REMUNOM
ISSN 2178-6925

Received: 13/01/2026 - **Accepted:** 01/03/2026
Vol: 13.01
DOI: 10.66104/bnxdt048
Pages: 1-23

MACROMORPHOLOGICAL SURVEY OF POLYPORACEAE MACROFUNGI IN AN URBAN AMAZONIAN FOREST FRAGMENT (TABATINGA, AM)

MACROFUNGOS POLYPORACEAE EM FRAGMENTOS DE FLORESTA URBANA AMAZONICA: REGISTRO MACROMORFOLÓGICO EM TABATINGA, AM

ESTUDIO MACROMORFOLÓGICO DE MACROHONGOS POLYPORACEAE EN UN FRAGMENTO FORESTAL URBANO AMAZÓNICO (TABATINGA, AM)

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Abstract
Macrofungi play a fundamental ecological role in the decomposition of organic matter and nutrient cycling in forest ecosystems, while also presenting important biotechnological potential due to the production of ligninolytic enzymes and bioactive compounds. This study aimed to record and characterize macrofungi associated with the family Polyporaceae in an urban forest fragment located in the Novo Progresso neighborhood, municipality of Tabatinga, Amazonas, Brazil. Field surveys were conducted between August and November 2024 through exploratory sampling and systematic visual searches. A total of eighteen macrofungal specimens were recorded during the surveys. Among these, six species were reliably identified based on macromorphological characteristics: *Pycnoporus sanguineus, Earliella scabrosa, Hexagonia hydnoides, Lentinus crinitus, Lentinus berteroi,* and *Phallus indusiatus*. Environmental parameters such as soil moisture and pH were also evaluated to characterize the ecological conditions of the study area. The results indicate that the fragment presents environmental characteristics favorable to saprophytic macrofungi, including high soil moisture, abundant leaf litter, and availability of decomposing wood substrates. The findings highlight the importance of urban forest fragments as reservoirs of fungal biodiversity in the Amazon and reinforce the need for further mycological studies in regions that remain poorly documented, such as the Upper Solimões.
Keywords: Macrofungi; *Polyporaceae;* Amazon; Tabatinga; Fungal biodiversity.

Resumo
Os macrofungos desempenham papel ecológico fundamental na decomposição da matéria orgânica e na ciclagem de nutrientes em ecossistemas florestais, além de apresentarem importante potencial biotecnológico devido à produção de enzimas ligninolíticas e compostos bioativos. Este estudo teve como objetivo registrar e caracterizar macrofungos associados à família Polyporaceae em um

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fragmento de floresta urbana localizado no bairro Novo Progresso, no município de Tabatinga, Amazonas, Brasil. As coletas foram realizadas entre agosto e novembro de 2024 por meio de amostragem exploratória e buscas visuais sistemáticas. Ao todo, foram registrados dezoito espécimes de macrofungos durante o levantamento. Dentre estes, seis espécies puderam ser identificadas com segurança com base em características macromorfológicas: *Pycnoporus sanguineus, Earliella scabrosa, Hexagonia hydnoides, Lentinus crinitus, Lentinus berteroi* e *Phallus indusiatus*. Parâmetros ambientais, como umidade do solo e pH, também foram avaliados a fim de caracterizar as condições ecológicas da área de estudo. Os resultados indicam que o fragmento apresenta características ambientais favoráveis ao desenvolvimento de macrofungos saprófitos, incluindo elevada umidade do solo, abundante serapilheira e disponibilidade de substratos lenhosos em decomposição. Os achados destacam a importância dos fragmentos florestais urbanos como reservatórios de biodiversidade fúngica na Amazônia e reforçam a necessidade de novos estudos micológicos em regiões ainda pouco documentadas, como o Alto Solimões.
Palavras-chave: Macrofungos; *Polyporaceae*; Amazônia; Tabatinga; Biodiversidade fúngica.

