

Description of Some Macrofungi from the Niokolo-Koba National Park in Senegal

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Abstract: The Niokolo Koba National Park (NKNP), established in 1954 and recognized as UNESCO World Heritage and Biosphere Reserve in 1981 is the largest biodiversity sanctuary in Senegal with special ecosystems of the Sudanese bioclimatic zone, a great floristic richness of 1500 species of flowering plants and a remarkable diversity of fauna. However, no data of fungi especially macrofungal is available from NKNP. The present study aims to provide for the first time data on the taxonomic of some macrofungi occurring in the Niokolo Koba biosphere reserve. Surveys carried out at Niokolo Koba allowed to sample, describe and identify 14 species of fungi with fruitbodies of ‘Parc National Niokolo Koba’. These species represent 12 genera, 7 families, 4 orders all-in the Basidiomycota. These species are: *Gymnopilus* sp, *Hexagonia* sp, *Lactocollybia* sp, *Lentinus* sp, *Lenzites cf acutus*, *Marasmiellus setulosipes*, *Marasmius castaneovelutinus*, *Marasmius* sp, *Polyporus arcularius*, *Psathyrella atroumbonata*, *Psathyrella tuberculata*, *Pulverolepiota* sp, *Pterula cf brunneola*, *Tetrapyrgos nigripes*.

Keywords: Biosphere Reserve, Macrofungi, Niokolo Koba National Park

1. Introduction

Fungi have so far been poorly studied in Senegal where they have been the subject of very limited studies [3]. Some studies have focused on arbuscular mycorrhizal fungi [13]; [24], pathogenic fungi in cultivated plants [30]. Also, some authors studied the ectomycorrhizal fungi [44]; [43]; [16] focusing mainly on their ecology and physiology with less interest on the taxonomic aspects. [25] mentioned 29 of macrofungi species including 7 that were identified only at the genus level. In the framework of a prospecting campaign on macrofungi diversity in Senegal, [27] collected nearly 300 samples of macromycetes representing 82 species, 41 genera and 23 families belonging to 13 orders, 3 subclasses of the Homobasidiomycetes class of the sub-division of Basidiomycotina. (Of the unidentified

species, 4 belonging to the genera *Lactocollybia*, *Melanoleuca*, *Pleurotus* and *Volvariella* seemed to be probable new species for science, showing that the necessity to carry out more study on the mycoflora of Senegal [26]; [28]. In the peninsula of Cape Verde a near to Senegal, [29] mentioned 12 species of Agaricales in the strict sense.

The Niokolo Koba National Park (NKNP) is the largest natural reserve in Senegal [17] and is one of the rare sites where large animals of the West Africa savannah still survive [4]. This park also has a great diversity of animals including 14 small mammal carnivorous documented and 73 fish species estimated [41], [5]. It also hosts more than 1500 species representing 62% of plant species documented in Senegal [1], [40]. Among these plants species are 50 woody plants mentioned [7]. Due to this rich biodiversity the park

was recognized as a World Heritage Site and Biosphere Reserve by UNESCO in 1981. However, no data on fungi especially macrofungi is available from the NKNP. The

present study aims to provide for the first time data on the taxonomic of some macrofungi occurring in the Niokolo-Koba biosphere reserve.

2. Description of the Study Site

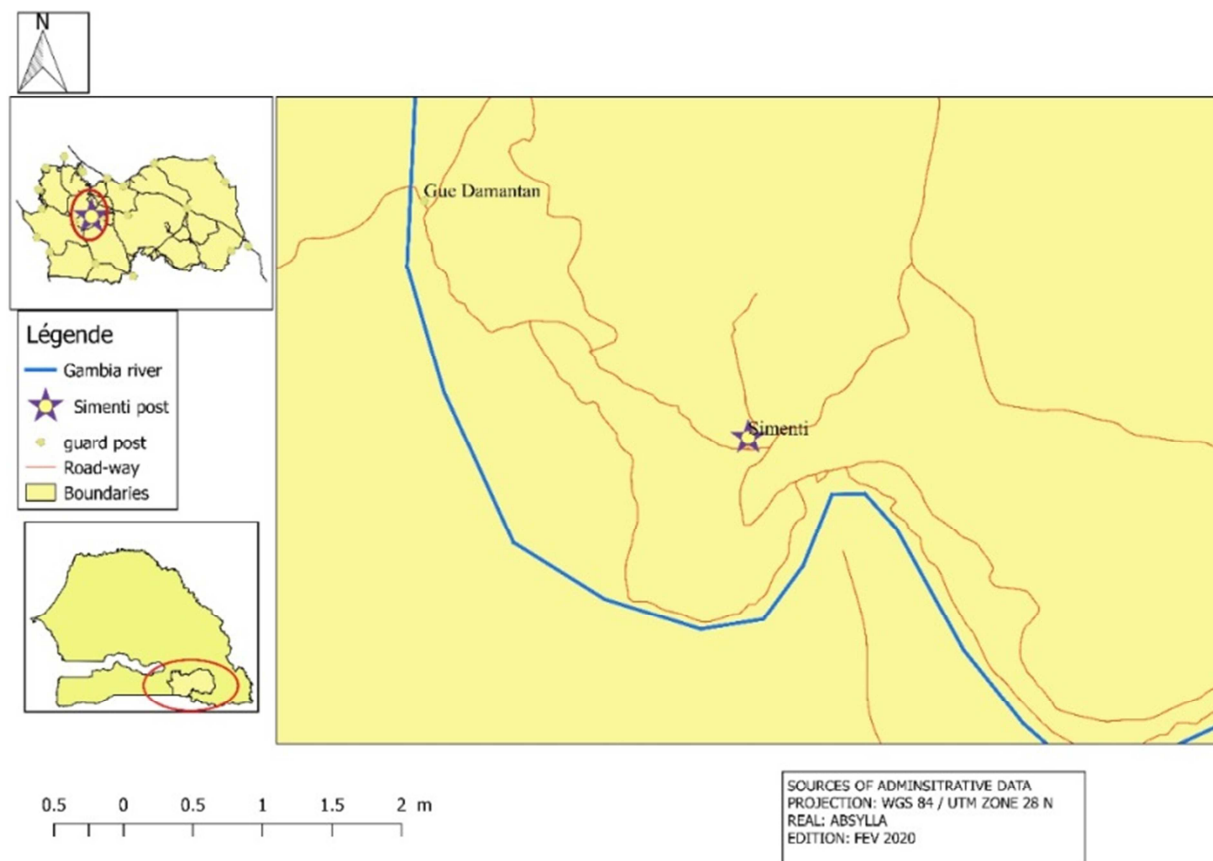


Figure 1. Niokolo Koba Park (Simenti area).

