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EXPLORATION OF ECTOMYCORRHIZAL FUNGI IN KLAMONO NATURE PARK SORONG DISTRICT

EKSPLORASI FUNGI EKTOMIKORIZA DI KAWASAN TAMAN WISATA ALAM KLAMONO KABUPATEN SORONG

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ABSTRACT

Ectomycorrhizal fungi form mutualistic associations with forest tree roots and play an important role in nutrient and water uptake as well as plant tolerance to environmental stress. This study aimed to identify the species composition of ectomycorrhizal fungi and evaluate their diversity, dominance, and evenness in Klamono Nature Park, Sorong Regency, Southwest Papua. Sampling was conducted using a purposive sampling method with ten 20 × 20 m plots. Species were identified based on the macroscopic morphology of their fruiting bodies. Community structure was analyzed using the diversity index (H'), dominance index (C), and evenness index (E). A total of 10 species comprising 205 individuals were recorded. Boletus sp1 was the most abundant species (19.02%), whereas Amanita phalloides was the least abundant (5.37%). The values of H' (0.954), C (0.12), and E (0.916) indicated low diversity, low dominance, and high evenness, respectively. These findings provide baseline information for biodiversity conservation and forest management in Southwest Papua.

ABSTRAK

Ektomikoriza merupakan kelompok fungi yang membentuk simbiosis mutualisme dengan akar tanaman hutan dan berperan penting dalam meningkatkan penyerapan air, unsur hara, serta ketahanan tanaman terhadap cekaman lingkungan. Penelitian ini bertujuan mengidentifikasi komposisi jenis fungi ektomikoriza serta menganalisis keanekaragaman, dominansi, dan kemerataannya di Taman Wisata Alam Klamono, Kabupaten Sorong. Penelitian menggunakan metode purposive sampling dengan 10 plot berukuran 20 × 20 m. Identifikasi dilakukan berdasarkan karakter morfologi makroskopis tubuh buah, sedangkan analisis menggunakan indeks keanekaragaman (H'), dominansi (C), dan kemerataan (E). Hasil penelitian menemukan 10 jenis fungi ektomikoriza dengan 205 individu. Boletus sp.1 merupakan jenis paling melimpah (39 individu; 19,02%), sedangkan Amanita phalloides merupakan jenis dengan jumlah individu terendah (11 individu; 5,37%). Nilai H' = 0,954 menunjukkan keanekaragaman rendah, C = 0,12 menunjukkan tidak adanya jenis yang mendominasi komunitas, dan E = 0,916 menunjukkan penyebaran individu antarjenis yang relatif merata. Hasil penelitian ini menjadi data dasar bagi pengelolaan kawasan konservasi dan penelitian biodiversitas fungi di Papua Barat Daya.

KATA KUNCI:

Dominasi, ektomikoriza, keanekaragaman, kemerataan

1. INTRODUCTION

Papua's tropical forests harbor exceptionally high biodiversity, including a wide diversity of fungi that form symbiotic associations with plants, known as mycorrhizae (Suharno *et al*., 2022). Mycorrhizae represent a mutualistic symbiosis between fungi and plant roots, in which fungal hyphae colonize root tissues and establish a mutually beneficial relationship. In this association, plants supply photosynthetically derived carbon compounds as an energy source for the fungi, while the fungi enhance the host plant's capacity to absorb water and essential mineral nutrients, particularly phosphorus (P), nitrogen (N), and various micronutrients from the soil (Opanida,at al., 2020; Smith & Read, 2008 ;Brundrett, at al, 2009). Mycorrhizal associations play a crucial ecological role in forest ecosystems by improving plant growth, survival, and adaptation to environmental stress. Plants colonized by mycorrhizal fungi generally exhibit greater tolerance to drought due to the extensive network of fungal hyphae that increases the effective absorptive surface area of the root system, thereby enhancing water uptake. Furthermore, mycorrhizal colonization can improve plant resistance to soil-borne pathogens through various biological mechanisms that suppress pathogen infection and disease development (Hidayat *et al*.,, 2016). According to the Global Biodiversity Information Facility (GBIF) database (2021), approximately 11,024 fungal species have been recorded in Indonesia. Of these, 7,237 species belong to the phylum Ascomycota, whereas 3,330 species are classified within the phylum Basidiomycota, the majority of which comprise macrofungi. Fungi constitute one of the most important components of forest biodiversity and represent the second most species-rich group of organisms after insects. Globally, fungal diversity is estimated to reach approximately 1.5 million species; however, only about 69,000 species have been formally identified and described to date (Wahyudi *et al*., 2016). Fungi are heterotrophic eukaryotic organisms that obtain nutrients by absorbing organic compounds from their surrounding environment (Hindersah *et al*., 2014). They occupy a wide range of habitats, including decaying wood, leaf litter, soil, and living organisms with which they establish diverse ecological interactions. Based on their nutritional strategies, fungi perform various ecological functions as saprotrophs, parasites, and mutualistic symbionts. Saprotrophic fungi play an essential role in the decomposition of organic matter, thereby facilitating nutrient cycling, improving soil fertility, and maintaining ecosystem functioning (Wahyudi *et al*., 2016).

