

Studies in *Perenniporia* s. lat. (Basidiomycota). African taxa V: *Perenniporia alboferruginea* sp. nov. from Cameroon

Cony Decock^{1,*}, Dominique C. Mossebo² & Prudence Yombiyeni³

¹Mycothèque de l'Université catholique de Louvain (MUCL), Earth and Life Institute – Mycology, Université catholique de Louvain, Croix du Sud 3, BE-1348 Louvain-la-Neuve, Belgium [MUCL is a member of the Belgian Coordinated Collections of Micro-organisms BCCM™]

²Université de Yaoundé 1, Laboratoire de Mycologie, B.P. 1456 Yaoundé, Cameroon

³Institut de Recherche en Ecologie Tropicale (IRET, CENAREST), Gros Bouquet, Libreville, Gabon

*Author for correspondence: cony.decock@uclouvain.be

Background and aims – The Polypores of central Africa (or in biogeographical terms, the Guineo-Congolian phytogeographic region) are still poorly investigated. As part of an ongoing survey of the Polypores in this region, an undescribed species of *Perenniporia* was collected in the Dja Biosphere Reserve, in south-eastern Cameroon.

Methods – Species are described using morphology-based methods.

Key results – *Perenniporia alboferruginea* sp. nov. is proposed, described and illustrated. Several new collections of poorly known species are reported, and an identification key for the *Perenniporia* species occurring in the Dja Biosphere Reserve and neighbouring areas is presented.

Conclusion – About ten years ago, two *Perenniporia* species were recorded from the Dja Biosphere Reserve. Nowadays, seven species are known from the area, of which four were described based on material originating from this locality.

Key words – Cameroon, Central Africa, *Perenniporia*, Polypores, taxonomy.

INTRODUCTION

The taxonomic knowledge of Polypores – the core polyporoid clade *sensu* Binder et al. (2005) – in Central Africa or, in biogeographical terms, the Guineo-Congolian phytogeographic region (or the Guineo-Congolian regional centre of endemism, White 1979, 1983) is still very fragmentary and the group is locally critically understudied (Ryvarden 1998, 2000). A fortiori, we know even less about their phylogenetic relationships.

As a part of an ongoing survey of Polypores in this area (Decock 2001a, 2001b, 2007, Decock & Mossebo 2001, 2002), a species of *Perenniporia* Murrill (Basidiomycota) was collected in the Dja Biosphere Reserve (DBR), in southern Cameroon, that could not be identified to any of the described taxa (Decock 2001a, 2001b, Decock & Mossebo 2001, 2002, Ryvarden & Johansen 1980). It is described below as *Perenniporia alboferruginea* sp. nov.

This is the fourth species of *Perenniporia* described based on material originating from the DBR, and currently, seven species are known locally. New records of two of them, *P. djaensis* Decock & Mossebo and *P. subdendrohyphidia* Decock are presented.

An identification key to the species occurring in the DBR and neighbouring areas is presented.

MATERIALS AND METHODS

Material and collecting localities

The type specimen was collected in the northern part of the DBR, in the vicinity of the village of Somalomo (ECOFAC station), along the Dja River. The Reserve (02°40'–03°23'N, 12°25'–13°35'E, alt. 400–800 m) consists in 526,000 ha of mainly dense evergreen Congo rainforest, with old secondary forests around villages, and various, scattered, *Gilbertiodendron dewevrei* (De Wild.) J.Léonard (Fabaceae) dominating stands.

The type or authentic specimens are preserved at MUCL and NY [herbarium acronyms are from Thiers (continuously updated)].

MUCL original strains were isolated from basidiome tissues during field works, 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 a duplicate of ex-type strain at the CBS.

