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Basidiomycetous Fungi in Mt. Palay-palay Protected Landscape, Luzon Island, Philippines

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ABSTRACT

Basidiomycetous fungi are ubiquitous organism thriving mostly in forest ecosystem. A study of these group of fungi was conducted at Mt. Palaypalay Protected Landscape (MPPL) in Southern Luzon, Philippines. This protected landscape was categorized by National Integrated Protected Areas System as one of the priority areas for biodiversity conservation. This study aimed to document the existence of Basidiomycetes in the Landscape. Collection and photo-documentations of fungi were done during the months of December 2014 to June 2015. Fungal sampling was done using Transect Line (TL) with a combination of quadrat and opportunistic sampling methods. Three transect lines, one kilometer each was laid out from baseline of 100 masl up to 500 masl. Ten quadrats of 15m x 20m with an interval of 250m were established for each TL. Fleshy and woody Basidiomycetous species were collected, identified, and characterized based on established dichotomous keys. Of the 434 specimens collected, there were 24 families, 37 genera, and 41 species identified. The Landscape is currently experiencing some degree of anthropogenic disturbances such as minor forest products gathering, slash-and-burn farming, and quarrying. Fungal diversity research efforts need to be encouraged to evaluate the effects of these human disruptions on the ecology of the Landscape.

Keywords: Basidiomycetous fungi, forest ecosystems, Mt. Palaypalay, Luzon Island, Philippines

INTRODUCTION

Fungi are organisms which are grouped together since they possess chitin in their cell walls, and they nourish themselves by digesting organic matter first then subsequently ingesting it. Even most fungi resemble plants in appearance, a distinct difference between the two groups is that the former nourish themselves by absorbing nutrients from dead or living organic matter which are by-products of the enzymatic degradation process they initiate by means of secreted exoenzymes. The following heterotrophy by absorption, fungal species cater to one of the most important ecological processes, nutrient recycling of organic matter (Taylor *et al.* 2006).

One apparent member of this kingdom that utilizes a variety of substrates are the Basidiomycota. Basidiomycota is a sister phylum to the monophyletic

Ascomycota and is morphologically observed as filamentous fungi that can reproduce asexually via the production of specialized club-shaped cells called basidia. These basidia normally contain four spores. Basidiomycota includes mushrooms, puffballs, earth stars, smuts, rusts, jelly fungi, bracket fungi among others (Swann and Hibbett 2007).

Mt. Palaypalay Protected Landscape (MPPPL) is a 4000-hectare mountain range located in the borders of Nasugbu, Batangas, and Ternate, Cavite and situated $14^{0}16'58.43''$ N latitude and $120^{0}51'49.22''$ E longitude. (Figure 1). The MPPPL has been a frequent study site for the assessment of plant and animal diversity (Luyon and Salibay 2007). This mountain range is teeming with various species of organisms but seems to be threatened as of today. This protected landscape experiencing some anthropogenic activities carried out within its vicinities such as charcoal manufacturing, farming, cattle grazing, collection of minor forest products, quarrying, and illegal cutting of trees particularly during the 1960s (Green for Life: One Million Trees and Beyond 2009). The landscape is a favorite destination for local hikers and campers and was categorized by NIPAS as Protected Landscape under Presidential Decree, Proclamation No. 1315 on June 27, 2007 in order to protected and preserve its biodiversity.

Currently, one group of organisms whose diversity in MPPPL has not been thoroughly studied are the fungi. In this study, fungal species belonging to Basidiomycota were identified and characterized to provide base line preliminary information regarding the diversity of this fungal group in Mt. Palaypalay Protected Landscape. They are known to have a significant role in the nutrient cycling of the forest ecosystem (Klemm 2005). Typically, they grow on decaying plants or animals, soil, leaf litter, rotting logs or compost heaps or manure (Reyes *et al.* 2009).

Plate 1. The views of Mt. Palaypalay Protected Landscape
from the highway near Puerto Azul.

OBJECTIVES OF THE STUDY

This research study was done to account the basidiomycetous fungi present in Mt. Palaypalay Protected Landscape. Specifically this research aimed to: (1) identify basidiomycetous fungi based on physical and anatomical features, (2) provide listing of this group of fungi present at MPPPL, and (3) determine the economic and ecological importance of this group of organisms in MPPPL ecosystem.