Several distinct types of mycorrhiza are recognized, including arbuscular mycorrhiza, ectomycorrhiza, ericoid, orchid, monotropoid, and arbutoid mycorrhiza, along with ectendomycorrhiza and intermediate forms (Smith and Read, 2008; Indriyani, 2017). Ectomycorrhizal fungi stand out as one of the most widespread and ecologically important groups within this set, comprising thousands of species worldwide whose full taxonomic and ecological picture is still being worked out (Wu *et al*., 2023 dan Hyde *et al*., 2020). Structurally, an ectomycorrhizal association is marked by a fungal mantle wrapping the root tip and a Hartig net a web of hyphae that pushes between, but never into, the cortical cells (Agerer, 2006; Smith & Read, 2008) That arrangement lets nutrients pass efficiently between fungus and plant without compromising the integrity of the root cells. Both partners benefit: the host supplies carbon for fungal growth, and the fungus in turn improves the plant's access to water, phosphorus, and nitrogen, strengthening its resilience to biotic and abiotic pressures, soil pathogens included (Zuo *et al*, 2022 ; Kebert *et al*., 2022). Woody plants in families such as Fagaceae, Myrtaceae, Fabaceae, Dipterocarpaceae, and Pinaceae are especially prone to forming these partnerships (Neves *et al*., 2012; Montoya *et al*., 2019).

Klamono Nature Park gained protected status under Decree of the Minister of Agriculture No. 820/Kpts/Um/11/1982, dated 10 November 1982. Its boundaries a perimeter of 19.77 km enclosing about 1,909.37 ha were surveyed in 1991 by the Sub-Balai Inventarisasi dan Perpetaan

Hutan of Manokwari, Irian Jaya, and marked with concrete posts measuring 10 × 10 × 130 cm (Kabupaten Klamono Papua Barat, 2007). The park matters to nearby communities well beyond its conservation value: many residents rely on it for non-timber products such as wild fruit, medicinal plants, and firewood. As human use of the area intensifies, however, the resulting pressure can degrade habitat quality, shift species composition, and disturb ecological relationships — including those involving mycorrhizal fungi and other forest organisms.

Ectomycorrhizal diversity has been studied across many Indonesian forest types, y*et al*most nothing has been documented about the species present, or how they are structured as a community, within Klamono Nature Park itself. That gap is worth closing precisely because the park's vegetation remains largely intact, making it a plausible refuge for a rich assemblage of ectomycorrhizal taxa tied to native tree species. Establishing baseline data on species composition, diversity, dominance, and evenness is therefore a necessary first step — both to understand the ecological character of this fungal community and to give conservation planning and forest management in the region a scientific footing. Such data also feed into the broader effort to document fungal biodiversity in Southwest Papua, an area whose biological richness remains comparatively unexplored.

This study accordingly provides the first baseline account of macroscopic ectomycorrhizal diversity in Klamono Nature Park. Its specific aims are to document which ectomycorrhizal species are present and to calculate diversity, dominance, and evenness indices that describe the community's structure. The resulting information is intended to support future biodiversity surveys, conservation planning, and sustainable forest management across Papua.