The prospecting that led to the discovery of the specimens studied took place in the Niokolo Koba National Park (NKNP) located in southeastern Senegal straddling the administrative regions of Kolda, Kedougou and Tambacounda (Figure 1). It is located at the geographical coordinate $13^{\circ} 04'N$ and $12^{\circ} 43'0$ with an area of 8 282 km² (9 130 km² including the buffer zone) [32].

The climate is Sudano-Guinean influenced by two air masses, the trade winds and the monsoon, but also by precipitation and temperature [15]. It corresponds to the tropical climate domain with a dry season in winter according to the Köppen classification [21]. Rainfall ranges between 900 and 1200 mm with a rainy season from June to October while temperatures range from 25°C in December to 33°C in May [32].

The Park's hydrographic system accounts for more than 10% of the Gambia River watershed (77000 km²), which covers nearly 200 km. Its two major tributaries are Koulountou in the west and Niokolo in the east [38].

The Niokolo Koba National Park (NKNP) is home to Senegal's richest fauna [17], [20], [15] with: 80 species of mammals, 330 species of birds, 36 species of reptiles, 20

species of amphibians and a rich and varied entomofauna.

The flora is also rich and varied. The NKNP contains 1500 species of vascular plants and is home to 80% of gallery forests and 97% of Senegal's Russian forests.

There are two main types of plant formations: savannah formations on plateaus and hills, and clear forests and gallery forests in river valleys [14].

3. Materials and Methods

Samples collected in the field are first numbered and tagged (harvester name, exact date and place of sampling, etc.) before being air dried for 48 hours.

Microscopic observations are made after assembling fragments in water, potassium hydroxide (5% KOH) and ammoniacal Congo (Congo Red 1% in ammonia), Melzer's reagent (chloral iodine) for evidence of amyloid or dextrinoid) or Cresyl blue.

The description of the samples takes into account the ecological and morphological characteristics (macro- and microscopic) following the protocol published by [9]. It is from all these descriptive information that an attempt was

made to identify the sample by working on the available literature.

Let us note only, as general works, the fascicles of the "Flore iconographique des champignons du Congo", of the "Flore illustrée des champignons d'Afrique centrale" ("A preliminary Agaric Flora of East Africa" or tropical, sometimes on world monographs (see references in the bibliography), some recent books such as the Guide of Edible Fungi of Benin [11], the Macromycetes Study of Burkina Faso: Ethnomycological and Therapeutic Approach [22] etc. also a first approach of the Macromycetes of some

neighboring countries of Senegal.

4. Results

4.1. List of Species of Sporophore Fungi Encountered in the Park and Their Systematic Position

Investigations in the Park allowed the identification of 14 species belonging to 12 genera and 6 families divided into 4 orders of Basidiomycota.

Table 1. List of Taxa.

Class	S/class	Order	Family	Genera	species
Holobasidiomycetes	Aphylophoromycetideae	Polyporales	Polyporaceae	<i>Polyporus</i>	<i>Polyporus arcularius</i> Rostk
				<i>Lenzites</i>	<i>Lenzites cfactus</i> Berk.
				<i>Hexagonia</i>	<i>Hexagoniasp</i>
		Clavariales	Lentinaceae	<i>Lentinus</i>	<i>Lentinussp</i>
			Pterulaceae	<i>Pterula</i>	<i>Pterula brunneola</i> Corner
			Lepiotaceae	<i>Pulverolepiota</i>	<i>Pulverolepiota sp</i>
	Agaricales	Copriniaceae	<i>Psathyrella</i>	<i>Psathyrella atroumbonata</i> Pegler	
				<i>Psathyrella tuberculata</i> (Pat.) A. H. Sm.	
				<i>Marasmius castaneovelutinus</i> Henn.	
		Agaricomycetidae	Tricholomatales	<i>Marasmius</i>	<i>Marasmiussp</i>
				<i>Marasmiellus</i>	<i>Marasmiellus setulosipes</i> (Murrill) Dennis
				<i>Lactocollybia</i>	<i>Lactocollybiasp</i>
Cortinariales	Cortinariaceae	<i>Tetrapyrgos</i>	<i>Tetrapyrgos nigripes</i> (Schwein.) E. Horak		
		<i>Gymnopilus</i>	<i>Gymnopilus sp</i>		

4.2. Descriptive Study of the Species Encountered in the PARK

This description will be in alphabetical order of genera. The sample number, the date of harvest and the ecology of the specimen will be exposed first and then follow the macro-morphological and micro-morphological descriptions. A thorough discussion of each identified specimen supporting our arguments (or their limitations) ends this part.

1 – *Gymnopilus* sp.

Studied specimens: National Park of Niokolo Koba, MK354 PNNK Sampling date: 22-09-08

Ecology: Harvested on dead wood. The area is wet, litter abundant around. Unspoiled wooded area and low light.

Macro-morphological characters

Fungi of orange color. Cap shaped circular, flattened to slightly concave. Smooth surface, orange color. Straight and smooth margin in young individuals but striated in older individuals. The stipe is central insertion, very slightly cylindrical, of rough consistency and striped ornamentation. Fistulous appearance in longitudinal section. Hymenophora consisting of decurrent leaves, dark yellow to orange in color and unequal in size (Gills, lamellae and short lamellae).