Resumen

Los macrohongos desempeñan un papel ecológico fundamental en la descomposición de la materia orgánica y en el ciclo de nutrientes en los ecosistemas forestales, además de presentar un importante potencial biotecnológico debido a la producción de enzimas ligninolíticas y compuestos bioactivos. Este estudio tuvo como objetivo registrar y caracterizar macrohongos asociados a la familia Polyporaceae en un fragmento de bosque urbano ubicado en el barrio Novo Progresso, en el municipio de Tabatinga, Amazonas, Brasil. Las recolecciones se realizaron entre agosto y noviembre de 2024 mediante muestreo exploratorio y búsquedas visuales sistemáticas. En total se registraron dieciocho especímenes de macrohongos durante el estudio. Entre ellos, seis especies pudieron ser identificadas con fiabilidad a partir de características macromorfológicas: *Pycnoporus sanguineus, Earliella scabrosa, Hexagonia hydnoides, Lentinus crinitus, Lentinus berteroi* y *Phallus indusiatus*. También se evaluaron parámetros ambientales, como la humedad del suelo y el pH, con el fin de caracterizar las condiciones ecológicas del área de estudio. Los resultados indican que el fragmento presenta características ambientales favorables para el desarrollo de macrohongos saprófitos, incluyendo alta humedad del suelo, abundante hojarasca y disponibilidad de sustratos leñosos en descomposición. Los hallazgos resaltan la importancia de los fragmentos de bosque urbano como reservorios de biodiversidad fúngica en la Amazonía y refuerzan la necesidad de realizar más estudios micológicos en regiones aún poco documentadas, como el Alto Solimões.
Palabras clave: Macrohongos; Polyporaceae; Amazonía; Tabatinga; Biodiversidad fúngica.

1. Introduction

Macrofungi play crucial ecological roles in terrestrial ecosystems, particularly in the decomposition of organic matter and nutrient cycling. By breaking down lignocellulosic compounds, these organisms release essential minerals that enhance soil fertility, support plant growth, and promote the ecological balance of forests (Cavalcante et al., 2024). This decomposing ability positions macrofungi as key agents in the maintenance and regeneration of natural ecosystems.

Beyond their ecological relevance, macrofungi exhibit remarkable biotechnological potential, serving as sources of bioactive compounds with

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applications in the pharmaceutical, food, environmental, and energy sectors. Several species produce secondary metabolites with antimicrobial, antioxidant, and immunomodulatory properties, as well as enzymes—such as laccases, cellulases, and peroxidases—used in biodegradation, bioremediation, and biofuel production (Timm; Serbent; Santiago, 2024).

The Amazon region hosts one of the richest fungal biodiversities on the planet. However, much of this diversity remains underexplored, especially in areas like the Upper Solimões, where systematized mycological data are still scarce (Mendoza et al., 2023). This knowledge gap underscores the need for research aimed at characterizing, monitoring, and valuing Amazonian mycodiversity—not only in pristine environments but also within urban contexts.

Even when embedded in urban landscapes, macrofungi continue to perform important ecological functions. They contribute to the decomposition of organic debris, aid in soil recovery, and serve as bioindicators of environmental quality (Cavalcante et al., 2024). Studying their presence in urban areas offers insights into the effects of urbanization on fungal diversity and supports strategies for their conservation.

In this context, the present study aims to record, identify, and characterize macrofungal species of the family Polyporaceae in an urban forest fragment located in the Novo Progresso neighborhood, municipality of Tabatinga-AM. Through photographic documentation and macromorphological analysis, this research contributes to regional mycological knowledge, highlights local biodiversity, and lays the groundwork for future investigations in the area.

2. Methodology

2.1. Characterization of the study area

Data collection was conducted in the Novo Progresso neighborhood, located in the municipality of Tabatinga-AM (coordinates: -4.235074, -69.912532), characterized by secondary vegetation typical of humid tropical forests in the Alto Solimões region. The municipality belongs to the Southwest Amazon Mesoregion

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and the Alto Solimões Microregion and features a hot and humid equatorial climate, with an average annual temperature of approximately 26 °C and annual rainfall ranging between 1,800 and 2,200 mm, according to data from the Brazilian Institute of Geography and Statistics (IBGE, 2018).

