EEET ECOLOGICAL ENGINEERING & ENVIRONMENTAL TECHNOLOGY

*Ecological Engineering & Environmental Technology*, 2025, 26(11), 389–404
https://doi.org/10.12912/27197050/213500
ISSN 2719–7050, License CC-BY 4.0

Received: 2025.09.29
Accepted: 2025.10.24
Published: 2025.11.01

# Study of some Polyporoid species from the Hymenochaetales and Polyporales orders

Abdesslam Bouchar[1*], Ali Outcoumit[1], Nour Id Elhakkar[1], Soukaina Msairi[1,2], Amina Ouazzani Touhami[1], Allal Douira[1]

[1] Laboratory of Botany, Biotechnology, and Plant Protection, Faculty of Sciences, Ibn Tofail University, Kenitra Morocco
[2] Research Center of Plant and Microbial Biotechnologies, Biodiversity and Environment, Laboratory of Botany and Valorization of Plant and Fungal Resources, Department of Biology, Faculty of Sciences, Mohammed V University in Rabat, Morocco
* Corresponding author's e-mail: bouchar2007@gmail.com

## ABSTRACT

Polypores are one of the most important groups of wood-decomposing fungi. Surveys conducted between 2003 and 2020 in various forests of Morocco led to the collection of basidiocarps of gastroid fungi belonging to Basidiomycetes. This study was complemented by a microscopic description of the spores and cross-sections of structures such as the hymeniu m, cuticle, flesh, and stipe. Eight species from the orders Hymenochaetales and Polyporales were studied, found in different surveyed regions. Five species were encountered in the Mamora Forest (*Coltricia perennis*, *Hymenochaete tabacina*, *Phlebia tremellosa*, *Polyporus arcularius*, and *Trichaptum fuscoviolaceum*), three in the Rif (*Phellinus torulosus*, *Steccherinum ochraceum*, and *Trichaptum fuscoviolaceum*), one in the Lalla Mimouna region (*Phellinus torulosus*), and one in the Middle Atlas (*Scenidium nitidum*). These species were recorded for the first time in Morocco, thereby enriching the knowledge of the country's mycoflora.

**Keywords:** forests, Hymenochaetales, Morocco, mycoflora, Polyporales wood-decomposing fungi.

## INTRODUCTION

Polypores (Basidiomycota, Agaricomycetes) are macro fungi that inhabit wood with a poroid hymenophore, growing on living trees, standing dead trees, fallen trunks, decayed wood, stumps, tree roots, and even the soil, but they are closely associated with trees (Gibertoni *et al.,* 2016; Wu *et al.,* 2022a). They represent a major group of wood-decaying fungi, playing a crucial role in the decomposition of lignified plant tissues. Through this process, they contribute significantly to nutrient cycling by releasing carbon, minerals, and other essential elements back into the ecosystem (Palviainen *et al.,* 2010; Berglund *et al.,* 2011; Miettinen *et al.,* 2016; Huang *et al.,* 2022). Wood-decaying fungi are generally classified as either white rot or brown rot fungi, depending on their ability to degrade the structural components of wood. White rot fungi can decompose all major constituents of wood, including lignin, cellulose, and hemicellulose, whereas brown rot fungi selectively degrade cellulose and hemicellulose (Riley *et al.,* 2014; Chung *et al.,* 2017; Hage *et al.,* 2021). In addition to their primary saprotrophic lifestyle, some polypores have been observed to form mycorrhizal associations (Alem *et al.,* 2021). Polypores are the most significant group of wood-inhabiting fungi. Most of these fungi can break down cellulose, hemicellulose, and lignin in plant cell walls, thereby playing a critical role in nutrient recycling in most forest ecosystems.

It is now established that "polypores" have evolved multiple times in different poroid and non-poroid groups. The poroid groups include Hymenochaetales, Gloeophyllales, Thelephorales, and Corticiales. The non-poroid groups

encompass certain gilled fungi such as Russulales, the genera Lentinus and Panus, as well as leafy fungi of the genus Sparassis (Binder *et al.,* 2005; Zmitrovich, 2006; Hibbett *et al.,* 2007).

The present study, aimed at exploring forest fungal diversity, focuses on five polyporoid species that were formerly classified under the order Aphyllophorales, but are now assigned to the orders Hymenochaetales and Polyporales. These species were examined based on specimens collected from various surveyed regions. The discovery of new national records, such as *Polyporus arcularius* and *Trichaptum fuscoviolaceum*, highlights the richness of Moroccan forest ecosystems and underscores their significance as reservoirs of fungal biodiversity.

## MATERIALS AND METHODS

Between 2003 and 2020, surveys conducted in various forested regions across Morocco led to the collection of basidiocarps of gasteroid fungi belonging to the Basidiomycetes (Figure 1). The fruiting bodies were photographed in situ, and macroscopic features such as shape, size, color, and texture were recorded. Specimens were then transported to the laboratory for comprehensive morphological analysis. Detailed descriptions were made of the basidiocarps, including the pileus, stipe, hymenium, and gleba. Microscopic examinations focused on spore morphology and the structure of the hymenium, cuticle, context (flesh), and stipe, and were carried out using tap water as the mounting medium (Ajana *et al.,* 2020a, 2020b; Lotfi *et al.,* 2019, 2020; El Kholfy *et al.,* 2021a, 2021b; Nmichi *et al.,* 2021; Bouchar *et al.,* 2023; El-Assfouri *et al.,* 2024, 2025a, 2025b).

The species was identified using determination keys (Eriksson *et al.,* 1981; Fiasson and Niemelä, 1984; Dai, 2010; Courtecuisse and Duhem, 2000; Hjortstam and Ryvarden, 2004; Miettinen *et al.,* 2012; Wu *et al.,* 2022b; Wang *et al.,* 2023; Liu *et al.,* 2023; Yu *et al.,* 2025; Id Elhakkar *et al.,* 2025a, 2025b).

## RESULTS

### Hymenochaetales Oberwinkler 1987

In its current sense, the order Hymenochaetales (Incertae sedis, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi) encompasses a morphologically diverse group of Homobasidiomycetes species. This order includes agaricoid forms, coralloid fungi, and clavarioid fungi. Moreover, the hymenium of these species can exhibit various structures, such as resupinate, spatulate, poroid, lamellate, or hydnoid forms. Consequently, Hymenochaetales bring together taxa that were previously classified within families such as the Agaricaceae, Polyporaceae, Corticiaceae, Stereaceae, and Hymenochaetaceae.

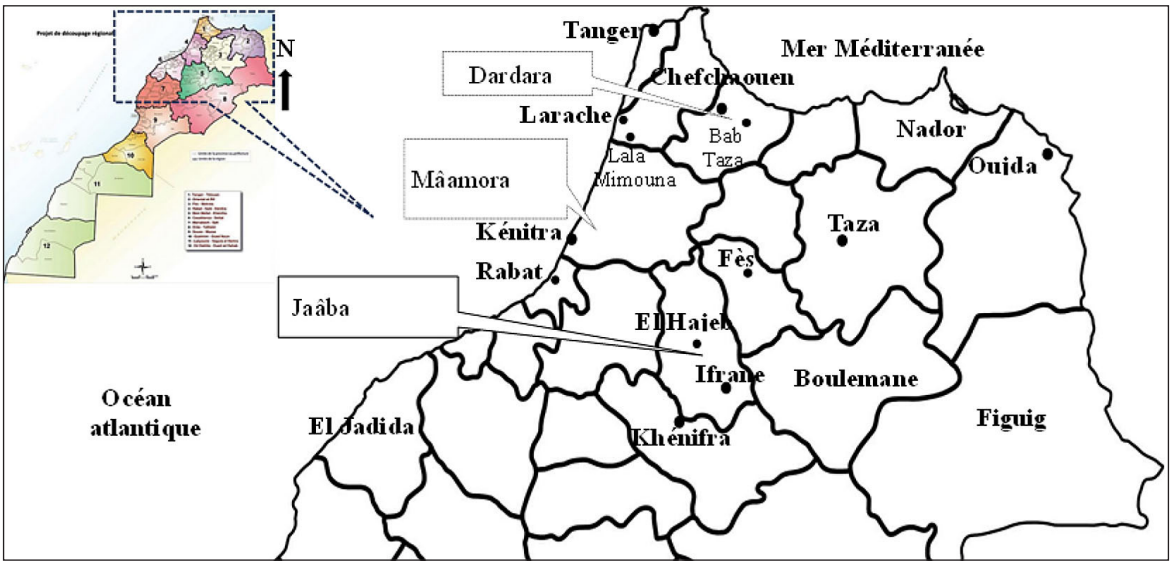


**Figure 1.** Geographical location of the collection areas of the fungal species studied

### Hymenochaetaceae Donk 1948

*Coltricia perennis (L.) Murrill 1903: New species for Mamora*

Harvest in March 2006 in Mamora and in February 2009 and 2020 in the Ferjana forest (Lalla Mimouna) (Figure 2). The basidiocarps are folded and stipitate, often forming clusters fused either at the base of the stipes or at their caps. The cap, ranging from 1 to 10 cm in diameter, is flat or funnel-shaped and can sometimes be umbilicate. Its surface appears matte and velvety-tomentose under a hand lens, displaying well-defined concentric bands in shades of cinnamon brown, beige, yellowish, yellowish-brown, gray-brown, or gray. The margin is thin, sharp, and can be curved inward, straight, or undulating. The flesh, 1 to 3 mm thick, is thin, tough, and leathery in fresh specimens but becomes hard and brittle upon drying or with age. Its color ranges from brown to rusty brown. The hymenophore is tubular-poroid. The pores, measuring 3 to 4 per mm, are fine and range in color from pale brown to cinnamon brown or buff. Initially round, they gradually become somewhat elongated and eventually angular. The tubes, approximately 3 mm in height, are subdecurrent to decurrent and share the same color as the pores. The stipe (0.5–5 × 0.3–1 cm) is central, cylindrical, solid, rigid, and either equal or flattened, ending in a rounded base. It is tomentose and exhibits an orange-brown color. The flesh of the stipe is compact and leathery. The spore print is yellowish-brown. When treated with 3% KOH, the flesh turns blackish. The specimen is odorless, and its taste is mild. The hymenium comprises basidia (12–25 × 5–7.5 µm) are cylindrical or clavate, bearing two or four basidiospores. The spores (6–8.5 (9) × 4–5 µm) are smooth and slightly flattened on one side. In water, the spores appear hyaline to greenish at the center and orangish at the periphery. In iodine water, they turn brownish (dextrinoid). The spores are oblong to elliptical and smooth (Figure 2).

