



Midterm Report

Exploring Macrofungal Diversity of Sacred Forests in Benin: Challenges and Perspectives for Conservation



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Executive Summary

Sacred forests represent some of the last refuges of biodiversity in West Africa, playing a critical role in the conservation of biodiversity, traditional knowledge, and culturally protected ecosystems. In Benin, these forests are increasingly threatened by anthropogenic pressures and the progressive erosion of traditional belief systems. While plants and animals have received growing conservation attention, fungi remain largely undocumented and neglected despite their essential ecological functions in nutrient cycling, symbiotic interactions, and ecosystem resilience. This project aimed to improve scientific knowledge, community awareness, and conservation planning for macrofungi in the sacred forests of Ewe-Adakplamé and Kperoussogbé through ecological inventories, ethnomycological surveys, and participatory conservation approaches.

Field inventories were conducted during the from July to November 2025 using systematic transects, permanent plots, and opportunistic sampling. A total of 132 field visits were completed, resulting in the collection of 167 specimens and the identification of 126 macrofungal species distributed across 52 genera and 31 families. The fungal communities showed strong ecological contrasts between the two forests. Ewe-Adakplamé was characterized mainly by saprotrophic fungi, whereas Kperoussogbé supported a richer ectomycorrhizal community. The project also generated 2,399 georeferenced occurrence records currently being standardized for publication on the Global Biodiversity Information Facility (GBIF), representing the first fungal occurrence dataset from sacred forests in Benin. These data significantly improve the representation of African fungal diversity in global biodiversity databases and provide an essential baseline for future ecological studies and fungal conservation planning.

Alongside the field inventories, ethnomycological surveys were conducted with 300 informants across the villages of Ewe, Adakplamé, and Sinaissiré. Results revealed extensive traditional knowledge related to edible, medicinal, and culturally important fungi. Species belonging to genera such as *Termitomyces*, *Lactifluus*, *Lentinus*, and *Candolleomyces* were highly valued for food and medicinal uses. However, the study highlighted a progressive erosion of traditional knowledge, with many respondents reporting limited transmission of fungal knowledge to younger generations. Most respondents also perceived a decline in fungal abundance and diversity linked to habitat degradation and climate change.

From a conservation perspective, the project identified multiple threats affecting fungal communities and their habitats, including agricultural expansion, deforestation, charcoal production, illegal grazing, gold mining, destruction of termite mounds, uncontrolled fires, and firewood collection. These pressures are intensified by the weakening of customary rules and sacred forest protection systems due to changing cultural and religious dynamics. To address these challenges, the project proposed a set of tailored conservation strategies combining ecological and socio-cultural approaches. These include strengthening community-based forest protection, restoring traditional conservation values and taboos, promoting agroecological practices, and supporting alternative livelihoods such as mushroom cultivation and beekeeping.

Outcome 1: Strengthened scientific insight into macrofungal diversity in the EweAdakplame and Kpéroussobé sacred forests, with occurrences data published on GBIF.

Field inventories were conducted during the mycological season from July to November across a range of microhabitats in the Ewe-Adakplamé (Guineo-Congolean region, coordinates 7.451–7.478 N and 2.558–2.585 E) and Kperoussogbé (Sudano-Guinean region, coordinates 10.064–10.078 N and 1.497–1.506 E) sacred forests (Figure 1). Ewe-Adakplamé is one of the last remnants of tropical rainforest, where the Rubiaceae family is the richest in species, followed by Fabaceae. In contrast, Kperoussogbé consists of a mosaic of savanna, gallery forest, and woodlands dominated by ectomycorrhizal (EcM) trees such as *Isoberlinia* spp., *Berlinia grandiflora*, *Azelia africana*, and *Monotes kerstingii* (Figure 2).

We combined both opportunistic and systematic sampling approaches to maximize species detection and ensure representative coverage. Systematic sampling was implemented through 200 m to 800 transects and the establishment of three 50 × 50 m plots in each sacred forest. Each plot was surveyed twice per week over a three-month period, ensuring consistent temporal coverage of fungal fruiting patterns. Opportunistic sampling complemented this design by capturing additional species encountered outside predefined plots. A total of 132 field visits were conducted. Figure 3 shows some field activities carried out in the sacred forests, including macrofungal inventories and specimen processing. Local guides actively supported fieldwork, improving access and incorporating indigenous ecological knowledge. All specimens were photographed, morphologically described, dried, and deposited at the Mycological Herbarium of the University of Parakou (UNIPAR). Data digitization is ongoing and aligned with GBIF standards.

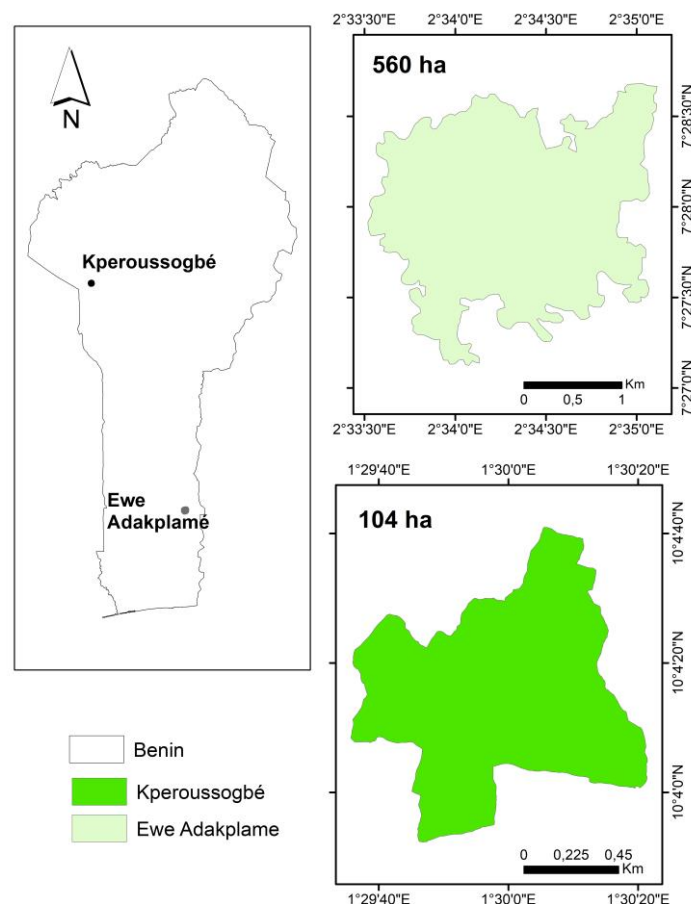


Figure 1. Location of the sacred forests of Ewe-Adakplamé and Kperoussogbé in Benin.