Cap diameter x 2 - 4 cm. Height of the stipe, 1.5 - 4 cm and x 0.3 cm.

Micro-morphological Characters

Spores (7.5-8.12- 8.5 x 5-5.05-5.2), (Q = 1.5-1.6-1.7) dextrinoid (darker: black-brownish under the melzer) of globular form in the immature state then ellipsoid to ovoid-elliptic. • Abundant cheilocystidia on the ridge. Half a dozen

observed, of capitate form at the top with wide neck. • Ridge probably sterile, no basidium observed on the ridge. Trichoderm revetment. Hyphae thick and 15 µm wide.

In the Key to East African Species presented by [34], no match was found. For species whose stipe does not have a ring, Pegler established the key based on the size of the spores (5-7.5) µm long. On this basis, the Senegalese species does not fall into this classification. We cannot confirm this description.

[10] studied a species of *Gymnopilus* from the Democratic Republic of Congo (formerly Zaire) which has the same spore size but slightly different shape with a brown-orange cap coloration in the Congolese species. Cheilocystidia do not also have the same shape. The Senegalese species is perhaps undescribed.

2 – *Hexagonia* sp

Studied specimens: National Park of Niokolo Koba, MK359 PNKK Sampling date: 22-09-08

Ecology: harvested on a piece of wood. The area is wet, light is weak and litter is plentiful.

Macro-morphological characters

The cap is hemi-circular and flattened, up to 3 cm in diameter. Dark beige to pale brown in the periphery and blackish brown towards the point of attachment, forming two clearly distinct and concentric zones, the peripheral zone being less wide. Straight margin and slightly flexuous. Radially corrugated surface.

The stipe lateral or practically nonexistent (0.3 cm long maximum). Hymenophora composed of hexagonal pores, whitish color.

Micro-morphological characters

- 1) Spores 5.5-8 x 7-9 μm , $Q = 0.78-0.88$ (very low abundance on our specimens), uniformly stained in blackish brown in Congo red and very largely rounded, without inclusion. Apiculate and individualized apicles on one of the spores observed.
- 2) Trama of cylindrical hyphae forming a monomitic structure, x 4 μm , 100 μm long, congophilic.
- 3) Pseudocystidia structures (27.5 x 5 μm), pale red in color, are found in Congo. The edge of the lamellae seems sterile. No basidium was observed there.
- 4) Cutis simple revetment. The hyphae are cylindrical and of the same size (x 4 μm).

The specimen presented here is included in the definitions of the genus. According to [39], the sessile sporophore, the largely angular or hexagonal pores, the surface of the struvous or velvety cap, a characteristic reported as very important by [19] quoted by [39], are found in the Senegalese harvest.. No correspondence was found in the authors' descriptions for the specific determination. The genus is totally tropical where 13 species have been recorded in Africa [39].

3- *Lactocollybia* sp.

Studied specimens: National Park of Niokolo Koba, MK365 PNKK Sampling date: 22-09-08

Ecology: mushroom harvested on the ground. Litter not abundant. Low light and average humidity.

Macro-morphological characters

Miniature mushrooms small but fleshy whitish to light beige.

Cap, x 0.9 cm, circular in shape and very slightly hemispherical to spread. Margin straight and slightly toothed. Smooth surface.

Stipe, 0.8 cm, central insertion and very slightly arched beige color. Finely striped, fistulous consistency with a regular base.

Hymenophora consisting of whitish lamellae (slightly yellowish), unequal (lamellae, and underlamellae), adnate with regular ridge.

Micro-morphological characters

- 1) Spores (6-7.63-8.5 x 4.5-4.68-5 μm) $Q = 1.33-1.63-1.91$, egg-shaped brown under the melzer. Apicula very slightly apparent on some spores. Double wall and strewn with fine granulations clearly visible under the microscope.
- 2) Basides (15-17 x 7 μm) with a bulbous base with 4 observed sterigmas.
- 3) Hymenium of trama showing a light yellow color in the ammoniac congo and parallel hyphae.
- 4) Fertile ridge but also showing cheilocystidia (20-15 x 3-4 μm), 1/3 on the ventral side.
- 5) A pleurocystidium (16 x 6 μm) of clavate form on the 2/3 starting from the bottom and upholstered in the 1/3 remaining observed.

This sample is easily attributable to the genus *Lactocollybia*, because of its remarkably developed system of hyphae and pseudocystidia with bright yellow content, very obvious under the microscope. On a macroscopic level, the

smooth revetment and the collybioid port may evoke a *Collybia* or a *Hydropus*, but the white color is characteristic of various *Lactocollybia*.

[34] mentions two species of *Lactocollybia* for eastern Africa: *L. gracillima* and *L. angiospermarum* Singer, a pantropical species distinguished by its distinctly larger spores (7.5-11.5 x 3.2-6 μm). [37] also describe 4 species from South Africa, with different microscopic characteristics of these crops.

In the section. *Alba*, grouping the species with clamps connection and with pseudocystidia [18], 14 species of tropical or Mediterranean distribution are recorded. None of these species has the association of Senegalese crop characteristics, especially the dimensions of spores and cheilocystidia. It is likely an undescribed species.

Comparisons have been made with descriptions of *Lactocollybia* sp 1 [25] but the micromorphological descriptions do not coincide in every respect with the crop presented here. In this extremely difficult group (17 species only known for the genus), we cannot for the moment put name for this harvest. Our next harvest may allow us to better distinguish this species.

4- *Lentinus* sp.

Studied specimens: National Park of Niokolo Koba, MK349 PNKK Sampling date: 22-09-08

Ecology: Harvested in muddy soil, scanty litter, wet area. Light moderately abundant.

Macro-morphological characters

- 1) Cap circular, x 1.6-2.7 cm, more or less flattened but rather narrow central depression, blackish color, with a discreet purplish tone. Hunchback margin then straight and ciliated. Mescal surface, especially in the center of the cap which is darker, these locks gradually spacing towards the margin of the cap where they end, concentrically ciliated; however, on the larger specimen, an area near the margin joins the hair dander into a nearly continuous dark circle.
- 2) Hymenophora consisting of white, adnate and unequal gills (lamellae and under-lamellae). Regular edge.
- 3) Central and slender base, 4.3 x 0.3 cm, cylindrical, rough, attenuated tapered at the base. Non-visible ornamentation (with fines wicks?) Due to the presence of mud from the substrate.