MATERIALS AND METHODS

Description of Study Site

The research study was carried out in Mt. Palay-palay Protected Landscape in Ternate, Cavite, which lies between 14°13.904' N latitude and 120°39.439' E longitude (Etrex GPS Device, Garmin). The area has two pronounced seasons, dry from November to April, and wet during the rest of the year. Weather is humid most of the year except December and March when there is characteristic dryness of the locality. Mt. Palay-palay is one of the three major peaks in the Landscape. Other peaks include Mataas na Gulod and Pico de Loro. The collection site was Mt. Palaypalay, which is the largest and best-conserved forest among the three.

The forested areas of the mountain boast a plethora of vegetation types ranging from sub-tropical to tropical. Because of its diverse topography and different climatic factors, the study site can be considered as highly diverse (Figure 2).

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Figure 2. Map of Cavite showing the study area,
Mt. Palay-palay National Park/ Protected Landscape.

Field Sampling of Basidiomycetous Fungi

Field sampling was completed using three transect lines (TL) with ten quadrats, 15m x 20m with an interval of 250m on each quadrat. Transect line was laid starting at 100m above sea level upward to the peak of 500 masl. A total of 30 quadrats were laid out in the study areas. The combination of quadrat method and opportunistic and or purposive sampling methods were employed in the study areas. All macroscopic basidiomycetous fungi found inside and outside the quadrat were photographed in their natural habitat, collected, identified and classified.

Fungal host, color, shape, the size of the fruiting bodies, prevailing temperature and humidity in the area at the time of collection and Global Positioning System (GPS) coordinates were recorded during the time of collection and documentation. Macroscopic fungi inhabiting the soil and ground litter were dug using a trowel, and, for those attached to tree branches or barks, were gathered using bolo and knife.

Specimen Collection

Field collection of specimen and data were done during rainy and summer season. Specimens were photographed in the field (as they occur in their natural habitats) and all important morphological characters including the substrata were noted.

During collection, fragile and fleshy specimens were not mixed with woody ones. The woody specimens were removed with the use of bolo together with the wood tissues while shovel was used in collecting the fleshy ones (Tadiosa *et al*. 2011).

Specimen Preservation

Collected specimens were preserved by mechanical oven drying and alcohol immersion. Field collection numbers were given to each and every specimen, and they were stored in the Natural History Collections of the Biological Sciences Department of De La Salle University-Dasmariñas for future reference.

The woody and bracket specimens were wrapped in newspaper while fragile and fleshy specimens were directly placed in wide-mouthed jars, together with the pertinent data and all other notes useful for taxonomic identification. They were dried and subsequently fumigated to kill insects, particularly the destructive larvae.

Upon reaching the laboratory, woody and fleshy specimens were segregated from one another. After additional notes had been taken, the woody specimens underwent drying as preservation and fleshy ones were immersed in 70% denatured alcohol as a preservative. The length of the drying period of all specimens collected varied depending upon the nature of the specimens and the prevailing temperature and the relative humidity of the air during collection (Karun and Sridhar 2013; Tadiosa *et al.* 2011).

Characterization of Collected Fungal Specimens

The following criteria were used to describe and identify the collected fungal specimens:

a. cap or pileus- size (cm), shape, color and color changes (upper and lower surface), margin, and firmness of basidiocarp;

b. gills or lamellae-attachment to the stipe, thickness, forking, color and color changes, and orientation of hyphae in the inner gills;

c. stipe or stalk- size (cm), diameter (cm), attachment or position, shape, and firmness;

d. presence or absence of cystidia, basidia, and basidioles;

e. presence or absence of sterigmata;

f. mycelium-if visible, color when still attached to the basal stipe and the roots;

g. hyphae- relative size, presence or absence of septation and clamp connection and,

h. habitat (substrate) and edibility.

Taxonomic Identification and Classification

Identification was facilitated using standard dichotomous keys such as those prepared by Arora (1986); Smith *et al.* (1988) and Hood (1992) together with colored and representative photographs from the books of Koon (1990), McKnight (1999), Quimio (1988 and 2001), and Laessoe (1998). Confirmation of initial identities of the specimens was further done by consulting with the expert from the Botany Division of the National Museum of the Philippines. After identification, collected specimens were listed according to their respective families.