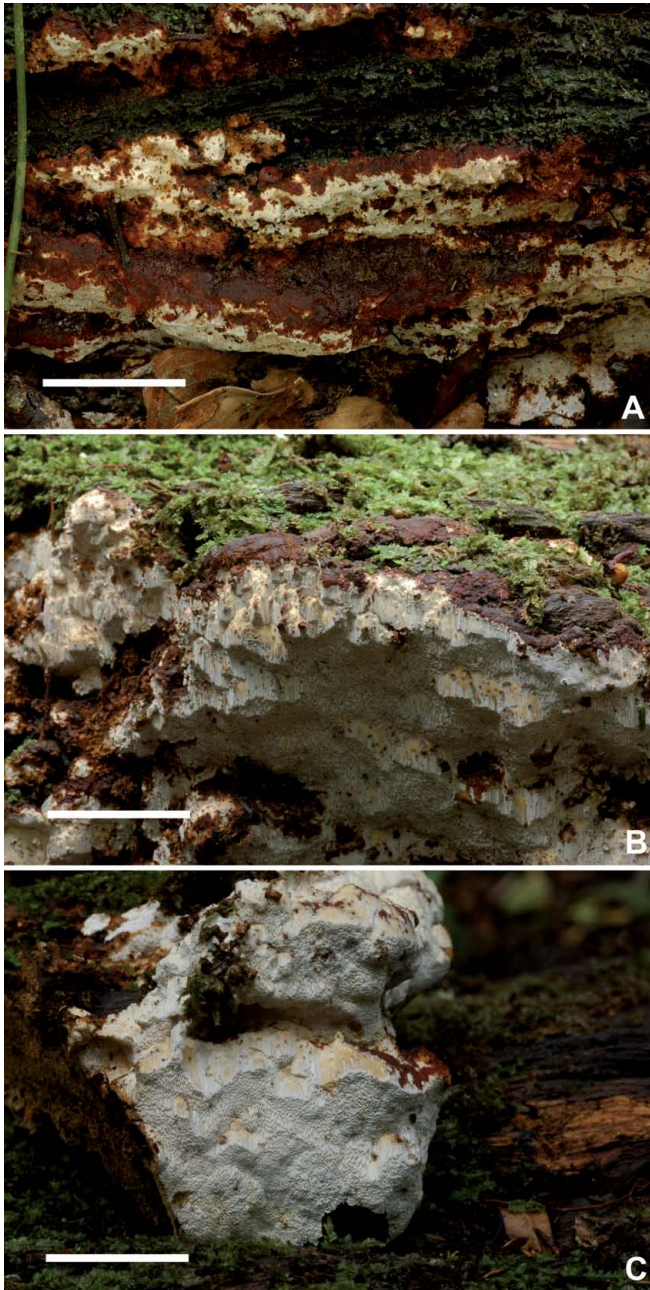


Figure 1 – *Perenniporia alboferruginea*. Basidiome of the holotype *in situ*. Scale bar = 10 mm.

Description

Colours are described according to Kornerup & Wanscher (1981). Sections were carefully dissected under a stereomicroscope in hot (40°C) NaOH 3% solution, and later examined in NaOH 3% solution at room temperature. Sections were also examined in Melzer's reagent and lactic acid cotton blue to evidence staining reaction. 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: \bar{X}

= arithmetic mean, R = the ratio of length/width of basidiospores, and \bar{X}_R = arithmetic mean of the ratio R.

RESULTS

Perenniporia alboferruginea Decock sp. nov.

Basidiocarpi annui, resupinati, adnati, effusi, margine albo vel ferrugineo; pori rotundati 5–6/mm, (105–)115–145(–150) μm lati, albidii; systema hypharum dimitica. Hyphae generativa fibulatae, hyalinae; hyphae skeletales pauciramosae, crassitunicatae; basidia clavata vel pedunculata, tetrasterigmatica; basidiosporae oblongae-ellipsoideae, ellipsoideae vel leviter ovoideae, cum apice truncata, crassitunicata, adextrinoidea, 4.5–5.5(–5.8) \times (3.0–)3.3–4.0 μm ($\bar{X} = 5.0 \times 3.6 \mu\text{m}$); chlamydosporae nullae. – Type: Cameroon, East Province, Dja Biosphere Reserve, near Somalomo, secondary forest located behind the sport field, along the Dja River, walking upstream, 03°20'44"N 13°02'15"E, alt. 650 m, on a dead fallen trunk of an unidentified angiosperm, 40–50 cm diam, 7 Apr. 2007, C. Decock CA-07-64 (holo-: herbarium MUCL 49279; iso-: NY; culture ex holotype in MUCL (MUCL 49279) and CBS); Mycobank number: MB 519515.