Ewe Adakplame Sacred Forest



Kperoussogbé Sacred Forest

Figure 2. Presentation of the forest ecosystems of the two sacred forests



Figure 3. Field inventory activities in the sacred forests of Ewe-Adakplamé and Kperoussogbé and macrofungal specimen processing.

The inventory generated substantial new data on macrofungal diversity in the study sites. A total of 126 species were recorded, distributed across 52 genera and 31 families, reflecting a high level of taxonomic diversity. Overall, 167 specimens were collected during the field surveys, providing a solid basis for morphological identification and herbarium preservation. The most dominant genera included *Lactifluus*, *Amanita*, *Trametes*, *Marasmius*, *Agaricus*, *Ganoderma*, *Russula*, and *Termitomyces* (Figure 4). Figure 6 shows illustration of some macrofungal species recorded in the sacred forests of Ewe-Adakplamé and Kperoussogbé.

The distribution of macrofungal ecological groups differed markedly between the two sacred forests (Figure 5). Overall, saprotrophic fungi were the dominant ecological group, with 71 species, representing approximately 56.8% of the total recorded taxa, confirming their major role in organic matter decomposition and nutrient cycling within these forest ecosystems. Ectomycorrhizal fungi accounted for 44 species (35.2%), highlighting the ecological importance of symbiotic associations with woody plant species. Parasitic fungi were less represented, with 5 species (4.0%), while termite-associated fungi (*Termitomyces*) also accounted for 5 species (4.0%).

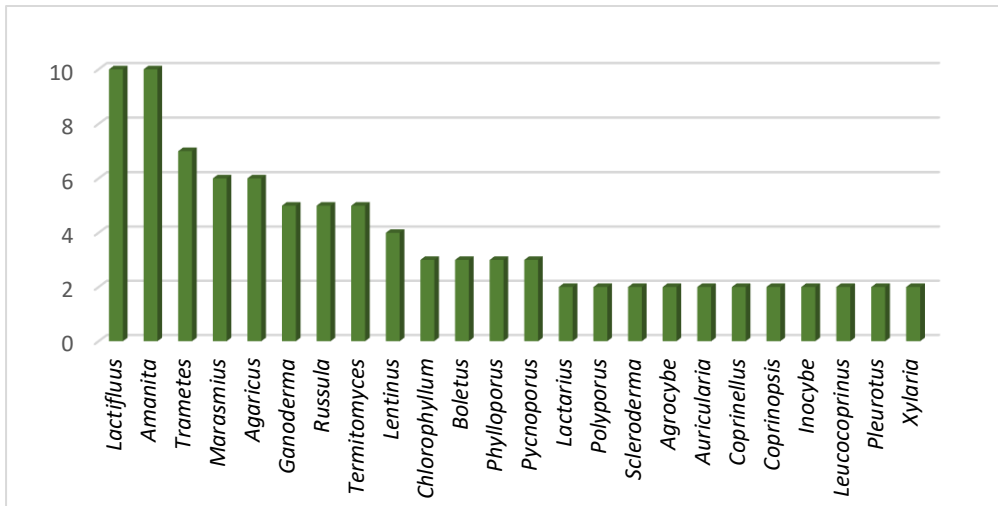


Figure 4. Most abundant macrofungal genera represented by at least two species in the sacred forests of Ewe-Adakplamé and Kperoussogbé.

Figure 5 also shows a clear ecological contrast that was observed between the two sacred forests. In Ewe Adakplamé, the fungal community was strongly dominated by saprotrophic species (42 species) and contained very few ectomycorrhizal fungi (1 species), suggesting a vegetation structure characterized mainly by non-ectomycorrhizal woody species and abundant decomposing organic matter. This forest also showed moderate representation of parasitic fungi (4 species) and a limited occurrence of termite-associated fungi (2 species).

In contrast, Kperoussogbé exhibited a high richness of ectomycorrhizal fungi (44 species) together with a substantial number of saprotrophic taxa (45 species), indicating a more functionally diverse fungal community and the likely presence of ectomycorrhizal host trees. Parasitic fungi were less abundant in Kperoussogbé (5 species), while termite-associated fungi were slightly more represented (3 species). These differences suggest that Ewe-Adakplamé is ecologically characterized by decomposition-driven fungal processes, whereas Kperoussogbé appears to support a more balanced and mature forest ecosystem with strong ectomycorrhizal interactions. Overall, the results emphasize the complementary ecological importance of both sacred forests for the conservation of macrofungal diversity and ecosystem functioning in Benin.

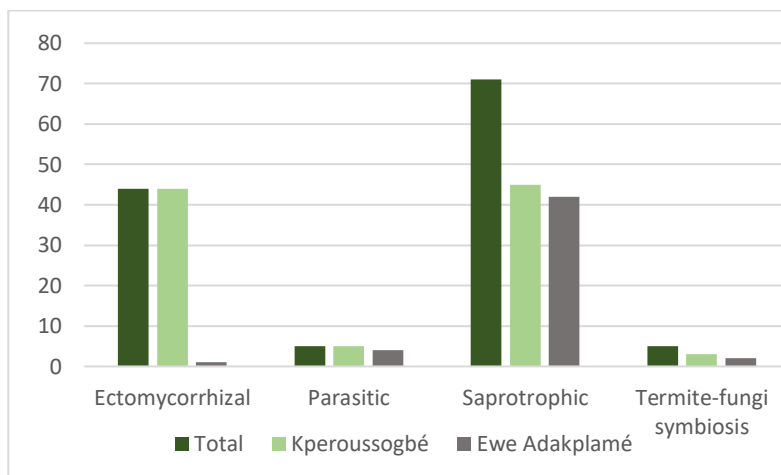


Figure 5. Distribution of macrofungal ecological groups across the sacred forests of Ewe-Adakplamé and Kperoussogbé.



Dacryopinax spathularia



Pulveroboletus sokponianus



Lactarius saponaceus



Scytinopogon anguiliformis



Paxilloboletus africanus



Cubamyces flavidus



Lentinus velutinus



Panaeolus sp



Amanita strobilaceovolvata



Xylaria sp



Russula ochrocephala



Termitomyces sp2



Auricularia delicata

Figure 6. Selected illustrations of macrofungal species recorded in the sacred forests of Ewe-Adakplamé and Kperoussogbé.

Table 1. Recorded macrofungal species identified in the sacred forests of Ewe-Adakplamé and Kperoussogbé, including their taxonomic classification, ecological groups, and distribution by forest.