2. MATERIALS AND METHOD

2.1. Place and Time of Research

The research took place within the forest of Klamono Nature Park, Sorong Regency, Southwest Papua. Field sampling ran for three months, from April through June 2023.

2.2 Materials and Equipment

The materials used in this study consisted of ectomycorrhizal fungi (sporocarps) collected from the study area as the primary research objects. The equipment included a map of Klamono Nature Park, a roll measuring tape, ruler, digital caliper, digital camera, specimen labels, plastic sample bags, a cool box for sample preservation during transportation, and field identification guides for ectomycorrhizal fungi. The primary object of this study was ectomycorrhizal fungi occurring within the forest ecosystem of Klamono Nature Park.

2.3 Research Method

Sampling locations were chosen purposively, targeting areas where vegetation known to associate with ectomycorrhizal fungi was present. Ten plots of 20 × 20 m (400 m^2) each were set up, giving a combined sampling area of 4,000 m^2 within the roughly 1,909.37-ha park. Within every plot, the ground was searched systematically — soil surfaces, leaf litter, decaying wood, and the base of likely host trees, all common locations for ectomycorrhizal fruiting bodies (Brundrett at al.,1996). Every sporocarp encountered in a plot was logged and collected for identification and subsequent analysis.

2.4. Research Procedure

2.4.1 Preparation

The preparation stage involved collecting relevant literature and background information related to the objectives of the study, including previous research on ectomycorrhizal fungi and the characteristics of the study area. A preliminary field survey was subsequently conducted to obtain an overview of the research site, identify potential sampling locations, assess accessibility, and facilitate logistical planning prior to field data collection. This stage also included the preparation of sampling equipment, specimen labels, and field documentation materials to ensure the systematic implementation of the study.

2.4.2 Establishment of Sampling Plots

Sampling plots were established using a purposive sampling method, whereby plot locations were deliberately selected based on vegetation characteristics and forest conditions considered suitable for the occurrence of ectomycorrhizal fungi. This approach was adopted because the distribution of ectomycorrhizal fungi is strongly influenced by the presence of compatible host plants and favorable habitat conditions rather than occurring randomly. A total of 10 permanent sampling plots (PSPs), each measuring 20 × 20 m (400 m^2), were established within the study area. The plots were systematically surveyed to inventory all ectomycorrhizal fungal sporocarps present. For each sporocarp encountered, the species was identified based on macroscopic morphological characteristics, including cap morphology, hymenophore type, stipe characteristics, color, texture, and other diagnostic features. In addition, the number of individuals of each species was recorded to provide quantitative data for subsequent analyses of species composition, diversity, dominance, and evenness.

2.4.3 Data Collection

Both primary and secondary data were gathered. Primary data comprised the ectomycorrhizal fungal species recorded within each sampling plot. The survey focused on macrofungal ectomycorrhizal sporocarps with a minimum pileus (cap) diameter of 0.5 cm, whereas smaller fruiting bodies were excluded because they could not be reliably identified based on macroscopic morphological characteristics (Lodge, at al., 2023)). Each sporocarp encountered during the survey was assigned a unique specimen label, photographed in situ using a digital camera, carefully collected, placed in a labeled paper envelope, and transported to the laboratory for further identification following the procedures described by Brundret *et al*., (1996), or each specimen, the number of individuals was recorded together with detailed macroscopic morphological characteristics, including pileus size and shape, color, surface texture, odor, hymenophore type (gills or pores), stipe morphology, stipe base characteristics, context (flesh), and other diagnostic morphological features used for macrofungal identification (Lodge,at al., 2023)

Habitat information was recorded for each plot as well, including the substrate a sporocarp was growing on (soil, litter, or decaying wood), the likely host tree species nearby, and general site conditions — variables known to shape where and how ectomycorrhizal fungi occur (Tedersoo, L., 2020). Secondary data came from earlier studies, journal articles, books, and institutional reports describing the park's general characteristics, environmental setting, and management history.