Basidiomes resupinate, effused, adnate, seasonal, extending up to 110 mm long \times 30 mm wide, from 2 mm up to 10 mm thick at the upper margin when growing on vertical substrate; margin irregular, white at the outside, with the upper surface crust-like, oxide (ferruginous) red [(8–9)(D–E)7, reddish brown, mahogany, oxblood red, dark ferruginous], discolouring to dark brown (7F7) in alkali, smooth, glabrous; pore surface even, white when fresh, drying whitish grey (1B1); pores even, round to angular, 5–6/mm, (105–)115–145(–150) μm wide ($\bar{X} = 128 \mu\text{m}$), or slightly elongated, 150–200 \times 105–125 μm ; dissepiments thin, entire, smooth, 25–55(–100) μm thick ($\bar{X} = 35 \mu\text{m}$); tube layer unique, with a (soft) corky consistency, a fibrous texture when fresh, 1–3 mm thick, white, whitish, or slightly darker, up to pale corky (5B3); subiculum 5–7 mm thick, pale corky to corky (5B3, greyish orange). Hyphal system dimitic, both in the context and the trama of the tubes, with generative and skeleto-binding hyphae; generative hyphae difficult to find, hyaline, sparsely branched, clamped, 1.5–3.0 μm diam; vegetative hyphae in the context and the hymenophoral trama of the skeleto-binding type, hyaline, (non-) to slightly dextrinoid, cyanophilous, variously branched, the branching denser in the hymenophoral trama compare to the context, with a short, poorly differentiated basal stalk, arising from a generative hyphae and clamped at the basal septum, 20–50 μm long ($\bar{X} = 29 \mu\text{m}$), widening from 1.5–2.5 μm wide at the basal septum ($\bar{X} = 2.3 \mu\text{m}$) to 2.0–4.0 μm wide ($\bar{X} = 2.9 \mu\text{m}$) at the apical branching point, sometime locally inflated, thick-walled but not solid, straight to geniculate then sometimes with small, lateral aborted processes, and one or two (rarely three) levels of branches, either lateral, sub-apical or apical, measured up to 250 μm long, then skeletal-like, straight to sinuous, thick-walled but not solid, and ending thin-walled (very occasionally with secondary septa), 2.0–2.8(–3.1) μm wide ($\bar{X} = 2.2 \mu\text{m}$) in the main part; upper crust made of short, 20–70 \times 4.0–7.5 μm , slightly clavate, thick-walled hyphae, ending rounded, yellowish, discolouring yellowish brown in alkali, densely packed, forming a palisade like hymenoderm-



Figure 2 – *Perenniporia alboferruginea*. Vegetative hyphae from the hymenophoral trama. Scale bar = 30 μm .

like structure. **Hymenium:** basidia hyaline, clavate to pedunculate, clamped, and with four sterigmata, $12\text{--}15 \times 7\text{--}10 \mu\text{m}$ ($\bar{X} = 13.5 \times 7.5 \mu\text{m}$); cystidia or other sterile structure absent; **basidiospores** ellipsoid, oblong-ellipsoid to broadly ellipsoid, or slightly ovoid, apically truncate, thick-walled but with an apical germ pore, with a small apiculus, hyaline, not dextrinoid, cyanophilous, $4.5\text{--}5.5(5.8) \times (3.0\text{--})3.3\text{--}4.0 \mu\text{m}$ ($\bar{X} = 5.0 \times 3.6 \mu\text{m}$), $R = (1.25)\text{--}1.25\text{--}1.5(1.66)$ ($\bar{X}_R = 1.4$). **Chlamydospores** absent. **Type of rot:** white rot [presence of laccases positive when tested with syringaldazine (Harkin & Obst 1974)]. Figs 1–3.