Species	Genus	Family	Ecological group	Forest
<i>Agaricus bingensis</i>	<i>Agaricus</i>	Agaricaceae	Saprotrophic	Kperoussogbé
<i>Agaricus crocopeplus</i>	<i>Agaricus</i>	Agaricaceae	Saprotrophic	Ewe Adakplamé
<i>Agaricus goossensiae</i>	<i>Agaricus</i>	Agaricaceae	Saprotrophic	Kperoussogbé
<i>Agaricus sp1</i>	<i>Agaricus</i>	Agaricaceae	Saprotrophic	Both forests
<i>Agaricus sp2</i>	<i>Agaricus</i>	Agaricaceae	Saprotrophic	Kperoussogbé
<i>Agaricus trisulphuratus</i>	<i>Agaricus</i>	Agaricaceae	Saprotrophic	Both forests
<i>Agrocybe cf. broadwayi</i>	<i>Agrocybe</i>	Strophariaceae	Saprotrophic	Ewe Adakplamé
<i>Agrocybe cf. elegantior</i>	<i>Agrocybe</i>	Strophariaceae	Saprotrophic	Ewe Adakplamé
<i>Amanita aff. craseoderma</i>	<i>Amanita</i>	Amanitaceae	Ectomycorrhizal	Kperoussogbé
<i>Amanita aff. vaginata</i>	<i>Amanita</i>	Amanitaceae	Ectomycorrhizal	Kperoussogbé
<i>Amanita albolimbata</i>	<i>Amanita</i>	Amanitaceae	Ectomycorrhizal	Kperoussogbé
<i>Amanita cf. annulatovaginata</i>	<i>Amanita</i>	Amanitaceae	Ectomycorrhizal	Kperoussogbé
<i>Amanita crasiconus</i>	<i>Amanita</i>	Amanitaceae	Ectomycorrhizal	Kperoussogbé
<i>Amanita masasiensis</i>	<i>Amanita</i>	Amanitaceae	Ectomycorrhizal	Kperoussogbé
<i>Amanita pulverulenta</i>	<i>Amanita</i>	Amanitaceae	Ectomycorrhizal	Kperoussogbé
<i>Amanita subviscosa</i>	<i>Amanita</i>	Amanitaceae	Ectomycorrhizal	Kperoussogbé
<i>Amanita strobilaceovolvata</i>	<i>Amanita</i>	Amanitaceae	Ectomycorrhizal	Kperoussogbé
<i>Amanita xanthogala</i>	<i>Amanita</i>	Amanitaceae	Ectomycorrhizal	Kperoussogbé
<i>Armillaria cf. heimii</i>	<i>Armillaria</i>	Physalacriaceae	Parasitic	Kperoussogbé
<i>Auricularia cornea</i>	<i>Auricularia</i>	Auriculariaceae	Saprotrophic	Both forests
<i>Auricularia delicata</i>	<i>Auricularia</i>	Auriculariaceae	Saprotrophic	Ewe Adakplamé
<i>Boletus sp1</i>	<i>Boletus</i>	Boletaceae	Ectomycorrhizal	Kperoussogbé
<i>Boletus sp2</i>	<i>Boletus</i>	Boletaceae	Ectomycorrhizal	Kperoussogbé
<i>Boletus sp3</i>	<i>Boletus</i>	Boletaceae	Ectomycorrhizal	Kperoussogbé
<i>Candolleomyces tuberculatus</i>	<i>Candolleomyces</i>	Psathyrellaceae	Saprotrophic	Ewe Adakplamé
<i>Cantharellus addaiensis</i>	<i>Cantharellus</i>	Cantharellaceae	Ectomycorrhizal	Kperoussogbé
<i>Chlorophyllum palaeotropicum</i>	<i>Chlorophyllum</i>	Agaricaceae	Saprotrophic	Kperoussogbé
<i>Chlorophyllum sp</i>	<i>Chlorophyllum</i>	Agaricaceae	Saprotrophic	Kperoussogbé
<i>Chlorophyllum sp1</i>	<i>Chlorophyllum</i>	Agaricaceae	Saprotrophic	Kperoussogbé
<i>Collybia cf. zonata</i>	<i>Collybia</i>	Tricholomataceae	Saprotrophic	Ewe Adakplamé
<i>Coprinellus disseminatus</i>	<i>Coprinellus</i>	Psathyrellaceae	Saprotrophic	Kperoussogbé
<i>Coprinellus sp</i>	<i>Coprinellus</i>	Psathyrellaceae	Saprotrophic	Ewe Adakplamé
<i>Coprinopsis cf. variegata</i>	<i>Coprinopsis</i>	Psathyrellaceae	Saprotrophic	Ewe Adakplamé
<i>Coprinopsis sp</i>	<i>Coprinopsis</i>	Psathyrellaceae	Saprotrophic	Both forests
<i>Cortinarius sp</i>	<i>Cortinarius</i>	Cortinariaceae	Ectomycorrhizal	Kperoussogbé
<i>Cubamyces flavidus</i>	<i>Cubamyces</i>	Hygrophoraceae	Saprotrophic	Ewe Adakplamé
<i>Cyathus olla</i>	<i>Cyathus</i>	Nidulariaceae	Saprotrophic	Both forests
<i>Dacryopinax spathularia</i>	<i>Dacryopinax</i>	Dacryopinaceae	Saprotrophic	Kperoussogbé

