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Species Listing of Macrofungi Found in Paracelis Mountain Province, Philippines

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Abstract

Mushrooms are an important natural source of food and medicine. In the Philippines, only a few studies have been conducted on the diversity of mushrooms especially in the mountainous areas. The present study was conducted to document the species of macrofungi found in Paracelis, Mountain Province. The knowledge gained from this study can reveal their importance to the community. A total of 37 macrofungi belonging to 16 families, 26 genera, and 29 species were collected and identified. Twenty nine of the collected macrofungi were identified up to its species level and eight were only identified at its genus level. The collected samples were subjected to morphological identification based on its macroscopic and microscopic characteristics. The identified macrofungi were: *Auricularia auricula-judae*, *Conocybe arrhenii*, *Coprinellus disseminatus*, *Coprinus* sp., *Crepidotus mollis*, *Daldinia concentrica*, *Earliella scabrosa*, *Favolus acervatus*, *Fomes fomentarium*, *Ganoderma applanatum*, *Ganoderma fornicatum*, *Ganoderma lucidum*, *Hygrocybe* sp., *Irpex lacteus*, *Lentinus strigosus*, *Lenzites elegans*, *Lepiota lilacea*, *Lepiota* sp., *Marasmiellus ramealis*, *Microporus xanthopus*, *Mycena* sp., *Panellus mitis*, *Paneolus cyanescens*, *Parasola plicalitis*, *Psathyrella candolleana*, *Psathyrella* sp., *Russula* sp. *Schizophyllum commune*, *Trametes elegans*, *Trametes gibbosa*, *Trametes hirsuta*, *Trametes versicolor*, *Trametes* sp. 1, *Trametes* sp. 2, and *Xylaria papulis.* Out of these macrofungi, four species were identified as edible, viz: *Auricularia auricula*, *Lentinus strigosus*, *Coprinus disseminatu,* and *Schizophyllum commune*.

Key Words: diversity , edibility, morphology, mushroom, substrate

Introduction

Mushrooms are macrofungus with a distinctive fruiting body which can be either epigeous or hypogeous and large enough to be seen by the naked eye and to be picked by hand (Chang & Miles, 1992; Chang, 1996; Hawksworth, 2001). They grow best during the rainy season and can be found in almost all types of substrates, e.g., soil, grassy ground, rotten wood, decaying organic matter, etc. (López-Quintero et al., 2012). Mushrooms are generally regarded as healthy foods, poor in calories and in fat, but rich in fiber, proteins, chitin, vitamins, minerals, and bioactive mycochemicals (Kalač 2013). Thus, the nutritional and medicinal properties of macrofungi are well-known and documented. In fact, mushrooms have shown several biological activities such as anti-hypertensive (Eguchi et al., 2014), anti-microbial (Reyes et al., 2017; Gaylan et al., 2018), anti-thrombotic (San Pedro et al., 2016), anti-mutagenic (Canalita & Bajo, 2017) ,and anti-angiogenic (Deocaris et al., 2005).

Furthermore, the number of macrofungi in the Philippines is abundant and its estimated species are between 10,000 up to 25,000 (Mueller et al., 2007). The study of Tadiosa et al. (2007, 2011) on Mt. Cuenca in Batangas and Bazal-Baubo in Aurora reported a total estimated list of 3,695 species and 818 genera of different fungal diversity. Recently, Liwanag et al. (2017) reported that in Norzagaray, Bulacan, a total of 21 species belonging to 10 families and 16 genera were identified. Moreover, Dulay & Maglasang (2017) reported that there were a total of 30 species belonging to 18 families and 21 genera from Bambanaba, Cuyapo, Nueva Ecija. Furthermore, Sibounnavong et al. (2008) documented 7 identified species with 1 species belonging to Order Tulasnellas or Tremellales (Jelly fungi), 4 species belonging to order Polyporales, and 2 species belong to order Agaricales at Puncan, Carranglan, Nueva Ecija. These findings indicate the species richness of mushrooms in the country. However, most researches are concentrated in the agroindustrial areas and very few studies were conducted to document the diversity of macrofungi in the mountainous areas such as the Mountain Province.

