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Diversity, composition and distribution of bracket fungi in Mt. Arayat Protected Landscape, Pampanga, Philippines

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Abstract. *Bustillos RG, De Guzman JMT, Caymo ES. 2025. Diversity, composition and distribution of bracket fungi in Mt. Arayat Protected Landscape, Pampanga, Philippines. Biodiversitas 26: 4954-4966.* Despite its recognition as a protected area, little attention was given to the macrofungal diversity of Mt. Arayat Protected Landscape (MAPL), Pampanga, Philippines. This study investigated current diversity of wood-inhabiting fungi in three collection sites of MAPL (i.e., North Peak, South Peak, Pinnacle) and varying elevation gradients (i.e.,100-250, 251-500, 501-750 masl). Bracket fungi were purposively collected and characterized using morphological properties and further validated by experts. A total of 47 species were identified, belonging to the class Agaricomycetes and grouped into 4 orders, 7 families, and 14 genera. Out of these, 32 species were identified down to the species level, while 15 were at the genus level and require DNA barcoding to confirm their identities. The order Polyporales and genus *Ganoderma* recorded the highest number of species. The majority of the bracket fungi were anchored on dead logs, living solitary and are non-edible. Shannon and Simpson diversity indices showed that the South Peak has the highest fungal diversity and richness. The three collection areas have almost even distribution of species. Sorensen index reveals high similarity of species found among collection sites. Moreover, diversity according to altitude is highest at 251-500 masl with moderate richness and even distribution of species. Only 251-500 masl and 501-750 masl share similar species, while slight variations are observed in other elevation ranges. This pioneering report on diversity of MAPL reflects its forest status that can be used as baseline information for continuous monitoring of its condition and contribute to biodiversity conservation and sustainability efforts.

Keywords: Conservation, elevation gradients, MAPL, sustainability, wood-inhabiting fungi

INTRODUCTION

Fungi are known as the second most diverse group of organisms, naturally inhabiting nearly all ecosystems. Fungal diversity worldwide recorded a total of 2.2 to 3.8 million species; however, only 3% of them have been identified (Hawksworth and Lűcking 2017). To date, 14,000 species of macrofungi have been recorded globally, of which 2,371 have been reported from the Philippines. These organisms are useful for human health and environmental function (Kirdeeva et al. 2022). In medicine, macrofungi have diverse medicinal properties for disease treatment and prevention. Many therapeutic drugs were derived from the bioactive components of macrofungi (Gafforov et al. 2023), which have antioxidant, hypocholesterolemic, hypoglycemic, anticancer, antiviral, antibacterial, anti-inflammatory, hepatoprotective, and immunomodulating effects, while continuously aiding in the development of new treatments and therapies (Bustillos et al. 2014; Dulay et al. 2020; Fokunang et al. 2022).

Bracket fungi, a type of polypore that is physiologically and ecologically important. They are spore-producing macrofungi with a distinct shelf-like appearance, typically anchoring on living or dead trees (Kinge et al. 2020). They are crucial to the decomposition process by breaking down cellulose and some lignin of plants (Singh and Singh 2023). These species are key members of the environment by providing a natural habitat for various organisms and by forming symbiotic relationship with their hosts and substrates (Sun et al. 2019; Suwannarach et al. 2022). Thus, they are considerably important indicators of forest health (Rakić et al. 2023).

In the Philippines, most macrofungal species, including bracket fungi, remain undocumented from the wild (Culala and Dulay 2018). Thus, there is a need to strengthen literatures via constant monitoring of forest ecosystem and the macrofungi thriving in them to rescue cell lines for the purpose of elucidating their promising medicinal and biotechnological potentials. Various studies of macrofungal diversity is focusing mainly across areas of Luzon Islands including Mt. Makiling Forest Reserve (MMFR), Mt. Banahaw-San Cristobal Protected Landscape (MBSCPL) in Quezon Province Southern Luzon (Parlucha et al. 2021), Quezon Protected Landscape-Northeast side (Brazas et al. 2020), Nueva Vizcaya (Torres et al. 2020), urban forest of Bicol region (Guerrero et al. 2020), Laguna (Tadiosa and Arsenio 2014), Bulacan (Liwanag et al. 2017), Nueva Ecija (De Leon et al. 2016), and Pampanga, Tarlac, and Zambales (De Leon et al. 2013). Despite these publications, only few studies have been specifically focused on the distribution of bracket macrofungi including the Mt. Kilakiron, province of Bukidnon in Mindanao (Cababan et al. 2021).

Mt. Arayat Protected Landscape (MAPL) is an isolated stratovolcano stands in Central Luzon Plains, Pampanga Province, Luzon Island. Covering a total land area of 3,715 ha its highest peak in the north is 1,030 meters above sea level (masl) (Suba et al. 2019b). This landscape harbors a rich flora and fauna (Bagunu et al. 2018; Suba et al. 2019a, b) and a home to endangered cycads (Bösenberg 2023) and myxomycetes (Dagamac et al. 2014). MAPL had been proclaimed protected area and recognized center of biodiversity conservation since 1997 (DENR/UNEP 1997). This territory in Luzon, formerly Mt. Arayat National Park is a lawfully recognized zone and presently has a recreational and ecotourism potential. Its unique topography and Type I climate with wet and dry seasons can be an exceptional attribute for the conducive environment for fungal population. Although macrofungal diversity studies have been initiated in various areas in Luzon, MAPL remains less investigated. To fill this gap, this study was done to investigate the diversity of bracket fungi. This initial study underscores the significance bracket fungi as an integral part of the forest; thus, it emphasizes its inclusion to biodiversity assessment and initiatives that will help understand trends on conservation not only in MAPL but across Philippines.

MATERIALS AND METHODS

Permit acquisition

A permit was obtained by presenting a research proposal to the regional office of the Department of Environment and Natural Resources (DENR) for the granting of a gratuitous permit. The collection of bracket fungi was permitted under Protected Area Management Board (PAMB) under Permit No. III-2023-008 (New) and was issued in May 2023 by the DENR III, San Fernando, Pampanga, the Philippines. Trained Forest Guides were assigned during the entire field work.