<i>Daldinia concentrica</i>	<i>Daldinia</i>	Hypoxylaceae	Saprotrophic	Both forests
<i>Desarmillaria cf. tabescens</i>	<i>Desarmillaria</i>	Physalacriaceae	Parasitic	Ewe Adakplamé
<i>Entoloma sp</i>	<i>Entoloma</i>	Entolomataceae	Saprotrophic	Kperoussogbé
<i>Fungi sp1</i>	<i>Indéterminée</i>	Indéterminée	Saprotrophic	Kperoussogbé
<i>Fungi sp2</i>	<i>Indéterminée</i>	Indéterminée	Saprotrophic	Kperoussogbé
<i>Fungi sp3</i>	<i>Indéterminée</i>	Indéterminée	Saprotrophic	Ewe Adakplamé
<i>Fungi sp5</i>	<i>Indéterminée</i>	Indéterminée	Saprotrophic	Kperoussogbé
<i>Fungi sp6</i>	<i>Indéterminée</i>	Indéterminée	Saprotrophic	Kperoussogbé
<i>Fungi sp7</i>	<i>Indéterminée</i>	Indéterminée	Saprotrophic	Kperoussogbé
<i>Fungi sp8</i>	<i>Indéterminée</i>	Indéterminée	Saprotrophic	Kperoussogbé
<i>Ganoderma aridicola</i>	<i>Ganoderma</i>	Ganodermataceae	Parasitic	Both forests
<i>Ganoderma enigmaticum</i>	<i>Ganoderma</i>	Ganodermataceae	Parasitic	Both forests
<i>Ganoderma mbrekobenum</i>	<i>Ganoderma</i>	Ganodermataceae	Parasitic	Kperoussogbé
<i>Ganoderma sp1</i>	<i>Ganoderma</i>	Ganodermataceae	Parasitic	Both forests
<i>Geastrum triplex</i>	<i>Geastrum</i>	Geastraceae	Saprotrophic	Ewe Adakplamé
<i>Gymnopus erythropus</i>	<i>Gymnopus</i>	Omphalotaceae	Saprotrophic	Ewe Adakplamé
<i>Hygrocybe sp</i>	<i>Hygrocybe</i>	Hygrophoraceae	Saprotrophic	Kperoussogbé
<i>Inocybe cf. beninensis</i>	<i>Inocybe</i>	Inocybaceae	Ectomycorrhizal	Kperoussogbé
<i>Inocybe sp</i>	<i>Inocybe</i>	Inocybaceae	Ectomycorrhizal	Kperoussogbé
<i>Laccaria cf. lacata</i>	<i>Laccaria</i>	Hydnangiaceae	Ectomycorrhizal	Both forests
<i>Lactarius sp1</i>	<i>Lactarius</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lactifluus cf. knobsoides</i>	<i>Lactifluus</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lactifluus pumulus</i>	<i>Lactifluus</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lactarius edulis</i>	<i>Lactifluus</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lactifluus flammans</i>	<i>Lactifluus</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lactifluus gymnocarpoides</i>	<i>Lactifluus</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lactifluus gymnocarpus</i>	<i>Lactifluus</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lactifluus longisporus</i>	<i>Lactifluus</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lactifluus luteopus</i>	<i>Lactifluus</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lactifluus sp1</i>	<i>Lactifluus</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lactifluus sp2</i>	<i>Lactifluus</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lactarius saponaceus</i>	<i>Lactifluus</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Lentinus squarrosulus</i>	<i>Lentinus</i>	Polyporaceae	Saprotrophic	Both forests
<i>Lentinus cladopus</i>	<i>Lentinus</i>	Polyporaceae	Saprotrophic	Both forests
<i>Lentinus tuber-regium</i>	<i>Lentinus</i>	Polyporaceae	Saprotrophic	Both forests
<i>Lentinus velutinus</i>	<i>Lentinus</i>	Polyporaceae	Saprotrophic	Ewe Adakplamé
<i>Leucocoprinus cf. cretaceus</i>	<i>Leucocoprinus</i>	Agaricaceae	Saprotrophic	Kperoussogbé
<i>Leucocoprinus cretaceus</i>	<i>Leucocoprinus</i>	Agaricaceae	Saprotrophic	Ewe Adakplamé
<i>Marasimus sp</i>	<i>Marasmius</i>	Marasmiaceae	Saprotrophic	Kperoussogbé
<i>Marasmiellus sp</i>	<i>Marasmiellus</i>	Marasmiaceae	Saprotrophic	Ewe Adakplamé
<i>Marasmius bekolacongoli</i>	<i>Marasmius</i>	Marasmiaceae	Saprotrophic	Ewe Adakplamé
<i>Marasmius buzungolo</i>	<i>Marasmius</i>	Marasmiaceae	Saprotrophic	Ewe Adakplamé
<i>Marasmius cf. brunneolus</i>	<i>Marasmius</i>	Marasmiaceae	Saprotrophic	Ewe Adakplamé
<i>Marasmius cf. buzungolo</i>	<i>Marasmius</i>	Marasmiaceae	Saprotrophic	Ewe Adakplamé

<i>Marasmius haematocephalus</i>	<i>Marasmius</i>	Marasmiaceae	Saprotrophic	Ewe Adakplamé
<i>Microporus concinnus</i>	<i>Microporus</i>	Polyporaceae	Saprotrophic	Kperoussogbé
<i>Neonothopanus hygrophanus</i>	<i>Neonothopanus</i>	Omphalotaceae	Saprotrophic	Ewe Adakplamé
<i>Panaeolus antillarum</i>	<i>Panaeolus</i>	Psathyrellaceae	Saprotrophic	Both forests
<i>Paxilloboletus africanus</i>	<i>Paxilloboletus</i>	Boletaceae	Ectomycorrhizal	Kperoussogbé
<i>Phylloporus sp</i>	<i>Phylloporus</i>	Boletaceae	Ectomycorrhizal	Kperoussogbé
<i>Phylloporus sp1</i>	<i>Phylloporus</i>	Boletaceae	Ectomycorrhizal	Kperoussogbé
<i>Phylloporus sp2</i>	<i>Phylloporus</i>	Boletaceae	Ectomycorrhizal	Kperoussogbé
<i>Piptoporellus baudonii</i>	<i>Piptoporellus</i>	Polyporaceae	Saprotrophic	Kperoussogbé
<i>Pleurotus pulmonarius</i>	<i>Pleurotus</i>	Pleurotaceae	Saprotrophic	Kperoussogbé
<i>Pleurotus sp1</i>	<i>Pleurotus</i>	Pleurotaceae	Saprotrophic	Kperoussogbé
<i>Polyporus sp1</i>	<i>Polyporus</i>	Polyporaceae	saprotrophic	Both forests
<i>Polyporus spp1</i>	<i>Polyporus</i>	Polyporaceae	Saprotrophic	Ewe Adakplamé
<i>Polyporus tricholoma</i>	<i>Polyporus</i>	Polyporaceae	Saprotrophic	Both forests
<i>Pulveroboletus sokponianus</i>	<i>Pulveroboletus</i>	Boletaceae	Ectomycorrhizal	Kperoussogbé
<i>Pycnoporus cf. sanguineus</i>	<i>Pycnoporus</i>	Polyporaceae	Saprotrophic	Kperoussogbé
<i>Pycnoporus cinnabarinus</i>	<i>Pycnoporus</i>	Polyporaceae	Saprotrophic	Ewe Adakplamé
<i>Pycnoporus sanguneus</i>	<i>Pycnoporus</i>	Polyporaceae	Saprotrophic	Kperoussogbé
<i>Scytinopogon anguiliformis</i>	<i>Ramaria</i>	Gomphaceae	Saprotrophic	Ewe Adakplamé
<i>Russula ochrocephala</i>	<i>Russula</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Russula compressa</i>	<i>Russula</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Russula congoana</i>	<i>Russula</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Russula oleifera</i>	<i>Russula</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Russula sp</i>	<i>Russula</i>	Russulaceae	Ectomycorrhizal	Kperoussogbé
<i>Schizophyllum commune</i>	<i>Schizophyllum</i>	Schizophyllaceae	saprotrophic	Both forests
<i>Scleroderma cf. verrucosum</i>	<i>Scleroderma</i>	Sclerodermataceae	Ectomycorrhizal	Kperoussogbé
<i>Scleroderma sp</i>	<i>Scleroderma</i>	Sclerodermataceae	Ectomycorrhizal	Kperoussogbé
<i>Scleroderma sp1</i>	<i>Scleroderma</i>	Sclerodermataceae	Ectomycorrhizal	Kperoussogbé
<i>Stereum cf. hirsutum</i>	<i>Stereum</i>	Stereaceae	Saprotrophic	Kperoussogbé
<i>Termitomyces aurantiacus</i>	<i>Termitomyces</i>	Lyophyllaceae	Termite-fungi symbiosis	Kperoussogbé
<i>Termitomyces letestui</i>	<i>Termitomyces</i>	Lyophyllaceae	Termite-fungi symbiosis	Ewe Adakplamé
<i>Termitomyces schimperi</i>	<i>Termitomyces</i>	Lyophyllaceae	Termite-fungi symbiosis	Kperoussogbé
<i>Termitomyces sp2</i>	<i>Termitomyces</i>	Lyophyllaceae	Termite-fungi symbiosis	Ewe Adakplamé
<i>Termitomyces sp1</i>	<i>Termitomyces</i>	Lyophyllaceae	Termite-fungi symbiosis	Kperoussogbé
<i>Trametes cingulata</i>	<i>Trametes</i>	Polyporaceae	Saprotrophic	Kperoussogbé
<i>Trametes palisotii</i>	<i>Trametes</i>	Polyporaceae	Saprotrophic	Kperoussogbé
<i>Trametes palyzona</i>	<i>Trametes</i>	Polyporaceae	Saprotrophic	Ewe Adakplamé
<i>Trametes sanguinea</i>	<i>Trametes</i>	Polyporaceae	Saprotrophic	Kperoussogbé
<i>Trametes socotrana</i>	<i>Trametes</i>	Polyporaceae	Saprotrophic	Kperoussogbé