Tabatinga lies at an average altitude of 73 meters and is situated at the tri-border region between Brazil, Colombia, and Peru, maintaining strong economic integration with the neighboring Colombian city of Leticia. The municipality covers a total area of 3,225.064 km² and has an estimated population of 64,488 inhabitants (IBGE, 2018), making it the most populous municipality in its microregion, with an average population density of 18 inhabitants per km².

The local geology is marked by moderately acidic yellow latosols with a clayey texture, as described by the Radambrasil Project (1977). The terrain is predominantly flat to gently undulating, featuring good drainage and some susceptibility to sheet erosion. The humid equatorial climate, combined with high relative humidity and the constant presence of decomposing leaf litter, creates favorable conditions for the development of saprobic macrofungi that feed on plant-derived organic matter.

During fieldwork, relevant environmental factors were recorded, including soil moisture and pH, as well as the composition of the predominant substrates (soil and decaying wood), following a methodology adapted from Santos (2006) for ecological studies of macrofungi in Amazonian forest environments.

2.2. Photographic record and field observation

Collections and photographic records were conducted between August and November 2024 through exploratory surveys in the urban forest fragment located in the Novo Progresso neighborhood, Tabatinga-AM. Four field campaigns were carried out during this period, each lasting approximately two hours.

The sampling effort consisted of systematic visual searches along informal walking transects covering different microhabitats within the fragment, including soil,

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decaying wood, trunks, branches, and leaf litter. The surveyed area corresponds to an estimated portion of approximately 0.5 hectares of the forest fragment.

Field observations prioritized the detection of visible basidiomata, which were photographed in situ and documented according to the Macrofungi Image Capture Protocol (Bittencourt et al., 2022).

2.3. Identification and classification

Species identification was performed based on their macromorphological characteristics, including pileus, stipe, pores, presence of a veil, coloration, and texture, according to methodologies proposed by Silva and Fortuna (2020). For taxonomic classification, scientific articles, specialized guides (Oliveira et al., 2023), and consultations of academic databases such as SciELO, PubMed, and Google Scholar were used. It is important to note that species identification in this study was based exclusively on macromorphological characteristics observed in the field and through photographic records. Although this approach is commonly employed in preliminary surveys of macrofungi, several taxa within the Polyporaceae exhibit considerable morphological plasticity and overlapping diagnostic features. Therefore, the taxonomic identifications presented here should be considered provisional. Future studies incorporating microscopic examination of spores and basidia, as well as molecular analyses, are recommended to confirm the species assignments.

2.4. Data analysis and literature review

After identifying the species, a survey of information was conducted regarding their potential medicinal, ecological, and biotechnological applications. The main classes of chemical compounds reported in the specialized literature were also analyzed (Melo et al., 2020).

2.5 Determination of Soil Moisture

Soil moisture was determined using the gravimetric method, as outlined by EMBRAPA (2017). Initially, soil samples were collected from the study area using a

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cutting spade and stored in pre-labeled containers. Each sample was weighed to obtain its wet mass using an analytical balance, then placed in an oven at 105 ± 2 °C for 24 hours.

After drying, the samples were cooled in a desiccator and reweighed to obtain the dry mass. Soil moisture content was then calculated based on the difference between the wet and dry masses, using the following formula:

$$Umidade\ (\%) = \frac{Massa\ úmida - Massa\ seca}{Massa\ seca}\ x\ 100$$

This method is widely used due to its simplicity and accuracy, and is recommended for both field and laboratory analyses.

2.6 Determination of Soil pH

To determine soil pH, the aqueous suspension method was used, in a 1:2.5 ratio (soil:water), as recommended by EMBRAPA (2017). Samples of dry, sieved soil (2 mm mesh) were weighed in quantities of 10 g and transferred to clean beakers. Then, 25 mL of distilled water was added, maintaining the 1:2.5 ratio (10 g of soil to 25 mL of water). The samples were agitated manually or with the aid of a mechanical stirrer for approximately 5 minutes and then left to stand for 30 minutes for decantation. After this period, the pH measurement was performed directly on the suspension using pH indicator strips.

