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Fungi of Taal Volcano Protected Landscape, Southern Luzon, Philippines

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Abstract - Fungal species collection was conducted at Taal Volcano Protected Landscape (TVPL) at Talisay area, Batangas, Southern Luzon, Philippines (13.66255^{0}N, 121.24797^{0}E) from the months of March to August 2012. TVPL has an elevation of 600 meters above sea level. This Protected Area is being considered as one of the most diverse forest ecosystems in CALABARZON region, thereby indicating the need for conservation and protection. This paper aims to document the fungal species in the area. Using transect line (TL) method, four transect lines were established from the baseline (200 masl) toward the peak (600 masl) with 20 m x 30 m quadrat sampling. All in all, 12 quadrats were laid out. The fungal species within the quadrats along the TLs were identified and recorded. Simpson's Index was the Diversity indices used as parameters in assessing fungal species in TVPL Talisay. Opportunistic sampling method was also used during the survey. Field sampling of fungi has resulted to the collection and identification of 75 species belonging to 36 genera and 23 families. There is relatively high

fungal species diversity in Taal Volcano Protected Landscape, Talisay as compared with those in other ecosystems in the region. This is the first report of fungi present in TVPL.

Keywords - biodiversity, field survey, forest ecosystem, fungi, Taal Volcano Protected Landscape

INTRODUCTION

One of the most diverse groups of organisms in Taal Volcano Protected Landscape Talisay area is 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 (Quimio and Capilit, 1981). Taal Volcano Protected Landscape has an elevation of 600 meters above the sea level which straddles the province of Batangas. It is situated in the municipalities of Talisay, Tanauan, Laurel, Agoncillo, Sta. Teresita, Cuenca, Alitagtag, Mataas na Kahoy, Lipa City, Balite and San Nicolas. (Fig.1). Batangas has a record of almost 100 species of fungi that consist of mainly basidiomycetes and ascomycetes (Tadiosa, Arsenio, and Marasigan, 2007). It is also a home of many species of flora and fauna, a number of which are endemic to the lake like the "tawilis" (*Sardinella tawilis*), the only freshwater sardine in the world.

Many studies utilize the presence of flora, fauna, and fungi in an area because these play an important role in determining the condition of a certain environment. It serves as an ecological indicator that can provide vital information on the ecosystem (Eusebio,1998). However, the diversity and distribution of fungal species remains poorly studied. Series of survey using transect and opportunistic method and documentation in TVPL watershed provide information such as maiden list of fungi in the area. The study has resulted to the collection and identification of 75 species belonging to 36 genera and 23 families.

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 become baseline information and can be 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. This mountain is being considered as one of the most diverse forest ecosystems in the Philippines, thereby indicating the need for forest conservation. This is the first report of fungi present in TVPL.

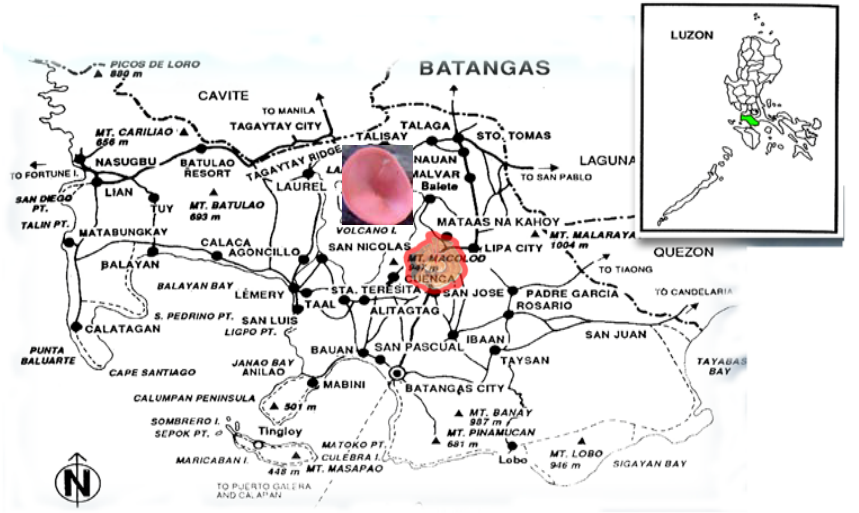


Fig. 1. Map of the Province of Batangas showing the study area, Taal Volcano Protected Landscape of Talisay.