<i>Trametes sp1</i>	<i>Trametes</i>	Polyporaceae	Saprotrophic	Both forests
<i>Trametes versicolor</i>	<i>Trametes</i>	Polyporaceae	Saprotrophic	Both forests
<i>Volvariella earlei</i>	<i>Volvariella</i>	Pluteaceae	Saprotrophic	Both forests
<i>Volvariella volvacea</i>	<i>Volvariella</i>	Pluteaceae	Saprotrophic	Both forests
<i>Xerocomus sp</i>	<i>Xerocomus</i>	Boletaceae	Ectomycorrhizal	Kperoussogbé
<i>Xylaria sp1</i>	<i>Xylaria</i>	Xylariaceae	Saprotrophic	Kperoussogbé
<i>Xylaria sp2</i>	<i>Xylaria</i>	Xylariaceae	Saprotrophic	Kperoussogbé

Outcome 2: Traditional knowledge of macrofungal species in and around the Ewe Adakplame and Kpéroussobé sacred forests documented, with findings contributing to the safeguarding of fungal cultural heritage, and sustainable resource use.

Ethnomycological surveys were conducted in the villages of Ewe, Adakplamé, and Sinaissiré using semi-structured interviews. A total of 100 participants per village (n = 300 informants) were selected for the study. Prior to each interview, informed consent was obtained from all participants, ensuring voluntary participation and adherence to ethical research standards.

Diversity and uses of macrofungi

A total of 32 edible macrofungal species were cited by respondents. Among these, 19 species were reported in Ewe-Adakplamé, while 23 species were recorded in Sinaissiré. The figure 7 illustrates some of edible mushrooms recorded in these sacred forests. The table 2 highlights a strong relationship between local ecological knowledge, species rarity, and cultural preferences among different ethnic groups. Overall, most vernacular names are closely linked to morphological traits, habitat, or phenology, such as substrate, host association, or seasonal cues, reflecting a deep ecological understanding of macrofungi. In terms of preference, several species are highly valued, particularly those belonging to genera such as *Termitomyces*, *Lactifluus*, *Lentinus*, and *Candolleomyces*, which are frequently described as preferred, most used, or recommended, indicating their importance in local diets and livelihoods. In contrast, a number of species are considered rare, especially in Ewe Adakplamé, suggesting either limited availability, seasonal constraints, or possible ecological decline. The distribution also reveals spatial and cultural differences, with Sinaissiré showing a higher diversity of preferred and commonly used species across Bariba, Yom, and Ditamari communities, whereas Ewe-Adakplamé (mainly Mahi and Yoruba) reports more species as rare or abundant but less frequently preferred. Additionally, termite-associated fungi (*Termitomyces*) stand out as culturally significant, often highly preferred despite being perceived as rare, highlighting their socio-economic and nutritional importance.

The study identified a limited but culturally significant group of medicinal macrofungi, including *Calvatia subtomentosa*, *Lentinus cladopus*, and *Termitomyces eurhizus*. These species are recognized by local communities not only for their nutritional value but also for their therapeutic properties, reflecting the integration of fungi into traditional healthcare practices. In particular, *Calvatia subtomentosa* and *Lentinus cladopus* are commonly used in the treatment of gastrointestinal disorders, including bloating and constipation. *Termitomyces eurhizus*, on the other hand, is traditionally used in the treatment of abscesses. These uses highlight the potential pharmacological value of macrofungi and underscore the importance of documenting and preserving indigenous ethnomycological knowledge.

Table 2. Edible macrofungal species recorded in the sacred forests of Ewe-Adakplamé and Kperoussogbé and their associated local uses.