Substrate – On a dead wood, unidentified angiosperm.

Distribution – Known only from the type locality in Cameroon.

DISCUSSION

The thick, resupinate and effused basidiome with a tinted (dark) ferruginous red upper margin, contrasting the pure white pore surface (fig. 1A–C) make the species unique within *Perenniporia*.

Microscopically, *P. alboferruginea* is above all characterized by small ($\bar{X} = 5.0 \times 3.6 \mu\text{m}$) ellipsoid to ovoid, truncate (fig. 2), and non-dextrinoid basidiospores. The vegetative hyphae in the upper surface (fig. 3A–B) make also the species peculiar. They are rather short, arising directly from generative hyphae or as a short lateral process, commonly unbranched, very thick-walled, yellowish brown in alkali, and densely packed, forming a palisade like hymenoderm-like structure. Otherwise, the hyphal system is dimitic. The

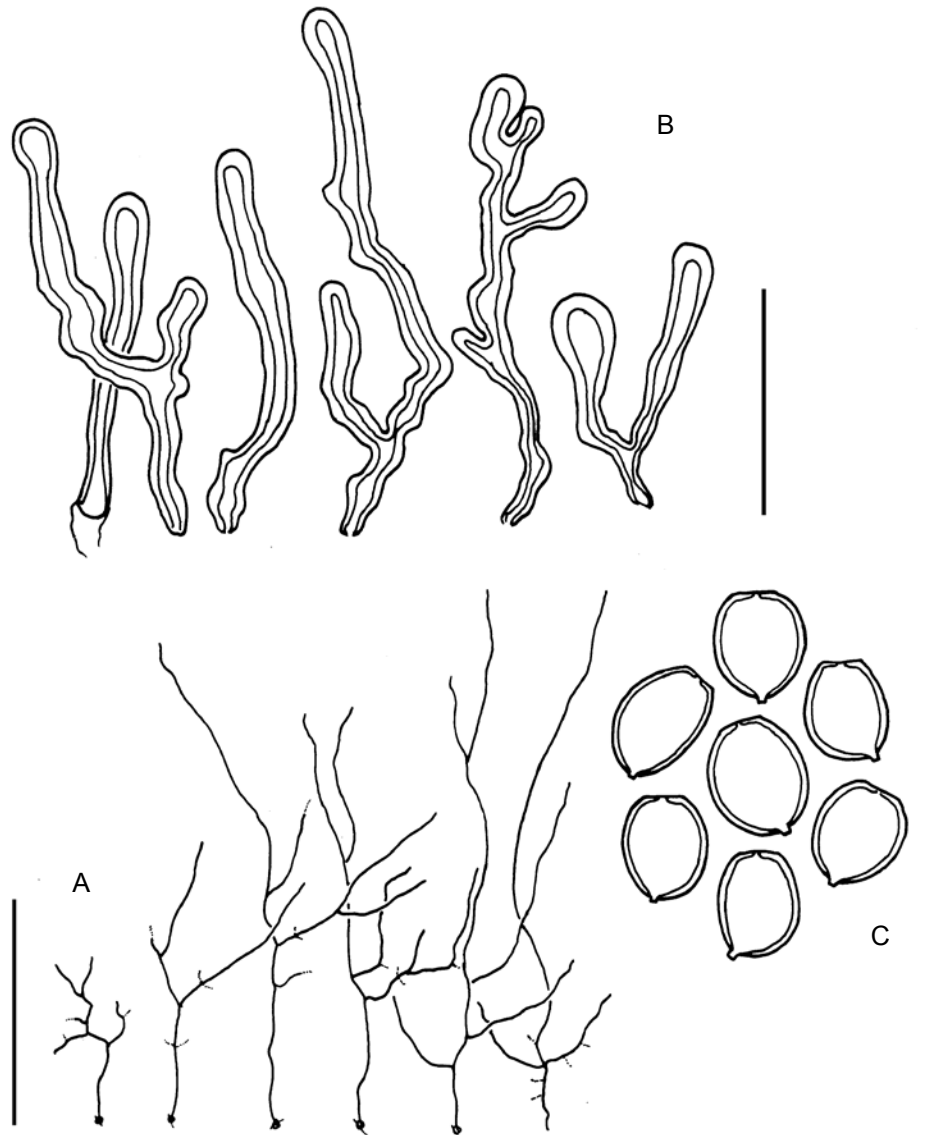


Figure 3 – *Perenniporia alboferruginea*; A, vegetative hyphae from the hymenophoral trama, schematic view, scale bar = 50 μ m; B, hyphae from the upper surface, scale bar = 40 μ m; C, basidiospores, scale bar = 5 μ m.

trama of the tubes is composed of variously branched vegetative hyphae, with as extremes, short, laxly branched, binding-like hyphae and skeleto-binding hyphae with long, unbranched skeletal-like processes. Intermediates exist forming a continuum from one extreme to the other. Reduction of the branching and elongation of one or two ramifications of binding-like hyphae can *in fine* lead to skeletal-like hyphae (fig. 3A–B). Branching and branch length may also vary with localization within the trama, with an increase of branching and shortening of branches from the context to the core of the hymenophoral trama, toward the hymenium.

Locally, *P. alboferruginea* should be compared to *P. centrali-africana* Decock & Mossebo (Decock & Mossebo 2001) that has a similar hyphal system and vegetative hyphae. *Perenniporia centrali-africana* is also, in a phylogenetic perspective (data not shown), thus far, the closest species. It forms pseudopilei which are dark brown to black with age,

without any tint of reddish, has a brown to greyish brown context and hymenophoral trama, smaller pores, [(6–)7–8/mm, 88–112 μ m diam], and wider, distinctly more globose basidiospores (3.8–5.3 μ m wide).

P. subdendrohyphidia (Decock 2001a) and *P. djaensis* (Decock & Mossebo 2002), both occurring in the DBR, differ in some characteristics. *Perenniporia subdendrohyphidia* has a white pore surface (fig. 5) but develops much smaller basidiomes on twigs or small branches on the ground, without any ferruginous colour. More fundamentally, it has a different vegetative hyphae differentiation, with (almost) unbranched skeletal hyphae having numerous lateral aborted processes (Decock 2001a).