3. Results and Discussion

3.1. Characterization of the study site

The macrofungi were recorded in an urban forest fragment located in the Novo Progresso neighborhood, Tabatinga-AM (Figure 1). The area is characterized by dense secondary vegetation composed of medium and large trees, shrubs, and climbing plants. The forest floor is covered by a thick layer of leaf litter formed by fallen leaves, branches, and decomposing wood, creating favorable conditions for saprophytic fungi.

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The canopy cover provides constant shading and contributes to maintaining high soil moisture and a stable microclimate within the fragment. These environmental characteristics favor the establishment of lignicolous macrofungi, particularly species associated with decaying wood and organic matter accumulation. Such conditions are commonly reported as suitable for the development of basidiomycetes involved in lignocellulosic decomposition (Osono, 2020).

During field observations, several microhabitats favorable to fungal colonization were identified, including fallen trunks, decomposing branches, moist soil, and areas with abundant leaf litter. These substrates provide the organic material necessary for fungal growth and contribute to the diversity of macrofungi observed in the study area.

Figure 1: Location where macrofungi were collected.

Source: Author (2025).

The dense tree canopy in the sampled area provides continuous shading, which plays a key role in maintaining soil moisture and stabilizing the local microclimate. According to Aalto et al. (2021), canopy cover significantly influences understory microclimatic conditions by reducing evaporation and promoting increased humidity. Similarly, Deng et al. (2022) emphasize the role of the canopy as a vertical thermal regulator in tropical forests, mitigating temperature fluctuations.

The soil remains consistently moist and is covered by a thick layer of decomposing leaf litter composed of fallen leaves, branches, and trunks. This organic layer provides a continuous source of nutrients and energy for saprophytic

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macrofungi, enhancing their occurrence and diversity. Giweta (2020) highlights the essential role of leaf litter in nutrient cycling and the maintenance of soil ecological structure, while Osono (2020) notes that ligninolytic fungi, particularly basidiomycetes, are highly effective in decomposing complex compounds such as lignin and cellulose, thus accelerating the organic matter degradation process.

Additionally, the presence of water accumulation in certain areas—such as temporary puddles and waterlogged zones—further increases relative humidity, creating favorable conditions for species adapted to moist environments. Chen et al. (2023) demonstrated that natural gradients in soil moisture directly influence fungal community structure and diversity, while Brabcová et al. (2022) found that the structural heterogeneity of soil and decaying wood is strongly associated with fungal richness in humid tropical forests.

The variety of ecological niches—ranging from decaying tree trunks and constantly moist soils to deep leaf litter—supports the establishment of macrofungi with varying ecological requirements. The presence of mosses and lichens, recognized bioindicators sensitive to changes in temperature, humidity, and air quality (Chaudhuri et al., 2023; Thakur et al., 2024), further reflects the environmental stability of the site. Together, these factors—canopy shading, soil moisture, and abundant organic matter—create optimal conditions for the development of macrofungi, justifying the observed species diversity in the study area (Figure 2).

Figure 2: Environmental conditions of the collection area.

Source: Author (2025).

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During data collection in the Novo Progresso neighborhood of Tabatinga (AM), the surveyed urban forest fragment revealed ecological characteristics typically associated with preserved environments, despite its location within an urban setting. The local vegetation comprises large trees, shrubs, and climbing plants that form a closed canopy, which limits direct sunlight exposure and contributes to maintaining a humid and stable microclimate. As noted by Aalto et al. (2021) and Deng et al. (2022), canopy shading serves as a natural regulator of temperature and humidity in the understory, creating optimal conditions for macrofungal development.

The soil is dark, moist, and covered by a dense layer of leaf litter composed of fallen leaves, branches, and decomposing wood fragments. This organic matter provides essential nutrients and substrate for saprophytic macrofungi. Giweta (2020) underscores the critical role of leaf litter in nutrient cycling and in maintaining soil ecological stability. Similarly, Osono (2020) highlights that ligninolytic fungi from the Polyporaceae family play a direct role in breaking down complex organic compounds such as lignin and cellulose.