Scientific name	Local name	Meaning of the vernacular name	Preference / importance	localities	Ethnic group
<i>Afrocastellanoa ivoryana</i>	Akpalohou	Gizzard of partridge	Rare	Ewe Adakplamé	Mahi
<i>Agaricus broadwayi</i>	Olou kpaki	Mushrooms growing on decomposing cassava peels	Rare	Ewe Adakplamé	Yoruba
	Hanmin hounto	Mushrooms appearing during maize flowering	Rare	Ewe Adakplamé	Mahi
<i>Amanita loosei</i>	Nòhòl gouha	Mushroom that grows in peanut fields	Preferred	Sinaissiré	Yom
<i>Amanita masasiensis</i>	Serkononni	Mushroom of the eyes of the weaver bird	No particular preference	Sinaissiré	Bariba
<i>Amanita subviscosa</i>	Nagueb gouhò	Mushroom that grows on soil fertilized by cattle dung	Recommended to others	Sinaissiré	Yom
<i>Calvatia subtomentosa</i>	Doukpoko, Gonmi-Poutanpourou	Mushroom that is like meat, resembling egg yolk	Preferred	Sinaissiré	Bariba
	Dinonkohon	Mushroom resembling the néré flower	Preferred	Sinaissiré	Ditamari
	Soutane k'da	Mushroom referring to the fruit of old, rotten trees	Preferred	Sinaissiré	Yom
<i>Cantharellus addaensis</i>	Gòomòssè	Very small red mushroom	No particular preference	Sinaissiré	Bariba
<i>Macrocybe lobayensis</i>	Ohounto daihou	Completely white mushrooms (celestial appearance)	Rare	Ewe Adakplamé	Mahi
<i>Agaricus goossensiae</i>	Alikpa hounto	Mushrooms growing along roadsides	Abundant	Ewe Adakplamé	Mahi
	Yaakon, Èkan fèrè	Mushroom that grows after ploughing	Recommended to others	Sinaissiré	Ditamari
<i>Chlorophyllum paleotropicum</i>	Nanbigonmi	Mushroom that grows where decomposed cow dung is found	Recommended to others	Sinaissiré	Bariba
	Maloumi hounto	Mushrooms from decomposed cow dung	Rare	Ewe Adakplamé	Mahi
	Ohounto kowhlè			Ewe Adakplamé	
<i>Chlorophyllum globosum</i>	Malou hounto	Mushrooms from decomposed cow dung	Rare	Ewe Adakplamé	Mahi

<i>Calvatia subtomentosa</i>	Akpalohoun	Champignons ressemblant au gésier de perdrix	Rare	Ewe Adakplamé	Mahi
<i>Candolleomyces tuberculatus</i>	Atingo hounto	Small mushrooms at the base of dead trees and palms	Very Abundant	Ewe Adakplamé	Mahi
	Kòcrekou	Small mushroom found in groups on dead wood	Most used	Sinaissiré	Bariba
	Goumpime	Small mushroom found in groups on dead wood	Most used	Sinaissiré	Yom
	Ikouhan	Small mushroom found in groups on dead wood	Preferred	Sinaissiré	Ditamari
<i>Echinochaete brachypota</i>	Dòbngoman	Mushroom that grows on dead néré wood	No particular preference	Sinaissiré	Bariba
<i>Lactifluus flammans</i>	Guingniké	Mushroom boiled with potash before cooking	Preferred	Sinaissiré	Bariba
<i>Lactifluus gymnocarpoïdes</i>	Èkonkon, Okontotoman	Isoberlinia mushroom boiled with potash before cooking	Preferred	Sinaissiré	Ditamari
<i>Lactifluus gymnocarpus</i>	Borokaki	—	Preferred	Sinaissiré	Bariba
	Gingniké	Mushroom prepared with potash	Preferred	Sinaissiré	Bariba
<i>Lentinus cladopus</i>	Tacmitacmi	Tender mushroom	Preferred	Sinaissiré	Yom
	Toukouan tantanti, Ikonpiòh	Tender mushroom	Preferred	Sinaissiré	Ditamari
	Catacabi	Mushroom that is both tough and tender	Preferred	Sinaissiré	Bariba
	Agboto	“Agbo’s ears”	Abundant	Ewe Adakplamé	Mahi
<i>Lentinus squarrosulus</i>	Demdbodjo daigbodjo Daidai	Tender mushrooms	Abundant	Ewe Adakplamé	Mahi
	Goutacmantahmi	Tender mushrooms	Preferred	Sinaissiré	Yom
<i>Marasmiellus inodorus</i>	Bossiwakin	Wood-inhabiting mushrooms	Abundant	Ewe Adakplamé	Mahi
<i>Phlebopus sudanicus</i>	Gourouwirou	“Rain head” mushroom, resembling clouds before rainfall	Preferred	Sinaissiré	Bariba
<i>Russula congoana</i>	Bossèglo, Serkononon	Mushroom compared to malaria (eye color of an infected person)	No particular preference	Sinaissiré	Bariba

	Koun win, Èkonhwan	Red mushroom	No particular preference	Sinaissiré	Ditamari
<i>Sporisorium reilianum</i>	Èyofanran	Sorghum parasitic fungus	No particular preference	Sinaissiré	Ditamari
<i>Pleurotus flabellatus</i>	Ohounto wini wini	Small mushrooms on dead wood	Abundant	Ewe Adakplamé	Mahi
<i>Termitomyces bulborhizus</i>	Yèkanfrè	Mushroom resembling a dog's penis	Preferred	Sinaissiré	Ditamari
<i>Termitomyces eurrhizus</i>	Kòssoé	Medium-sized termite mound mushrooms	Rare	Ewe Adakplamé	Mahi
	Gomis Boochéman	Mushroom of the dog's penis	Preferred	Sinaissiré	Bariba
<i>Termitomyces le-testui</i>	Olou olidi dèrè	Long-stem termite mushrooms	Rare	Ewe Adakplamé	Yoruba
	Adjakassi		Rare	Ewe Adakplamé	Mahi
	Olou igbodi		Rare	Ewe Adakplamé	Yoruba
	Ètoukpunkou	Long-stemmed mushroom growing on old termite mounds	Preferred	Sinaissiré	Ditamari
	Nòhòl tchao	Long-stemmed mushroom growing on old termite mounds	Preferred	Sinaissiré	Yom
	Gbagon-tonni	Long-stemmed mushroom growing on old termite mounds	Most used	Sinaissiré	Bariba
<i>Termitomyces microcarpus</i>	Kossué	Small termite mound mushrooms	Rare	Ewe Adakplamé	Mahi
<i>Termitomyces schimperi</i>	Ohounto olouérin	"Iron mushroom" (hard and firm flesh)	Rare	Ewe Adakplamé	Holli
	Kolisso	Large termite mound mushrooms	Rare	Ewe Adakplamé	Mahi
<i>Termitomyces striatus</i>	Kataoukpa		Rare	Ewe Adakplamé	Mahi
<i>Volvariella volvacea</i>	ETékpo hounto	Mushrooms on decomposing oil palm	Rare	Ewe Adakplamé	Mahi
	Korogonmi	Mushroom that grows after ploughing	Preferred	Sinaissiré	Bariba
	Nòhòl gouha	Mushroom that grows after ploughing	Preferred	Sinaissiré	Yom
	Yaakon	Mushroom that grows after ploughing	Preferred	Sinaissiré	Ditamari
<i>Volvariella earlei</i>	Korogonmi	Mushroom that grows after ploughing	Preferred	Sinaissiré	Bariba
	Ecompia	Mushroom that grows after ploughing	No particular preference	Sinaissiré	Ditamari
	Olou atòrò	Mushrooms appearing after soil tillage	Abundant	Ewe Adakplamé	Mahi

<i>Volvopluteus earlei</i>	Ewèdji hounto	Mushrooms appearing after soil tillage	Abundant	Ewe Adakplamé	Mahi
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Lactifluus gymnocarpoides



Lactifluus flammans



Termitomyces le-testui



Lentinus squarrosulus



Lentinus cladopus



Candolleomyces tuberculatus



Termitomyces schimperi



Amanita masasiensis



Volvopluteus earlei



Chlorophyllum paleotropicum



Amanita loosei



Amanita subviscosa

Figure 7. Illustration of some edible macrofungal species recorded in the sacred forests of Ewe-Adakplamé and Kperoussogbé.