RESULTS AND DISCUSSION

Taxonomy of Collected Basidiomycetous Fungi

Field sampling of Basidiomycetous fungi had resulted in the identification of 24 families (Table 1), 37 genera, and 41 species with a total of 434 individuals. The dominant group is the Polyporaceae with 6 out of 41 species identified or 14% of the species collected. Coriolaceae and Tricholomataceae with four species each are next in abundance with roughly 10% of the species collected, and the third is Ganodermataceae having 3 species or 7% of the species collected. The rest of the families have less than 3 species each. Basidiomycetous fungi were found growing mostly on rotten trunks, branches, and stumps of dying trees.

Table 1. The Taxa and Its Substrates where these Fungi Grow Including the Elevation where these are found as well as Growth Habit

TAXA	HOST/ SUBSTRATE	ELEVATION (masl)	GROWTH HABIT
AGARICACEAE			
Lepiota cristata	soil, along the trail	242	solitary
AURICULARIACEAE			
Auricularia auricula	on rotten trunk of *Psidium guajava*	256	gregarious
Auricularia polytricha	on rotten branch of *Bauhinia purpurea*	238	gregarious
CANTHARELLACEAE			
Cantharellus infundibuliformis	on rotten stump of *Gmelina arborea*	254	gregarious
COPRINACEAE			
Coprinus disseminatus	soil, grassland	235	gregarious
Coprinus plicatilis	soil, grassland	246	gregarious
CORIOLACEAE			
Hexagonia apiaria	on rotten branch of *Vitex parviflora*	458	solitary to gregarious (3-5 in a group
Hexagonia tenuis	on rotten branch of *Leucaena leucocephala*	478	gregarious
Lenzites repanda	on rotten branch of *Dillenia philippinensis*	494	solitary to gregarious (3-5 in a group)
Trametes corrugate	on rotten branch of *Syzygium subcaudatum*	492	solitary to gregarious (4-6 in a group)
CORTINARIACEAE			
Cortinarius callisteus	soil, along the trail	345	solitary
CREPIDOTACEAE			
Crepidotus mollis	on rotten branch of *Canarium asperum*	465	gregarious
DACRYOMYCETACEAE			
Dacryopinax spathularia	on rotten trunk of *Pterocarpus indicus*	458	gregarious
GANODERMATACEAE			
Amauroderma rugosum	on rotten roots of *Diospyros pilosanthera*	365	solitary
Ganoderma applanatum	on rotten stump of *Leucaena leucocephala*	348	solitary to gregarious (3-5 in a group)
Ganoderma lucidum	on rotten stump of *Dracontomelon dao*	412	solitary
GEASTRACEAE			
Geastrum saccatum	soil, along the trail	242	gregarious
HYGROPHORACEAE			
Hygrophorus pratensis	soil, thickets	238	gregarious
HYMENOCHAETACEAE			
Hymenochaete rubiginosa	on rotten trunk of *Wrightia pubescens*	346	solitary to gregarious (3-5 in a group)
Phellinus gilvus	on rotten branch of *Swietenia macrophylla*	354	solitary

MARASMIACEAE			
Marasmius rotula	on rotten roots of *Antidesma bunius*	376	gregarious
MYCENACEAE			
Mycena galopus	soil, thickets	465	gregarious
PLEUROTACEAE			
Pleurotus ostreatus	on rotten trunk of *Aglaia sp.*	478	gregarious
PLUTEACEAE			
Volvariella volvacea	banana leaves	450	gregarious
POLYPORACEAE			
Daedalea ambigua	on rotten branch of *Pterocarpus indicus*	486	solitary
Daedalea flavida	on rotten branch of *Vitex parviflora*	493	solitary
Favolus reniformis	on rotten branch of *Leucaena leucocephala*	345	solitary
Fomes gilvus	on rotten stump of *Shorea guiso*	365	solitary
Microporus xanthopus	on rotten stump of *Cordia sp.*	453	solitary to gregarious (3-6 in a group)
Pycnoporus sanguineus	on rotten branch of *Macaranga grandifolia*	465	solitary to gregarious (3-5 in a group)
RUSSULACEAE			
Lactarius piperatus	soil, grassland	456	solitary
SCHIZOPHYLLACEAE			
Schizophyllum commune	on rotten branch of *Glochidion sp.*	246	gregarious
STEREACEAE			
Stereum complicatum	on rotten branch of *Antidesma sp.*	432	solitary to gregarious (3-5 in a group)
Stereum sanguinolentum	on rotten branch of *Myristica sp.*	476	solitary to gregarious (4-6 in a group)
STROPHARIACEAE			
Hypholoma fasciculare	soil, thickets	465	solitary
THELEPHORACEAE			
Thelephora terrestris	on rotten roots of *Canarium sp.*	342	gregarious
TREMELLACEAE			
Tremella fuciformis	on rotten trunk *Leucaena leucocephala*	245	gregarious
TRICHOLOMATACEAE			
Collybia maculate	soil, grassland	346	solitary
Panus rudis	soil, grassland	321	solitary to gregarious (3-5 in a group)
Termitomyces striatus	soil, termite mound	238	gregarious
Lentinus strigosus	soil, grassland	265	gregarious

