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SPECIES LISTING OF MACROFUNGI IN ANGAT WATERSHED RESERVATION, BULACAN PROVINCE, LUZON ISLAND, PHILIPPINES

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ABSTRACT

This work reported the different naturally occurring macrofungi in Angat Watershed Reservation in Norzagaray, Bulacan Province, Philippines. Macrofungi were collected and identified based on their micro- and macro-morphological characteristics. A total of 21 species belonging to 10 families and 16 genera were identified. These include *Cantharellus* sp., *Hexagonia tenuis*, *Lenzites* sp., *Trametes corrugata*, *Trametes versicolor*, *Crepidotus* sp., *Ganoderma applanatum*, *Ganoderma* sp., *Phelinus* sp., *Daedalea ambigua*, *Fomes* sp., *Microporus* sp., *Microporus vernicipes*, *Microporus xanthopus*, *Polyporus hirsutus*, *Polyporus* sp., *Pycnoporus sanguineus*, *Cookeina tricholoma*, *Schizophyllum commune*, *Daldinia concentrica*, and *Xylaria polymorpha*. Among the 10 families, most of the collected macrofungi belong to Basidiomycota and two families belong to Ascomycota. Some of the collected mushrooms are edible like *Cantharellus* sp., *Ganoderma applanatum, Ganoderma* sp., *Phelinus* sp., and *Schizophyllum commune* and medicinal such *Ganoderma, Phelinus, Trametes, Schizophyllum, Fomes* and others. Therefore,

Angat Watershed Reservation is a natural habitat of diverse macrofungi with promising potentials as source of food and medicine, which are necessary to harness.

Keywords: Basidiomycetes, Ascomycetes, Angat Watershed Reservation, species listing, macrofungi

INTRODUCTION

Mushrooms have been valuable source of food and medicines in the past several decades. They contain polysaccharide, proteins, crude fat, crude fiber, minerals and vitamins. triterpenoids, phenols, nucleotides and their derivatives, glycoproteins and sterols **[1]**. As natural medicine, mushrooms are utilized as alternative remedy for bronchitis, inflammation, flu, asthma, arthritis, hypertension, diabetes, gastric ulcer, hepatitis, kidney failure, tumor and cancer **[2]**. Because of these advantages, wild edible mushrooms are being collected and rescued their cell lines in order to harness their potential in mushrooms production.

The Philippines is a haven of diverse biological resources and remains one of the biodiversity hotspots in the planet **[3]**. Many studies have been conducted on the inventory and survey of different species of plants, animals, insects, marine organism but very limited on mushrooms. Species listing and molecular identification of mushrooms present in the six Aeta tribal communities in Central Luzon was done by De Leon et al. **[4]**, and they found out that there were 76 macrofungi identified down to genus and species level. This finding indicates the species richness of mushrooms in the country.

The Angat Watershed Reservation is one of the remaining well-forested and managed watersheds in the Philippines. It is the principal source of water supply and it is enclosed lowland rainforest. It has a total area of 62,309 hectares and lies in the southernmost of the Sierra Madre Mountain Range. It is situated largely in the Municipalities of Doña Remedios Trinidad, Norzagaray and San Jose Del Monte, all in the Province of Bulacan. The northeastern boundaries stretch into the Municipalities of General Tiñio, Province of Nueva Ecija and Infanta, Province of Quezon. The conservation areas of the watershed are composed of important forest tree species and decomposer of forest litters, the macrofungi. However, no report has been found on mycoflora of Angat Watershed Reservation, therefore, the conduct of this study.

To the best of our knowledge, this paper is the first report on a wide variety of macrofungi species that naturally inhabiting in the Angat Watershed Reservation. Herein, we survey, collect, and identify the different macrofungi from the three collection sites with promising potential for cultivation as source food and/or medicine for the Filipino people.

MATERIALS AND METHODS

Study site

The collection sites were in Angat Watershed Reservation in Norzagaray, Bulacan. The topographic map and the three collection sites are shown in Figure 1. The watershed area is located geographically between the coordinates of 121º00 to 121º31 longitudinal and 14º 54º to 15º 21' latitudes and approximately 50 km northeast of Quezon City. It can be reached through a road from Manila via Fairview, Tungko, City of San Jose Del Monte, Bigte and San Mateo, Norzagaray, Bulacan. The area has a small temperature range and high rainfall at 3,200 mm. Three (3) study sites within the forest reserve of Angat Watershed, Norzagaray, Bulacan were designated and these were Station 1: Hilltop Site, Station 2: Mahogany Plantation, and Station 3: Spillway or Geology Site. These study sites were selected due to availability of mushroom species and accessibility of the location. A permit was secured from the National Power Corporation-Angat Watershed Area Team (NPC-AWAT) who has the jurisdiction and has legal mandates over the area of collection.