2.5. Data Analysis

Data were analyzed quantitatively for each parameter of interest and supplemented with qualitative description to aid ecological interpretation; results are presented as tables, figures, and narrative summaries of the ectomycorrhizal community. The analysis covered species composition, abundance (individual counts), diversity, dominance, and evenness. Composition was based on the taxa identified and their occurrence across plots, while abundance was expressed as the total sporocarp count per species. Community structure was then assessed using three standard ecological indices the Shannon–Wiener diversity index (H′), Simpson's dominance index (C), and Pielou's evenness index (E) covering, respectively, how diverse the community is, whether any taxa dominate it, and how evenly individuals are spread among species. The formulas for each are given below.

2.5.1 Ectomycorrhizal Fungal Species Diversity

Species diversity was measured with the Shannon–Wiener index (H′), a widely used metric that combines species richness with relative abundance to summarize how diverse and structurally complex a community is; larger H′ values reflect greater diversity. where H′ is the Shannon–Wiener diversity index, ni is the number of individuals of species i, and N is the total number of individuals across all species (Shanon dan Wiener dalam Indriyanto, (2006):

$$H' = -\Sigma \left[\frac{\mathrm{ni}}{\mathrm{N}}\right] \log \left[\frac{\mathrm{ni}}{\mathrm{N}}\right] \qquad (1)$$

Note: H′ = Shannon–Wiener diversity index; (ni) = number of individuals of the *i*th species; N = total number of individuals of all species.

H′ values were classified following Fahrul, (2007) H′ > 3 signals high diversity, H′ between 1 and 3 signals moderate diversity, and H′ < 1 signals low diversity.

2.5.2 Ectomycorrhizal Fungal Species Dominance

Dominance was assessed with Simpson's dominance index Simpson's Dominance Index (C), following Indriyanto (2006) using the formula below

$$C = \sum \left[\frac{\mathrm{ni}}{\mathrm{N}}\right]^2 \qquad (2)$$

Note: C = Simpson's dominance index; (ni) = number of individuals of the *i*th species; N = total number of individuals of all species.

Where C is Simpson's dominance index, ni is the number of individuals of species i, and N is the total number of individuals across all species. Alongside the index calculation, total individual counts per species were tabulated across all plots to characterize abundance and flag which taxa, if any, dominated the community. Index values were interpreted per Indriyanto (2006) 0.00 < C ≤ 0.30 indicates low dominance, 0.30 < C ≤ 0.60 moderate dominance, and 0.60 < C ≤ 1.00 high dominance..

2.5.3 Ectomycorrhizal Fungal Species Evenness

Evenness — how uniformly individuals are distributed among species — was measured with Pielou's evenness index (J′ or E). Higher values mean a more even spread across species, while lower values point to a community skewed toward a handful of dominant taxa Pielou (1966) cited in Indriyanto 2006):

$$e = H/\mathrm{Log}\ S \qquad (3)$$

Note: E = Pielou's evenness index; H′ = Shannon–Wiener diversity index; S = total number of species.

Where E is Pielou's evenness index, H′ is the Shannon–Wiener diversity index, and S is the total number of species. Values were interpreted following Krebs (1978) cited in Odum (1996): E > 0.60 indicates high evenness, 0.40 < E ≤ 0.60 indicates moderate evenness, and 0 < E ≤ 0.40 indicates low evenness

3. RESULT AND DISCUSSION

3.1 Species Composition of Ectomycorrhizal Fungi

Surveys across the ten plots yielded 10 ectomycorrhizal species totaling 205 individuals (Table 1). Boletus sp1 was the most numerous, with 39 individuals (19.02%), followed closely by Boletus sp2 with 36 (17.56%). That both Boletus taxa were so common suggests they are particularly well suited to the study area's conditions and readily form associations with compatible host trees. Corrales at al., (2022), similarly note that Boletus species are among the most frequently encountered ectomycorrhizal fungi in tropical forests, capable of partnering with a wide range of woody hosts — consistent with the general pattern in which ectomycorrhizal fungi trade improved water and mineral uptake for a share of the host's photosynthetic carbon (Smith and Read, 2008),). Other taxa recorded included Amanita sp. (28 individuals; 13.66%), Russula sp1 (16 individuals; 7.80%), Scleroderma citrinum (14 individuals; 6.83%), and Scleroderma sinnamariense, Laccaria sp., and Hydnum repandum, each with 13 individuals (6.34%). Amanita phalloides was the least abundant, with 11 individuals (5.37%)..

