Vol. 5 January 2014
CHED Accredited Research Journal, Category A
Print ISSN 2094-5019 • Electronic ISSN 2244-0461
doi: http://dx.doi.org/10.7828/ajob.v5i1.483

Asian Journal of Biodiversity
This Journal is in the Science Master Journal List of
Thomson Reuters (ISI) Zoological Record

A Taxonomic Study of Wood-Rotting Basidiomycetes at the Molave Forest of San Fernando City, La Union Province, Philippines

EDWIN R. TADIOSA
ORCID No. 0000-0002-0286-692X
ertadiosa@yahoo.com
Philippine National Herbarium, Botany Division,
National Museum of Natural History
P. Burgos St., Manila

JETHRO S. ARSENIO
ORCID No. 0000-0003-3569-8675
Jsarsenio.orcid@gmail.com
Biology Department, College of Science,
De La Salle University-Dasmarinas, Cavite

ABSTRACT

A taxonomic study of the wood-rotting basidiomycetes was conducted at the Molave Forest of San Fernando City, La Union, Northern Luzon, Philippines. This mountainous forest located in the eastern boundaries of the City is being considered as one of the most important forest ecosystems in Ilocos Region, thereby indicating the need for conservation and protection. This paper attempts to document all the macroscopic fungal basidiomycetous species in the area by preparing taxonomic accounts based on an extensive systematic collection and by facilitating the identification or recognition of each fungal species. As there has been no comprehensive work done on the diversity of macroscopic fungi in this area, hence this study was conducted. Using transect line (TL) method, four transect lines were established from the baseline (100m asl) toward the peak (300m asl) with 10m x 25m quadrat sampling each transect line and an interval of 50 meters between quadrats. All in all 20 quadrats were laid out. The fungal species within the quadrats along the TLs were identified and recorded. This study of wood-rotting basidiomycetes in the molave forest of La Union documented fifty one species. Each species is described including substrata/hosts, synonymies, and habitat. Some of these species, being the most destructive fungi are largely responsible for the decay of living trees. We found out that fungal species richness decreased if the condition of the area is relatively dry.

Keywords - basidiomycetes, molave forest, field survey, macrofungi, taxonomic study, species richness, wood-rotting, San Fernando City, Philippines

INTRODUCTION

The hilly portion of San Fernando City in the province of La Union has an existing molave forest, reaching an altitude of about 200-300m above sea level. This kind of forest is typical for the limestone soils in the coastal areas in the Philippines, which are usually quite shallow and excessively drained (Dano and Ociones 2000). Molave (*Vitex parviflora* Juss.) is the dominant tree species from which the whole forest association took its name. Molave forest, which is located in the eastern part of the City, is one of the important forest ecosystems in the province and nearby surrounding provinces of Pangasinan, Benguet, Ilocos Sur and Abra. San Fernando City is strategically located at the heart of La Union Province. It straddles the boundaries of the municipalities of San Juan, Bagulin, and Bauang (Lancion 1995). This mountainous forest located in the eastern boundaries of the City is being considered as one of the most important forest ecosystems in Ilocos Region, thereby indicating the need for conservation and protection.

One of the most diverse groups of organisms in San Fernando's Molave Forest is the fungi. Now recognized distinct from plants and animals, the fungi are a large group of eukaryotic, spore-bearing and achlorophyllus organisms which constitute an abundant element of terrestrial biota in the Philippines. About 120,000 species have been reported in the world (Hyde 1998). In the Philippines, about 3,755 species have been recorded (Quimio and Capilit 1981), and these mostly belong to the following groups – egg fungi, sac fungi, club fungi and imperfect fungi. Although many fungal species are economically important, some are considered as disadvantageous to the hosting plants to which they are attached.

The pore fungi, for instance, together with a few gilled-species are largely responsible for decay in living trees, stumps, fallen branches, logs, and structural timbers (Worral et al. 1997). These are commonly considered as harmful organisms that cause great economic losses of wood. While that is true, they can be beneficial to the ecosystems. As they weaken older trees, dead trunks and stumps, they also make them vulnerable to wind throw and natural removal from the stand. These permit the growth of young and vigorous trees and thereby play an integral role in maintaining the dynamic and ever-changing nature of the forests. The decayed wood residues become important components in the forest soils and increase water-holding capacity, thereby enhancing the growth of different tree species (Gilbertson 1980).