Micro-morphological characters

- 1) Spores broadly elliptical to cylindraceous, 8-9.5 x 4-5 μm , $Q = 1.8-2$, practically hyaline in Congo red, non-amylid. Several inclusions of variable size are observed in the majority of mature spores. The apex barely visible in most spores seems to be individualized in others.
- 2) Skeletal hyphae with globose endings, resembling cystidia on the edge of the lamellae. These terminations can measure between 4 and 9 μm long and 2 μm wide.
- 3) Basidium 20 x 7 μm , almost all immature on the specimens observed. Only one basidium with two sterigmata has been observed, suggesting that the

basidia may be bisporic (no tetrasporicbasidium observed). The subhymenium is highly developed and accrescent.

4) No cystidium observed.

5) Simple and regular cut peeling in cutis with hyphae with clamp practically at all the partitions.

African *Lentinus* have received very little study. If *L. squarrosulus* remains an extremely widespread species among paleo tropical species [34], it is not the same for the other species of *Lentinus*. The species studied here does not correspond to any description of the world monograph of [34]. It seems closer to *Lentinus nigroosseus*, by the abundant wicks that cover the surface of the cap, the size of the basidium and the shape of the spores but differs from it by the stocky stipe and of dimension inferior to the Senegalese harvest. Spore sizes are slightly lower in *L. nigroosseus*. Undoubtedly the Senegalese species belongs to the *Lentinus* section by the abundance of hairs on the surface of the cap, by the ciliated margin and by the presence of skeletal hyphae. It is probably an undescribed species that we cannot validate because of the insufficient maturity of the fruit. It will be necessary to try to find it in the field before considering its publication.

5 – *Lenzites cf. acutus* Berk., in Hooker, 1842, London J. Bot. 1, p. 146

Studied specimens: National Park of Niokolo Koba, MK363 PNKK Sampling date: 22-09-08

Ecology: harvested on a tree trunk, strongly anchored and difficult to separate from the tree trunk. The tree trunk is wet and the light does not exist.

Macro-morphological characters

1) Circular and flat cap; 3-4.6 cm in diameter. Surface streaked concentrically (somewhat reminiscent of some ganodermas, seen from above), of a color ranging from beige to brown, the young margin being whitish. Straight margin and slightly flexuous. These streaks are concentric reminiscent of ganodermas.

2) Side stipe, practically absent (between 0.3 and 0.4 cm long and 2 cm wide).

3) Hymenophora consisting of white, white poral pores.

Micro-morphological characters

1) No spores were observed. • Basidia 15-18 x 4-5 µm, thin, very lightly claved and especially visible towards the ridge.

2) Hymenial trama frame. No clamp observed. Unobserved cystidia. • Pigments present in the preparations of the hymenium. • Trichoderma cap revetment. Skeletal hyphae x 5.5 µm maximum, devoid of any noticeable difference with the hyphae of the weft.

This magnificent polypore, whose hymenophora gradually grows from pure white alveolated pores, which end up being organized into a radially stretched, maze-shaped network, has been determined based on the descriptions of [39]. Our harvest is identical in all respects to those made in French Guiana. The identity is yet to be confirmed, as part of an ongoing molecular study on the genus *Trametes* and refined

fungi.

This species has been repeatedly described as new because of the variability of the hymenophora, but the comparison of all the descriptions made refers to the same species. The typical character of this species remains the yellow to brown color of all parts of the fruit. The concentric stripes of the cap, the soft and velvety surface in the fresh state then becoming glabrous in the dry state, recall *Lenzites elegans* with which it is sometimes confused, which has a denser and purely white to pale cream the whole surface [39].

Geographical distribution and edibility: This species is found in Australia, Asia (common in Pakistan, the Phillipine Islands, China and southern Australia), and particularly in arid regions. Edibility unknown.

6- *Marasmiellus setulosipes* (Murrill) Dennis, 1970, Kew Bull. Add. Ser. 3, p. 33

Studied specimens: National Park of NiokoloKoba, MK355 PNKK Sampling date: 22-09-08

Ecology: mushrooms harvested on a very fine piece of wood.

Macro-morphological characters

1) Miniature mushrooms whose stipe size and cap diameter hardly exceed 1 cm.

2) Cap shaped circular and flattened. Margin right and toothed sometimes widely cracked. Dandruff cap, not fleshy. Smooth surface and showing large streaks reminding the footprint of the gills. Nipple visible on the cap, dark beige on a background of whitish color. Central insertion point, very finely cylindrical with regular base, striped ornamentation. Two apparent colors: a brownish base; another towards the middle clearer.

3) Hymenophora consisting of whitish gills, large, broad and adorned and with regular ridge.

Micro-morphological characters

1) Spores (6-7.5 x 2.5-3.5 µm), Q = 2.14-3, light pink in color with a clear apiculus rather similar to a germinal pore but not one. Subglobose form in young spores with an apiculus slightly forwarded forward and becoming ovoid to elliptic in mature spores. Other spores have a more hyaline color.

2) A slightly cylindrical (9 x 3.5) µm biposporic basidium was observed.

3) Unripe Basidia measuring up to 10 µm long.

4) Hymenial trama matrix with multi-articulated hyphae with articles up to 10 µm x 5 µm. Others smaller than the previous ones are entangled with each other. Subhymenium practically nonexistent. The net and visible hymenium. • Cystidia (cheilocystidia) structures (30 to 35 x 5 to 7 µm) are observed. They have a generally claved shape and are 2/3 captivated over the width at the top of the cyst. • Trichoderm revetment. Entangled and trabecular-looking hyphae.