Study site

The Mt. Arayat Protected Landscape (15°12'06"N 120°44'13"E) is a protected area declared by the DENR (Figure 1). The mountain sits in the municipality of Arayat in the province of Pampanga, in the central plains of Central Luzon, Philippines. It is a dormant mountain covered with forest with peak of 1,030 meters above sea level (masl). The landscape is divided into three peaks: North Peak (15°12'08"N 120°44'34"E) near the Barangay Ayala, Magalang and where the summit is situated, South Peak (15°11'37"N 120°44'34"E) and Pinnacle Peak (15°11'43"N 120°44'44"E) near the San Juan Baño, Arayat, Pampanga. The whole area is characterized by Type I climate which is wet in the months of May until October and dry in November until April (Dagamac et al. 2012). The topography has a moderate steepness in the North Peak, while the South Peak and Pinnacle are generally steep. The lower elevations, herbs and grasses are predominant vegetation while massive forest cover the higher elevations. But due to its ridge line some areas are inaccessible for collection particularly the Pinnacle. Its recognition as a protected area also adds on its protection for collection of macrofungi, making MAPL as an ecologically diverse forest ecosystem in Luzon Island, Philippines.

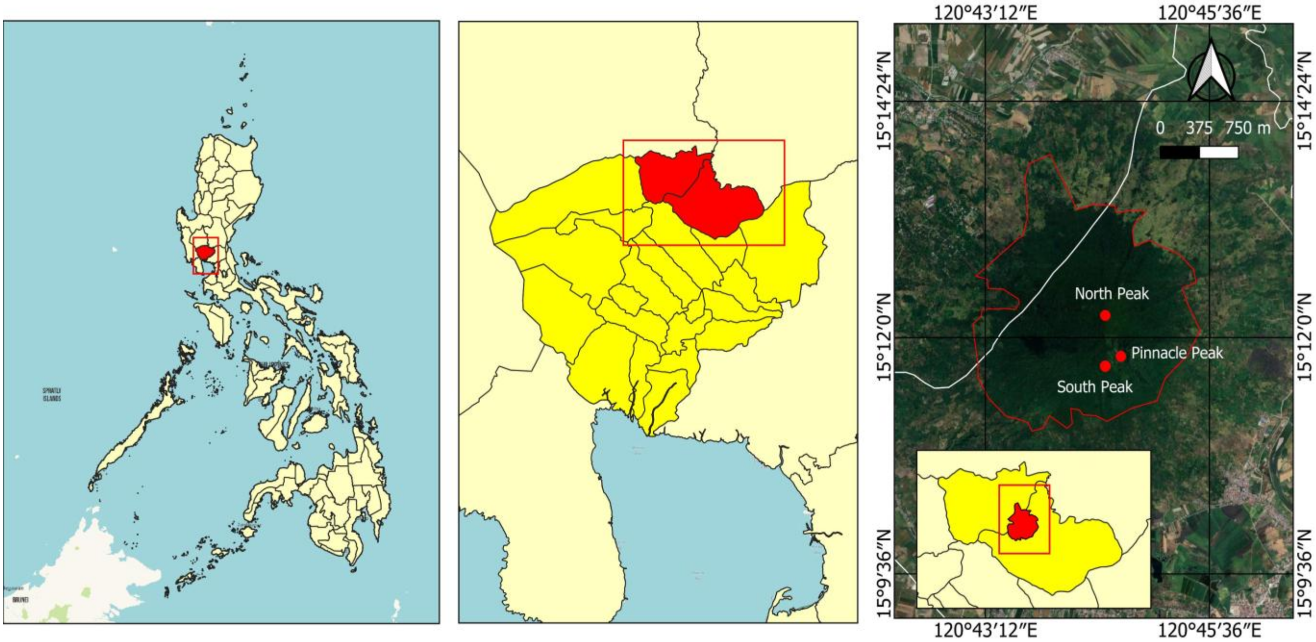

Figure 1. Map of Mt. Arayat Protected Landscape (MAPL), showing the different study sites: North Peak, South Peak, and Pinnacle Peak, Pampanga, Philippines

Field sampling of bracket fungi

Opportunistic and purposive sampling (Dulay et al. 2020) was used as a template to maximize documentation of bracket fungi in this study. Three transect lines (one in each peak) measuring 1,000 m long were used as collection sites and visited once in each month in January, March and May of 2024. All visible sporulation bodies anchoring on either living and dead logs, twigs and trunks along both sides (left and right) of the transect lines were considered for collection and documentation. During the period of collection, relative humidity and temperature were documented from 7:00 AM-1:00 PM in the natural habitats of the bracket fungi. The location and elevation of bracket fungi were documented using Global Positioning System (GPS). Specimens were photo-documented and carefully collected from their substrates for morphological identification.

Morphological identification of collected bracket fungi

The morphological identification of the collected bracket fungi was classified based on their morphological structures. Their micro and macroscopic attributes were analyzed for identification focusing mainly on features such as color, size, shape, margin, gills, and stipe following and validating through the works of Bustillos et al. (2024, 2025). Pictorial Guide of Philippine Indigenous Mushrooms Dulay et al. (2020), Cababan et al. (2021), Kalaw et al. (2023) and further authenticated by a mycologist. All collected samples were not preserved in any herbarium; however, a few species were tissue cultured for further molecular identification and biological analysis.

Data analysis

The percentage composition of the macrofungal taxa was computed to assess the occurrence of macrofungal species in three collection sites (North Peak, South Peak, Pinnacle), three collection months (January, March, May), and three elevation ranges (100-250, 251-500, and 501-750 masl). The formula used is as follows:

Composition (%) = (total number of macrofungi occurred/total number of macrofungal taxa) × 100

Biodiversity indices of bracket fungi diversity were calculated using PAST 4.0 software to analyze the Shannon Index (H'), Simpson's Index (D) and Margalef's Index (R) through standard formulae (Guron et al. 2019), from the works of Simpson (1949), Hussain et al. (2012), Fernando and Cereno (2020) and Latumahina et al. (2020). Sorensen Similarity Index (Sorensen 1948) was used to calculate similarities of species between ecological sites. Macrofungi species were also described based on their substrate, growth habit, habitat and edibility. Taxonomic classification of the macrofungi using the morphological data was also described in this study.