Perenniporia djaensis has larger pores [(2–)3–4/mm], whitish to pale cork coloured, without any reddish colour

Key to the *Perenniporia* species (*sensu* Ryvarden & Johansen 1980)
so far known in the Dja Biosphere Reserve and neighbouring areas

1. Basidiomata pileate.....2
- 1'. Basidiomata mainly resupinate (occasionally with the upper margin forming a pseudo-pileus, or reflexed).....4
2. Pileus applanate with a dark brown to black crust, usually large (> 5 cm, to 40 cm); pore surface white; context and hymenophoral trama white to whitish creamy; vegetative hyphae unbranched, strongly dextrinoid; cystidia ventricose, thick-walled, apically incrustated; basidiospores pip-shaped, dextrinoid.....*P. latissima*
- 2'. Pileus applanate to unguulate, lateral or pendant, without dark crust, small (< 3 cm); pore surface greyish cream to grey; context and hymenophoral trama brown to greyish brown; vegetative always variably branched, variably dextrinoid; basidiospores subglobose to ovoid.....3
3. Pileus unguulate, usually pendant, sulcate, commonly in large number; pore surface greyish to grey; basidiospores subglobose, non-dextrinoid.....*P. inflexibilis*
- 3'. Pileus applanate, as the reflexed part of an otherwise effused basidiomata, with a few large bands, usually solitary or in small numbers; pore surface creamy white to greyish cream; basidiospores ovoid, dextrinoid.....*P. centrali-africana*
4. Basidiomata annual, with a soft corky consistency; subiculum white to pale corky coloured.....5
- 4'. Basidiomata perennial, with a hard consistency, occasionally with a (pseudo)-pileus; subiculum greyish, to brown.....7
5. Dendrohyphidia present in the dissepiments; pore surface white (to pale pinkish); pores 6–7/mm; vegetative hyphae mostly unbranched.....*P. subdendrohyphidia*
- 5'. Dendrohyphidia absent; pores ≤ 6/mm; vegetative hyphae always branched.....6
6. Pore surface pure white; margin in oxide red tint; pores 5–6/mm; basidiospores non-dextrinoid.....*P. alboferruginea*
- 6'. Pore surface white to pale corky, margin concolorous; pores (2–)3–4/mm; basidiospores dextrinoid...
.....*P. djaensis*
7. Pore surface grey to greyish; subiculum and hymenophoral trama greyish brown to brown; vegetative hyphae unbranched, yellowish, dextrinoid; in open area.....*P. tephropora*
- 7'. Pore surface creamy to greyish cream; subiculum / hymenophoral trama greyish brown, brownish; vegetative hyphae branched; growing within the forest.....*P. centrali-africana*