### Hymenochaete Léveillé 1846

*Hymenochaete tabacina (Sowerby) Lév. 1846: New species for Mamora*

Harvest of March 15, 2007 and November 26, 2008 and December 2019 in Mamora (Figure 3). The carpophores, measuring 1 to several centimeters in diameter, initially appear as rounded patches that are resupinate, semi-pileate, or pileate and sessile. The upper surface varies in color from tobacco-brown to rust-brown or reddish-brown. It is felted, radially striated-wrinkled, and zoned. Toward the margin, it is orange-brown, while near the attachment point, it shifts to gray-brown. Multiple basidiocarps often merge to form plaques measuring 20 to 30 cm, which are somewhat discontinuous. The flesh is leathery but can tear into star-like shapes. The margin is sinuous, reflexed, and transitions from yellow-orange to rust over time. The pileal surface is felted and changes color from orange-brown to grayish-brown. The fertile underside is matte and finely felted, with emergent setae visible under 10x magnification. It is more or less circularly zoned around the attachment point and exhibits shades from tobacco-brown to rust-brown or coffee-brown. Upon drying, the edges turn whitish to pale yellow. The spores, measuring 4.5–6 × 1.5–2 µm, are hyaline, smooth, cylindrical, slightly allantoid, and non-amyloid.

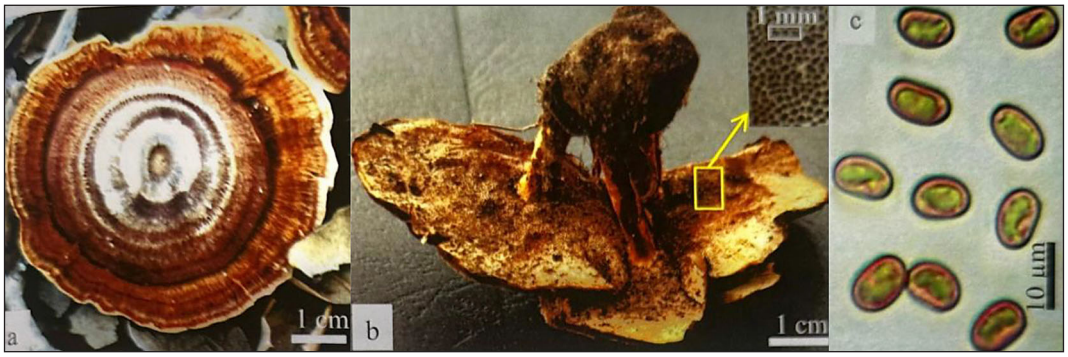


**Figure 2.** *Coltricia perennis* (L.) Murrill: A basidiom (*in situ*) with a concentrically zoned cap of grey, buff, brown, tawny, velvety – tomentose colour, with a clear and wavy margin (a); tufts of specimens stuck together by their caps and feet and tubular-porous hymenophore subdecurrent to decurrent and circular or angular pores (b); basidiospores (c); microscopic observations in cotton blue x 400

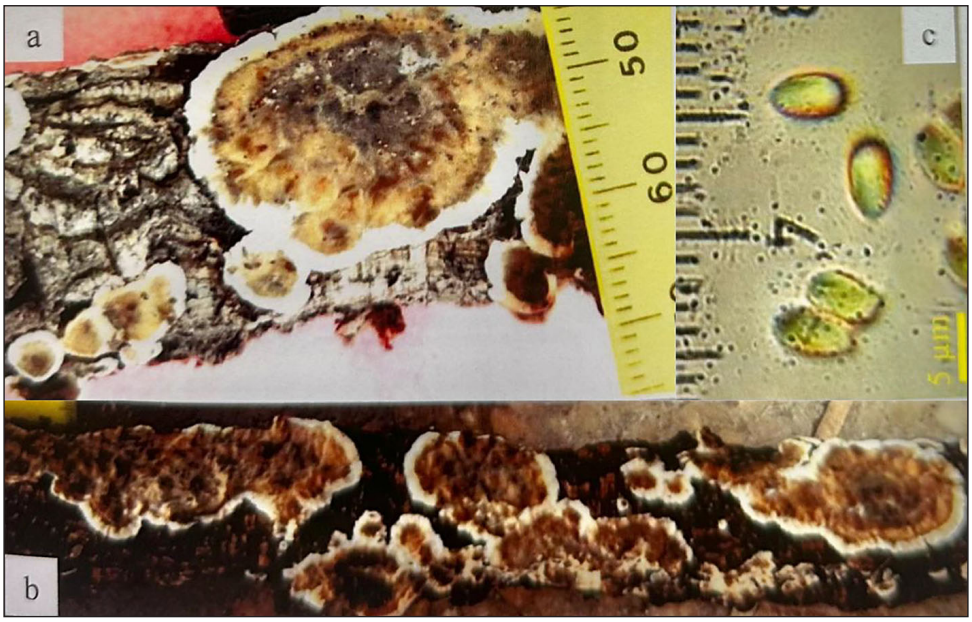


**Figure 3.** *Hymenochaete tabacina* (Sowerby) Lév. 1846: Resupinate basidiomes on dead wood of *Quercus suber* (a) and lithoid Thymelaea (b) and basidiospores in water (c)


**Figure 4.** *Phellinus torulosus* (Pers.) Bourdot and Galzin: Basidioma on the neck of Erica arborea (a); hymenial surface and pores enlarged 20 times (b).

## Phellinus Quélet 1886

### *Phellinus torulosus (Pers.) Bourdot and Galzin 1925*

Harvest on April 18, 2007, and April 20, 2021 at Bab Taza (Chefchaouenne) (Figure 4). The basidiomes (10–35 × 10–26 × 1.2–5 cm) are perennial, woody, or pileate-sessile, attached to the woody substrate across their entire width. They are flat to convex, either solitary or clustered. The cap is yellow-brown to dark brown, almost black in older specimens. It is concentrically zoned, glabrous to tomentose, particularly towards the base. The edges are entire or undulate, and are yellow-brown in color.

The hymenophore is tubular and poroid. The pores (6–7 per mm) are round and light brown to yellow-brown near the edge. The tubes (up to 5 cm) are pale yellow-brown with unevenly distributed whitish tones. The flesh (up to 5–7 cm thick) is brown, hard, woody, and slightly zoned, with a black line separating it from the cap surface. The generative hyphae (2.5 to 4 µm in diameter) are septate, simple or branched, and have moderately thick walls. They are hyaline, yellowish or yellow-brown, and non-amyloid. The skeletal hyphae (3–5 µm in diameter) are non-septate and have thick walls (1–1.5 µm). They are reddish-brown and non-amyloid. The cystidia (40–50 ×


**Figure 5.** *Phlebia tremellosa* (Schrad.) Nakasone and Burds: Basidiocarps on a dead pine tree trunk in the Mamora (a); upper surface hairy and whitish ochraceous (b); hymenial face wrinkled - pleated (c); basidium (d); cystidium (e); basidiospores. Microscopic observations x600

10 µm) are fusoid, ventricose, and surrounded by a wall 2 to 3 µm thick. The basidia (20–30 × 8–10 µm) are straight, cylindrical, and tetraspored. The basidiospores (4–6 × 3–4 µm) are ovoid to ellipsoid, hyaline, and have a smooth wall.

### Meruliaceae P. Karst. 1881

*Phlebia tremellosa (Schrad.) Nakasone and Burds. 1984: New species for La Mamora*

Harvest of November 29, 2008 and December 2022, in Mamora (Figure 5). The basidiomes (3–10 cm in diameter) are resupinate without a stipe, irregular in shape with a truncated upper edge. The upper surface is velvety, woolly, and whitish. The fertile underside is translucent, somewhat gelatinous, and orange to pink in color, turning red upon maturity. It is pleated and wrinkled. The flesh is thin and whitish. The spore print is white. The cystidia (20–25 × 4–5 µm) are scattered, tapered, and often incrusted, with only slightly protruding apices. The basidia (25–30 × 5–6 µm) are cylindrical to claviform and tetraspored. The spores (3–5 × 1–2 µm) are allantoid, smooth, and non-amyloid.

### Polyporaceae Fr. ex Corda 1839

*Polyporus arcularius (Batsch) Fr. 1821: New species for Morocco*

Collections of November 30, 2005 and January 25, 2006, 25 April 2018 on rotten wood of *Acacia* sp. (Mamora) (Figure 6). The basidiome is pileate and stipitate. The cap (3–5 cm) is initially hemispherical, then becomes circular and centrally depressed. The surface of the cap is dry, more or less zoned, and covered with compressed, pyramid-shaped scales. It is brown, beige-brown, dark brown, or reddish-brown in color. The margin is initially slightly incurved, then becomes straight. It is thin and ciliate. The flesh (0.1–0.3 cm) is thin, elastic, and white to cream or chamois-colored. The hymenophore is tubular-pored. The tubes (0.5 to 2 mm in height) are subdecurrent to decurrent. The pores (approximately 1 × 1 mm) are broad, hexagonal, and angular.They are initially white, then become cream to chamois-colored, or brown. The stipe (2–5 × 0.3–0.5 cm) is central, equal, straight or sinuous. It is coriaceous and brown to dark brown or blackish in color. The stipe is slightly velvety. The spore print