RESULTS AND DISCUSSION

Bracket fungi composition of Mt. Arayat Protected Landscape

A total of 164 samples of bracket fungi sporulating bodies were collected during the three months of collection from the MAPL Arayat, Pampanga, Philippines. However, due to the occurrences of the same species in different sites and elevations, distribution was calculated on the number of collections instead of species count, with a total of 89 species (Table 1); however, only 47 were identified based on the species count. South Peak had the highest composition with 74.47%, while the Pinnacle Peak had the lowest number of bracket fungi at 42.55%. Additionally, January (78.72%) recorded the majority of species and lowest in May (31.91%). This study also investigated the abundance of bracket fungi in three elevation ranges: 100-250, 251-500 and 501-750 masl. Among the three elevation ranges, majority of species were obtained from the 251-500 masl with 87.23%, whereas 100-250 masl documented the lowest number of species with 40.43%.

Commonly, temperature and moisture are precursors for aggressive sporulation of macrofungi. They grow optimally in temperature ranging at 24-35°C for mycelial production (Bustillos et al. 2024). The months of January to May are characterized by hot summer season with minimal rainfall and humidity which limits mycelial proliferation. The decreasing trend in abundance of species from January to May is mainly an attributed effect of abiotic factors such as temperature, rainfall and humidity. During the sampling period the existing factors such as temperature, rainfall and humidity were recorded based on the current data of PAG-ASA (Philippine Atmospheric, Geophysical and Astronomical Services Administration) where January recorded the lowest temperature at 33.33°C while May registered the highest at 37.78°C. On the other hand, precipitation was at the lowest in a year in the month of May with 23.33 mm. Due to this, basidiomycetes became more abundant in MAPL during the wet season from June to October (Bustillos et al. 2024) compared to the dry months of November to May (Arenas et al. 2018; Dulay et al. 2020; Bustillos et al. 2024). Apparently, this discrepancy is a common observation that after a heavy precipitation, mycelia of mushrooms proliferate aggressively in their natural substrates such as soil, leaf litters and fallen logs. This notion is supported by the study of Priyamvada et al. (2017) in Hindu Kush range, Bajaur, Pakistan where macrofungi composition is higher in the rainy months and gradually decreasing in the dry season from December to May (Zeb et al. 2023). The lack and availability of moisture are prominent factor in promoting fructification.

Table 1. The distribution and composition of 47 species of bracket fungi in different collection sites, months, and elevation ranges in Mt. Arayat Protected Landscape, Philippines

Species	Collection sites			Collection month			Elevation (masl)		
	North Peak	South Peak	Pinnacle	Jan	Mar	May	100-250	251-500	501-750
Auricularia polytricha (Mont.) Sacc.		▪		◆			•	•	
Coltricia cinnamonea (Jacq.) Murrill		▪		◆			•		
Coltricia parennis (L.) Murrill	▪	▪		◆		◆	•		•
Coltricia sp. 1	▪	▪			◆		•	•	
Coltricia sp. 2	▪	▪	▪		◆		•	•	
Cryptoporus volvatus (Peck) Shear	▪	▪		◆			•		
Fomes faciatus (Sw.) Cooke	▪	▪		◆	◆	◆	•	•	•
Fomes fomentarius (L.) Fr.		▪		◆				•	
Fomitopsis feei (Fr.) Kreisel	▪	▪	▪	◆	◆	◆			•
Fomitopsis pinicola (Sw.) P.Karst.	▪	▪		◆	◆	◆		•	•
Fomes sp. 1	▪	▪			◆			•	
Fomes sp. 2	▪	▪	▪		◆			•	
Ganoderma applanatum (Pers.) Pat.	▪	▪	▪	◆	◆	◆	•	•	•
Ganoderma australe (Fr.) Pat.	▪	▪	▪	◆	◆		•	•	
Ganoderma carnosum Pat.	▪	▪		◆	◆		•	•	
Ganoderma ellipsoideum Hapuar., T.C.Wen & K.D.Hyde	▪			◆			•	•	
Ganoderma lobatum (Cooke) G.F.Atk.	▪		▪	◆	◆	◆	•	•	
Ganoderma lucidum (Curtis) P.Karst.	▪	▪	▪	◆	◆	◆	•		
Ganoderma sp. 1	▪			◆	◆			•	•
Ganoderma sp. 2		▪		◆				•	•
Ganoderma sp. 3		▪		◆				•	
Ganoderma sp. 4		▪			◆		•	•	
Ganoderma tsugae Murrill	▪			◆			•	•	
Hexagonia hydnoides (Sw.) M.Fidalgo		▪		◆				•	
Microporus affinis (Blume & T.Nees) Kuntze	▪	▪	▪	◆	◆	◆		•	•
Microporus sp.1	▪			◆				•	
Microporus vernicipes (Berk.) Kuntze		▪		◆				•	•
Microporus xanthopus (Fr.) Kuntze	▪	▪	▪	◆		◆		•	•
Phellinus conchatus (Pers.) Quél.	▪			◆				•	
Podoscypha elegans (G.Mey.) Pat.			▪		◆			•	•
Podoscypha sp. 1	▪	▪		◆	◆			•	•
Polyporus alveolaris (DC.) Bondartsev & Singer	▪	▪	▪		◆	◆	•	•	
Polyporus sp. 1		▪		◆				•	•
Polyporus tuberaster (Jacq. ex Pers.) Fr.		▪	▪	◆				•	
Pycnoporus sanguineus (L.) Murrill	▪		▪	◆	◆				•
Stereum lobatum (Kunze ex Fr.) Fr.		▪		◆		◆		•	•
Stereum insignitum Quél.	▪		▪	◆	◆			•	•
Stereum ostrea (Blume & T.Nees) Fr.	▪		▪		◆	◆		•	•
Stereum sp. 1	▪	▪			◆			•	
Trametes elegans (Spreng.) Fr.	▪	▪	▪	◆	◆	◆	•	•	•
Trametes hirsuta (Wulfen) Lloyd	▪	▪	▪		◆			•	•
Trametes parvispora Olou, Yorou & Langer	▪	▪	▪	◆	◆		•	•	•
Trametes pubescens (Schumach.) Pilát	▪	▪	▪	◆	◆	◆		•	•
Trametes sp. 1	▪			◆				•	
Trametes sp. 2	▪			◆				•	•
Trametes sp. 3		▪		◆				•	
Trametes versicolor (L.) Lloyd	▪	▪	▪	◆	◆		•	•	•
Total	34	35	20	37	28	15	19	41	23
Composition (%)	72.37	74.47	42.55	78.72	59.57	31.91	40.43	87.23	48.94