There has been no comprehensive taxonomic treatment done yet on the biodiversity of fungi, even on a regional basis in the Philippines, hence this study was conducted. It is hoped that this regional work will form a segment of a more comprehensive study of all the fungi in the country. Many of these species demand a growing need to study their morphological and anatomical features and differences which can be attained through the science of taxonomy.

Fig. 1. Map of the Province of La Union showing the study area, the Molave Forest of San Fernando City.

OBJECTIVES OF THE STUDY

This taxonomic study aimed to document the wood-rotting basidiomycetes in the molave forest of San Fernando City, La Union. The specific objectives aimed to: (1). prepare a taxonomic account of the wood-rotting basidiomycetes based on an extensive systematic collection; (2). facilitate the identification of each species; and, (3). determine the bio-physical factors affecting the growth of fungi.

MATERIALS AND METHODS

Study Area

The molave forest, where the wood-rotting fungi were collected is located in the eastern boundaries of the City of San Fernando, province of La Union. Such boundaries, consisting of the foothills of the Cordillera Mountain Range, are positioned in a linear North and South arrangement. An elevation of more than 200m is reached in the San Fernando area and extends to about 395m in other areas of the mountain range.

San Fernando is 270 km. north-northwest of Manila. It is the capital city of the province of La Union. Of the total land area, which is 10,525 hectares, 896 hectares are forest lands (Fig. 2). Molave (*Vitex parviflora* Juss.) is the dominant species in the study area where the soil is excessively drained and a climate characterized by a distinct dry season. Other important tree species found within molave area are: kariskis [*Albizzia lebbekoides* (DC.) Benth.]; banaba [*Lagerstroemia speciosa* (L.) Pers.]; hararosip [*Polyalthia suberosa* (Roxb.) Thw.]; kakawate [*Gliricidia sepium* (Jacq.) Steud.]; balinghasai [*Buchanania arborescens* (Blume) Skeels]; uas [*Harpulia arborea* (Blco.) Radlk.]; panalayapen (*Endiandra coriacea* Merr.); lapting (*Ficus variegata* Bl.); anteng (*Canarium hirsutum* Willd.); mimisan (*Canthium horridum* Bl.); narra (*Pterocarpus indicus* Willd.); bitaog (*Calophyllum inophyllum* L.); monat (*Goniothalamus lancifolius* Merr.); ked-deng [*Colona blancoi* (Rolfe) Merr.]; lumboy [*Syzygium cuminii* (L.) Skeels.]; adaan (*Adenanthera intermedia* Merr.); arangen (*Ganophyllum falcatum* Bl.); maratabako (*Wendlandia membraniifolia* Elm.); takip-asin (*Macaranga grandifolia* L.); laniti [*Wrightia laniti* (Blco.) Merr., among others.

Fig. 2. Molave forest in San Fernando City
where the study areas are located.

Field Sampling and Collection of fungi

Transect line and quadrat methods in field samplings were used. Using transect line (TL) method, four transect lines were established from the baseline (100 masl) toward the peak (300 masl) with 10m x 25m quadrat sampling each transect line and an interval of 50 meters between quadrats. All in all 20 quadrats were laid out.

All fungal species found in each quadrat along the TL's were identified, recorded, and documented. When not possible to identify on site, taxonomic and morphological features of the fungi were noted. Simpson's Index was the Diversity indices (includes species richness, abundance or evenness of spread of the species in the habitat) used as parameters in assessing fungal species growing in San Fernando's molave forest.

Identification of Fungi

The fungal collected were properly labeled and brought to the laboratory for identification. They were examined promptly; otherwise they should be air-dried or properly treated to avoid molds. These fungi were identified based on the macro-and microscopic characteristics of the fruiting body.

Collected specimens were compared with identified specimens deposited at Philippine National Herbarium (PNH) and the UPLB Museum of Natural History (CAHUP) for confirmation and also by using a dichotomous key, and by comparing to colored photographs.