Table 2. Basidiomycetous Fungal Families and Its Corresponding Number of Species Collected at MPPPL

FUNGAL FAMILIES	NUMBER OF SPECIES
Agaricaceae	1
Auriculariaceae	2
Cantharellaceae	1
Coprinaceae	2
Coriolaceae	4
Cortinariaceae	1
Crepidotaceae	1
Dacryomycetaceae	1
Ganodermataceae	3
Geastraceae	1
Hygrophoraceae	1
Hymenochaetaceae	2
Marasmiaceae	1
Mycenaceae	1
Pleurotaceae	1
Pluteaceae	1
Polyporaceae	6
Russulaceae	1
Schizophyllaceae	1
Stereaceae	2
Strophariaceae	1
Thelephoraceae	1
Tremellaceae	1
Tricholomataceae	4
Number of Families = 24	**Number of Species = 41**

Pycnoporus sanguineus (Fr.) Murr. — *Ganoderma lucidum* (Leys.) Karst.

Microporus xanthopus (Fr.) Kuntze — *Daedalea ambigua* Berk.

Hexagonia tenuis (Hook.) Fr. — *Auricularia polytricha* (Mont.) Sacc.

Ganoderma applanatum (Pers.) Pat. — *Schizophyllum commune* Fr.

Plate 1. Some of the Basidiomycetous Fungi Documented at Mt. Palaypalay Protected Landscape.

Suitability of Growth and Factors Affecting the Diversity of Fungi in MPPPL Area

The interplay between factors such as wind speed, temperature, humidity, and faunal statistics is responsible for the diversity of Basidiomycetous fungal specimens collected at the study site. As organisms that rely heavily on spore dispersal and high moisture content of the environment, it is logical to think that these species will thrive in areas that are always almost humid. Forested areas in Southern Luzon such as MPPPL is itself a suitable environment for the reproduction of these organisms.

Wind speed assists in the rapid dispersal of spores were bringing them to other places that can support their development to adulthood. Season of collection directly influences the number of fungal organisms that can be collected and observed. During the dry season (December to May), where humidity is low and it is usually hot, diversity of Basidiomycetous fungi tend to decrease as compared to the wet season where enough moisture is received by substrate tree tissues and soil to support the proliferation and development of varying Basidiomycetes and the plethora of fruiting bodies they have. The variety of insects feeding on fungal fruiting bodies also dictates the kinds of Basidiomycetes that can be surveyed for a particular period.

CONCLUSIONS AND RECOMMENDATIONS

Albeit with limited time and the season during collection which is not so ideal for specimen collection, the unique diversity of Basidiomycetous fungi in MPPPL was still observed and accounted for. After identifying the collected specimens and providing a listing of it, the results of this study indicate that MPPPL is one of the species-rich areas of the country teeming with many organisms. Based on our observation, these fungi are great decomposers in the forest ecosystem. These fungi are largely responsible for decay in living trees, rotten branches and trunk, other wood in service and valuable standing timbers. Other species have known for its edibility and can be a source of food and medicine.

Therefore, it is recommended that continuous researches be done to acquire more data establishing the seasonal fungal biodiversity profile of the study site which is very important in devising conservation measures to protect and preserve the richness of MPPPL.

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