Dynamics of local knowledge transmission on edible fungi

The information collected indicates that the differentiation between edible and toxic fungi is primarily based on endogenous knowledge transmitted from generation to generation, relying on the observation of several morphological and ecological features. Edible fungi are generally identified by their colour, shape, and habitat: they often grow on cow dung, termite mounds, dead trees, or in cultivated fields, especially after ploughing. They typically have a pleasant smell of wet earth and a relatively firm texture. In contrast, fungi considered inedible are distinguished by characteristics such as colour change after harvesting, the presence of dust or stains on their fruiting bodies, high fragility to the touch, as well as bright colours like yellow or red (with some exceptions). They may also emit unpleasant odours and frequently attract flies.

However, a significant proportion of respondents (39.84%) report that they do not transmit this knowledge, while 32.04% indicate a lack of interest from younger generations. Less than one third (28.12%) of those surveyed ensure the transmission of this knowledge. This situation highlights a gradual erosion of local knowledge. Furthermore, this progressive loss of traditional knowledge poses a threat to the conservation and sustainable use of fungal resources. Indeed, this knowledge plays a key role in species recognition, selection of harvesting sites, and the adoption of ecosystem-friendly gathering practices. Its decline leads to unsustainable practices, overexploitation of certain species, and a decrease in fungal diversity. Moreover, the disinterest of younger generations undermines the continuity of cultural practices related to fungi and limits opportunities for socio-economic valorisation of these resources. It also increases the risk of poisoning due to misidentification of species.

In this context, it is essential to promote intergenerational transmission of local knowledge through awareness-raising, education, and cultural valorisation actions. Integrating this knowledge into participatory conservation strategies, combined with scientific approaches, could contribute to the sustainable management of edible fungi and the preservation of fungal biodiversity.

Perception of main threats and dynamics of fungal communities

The main threats identified by respondents are dominated by intensive agriculture (71.09%), followed by deforestation (53.91%) and climate change (39.06%). In contrast, overexploitation of fungi is mentioned very rarely (0.78%), suggesting it is perceived as a marginal threat in the study area. These results highlight the predominance of anthropogenic pressures on fungal ecosystems. Intensive agriculture, through habitat transformation, repeated ploughing, and the use of inputs, contributes to the degradation of conditions favourable to fungal development. Similarly, deforestation leads to the disappearance of essential microhabitats, including dead wood and symbiotic associations with forest vegetation. Climate change also constitutes a major threat, altering rainfall and temperature patterns with direct effects on fungal fruiting.

Furthermore, the majority of respondents (86.72%) perceive a decline in fungal abundance and/or diversity, while 12.5% believe no notable change has been observed. This widespread perception of decline suggests an alteration of local ecological conditions, likely affecting the availability of fungal resources.

However, respondents reveal that they implement no specific actions aimed at promoting fungal regrowth and conservation. This general absence of management or regeneration-stimulating practices reflects a low level of integration of active conservation strategies into local practices. It also indicates a strong dependence on environmental and seasonal conditions, as well as a lack of knowledge about practices that could support the sustainability of fungal resources.

Community proposals for the conservation of fungi and their habitats

communities proposed a variety of measures to improve the conservation of fungi and their habitats. The most frequent suggestions concern the reduction of pesticide use and agricultural chemicals, as well as the adoption of more soil-friendly farming practices. Reforestation and tree planting are also widely mentioned, reflecting an awareness of the role of forest cover in maintaining fungal habitats. Furthermore, several proposals emphasize the fight against deforestation, including reducing tree cutting and charcoal production, as well as protecting dead wood and termite mounds, considered essential microhabitats for certain fungal species. Agroecological practices, such as no-till farming or agroforestry, are also mentioned as conservation-friendly alternatives.

In addition, respondents stress the importance of raising awareness and training local populations, particularly farmers and young people, to strengthen knowledge about the ecological, nutritional, and economic importance of fungi. Finally, some suggestions focus on the valorisation of fungi through local production, especially during the dry season, in order to reduce pressure on natural resources and promote their sustainable management.

Outcome 3: Detailed risk analysed for macrofungal species, with tailored conservation strategies that address immediate threats in Ewe-Adakplame and Kpéroussobé sacred forests, while strengthening long-term fungal protection and ecosystem resilience.

Threats to macrofungal communities and their habitat

A detailed field-based assessment reveals multiple threats affecting macrofungal communities in the Ewe-Adakplamé and Kperoussogbé sacred forests (Figure 8). In Kperoussogbé, small-scale gold mining activities are causing severe soil disturbance, leading to habitat degradation and disruption of fungal substrates. Illegal grazing further exacerbates ecosystem stress through trampling, soil compaction, and progressive vegetation loss. In addition, the destruction of termite mounds for rodent hunting and termite queen harvesting directly threatens termite-associated fungi (*Termitomyces* spp.), which depend on these specialized microhabitats.

Across both forests, tree felling for charcoal production represents a major driver of habitat degradation, reducing host tree availability and disrupting ectomycorrhizal associations, while also altering microclimatic conditions such as humidity and soil temperature that are essential for fungal development. Similarly, agricultural expansion into forest areas contributes to progressive habitat loss and fragmentation, further reducing fungal diversity. The collection of firewood and construction wood intensifies these impacts by removing deadwood substrates crucial for saprotrophic and wood-decaying fungi. Moreover, human-induced fires used for wildlife hunting negatively affect soil moisture, destroy organic layers, and disrupt mycelial networks, leading to long-term declines in fungal productivity and ecosystem functioning.

Collectively, these threats are strongly exacerbated by the progressive erosion of traditional belief systems that historically ensured the protection of sacred forests. The weakening of customary rules, largely influenced by the expansion of monotheistic religions and associated changes in cultural values, has reduced the spiritual restrictions that previously limited exploitation of these ecosystems. As a result, sacred forests are increasingly perceived as open-access resources, accelerating their degradation and intensifying pressure on fungal biodiversity.