Mountain Province is known to be the Philippines biggest and highest chain of mountains (Cordillera Administrative Region [CAR], 2017). It lies within the center of the Grand Cordillera, and is bound to the north by Kalinga, south by Benguet and Ifugao, to the east by Ilocos Sur, and to northwest by Abra. The province exhibits Type I climate which has two marked distinct seasons: dry and wet. Dry season is from November to April and wet season is from May to October (CAR, 2017). Due to this climatic conditions, macrofungi are abundant within the area, which makes it a very good site for mushroom documentation. Thus, this study was conducted with the aim to collect, identify, document, and characterize the different species of macrofungi that are found in Paracelis, Mountain Province. This study, will help reveal the importance of the macrofungi in the area, and contribute in the growing knowledge in the field of fungal diversity in the country.

Materials and Methods

Ethics Requirement

A letter of request was given to the Mayor of Paracelis, Mountain Province as well as to the barangay chieftain of Poblacion to allow the researchers to conduct the research in their area.

Collection Site

Macrofungi were collected from the Barangay Poblacion of Paracelis, Mountain Province, Philippines in January of 2019. The study sites were thoroughly searched to locate different macrofungi species.

Collection of Samples

The collection was done with the assistance of some of the members of the community who are more familiar with the area. Purposive sampling method was used in the collection of macrofungal species. Macrofungi were collected on their fruiting stage and was photographed in their natural habitat. Other important information were also taken.

The fruit bodies in soil and ground litter were dug carefully so as not to damage their bases. For wood-rotting mushrooms, these were cut off from the bark of trees where they were attached. All collected specimens were then labeled, wrapped in wax paper, placed in paper bags, and brought to the laboratory for identification.

Morphological Characterization

All collected macrofungi were identified based on their macroscopic (fruiting bodies) and microscopic (spore morphologies) features. Morphometric data collected for each of the specimens were the different features of the cap, gills, and stalk of the mushrooms. A spore print was also prepared from fleshy mushrooms, while tissues sectioning was done for non-fleshy mushrooms. This was to observe for microscopic features such as spore color, shape, and size.

To examine the spore under the microscope, the hymenium was cut into pieces and submerged in distilled water, yielding a spore suspension. A few drops of the spore suspension were place on a microscopic slide and covered with a glass cover slip and the mounted spore suspension was examined under the microscope and each spore of the specimen was measured using a micrometer.

Identification of the collected samples was compared to the morphologies of the published literatures of Rydin et al. (1997), Quimio (2001), and Lodge et al. (2004). Taxonomic classification was based on the work of Laessoe and Lincoff (1998), Kuo (2015), Phillips (2006), and Quimio (2001).

The substrate pH was noted by collecting a portion of the substrate (leaf litter, soil, wood bark). The soil and leaf litter substrate were submerged in distilled water and the pH was measured using a pH meter. For the wood substrate, it was soaked overnight in distilled water before measuring the pH of the substrate.

Species Listing

The genera and species of macrofungi that were observed in the area were listed and the number of each species and genera was noted. The natural habitat of the macrofungi species was documented, especially, their locations and their substrates.

Results and Discussion

Study Site

` Paracelis is located at the easternmost of Mountain Province with a latitude of 17°10'21.7" N and longitude of 121°21'58.3 E (Figure 1), with an elevation of 238 meters above sea level (masl), air temperature at 26°C, and 60% relative humidity.

The province has two general types of climate. The western portion is under Type I with two pronounced seasons; dry from November to April and wet during the rest of the year. The eastern portion is under Type II with season not very pronounced: relatively dry from November to April and wet for the rest of the year (Department of Interior and Local Government in Cordillera Administrative Region [DILG CAR], 2015a). The topography of Mountain Province is roughly characterized by very steep slopes and deep ravines. Small patches of gentle stones may be found along river banks, narrow valleys, and tops of ridges. Elevation ranges from 500 meters to as high as 2,714 meters (DILG CAR, 2015b).