(fig. 4A & B) (Decock & Mossebo 2002). It is phylogenetically distantly related (data not shown).

In a phylogenetic perspective, analysis of a *Perenniporia* ITS and LSU DNA sequence dataset, of worldwide origin (> 200 specimens, data not shown) showed that, so far, *P. alboferruginea* nests in a clade together with *P. centrali-africana*, an additional undescribed African species known from more open habitat in Senegal and Zimbabwe, and two undescribed species known from Meso-America (Mexico) and the Caribbean (Cuba). However, for the time being, DNA data are still lacking for many *Perenniporia* species impeding any sound phylogenetic conclusions.

Additional collections of poorly known species in the DBR

About ten years ago, two species of *Perenniporia* were reported from the DBR (Núñez & Daniëls 1999). Currently, seven species are known from the area, viz., in addition to *P. alboferruginea*: *P. centrali-africana*, *P. djaensis*, *P. inflexibilis* (Berk.) Ryvarden, *P. latissima* (Bres.) Ryvarden, *P. subdendrohyphidia*, and *P. tephropora* (Mont.) Ryvarden. *Perenniporia alboferruginea* and *P. subdendrohyphidia* are so far known only from the DBR.

Perenniporia djaensis Decock & Mossebo (Decock & Mossebo 2002: 55).

The species was originally described from the DBR. It has been re-collected at several occasions in the DBR, at the mount 'Kala', near Yaoundé, and at two localities in Gabon, viz. the Sibang Arboretum (Prov. Estuaire, near Libreville) and Ipassa Makokou Biosphere Reserve (Prov. Ogooué-Ivindo). Fig. 4.

Specimens examined – Cameroon. East Province: Dja Biosphere Reserve, Ekom village, near the Ekom local ECOFAC Station, 03°20'44"N 13°02'15"E, alt. 650 m, on a dead fallen branch of an unknown angiosperm, 9 Apr. 2001, *C. Decock* Dja 24 (MUCL 43385; holotype); *ibid.*, on a dead fallen trunk, 15–20 cm diam., 4 Apr. 2007, *C. Decock* CA-07-20 (MUCL 49254); *ibid.*, on a small (30 cm diam.) fallen trunk, completely rotten, 5 Apr. 2007, *C. Decock* CA-07-34 (MUCL 49261); *ibid.*, on a dead fallen branch, 15–20 cm diam., 12 Apr. 2007, *C. Decock* CA-07-133 (MUCL 49311).

Central Province: Mount 'Kala', near Yaoundé, on a dead fallen branch, 10–15 cm diam., 3 Apr. 2007, *C. Decock* CA-07-02 (MUCL 49247).