Such differences in abundance likely reflect a mix of environmental influences host-tree composition, soil physical and chemical properties, moisture, rainfall, light exposure, and the seasonal timing of sporocarp production. Anthony at al., (2025) reports that host-tree composition and broader forest characteristics are major drivers of ectomycorrhizal community structure, and that sporocarp output depends heavily on favorable conditions, meaning fruiting-body counts in the field do not necessarily track the full extent of the underlying mycelial network. That so many ectomycorrhizal taxa were recorded here suggests Klamono Nature Park offers suitable habitat for a fairly diverse set of species associated with its forest trees (D'Entremont & Kevlin, 2023).). Most sporocarps were found on soil and in leaf litter, matching Rikardo *et al*., (2021), who reported that fungi commonly inhabit soil, decaying wood, leaf litter, and other organic who likewise found fungi concentrated in soil, decaying wood, and litter. Light, temperature, and moisture are also recognized as key drivers of fungal growth, fruiting, and distribution (Annissa *et al*., 2017).

3.2. Macroscopic Morphology of Ectomycorrhizal Fungi in Klamono Nature Park

Macroscopic examination confirmed 10 ectomycorrhizal species in the park's forest ecosystem, identified from features such as pileus shape and color, hymenophore type, stipe morphology, surface texture, and other diagnostic traits. A summary of each species' macroscopic characteristics is given in Table 2.

Tabel 1. Species composition and abundance of ectomycorrhizal fungi recorded in Klamono Nature Park

No	Species Name	Individuals	Percentage (%)
1	*Hydnum repandum*	13	6,34
2	*Scleroderma sinnamariense*	13	6,34
3	*Scleroderma citrinium*	14	6,83
4	*Amanita phallloides*	11	5,37
5	*Laccaria sp*	13	6,34
6	*Russula sp2*	16	7,80
7	*Rusula sp1*	22	10,73
8	*Boletus sp1*	39	19,02
9	*Amanita sp*	28	13,66
10	*Boletus sp2*	36	17,56
	Total species	205	205

Tabel 2. Macroscopic Morphological Characteristics of Ectomycorrhizal Fungi Recorded in Klamono Nature Park

No.	Fungal Species	Description
1	*Lacaria* sp. 	Macroscopic Description: Fruiting bodies are umbrella-shaped, with a pileus diameter ranging from 1.0 to 2.5 cm and a stipe height of 8.0–12.0 cm. The pileus is yellow with a smooth surface texture. Sporocarps occur either solitarily or in small colonies. They are typically found growing on soil in open areas, at a distance of approximately 1–4 m from the nearest potential host tree.
2	*Hydnum repandum* 	Macroscopic Description: The fungus exhibits a saprotrophic growth habit. The sporocarp has an open umbrella-shaped pileus with a diameter of approximately 3.9 cm, a stipe height of 5.5 cm, and a pileus thickness of approximately 1.3 cm. The pileus is brownish-white with a smooth surface texture. The sporocarp grows on soil, typically occurring at a distance of 1–4 m from the nearest potential host tree.
3.	*Scleroderma citrinium* 	Macroscopic Description: The sporocarp is brown and subglobose to globose in shape, with a diameter of approximately 1.3 cm. The outer surface is hairy (tomentose) and attached at the center by a short stipe. The sporocarp lacks a differentiated pileus, pileus surface, lamellae (gills), and annulus (ring). It is typically found growing on decaying wood, indicating a wood-associated habitat.
4.	*Scleroderma sinnamariense* 	Macroscopic Description: The sporocarp is globose to slightly protruding in shape, with a conspicuous coloration ranging from yellowish to brown. The outer peridium is hard with a smooth surface that develops fine cracks as the fruiting body matures. The sporocarp typically grows on the soil surface or at the base of tree trunks, where it forms ectomycorrhizal associations with nearby host trees.
5.	*Armanita* sp 	Macroscopic Description: The sporocarp possesses a pileus measuring 3.5–7.0 cm in diameter, ranging from convex to umbrella-shaped, with a white, smooth surface. The stipe is also white, smooth, and measures approximately 10.0–15.3 cm in height. Sporocarps occur solitarily or in small colonies in relatively open habitats with a leaf litter layer of approximately 2 cm. The fruiting bodies were recorded at distances of approximately 2.5–3.5 m from the nearest potential host tree, indicating their association with ectomycorrhizal host species.
6.	*Russula* sp[1] 	Macroscopic Description: The sporocarp has a cup-shaped to deeply concave pileus measuring approximately 8.3 cm in diameter. The pileus is purple with a smooth surface texture. The stipe is white, approximately 5.3 cm in height, and supports the fruiting body. Sporocarps occur solitarily in relatively open habitats and were observed growing at a distance of approximately 2–3 m from the nearest potential host tree, indicating an association with ectomycorrhizal host species.
7.	*Russula* sp[2] 	Macroscopic Description: The sporocarp has a convex pileus measuring approximately 5.4 cm in diameter. The pileus is purple with a smooth surface texture. The stipe is approximately 3.8 cm in height. Sporocarps occur solitarily in relatively open habitats and were observed growing at a distance of approximately 1–2 m from the nearest potential host tree, suggesting an ectomycorrhizal association with nearby host plants.

