part, down to 1–1.5 μm at the tips.

Hymenium. Basidia hyaline, broadly clavate to slightly pedunculate, guttulate, clamped at the basal septum, and with 4 sterigmata, 12–17 \times 7–9 μm (ave = 13.5 \times 7.5 μm); cys-

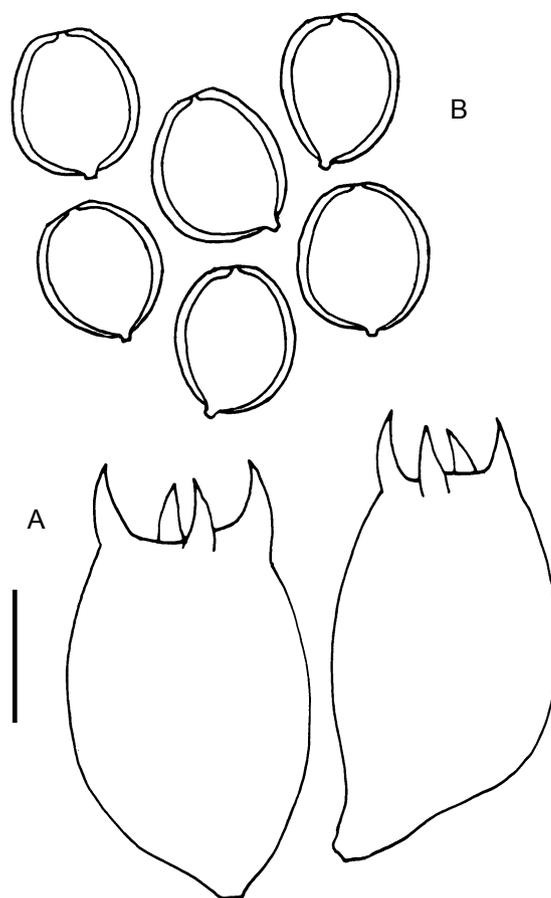


Figure 3 – *Perenniporia globispora*: A, basidia; B, basidiospores. Scale bar = 5 μm .