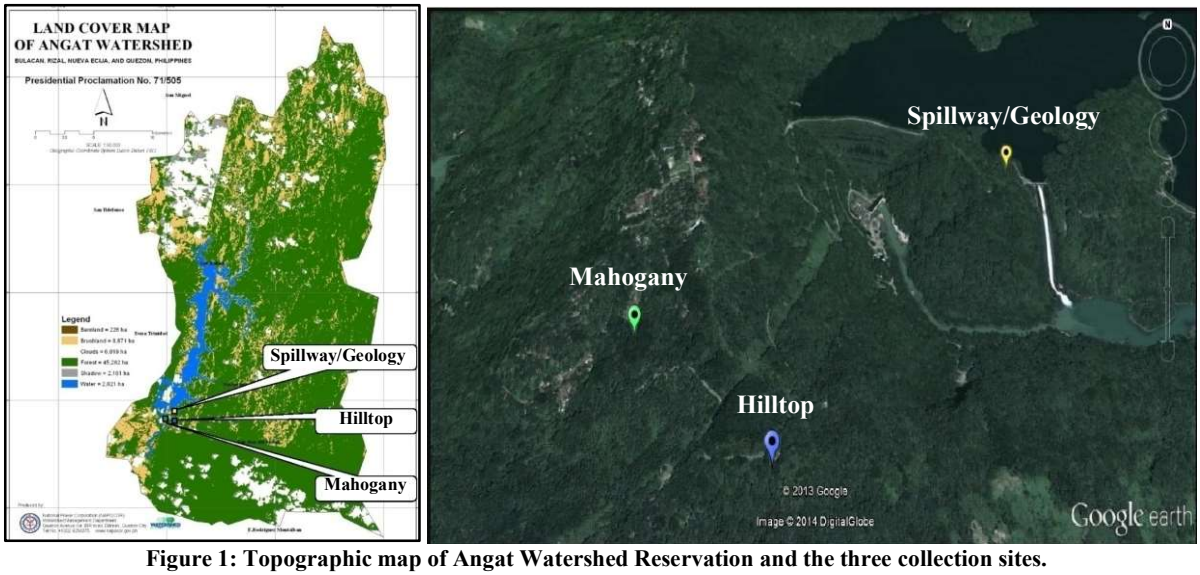

Figure 1: Topographic map of Angat Watershed Reservation and the three collection sites.

Macrofungi collection and preservation

Survey, inventory and collection of all macrofungi were done in the period of December 2013 to January 2014. Macrofungi were photo-documented in their natural habitat. Fruiting bodies were carefully collected using shovel obtaining part of the substrate to ensure that they were not damaged. Collected specimens were properly labeled and individually placed in a brown paper bag and brought to the laboratory for identification. To preserve the collected samples, fleshy fruiting bodies were pickled in 10% formalin solution while those wood rotters were air-dried for 3-5 days and placed in specimens' box. Specimens were deposited in the Biology Laboratory of the College of Science, Bulacan State University, City of Malolos, Bulacan, Philippines.

Morphological characterization and identification

Macrofungi were identified and taxonomically classified using the standard procedure of Quimio **[5]** and Tadiosa et al **[6]**. Morphometric data such as the shape of the fruiting body and the cap, gills in section, textures and colors together with the measurement of the cap or pileus (diameter and height), stalk or stipe (width and height), and bracket thickness were gathered while spore shape, size and color were observed. To verify the authenticity of the specimens, the expertise of Dr. Edwin Tadiosa of the Mycology Department of the National Museum of the Philippines was sought. A taxonomic checklist of macrofungi of Angat Watershed Reservation was prepared.

RESULTS AND DISCUSSION

A total of 21 species of naturally occurring mushrooms were collected and identified from the three collection sites in Angat Watershed Reservation, Bulacan, Philippines. These species were belonging to 10 families and 16 genera. Eight mushrooms were identified down to genus level while 13 mushrooms were identified down to species level. A taxonomic checklist of mushrooms was prepared based on their family names in alphabetical order with their description, edibility, substrate, and location in the collection area.

Cantharellaceae
Cantharellus sp.
Description : has yellow stalk and forking yellow or grayish ridges on underside of cap, which is grey and brown or entirely yellow on top.
Edibility : edible
Substrate : decaying wood
Location : Spillway/Geology Site
Coriolaceae
Lenzites sp.