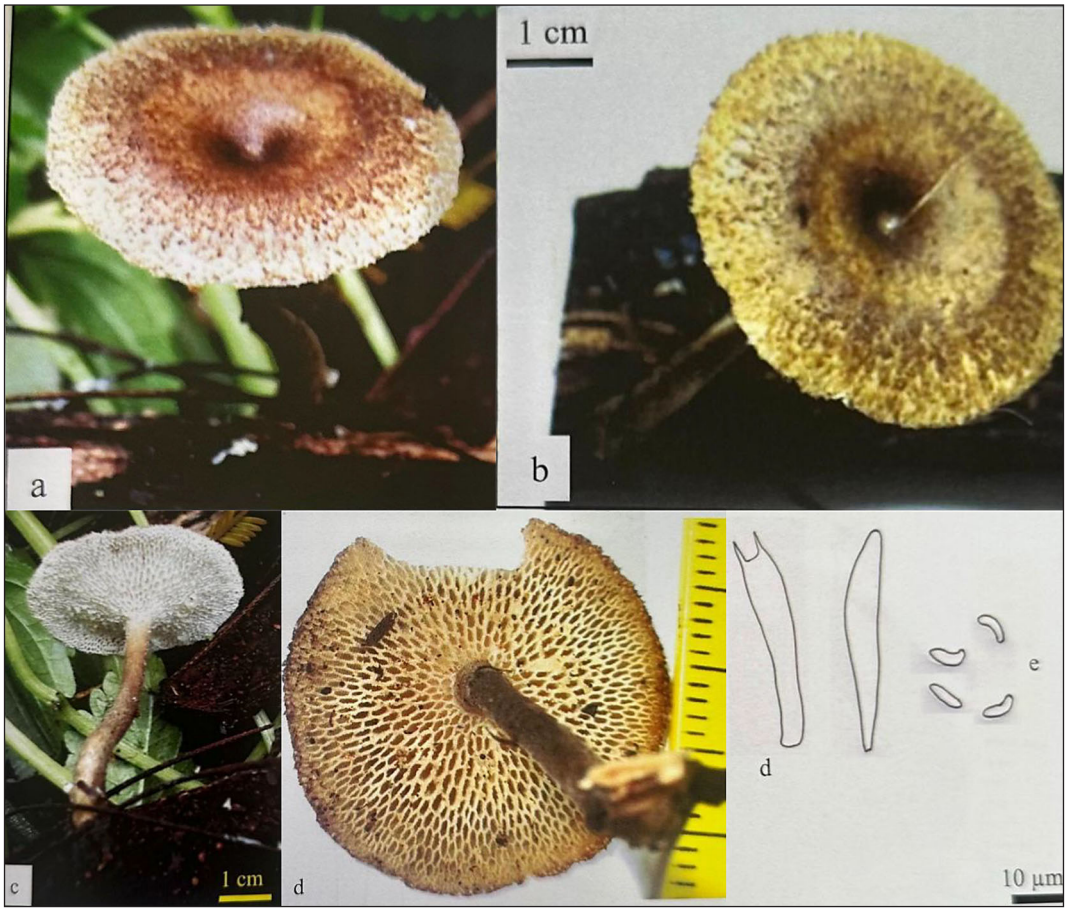


**Figure 6.** *Polyporus arcularius* (Batsch.) Fr.: Basidiom with ochraceous brown cap, zoned and flexuous foot on rotten Acacia wood (a); basidiom with creamy brown cap, zoned and straight foot on rotten Acacia wood; hymenophore with white and decurrent angular pores and sinuous foot (c); cream-coloured hexagonal pores and straight foot (d); basidiospores x 600 (e)

is white. The odor and taste are not perceptible. The basidia (25–35 × 5–6 µm) are clavate, tetrasterigmate, and have a curled base. Cystidia are absent.The basidiospores (7–9 × 2.5–3 µm) are hyaline, smooth, cylindrical, straight to slightly curved, and non-amyloid.

### *Trichaptum fuscoviolaceum (Fr.) Ryvarden 1972: New species for the Moroccan fungus*

Collection on 18 February 2007 in Dardara (Rif) and in December 2010 and 2019, in Mamora (Figure 7). The basidiome (up to 8 cm in length and 3 cm in width) is sessile, often reflexed, and rarely resupinate. It is elastic and tough. The cap may be simple, in clusters, or laterally fused. The cap is fan-shaped and deeply attached to the substrate. The upper surface is beige, grayish-white to brownish. It is undulate, smooth or bumpy, and may or may not be concentrically zoned. The surface is tomentose, strigose, and hirsute in young specimens, becoming glabrous with age. The margin is white to pale brown, thin, acute, entire, laciniate to crenulate, sinuous, and curved when dry.

The flesh (0.2 to 0.3 cm) is thin, elastic, white in the upper part and matching the color of the hymenophore in the lower part. The underside is violet, bright purple to cocoa brown when fresh, and gray-violet, gray-brown, ochraceous to pale brown with age and when dry. It is hydnoid-denticulate. The teeth merge to form plates 1 to 5mm long, arranged in series. The plates are shorter, irregular, elongated, and laciniate. The spore print is white. The hymenium consists of basidia (15–25 × 4.5–6 µm), clavate, with a curled base and four sterigmata. The cystidia (20–35 × 4–9µm) are abundant, clavate to fusiform, with a hyaline wall and topped with a crystalline mass. The spores (6–8.5 × 2.5–3 µm) are allantoid or cylindrical, with a thin wall, smooth, hyaline, and non-amyloid.

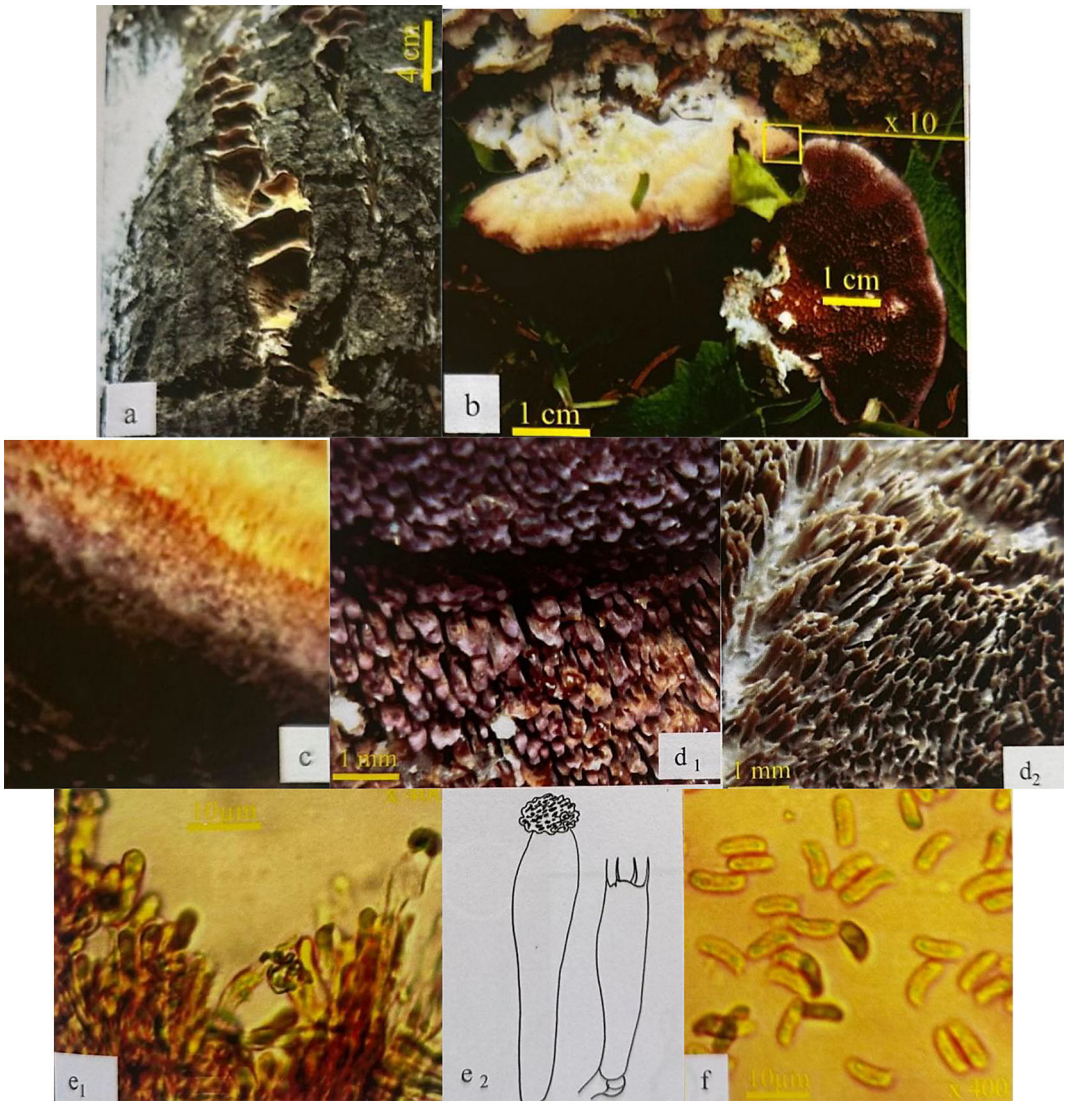


**Figure 7.** *Trichaptum fuscoviolaceum* (Fr.) Ryvarden: Basidiomes on a dead *Quercus suber* tree in Dardara (the Rif) (a); upper surface of a basidiome zoned and wavy and mauve hymenial surface (b); hirsute upper surface (c); mauve irpicoid hymenophore in young individuals (d,) and brownish in old specimens (d2); Hymenium composed of cylindrical basidia, basidiolar bodies and cystidia crowned with a crystalline mass (c) and diagram of a basidium and a cystidia (e2) and cylindro-allantoid spores (f). Microscopic observations were made in iodized water

*Scenidium nitidum (Dur. et Mont.) O. Kuntze (Apoxona nitida (Dur. Et Mont.) Dur. et Mont.) Donk = Hexagona nitida Mont.)*

Collection of April 18, 2007 and 20 April 2018, in the Jâaba forest and of April 14, 2011, in the Khénifra region (Middle Atlas) (Figure 8). The Carpophores of *Scenidium nitidum* (3–10 cm wide, 2–7 cm deep and 1–4 cm thick) are pilate, sessile and console. The pileated surface is smooth, shiny, concentrically furrowed, date brown, warm brown and zoned with dark brown. The hymenium consists of rigid tubes 1–3 cm long; the tubes open by pores (1–3 mm) angular to hexagonal, pale yellow-brown, pale brown then dark brown.