Note: (◆ ▪ •): Present

Table 2. Bracket fungi species diversity and similarity index comparing the three collection sites in Mt. Arayat Protected Landscape, Philippines

Collection sites	Total individuals (N)	Number of genera (S)	Shannon Index (H')	Simpson Index (D)	Margalef's Richness (R)	Pielou's Evenness (J')
North Peak	59	12	2.15	0.82	2.67	0.81
South Peak	62	12	2.18	0.86	2.70	0.88
Pinnacle	43	9	2.05	0.80	2.13	0.84

Sorensen Similarity Index	
South Peak vs North Peak	0.83
South Peak vs Pinnacle	0.86
North Peak vs Pinnacle	0.70

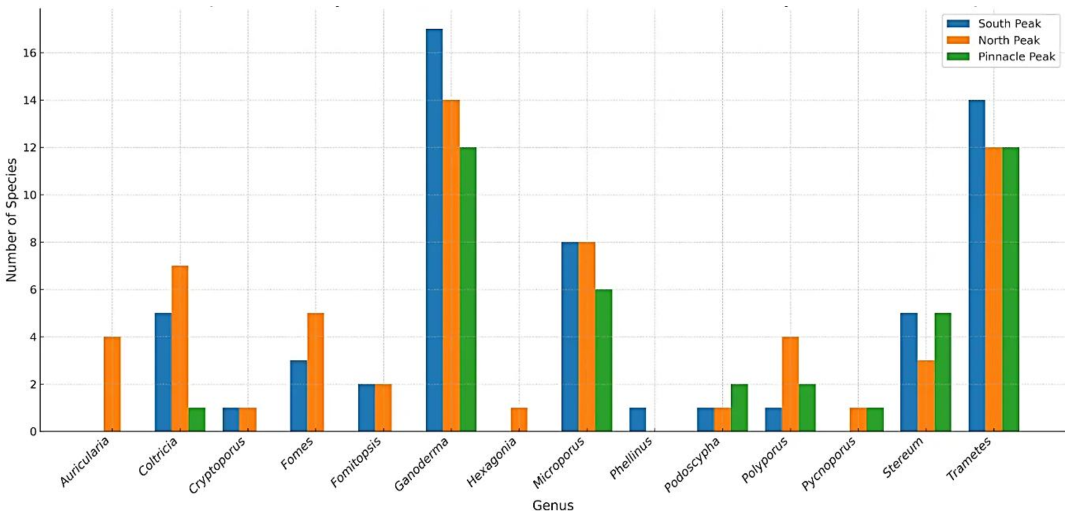

Figure 2. Diversity of bracket fungi based on their genera different collection sites of Mt. Arayat Protected Landscape, Philippines

Bracket fungi diversity across study sites

Fungal diversity was assessed and calculated using the Shannon-Weiner diversity Index (H) following the classification scheme of Fernando et al. (1998), whereas, Simpson (D), Margalef (R) and Evenness (J) measure dominance, richness and evenness, respectively. Sorensen similarity Index was used to quantify similarity between samples within their respective collection sites (Table 2). The site with the highest species diversity was the South Peak (H=2.18 and D=0.86). The site also exhibited highest richness (R=2.70) and evenness of distribution (J=0.88). Sorensen similarity index indicates that all collection sites share the same kind of species.

Amongst all study sites, the South Peak has higher species diversity due to its thick canopy and presence of lusher vegetation. The Pinnacle is mainly rocky in northeastern side and has a very steep terrain and ridgeline making it difficult for collection. Thus, thorough collection procedure is suggested to come up with a more comprehensive assessment. Although the North Peak has a wider rim, it is more prone to disturbances due to agricultural conversion and increasing popularity as a recreational site (Dagamac et al. 2014). It is also a common site for pilgrimage during the summer months. During the field sampling, there was evidence of fragmented slash-and-burns as well as charcoal processing, which augments the disturbance of the natural forest. This report aligns with the findings of Saado (2018) in Kereita Forest, Kenya which reported that is macrofungi is highly present in natural forest and lowest at the altered habitats. Abundance is reduced due to unavailability of substrates caused by certain human activities. Since the availability of anchorage for macrofungi is important, diversity is affected by their presence and therefore crucial to building of macrofungal communities (Siwulski et al. 2019).

Forty-seven polypore species in 14 genera were documented in this study (Table 5). These polypores specifically found thriving in woody area in the upper elevation, attached to wood substrates either living or rotten logs and tree branches. The genera *Ganoderma*, *Trametes* and *Microporus* are common to all study sites but highest in the South Peak (Figure 2). Their abundance could be due to the availability of favorable substrates which also favors their fruiting body formation. The undisturbed portions, presence of low temperature and optimal pH are contribute to their abundance (Cababan et al. 2016). The saprophytic and decomposing ability of these genera provides a good condition releasing organic acids in the soil and providing optimal pH for the survival of other organisms. Although the overwhelming number of macrofungi in MAPL in the rainy season did not exceed by this present result, its unique bracket fungal composition during the dry months are proofs that the forest suffices their requirements to survive. Thus, it is further suggested that monitoring must be done regularly to assess their growth, and distribution trends spatially and seasonally in a longer period.

Bracket fungi diversity along elevation gradients

The distribution according to elevation gradients is also described in this study as depicted in Table 3 and Figure 4. True enough that macrofungi density can be influenced by the presence of natural substrates. Another contributing factor is the altitude, which may be composed of distinct microclimatic conditions that influence growth (Brazas et al. 2020; Mannaa and Kim 2018). With varying altitudes, different macrofungi are distributed accordingly. Amongst the elevation ranges studied, macrofungal composition was found higher in the mid-elevation (251-500 masl). Shannon and Simpson indices revealed that 251-500 masl obtained the highest diversity with H=2.09 and D=0.85, respectively. The mid-elevation showed highest fungal richness (H=2.46), suggesting a favorable substrate condition. The three elevation ranges have even distribution of macrofungi ranging from J=0.72-0.84. Moreover, Sorensen similarity index revealed that similarity of species is common only between 251-500 masl vs 501-750 masl while slight variation and overlap occur in other altitudes.