Description : mussel-like, leather or cork-like hat, whose underside is covered with radiating, by cross walls interconnected plates and white color. strongly convex dorsal surface, dark brown densely hairy pileus
Edibility : non-edible
Substrate : rotten tree
Location : Spillway/Geology Site

Crepidotaceae

***Crepidotus* sp.**
Description : have small, convex to fan-shaped sessile caps with yellow to brown spore prints
Edibility : non-edible
Substrate : leaf-litters
Location : Hilltop

Fomitopsidaceae

***Daedalea ambigua* Berk.**
Description : has lumpy feature near the area of attachment and smoother near the rounded margin. The underneath may be round to angular pores, a maze-gill pattern, and gill like structures.
Edibility : non-edible
Substrate : dead wood
Location : Spillway/Geology Site

***Fomes* sp.**
Description : has hoof-shaped pileus having a dimension of up to 20 cm wide. The upper surface are pale dark gray to dark brown; concentrically furrowed; zonate, hard and woody; blunt margin extending beyond pore surface. The pore surface is cream-colored at first then become brownish.
Edibility : non-edible
Substrate : bark of a tree
Location : Hilltop Site

Ganodermataceae

***Ganoderma applanatum* (Pers.) Pat.**
Description : the upper surface is concentrically furrowed; gray to grayish-black or brown; white margin when growing; surface hard, crusty, finely cracked and wrinkled; dull
Edibility : edible but not palatable
Substrate : living bark of a tree
Location : Hilltop Site, Mahogany Site

***Ganoderma* sp.**
Description : upper surface is gray to brown that hard and though while lower surface is a lighter brown with numerous pores
Edibility : edible but not palatable
Substrate : fallen log
Location : Hilltop Site

Hymenochaetaceae

***Phelinus* sp.**
Description : has corky yellowish to brownish to gray to black pileus which may be cracked or not. The pore surface is brownish.
Edibility : edible but not palatable
Substrate : bark of tree
Location : Hilltop Site

Polyporaceae

***Hexagonia tenuis* (Hook.) Fr.**
Description : a thin, leathery bracket fungus which upper surface is smooth and generally concentrically zoned in various shades of brown while the underside has hexagonal or honeycomb-like pores
Edibility : non-edible
Substrate : dead log
Location : Hilltop Site, Mahogany Site

***Microporus* sp.**
Description : fruiting body has yellow to red-footed stipe and have thin, funnel-shaped pileus that are concentrically zoned in various shades of brown red.
Edibility : non-edible
Substrate : dead fallen log
Location : Hilltop Site

***Microporus vernicipes* (Berk.) Kuntze**
Description : pileus has thin, tough, glossy, semicircle or kidney with lemon yellow or dark red color.
Edibility : non-edible

Substrate : fallen log
Location : Hilltop Site, Mahogany Site

***Microporus xanthopus* (Fr.) Kuntze**
Description : has funnel-shaped with distinct bands in various shades of brown and cream on the inner surface. The lower surface is white to pale brown in color and is covered with numerous minute pores
Edibility : non-edible
Substrate : dead part of a tree
Location : Hilltop Site, Spillway/Geology Site

***Polyporus hirsutus* (Wulf.) Fr.**
Description : The cap is leathery and hairy with pores on the underside
Edibility : non-edible
Substrate : dead branch of a tree
Location : Hilltop Site

***Polyporus* sp.**
Description : has leathery and initially pliable, kidney-shaped fruiting body
Edibility : non-edible
Substrate : rotten wood
Location : Spillway/Geology Site

***Pycnoporus sanguineus* Fr.**
Description : the bright orange fruiting body is thin dry conk with a lateral attachment to its substrate
Edibility : non-edible
Substrate : dead log
Location : Spillway/Geology Site

***Trametes corrugata* (Pers.) Bres.**
Description : has tough and leathery sporocarp with bracket-shaped, or kidney-shaped often fused with other caps; often with alternating zones of texture; with concentric zones of white, brown and cinnamon
Edibility : non-edible
Substrate : dead piece of stem wood
Location : Mahogany Site

***Trametes versicolor* (L.) Lloyd.**
Description : cap upper surface are multicolored with yellowish, grayish, bluish, blackish, and reddish-brown wavy brown to yellowish-brown
Edibility : non-edible
Substrate : dead fallen tree
Location : Mahogany Site

Sarcoscyphaceae

***Cookeina tricholoma* (Mont.) Kuntze**
Description : a hairy goblet fungus, deeply cup-shaped fruiting bodies with a distinct stipe that is strongly attached to the substrate.
Edibility : non-edible
Substrate : decaying part of wood
Location : Mahogany Site

Schizophyllaceae

***Schizophyllum commune* Fr.**
Description : a fan-shaped fungus with short stipe and gill-like structures that are split lengthways
Edibility : edible
Substrate : fallen branch of tree
Location : Spillway/Geology Site

Xylariaceae

***Daldinia concentrica* (Fr.) Ces. &de Not.**
Description : has a nearly globose to hemispherical (but often irregularly shaped) fruit bodies are grayish-white to pinkish brown at first and becomes grayish-brown to blackish when matures
Edibility : non-edible
Substrate : dead root of a tree
Location : Hilltop Site