The total land area of the municipality of Paracelis is 55,160 has as per record of the DENR-CAR. Only 4,686 hectares or 8.5% of the total land area is classified as alienable and disposable. The bigger part which is, 50,474 hectares is designated as public forest. Woodland comprises the biggest area (25,851 hectares) followed by grassland/shrubland (23,041 hectares). Agricultural areas consist of 5,748 hectares or 10.42% of the total land area (DILG CAR, 2015a). Built-up areas consist of 350 hectares or 0.63% and the riverwash is 170 hectares or 0.31% of the total land area. Forest abounds in the northern and western part but is being denuded due to unabated logging and swidden farming. The total built-up and agricultural areas of 6,098 hectares exceed the 4,686 hectares designated as alienable and disposable. This is due to the fact that the main source of livelihood of the people is agriculture (DILG CAR, 2015a).

Natural Habitat of Wild Mushrooms

Most of the macrofungi grow in decaying woods and logs which are commonly seen in the mountainous place. Macrofungi can suitably occur in most terrestrial habitats, from woodlands to grasslands, however they are most likely found diverse in forests, where they can have the right climate to form mature fruiting bodies. Particularly, moisture to allow their spores to develop (Orgiazzi et al., 2016). Liwanag et al. (2017) documented 11 species of fungi in wood areas where large trees, shrubs, and lianas abound. Furthermore, De Leon et al. (2019) mention that the Philippines supports a very rich and diverse assemblage of macrofungi that are naturally growing on different substrates such as leaf litter, decaying plant residues, and decomposing logs of trees during the rainy season. As one-third of the fungal diversity is believed to exist in the tropical region, macrofungi putatively comprise 10% of the total fungal diversity (Mueller et al., 2007; Rossman, 1994).

Figure 1

Satellite image of Paracelis, Mountain Province.

Note: Paracelis, Mountain Province (n.d.). https://www.google.com/maps/place/Paracelis,+Mountain+Province

Species Profile and Listing

Identified macrofungi were arranged and listed alphabetically according to their Family. Descriptions such as taxonomic name, macrofungi color, size, substrate, and substrates pH were also included. Selected macrofungi is presented in Figure 2.

Agaricaceae

Lepiota lilacea

Description :pileus is bell-shaped and size is 20–30 mm in diameter with patches over the surface. The scaly stipe length is 25–35 mm long and 3.5 mm thick. The gills are free, close, and white color. Spores 4.65 x 2.86, ellipsoid and spore print is white.

Edibility : inedible

Substrate : decaying wood

pH: 6.80

Auriculariaceae

Auricularia auricula

Description :commonly known as "Tengang Daga". It is lobed and veined like ear shaped, has a viscid surface, smooth, wavy margin, and brown-colored. It measures 43 mm wide and 18 mm long. Spores 14 x 5.5 µm and sausage-shaped.

Edibility : edible

Substrate : decaying wood

pH: 6.17

Bolbitaceae

Paneolus cyanescens

Description :has a convex pileus, light brown to light gray color, surface is smooth and measures 18.25 mm diameter. Gills attachment is adnexed, close and gray in color. Stipe measures 118 mm long by 2.8 mm thick. Spores elliptical and smooth, black.

Edibility : psychoactive, medicinal

Substrate : dung

pH: 6.17

Conocybe arrhenii

Description :brick red at center, convex pileus measures 23 mm in diameter with striate margin. Gills are crowded and adnexed. Stipe is pale brown at the base, becoming paler towards top and has a length of 42 mm long and 2.3 mm thick. Stipe surface is scaly with white ring on top. Spores ellipsoidal smooth 7.5 x 4 µm, brown.

Edibility : inedible

Substrate : decaying banana

pH: 7.35

Coprinaceae

Coprinus sp.

Description :pileus is campanulate with a measurement of 10 mm in diameter. Gills are free to adnexed and deliquescent in age. Stipe is thin and measures 4 mm long and 1.5 mm thick. Spores 7 x 9.5 µm, narrowly elliptical, spore print black.

Edibility : inedible

Substrate : dung

pH: 6.45

Crepidoptaceae

Crepidotus mollis

Description :convex pileus covered with dark brown, small fibrous scales, measures 15–20 mm broad and 20–23 mm wide. Gills are close, narrow, brown to red-brown. Stipe is absent, merely a short basal plug covered with minute hairs. Spores broadly ellipsoidal, smooth, 7–9 x 5–7 µm, brown in color.