This sample fits well into the definitions of the genus *Marasmiellus* sect. *Candidi* with a basidiocarp marasmiod with a central and developed stipe, non-gelatinous, a simple cutis weakly developed. [34] described 3 *Marasmiellus* in this

section, but the description that best describes the Senegalese crop is *M. setulosipes*. The other 2 being *M. echinocephalos* and *M. hirtellus*. The descriptions of the cap, stipe and lamellae are more consistent with Pegler's [34] description. On the microscopic level, the shape of the spores and their dimensions correspond to those measured on the Senegalese crop. Without a doubt, we attribute this harvest to *M. setulosipes*.

M. setulosipes was not identified in the [42] monograph of the genus [42] in which 134 species of *Marasmiellus* were recorded under the Neotropics.

Geographical distribution: This species is found everywhere in Tanzania according to [36] where it is often found in forest (saprotroph).

7 – *Marasmius castaneovelutinus* P. Hennings, 1905, *Bot. Jahrb. f. Syst. Pflanzengesch. Pflanzengeogr.* 38, p. 124

Studied specimens: National Park of Niokolo Koba, MK367 PNKK Sampling date: 22-09-08

Ecology: harvested on a piece of wood, wetland, abundant litter and low light. Saprotroph

Macro-morphological characters

Cap 0.6-1.5 cm, dark brown in color, papery, circular in shape with a broadly flexuous and straight margin. • Stipe 2 to 4 cm long, central, very slender and composed of two colors: one darker towards the base of the stipe. • Lamellae slightly yellow, not free, simple and very fine.

Micro-morphological characters

- 1) Unobserved spores (very rare in dry specimens of *marasmus*).
- 2) Basidia (20 x 5 µm), slightly clavate and forming a regular hymenium. The sub-hymenium is developed and accrescent. This sub-hymenium rests on a trama formed of hyphae forming clamps at the level of the partitions. Dextrinoid hyphae.
- 3) Cheilocystidia consist of two types: some brush-shaped with several fingerings, resting directly on the sub-hymenium; the others (20-30 x 5-6 µm) rather slightly clavate intermingled with several basidia thus making the edge fertile. Clamps can be observed on the hyphae of the trama.
- 4) Pleurocystidia (22 x 6 µm) also present. There are clavate at the base and tapered towards the top thus forming a fingerprint. • Hymenodermal revetment, consisting of thick, double-walled, pointed elements that protrude on practically lying hyphae whose width rarely exceeds 2.5 µm. • Clamps present practically to all the partitions.

In comparison with other tropical regions, tropical Africa lagged far behind in research on marasmioid fungi [2]. This author has largely contributed to the study of the genus in tropical Africa by presenting a monograph of the genus *Marasmius*.

The Senegalese species presented here is included in the definitions of the genus. *M. castaneovelutinus* belongs to the section *Sicci* Singer, series *Spinulosi*. It is characterized by a dark brown cap, tight gills, rather wide spores, well-developed pleurocystidia, a revetment of brush elements [2].

So many characters, with the exception of spores (unobserved), found in the Senegalese crop. The dimensions of the basidia, cheilocystidia and pleurocystidia perfectly correspond to those measured on the Senegalese species. Without a doubt, it is the same species.

Geographical distribution and edibility: this fungus is known in Sierra Leone, Uganda and probably the Democratic Republic of Congo [2] and Cameroon. Its edibility is unknown.

8 – Marasmius sp [sect Sicci]

Studied specimens: National Park of Niokolo Koba, MK368 PNKK Sampling date: 22-09-08

Ecology: this mushroom is harvested from dead wood. The litter is plentiful, the humidity is important. The area is dark.

Macro-morphological characters

Cap, 0.6-3.7 cm, first hemispherical and circular then slightly spread until spread in adult individuals. Straight margin and very slightly flexing toothed. Smooth surface with a darker nipple (brownish-tinged orange color).

- 1) Stipe, 4.2-6 cm, initially whitish in color, slightly viscous, browning when drying from the center to the bottom of the stipe. It is cylindrical in shape with a slightly thinned base. Longitudinal fistulous section, smooth ornamentation without visible scratches, central insertion.
- 2) Hymenophora consisting of whitish to very light beige lamellae. Very thin lamellae, anastomosed and adnate.

Micro-morphological characters

- 1) Spores (5.5-7 x 3-4 µm), $Q = 1.66-1.9$ µm, slightly ellipsoid in shape and light in color.
- 2) Feiform and slightly emergent basidia (25-30 x 9 µm). Other more mature clavate (20 x 7 µm) observed. Mature basidia not observed on the second specimen.
- 3) Cheilocystidia of shape and structure in brushes with rather large elements (12-18 x 5-8 (10) µm). The brush portion is 5-8 (10) µm long, medium brownish-yellow in color. 0.5-1 µm, stiff or a little sinuous.
- 4) Caulocystidia also observed and cylindrical with a bifurcation at the top of the cyst.
- 5) Hyphae x 3-8 (10) µm, parallel or intermingled, red in the congo (distinctly congophilic), a little thicker, without embedding pigment. The clamps observed almost at all the partitions. Powdered dextrinoid revetment • Dextrinoid stipe revetment.

This species is easily attributable to the genus *Marasmius*, *Sect. Sicci*, because of its collyboid shape, its small size, its membranous to slightly fleshy cap, its striated margin and its cylindrical stipe. On the microscopic level, the presence of hymenodermic brush elements confirms this sample in this section.

In *Sect. Sicci*, a group with hymenodermic elements in brush, 46 species belonging to tropical Africa have been listed [2]. No description, especially the microscopic elements, corresponds to the description of the Senegalese sample. On a macroscopic level, the closest species seems to be *Marasmius confertus* Berk. & Br. Particularly by the size of the sporophores, the radially striated margin, the orange to

slightly brownish color of the cap, the smooth, glabrous stipe, initially whitish then browning. Lamellae first whitish in the young state and then yellowing with the adult blossoms [2] So many macroscopic characters found in the Senegalese species. But because of the divergence of the microscopic elements, we cannot confirm this species. It may be an undescribed species.