8.	*Boletus* sp^{1} 	Macroscopic Description: The sporocarp has a pileus measuring 1.4–6.3 cm in diameter, varying from convex to plane (flattened) in shape. The pileus is orange with a smooth surface texture. The stipe is orange, smooth, and ranges from 3.3 to 8.2 cm in height. Sporocarps occur solitarily or in small colonies in relatively open habitats with a leaf litter layer of approximately 4 cm. Fruiting bodies were recorded at distances of approximately 0.5–2.5 m from the nearest potential host tree, indicating their association with ectomycorrhizal host species.
9.	*Boletus* sp^{2} 	Macroscopic Description: The sporocarp has a pileus measuring 3.5–7.0 cm in diameter, varying from convex to plane (flattened) in shape. The pileus is white with a smooth surface texture. The stipe is orange, smooth, and ranges from 3.3 to 8.2 cm in height. Sporocarps occur solitarily or in small colonies in relatively open habitats with a leaf litter layer of approximately 4 cm. Fruiting bodies were observed at distances of approximately 0.5–2.5 m from the nearest potential host tree, indicating their association with ectomycorrhizal host species.
10.	*Amanita phallloides* 	Macroscopic Description: The sporocarp is white and possesses an umbrella-shaped pileus measuring approximately 3–6 cm in diameter with a smooth surface texture. The stipe is cylindrical, white, and smooth. Sporocarps were found growing on decaying wood, leaf litter, and soil, indicating a preference for organic substrates. Fruiting bodies were recorded at distances of approximately 0.5–2.0 m from the nearest potential host tree, consistent with their occurrence in association with ectomycorrhizal host species.

3.3 Diversity, Dominance, and Evenness Indices of Ectomycorrhizal Fungi

Figure 1 (referenced here as the summary chart of computed index values) shows H′ = 0.95, C= 0.12, and E = 0.92 for the ectomycorrhizal community of Klamono Nature Park. The Shannon–Wiener index (H′ = 0.95) falls in the low-diversity range, implying the community is built from relatively few species and has limited overall richness. Such a low value may mean that only a small subset of ectomycorrhizal taxa is well adapted to local conditions, or that environmental constraints are limiting how many species can establish and persist. Both biotic and abiotic factors shape ectomycorrhizal diversityt Suza *et al*., (2017) found that differences in environmental setting influence taxonomic and functional diversity, with forest stand structure playing a central role, while. Rosinger *et al*., (2018) showed that soil properties, nitrogen availability, temperature, and precipitation all significantly affect diversity and community composition. These influences plausibly help explain the comparatively low diversity recorded in the present study.