Edibility : inedible

Substrate : decaying log

pH: 7.46

Fomitopsidaceae

Fomitopsis feei

Description :semi-circular to fan-like shaped fruiting body with a measurement of 82.9 x 43.5 mm. The upper surface is purple in color with a white margin. Spores 5–6.5 x 2–3.5 µm, cylindrical to oblong in shape.

Edibility : medicinal

Substrate : decaying log

pH: 7.41

Ganodernataceae

Ganoderma applanatum

Description :has a hard and tough fruiting body, inverted fan-like structure, brown to dark-brown in color with a white margin. Pileus measures 10–30 cm across, 8–14 cm deep, semicircular in outline, or irregular. Spores 6–9 x 4–5 µm, ellipsoid, brown in color.
Edibility : medicinal
Substrate : decaying log
pH: 7.19

Ganoderma fornicatum
Description :fan-like to semicircular shape fruiting body coloring from red brown to brown toward the margin, measures from 2.5 x 3.5 mm up to 28 mm thick at the base.
Edibility : inedible
Substrate : decaying wood
pH: 7.19

Ganoderma lucidum
Description :with a shiny surface with a measurement of 112.4 in length and 21.8 mm wide. Fruiting body is brown-red to black in color. Spores 8.2–12.1 x 4.8–8.9 µm, brown.
Edibility : medicinal
Substrate : log
pH: 7.19

Hygrophoraceae
Hygrocybe sp.
Description : has a red cap with yellow margin and measures 12.5 mm wide and 2 mm long, smooth, and fibrillose. Pileus margin is crenate and slightly incurved. Gills are free and close in spacing. Stipe is clavate 1.5 mm wide and 20 mm tall. Stipe surface is smooth. Spores are large smooth and inamyloid with white spore print.
Edibility : inedible
Substrate : soil
pH: 7.40

Irpicaceae
Irpex lacteus
Description :irregular with tooth-like patch white pileus measuring 53.6 x 22.3 mm. It is white when fresh and whitish-yellow to whitish-green when dry. Spores 5–7 x 2–3 µm, smooth, elliptical, and white spore print.
Edibility : inedible
Substrate : dead log
pH: 7.39

Lepiotaceae
Lepiota sp.
Description :pileus is broad, brown with scaly surface and the center remaining darker, margin is finely wavy and straight. Gills attachment is free and equal. Stipe measures 35 mm tall and 5 mm wide and is equal in shape, has a brown smooth

surface and a ring on the upper portion. Spores 5–8 x 2.5–4 µm, subfusiform, smooth, white spore print.
Edibility : inedible
Substrate : soil
pH: 5.40

Polyporaceae

Earliella scabrosa
Description :fan-shaped bracket macrofungi, has a rigid cap with a concentric zone of brown, red, yellow and white measuring from 35.9 x 31 mm. Spores 8–12.5 × 3.5–5 µm, cylindrical to oblong ellipsoid.
Edibility : inedible
Substrate : decaying logs
pH: 7.19

Favolus acervatus
Description :fan-like shape, light brown fruiting body, with a measurement of 53.6 x 22.3 mm. It has leathery to leathery cork in dried condition. Spores 7–10.5 x 2.5–4 µm, cylindrical, smooth.
Edibility : inedible
Substrate : decaying logs
pH: 7.39

Fomes fomentarium
Description :semi-circular, tough and smooth surface, bracket fungi with a measurement of 52.1 x 48.1 mm. Brown-green to brown fruiting body. Spores 12–20 x 4–7 µm, cylindric, inamyloid, smooth.
Edibility : medicinal
Substrate : tree trunk
pH: 7.37

Lentinus strigosus
Description :has an uplifted pileus, measures 13–17 mm long and 15–18 mm wide, tomentose margin, hairy surface, clavate shape and hollow flesh. Gills are crowded, decurrent, light brown in color and with smooth margin. Stipe is off-center. Spores measures 11.1 x 7.52 µm, elliptical in shape, and white color.
Edibility : edible, medicinal
Substrate : decaying wood
pH: 6.80

Lenzites elegans
Description :circular to semicircular smooth fruiting body, brown wart pileus with lobed thin margin that measure 81 x 33.6 mm. White to pale cream in color. Spores 5–7 x 2–3 µm, smooth, cylindric to long elliptic, white spore print.
Edibility : inedible
Substrate : decaying log
pH: 7.58