9 – *Polyporus arcularius* (Batsch: Fr.) Fr., 1821, *Syst. Mycol.* 1, p. 342

Studied specimens: National Park of Niokolo Koba, MK350 PNKK Sampling date: 22-09-08

Ecology: harvested on a piece of dead wood. Abundant litter around in a wet area.

Macro-morphological characters

- 1) Mushroom beige to slightly brownish. Cap x 3-3, 8 cm, circular, more or less flattened but with a depression forming a cavity in the center (slightly infundibuliform). Straight margin and abundantly ciliate, the eyelashes extending to the underside of the cap. Smooth surface or embossed honeycomb.
- 2) Hymenophora consisting of angular pores forming a white disposition.
- 3) Central stipe, 2.5-3.3 cm long, rough, with regular cylindrical, cylindrical ornamentation, fistulous longitudinal section.
- 4) *Micro-morphological characters*
- 5) Spores (7-9 x 3-3.5 μm), Q = 2.33-2.57, hyaline and cylindrical. Apiculus well loosened. Fine inclusions are observed in the spores.
- 6) Basidia 13 x 6 μm , rare in the mature state (a bisporic basidium observed), rather immature basidia on our specimens. • Accessional subhymenium.
- 7) Matted structure with a dimitic structure, prolonged by hyphae having the value of cystidia, of more clavate form towards the top of the hypha. The end of these hyphae of more or less clavate form extend over a length of 60 microns with a width of between 6 and 8 microns.

The species presented here does not pose a problem of determination with the description made by [39]. The only reserve we can do, the specimens described by these authors are larger than 7 cm in diameter and 8 cm for the size of the stipe. This could be explained by an insufficient maturity of the Senegalese sample. The ciliated margin, the angular pores, and radially related to the stipe are also observed. On the microscopic level the size of the spores corresponds perfectly with those of the Senegalese species. The spores are also cylindrical and smooth. Without doubt, it is the same species.

Notes: The infundibuliform shape of the cap with the ciliated margin and relatively large pores are the most remarkable features of this species [39].

Geographical distribution and edibility

According to [39] this species is found throughout the tropics. It is also subtropical and in warm parts of temperate zones. In Africa the species is collected in Sierra Leone, Kenya and Tanzania. She is also present in South Africa.

Its edibility is unknown. It is also found in Benin [45].

10– *Psathyrella atroumbonata* Pegler, 1966, *Persoonia* 4 (2), p. 86

Studied Specimens: UCAD, Nioro, Ziguinchor, Oussouye, National Park Niokolo Koba, MK 256/338SN

Sampling date: 21-09-07/ 25-08-08

Ecology: these mushrooms do not have a particular ecology, they are harvested everywhere: on bare soil or slightly covered with litter but always in high humidity.

Macro-morphological characters

- 1) Mushrooms living in a large colony, very common. Circular and slightly conical cap in young individuals and then slightly spread in adult specimens. Slightly flexing margin that may be slightly toothed to eroded extending towards the surface of the cap by fine scratches resembling fine cracks. The color of the cap is mostly light beige towards the margin becoming darker towards the center which ends up forming a brownish to light brown conical nipple.
- 2) Whitish stipe and central insertion very slightly off-center, very fragile and cracking very quickly under the effect of the cap. The ornamentation looks smooth and the shape slightly cylindrical.
- 3) Gills of the same color as the cap, very uneven. Lamellae and short lamellae present. These lamellae appear slightly eroded and do not always have a regular edge. Even if they seem to adhere to the stipe, they are immediately free.
- 4) Height of the stipe: 2.1 cm. Diameter 1,5 - 3,4 cm.

Micro-morphological characters

- 1) Spores (6-7-8 x 4-4,3-4,7, Q = 1,62-1,65-1,75 μm , brownish to slightly dark in 5% KOH, ellipsoids without net apicoid, a clearly visible pore and a thin wall.
- 2) Sterile edge formed of palissadic cheilocystidia (13-18 x 7.5-8.5) μm .
- 3) Short basidia, do not exceed 10 μm long and 8 μm wide, subglobose or globose, tetrasporic for the majority, collapsed and not forming a regular hymenium.
- 4) Cellular matrix consisting of spherocytes and having no clearly individualized elements.
- 5) Pileus revetment consisting of spherocytes.

Tropical *Psathyrella* has been the subject of very few studies or even none at all [11]. According to [33] quoted by de [11], the name 'wowo' which means fragile is given by the Yorubas to *Psathyrella atroumbonata* Pegler, the latter is macromorphologically close to *P. tuberculata* but lacks a ring.

The sample presented here does not pose a problem with its determination if one refers to the descriptions of [34]: the diameter of the hat, the size of the foot, the conical and then flattened shape of the hat which forms a more colored obfuscated umbo dark than the rest of the hat. On the micromorphological level, the spores correspond in size and shape, the basidia also, the abundance of cheilocystidia on a sterile ridge, the absence of pleurocystidia, the regular hymenial pattern are all characteristics found in the Senegalese sample. Without a doubt, it is the same species.

[34] noted the presence of an appendicular veil on the margin of the hat of young individuals, which disappears at maturity. This veil has not been noticed on the Senegalese crops, all of which have mature individuals. The presence of this veil, the absence of pleurocystidia, the hymenial hyaline framework and the small spores could make Pegler think of *P. candolleana* (Fr.) Mayor and place him in the subgenus *Hypholoma* (Fr.) Sing. However, it is admitted that they are distinguished by a certain number of characters, particularly by the lack of purple coloration observed on the blades, the dark brown nipple of the hat and the small and differently shaped cheilocystidia observed.

Geographical distribution: This fungus is found in Tanzania, Kenya and Uganda. Unknown uses.