RESULTS AND DISCUSSION

Species Richness and Composition

Field sampling of fungi has resulted to the identification of 15 families 24 genera, and 51 species with a total of 184 individuals. The dominant fungal species in Transect line 1 (TL-1) were at Qt1: *Ganoderma lucidum* (Leys.) Karst. (Ganodermataceae); Qt2: *Auricularia auricula* (L.) Schroet. (Auriculariaceae); Qt3: *Ganoderma applanatum* (Pers.) Pat. (Ganodermataceae); Qt4: *Schizophyllum commune* Fr. (Schizophyllaceae); Transect line 2 (TL-2) were at Qt1: *Fomes pachyphloeus* Pat. (Polyporaceae); Qt2: *Hexagonia tenuis* (Hook.) Fr. (Coriolaceae); Qt3: *Ganoderma lucidum* (Leys.) Karst. (Ganodermataceae); Qt4: *Microporus xanthopus* (Fr.) Kuntze (Hymenochaetaceae); Transect line 3 (TL-3) were at Qt1: *Auricularia auricula* (L.) Schroet. (Auriculariaceae); Qt2: *Ganoderma lucidum* (Leys.) Karst. (Ganodermataceae); Qt3: *Fomes pachyphloeus* Pat. (Polyporaceae); Qt4: *Pycnoporus sanguineus* (Fr.) Murr. (Polyporaceae) and for Transect line 4 (TL-4) were at Qt1: *Pycnoporus sanguineus* (Fr.) Murr. (Polyporaceae); Qt2: *Cyathus striatus* Willd. (Nidulariaceae) Qt3: *Auricularia auricula* (L.) Schroet. (Auriculariaceae) and Qt4: *Ganoderma lucidum* (Leys.) Karst. (Ganodermataceae).

The frequently occurring fungi were found at the range from 5 to 20%. These include *Ganoderma lucidum* (20.18%); *Auricularia auricula* (18.19%); *Fomes pachyphloeus* (17.20%); *Ganoderma applanatum* (16.46%); *Schizophyllum commune* (14.84%); *Hexagonia tenuis* (10.16%); *Microporus xanthopus* (8.54%); *Pycnoporus sanguineus* (7.25%); *Cyathus striatus* (6.10%); and *Polyporus hirsutus* (5.12%). The remaining 45 species are rarely found in the forest.

Table 1. The Families of Wood-rotting Fungi in the Order Tremellales, Aphyllophorales, Agaricales, Lycoperdales, and Nidulariales

Aphyllophorales	Agaricales	Tremellales	Nidulariales	Lycoperdales
Polyporaceae Ganodermataceae Thelephoraceae Corticiaceae Stereaceae Hydnaceae Coriolaceae	Agaricaceae Tricholomataceae Schizophyllaceae Cantharellaceae	Auriculariaceae Dacryomycetaceae	Nidulariaceae	Geastraceae

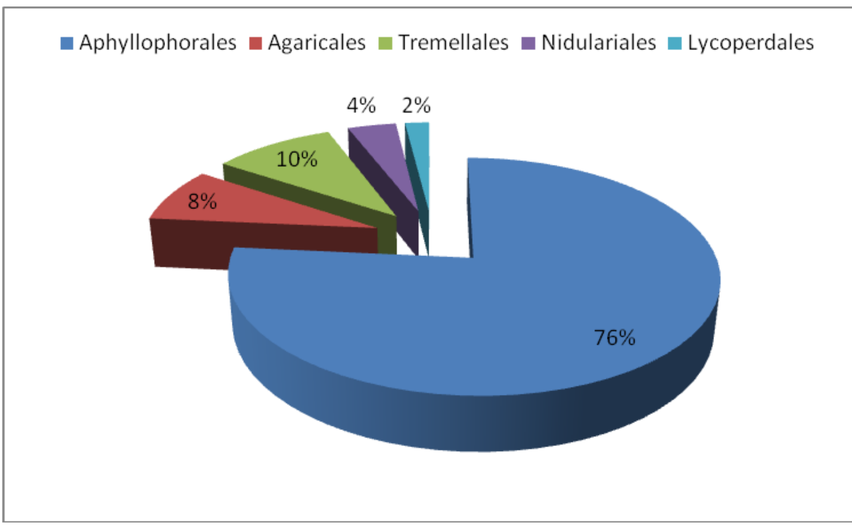

Fig. 4. Percentage Composition of Fungal Species (n=51) in relation to Fungal Orders.

Table 2. The number of fungal species of wood-rotting fungi in the different fungal families (n=51).