The flesh (3 to 5 mm thick) is leathery, woody, hard, it is pale brown and blackens under the action of KOH (5%). The sporea is white. The spores (9–14 × 3.5–5 um) are hyaline, smooth, long elliptical to cylindrical and non-amyloid.

## Steccherinaceae Parmasato (1968)

*Steccherinum ochraceum (Persoon: Fries) Gray*

Harvest of April 19/2007 to April 28 /2016, in Dardara (the Rif) (Figure 9). The fruiting bodies

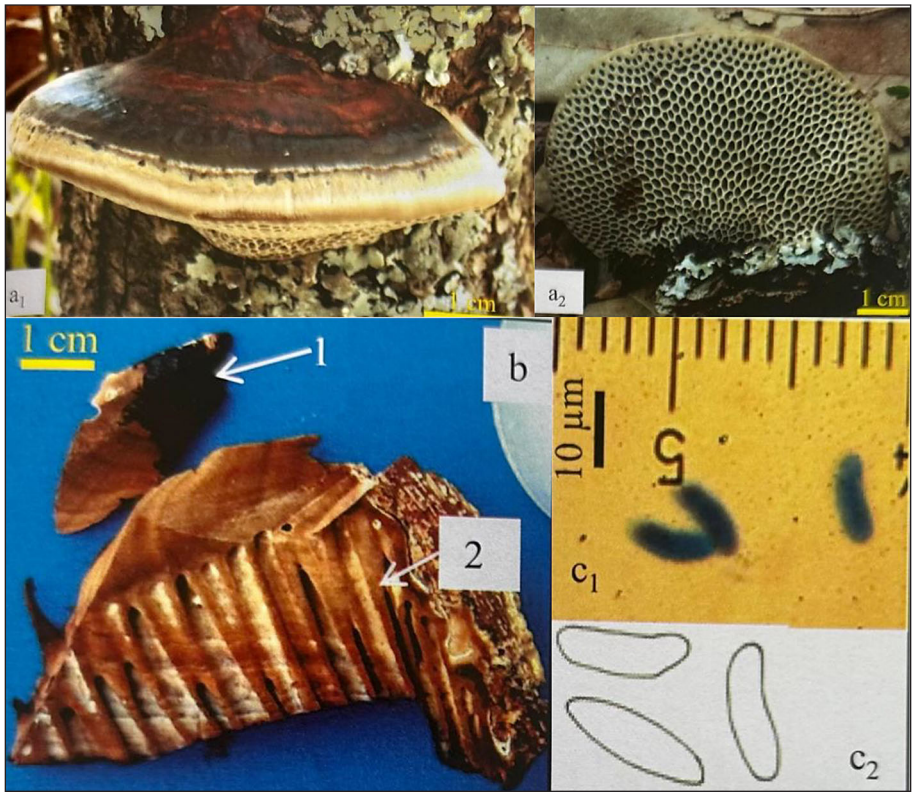


**Figure 8.** *Scenidium nitidum* (Dur. et Mont.) O. Kuntze: Basidiocarp (a,) hymenial surface with hexagonal pores (a2); blue-black coloring of brown flesh, under the effect of ammonia (b,); tubes (02) and spores in cotton blue and diagrams (c, and c2)

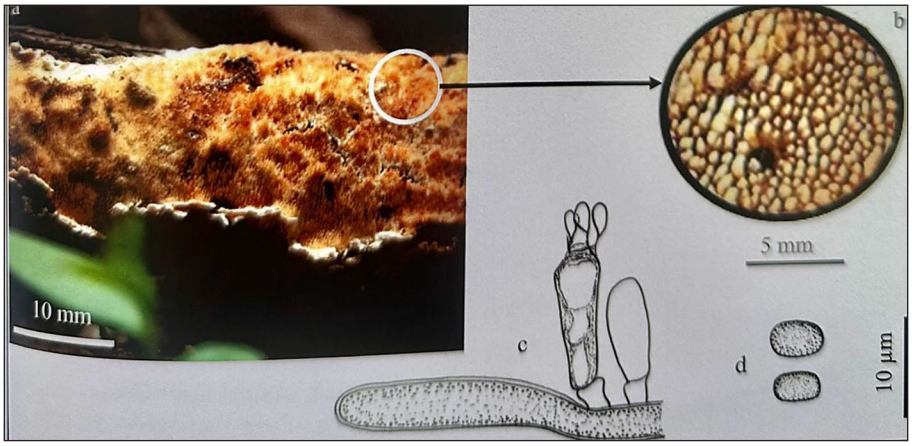


**Figure 9.** *Stecherinum ochraceum* (Persoon: Fries) Gray): Pileated and resupinate carpophore (a); hymenophore with enlarged prickles (b); basidium, cystidium and skeletal hypha (e); spores (d)

of *Steccherinum ochraceum* are semi-pilate or entirely resupinate and 0.5 to 2 mm thick. The upper surface (poorly developed or absent) is velvety or felted and sometimes zoned. It is whitish ochraceous or grayish orange. The margin is whitish, fimbriate and more or less hairy. The flesh is thin and leathery. The hymenophore is made up of spines (0.5–1.5 mm long, with an average of 3 to 5 spines per millimeter) that are thin, orange-yellow or ochre, becoming reddish with age.

The hymenium, of the palisade type, is composed of basidia (16–22 × 5 um) cylindrical to cylindroclavate, bi or tetrasporic and cystidia (12–18 × 4–5 um) cylindrical or fusiform and encrusted. The framework is dimitric composed of curly generative hyphae and skeletal hyphae (7 to 9 um wide) with thick walls. The spores (3.5–4 × 2.5–3 um) are smooth hyaline and ovoid to elliptical.

## DISCUSSION

*Coltricia perennis* (L.) Murrill 1903 (Coltricia, Hymenochaetaceae, Hyménochaetales, Agaricomycetes, Basidiomycotina, Fungi) is known by several different synonyms: *Boletus perennis* 1753, *Polystictus perennis* (L.) Fr. 1879, *Boletus subtomentosus* Bolton 1788, *Boletus cyathiformis* Vill. 1789, *Boletus leucoporus* Holmsk 1790, *Boletus fimbriatus* Roth 1797, *Boletus infundibulum* Roth 1797, *Boletus confluens* Schumach., Enum. pl. (Copenhagen) 1803, *Coltricia connata* Gray 1821, *Polyporus perennis* (L.) Fr. 1821, *Polyporus perennis* (L.) Fr. 1821 var. *perennis, Boletus lejeunii* Marchand 1826, *Boletus perfossus* L. Marchand 1826, *Trametes perennis* (L.) Fr. 1849, *Polyporus scutellatus* Borshch. 1856, *Pelloporus perennis* (L.) Quél. 1886, *Ochroporus perennis* (L.) Schröt (1888), *Xanthochrous perennis* (L.) Pat. 1900, *Microporus perennis* (L.) Kuntze 1898, *Polystictus prolifer* Lloyd 1908, *Pelloporus parvulus* Lázaro Ibiza 1916*, Polystictus decurrens* Lloyd 1908, *Polyporus parvulus* Lázaro Ibiza, (1916) (Kirk *et al.,* 2008).

This species is found in Europe, America, and Australia, and is often associated with conifers, in fire sites (brûlis), and disturbed areas. It is also sometimes considered an ectomycorrhizal species of pine trees (Baar *et al.,* 1997, 1999).

In Morocco, *C. perennis* was previously reported in Tangier by Malençon (1956) and cited by El-Assfouri in 2003, in the Rif Mountains (Malençon and Bertault, 1961; Ait Aguil, 2005), in the Mamora forest (Malençon and Bertault, 1960; El-Assfouri, 2006), and in the Ferjana forest near Lalla Mimouna (Bertault, 1972). We encountered this species in 2006 under *Quercus suber* in the Mamora forest and again in 2009 in the Ferjana forest near Lalla Mimouna. Species of the genus *Coltricia* can be found on the ground or on wood. The basidiocarps of these species typically have central stipes. Their hyphae are monomitic, and the subhymenium may or may not be present. The basidiospores are dextrinoid in some species, and when mature, they turn from golden yellow to rusty brown (Teixeira, 1962). *Hymenochaete tabacina* (Sowerby) Lév. 1846 (Hymenochaetaceae, Hymenochaetales, Incertae sedis, Agaricomycetes, Basidiomycota,Fungi) (Kirk et al., 2008) = *Pseudochaete tabacina* (Sowerby) Wagner and Fisch 2002 = *Auricularia tabacina* Sowerby 1797 = *Daedalea lirellosa* Pers 1828 = *Helvella nicotiana* Bolton 1792 = *Hymenochaete avellana* (Fr.) Lév.1880 = *Hymenochaete badioferruginea* (Mont.) Lev. 1846 = *Hymenochaete nigrescens* Cooke 1890, *Hymenochaete obesa* G. Cunn. 1957 = *Hymenochaete tabacina* (Sowerby) Lév. 1846= *Hymenochaete tabacina* = *Telephora juratensis* Pers, 1822 = *Thelephora tabacia* (Soerby) Ft.1822 is an annual, saprophytic species that grows on dead branches and dead trunks, especially of broadleaf trees (Niemalae *et al.,* 1995). It has been found on dead wood of *Quercus suber* and on dead branches of *Thymelaea lithoïdes* in the Mamora. Previously, the species was reported on cedar in the Rif (Malençon and Bertault, 1960; Ait Aguil, 2005), it is a new species for the Mamora. According to Bessette *et al*., (1997), *H. tabacina* is a complex species that also includes *H. Badioferruginea* (Mont.) Lev.1846. However, in Dictionary of Fungi the two taxa are considered synonyms (Kirk et al., 2008). *H. tabacina* is inedible. It is a lignicolous species, decomposer that causes white rot (Minter, 2006). The genus is distinguished by its annual basidiocarps that are generally resupinate or effusion-reflexed. The hymenial surface is tuberculate. In the majority of species, the hyphal system is dimitric; in some, it is monomitric. The silks are always present. The basidiospores are hyaline and not amyloid (Teixeira, 1962).