Microporus xanthropus
Description :funnel-shaped fruiting body with light-brown to dark-brown strips that measures 20.8 x 16.7 mm. Smooth and shiny when fresh and dull when dry.
Edibility : inedible
Substrate : decaying tree branch
pH: 6.38

Pycnoporus sanguineus
Description :fan-shaped pileus with a wavy margin that measures 113.7 x 74 mm. Fruiting body is dry, red orange to orange in color. Spores of 5–6 × 2–3 µm, smooth, hyaline, non-amyloid, thin-walled.
Edibility : medicinal
Substrate : dead trunk
pH: 6.76

Trametes elegans
Description :irregular to semi-circular, thick, rough/lumpy to smooth pileus towards the margin that measure 29.9 x 35 mm. White and cream when fresh and pale when dried. Spores 5–7 x 2–3 µm, smooth, cylindric to long elliptic, white spore print.
Edibility : inedible
Substrate : decaying trunk
pH: 7.21

Trametes gibbosa
Description: has a semi-circular pileus that measures from 61.4 to 40 mm. It has wavy margin with dirty white color. Spores ellipsoidal to sausage-shaped, smooth, 4–6 x 2–2.8µm; hyaline, inamyloid, white spore print.
Edibility : medicinal
Substrate : living tree
pH: 7.20

Trametes hirsuta
Description :circular to semi-circular fruiting body with a hairy surface with a concentric color of yellow-green to green to brown that measures 81 x 33.6 mm. Spores cylindrical, smooth, 5.5–8.5 x 1.6–2.5µm; inamyloid, white spore print.
Edibility : medicinal
Substrate : dead tree trunk
pH: 7.58

Trametes versicolor
Description :fan-like shaped pileus which measures 113.7 x 74 mm, margins velvety surface with folds and light brown to dark-brown color arranged in alternating pattern. Spores curved cylindrical (sausage-like), smooth, 4–6 x 1.5–2.5µm; inamyloid, white spore print.
Edibility : medicinal
Substrate : decaying logs
pH: 8.03

Trametes sp. 1 and *Trametes* sp. 2

Description :fan-shaped to semi-circular pileus with smooth margin and measures 22.2 x 27.2 mm. The fruiting body is dry, black to brown (*Trametes* sp. 1) and green to dirty white (*Trametes* sp. 2). Spores 4.5–5.5 x 1.5–2 µm, cylindric, smooth, inamyloid.

Edibility : inedible

Substrate : dead trunk

pH: 7.75

Psathyrellaceae

Coprinellus disseminatus

Description :pileus measures 9–11 mm across, radially fibrillose surface and plicate-striate margin. Gills that are closely crowded. Stipe is 5–25 mm long and 1–2 mm thick, smooth surface towards the base, equal shape and hollow flesh that is centrally attached to the pileus. Spores 8.53 x 4.50 µm, ellipsoid with a pore and black color.

Edibility : edible

Substrate : decaying woods

pH: 6.18

Parasola plicalitis

Description :has a conical pileus, smooth surface and pleated, measurement is 10–15 mm in diameter. Gills are free and close or nearly distant. Stipe is smooth and equal, fragile, white color without a ring and measures 35–40 mm and 1 mm thick. Spores irregularly ellipsoidal to ellipsoidal, 10–13 x 7–10.5 x 6.5–8 µm, black spore print.

Edibility : inedible

Substrate : decaying banana trunk

pH: 7.40

Psathyrella candolleana

Description :convex pileus, center has a yellow-brown color and the rest is cream white which measures 17 mm in diameter, smooth cap surface and margin. The gills are adnexed, brown color, and crowded in spacing. Stipe is equal and has a length of 35 mm and 2.1 mm thick, smooth in surface. Spores, ellipsoidal, smooth, 6.5–9.5 x 4–5 µm, spore print dark brown.

Edibility : inedible

Substrate : decaying banana leaf

pH: 7.50

Psathyrella sp.

Description: pale brown becoming cream in the center of the pileus, measures 15–20 mm wide, texture is smooth but slightly viscid. White gills are cream to tan and slightly decurrent. Stipe is smooth to cream white which measures 20–40 mm tall and 1–2 mm wide. Spores 6.5–9.5 x 4-–5 µm, ellipsoid, smooth, dark brown in color.