Gabon. Estuaire Province: Libreville, Sibang arboretum, 00°25.058 N 009°29.393 E, alt. 34 m, on a dead fallen trunk (30–40 cm diam.), 21 Mar. 2008, *C. Decock* & *P. Yombiyeni* GA-08-271 (MUCL 51272). **Ogooué-Ivindo Province:** Ipassa Makokou Bio-

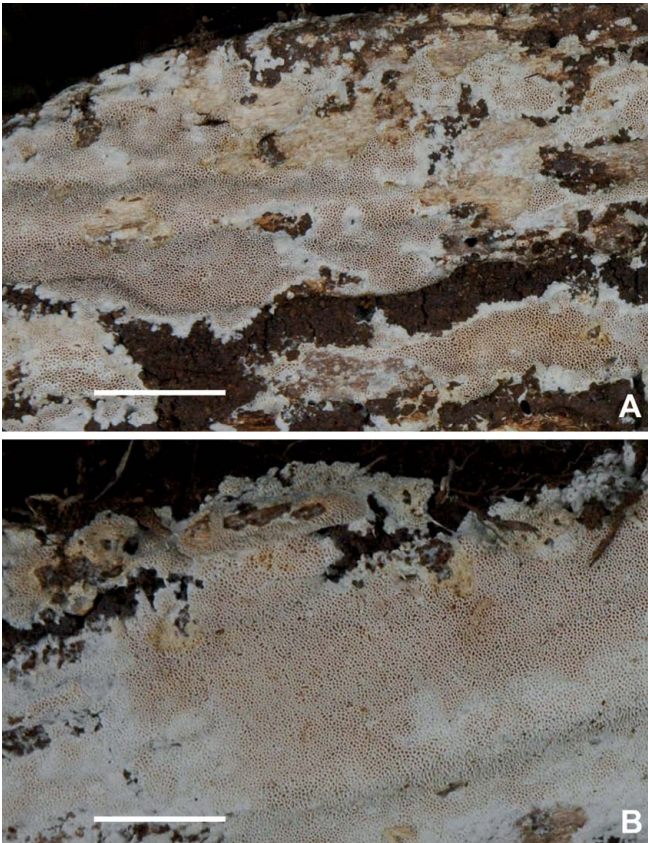


Figure 4 – *Perenniporia djaensis*, MUCL 49247, basidiome *in situ*. Scale bars = 20 mm.



Figure 5 – *Perenniporia subdendrohyphidia*, MUCL 52988, basidiome *in situ*. Scale bar = 10 mm.

sphere Reserve, 0°30'25" N 12°47'47" E, alt. 550 m, on dead fallen branches (10–15 cm diam.), well rotten, 17 Apr. 2006, *C. Decock* GA-06-229 (MUCL 47539); *ibid.*, on a small, dead, fallen branch, 1–1.5 cm diam., 5 Apr. 2006, *C. Decock* GA-06-031 (MUCL 47558).

Perenniporia subdendrohyphidia Decock (Decock 2001a: 48)

The species was known from the type specimen only. It has been collected a second time in 2007. The two collections were made in *Gilbertiodendron dewevrei* dominating areas

in the DBR (Decock 2001a, Núñez & Daniëls 1999). This species was not observed in a similar *G. dewevrei* spot at Ipassa Makokou Biosphere Reserve in Gabon (00°30.160'N – 012°46.781' E, alt. 503 m), during two surveys. A possible host relationship (specificity / preference) of *P. subdendrohyphidia* / *G. dewevrei* could be evaluated; but too few data are available for the time being in order to draw any conclusion in this respect. Fig. 5.

Specimens examined – Cameroon. East Province: Dja Biosphere Reserve, Somalomo, 3°23'N 12°44'E, 640 m a.s.l., in a *Gilbertiodendron dewevrei* forest, on bark of a fallen branch, unidentified angiosperm, 27 Jun. 1997, *P.P. Daniëls & R. Nnamedoumou* C45Daniëls (MA-Fungi 38246; holotype); *ibid.*, 03°21.26' N 12°43.5' E, on a small dead twig on the ground, 4 Apr. 2007, *C. Decock* CA-07-19 (MUCL 52988).