*Phellinus torulosus* (Pers.) Bourdot and Galzin = *Fuscoporia t*orulosa (Pers.) Wagner and Fisch (2001) is a polyporoid species of the genus *Phellinus* Quél. 1886 (Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Agaricomycotina) (Hibbett *et al.,* 2007; Kirk *et al.,* 2008). It is a lignicolous and thermophilic species that develop on roots, sometimes at the base of tree trunks, extending up to 2 meters in height (Tomsovsky and Jankovsky, 2007). In Morocco, *P. torulosus* has been reported on several hosts, including *Quercus rotundifolia*, *Suber*, *Eucalyptus globulus*, *Eucalyptus* sp., *Alnus glutinosa*, *Erica arborea*, *Acacia m*ollissima, *Cupressus* sp., *Arbustus unedo* and *Chamaerops humilis*) in the Rif, the Tangier region, the Larache region, Lalla Mimouna, the Mamora forest (Malençon, 1956; Malençon and Bertault, 1960; El-Assfouri, 2003; Ait Aguil, 2005). We encountered *P. torulosus* on *Eucalyptus globulus* in Kenitra, on *Eucalyptus* sp. in the Lalla Mimouna region, and on *Erica arborea* in Bab Taza, Rif. Although *P. torulosus* is a species that grows on a wide host range and its basidiomata can be found on roots as well as trunks,

DNA analysis by Tomsovsky and Jankovsky in 2007 showed that they are the same species.

*P. torulosus* (Pers.) is a phytopathogen that causes white rot of roots and collars of trees and shrubs of many species (Campanile et al., 2004). Basidiocarps of Phellinus species are resupinate, effusion-reflexed, sessile, and perennial or rarely annual. The hymenial surface is poroid and sometimes daedaloid. The hyphal system is dimitic with skeletal hyphae. In some species it is suggested to be monomitic. Setae may or may not be present. In most species, basidiospores are hyaline; in some species, the spores are pigmented but to varying degrees. The spore walls are nonamyloid and generally nondextrinoid.

All species of the genus *Phellinus* are parasites and/or saprophytes on wood and cause white rot (Teixeira, 1962). In its current sense, the definition of the order Hymenochaetales (Incertae sedis, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi) (Kirk *et al.,* 2008) is no longer based on the morphological criteria of its representatives but on molecular phylogeny (Zmitrovich *et al.,* 2006). Indeed, according to Moncalvo *et al.,* (2002), although Hymenochaetaceae are generally represented, species belonging to the Hymenochaetales present significant morphological diversity and different lifestyles. According to Moncalvo *et al.* (2002), some members of the Corticiaceae, Stereaceae, polyporoids, clavarioids of the agarics are phylogenetically related to species of the former order Hymenochaetales and together constitute the same order in its current sense. Thus, this order includes about 600 species that were later classified in the Polyporales, Clavariales and Agaricales (Binder et al., 2005). Hymenochaetales can be saprophytic, parasitic and rarely symbiotic (Larsson et al., 2006). Species of Hymenochaetales are of economic importance. Indeed, some of them are wood decomposers and sometimes cause losses in the forestry sector. Some have therapeutic properties and are commercialized (Larsson *et al.,* 2006; Zmitrovich *et al.,* 2006). The Hymenochaetaceae family, which consists of 27 genera and 487 species (Kirk *et al.,* 2008), includes the species of Hymenochaetales, with basidiocarps that are generally resupinate to pilate. The hymenium of these species, which are generally found on wood, may or may not be poroid (Binder et al., 2005). The three species of Hymenochaetaceae: *Coltricia perennis*, *Hymenochaete tabacina* and *Phellinus torulosus* were described for the first time in Morocco.

**Polyporales Gäum. 1926**

Molecular biology research, based on cladistic analysis of DNA sequences, has allowed the restructuring and redefinition of the order Polyporales which is the equivalent of the polyporoid clade (Hibbett, 2001; Binder *et al.,* 2005; Hibbett *et al.,* 2007).

Although the precise boundaries of the Polyporales order and the families within it still need to be clarified, the Polyporaceae family continues to serve as the core of this order (Hibbett et al., 2007). Additional representatives have been added to this family from other families or orders. For example, species from the Fomitopsidaceae, Meripilaceae, and Ganodermataceae families have been integrated into the Polyporales. Additionally, species of corticioid fungi from the Cystostereaceae, Meruliaceae, Phanerochaetaceae, Xenasmataceae, and Sparassidaceae families are now included in this order (Kirk *et al.,* 2008). The current order of the Polyporales has been thoroughly reorganized and differs from the classification established before the introduction of molecular biology into fungal systematics. All species of Polyporales are lignicolous; most are saprotrophic, many are phytopathogenic, and some species are marketed for therapeutic uses (Lee *et al.,* 2006).

Worldwide, the Polyporales are cosmopolitan and are represented by approximately 1800 species, classified into twelve families and ten other genera of uncertain placement (Incertae sedis) (Sjökvist *et al.,* 2009). Systematic revisions are still ongoing, and it is difficult to estimate the number of Polyporales species present in the Moroccan mycota. The Meruliaceae P. Karst. 1881 (Polyporales, Agaricomycetidae, Basidiomycetes, Basidiomycota) (Kirk *et al.,* 2008) includes species with basidiocarps that are laterally attached to the substrate, flattened, and more or less appressed or incrusted. The hymenial surface of the basidiomata of these species is resupinate and may be irregularly wrinkled, striated, wrinkled, denticulate, or spinose. Their hymenia have cystidia. The basidiospores are hyaline, nonamyloid, and smooth-walled. The hyphae are monomitric (Watson and Dallwitz, 2008). The genus *Phlebia* Fr. 1821 (Meruliaceae) consists of fungi with a cartilaginous or subcartilaginous consistency. The basidiocarps are normally completely resupinate, rarely more or less pileated. The hymenophore may be smooth, tuberculate, phlebioid,

merulioid, or poroid. The hyphae embedded in a gelatinous matrix are thin-walled and pinched at the septa. Cystidia are usually absent; when present, they are thin- or thick-walled and contain crystalline encrustations. The basidia are clavate. The spores are allantoid to ellipsoid, smooth, thin-walled, non-amyloid and non-cyanophilic (Eriksson *et al.,* 1981). The classification of species in this genus is still not well-defined. It was long classified within the Hydnaceae. Some species, and even the genus itself, have been placed in the Corticiaceae, while others have been transferred to the genus *Mycoacia* (Fr.) Donk in the Meruliaceae family. Additionally, some species have been phylogenetically recognized as related to the Strophariaceae (Agaricales) (Hildén, 2008). Species of the genus *Phlebia* are known to cause wood rot (Hildén, 2008). Phlebia tremellosa (Schrad.) Nakasone and Burds. (Meruliaceae, Polyporales, Incertae sedis, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi) (Kirk *et al.,* 2008) is a synonym of Merulius tremellosus Schrad. 1794. P. tremellosa (Schrad.) Nakasone and Burds. is a saprophytic species, solitary or in overlapping clusters, primarily found on dead hardwood, but also on conifer wood, causing white rot (Blanchette et al., 2004). In Morocco, *P. tremellosa* has been reported in the Rif without any precision of locality or substrate (Malençon and Bertault, 1961; 1967 c, d, e, f; Ait Aguil, 2005). It has also been reported in Tangier on *Bucalyptus*, *Pinus* and *Quercus suber* (Malençon and Berault, 1968). We encountered *P. tremellosa* for the first time in the Mamora on the trunk of a dead, decomposing pine tree.

*Polyporus arcularius* (Polyporaceae, Polyporales, Incertae sedis, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi) is found on dead wood of deciduous trees and rarely on conifers (Kuo, 2004). We encountered it only twice on rotten wood of Acacia. Both encounters were carried out in the same station in a suburban garden in the city of Kenitra. The first, on November 30, 2005 and the second, on January 25, 2006.

*P. arcularius* differs from related species by its large, hexagonal pores. *P. brunalis*is characterized by fine, round pores (2–3 pores/mm) and *P. ciliatus* has 5–6 pores/mm.

*P. arcularius* is a dead wood decomposer fungus that causes homogeneous white rot (Kuo, 2004). According to Krüder and Gargas (2004), *P. arcularius*, *P. brunalis* and *P. ciliatus*are phylogenetically related to species of the genus Lentinus (gilled fungi).

*P. arcularius* is a medicinal fungus. Liquid and organic extracts from its mycelium have shown antibacterial activity against *Escherichia coli*, *Salmonella typhimurium*, *Staphylococcus aureus*, and *Bacillus subtilis*. Additionally, polysaccharides extracted from this fungus have demonstrated antitumor activity (Cabrera *et al.* 2002). *Trichaptum Murrill* (1904) which was classified by Donk (1964) in the Polyporaceae consists of species with resupinate or effusion-reflexed basidiocarps. The hymenial surface is generally irpicoid or sometimes poroid. The hyphal system is dimitric, the hyphae are pinched unlike those of the Hymenochaetaceae species which are curly. The cystidia are abundant and the basidiospores are always hyaline and not amyloid. *Trichaptum fuscoviolaceum* (Ehrenb.) Ryvarden 1972 = *Acia hollii* (J.C. Schmidt) P. Karst. 1879, Agaricusdecipiens Willd.1778= *Boletus decipiens* (Willd.) J.F. Gmel., 1792 = *Hirschioporus Juscoviolaceus* (Ehrenb.) Donk1933 = *Hirschioporus fuscoviolaceus* f. hollii (J.C. Schmidt) Bondartsev 1953 = *Hydnum decipiens* (Willd.) Schrad. 1794 = *Hydnum fuscoviolaceum* (Ehrenb.) Fr. 1821 = *Hydnum hollii* (J.C. Schmidt) Fr. 1821 = *Hydnum hollii* var. *carneum* (Ehrenb.) Schltdl. 1824 - *Hydnum hollii* (J.C. Schmidt) Fr. 1821var. *hollii* = *Irpex candidus* (Ehrenb.) Weinm. 1836 = *Irpex fuscoviolaceus* (Ehrenb.) Fr. 1828= *Irper violaceus* (Pers.) Quél. 1888 = *Merulius violaceus* Pers. 1797 = *Odontia hollii* (J.C. Schmidt) Rea 1922 = *Polyporus abietinus* f. fuscoviolaceus (Ehrenb.) D.V. Baxter1946= *Sistotrema carneum* Ehrenb. 1818 = *Sistotrema fuscoviolaceum* Ehrenb. 1818 = *Sistotrema holli* J.C. Schmidt1817 = *Sistotrema violaceum* var. *fuscoviolaceum* (Ehrenb.) Pers. 1825 =*Trametes abietina* var. *fuscoviolacea* (Ehrenb.) Pilát 1939 = *Trichaptum hollii* (J.C. Schmidt) Kreisel 1984 = *Xylodon candidus* Ehrenb. 1818 = *Xylodon fuscoviolaceus* (Ehrenb.) Kuntze 1898 (Polyporaceae, Polyporales, Agaricomycetes, Agaricomycotina, Dikarya, Fungi) (Kirk *et al.,* 2008) is a woody polypore with annual or perennial fruiting. It occurs in large numbers on trunks and dead trees. The species *T. fuscoviolaceum* is primarily reported on the dead wood of conifers (Bordeleau *et al.,* 2005). It can be confused with *Trichaptum abietinum* (Dicks: Fries) Ryvarden 1972. Indeed, both species share similar habitats and almost identical macroscopic and microscopic characteristics. However, they differ in their hymenophore.