The difference in macrofungal diversity according to elevation gradients can be attributed to the type and quantity of substrate such as trees and growing plants. The well-preserved old forest at mid-elevation composed particularly of diverse wood species and substrates with high water holding potentials provides refuge to the growth and survival of macrofungi in MAPL. This finding aligns with that of Noordin et al. (2024), who conducted a study on species diversity in the Lentang Forest Reserve, Malaysia. The most frequently encountered genera in particularly in the mid-elevation area are *Ganoderma* and *Trametes* (Figure 3). This investigation aligns with the findings in Mt. Kilikaron, Bukidnon Province, the Philippines where *Ganoderma* and *Trametes* dominates the collected samples. The highest number of species was recorded in mid-elevation of three sampling sites. There were 44 samples collected belonging to 25 species compared to 17 and 20 samples collected from the two other sampling sites (Cababan et al. 2021). This result is still in congruence with report where macrofungal composition is relatively higher in mid-range elevation compared to higher elevations as emphasized in the Byeonsanbando National Park Tibetan Plateau (Han et al. 2023). Also, a study of Zhang et al. (2024) reported an observed trend that increasing altitude leads to decreasing canopy, which affects macrofungal abundance. The higher elevation of MAPL has a rocky topography, and this contributes to the minimal macrofungal growth due to the inadequacy of tree substrate.

Table 3. Bracket fungi species diversity and similarity index comparing the three elevation ranges in Mt. Arayat Protected Landscape, Philippines

Elevation ranges	Total individuals (N)	Number of genera (S)	Shannon Index (H')	Simpson Index (D)	Margalef's Richness (R)	Pielou's Evenness (J')
100-250	29	7	1.40	0.65	1.78	0.72
251-500	87	12	2.09	0.85	2.46	0.84
501-750	48	9	1.81	0.79	2.07	0.82

Sorensen Similarity Index	
100-250 masl vs 251-500 masl	0.63
100-250 masl vs 501-750 masl	0.50
251-500 masl vs 501-750 masl	0.76

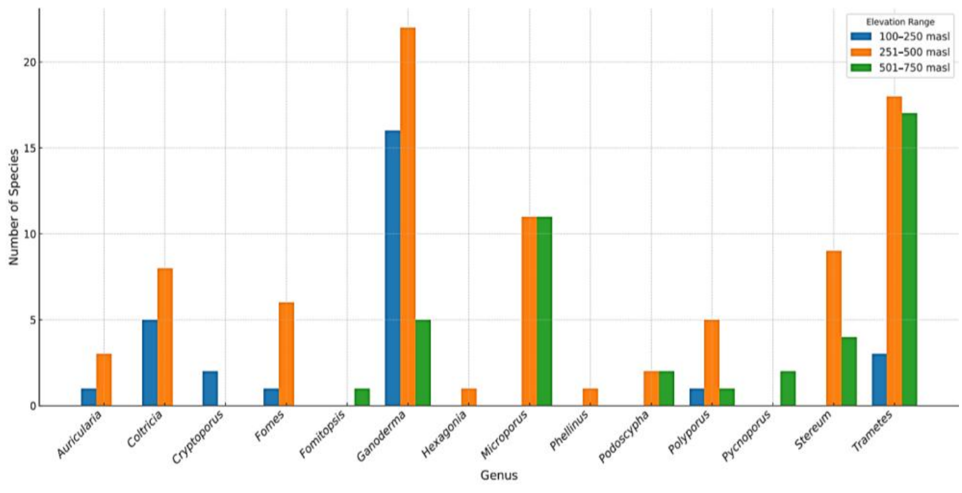

Figure 3. Diversity of bracket fungi based on their genera different elevation gradients of Mt. Arayat Protected Landscape, Philippines