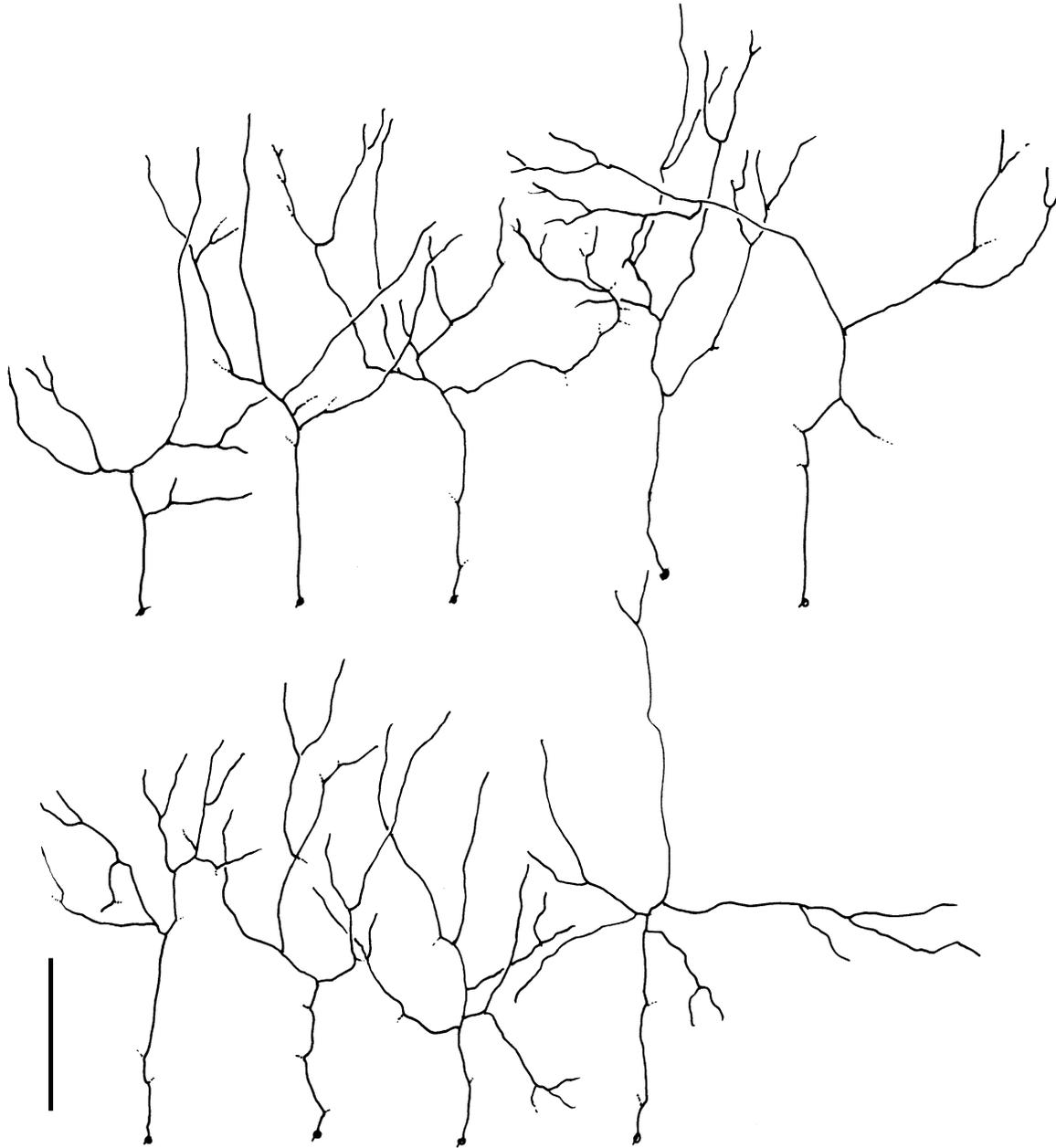


Figure 4 – *Perenniporia globispora*: vegetative hyphae from the hymenophoral trama, schematic view. Scale bar = 50 μ m.

tidia or other sterile structures absent; basidiospores broadly ellipsoid, broadly ovoid to subglobose, apically narrowly truncate, thick-walled but with an apical germ pore, with a small apiculus, hyaline, not to faintly dextrinoid (best seen in mass), cyanophilous, (5–)5.2–6.2 \times (4.2–)4.5–5.5(–5.8) μ m (ave = 5.6 \times 4.9 μ m), R = (1.0–)1.06–1.25(–1.29) (ave_R = 1.15); chlamydospores absent. Type of rot: white rot (presence of laccases positive when tested with syringaldazine; Harkin & Obst 1974). Figs 3–5.

Substrate – On a dead fallen branch (5–10 cm diam.) of an unidentified angiosperm.

Distribution – Known so far only from southwestern highland of Uganda (Bwindi) and southwestern highland of Ethiopia.

Specimens examined. Ethiopia: Southern Nations, Nationalities, and Peoples' region, Kefa Zone, between Jimma and Bonga, Afro-montane degraded, pastured forest, approx. 07°36'N 36°45'E, elev. approx. 1750 m, on a dead fallen branch (2–4 cm diam.) of an unidentified angiosperm and surrounding plant debris, 21 Jul 2003, *C. Decock & A. Bitew* ET-03-05, in herbarium MUCL 44778 (culture ex-MUCL 44778); *ibid.*, in degraded, pastured forest, approx. 07°14'N 35°51'E, elev. approx. 2000 m, on a dead fallen branch (2–4 cm diam.) of an unidentified angiosperm, 23 Jul 2003, *C. Decock & A. Bitew* ET-03-48, in herbarium MUCL (MUCL 44780 (culture ex-MUCL 44780 and CBS); *ibid.*, 23 Jul 2003, *C. Decock & A. Bitew* ET-03-45, in herbarium MUCL 44784 (culture ex. MUCL 44784).

Uganda: Rukungiri District, Bwindi Forest National Park, approx. 1°38'S 29°29'E, Buhoma, Kasiru 1, in mature, mixed forest, on roots of a dead strangler fig tree (*Ficus* sp.), 22 May 2003, *Ipulet* F1614, in herbarium O (holotype of *P. globispora*).



Figure 5 – *Perenniporia globispora*: vegetative hyphae from the hymenophoral trama. Scale bar = 50 μm .

DISCUSSION

Perenniporia abyssinica is characterized by a resupinate to slightly reflexed basidiomes, with small marginal, cinnamon to cocoa brown pseudopileus, a white (whitish) pore surface, (4–)5(–6) pores/mm, a dimitic hyphal system with arboriform, branched vegetative hyphae with long skeletal-like branches, and oblong-ellipsoid, slightly dextrinoid basidiospores.