*T. fuscoviolaceum* has an irpicoid hymenophore, which is similar to that of hydnoid fungi, while *T. abietinum* has a tubular-poroid hymenophore. The pores of *T. abietinum* are entire, laciniate, and spacious (Courtecuisse and Duhem, 2000). It is an important decomposer as a saprophytic species. However, it can also attack living trees, causing white rot in these trees (Bordeleau *et al.,* 2005). *T. fuscoviolaceum* is not edible, as its fruiting bodies are very tough. This species had not been reported in previous studies in Morocco and had never been noted on *Quercus suber*. It is a new species for the Moroccan mycota and a new host for *T. fuscoviolaceum*. We encountered it in both the Rif and Mamora regions. In Morocco, no studies or descriptions had previously been made for this Mediterranean species (Courtecuisse and Duhem, 2000). Under the name *Hexagona nitida* Durieu et Mon., *S. nitidum* was reported by Malençon 1956, 1960 1967a, b, c, d, 1968 and El-Assfouri in 2006, on oaks in the Rif and Middle Atlas regions. We encountered *S. nitidum* in the Middle Atlas. The first observation was on April 18, 2007, on *Quercus faginea* in the Jâaba Forest (Ifrane region), and the second on April 17, 2011, on *Q. rotundifolia* near the sources of Oum Rabia in the Khénifra region. Courtecuisse and Duhem (2000), based on the type of hymenium and basidiome, subdivide species of the Aphyllophoromycetideae into five morphological groups: Corticioid, Polyporoid, Hydnoid, Clavarioid, and Cantharelloides. In this classification, *Scenidium nitidum* is placed among the Polyporoid species. Gerault (2006), while highlighting the distinct position of this genus, reclassified *Scenidium* into the Scutigeraceae family (Bondartsev and Singer, 1941), within the order Poriales. These are separated from other orders in the former Polyporales. In the tenth edition of Index Fungorum, species of the genus *Scenidium* are scattered across several families: Polyporaceae, Hymenochaetaceae, Fomitopsidaceae, and Aporpiaceae. *Apoxona nitida* (Dur. et Mont.) Donk is classified in the Polyporaceae family, within the order Polyporales (Kirk et al., 2008). *Scenidium nitidum* is a thermophilic species found on oaks (Courtecuisse and Duhem, 2000). It degrades the lignin in wood, causing white rot in the host plants (Gerault, 2006). The Steccherinaceae (Polyporales) (Kirk et al., 2008) are homobasidiomycetes that live as saprophytes or parasites on wood. The fruiting bodies of the species in this family are typically flattened or appressed, sometimes even incrusted into the substrate. The hyphal system is dimitic. The hymenium, oriented outward, is often incrusted or resupinate and can be wrinkled, grooved, or ridged. Cystidia are present, and the spores are of the ballistospore type, non-amyloid, and have smooth walls. Steccherinaceae, which were previously classified in the order Stereales, are represented by 106 species across 14 genera (Watson and Dallwitz, 2008). The taxa composing the genus *Steccherinum* Gray (1821) are essentially characterized by a hydnoid morphology developing on the wood with a coriaceous, resupinate, dimidiate or stipitate piliate basidiom and an aculeolate hymenophore with very dense, fine and generally orange-pink or ochraceous points (Romagnesi, 1995; Courtecuisse and Duhem, 2000). As for Macromycetes in general, the genera of Aphyllophoromycetideae and the species composing them are constantly reworked in the systematics. Thus, the genus *Steccherinum* is constantly moved from one family to another and even from one order to another, the different synonyms testify to this uncertain systematic position. Among the families in which this genus is classified; Corticiaceae (under the name) Odontia Fr. (Lanier *et al.,* 1978), Hydnaceae (with the name Mycoleptodon Pat.), these two families being classified in the order Aphyllophorales. Courtecuisse and Duhem (2000), likely due to the ongoing reorganization of fungal systematics, used general terms and classified *Steccherinum* among the hydnoid species. Recently, *Steccherinum* has been placed in the Steccherinaceae family (Parmasto, 1968), within the order Poriales (Gerault, 2006). In the same edition of the Dictionary of Fungi (Kirk *et al.,* 2008), *Steccherinum* is classified under two families: *Steccherinaceae* and *Meruliaceae*. Both families are grouped within the order *Polyporales* (Incertae sedis, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi). The family of this genus has not yet been definitively established, and it is retained in its original family, *Steccherinaceae*. In Morocco, three representatives of the genus Mycoleptodon are reported in the bulletins and reports of the Scientific Institute: *Mycoleptodon dichroum* sensu Bourdot and Galzin (1927), *Mycoleptodon fimbriatum*(Pers.) Bourdot and Galzin (1914), and *Mycoleptodon ochraceum* (Pers.) Bourdot and Galzin (1900). These species have been encountered in the forests of the Northwest, in the Rif, Middle Atlas, and Tazekka (Taza) regions. These collections were made on *Quercus suber*, on dead wood of *Q. suber*, on burned wood of *Q. faginea*, *I. rotundifolia*, *Arbutus unedo*, *Crataegus*

*monogyna*, and on various twigs (Malençon and Bertault, 1956, 1961, 1967). The specimens of *M. ochraceum* we studied were found on dead branches of *Quercus suber* in Dardara (Rif). *M. ochraceum* is a non-edible species that causes white rot in wood (Gerault, 2006).

## CONCLUSIONS

In this study, eight species from the Hymenochaetales and Polyporales were examined. These species were encountered in various regions surveyed:

- In the Mamora Forest – *Coltricia perennis*, *Hymenochaete tabacina*, *Phlebia tremellosa*, *Polyporus arcularius*, and *Trichaptum fuscoviolaceum*.
- In the Lalla Mimouna region – *Phellinus torulosus*.
- In the Rif – *Phellinus toru*losus, *Steccherinum ochr*aceum, and *Trichaptum fuscoviolaceum*.
- In the Middle Atlas – *Scenidium nitidum*.

Two of these species, *Polyporus arcularius* (Batsch) Fr. and *Trichaptum fuscoviolaceum* (Fr.) Ryvarden, are new to their regions and to Morocco.

This study not only adds new species to the Moroccan mycobiota, but also reveals distinct biogeographic patterns and possible endemism or habitat preference and highlights the richness of Moroccan forest ecosystems and their importance as reservoirs of fungal diversity.

### Acknowledgements

We would like to thank Professor Douira Allal for providing the necessary facilities, as well as for his assistance and valuable contributions throughout the preparation of this manuscript.

## REFERENCES

1. Ait Aguil, F. (2005). *Contribution à l'étude de la biodiversité de la flore fongique des forêts marocaines: Cas des Basidiomycètes du Rif Oriental et du Rif Occidental et des Gasteromycètes de la Mamora.* Doctoral thesis, Ibn Tofail University, Faculty of Sciences, Kenitra, Morocco. 127.
2. Ajana, M., El Kholfy, S., Ouabbou, A., Nmichi, A., Ouazzani Touhami, A., Benkirane, R., Douira, A. (2020a). Study of *Panaeolussemiovatus* (Sowerby) S. Lundell and Nannf., (1938), a fungus coprophilous. *Plant Archives, 20*(1), 1856–1858.
3. Ajana, M., El-Assfouri, A., El Kholfy, S., Nmichi, A., Ouazzani Touhami, A., Benkirane, R., Douira, A. (2020b). A new decomposer of *Quercus Suber* (Morocco): *Gymnopilus liquiritiae* (Pers.) P. Karsten (1879). *Plant Archives, 20*(1), 2311–2312.
4. Alem, D., Dejene, T., Oria-de-Rueda, J.A., Martín-Pinto, P. (2021). Survey of macrofungal diversity and analysis of edaphic factors influencing the fungal community of church forests in Dry Afromontane areas of Northern Ethiopia. *For. Ecol. Manag., 496*, 119391. https://doi.org/10.1016/j.foreco.2021.119391
5. Baar, J., Comini, B., Oude Elferink, M., Kuyper, Th.W. (1997). Performance of four ectomycorrhizal fungi on organic and inorganic nitrogen sources. *Mycological Research, 101*(5), 523–529. https://doi.org/10.1017/S0953756296002912
6. Baar, J., Horton, T.R., Kretzer, A.M., Bruns, T.D. (1999). Mycorrhizal colonization of *Pinusmuricatafrom* resistant propagules after a stand-replacing wildfire. *New Phytol, 143*, 409–418. https://doi.org/10.1046/j.1469-8137.1999.00452.x
7. Berglund, H., Jonsson, M.T., Penttil, R., Vanha-Majamaa, I. (2011). The effects of burning and deadwood creation on the diversity of pioneer wood-inhabiting fungi in managed boreal spruce forests. *For. Ecol. Manag., 261*, 1293–1305. https://doi.org/10.1016/j.foreco.2011.01.008
8. Bertault, R. (1972). Centre de Tanger : Excursions à Cherf-el-Akab, Perdicaris, à la Cuesta Colorada, El-Araïch, Khmis-de-Sahel, Jbel Kbir, et forêt de Ferjana. Comptes redus mensuels des Séances de la Société des Sciences Naturelles et physiques du Maroc. T. 38, *Presses des éditions Marocaines et Internationales, Tanger, Maroc*, 121–145.
9. Bessette, A.E., Bessette, A.R., Fischer, D.W. (1997). *Mushrooms of Northeastern North America, Arleen R.* Bessette Natural history Ed.Syracuse University Press, 582.
10. Binder., M., Hibbett, D.S., Larsson, K.H., Larsson, E, et al. (2005). The phylogenetic distribution of resupinate forms across the major clades of mushroom-forming fungi (Homobasidiomycetes). *Systematics and Biodiversity, 3*, 113–157.
11. Blanchette, R.A., Obst, J.R., Timell, T.E. (2004). Biodegradation of compression wood and tension wood by white and brown rot Fungi. *Holzforschung, 48*, 34–42.
12. Bondartsev, A.S., Singer, R. (1941). Zur Systematik der Polyporaceen. *Annales Mycologici*, 39(1), 43–65.
13. Bordeleau, C., Fortin, J., Gagnon, G., Innes, L., Lachance, C., Marchand, L., Morneau, L., Paré, D., Prémont, M., Simard, S. (2005). *Insectes, maladies et feu des forêts Québécoises en 2005. Ministère des ressources naturelles et de la faune*. Direction de la protection des forêts, Services des relevés et

des diagnostics, Québec.