Illegal grazing



Destruction of termite mounds



Gold mining



Tree felling for charcoal production



Logging for firewood and construction

Figure 8. Illustration of observed threats affecting macrofungal communities and their habitats in the sacred forests of Ewe-Adakplamé and Kperoussogbé.

Tailored conservation strategies

To address the identified threats and strengthen the long-term conservation of macrofungal diversity in the Ewe-Adakplamé and Kperoussogbé sacred forests, a set of targeted and context-specific strategies is required. First, efforts should focus on restoring and reinforcing traditional taboos, customary regulations, and ancestral beliefs that historically contributed to the protection of sacred forests and their biodiversity. Revitalizing these cultural values through collaboration with traditional authorities and local communities could strengthen conservation ethics and reduce unsustainable exploitation.

Community-based protection of sacred forest boundaries should also be reinforced to limit agricultural encroachment, illegal grazing, and unsustainable wood extraction. This can be achieved through locally agreed regulations and participatory monitoring systems involving village committees, traditional leaders, and local forest users. In parallel, the adoption of agroecological practices around forest margins should be promoted to reduce pressure on natural ecosystems while improving local livelihoods and soil sustainability.

The regulation of extractive activities, including charcoal production, firewood harvesting, and gold mining, is essential, particularly in Kperoussogbé where soil disturbance is severe. Promoting alternative livelihood opportunities, such as mushroom cultivation and beekeeping, could provide sustainable income sources for local populations while reducing dependence on destructive activities. Sustainable energy solutions, including improved cookstoves and community agroforestry woodlots, may further reduce pressure on forest resources. In addition, the establishment of buffer zones around sacred forests should be encouraged to reduce direct human pressure on core conservation areas. These buffer zones could serve as areas for agroecological production, controlled resource use, and ecological restoration, while also helping to maintain habitat connectivity and protect sensitive fungal microhabitats from further degradation.

In addition, key fungal microhabitats require explicit protection, including termite mounds, deadwood, and mature host trees that support ectomycorrhizal fungi. The destruction of termite mounds should

be actively discouraged through environmental education and awareness campaigns emphasizing their ecological importance for *Termitomyces* species and nutrient cycling processes.

Fire management strategies should also be implemented to reduce the use of uncontrolled burning for hunting. These may include the establishment of community firebreaks, controlled early dry-season burning where appropriate, and participatory fire monitoring systems aimed at protecting soil moisture and preserving fungal mycelial networks.

Furthermore, sustainable harvesting guidelines for edible macrofungi should be developed to prevent overexploitation of highly valued species and ensure that harvesting practices maintain population viability and reproductive regeneration.

Finally, integrating ethnomycological knowledge into conservation planning is essential. Local perceptions of rarity, preference, and use value can help guide conservation priorities and strengthen community ownership of management strategies. Collectively, these measures will enhance ecosystem resilience, safeguard fungal diversity, and promote sustainable coexistence between local livelihoods and sacred forest conservation.

Outcome 4: Strengthened community engagement and awareness initiatives around Ewe-Adakplame and Kpéroussobé sacred forests, fostering local stewardship, and sustainable fungal conservation through culturally relevant education and collaborative decision-making.

The preliminary results of this project were presented at the 4th International Congress on Fungal Conservation and during the doctoral research days at University of Parakou. These scientific dissemination activities contributed to increasing awareness of fungal conservation issues among researchers, students, and conservation stakeholders.

In parallel, awareness-raising activities have already been initiated through the Facebook page “Les Champignons Comptent (Fungi Matter),” which promotes fungal biodiversity, ethnomycological knowledge, and conservation messages to the general public. More than 80 educational publications have been shared so far, exceeding 1,000 views and demonstrating growing public interest and engagement in fungal conservation and sustainable management of sacred forest ecosystems.

Future Perspectives

The results of this first Rufford-supported project provide a foundational baseline for macrofungal diversity and ethnomycological knowledge in Benin’s sacred forests. Building on these achievements, several priority directions are envisioned for the next phase of research and conservation action.

1. Molecular characterization and taxonomic revision

Although morphological identification allowed the recognition of 126 taxa, many collections remain undetermined or tentatively named. Future work will integrate DNA barcoding to resolve ambiguous taxa. This will also support the publication of updated identification keys for West African macrofungi.

2. Expansion of inventories across seasons and regions

Future perspectives should focus on long-term monitoring of fungal communities across multiple seasons to better understand temporal dynamics and the effects of climate variability. Expanding fungal inventories to other sacred forests in Benin would strengthen national fungal conservation efforts and biodiversity databases.

3. Conservation action on the ground

The proposed tailored strategies (restoration of taboos, buffer zones, alternative livelihoods) will be implemented in close collaboration with village committees. Pilot actions include:

- Mushroom cultivation training for women groups using local substrates.
- Community-led termite mound protection agreements.
- Reforestation with EcM host trees in degraded buffer areas to restore mycorrhizal potential.

4. Strengthening ethnomycological knowledge transmission

To counter the erosion of traditional knowledge (only 28% of respondents actively transmit it), the project will develop bilingual educational materials (Bariba, Mahi, French) for primary schools and youth groups.

Conclusion

This Rufford-supported project provides the first comprehensive assessment of macrofungal diversity, traditional knowledge, and conservation challenges within the sacred forests of Ewe-Adakplamé and Kperoussogbé in Benin. The study documented 126 macrofungal species belonging to 52 genera and 31 families, highlighting the ecological and cultural importance of these threatened forest ecosystems. The publication of 2,399 georeferenced occurrence records on GBIF will significantly improve the representation of African fungal diversity in global biodiversity databases and provide an essential baseline for future ecological research and conservation planning.

The results revealed strong ecological differences between the two forests, with Kperoussogbé supporting a high diversity of ectomycorrhizal fungi associated with relatively mature forest conditions, while Ewe-Adakplamé was largely dominated by saprotrophic species linked to decomposition processes. Ethnomycological investigations further demonstrated the richness of indigenous knowledge related to edible and medicinal fungi, while also revealing an alarming decline in intergenerational knowledge transmission.

The study also identified multiple anthropogenic threats, including deforestation, agricultural expansion, uncontrolled fires, grazing, and gold mining, all exacerbated by the erosion of traditional beliefs that historically protected sacred forests. In response, the project proposes integrated conservation strategies combining scientific research, community participation, agroecological practices, cultural revitalization, and sustainable livelihood alternatives. Overall, this work establishes a critical foundation for long-term fungal conservation and community-based ecosystem management in Benin.

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