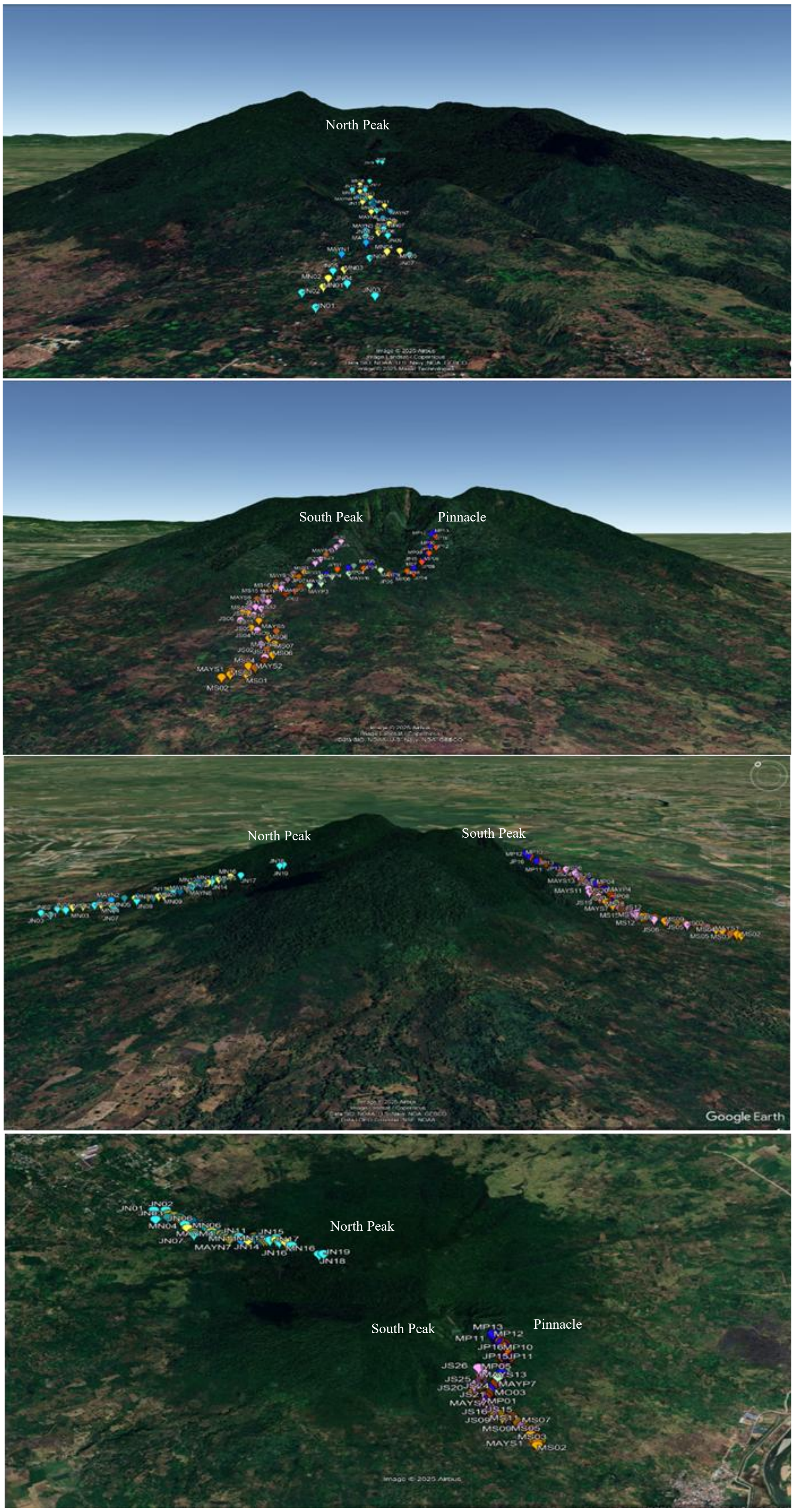

Figure 4. The distribution of investigated bracket fungi in the collection sites of Mt. Arayat Protected Landscape, Philippines (South Peak, North Peak and Pinnacle) at varying elevation ranges. They were specified with symbols J (January), M (March) and May (May)

However, on the contrary, Arenas et al. (2018) documented a higher macrofungal composition in higher elevation than in mid-range and lower elevation in Mt. Maculot, Batangas, Philippines. This also aligns with the study of Dulay et al. (2020), where the higher elevation recorded higher number of macrofungi due to the disturbed condition of the lower elevated collection sites in Tarlac, Philippines. On the contrary, the low species richness in the lowest elevation of MAPL is perhaps caused by the absence of favorable substrates such as trunks and decaying logs where they get their nourishment. Also, the absence of trees exposes the area to extreme heat in the summer months, which limits the presence of desirable substrate. Macrofungi prefer a cooler and moist environment (Laggui 2019), as this is a limiting factor that can either positively or negatively affect their morphology and growth rate (Luo et al. 2021). Relative to this, highest abundance of macrofungi was recorded at lowest elevation (Han et al. 2023), which occurred in the rainy seasons where order Agaricales is the most frequently encountered species (Bustillos et al. 2024).

Substrates and growth habit of bracket fungi in MAPL

This study also describes the ecological characteristics of 47 species, characterizing their substrate, growth habit, habitat and edibility. As presented in Table 4, the majority of species were found on dead logs and trunks, growing solitary, while others exhibit a gregarious nature. The intact forest particularly within 251-500 masl maintained the presence of these macrofungi. In terms of edibility, most of the collected samples were classified as non-edible, while the remaining species are identified as edible, but are considered non-palatable.

The abundance of bracket fungi in MAPL is attributed to their role in the ecosystem. Those found in decaying logs like *Schizophyllum* spp. indicates their decomposition activity (Matsumae et al. 2025). Aside from their decomposition activity, some macrofungi are also important symbionts. They either provide a mutualistic or parasitic response to trees and other plants hosts (Wei et al. 2024). There are species of macrofungi like Termitomyces that are found in termite mounds and symbiotically help termites to degrade plant-derived material (Ghorai et al. 2011). Meanwhile other bracket fungi species such as *Fomitopsis*, *Ganoderma* and *Microporus* are found anchoring on living trees suggesting their parasitic nature and anchoring on fallen dead logs to absorb organic food since none of them are photosynthetic. Altogether, the presence of these macrofungi, specifically the bracket fungi, reflects the composition of a forest, their distribution and abundance, thus suggesting forest health conditions.

Taxonomic listing of bracket fungi

After examination, the collected bracket fungi (Table 5) were classified into 1 phylum, 1 class, 4 orders, 7 families, 14 genera, and 47 species. All belonged to phylum Basidiomycota and class Agaricomycetes. Majority are within the order Polyporales followed by Hymenochaetales and Russulales and one is listed under Auriculariales. The highest number of species was observed under Polyporaceae, followed by Ganodermataceae, while the lowest number was recorded on Fomitopsidaceae and Auriculariaceae. *Ganoderma* and *Trametes* are the most recorded genera. However, of the 47 identified species only 15 were identified on their genus level namely: *Coltricia* spp. (2), *Ganoderma* spp. (4), *Microporus* sp. (1), *Podoscypha* sp. (1), *Polyporus* sp. (1), *Stereum* sp. (1), and *Trametes* spp. (3). This data highlights the need for further studies on bracket fungi using the DNA barcoding to reveal their appropriate species identities. Molecular identification can comprehensively provide accurate information in confirming their identities and for the purpose of discovering new species (Noordin et al. 2024).

Most of the collected species from order Polyporales (Figure 5)anchor on dead and rotten logs and fallen twigs of trees as common substrates (Zabel and Morell 2020). Similar results were obtained by Paguirigan et al. (2020) in Mt. Isarog National Park, Cababan et al. (2021) in Mt. Kilikaron, Bukidnon and Parlucha et al. (2021) in mountain forest ecosystems of Southern Luzon, Philippines. Moreover, this order accounted for the most prevalent species in Perlis State Park (Ahmadni et al. 2024), along with Gunung Korbu, Perak (Bakray et al. 2020), both in Malaysia. Agaricales and Polyporales are the most abundant in Dongling Mountains, Western Beijing, China while their occurrence is affected by either deciduous or coniferous vegetation types (Huang et al. 2025). Some forest composition is merely affected by the presence of substrates, such as stem thickness, which may influence temperature and humidity in a forest, thereby dictating what macrofungi survive (Pouska et al. 2016). This similar condition in MAPL is a predictor of polypore prevalence. The dominance of the order Polyporales in MAPL is attributed to the profound availability of weathered wood and logs (Bustillos et al. 2024). Species under this order are saprophytic fungi relying primarily on decomposition of organic material from decaying wood as a source of nutrients for survival (Chen et al. 2018; Karun et al. 2018). Overall, the presence of these species participates on the decomposition and balanced nutrient cycling in the forest (Fukasawa 2021).