11 – *Psathyrella tuberculata* (Patouillard) A.H. Smith, 1972, *Mem. N.Y. Bot. Gdn* 24, p. 78

BASIONYM: *Hypholoma tuberculatum* Patouillard, 1899, *Bull. Soc. mycol. Fr.* 15, p. 196

Studied specimens: UCAD, PNNK, MK122/104DKR

Harvest date: 11-09-06 / 06-09-06

Ecology: this fungus occurs in several samples living in large colony on a dead tree trunk. Litter is abundant, light is poor and moisture is average

Macro-morphological characters

- 1) Mushroom with beige to brownish color (cap and hymenophora), white stipe.
- 2) cap x 1.5 - 1.7 cm, circular and convex. Margin straight and slightly toothed. Smooth cap surface with small dots resembling fine scales that disappear at the maturity of the mushroom. Nipple slightly tapered and visible in the center of the cap.
- 1) Stipe, 3 - 4 cm centrally inserted with a cylindrical base, mottled ornamentation, longitudinal fistulous section.
- 2) Hymenophora formed from beige to whitish laminae, slightly spaced with regular ridge.
- 3) Partial veil constituted by an inferior ring. General sail absent.

Micro-morphological characters

- 1) Spores 6-6.6-7.1 x 3.7-4.17-4.5 µm, Q = 1.42-1.58-1.65, clear to slightly yellowish in the Melzer with a slightly thickened wall while they have a dark yellow color in the ammoniac congo. Apiculus not noticed. Spores ovoid to ellipsoid.
- 2) Basidia (18.5-20 x 7.2 -7.5 µm) 2-sporic, immature basidia in abundance with an accrescent subhymenium.
- 3) Cheilocystidia (15.2-20.3 x 11.5-11.2 µm), clear without apparent inclusion and abundant on the edge sterile from the outset. Pleurocystidia absent.
- 4) Simple epithelial revetment of pileus with more or less rounded cells. • Clamps absent.

This *Psathyrella* does not pose a problem with its determination. The macro-morphological characters described by de [11] of the species harvested in Benin coincide perfectly with the Senegalese crop. The spores also correspond in shape and size.

In the genus *Psathyrella*, *Psathyrella tuberculata* is easily recognized by its growth in Tufts on dead wood, its small

size, its persistent ring and fine granular scales on the cap [11]. These observations were also made during our surveys where the fungus was still growing in clumps in a very large population. It has been harvested several times on tree trunks in senescence and rotten at least on the part where the mushroom was harvested and also on other substrates.

Psathyrella tuberculata is new to the African continent, known only from the West Indies [35]. Tropical *Psathyrella* studies are non-existent and the number of species is probably high (De Kessel et al., 2002).

Geographical distribution: *Psathyrella tuberculata* is known from the West Indies [35] in [11], from Benin and Burkina Faso [22].

Edibility: This fungus is consumed in Benin where the populations mainly use the young specimens in sauce preparation [11].

12 – *Pterula cf. brunneola* Corner, 1950, *Ann. Bot. Mem.* 1, p. 608

Studied specimens: National Park Niokolo Koba (Kedougou), MK370 PNKK,

Sampling date: 22-09-08

Ecology: harvested on dead tree trunk and very wet. Wooded area.

Macro-morphological characters

Basidioma erect, in arbuscule up to 1.5-5 cm high. Appearance bushy, with main branches more or less vertical, fine and branched, especially towards the base which has arched branches, horizontal or ascending. The ends of the branches are thin and pointed. General color clear, oily cream with a slightly pinkish tone.

Micro-morphological characters

- 1) Spores 6.5-7.5 x 3.8-4.5 µm, Q = 1.66-1.71, ovoid, clear in the ammoniacal Congo, with numerous internal guttules, with rather thin walls. Apical almost null and slightly pointed.
- 2) Basidia 18-20 x 7-8 µm, clavate to widely clavate, presenting like spores many inclusions. They form a regular hymenia.
- 3) Cystidia 12-13 x 6-5 µm, subcylindrical, sometimes strangulated on the upper 1/3 and slightly captive at the apex. Two types of hyphae observed: a first wide of 8 microns in central position and a second very fine (4 µm wide) surrounding the first on both sides.

Pterula brunneola was described by [8]; as it is presented here [8], possesses practically the same micro-morphological characters of the Senegalese sample (with the exception of cystidia that were not observed on the Corner sample). It is for this reason that it would be imprudent to conclude that there is a definite determination. The macro-morphological characters also correspond even if the diameter of the branches (1.5 to 2 mm) has not been measured on the Senegalese sample. An important ecological trait: the Senegalese specimen was collected on dead wood in the forest, that of Corner (in humus soil in the forest). But Corner does not exclude that species of the genus can also be sampling on wood.

Geographical distribution of *P. brunneola* type: Malaya forest

Uses: no clarification has been made as to the uses.

13 – *Pulverolepiota* sp

Studied specimens: National Park of NiokoloKoba, MK 352PNKK

Sampling date: 22-09-08

Ecology: sampling on the ground. Moderately abundant litter; wet and dark area: weak light.

Macro-morphological characters

- 1) Lepiote scale shinel (resembling an Echinoderma). • Cap x 2 - 2.5 cm, first hemispherical then slightly spread and circular. Margin straight and smooth. Thorny surface. These spines have sharp ends.
- 2) Stipe, 5.5 - 6 cm x 0.6 cm, central also surmounted by rolled scales (spines). Wide cylindrical stipe with a bulbous base. Bunching mushrooms. Ring above the scales. The rest of the stipe outside the scales is finely scratched. Fibrous consistency.
- 3) Lamellae white, free, uneven and with regular ridge.

Micro-morphological characters

- 1) Spores (7-7,5-8,5 x 4-4,35-5) μm , Q = 1,55- 1,72-1,87, ovoid, clear in congo ammoniacal red. Apicula slightly depressed on some spores but seems central in others. A big guttula is observed in the spores. Non porous spores with endospore metachromatic.
- 2) Basidia (18-20 x 8-9 μm), 4-spore forming a regular hymenium and having a club-like shape.
- 3) Cheilocystidia, (10-15 x 6-7.5), slightly variable in shape: generally clavated upwards to ventro-central on one or two cystidia with a slight depression towards the base.
- 4) Chained hyphae observed on the spines of the hat. • Pseudo-hymenodermal revetment with interlocking clavated elements up to 30 μm long and up to 5.5 μm wide.