Families	Number	%
Polyporaceae	28	54.90
Ganodermataceae	6	11.76
Auriculariaceae	4	7.84
Nidulariaceae	2	3.94
Other families(<2 species)	11	21.56
TOTAL	**51**	**100**

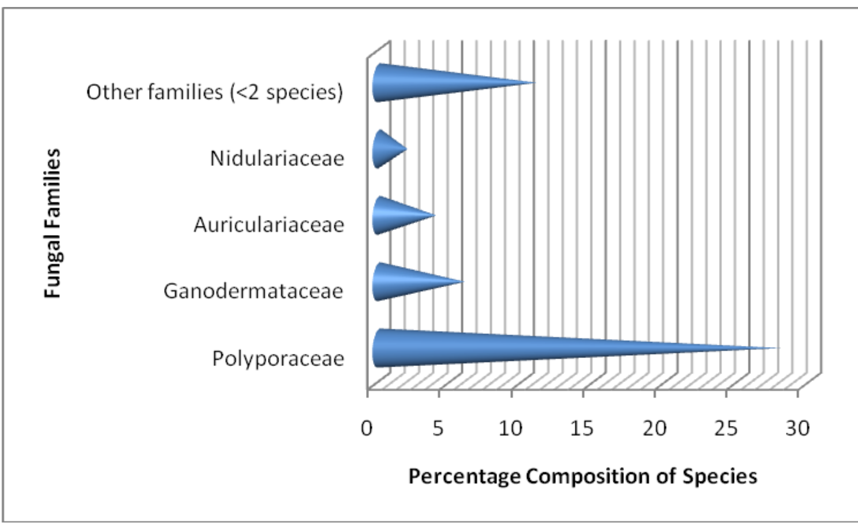

Fig. 5. Percentage composition of fungal families with abundant species (n=51).

Table 3. Wood-rotting Fungi in the Molave Forest of La Union and the Trees they Attacked.
(Teodoro 1937; Quimio and Capilit 1983; Dai, Zhang, and Zhou 2000; Wen and Sun 1999; Tadiosa, Agbayani and Agustin 2011)

Species	Tree Species Being	Parts of the Tree	Status of Decay
	Attacked	Where Fungi Occur	
Amauroderma auriscalpium Lloyd.	bitaog, takip-asin	trunks	/
Amauroderma rogusom (Bl.and Ness.) Bres.	balinghasai, santol	stumps	/
Auricularia auricula-judae (L.) Schroet.	hauli,tangisang bayawak	stumps and trunks	XX
Auricularia cornea Ehrenb.	rain tree, kakawate	trunks	X
Auricularia mesenterica (Dicks.) Pers.	hauli,tangisang bayawak	trunks	X
Auricularia polytricha (Mont.) Sacc.	rain tree, balinghasai	trunks and branches	XX
Cantharellus infundibuliformis (Scop.) Fr.	lanuting puti	trunks and branches	/
Coriolus versicolor (Lev.) Pat.	rain tree, arangen	stumps	/
Corticium salmonicolor Berk.and Br.	anilao,adaan, anteng	branches	XX
Cyathus striatus Willd.	molave, narra	slabs	XX
Cyathus rudis Pat.	kakawate, ked-deng	stumps	XX
Dacryopinax spathularia (Schwein.) Martin	ipil-ipil, narra, kakawate	trunks	/
Daedalea amanitoides Beauv.	balinghasai, ipil-ipil	branches	XX
Daedalea ambigua Berk.	narra, kakawate	stumps and trunks	X
Daedalea flavida Lev.	molave, panalayapen	trunks	XX
Daedalea hobsoni Berk.	narra, takip-asin	stumps	X
Daedalea palisoti Fr.	ipil-ipil, panalayapen	stumps	X
Daedalea sp.	rain tree	stumps	X
Fomes caryophylli (Rac.) Bres.	kamagong,narra, arangen	stumps	X
Fomes gilvus (Schwein.) Lloyd.	adaan, kakawate	wood	X
Fomes linteus (Berk.and Curt.) Cke.	maratabako, ipil-ipil	stumps	XX
Fomes pachyphloeus Pat.	narra, arangen	trunks and stumps	/
Fomes senex (Nees.and Mart.) Cooke.	ked-deng, kakawate	branches	/