Fallen logs and stumps at various stages of decomposition were also observed, many of which were already colonized by visible fungal structures, indicating active decomposition processes. According to Brabcová et al. (2022), decaying wood serves as an important microhabitat by retaining moisture and offering a suitable substrate for fungal germination and growth.

In more shaded portions of the forest, mosses and lichens were found growing on tree trunks and rocks—organisms known to be sensitive bioindicators of environmental quality, particularly in relation to temperature, humidity, and air purity (Chaudhuri et al., 2023; Thakur et al., 2024). These combined factors—moist soil, abundant decaying organic matter, and dense vegetative cover—reflect a well-balanced ecosystem that favors fungal colonization and diversity, thus explaining the high occurrence of macrofungi documented in the study area.

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3.2. Determination of Soil Moisture

The gravimetric moisture determination was conducted according to the protocol described by Embrapa (2017), analyzing three experimental plates from the sampled area. The results obtained are presented in Table 1, which shows the variation in moisture content among the evaluated samples.

Table 1 – Gravimetric moisture values of the analyzed soil.

Sample	Wet Weight (g)	Dry Weight (g)	Moisture (%)
1	30.7369	21.0751	45.85
2	30.5613	20.6886	47.74
3	30.3282	20.9871	44.52

Source: Author (2025).

Average moisture values ranged from 44.52% to 47.74%, indicating a soil with high water retention. This condition reflects the presence of organic matter and dense vegetation cover, factors that reduce water loss through evaporation. The high humidity characterizes the environment as favorable for the colonization of saprophytic macrofungi, which depend on stable conditions for the development of their basidiomata and the maintenance of enzymatic activities.

The observed moisture levels corroborate the typical environmental conditions of humid forest ecosystems, in which the canopy structure and litter layer reduce evaporation and promote greater water retention in the soil. This condition is crucial for the metabolism of ligninolytic fungi of the *Polyporaceae family* , whose enzymatic activity sustains the decomposition of woody substrates and nutrient cycling (OSONO, 2020).

In line with this scenario, the literature indicates that shaded and humid microclimates favor the colonization and fruiting of polyporaceous species, such as *Pycnoporus sanguineus*, *Lentinus berteroi*, *Hexagonia hydnoides*, and *Earliella scabrosa*, especially in areas with greater availability of decaying wood (BRABCOVÁ *et al.,* 2022; CHAUDHURI *et al.,* 2023).

The high soil moisture observed in the analyzed samples reveals environmental conditions conducive to the development and functional performance

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of saprophytic macrofungi, with direct implications for local biogeochemical dynamics. This pattern reinforces that water availability in the soil is a determining factor for fungal diversity and for the decomposing activity of lignocolous species, highlighting the ecological importance of the Polyporaceae family in nutrient cycling processes and the maintenance of ecological balance in Amazonian environments.

The high soil moisture observed in the study area likely contributed to the occurrence of lignicolous macrofungi recorded during the field surveys. Moist and shaded environments favor the development of basidiomata and support the enzymatic activity of saprophytic fungi responsible for the decomposition of lignocellulosic substrates. These conditions are commonly associated with the presence of species belonging to the Polyporaceae family, which typically colonize humid forest substrates such as decaying wood and leaf litter.

3.3. Soil pH analysis

Soil pH analysis is an essential step in understanding the physical and chemical conditions of the environment and its influence on local biological activity. In this study, soil samples were collected from an urban forest fragment and subjected to pH determination using universal indicator strips (pH-Fix 0–14). This method allowed for a quick and reliable assessment of soil acidity, enabling the characterization of the collection environment.

The results obtained revealed average pH values around 6, as shown in Figure 3, which characterizes the soil as weakly acidic. This chemical condition indicates an environment conducive to microbial activity and the decomposition of organic matter. Soils within this pH range generally exhibit a balance between nutrients and microorganisms, favoring the maintenance of natural fertility and biogeochemical cycling.

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Figure 3: Determining soil pH.

Source: Author (2025).