Ecological roles and conservation of bracket fungi

Macrofungi are crucial organisms in the ecosystem. Majority of them participate in the organic matter decomposition and form symbiotic relationships with other organisms and so regarded as responsible for nutrient cycling. The Philippines being in a tropical region is perceived to have rich macrofungal diversity. This investigation contributes to the baseline information of bracket fungi in Mt. Arayat Protected Landscape emphasizing the 47 bracket fungi diversity and characterizing their distribution and roles in the Philippine forests. The considerable abundance of bracket fungi in the summer months is overwhelming result that reflects the vast forest composition of MAPL and may indicate how healthy the forest is (Rakić et al. 2023). Understanding their diversity provide a concrete assessment into their association and relationship to their ecosystems. Bracket fungi are forest species that needs recognition for their roles becoming a subject for mycologists and conservationists.

Table 4. Substrate, growth habit, and habitat and edibility of the collected bracket fungi in Mt. Arayat Protected Landscape, Philippines

Species	Substrate	Growth habit	Habitat	Edibility
Auricularia polytricha (Mont.) Sacc.	Dead log	Gregarious	Grassland/ Forest	E
Coltricia cinnamonea (Jacq.) Murrill	Dead log	Gregarious	Forest	N E
Coltricia parennis (L.) Murrill	Dead log	Gregarious	Forest	N E
Coltricia sp.1	Dead log	Gregarious	Forest	N E
Coltricia sp. 2	Dead log	Gregarious	Forest	N E
Cryptoporus volvatus (Peck) Shear	Dead log	Solitary	Grassland	E- NP
Fomes faciatus (Sw.) Cooke	Dead log	Gregarious	Forest	N E
Fomes fomentarius (L.) Fr.	Dead log	Solitary	Grassland	N E
Fomitopsis feei (Fr.) Kreisel	Dead log	Gregarious	Forest	N E
Fomitopsis pinicola (Sw.) P.Karst.	Dead trunk	Gregarious	Forest	N E
Fomes sp. 1	Dead log	Solitary	Forest	N E
Fomes sp. 2	Dead log	Solitary	Grassland	N E
Ganoderma applanatum (Pers.) Pat.	Dead log	Solitary	Grassland/ Forest	E-NP
Ganoderma australe (Fr.) Pat.	Dead log	Solitary	Forest	E-NP
Ganoderma carnosum Pat.	Dead log	Solitary	Forest	E-NP
Ganoderma ellipsoideum Hapuar., T.C.Wen & K.D.Hyde	Dead log	Solitary	Forest	E-NP
Ganoderma lobatum (Cooke) G.F.Atk.	Dead log	Solitary	Grassland/ Forest	E-NP
Ganoderma lucidum (Curtis) P.Karst.	Fallen dead trunk	Solitary	Forest	E-NP
Ganoderma sp. 1	Log	Solitary	Grassland	E-NP
Ganoderma sp. 2	Dead trunk	Solitary	Forest	E-NP
Ganoderma sp. 3	Dead trunk	Gregarious	Forest	E-NP
Ganoderma sp. 4	Dead trunk	Solitary	Forest	E-NP
Ganoderma tsugae Murrill	Dead log	Solitary	Forest	E-NP
Hexagonia hydnoides (Sw.) M.Fidalgo	Dead log	Solitary	Forest	N E
Microporus affinis (Blume & T.Nees) Kuntze	Dead log	Scattered	Grassland/ Forest	N E
Microporus sp.1	Dead log	Scattered	Grassland/ Forest	N E
Microporus vernicipes (Berk.) Kuntze	Dead trunk	Scattered	Grassland	N E
Microporus xanthopus (Fr.) Kuntze	Dead log	Scattered	Grassland/ Forest	N E
Phellinus conchatus (Pers.) Quél.	Log	Gregarious	Forest	N E
Podoscypha elegans (G.Mey.) Pat.	Dead log	Solitary	Forest	N E
Podoscypha sp. 1	Rotten trunk	Solitary	Forest	N E
Polyporus alveolaris (DC.) Bondartsev & Singer	Dead trunk	scattered	Grassland	E
Polyporus sp. 1	Dead log	Gregarious	Forest	N E
Polyporus tuberaster (Jacq. ex Pers.) Fr.	Dead trunk	Solitary	Forest	E
Pycnoporus sanguineus (L.) Murrill	Dead log	Scattered	Forest	N E
Stereum lobatum (Kunze ex Fr.) Fr.	Dead log	Gregarious	Forest	N E
Stereum insignitum Quél.	Rotten log	Gregarious	Forest	N E
Stereum ostrea (Blume & T.Nees) Fr.	Rotten log	Gregarious	Forest	N E
Stereum sp. 1	Dead log	Gregarious	Forest	N E
Trametes elegans (Spreng.) Fr.	Dead log	Solitary	Forest	N E
Trametes hirsuta (Wulfen) Lloyd	Rotten twig	Solitary	Forest	N E
Trametes parvispora Olou, Yorou & Langer	Rotten bamboo	Solitary	Forest	N E
Trametes pubescens (Schumach.) Pilát	Trunk	Solitary	Forest	N E
Trametes sp. 1	Log	Solitary	Forest	N E
Trametes sp. 2	Log	Solitary	Forest	N E
Trametes sp. 3	Dead trunk	Solitary	Grassland/ Forest	N E
Trametes versicolor (L.) Lloyd	Dead log	Solitary	Forest	N E

Note: E: Edible; NE: Non-Edible; E-NP: Edible but Non-Palatable

Undeniably, bracket fungi play not only an ecological role but also economical and medicinal. Although the edibility of bracket fungi is not popularly known, their capability for various applications, such as in the treatment of ailments and other conditions (Fokunang et al. 2022; Gafforov et al. 2023) highlights their significance in the industry. In fact, Parkash and Sharma (2016), proved the antimicrobial property of bracket fungi including *Ganoderma lucidum* and *Polyporus officinalis* through in-vitro approach. A popular species *Ganoderma applanatum* was found rich in carbohydrates and protein making it a good nutritional source. It possesses the ability to protect a system from a generation of free radicals, hence considered a therapeutic agent that helps reduce illness like cancer synthesized by oxidative stress (Rijia et al. 2024). *Auricularia* spp., are reported to have antihypoglycemic and anti-hypercholesterolemic properties (Bandara et al. 2019). Polyporus, the dominant group in MAPL, share the same medicinal activities with *Lentinus* including a memory-enhancing activities (Bandara et al. 2015; Tang et al. 2016). Although non-palatable, *Trametes* and *Ganoderma* are important mushrooms in processing of food industry. They are powderized and introduced in various food products and supplements making their bioactive components more accessible for consumption (Tian et al. 2023). Thus, these macrofungi with these functional properties can be further exploited and documented for the advancement of pharmaceutical and food industries.