Ganoderma applanatum (Pers.) Pat.	narra, kakawate, milipili	stumps	XX
Ganoderma lucidum (Leys.) Karst.	fire tree, anilao	trunks and stumps	/
Ganoderma mangiferae (Lev.) Pat.	mango tree	trunks	/
Ganoderma sp.	mimisan	trunks	/
Geastrum triplex Jungh.	narra, ipil-ipil	stumps	X
Hexagonia apiaria (Pers.) Fr.	ipil-ipil, kakawate	trunks	/
Hexagonia tenuis (Hook.) Fr.	mango tree, kakawate	branches	/
Irpex flavus Klotz.	kakawate,ipil-ipil,laniti	twigs	X
Lenzites betulina (L.) Fr.	adaan, milipili	branches and stump	/
Marasmius rotula (Scop.) Fr.	adaan, monat	roots	/
Microporus xanthopus (Fr.) Kuntze	kupang, adaan, anilao	branches	/
Phellinus gilvus (Schw.) Fr.	tadiang anuang, narra	stumps	X
Pleurotus opuntiae Lev.	uas, takip-asin	branches	/
Polyporus cuticularis (Bull.) Fr.	duhat, ipil-ipil	barks	X
Polyporus grammocephalus Berk.	ipil-ipil, kariskis	trunks	X
Polyporus hirsutus (Wulf.) Fr.	laniti, banaba	stumps	/
Polyporus pinsitus Fr.	rain tree, duhat	wood	X
Polyporus sp.	molave, banaba	trunks	/
Polystictus affinis (Nees.) Fr.	binunga, panalayapen	branches	/
Polystictus connexus (Liv.) Cooke	banaba	branches	/
Polystictus incomptus Fr.	himbabao, arangen	branches	/
Polystictus occidentalis (Klotz.) Fr.	duhat, kakawate	trunks	/
Poria latemarginata (Fr.) Karst.	kariskis, uas, kakawate	branches	XX
Pycnoporus sanguineus (Fr.) Murr.	lanuting puti, narra	branches	/
Schizophyllum commune Fr.	molave,kakawate,ipil-ipil	trunks and branches	/
Stereum ostrea (Bl.and Ness.) Fr.	balinghasai, kakawate	branches	/
Thelephora terrestris (Ehrenb.) Fr.	uas, maratabako	branches and trunks	X
Trametes aspera Jungh.	molave, banaba	branches	/

LEGEND:
/ - bark still present X - bark absent XX - rotting wood

Taxonomic Relationships

Fifty one species of wood-rotting fungi belonging to the Class Basidiomycetes have been accounted for in the molave forest of La Union. The list of the species is shown in Table 3. Basidiomycetes are so named because they form spores on structures called basidia (singular, basidium) which are hyphal swellings that bear spores on tiny pegs. The fruiting body is a basidiocarp which is best known in the form of mushrooms, bracket fungi, puffballs, earthstars, coral fungi, bird's nest fungi and stinkhorns. Basidiomycetes also include rusts and smuts, which cause plant diseases and do not form basidiocarps, the basidiomycetes have a common reproductive cycle.

The different species of wood-rotting fungi found in the molave forest of La Union belong to the following Orders: Aphyllophorales, Agaricales, Tremellales, Lycoperdales, and Nidulariales. The basis of placing them into their respective Orders are : (1) types of basidia; (2) presence or absence of epibasidia; (3) types of basidiocarps; (4) form of hymenophore, and (5) hymenium characteristics.

Based on family groupings, wood-rotting fungi are polypores (Polyporaceae), conks (Ganodermataceae), teeth fungus (Hydnaceae), jelly fungus (Dacryomycetaceae), ear fungus (Auriculariaceae), chantrelles (Cantherellaceae), crust fungus (Stereaceae), earth fan fungus (Thelephoraceae), painted stick fungus (Corticiaceae), many-zoned polypores (Coriolaceae), gill fungus (Agaricaceae), little wheel fungus (Tricholomataceae), split gills (Schizophyllaceae), earthstars (Geastraceae), and the bird's nest fungus (Nidulariaceae).

The Ganodermataceae is closely related to the Polyporaceae, in fact, it was used to be included in the latter. The outstanding feature that makes it a distinct family is the presence of lignicolous forms which are producing spores, each of which has an inner brown layer covered with spines that pierce an outer hyaline layer.

The Nidulariaceae is quite distinct from the other families of wood-rotting fungi. Its basidiocarp which measures 5-12 mm high and 4-8 mm wide at the top is shaped like an inverted cone containing several egg-shaped fertile structures. This family is further characterized by its minor decaying effect on wood.