Simpson's dominance index (C) was 0.12, pon to low species dominance within the ectomycorrhizal fungal community. This result suggests that no single ectomycorrhizal species numerically dominated the community, and that the recorded species were relatively evenly represented across the study area. The absence of a dominant species reflects a balanced community structure in which individuals are distributed among multiple ectomycorrhizal taxa rather than being concentrated in a single species. The dominance pattern of ectomycorrhizal fungi is influenced by several ecological factors, including species composition, spatial distribution, habitat characteristics, and interactions with compatible host plants. Variations in these factors determine the abundance and competitive success of individual ectomycorrhizal species within forest ecosystem.

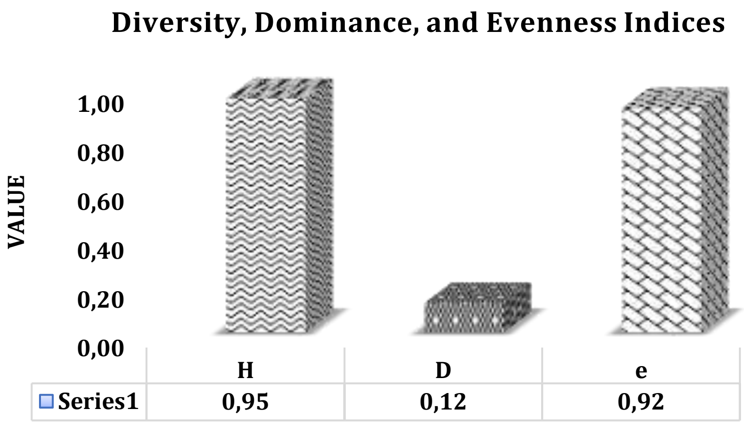

Figure 1. Diversity, Dominance, and Evenness Indices

Kasongat *et al*., (2019) eported that the dominance index of ectomycorrhizal fungi is primarily determined by the occurrence and distribution of ectomycorrhizal species within a forest community and reflects the degree to which one or a few species predominate in terms of abundance. The low dominance value observed in the present study therefore indicates a relatively balanced ectomycorrhizal fungal community, with no evidence of ecological dominance by a particular species. The Pielou's evenness index (E) was 0.92, indicating a high level of species evenness within the ectomycorrhizal fungal community. This result demonstrates that individuals were distributed relatively uniformly among the recorded ectomycorrhizal species, with no single species overwhelmingly dominating the community. High evenness is generally indicative of a stable community structure in which species coexist with relatively similar abundances. The observed high evenness is likely influenced by several ecological factors, including species distribution, habitat heterogeneity, and interactions between ectomycorrhizal fungi and their host plants. Ponisri *et al*., (2022), uggested that habitat characteristics, particularly topographic slope and the composition of compatible host vegetation, play important roles in determining the growth, establishment, and spatial distribution of ectomycorrhizal fungi within forest ecosystems. These environmental conditions may have promoted a relatively balanced distribution of ectomycorrhizal species throughout the study area. Baderan *et al*., (2021) reported that a high species evenness index reflects a community in which individuals are distributed more uniformly among species, with no single species exhibiting ecological dominance. Such a pattern is generally considered an indicator of a stable and well-balanced biological community. The high evenness recorded in the present study therefore suggests that the ectomycorrhizal fungal community in Klamono Nature Park is characterized by a relatively balanced species distribution despite its low overall species diversity.

4. CONCLUSION

This study documented 10 ectomycorrhizal species and 205 individuals in Klamono Nature Park, Southwest Papua: Boletus sp1 (39; 19.02%), Boletus sp2 (36; 17.56%), Amanita sp. (28; 13.66%), Russula sp1 (22; 10.73%), Russula sp2 (16; 7.80%), Scleroderma citrinum (14; 6.83%), Scleroderma sinnamariense, Laccaria sp., and Hydnum repandum (13 each; 6.34%), with Amanita phalloides the least abundant (11; 5.37%). The Shannon–Wiener index (H′ = 0.954) indicates low species diversity, Simpson's dominance index (C = 0.12) shows that no single species dominates the community, and Pielou's evenness index (E = 0.916) reflects a fairly uniform distribution of individuals among species. Overall, although the ectomycorrhizal community of Klamono Nature Park has limited species richness, its structure is balanced, with no evidence of dominance by any single taxon.

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