The results obtained demonstrate that the chemical conditions of the analyzed soil are compatible with stable forest environments, in which the slightly acidic pH contributes to the maintenance of active decomposer communities. This acidity range also reduces nutrient loss through leaching, ensuring a balance between organic matter and mineralization processes essential to the functioning of the ecosystem.

According to Vargas-Isla and Ishak (2021), pH is a determining factor in the structure of microbial and fungal communities, influencing the abundance and diversity of decomposer organisms. Soils with a pH close to neutrality tend to exhibit greater enzymatic stability, which enhances the decomposition of organic compounds and the return of nutrients to the ecosystem.

Osono (2020) highlights that pH values between 5.5 and 7.0 favor the action of oxidative enzymes, such as laccases and peroxidases, which are fundamental in the degradation of lignocellulosic materials. Therefore, the value identified in this study suggests conditions suitable for the metabolic activity of organisms responsible for the decomposition and cycling of organic matter in the soil.

Finally, the slightly acidic pH found is associated with the presence of decomposing organic matter and low leaching of basic cations, typical characteristics of well-structured or regenerating forest soils (Giweta, 2020). This environmental configuration indicates a balanced ecosystem, in which the interaction between chemical and biological factors sustains soil stability and biodiversity.

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The slightly acidic pH recorded in the analyzed soil is consistent with conditions commonly reported in tropical forest ecosystems where decomposer fungi are abundant. This pH range favors the activity of ligninolytic enzymes involved in the degradation of plant residues and supports the establishment of saprophytic macrofungi. Therefore, the chemical characteristics of the soil observed in this study likely contributed to the occurrence of the macrofungal species documented in the area.

3.4. Mycological diversity and composition by groups

A total of eighteen (Figure 4) macrofungal specimens were recorded during the field surveys conducted in the urban forest fragment of the Novo Progresso neighborhood, Tabatinga-AM. These records were obtained through photographic documentation and field observation of basidiomata growing on different substrates such as soil, leaf litter, and decaying wood.

To improve the organization of the records obtained during field surveys, the macrofungi observed in the study area were catalogued according to their identification level and substrate. While six species were reliably identified based on macromorphological characteristics, the remaining specimens were documented as morphotypes due to the absence of sufficient diagnostic features for precise taxonomic determination.

Table 2 – Macrofungi recorded in the urban forest fragment of Novo Progresso, Tabatinga-AM

Specimen Code	Identification	Substrate	Identification Level
MF01	*Pycnoporus sanguineus*	Decaying wood	Species
MF02	*Earliella scabrosa*	Decaying wood	Species
MF03	*Hexagonia hydnoides*	Decaying wood	Species
MF04	*Lentinus crinitus*	Soil / organic matter	Species
MF05	*Lentinus berteroi*	Decaying wood	Species
MF06	*Phallus indusiatus*	Soil	Species
MF07	Basidiomycete morphotype 1	Wood	Morphotype
MF08	Basidiomycete morphotype 2	Wood	Morphotype
MF09	Basidiomycete morphotype 3	Soil	Morphotype
MF10	Basidiomycete morphotype 4	Wood	Morphotype

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MF11	Basidiomycete morphotype 5	Leaf litter	Morphotype
MF12	Basidiomycete morphotype 6	Wood	Morphotype
MF13	Basidiomycete morphotype 7	Wood	Morphotype
MF14	Basidiomycete morphotype 8	Soil	Morphotype
MF15	Basidiomycete morphotype 9	Leaf litter	Morphotype
MF16	Basidiomycete morphotype 10	Wood	Morphotype
MF17	Basidiomycete morphotype 11	Soil	Morphotype
MF18	Basidiomycete morphotype 12	Wood	Morphotype

Source: Authors (2025).

Due to limitations inherent to macromorphological identification, only six species could be reliably identified based on diagnostic external characteristics. The identified taxa include *Pycnoporus sanguineus, Earliella scabrosa, Hexagonia hydnoides, Lentinus crinitus, Lentinus berteroi*, and *Phallus indusiatus*. The remaining specimens were documented as morphotypes but could not be assigned to species level with sufficient taxonomic certainty.