The largest basidiocarp, measuring about 28-34 cm width is found in both the Polyporaceae and Ganodermataceae measuring about 28-34 cm width.

The families with one species each can be easily distinguished from each other. The Dacryomycetaceae is jelly-like, characterized by its ladle-like shaped which is flattened on one end. The Thelephoraceae is characterized by having flattened;

Pycnoporus sanguineus (Fr.) Murr.

Hexagonia tenuis (Hook.) Fr.

Schizophyllum commune Fr.

Auricularia auricula (L.) Schroet.

Ganoderma lucidum (Leys.) Karst.

Microporus xanthopus (Fr.) Kuntze

Plate 1. Common species of fungi collected at San Fernando City's Molave Forest.

fan-shaped lobes frequently fused giving rosette appearance. The Corticiaceae has its fungal tissue lying flat on the surface of twigs or rotting logs and its look like paint that has been poured over the substrate. The Hydnaceae has its teeth-like structure on the fruiting surface which is always directed toward the earth. The Stereaceae has its large fan-shaped fruiting body with long rays. Stereaceae is very similar to Corticiaceae instead of being flattened, its basidiocarp is semi-upright. The Cantharellaceae has its membranous cap and the gills are generally forked in pairs once or several times. The Coriolaceae has basidiocarp with contrasting zones of black, gray and brown with a paler, undulating margin. The Agaricaceae's basidiocarp has gills that are usually blade-like on the underside of the cap. The gills radiate from the stem, which is usually central, but sometimes eccentric or lateral. The Tricholomataceae is characterized by its parachute like cap and presence of long, wiry stalk. The Schizophyllaceae is characterized by its hymenial layer consists of thick lamellae that are split longitudinally with both edges folded back, and the Geastraceae is easily recognized by its star-like appearance. The fruiting body is more or less bulb-shaped, the outer coat splitting at the apex into 4-6 rather uniform segments or rays, spreading back to form a star-shaped and often splitting into two layers.

The majority of the wood-rotting fungi are the bracket fungi which are the familiar shelf-like growths seen on the stumps, and on trunks of trees, they may either be parasites on living trees or saprophytes, living on dead wood. They are the most destructive of the wood-rotting fungi. They are woody in texture when old and remain attached to the host year after year.

The mycelium of the bracket fungi penetrates the woody tissue of the host and causes it to disintegrate internally.

Pathological Relationship

Most of the wood-rotting fungi collected are pure saprophytes and occur only on dead woody plants. Many, however, have evolved as they acquired the ability to invade living plants and to decay heartwood. The polyporous group can be counted in this regard. The decay according to Hartig (1949), begun as a result of wounding trees and formation of infection courts which exposed heartwood or dead sapwood continuous with heartwood. Infection courts include poorly healed branch stubs, broken limbs and tops, fire scars, damage by birds, mammals, and insects, lightning injury, mechanical damage from falling trees or man related activities such as logging, and stem cankers caused by other fungi. Wood-rotting fungi are believed to enter these fresh wounds through spore germination or dissemination and to cause decay which, once established, grew unrestricted through the heartwood, progressively decaying the wood in the process.

Factors affecting the growth of fungi

Climate, which has been a limiting factor in the diversity of fungi in the molave forest of San Fernando City, fall within the first type in accordance with the classification based on rainfall. It has two pronounced season, six months dry season and six months rainy season. A combination of the climatic factors, such as rainfall, temperature, relative humidity, wind velocity, and direction is responsible for the existing mycological composition of the area. During the dry season, fungi have lesser species on exhibit considering that moisture on substratum is not sufficient for the growth of their fruiting bodies (Bernicchia 2001). The rainy season, on the other hand, is a prolific time for them due to the rather constant and often high moisture content of the substratum and humidity of the air. Wind velocity with a speed of over 25kph plays a key role in the distribution of fungi although much higher if the typhoon occurs. La Union is not a typhoon-prone area, the trees and other substrates has a lesser effects that can cause to break the branches and other parts of trees to make them fall, thus cannot providing more substrata for the wood-rotting fungi.