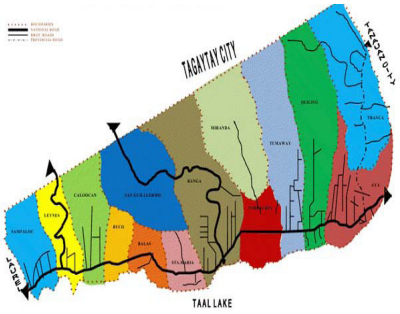
OBJECTIVES OF THE STUDY

This research study generally aimed to document the existing fungi grow at Taal Volcano Protected Landscape (TVPL), Talisay area in the Province of Batangas. The specific objectives are: (1) to prepare a taxonomic account of the fungi found in TVPL based on an extensive systematic collection; (2) to facilitate the identification or recognition of each species; (3) to assess the diversity of fungi in the area, and (4) to determine the bio-physical factors affecting the growth and presence of fungi.

MATERIALS AND METHODS

Study Areas

The fungal study site covers an area of 32 hectares. It lies along 13. 66225^0 North latitude and 121.24797^0 East longitude which is 50 km away from Manila and approximately 7 km away from Talisay town proper (Fig. 2a). A portion of the area was converted and planted with coconut and agricultural crops while the rest of the areas showed primary vegetation and secondary succession where residual trees, shrubs, lianas and grasses had grown (Fig. 2b). At the mid-portion of the watershed, a section being preserved by the Department of Environment and Natural Resources (DENR) and the local government of Talisay purposely for the protected landscape, are trees with an estimated height from 20-40 ft. tall and a diameter breast height (dbh) of 50-100 cm. It was observed that human settlement was slowly encroaching into the area. There are different organizations (environmental, civic, school-based, government and nongovernment organization) that help in the reforestation program for the watershed since 1980's.



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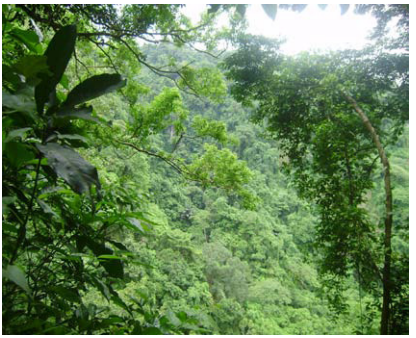
a) Map of Talisay



b) Study areas in Talisay

Fig. 2. Map of the municipality of Talisay and its watershed.

Survey, collection, and documentation of fungi

Transect line and quadrat methods were used in the field samplings. Using transect line (TL) method in samplings, four transect lines were established. These were set-up from the baseline (200 masl) toward the peak (600 masl) with a 20 m x 30 m quadrat sampling each transect line and at an interval of 200 meters between quadrats. All in all, 12 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 the area. Two to three samples of fungi were collected prior to identification and served also as herbarium specimens.

Fungal collections in the field were done. The data characteristics of each fungal species such as host tree, substratum, form, texture, size, color, and other noteworthy features were recorded at the time of collection. Each of the specimens was wrapped in a newspaper together with the pertinent data and other relevant information. Fragile and fleshy specimens were separated from the woody ones in the same collection basket. The woody specimens collected were removed with a bolo together with the wood tissues while knife were used in collecting fleshy ones. When the fungal specimens arrived at the Philippine National Herbarium, the woody fungi were dried immediately and fumigated with paradichloro-benzene crystals and ethanol in an airtight improvised fumigation chamber to kill insects, and other destructive larvae.

Identification and Classification of fungi

Each specimen was properly labeled and brought to the laboratory for identification. They were examined promptly; otherwise they should be air-dried or properly treated to avoid molding. These fungi were identified based on the macro - and microscopic characteristics of the sporocarps.

Sporocarps were identified based on the characteristics described in the Workbook in Tropical Fungi by Quimio et al. (2001); Handbook on Mushroom by Laessoe (1998); National Audubon Society Field Guide to Mushroom by Knopf (1995) and Illustrated Genera of Wood decay Fungi by Fergus (1960) for initial identification. The identification of the fruiting body was made also based on the taxonomic keys of Barnett and Hunter (1973); on Ainsworth & Bisby's Dictionary of Fungi (Hawksworth et al., 1995), on key to the identification of fungi (Quimio and Uyenco, 1985) on the characteristics of the various fruiting bodies collected and consultation with specialists.

Fig. 3 (Left photo) Dr. Tadiosa explores the Watershed looking for the amazing fungi in the area. He collects *Ganoderma lucidum*, common species of fungus in TVPL (Right photo).

RESULTS AND DISCUSSIONS

Characteristics of the study area

Transect Line 1 (Station 1). The area is located on rolling terrain. The vegetation in this area were composed of large trees, shrubs, bamboos and lianas. Herbs and weeds were grown and dominated ground cover. There were plenty of fallen branches, stumps and rotten trunks of wood. The presence of leaf litters favors the luxuriant growth of the fungi. There was a small portion of cogonal areas where grasses and small plants grow. Transect line 1 has an altitude ranged from 200-230 meter above sea level (masl). The average temperature was 25^{0}C while relative humidity was 73%. The soil pH ranged from 6.3 to 7.0 with an average of 6.8.