***Xylaria polymorpha* (Pers.) Grev.**
Description : has large, club-shaped black fruiting body which grows in clusters on dead stumps and quite variable in form.
Edibility : non-edible
Substrate : fallen pieces of woods
Location : Spillway/Geology Site

The different collected and identified macrofungi include *Cantharellus* sp., *Hexagonia tenuis*, *Lenzites* sp., *Trametes corrugata*, *Trametes versicolor*, *Crepidotus* sp., *Ganoderma applanatum*, *Ganoderma* sp., *Phelinus*sp., *Daedalea ambigua*, *Fomes* sp., *Microporus* sp., *Microporus vernicipes*, *Microporus xanthopus*, *Polyporus hirsutus*, *Polyporus* sp., *Pycnoporus sanguineus*, *Cookeina tricholoma*, *Schizophyllum commune*, *Daldinia concentrica*, and *Xylaria polymorpha*. Most of the collected macrofungi belong to Basidiomycota that includes the family of Cantharellaceae, Coriolaceae, Crepidotaceae, Fomitopsidaceae, Ganodermataceae, Hymenochaetaceae, Polyporaceae, and Schizophyllaceae. The remaining two families belong to Ascomycota. *Cookeina tricholoma, Daldinia concentrica,* and *Xylaria polymorpha* were the collected species of Ascomycota. Majority (14 macrofungi) of the collections was belonged to Polyporales, and Polyporaceae family was the most number of collected mushroom samples. Two Agaricales including *Crepidotus* sp. and *Schizophyllum commune* were identified. Aside from Polyporales and Agaricales, other order of mucrofungi such as Cantharellales, Hymenochaetales, Pezizales, and Xylariales were also recorded.

Eleven species of fungi are found in wood areas where large trees, shrubs, and lianas abound. These were *Ganoderma* sp*., Daedalea ambigua, Polyporus hirsutus, Polyporus* sp., *Pycnoporus sanguineus, Trametes corrugata, Trametes versicolor, Hexagonia tenuis, Daldinia concentrica, Lenzites* sp. and *Xylaria polymorpha.* Some species found in lowland tropical areas including *Schizophyllum commune, Cantharellus* sp., *Cookeina tricholoma* and *Fomes* sp.. Fallen branches, stumps and rotten trunks of wood are home to *Microporus* sp., *Microporus vernicipes,* and *Microporus xanthopus*. Some are in living trees which are *Ganoderma* sp., *Ganoderma applanatum,* and *Phellinus* sp. Leaf litter is the substrate of *Crepidotus* sp. Macrofungi perform very vital role in the natural and balance ecosystem. They breakdown complex carbohydrates of the lignocellulosic plant residues through decomposition process which makes the soil enrich with essentials substances and minerals such as phosphorus, potassium, iron, copper, and zinc, for the plants.

Some of the collected mushrooms are edible like *Cantharellus* sp., *Ganoderma applanatum, Ganoderma* sp., *Phelinus* sp., and *Schizophyllum commune*. However, *Ganoderma* and *Phelinus* are not palatable,

they are commonly prepared as tea. *S. commune* is usually collected from the wild and combined to other vegetables to prepare native delicacies. Among the collected macrofungi, some are considered medicinal, for example, *Ganoderma, Phelinus, Trametes, Schizophyllum, Fomes* and others. *Ganoderma* is used to treat and prevent gastric cancer, hypertension, hepatitis, chronic bronchitis, and hypercholesterolemia **[7]**. *Phelinus linteus* extract has anti-inflammatory activity in LPS-stimulated RAW264.7 cells by virtue of its ability to suppress the production of inflammatory cytokines and chemokines via inhibition of MAPK activation and up-regulation of antioxidant activities **[8]**. *Trametes versicolor* exhibits anti-tumor properties against a large spectrum of tumor cell lines from gastric, lung, prostate, breast, melanoma, and liver tumors, leukemia and lymphoma **[9]**. Moreover, some other mushrooms are valuablesource of agents against cancer.These are *Phellinus, Pleurotus, Agaricus, Ganoderma, Clitocybe, Antrodia, Trametes, Cordyceps, Xerocomus, Calvatia, Schizophyllum, Flammulina, Suillus, Inonotus, Inocybe, Funlia, Lactarius, Albatrellus, Russula,* and *Fomes* **[10]**.

In conclusion, Angat Watershed Reservation has diverse mycological resources with total of 21 collected and identified macrofungi from the three collection sites, which belong to 10 families and 16 genera. These naturally occurring macrofungi have promising potential as source of food, medicine and additional income for the community. Therefore, harnessing the cultivation potential of these wild mushrooms is indeed necessary.

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