14. Bouchar, A., Sellal, Z., Maazouzi, S., Msairi, S., El Kholfy, S., Benkirane, R., Ouazzani Touhami, A., Douira, A. (2023). Inventory of Corticolous Lichens and Argan Wood Fungi. In J. Kacprzyk, M. Ezziyyani; V. E. Balas (Eds.), International Conference on Advanced Intelligent Systems for Sustainable Development. AI2SD 2022 (Lecture Notes in Networks and Systems, 713. 575–583). Springer, Cham. https://doi.org/10.1007/978-3-031-35248-5_47
15. Cabrera, G.M., Roberti, M., Wright, J.E., Seldes, A.M. (2002). Cryptoporic and isocryptoporic acids from the fungal cultures of *Polyporus arcularius* and *P. ciliatus. Phytochemistry, 61*(2), 189–19. https://doi.org/10.1016/S0031-9422(02)00221-2
16. Campanile, G., Luisi, N. (2004). The occurrence of *Phellinus torulosus* in Apulia and Basilicata (Southern Italy): identification of isolates by morphologic, microscopic, and molecular means. *Phytopathologia Mediterranea, 43*(2), 289–298. https://doi.org/10.14601/Phytopathol_Mediterr-1757
17. Chung, C.L., Lee, T.J., Akiba, M., Lee, H.H., Kuo, T.H., Liu, D., Ke, H.M., Yokoi, T., Roa M.B., J Lu, M.Y., Chang, Y.Y., Ann, P.J., Tsai J.N., Chen C.Y., Tzean, S.S., Ota, Y., Hattori, T., Sahashi, N., Liou, R.F., Kikuchi, T., J Tsai, I. (2017). Comparative and population genomic landscape of Phellinus noxious: a hypervariable fungus causing root rot in trees. *Mol. Ecol, 26*, 6301–6316. https://doi.org/10.1111/mec.14359
18. Courtecuisse, R., Duhem, B. (2000). *Guide des champignons de France et d'Europe.* Delachaux and Niestlé S.A. Lausane (Switzerlande), 409.
19. Dai, Y.C. (2010). Hymenochaetaceae (Basidiomycota) in China. *Fungal Diversity 45*, 131–343. https://doi.org/10.1007/s13225-010-0066-9
20. Donk, M.A. (1964). The conspectus of the families of the Aplyllophorales. *Persoonia 3*, 199–324.
21. El-Assfouri, A. (2006). *Biodiversité fongiquedu Maroc: Etudedes Basidiomycètesde la forêt dela Mamora.* Doctoral thesis, Université Ibn Tofail, Faculté des Sciences, Kénitra, Morocco, 251.
22. El-Assfouri, A., Ouazzani Touhami, A., Fennane, M., Douira, A. (2003). Inventory of fungal specimens in the National Herbarium of the Rabat Scientific Institute. *Bulletin de l'Institut Scientifique, Rabat, Maroc, section Sciences de la vie, 25*, 1–23.
23. El-Assfouri, A., Ouazzani Touhami, A., Douira, A. (2024). *A New Mycorrhizal Association of Quercus suber (Morocco): Lactarius glaucescens Crossl., 1900*. In: Ezziyyani, M., Kacprzyk, J., Balas, V.E. (eds) International Conference on Advanced Intelligent Systems for Sustainable Development (AI2SD '2023). AI2SD 2023. Reading Notes in Networks and Systems, vol. 930. Springer, Cham. https://doi.org/10.1007/978-3-031-54318-0_1
24. El-Assfouri A., Ouazzani Touhami A. , Douira A. (2025a). *Rediscovery and Typification of Amanita From the Cork Groves of Morocco. Book chapter in Obstacles Facing Hydrogen Green Systems and Green Energy*, ed. Jamal Mabrouki 393–408. IGI GLOBAL https://www.igi-global.com/chapter/rediscovery-and-typification-of-amanita-from-the-cork-groves-of-morocco/379754
25. El-Assfouri, A., Rahou, E.h., Bouchar, A., Ouazzani Touhami, A., Douira, A. (2025b). *The New Taxa of Basidiomycetes from the Moroccan Rif.* In: Ezziyyani, M., Kacprzyk, J., Balas, V.E. (eds) International Conference on Advanced Intelligent Systems for Sustainable Development (AI2SD 2024). AI2SD 2024. Lecture Notes in Networks and Systems, 1402. Springer, Cham. https://doi.org/10.1007/978-3-031-91334-1_59
26. El Kholfy, S., Nmichi, A., Bouchar, A., Belahbib, N., Ouazzani Touhami, A., Douira, A. (2021a). First report of *Mycena haematopus* (Pers.) P. Kumm., Führ. Pilzk. (Zerbst) for the fungal flora of Mamora (Morocco). *Plant Cell Biotechnology and Molecular Biology, 22*(21–22), 34–37.
27. El Kholfy, S., Nmichi, A., Bouchar, A., Ouabbou, A., Ouazzani Touhami, A., Douira, A. (2021b). Study of three species of Basidiomycetes of the genus *Bolbitius*, two news for the fungal diversity of Morocco: *Bolbitius grandiusculus* and *Bolbitius lacteus*. *Plant Cell Biotechnology and Molecular Biology, 22*(43–44), 62–6.
28. Eriksson, J., Hjortstam, K., Ryvarden, L. (1981). *The Corticiaceae of North Europe vol. 6: Phlebia–Sarcodontia.* Fungiflora, Norway.
29. Fiasson, J.L., Niemelä, T. (1984). The Hymenochaetales: a revision of the European poroid taxa. *Karstenia, 24*, 14–28.
30. Gerault, A. (2006). *Homobasidiomycètes, Hymenochaetales, Lachnocladiales, Ganodermatales, Poriales, Polyporales, Schizophyllales, Florule évolutive des Finistère*. V2, Site web :Basidiomycotina du projet.aulnaies.free.fr/Florules/Agaricales.pdf, 63.
31. Gibertoni, T.B., Medeiros, P.S., Soares, A.M.S., Gomes-Silva, A.C., J.P. Santos, P., M.P. Sotão, H., V. Ferreira, L., Savino, E. (2016). The distribution of polypore fungi in endemism centres in Brazilian Amazonia. *Fungal Ecology, 20*, 1–6. https://doi.org/10.1016/j.funeco.2015.09.012
32. Hage, H., Miyauchi, S., Virágh, M., Drula, E.,…., Rosso, M.N. (2021). Gene family expansions and transcriptome signatures uncover fungal adaptations to wood decay. Environ. *Microbiol, 23*, 5716–5732. https://doi.org/ 10.1111/1462-2920.15423
33. Hibbett, D.S., Thorn, R.G. (2001). *Basidiomycota: Homobasidiomycètes* In: Mc Laughlin D.J, Mc Laughlin E.J., Lemke P.A. (eds.). The Mycota vol. VII, Part B., Systematics and Evolution. Springer

Verlag, Berlin, pp 121–168.