This *lepiota* resembles the macro-morphological descriptions of an Echinoderma by the abundance of spines on the hat and on the base of the foot [6] but the metachromatic reaction observed on the spores literally spreads this hypothesis. This chemical reaction leads us into Leucocoprinoidae. The small leucocoprinoids according to these descriptions are *Pulverolepiota* [6]. However, a notorious powderiness has not been observed in the Senegalese species, which does not comfort us the attribution of this species to the genus *Pulverolepiota*.

14 – *Tetrapyrgos nigripes* (Schw.) Horak, 1987 ('1986'), *Sydowia* 39, p. 102

Studied specimens: National Park of Niokolo Koba, MK 353PNKK

Sampling date: le 22-09-08

Ecology: harvested on small pieces of wood, wet area, low light, abundant litter, tree area.

Macro-morphological characters

- 1) Fungus whitish but fast, with a bluish tendency, sometimes even purplish, darkening with age, especially by the base of the stipe.
- 2) Cap x 2.4-3 cm, circular and flattened. Margin straight and smooth. Smooth surface.

- 3) Stipe 1.8 to 2.5 cm long, central, tapered, and fistulous on a regular basis, without apparent ornamentation or a little furfurace towards the base.

- 4) Lamellae spaced, rather thick, unequal, adnate.

Micro-morphological characters

- 1) Only one spore observed.
- 2) Basidia (17-18 μm x 5 μm), mostly club-shaped, form a regular hymenium. Some bi-spore basidia observed here and there. Slightly arched sterigmata. Sub-hymenium developed and accrescent. A parietal pigment observed on the hyphae of the frame.
- 3) Cheilocystidia (14-15 μm x 5 μm) slightly clavated at the base, strongly fingered towards the top. The top of some cheilocystidia looking like gloves fingers.
- 4) A pleurocystidia (13 x 5 μm) observed. It is also clavated in 2/3 and tends to be tapered to the top.
- 5) Revetment of pileus is cutis rather ordinary, formed of simple hyphae, thin and recumbent; other, larger, curly hyphae with slightly rounded ends are slightly upright.

Tetrapyrgos nigripes is a pantropical species described in Africa (Pegler, 1986), in the West Indies (Pegler, 1983). It is also subtropical (described in North America) [31].

The descriptions of [36] correspond to the characters of our sample, in particular by the diameter of the hat which rarely exceeds 2.5 cm, the appearance of the hat on a white background and of superficial color which turns blue, the stipe blackening towards the base, the cream color of the blades; these macro-morphological characters found in the Senegalese sample.

From the micro-morphological point of view, the descriptions of [23]; [36] show spores of particular shape, characteristic of the genus *Tetrapyrgos*: tetrahedral with 4 radial horns; a single spore (with the same characters) is observed on the Senegalese sample (because of the dryness of the specimens: characteristic of the marasms which lose their spores in the dry state), but the shape of basidia and their dimensions, as well as the digitalized cheilocystidia, the form of the pleurocystidia, and the nodular hyphae forming branches are all characters also observed in the Senegalese sample. Without a doubt, it is the same species.

5. Conclusion and Perspectives

Despite the partial nature of sampling (carried out in 2 days), the taxonomic diversity is considerable. No less than 14 species were collected divided into 12 genera, belonging to 6 families belonging to 4 orders of Basidiomycota. Only one edible species has been identified. No toxic species has been harvested. The samples are dominated by Marasmiaceae and Polyporaceae (which is normal because they are grown in the forest). All the sampling species are new to the fungal diversity of Senegal and can be, among the unidentified specimens to the specific level, are new species for science.

It will be necessary to undertake new harvesting campaigns, to strive to find mature samples of *Lentinus* sp finally to consider its publication as a new species.

Appendix



Figure A1. *Lentinus* sp.



Figure A2. *Hexagonia* sp.



Figure A3. *Polyporus arcularius*.



Figure A4. *Lenzites cf acutus*.



Figure A5. *Pterula brunneola*.



Figure A6. *Lactocollybia* sp3.

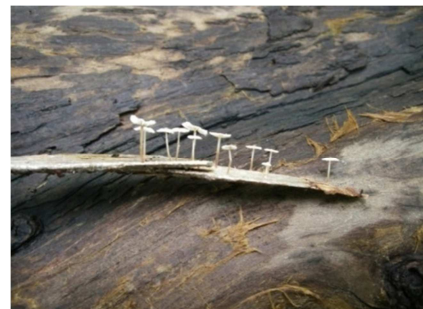


Figure A7. *Marasmiellus setulosipes*.

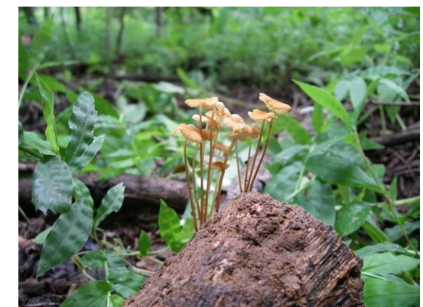


Figure A8. *Marasmius castanevelutinus*.

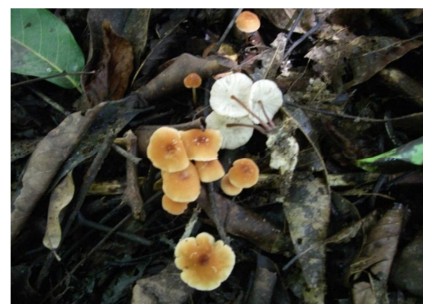


Figure A9. *Marasmius* sp sect *Sicci*.



Figure A10. *Tetrapyrgos nigripes*.



Figure A11. *Psatyrella atroumbonata*.



Figure A12. *Psatyrella tuberculata*.



Figure A13. *Gymnopilus* sp.



Figure A14. *Pulverolepiota* sp.

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