In phylogenetic (in prep.) and morphological perspectives, *P. abyssinica* shares clear affinities with several taxa having a northern Eurasian and North American distribution, especially *P. maackiae* (Bondartsev & Ljub.) Parmasto and

P. tenuis var. *pulchella* (Schwein.) Lowe. Phylogenetically, they belong to the same clade within *Perenniporia*; morphologically, the hyphal systems, the differentiation of the vegetative hyphae, and the faintly dextrinoid, oblong-ellipsoid basidiospores are shared by these three taxa. Moreover, *P. maackiae* develops also marginal pseudopilei (Dai & Niemelä 1995).

Both *P. maackiae* and *P. tenuis* var. *pulchella* differ in having a bright yellow pore surface when fresh and occurring respectively in far eastern Russia and northeastern China, preferably on *Maackia* (Fabaceae) for the former (Dai & Niemelä 1995), and in eastern North America and northern Europe, mainly on Betulaceae or Salicaceae for the latter

(Gilbertson & Ryvarden 1986, Niemelä et al. 1992, Ryvarden & Gilbertson 1994).

Perenniporia tenuis (Schwein.) Ryvarden var. *tenuis*, a taxon of uncertain status, known from eastern USA (Gilbertson & Ryvarden 1986), may also be related. It differs from *P. abyssinica* in having a cream to buff pore surface, absence of pseudopileus, and apparently thin-walled basidiospores (Gilbertson & Ryvarden 1986).

In tropical Africa, *P. abyssinica* could be compared morphologically to *P. centrali-africana* Decock & Mossebo, a species hitherto known only from the western edge of Central Africa (Decock & Mossebo 2001). The latter also has a whitish to greyish white pore surface and marginal pseudopileus. It differs in having cork-coloured to greyish brown context and tube layers, smaller pores [(6–)7(–8)/mm], more globose (4.8–6.0(–6.5) × (3.5–)4.0–5.0(–5.5) μm, R = 1.0–1.3), and strongly dextrinoid basidiospores. Phylogenetically, *P. centrali-africana* and *P. abyssinica* are distantly related, and belong to two distinct clades within *Perenniporia* (in prep.).

Perenniporia globispora is characterized by resupinate basidiomes that has a white pore surface with a slight pinkish tint when fresh, drying or bruising pale cinnamon brown. The hyphal system is dimitic with branched, arboriform, and strongly dextrinoid vegetative hyphae, and subglobose to broadly ellipsoid basidiospores, averaging 5.6 × 4.9 μm, apically narrowly truncate, and non- or only faintly dextrinoid.

From a morphological point of view, *P. globispora* has as yet no close relative in tropical Africa. *Perenniporia africana* Ipulet & Ryvarden (Ipulet & Ryvarden 2005) is superficially similar. The species, described from material originating from the same locality in western Uganda (Ipulet & Ryvarden 2005) [Isotype at MUCL: Uganda, Kabale district, Bwindi Forest National Park (Bwindi Impenetrable forest), approx. 1°08'S 29°38'E, Ruhija, elev. approx. 3000 m, on a rotting log, 18 Nov 2002, *P. Ipulet* # Ipulet F1111, in herbarium MUCL 53214], differs fundamentally from *P. globispora* in having totally unbranched skeletal hyphae and non-truncate basidiospores, without germ pore. These features clearly point toward the *Perenniporia subacida* (Petch) Donk complex, the species of which should be excluded from *Perenniporia* s.s. (Decock & Stalpers 2006).

Phylogenetically, *P. globispora* has no known relatives in Africa; analysis of a *Perenniporia* ITS and LSU DNA sequence dataset of worldwide origin (> 200 specimens, in prep.) showed this species to be isolated, its closest relatives originating from southern, tropical China.

ACKNOWLEDGMENTS

The authors warmly thank the Addis Ababa University, Ethiopia, for the facilities offered during two collecting trips in Central and Southwestern Ethiopia in November 2002 and July 2003. Cony Decock gratefully acknowledges the financial support received from the Belgian State – Belgian Federal Science Policy (contract BCCM C3/10/003) and the Fonds de la Recherche Fondamentale Collective (FRFC contracts # 2.4551.99 and # 2.4515.06).

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Manuscript received 7 Jan. 2011; accepted in revised version 6 Apr. 2011.

Communicating Editor: Bart Van de Vijver.