Despite the fact that the Philippines is regarded hotspot of flora and fauna, only limited studies are allocated to macrofungi of the forest ecosystems. Little attention has been given to biodiversity assessment of macrofungi. Forests are being threatened by several global issues. The introduction of pollutants to air is an environmental factor that triggers greenhouse effects and modifies vegetation (Parlucha et al. 2021). Climate-sensitive species, including macrofungi that are primarily carbon and moisture, might be put at risk (Pampolina et al. 2023). Also, bioaccumulation of heavy metals brought by human deposition to the ecosystem post an arising problem to human health and fungal communities (Chawngthu et al. 2024). Overharvesting of economically important and valued species affects their population.

Table 5. Taxonomical position of 47 collected bracket fungi in Mt. Arayat Protected Landscape, Philippines

Phylum	Class	Order	Family	Genus	Species
Basidiomycota	Agaricomycetes	Auriculariales	Auriculariaceae	*Auricularia*	*Auricularia polytricha* (Mont.) Sacc.
		Hymenochaetales	Hymenochaetaceae	*Coltricia*	*Coltricia cinnamonea* (Jacq.) Murrill
					Coltricia parennis (L.) Murrill
					Coltricia sp.1
					Coltricia sp. 2
				Phellinus	*Phellinus conchatus* (Pers.) Quél.
		Polypolares	Fomitopsidaceae	*Fomitopsis*	*Fomitopsis feei* (Fr.) Kreisel
					Fomitopsis pinicola (Sw.) P.Karst.
			Ganodermataceae	*Ganoderma*	*Ganoderma applanatum* (Pers.) Pat.
					Ganoderma australe (Fr.) Pat.
					Ganoderma carnosum Pat.
					Ganoderma ellipsoideum Hapuar., T.C.Wen & K.D.Hyde
					Ganoderma lobatum (Cooke) G.F.Atk.
					Ganoderma lucidum (Curtis) P.Karst.
					Ganoderma tsugae Murrill
					Ganoderma sp. 1
					Ganoderma sp. 2
					Ganoderma sp. 3
					Ganoderma sp. 4
			Meruliaceae	*Podoscypha*	*Podoscypha elegans* (G.Mey.) Pat.
					Podoscypha sp. 1
			Polyporaceae	*Cryptoporus*	*Cryptoporus volvatus* (Peck) Shear
				Fomes	*Fomes faciatus* (Sw.) Cooke
					Fomes fomentarius (L.) Fr.
					Fomes sp.1
					Fomes sp.2
				Hexagonia	*Hexagonia hydnoides* (Sw.) M.Fidalgo
				Microporus	*Microporus affinis* (Blume & T.Nees) Kuntze
					Microporus vernicipes (Berk.) Kuntze
					Microporus xanthopus (Fr.) Kuntze
					Microporus sp.1
				Polyporus	*Polyporus alveolaris* (DC.) Bondartsev & Singer
					Polyporus tuberaster (Jacq. ex Pers.) Fr.
					Polyporus sp. 1
				Pycnoporus	*Pycnoporus sanguineus* (L.) Murrill
				Trametes	*Trametes elegans* (Spreng.) Fr.
					Trametes hirsuta (Wulfen) Lloyd
					Trametes parvispora Olou, Yorou & Langer
					Trametes pubescens (Schumach.) Pilát
					Trametes versicolor (L.) Lloyd
					Trametes sp. 1
					Trametes sp. 2
					Trametes sp. 3
		Russulales	Stereaceae	*Stereum*	*Stereum insignitum* Quél.
					Stereum lobatum (Kunze ex Fr.) Fr.
					Stereum ostrea (Blume & T.Nees) Fr.
					Stereum sp. 1

Figure 5. Wood-inhabiting macrofungi in Mt. Arayat Protected Landscape, Philippines. A. *Ganoderma applanatum,* B. *Cryptoporus volvatus,* C. *Trametes* sp. 1*,* D. *Pycnoporus sanguineus,* E. *Microporus xanthopus,* F. *Microporus vernicipes,* G. *Fomitopsis feei,* H. *Trametes versicolor,* I. *Trametes elegans,* J. *Ganoderma* sp. 1*,* K. *Trametes* sp. 2*,* L. *Phellinus conchatus*

Although MAPL is a protected area, anthropogenic influences become unavoidable, including charcoal-making, slash-and-burn practices, and utilization of the forest cover as agricultural lands (Suba et al. 2019a, b). Agricultural expansions in the lower rims of the North Peak and South Peak were observed during the course of sampling. Since MAPL is a national park as well, it is gaining attention to many mountain enthusiasts and visitors that trespass even the prohibited zones (Suba et al. 2019a, b) and leave unnecessary garbage in the forest. Several government and non-government projects have been employed in the past years in MAPL, including the involvement of Indigenous Peoples, women, and other sectors, to ensure that protection and rehabilitation are served (DENR-Region III 2018). The result of this investigation in MAPL mirrors the health status of its forest ecosystem forest. Given all these functional properties of macrofungi, medicinal an environmental it is imperative to create protection policies. There is a need of local and national support for funding because insufficiency of this causes forest managers to poorly implement conservation measures and laws (Bagadion and Juan 2013). Training of young Filipino scientists in the mycological field will augment appreciation of the value of macrofungi in the Philippines.

In conclusion, this study assessed bracket fungi in three collection sites within MAPL that serve as natural habitats for Basidiomycetes, consisting of 4 orders, 7 families, 14 genera, and 47 species. The distribution of these bracket fungi is high in the South Peak, 251-500 masl and decreasing from January to May. Since macrofungi are habitat-dependent, this investigation highlights the need to conserve and sustain macrofungal diversity in MAPL. Majority of the species belong to order Polyporales. The presence of these important wood-inhabiting fungi is a relevant consideration in determining forest health conditions. Aside from strengthening the documentation of mycological resources in MAPL, it serves as database to improve monitoring schemes in ensuring proper conservation management and sustainability of the forest ecosystem of MAPL.

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