Edibility : inedible

Substrate : decaying wood

pH: 6.20

Russulaceae

Russula sp.

Description :has a depressed violet pileus with smooth surface and measures 9.8 mm wide and 8.9 mm long, margin is smooth with crowded gill spacing. Stipe measures 5.82 mm long and 3.51 mm wide and it is equal and no ring and volva. Spores 6.5–8.5 x 5.5-8 µm, usually globose or subglobose, cream to pale yellow spore print.

Edibility : inedible

Substrate : decaying wood

pH: 6.70

Schizophyllaceae

Schizophyllum commune

Description: locally known as "kudit." Pileus measures 23 mm across, with a whitish gray color when dry or brown color when moist, surface is felty and scurfy with crenate and straight margins with streaked surface. Gills is crowded. Spores cylindrical to ellipsoidal, smooth, 4–6 x 1.5–2.5 µm, white spore print.

Edibility : edible

Substrate : decaying wood

pH: 6.65

Tricholomataceae

Mycena sp.

Description :has a small conical pileus, dry with a measurement of 4 mm wide and 3 mm tall. Gills attachment are adnate and close gills spacing. The thin and equal stipe is 5 mm tall and 1 mm wide. Spores cylindric to long-ellipsoid, 2.5–3.5 µm.

Edibility : edible

Substrate : banana leaf

pH: 7.01

Panellus mitis

Description :has a shell-shaped pileus that measures 10-20 mm in diameter with pale brown color, surface is smooth and has a radiating margin. The white gills are well-spaced. Spores 3.5-6 x 1–1.5 µm, cylindrical to sausage shape.

Edibility : inedible

Substrate : dead trunks

pH: 7.46

Marasmellus ramealis

Description :cream to pale brown convex-shaped pileus with a diameter of 10–15 mm, surface texture is wrinkled, and margin is lobe and straight. Gill attachment is adnexed and broad gills are widely spaced. Stipe is tapered downward and clavate with a length of 10_15 mm and 0.5 mm thick with smooth surface. Spores, elongate, elliptical, 8.0–10 x 3–4 µm.

Edibility : inedible

Substrate : decaying wood

pH: 7.20

Xylariaceae

Daldinia concentrica

Description :has a ball shape, hard, shiny purple fruiting body, with a measurement of 32 x 27.6 mm. Reddish-purple to purple when young and becoming black when old and about to dry. Spores ellipsoidal to fusiform, 12–17 x 6–9 µm, spore print is black.

Edibility : medicinal

Substrate : decaying tree

pH: 8.00

Xylaria papulis

Description :finger-shaped to club-shaped macrofungi measuring from 85.3 x 50.4 up to 101 x 56.2 mm. It has a yellow fruiting body that turns black when bruised. Spores dark brown, broad fusoid, 7–9 × 4–4.5 µm.

Edibility : inedible

Substrate : soil

pH: 7.55

Habitat and Importance of Collected Macrofungi

The collected macrofungi in the study site were classified per taxonomic family and their growth habit as well as their importance were also evaluated. The collected samples belonging to 16 families namely: Agaricaceae, Auriculariaceae, Bolbitaceae, Crepidoptaceae, Coprinaceae, Fomitopsidaceae, Ganodermataceae, Hygrophoraceae, Irpicaceae, Lepiotaceae, Polyporaceae, Psathyrellaceae, Russulaceae, Schizophyllaceae, Tricholomataceae and Xylariaceae. Among the 16 families, Polyporaceae has the highest collected and identified macrofungi with a total of 13 species. Of the 37 macrofungi identified, 21 species are classified as saprobic, 10 medicinal, 2 nutraceutical, and others with 1 species each are therapeutic, bioremediator, and pathogen (Table 1).