ACKNOWLEDGMENT

Cony Decock and D. Mossebo are grateful to the Cameroon Minister of Environment and Forestry, Department of Wildlife and Protected Areas, and of Minister of Scientific and Technical Research for having granted research and collection permits for the Dja Biosphere Reserve. Cony Decock and P. Yombiyeni thank also Dr. Ludovic Ngok Banak, Director of the Institute for Research on Tropical Ecology (IRET), Gabon, for granting work and collection permits, and facilities for field research in Gabon. 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 contract # 2.4515.06). Prudence Yombiyeni gratefully acknowledges the financial support received from the ACP-FORENET project funded by the EU (project grant 9ACP RPR91#1). Dominique Mossebo acknowledges the financial support received from the “Sud Expert Plantes project” (SEP 304).

REFERENCES

- Binder M., Hibbett D., Larsson K.-H., Larsson E., Langer E., Langer G. (2005) The phylogenetic distribution of resupinate forms across the major clades of mushroom-forming fungi (Homobasidiomycetes). *Systematic and Biodiversity* 3: 113–157. doi:10.1017/S1477200005001623
- Decock C. (2001a) Studies in *Perenniporia* (Basidiomycetes, Polypores): African taxa I. *Perenniporia dendrohyphidia* and *Perenniporia subdendrohyphidia*. *Systematics and Geography of Plants* 71: 45–51.
- Decock C. (2001b) Elements for a revision of the genus *Perenniporia* (Basidiomycetes, Perenniporiales). PhD thesis, Université catholique de Louvain, Louvain-la-Neuve, Belgium.
- Decock C., Mossebo D. (2001) Studies in *Perenniporia* (Basidiomycetes, Polypores): African taxa II. *Perenniporia centrali-africana* sp. nov. from Cameroon. *Systematics and Geography of Plants* 71: 607–612.
- Decock C., Mossebo D. (2002) Studies in *Perenniporia* (Basidiomycetes, Polyporaceae): African taxa. III. The new species *Perenniporia djaensis* and some records of *Perenniporia* for the Dja Biosphere Reserve, Cameroon. *Systematics and Geography of Plants* 72: 55–62.

- Decock C. (2007) On *Microporellus* with two new species and one recombination (*M. papuensis* sp. nov., *M. adextrinoideus* sp. nov., *M. terrestris* comb. nov.). *Czech Mycology* 59: 153–170.
- Harkin J.M., Obst J.R. (1974) Use of syringaldazine for detection of laccases in sporophores of wood-rotting fungi. *Mycologia* 66:469–476.
- Kornerup A., Wanscher J.H. (1981) *Methuen handbook of colour*. 3rd Ed. London, Methuen.
- Núñez M., Daniëls P.P. (1999) Fungi from the Dja Biosphere Reserve (Cameroon). II. Polypores. *Mycotaxon* 73: 235–246.
- Ryvarden L. (1998) African Polypores – A review. *Belgian Journal of Botany* 131: 150–155.
- Ryvarden L. (2000) A critical checklist of African Polypores. In: *Associazione Micologica Bresadola* (ed.) *Micologia 2000*: 471–483. Bagnollo Mella, Fondazione Centro Studi Micologici dell'Associazione Micologica Bresadola.
- Ryvarden L., Johansen I. (1980) A preliminary polypore flora of east Africa. Oslo, *Fungiflora*.
- Thiers B. [continuously updated] *Index Herbariorum*: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available at: <http://sweetgum.nybg.org/ih/> [accessed 9 Mar. 2011]
- White F. (1979) The Guineo-Congolian Region and its relationships to other phytochoria. *Bulletin du Jardin botanique national de Belgique* 49:11–55.
- White F. (1983) *The vegetation of Africa, a descriptive memoir to accompany the UNESCO/AETFAT/UNSO Vegetation Map of Africa*. Paris, UNESCO.

Manuscript received 10 Sep. 2010; accepted in revised version 11 Jan. 2011.

Communicating Editor: Bart Van de Vijver.