Figure 4: Macrofungi observed and collected in the Novo Progresso neighborhood,

Source: Author (2025).

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The diversity recorded in this study aligns with previous research reporting high macrofungal richness in humid tropical environments, particularly those characterized by dense vegetation and abundant decomposing organic matter (Lodge et al., 2008; Silveira et al., 2023). Such ecosystems provide ecologically favorable conditions for fungal development, supporting both species proliferation and diversification.

The predominance of lignicolous species, particularly those associated with logs in advanced stages of decomposition, emphasizes the ecological role of macrofungi in nutrient cycling and plant biomass degradation (Martínez-Sánchez et al., 2015). This functional contribution is vital for the renewal of soil organic matter and the maintenance of biotic equilibrium in forest ecosystems (Baldrian, 2017).

The morphological diversity of the observed basidiomes — exhibiting marked variation in color, texture, and structure — can be attributed to specific microenvironmental factors, including high humidity, dense canopy cover, and consistent shading. These variables are well-documented as favorable to macrofungal growth and sporocarp formation (Oerther et al., 2018; Piepenbring, 2007).

Urban forest fragments, even those of limited size, can maintain high levels of fungal richness, serving as important biodiversity reservoirs and strategic sites for environmental monitoring (Dighton, 2003).

To date, six macrofungal species have been reliably identified in the study area: *Pycnoporus sanguineus*, *Earliella scabrosa*, *Hexagonia hydnoides*, *Lentinus crinitus*, *Lentinus berteroi*, and *Phallus indusiatus*. These taxa are recognized for their ecological and biotechnological relevance, particularly their lignocellulolytic capabilities, involvement in organic matter decomposition, and enzymatic potential across multiple applications. Table 2 summarizes the identified species alongside recent literature references.

Table 02: Species of macrofungi identified and their respective recent references.

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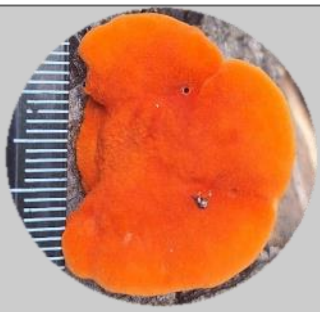
Scientific name	Image	Substrate	References
P. sanguineus		Wood	MENG, D. *et al.* Pigment production by a newly isolated strain *Pycnoporus sanguineus* SYBC-L7 in solid-state fermentation and its biological activity. **Frontiers in Microbiology** , vol. 13, p. 1015913, 2022. DOI: 10.3389/fmicb.2022.1015913.
E. scabrosa		Wood	ALFARO, ME *et al. Earliella scabrosa* (Polyporaceae): a white-rot fungus with biotechnological potential for lignin degradation. International Biodeterioration & Biodegradation , vol. 164, p. 105276, 2021. DOI: 10.1016/j.ibiod.2021.105276.
Hexagonia hydnoides		Wood	RAHMAN, MA; MAHMOOD, H.; ALAM, N. Taxonomic studies and antioxidant potential of *Hexagonia hydnoides* from Bangladesh. **Bangladesh Journal of Botany** , vol. 50, no. 4, p. 1285–1292, 2021. DOI: 10.3329/bjb.v50i4.57178.
Lentinus crinitus		Soil	DOS SANTOS FILHO, JR *et al. Lentinus crinitus* : traditional use, phytochemical profile, and enzyme potential. **Food Bioscience** , vol. 56, p. 103836, 2023. DOI: 10.1016/j.fbio.2023.103836.