Discussion

The abundance of Polyporaceae in this study is understandable since this family is commonly found growing in decaying log, fallen branches of trees, hardwood and tree trunks (Liwanag et al., 2017) that are rich in mountainous regions like the Mountain Province. Similar results were obtained with the study of De Leon et al. (2013) in Tarlac, Pampanga and Zambales, and Tadiosa et al. (2011) in Aurora which are mountainous provinces. This result is not surprising, for polypores play a primary and central role in decomposition and nutrient cycling in forest ecosystems (Adarsh et al. 2018). The collected macrofungi were mostly found growing in wood, decaying tree trunks, and decaying branches of trees. Wood-decaying fungi are important natural components of indigenous forests; their growth and distribution are affected by a multitude factors such as difference in elevations (Adarsh et al., 2018), host specificity (Gilbert & Sousa 2002) and many others. The pattern of host specificity had been previously observed from tropical polypores and are generally most prominent among fungi in decaying wood that are in their early decomposing stages (Gilbert & Sousa, 2002). The colonization of polypores is through germinating spores and migratory mycelia (Adarsh et al., 2018). They are dispersed by airborne basidiospores and geographical barriers, such as mountains, rivers, and floodplains (Gibertoni et al., 2016).

Studies of Clausen-Heilmann and Christensen (2005) and May (1991) suggest that highly diverse forests (with a high number of tree species and scattered trees of each species) would promote low specificity of fungal species. Thus, low diversified forest results to higher fungal species specificity (Gilbert, 2005). Mountain Province is considered as a diverse forest, since it is composed of several species of fruit trees of the agroforestry farms (Baldic, 2016) as well as other naturally occurring tree species on the province. However, Schmitt (2005) mentioned that the macrofungi is not widely distributed as that of the trees; they also added that there must be other factors that limit the distribution of macrofungi. These limits could be the environmental factors that are associated with differences in elevation and more importantly in the temperature, precipitation duration, intensity of illumination, physical and chemical characteristics of the soil, topographic position, and tree density (Zhang et al., 2010).

Second to Polyporaceae is Psathyrellaceae with four species followed by Ganodermataceae, and Tricholomataceae with three species each. De Leon et al. (2013) reported 76 species of macrofungi in six Aeta tribal communities in Luzon. While Corazon and Licyayo (2018) in the Cordillera Region reported that there were 30 species from 23 genera of wild edible fungi identified and most of the species were found in Benguet and Mt. Province areas where the coniferous type of forest was abundant and conducive to the growth of wild edible mushrooms. The exhibited patterns of diversity of macrofungi were relative to their substrates, host availability, and the climatic condition (Parveen et al., 2017).

Twenty one species of the collected marcrofungi were classified as saprobic. These were: *L. lilacea, A. auricularia-judae*, *C. arrheni, Coprinus* sp., *C. mollis*, *G. fornicatum*, *Hygrocyb*e sp., *Lepiota* sp., F. acervatus, *L. elegans*, *Trametes* sp. 1 and 2, *C. plicalitis, Psathyrella* sp., *P. candolleana, Mycena* sp., *P. mitis, M. ramealis*, *Rusulla* sp. and *X. papulis*. Almost all of the species collected were saprophytic fungi which obtain food by absorbing dissolved organic material from decayed wood and soil organic matters. According to Parveen et al. (2017), saprophytic fungi break down dead and decaying organic matter into simple substance that can be taken up and recycled by plants, thus maintaining forest ecosystem balance. Niem and Baldovino (2015) reported that in Cavinti Underground River and Cave Complex in Cavinti, Laguna, most species were saprotrophs.

Aside from being edible, many of the identified mushrooms were also medicinal such as *P. cyanescens*, G. applanatum, G. lucidum, *F. fomentarium*, *L. strigosus*, *P. sanguineus*, *T. gibbosa*, *T. hirsuta, T. versicolor, C. disseminatus, D. concentrica*. These mushrooms could be significant sources of bioactive compounds with various functional activities. One of the most important medicinal mushrooms is *G. lucidum*. It is used to treat chronic hepatitis, hypertension, arthritis, insomnia, bronchitis, asthma, gastric ulcer, diabetes, and cancer. It possesses anti-tumor activity and has also been found to inhibit platelet aggregation and to lower blood pressure, cholesterol, and blood sugar (Borchers et al., 2004).