34. Hibbett, D.S. (2007). *Agaricomycotina, Jelly Fungi, Yeasts and Mushrooms, Version* 20 April 2007.
35. Hildén, K.S., Bortfeldt, R., Hofrichter, M., Hatakka, A., K Lundell, T. (2008). Molecular characterization of the Basidiomycete isolate *Nematoloma frowardii* b19 and its manganese peroxidase places the Fungus in the corticioid genus *Phlebia*. *Mycrobiology, 154*, 2371–2379. https://doi.org/10.1099/mic.0.2008/018747-0
36. Hjortstam, K., Ryvarden, L. (2004). Some new and noteworthy corticioid fungi (Basidiomycotina, Aphyllophorales) from Japan. *Synopsis Fungorum, 18*, 8–13.
37. Huang, C., Wu, X., Liu, X., Fang, Y., et al. (2022). Functional fungal communities dominate wood decomposition and are modified by wood traits in a subtropical forest. *Sci. Total Environ. 806*, 151377. https://doi.org/10.1016/j.scitotenv.2021.151377
38. Id Elhakkar, N., Outcoumit, A., Selmaoui, S., Mouden, N., El Alaoui, M.A., Ouazzani Touhami, A., Douira, A. (2025a). *Study of Some Fungicolous Fungi in Morocco. Book chapter in Technical Innovation and Modelling in the Biological Sciences*, ed. Jamal Mabrouki, 503–520. IG Global. https://www.igi-global.com/chapter/study-of-some-fungicolous-fungi-in-morocco/378420
39. Id Elhakkar, A., Bouchar, A., Outcoumit, A., El Gabardi, S., El Assfouri, A., Selmaoui, K., El Alaoui, M.A., Ouazzani Touhami, A., Douira, A., (2025b). *Contribution to the Study of Some Gasteroid Macromycetes Species of Morocco. Book chapter in Obstacles Facing Hydrogen Green Systems and Green Energy,* ed. Jamal Mabrouki, 85–98. IGI GLOBAL, https://www.igi-global.com/chapter/contribution-to-the-study-of-some-gasteroid-macromycetes-species-of-morocco/379737
40. Kirk, P.M., Cannon, P.F., Minter, D.W., Stalpers, J.A. (2008). *Ainsworth & Bisby's Dictionary of the Fungi. 10th edn.* Wallingford: CAB International.
41. Krüder, D., Gargas, A. (2004). The Basidiomycete genus Polyporus - an emendation based on phylogeny and putative secondary structure of ribosomal RNA. University of Wisconsin, Botany Department, Madison molecules. *Feddes Repertorium, 115*: 7–8
42. Kuo, M. (2004). *Polyporales: The polypores, retrieved from the Mushroom Expert*. Com Web site: http://www.mushroomexpert.com/polyporales.html. *Amanita vaginata*. Retrieved from the Mushroom Expert.
43. Lanier, L., Joly, P., Bondoux, P., Belemtre, A. (1978). *Mycologie et pathologie forestière.* Tome 1, Masson, Paris, New York, Barcelone, Milan, 487.
44. Larsson, K.H., Parmasto, E., Fischer, M., Langer, E., Nakasone, K.K., Redhead, S.A. (2006). Hymenochaetales, a molecular phylogeny for the hymenochaetoid clade. *Mycologia, 98*, 926–936. https://doi.org/ 10.3852/mycologia.98.6.926
45. Lee, J.S., Lim, M.O., Cho, K.Y., Chang, S.Y., Nam, D.H. (2006). Identification of medicinal mushroom species based on nuclear large subunit rDNA sequences. *Microbial, 44*(1), 29–34. https://doi.org/2340
46. Liu, S., Chen, Y.Y., Sun, Y.F., He, X.L., Song, C.G., Si, J., Liu, D.M., Gates, G., Cui B.K. (2023). Systematic classification and phylogenetic relationships of the brown rot fungi within the Polyporales. *Fungal Diversity 118*, 1–94. https://doi.org/10.1007/s13225-022-00511-2.
47. Lotfi, N., El Kholfy, S., Ajana, M., Nmichi, A., El Assfouri, A., Ouabbou, A., Ouazzani Touhami, A., Benkirane, R., Douira, A. (2019). Some data on the almost permanent presence of *Volvariella bombycina* (schaeff.) singer (1951) in the forest of Mamora (Morocco). *Plant Archives, 19*(2), 3050–3052.
48. Lotfi, N., El Kholfy, S., Bouchar, A., Nmichi, A., Outcoumit, A., Selmaoui, K., Ouazzani Touhami, A., Benkirane, R., Douira, A. (2020). *Lepiota pseudofelina* J.E. Lange ex J.E. Lange, A new fungal taxon in Morocco. *Plant Cell Biotechnology and Molecular Biology, 21*(7& 8), 1–5.
49. Malençon, G., Bertault, R. (1960). *Champignons de la région de Tanger, feme liste de Tanger. Comptes rendus de la Société des Sciences Naturelles et Physiques du Maroc.* Publication de l'Institut Scientifique Chérifien, Rabat, Maroc, tome, 26, 6, 99–102.
50. Malençon, G., Bertault, R. (1961). *Champignons du Rif, 8ème liste de Tanger. Comptes rendus de la Société des Sciences Naturelles et Physiques, T. 27,* Institut Scientifique, Rabat, Maroc. 141–145.
51. Malençon, G., Bertault, R. (1967a). *Champignons de la région de Tanger: Neuvième liste. Bulletin de la Société des Sciences Naturelles et Physiques du Maroc*. Tome 47, 3ème et 4ème Trimestres, 238–239.
52. Malençon, G., Bertault, R. (1967b). *Champignons du Rif: Neuvième liste.* C. R. de la Société des Sciences Naturelles et Physiques du Maroc. Tome, 47, 251–253.
53. Malençon, G., Bertault, R. (1967c). Champignons du Plateau central et des subéraies de la Meseta : Première liste. *Bulletin de la Société des Sciences Naturelles et Physiques du Maroc. Tome 47*, 3ème et 4ème Trimèstre,: 271.
54. Malençon, G., Bertault, R. (1967d). *Champignons du Moyen Atlas : Cinquième liste.* C. R. de la Société des Sciences Naturelles et Physiques du Maroc. Tome, 47, 259–270.
55. Malençon, G., Bertault, R. (1968). Champignon de la région de Tanger et de Larache (9ème liste de Tanger et 1ère liste de Larache). *Bulletin de la Société des Sciences Naturelles et Physiques du Maroc, Rabat, T 47*, 237–250.

56. Malençon, G., Bertault, R. (1956). *Champignonssupérieursde larégion de Tanger:2me liste de Tanger.* Comptes rendus mensuels des séances de la société des Sciences naturelles et Physiques du Maroc. T. XXII, 5, 86–89.
57. Malençon, G. (1955). Le développement du *Torrendia pulchella* Bres, et son importance morphogénétique. *Revue de Mycologie.* (Paris) 20, 81–130.
58. Miettinen, O., Larsson, E., Sjökvist, E., Larsson, K.H. (2012). Comprehensive taxon sampling reveals unaccounted diversity and morphological plasticity in a group of dimitic polypores (Polyporales, Basidiomycota). *Cladistics, 28*, 251–270. https://doi.org/ 10.1111/j.1096-0031.2011.00380.x
59. Miettinen, R., Riley, K., Barry, D., Cullen, R.P., deVries, M., Hainaut, M., Hatakka, A.,…, Hibbett, D.S. (2016). Draft genome sequence of the white-rot fungus *Obba rivulosa* 3A-2. *Genome Announc, 4*(5), 00976-16. https://doi.org/10.1128/genomea.00976-16
60. Minter, D.W. (2006). Fungi on Quercus. Version 1.00. www.cybertruffle.org.uk/querfung.
61. Moncalvo, J.M., Vilgalys, R., Redhead, S.A., Johnson, J.E., James, T.Y., Aime, M.C., Hofstetter, V., J W Verduin, S., Larsson, E., J Baroni, T., Thorn, R.G., Jacobsson, S., Clémençon, H., K Miller Jr, O. (2002). One hundred and seventeenclades of euagarics. *Cladistics, 23*, 357–400. https://doi.org/10.1016/S1055-7903(02)00027-1
62. Niemalae, T., Renvall, P., Penttilae, R. (1995). Interaction of fungi at late stages of wood decomposition. *Annales Botanici Fennici, 32*(3), 141–152.
63. Nmichi, A., El Kholfy, S., Imrani, N., Belahbib, N., Ouazzani Touhami, A., Douira, A. (2021). Two new species of basidiomycetes for fungal diversity in Morocco: Cortinarius saturninus and Cortinarius leucopus. *Plant Cell Biotechnology and Molecular Biology, 22*(25–26), 72–78.
64. Palviainen, M., Finer, L., Laiho, R., Shorohova, E., Kapitsa, E., Vanha-Majamaa, I. (2010). Carbon and nitrogen release from decomposing Scots pine, Norway spruce and silver Forest Ecosystems 11 (2024) 100200 birch stumps. *For. Ecol. Manag. 259*, 390–398. https://doi.org/10.1016/ j. foreco. 2009.10.034
65. Parmasto, E. (1968). Conspectus systematis corticiacearum. Institutum zoologicum et botanicum Academiae scientiarum R.P.S.S. *Estonicae*, 229–244.
66. Riley, R., Salamov, A.A., Brown, D.W., Nagy, L.G.,…., Grigoriev, I.V. (2014). Extensive sampling of basidiomycete genomes demonstrates inadequacy of the white-rot/brown-rot paradigm for wood decay fungi. *Proc. Natl. Acad. Sci. Unit. States Am., 111*, 9923–9928. https://doi.org/10.1073/pnas.1400592111
67. Romagnesi, H. (1995). *Atlas des champignons d'Europe, ouvrage publié sous le patronage de la société Mycologique de France*, éd. Bordas, Paris, 290.
68. Sjökvist, E., Larsson, E., Larsoon, K.H. (2009). *A multi-locus phylogeny of the Polyporales 'Abstract'.* Abstract Book, Botany and Mycology, Snowbird, Utah. 25–29.
69. Teixeira, A.R. (1962). The taxonomy of the Polyporacee. *Biol. Rev., 37*, 51–81.
70. Tomšovsky, M., Jankovsky, L. (2007). DNA sequence analysis of extraordinary fruiting specimens of *Fuscoporia torulosa* (Phellinustorulosus) on *Pyrus* spp. *Czech Mycol., 59*(1), 91–99
71. Wang, X.W., Liu, S.L., Zhou, L.W. (2023). An updated taxonomic framework of Hymenochaetales (Agaricomycetes, Basidiomycota). *Mycosphere 14*(1), 452–496, https://doi.org/ 10.5943/mycosphere/14/1/6
72. Watson, L., Dallwitz, M.J. (2008). The Families of Mushrooms and Toadstools Represented in the British Isles, version 2011.
73. Wu, F., Man, X.W., Tohtirjap, A., Dai, Y.C. (2022a). A comparison of polypore funga and species composition in forest ecosystems of China, North America, and Europe. *For. Ecosyst, 9*, 100051. https://doi.org/10.1016/j.fecs.2022.100051
74. Wu, F., Zhou, L.W., Vlasak, J., Dai, Y.C. (2022b). Global diversity and systematics of Hymenochaetaceae with poroid hymenophore. *Fungal Divers, 113*, 1–192. https:// doi.org/10.1007/s13225-021-00496-4
75. Yu, L., Taihui, L., Zhuliang, Y. (2025). *Atlas of Chinese Macrofungal Resources: Volume 2: Polyporoid, Hydnaceous and Thelephoroid Fungi*. Ed. Springer Nature, Central China publishinf House, 305.
76. Zmitrovich, I.V., Malysheva, V.F., Spirin, W.A.A. (2006). New morphological arrangement of the Polyporales, Phanerochaetineae. *Mycena, 6*, 4–56.