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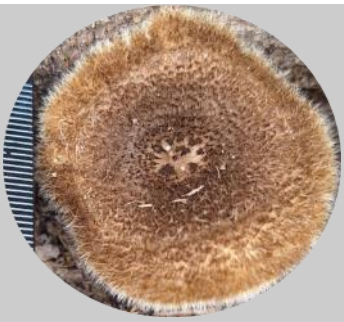
Lentinus berteroi		Wood	GÓMEZ, RA *et al.* Comparative study of ligninolytic enzyme production by *Lentinus berteroi* and *Lentinus crinitus* under different cultural conditions. **Mycology** , v. 114, no. 2, p. 365–375, 2022. DOI: 10.1080/00275514.2021.2008759.
Phallus indusiatus		Soil	LIU, Y. *et al.* Immunomodulatory and antitumor activities of polysaccharides from *Phallus indusiatus* . **Carbohydrate Polymers** , vol. 230, p. 115586, 2020. DOI: 10.1016/j.carbpol.2019.115586.

Source: Author, 2025.

3.5 Notable species and their reported applications

3.5.1 *Pycnoporus sanguineus*

P. sanguineus is a lignicolous basidiomycete widely distributed in tropical ecosystems and recognized for its ecological role in lignin degradation. This species produces ligninolytic enzymes such as laccases and peroxidases, which contribute to the decomposition of woody substrates and nutrient cycling in forest environments (Baldrian, 2006; Pointing, 2001). In addition to its ecological relevance, previous studies have reported the production of bioactive pigments such as cinnabarin, which exhibit antimicrobial and antioxidant properties (Couto & Herrera, 2006; Chagas et al., 2022). The occurrence of *P. sanguineus* in the studied urban forest fragment highlights its ecological adaptability and its role in organic matter decomposition.

3.5.2 *Lentinus crinitus*

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L. crinitus is a saprophytic macrofungus commonly associated with decomposing plant material in tropical forests. The species plays an important ecological role in lignocellulosic degradation through the production of enzymes such as laccases and cellulases, which facilitate the breakdown of plant biomass and contribute to nutrient cycling in forest ecosystems (Menezes et al., 2010; Gusmão et al., 2015). Beyond its ecological importance, previous studies have highlighted the species' enzymatic potential for applications in environmental biotechnology, including the biodegradation of organic residues and agroindustrial wastes.

3.5.3 *Phallus indusiatus*

P. indusiatus is a tropical macrofungus widely known for its distinctive morphological structure and occurrence in humid forest environments. Ecologically, the species contributes to the decomposition of organic matter in forest soils. Additionally, studies have reported the presence of bioactive polysaccharides with antioxidant and immunomodulatory properties, which have attracted attention for potential pharmaceutical and nutraceutical applications (Ngai & Ng, 2005; Liu et al., 2020). The presence of this species in the study area reinforces the ecological diversity of macrofungi within the urban forest fragment.

3.6 Contributions of the study

This study advances the understanding of macrofungal diversity in urban forest fragments of the Amazon, a region still poorly explored from a mycological perspective. The identification of species such as *Pycnoporus sanguineus*, *Lentinus crinitus*, and *Phallus indusiatus* underscores their ecological importance in organic matter decomposition and nutrient cycling (Baldrian, 2017; Montalvo et al., 2010), while also highlighting their potential as bioindicators and sources of bioactive compounds for pharmaceutical and industrial applications (Pointing, 2001; Garcia et al., 2018).

Beyond its scientific contributions, the research holds educational and social value. Conducted in the Novo Progresso neighborhood of Tabatinga-AM, the study

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ISSN 2178-6925

Received: 13/01/2026 - **Accepted:** 01/03/2026
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provides a basis for environmental education initiatives and promotes awareness of local biodiversity. By bridging science and community, it supports sustainable practices and encourages future research focused on the conservation and responsible use of Amazonian natural resources (Anderson & Lodge, 2003; Souza et al., 2020).

4. Final Considerations

This study highlights the ecological and biotechnological importance of macrofungi found in urban fragments of the Amazon. The species identified — including *Pycnoporus sanguineus*, *Lentinus crinitus*, and *Phallus indusiatus* — play key roles in organic matter decomposition and nutrient cycling, while also presenting significant potential for pharmaceutical, environmental, and industrial applications.

By documenting fungal diversity in an urban area of Tabatinga-AM, the research contributes to the mycological knowledge of a still underexplored region and reinforces the value of preserving urban green spaces. These findings support future studies, environmental education actions, and the sustainable use of Amazonian fungal resources.

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