Figure 2

Selected Species of Macrofungi Collected from Paracelis Mountain Province: A *Lepiota lilacea.* B *Auricularia auricula-judae*. C *Fomitopsis feei*. D *Ganoderma applanatum*. E *Ganoderma fornicatum*. F *Ganoderma lucidum*. G *Irpex lacteus*. H *Earliella scabrosa*. I *Favolus acervatus*. J *Fomes fomentarium*. K *Lentinus strigosus*. L *Lenzites elegans*. M *Microporus xanthopus*. N *Pycnoporus sanguineus*. O *Trametes elegans*. P *Trametes gibbosa*. Q *Trametes hirsute*. R *Trametes versicolor*. S *Trametes* sp. 1. T *Trametes* sp. 2. U *Coprinellus disseminatus*. V *Psathyrella* sp. W *Schizophyllum commune*. X *Daldinia concentrica*.

Table 1

The Number of Bracket Macrofungi Listed per Family with their Substrate and Importance

	GROWTH HABIT	IMPORTANCE
Agaricaceae		
L. lilacea	Solitary	Saprobic (Kuo, 2015)
Auriculariaceae		
A. auricularia	Gregarious	Saprobic (Kuo, 2015)
Bolbitaceae		
P. cyanescens	Gregarious	Medicinal (Bustillos et al., 2014)
C. arrhenii	Solitary to gregarious	Saprobic
Crepidoptaceae		
C. mollis	Gregarious	Saprobic
Coprinaceae		
Coprinus sp.	Gregarious	Saprobic
Fomitopsidaceae		
F. feei	Gregarious in clusters	Saprobic
Ganodermataceae		
G. applanatum	Solitary	Medicinal (De Leon et al., 2013)
G. lucidum	Gregarious in clusters	Medicinal (De Leon et al., 2013)
G. fornicatum	Solitary to gregarious	Saprobic
Hygrophoraceae		
Hygrocybe sp.	Solitary	Saprobic
Irpicaceae		
I. lacteus	Resupinate	Bioremediation (Novotny et al., 2009)
Lepiotaceae		
Lepiota sp.	Solitary	Saprobic
Polyporaceae		
E. scabrosa	Gregarious	Pathogen (He et al., 2018)
F. acervatus	Solitary to gregarious	Saprobic
F. fomentarium	Solitary	Medicinal (Peintner et al., 1998)
L. elegans	Solitary	Saprobic
L. strigosus	Gregarious	Medicinal (Tapwal et al., 2013)
M. xanthopus	Solitary to gregarious	Nonedible (Tapwal et al., 2013)
P. sanguineus	Solitary to gregarious	Medicinal (Cota et al., 2008)
T. elegans	Solitary	Therapeutic (Awala & Ayetayo,2015)
T. gibbosa	Solitary to gregarious	Medicinal (Ren et al., 2006)
T. hirsuta	Solitary	Medicinal (Knezević et al., 2018)
T. versicolor	Gregarious	Medicinal (Tapwal et al., 2013)
Trametes sp. 1	Solitary to gregarious	Saprobic
Trametes sp. 2	Solitary to gregarious	Saprobic
Psathyrellaceae		
C. disseminatus	Gregarious	Nutraceutical (Novakovic et al., 2016)
P. plicalitis	Gregarious in clusters	Saprobic (Kuo, 2015)
Psathyrella sp.	Gregarious	Saprobic (Kuo, 2015)
P. candolleana	Solitary	Saprobic

Table 1 (continued)

Russulaceae		
Russula sp.	Solitary to gregarious	Saprobic
Schizophyllaceae		
S. commune	Gregarious	Nutraceutical (Kuo, 2015)
Tricholomataceae		
Mycena sp	Solitary	Saprobic
P. mitis	Gregarious	Saprobic (Kuo, 2015)
M. ramealis	Gregarious in clusters	Saprobic
Xylariaceae		
D. concentrica	Gregarious	Medicinal (Dutta & Acharya, 2014)
X. papulis	Gregarious in clusters	Saprobic

Conclusion

In conclusion, 37 macrofungi belonging to 16 families, 26 genera, and 29 species were collected and identified. Twenty-one were saprobic, 10 medicinal, 2 nutraceutical, 1 therapeutic, and 1 for bioremediation. Generally, Paracelis in Mountain Province is a natural habitat of several mushrooms with great potential for cultivation that could demonstrate different biological activities. Therefore, further assessment of the area is recommended.

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