CONCLUSIONS

The wood-rotting basidiomycetous fungi in the molave forest of La Union are composed of 51 species belonging to 24 genera and 15 families. They are the principal causes of decay of the wood particularly those growing on molave (*Vitex parviflora* Juss.); narra (*Pterocarpus indicus* Willd.); kakawate (*Gliricidia sepium* (Jacq.) Walp.); fire tree (*Delonix regia* (Boj. ex Hook.) Raf.); ipil-ipil (*Leucaena leucocephala* (Lam.) de Wit.); and balinghasai (*Buchanania aborescens* Blume).

A full understanding of the diverse kinds of wood-rotting fungi will definitely provide significant inputs to prevent and control wood decay. This will provide forest pathologists, foresters, and field technicians a working knowledge of the conditions under which the fungal infections may cause diseases and great damage to forest trees.

The six month-rainy period favors the luxuriant growth of the wood-rotting fungi in the molave forest of La Union.

RECOMMENDATIONS

Following study requirements of macrofungi in San Fernando's molave forest, it is recommended that a similar study be made on other forests whether it is dipterocarp, beach forest, mangrove forest, mid-montane and pine forests.

Additional important taxonomic works will enable all mycologists to document altogether the macrofungi in the entire Philippine archipelago to come up with more substantial information in this kind of work.

ACKNOWLEDGMENTS

The authors are grateful to the people of San Fernando City particularly to the then Mayor Mary Jane C. Ortega and the former director of the La Union Botanical Garden (LUBG), Dr. Romualdo M. del Rosario by allowing the senior author to stay in the Staff House while doing the study. The staff of the LUBG for accompanying the authors in the field. The support for this survey was provided by the National Museum of the Philippines and the local government of San Fernando City, La Union.

LITERATURE CITED

Bernicchia, A.P.
2001 Aphyllophoraceous Wood Inhabiting Fungi of Lanaitu Valley. Sardinia. Mycotaxon. LXXVII. 15-23.

Dai, Y. C, X. Q. Zhang and T. X. Zhou
2000 Changbai Wood-rotting Fungi: Species of Hymenochaete (Basidiomycota). Mycotaxon LXXVI, 445-450.

Dano,AM and F.T. Ociones.
2000 The Dularuan molave forest: Its ecological importance to the coastal area of Puerto Galera. Canopy International, Vol.26 No.2, March-April 2000.

Gilbertson, R.L.
1980 Wood-rotting Fungi of North America. Mycologia. Department of Plant Pathology, University of Arizona, Tuczon, Arizona.

Hartig, R.B.
1949 *Zersetzungserscheinungen des Holzes* .Initiated the modern era of understanding of wood decay. New York: Dodd, Mead.

Hyde, K.D.
1998 Where are the missing fungi? Souvenir program and abstracts of papers of "Tropical Microbial Biodiversity" symposium held at University of the Philippines, Visayas, Iloilo, October 19-21 1998.

Lancion, C.M.
1995 Fast Facts about Philippine Provinces. Tahanan Books, Manila.

Quimio, T.H.
1988 Illustrated Philippine Fungi. Techguide Series No.24. University of the Philippines at Los Banos, Laguna and the Technology and Livelihood Resource Center, Quezon City.

Quimio, T.H. and A.B. Capilit.
1983 Enumeration and bibliography of Philippine fungi (1936-1977) published by BIOTECH-UPLB.

Tadiosa, E.R.
1998 Some Noteworthy Species of Wood-rotting Fungi found in the Forested Hills of La Union Province, Northern Luzon, Philippines. UST Journal of Graduate Research. Vol.25 No.2, pp.55-58.

Tadiosa, E.R, E.S. Agbayani and N.T. Agustin
2011 Preliminary Study on the Macrofungi of Bazal-Baubo Watershed, Aurora Province, Central Luzon, Philippines Asian Journal of Biodiversity 2:149-171.

Teodoro, N.G.
1937 An Enumeration of Philippine Fungi. Comm. Phil. Dept. Agri., Manila. Tech. Bull. 4:1-568.

The Mycological Society of the Philippines.
2001 Workbook on Tropical Mycology: Collection, Isolation and Identification. Quimio, T.H. (eds) Bureau of Agricultural Research, Quezon City.

Wen, H. A and S. X. Sun
1999 Fungal Flora of Tropical Guangxi, China: Macrofungi. Mycotaxon. XXXII, 359-369.

Worral, J.J., S.E. Anagnost and R.A. Zabel.
1997 Comparison of wood decay among diverse lignicolous fungi. Mycologia Vol.89 No.2 pp.199-219.