Transect Line 2 (Station 2). The area is located on a flat to rolling terrain. It consisted mostly of tall and big trees, shrubs and lianas. There were some patches of open areas wherein some species of grasses grow. The leaf litters were so thick because of the trees present in the area. Transect line 2 has an altitude ranged from 210-235 masl. The average temperature was 24^0C while relative humidity was 74.50%. The soil pH ranged from 5.7 to 7.1 with an average of 6.4. This means that the soil in this area was slightly acidic. The growth of the plants were favorable; thus the number of plants including trees were abundant. This attributed as an abundant substrate in order the fungi grow.

Transect Line 3 (Station 3). The area is located on a shallow to rolling terrain. The vegetation was composed of tall and big trees, stout and short trees toward the peak, shrub and vines. Tree ferns and ground ferns were scattered on the area. There were no open area that is why the leaf litters were so thick and weeds and grasses can't grow. Transect line 3 has an altitude ranged from 220-240 masl. The average temperature was 25^0C while relative humidity was 73.20%. The soil pH ranged from 6.4 to 7.2 with an average of 6.8. This value was considered neutral, but growths of plant are still favorable, thus also favorable for the growth of the fungi.

Transect Line 4 (Station 4). The area is located on a very steep terrain. It consisted of small and big trees, shrubs, bushes and vines. Transect line 4 has an altitude ranged from 320-350 masl. The average temperature was 23^0C while relative humidity was 75.60%. This transect line is the coolest areas among the four transect lines. The soil pH ranged from 5.4 to 7.1 with an average of 6.3. The growth of fungi and their hosts and substrate were abundant because of the favorable condition.

Species Richness and Composition

A total of 3,755 species of fungi in the Philippines was reported by Quimio and Capilit (1981). Considering the extremely rich and diverse tropical fungal flora of the region, this number seems small, showing that the vast tracts of tropical habitats are still unexplored. The estimated number of fungi in the world is 1.4 million and with only 120,000 so far been reported (Hyde, 1998). With the vast

conversion of natural areas to housing subdivisions and commercial areas in many parts of the country, if not given attention and properly documentation, many unreported fungal species, might just vanish before there are discovered (Quimio, 1997). The study identified 75 species using transect, quadrats, and opportunistic sampling methods.

Most of the fungi under families Ganodermataceae, Polyporaceae, Auriculariaceae, and Xylariaceae were commonly found in the forested and open areas. Fig. 4 shows few rare and or uncommon species of fungi during the survey, namely: *Cookeina sulcipes*, *Galiella rufa*, *Dictyophora duplicata*, *Cymatoderma elegans*, *Microporus vernicipes*, and *Xylaria longipes*.

Fig. 4. Uncommon species of fungi collected at Taal Volcano Protected Landscape, Talisay area.

Table 1. List of Fungal Species collected at four stations in Taal Volcano Protected Landscape Talisay Watershed.

(Bresadola and Sydow, 1914; Dai, Zhang, and Zhou, 2000; Graff, 1913; Quimio and Capilit, 1983; Reinking, 1921; Ricker, 1906; Tadiosa, Agbayani and Agustin, 2011; Teodoro, 1937; Wen and Sun,1990; and Uyenco,1974)

List of collected species			Station 1	Station 2	Station 3	Station 4
ORDER	**FAMILY**	**SPECIES/TAXA**				
Agaricales						
	Agaricaceae					
		Agaricus campestris Linn.	X			
		Coprinus micaceus (Bull.) Fr.	X			
		Lepiota cristata (Bolt.) Kumm.		X		X
		*Lepiota sp.*1	X		X	
		*Lepiota sp.*2	X			
	Hygrophoraceae					
		Hygrocybe sp.	X			
	Lycoperdaceae					
		Calvatia sp.		X		
	Mycenaceae					
		Mycena sp.1	X		X	
		Mycena sp.2	X	X		
	Pleurotaceae					
		Pleurotus porrigens (Pers.) P.Kumm.	X			
	Pluteaceae					
		Volvariella volvacea (Bull.) Sing.	X			
	Strophariaceae					
		Agrocybe sp.	X		X	
	Schizophyllaceae					
		Schizophyllum commune Fr.	X	X	X	X

	Tricholomataceae					
		Clitocybe sp.		X		
		Omphalina sp.		X		
		Tricholomopsis sp.			X	
Auriculariales						
	Auriculariaceae					
		Auricularia auricula-judae (Mont.) Sacc.	X	X	X	X
		Auricularia cornea Ehrenb.	X		X	
		Auricularia fusco-succinea (Mont.) Sacc.		X	X	
		Auricularia mesenterica (Dicks.) Pers.	X	X		
		Auricularia polytricha (Mont.) Sacc.		X		X
		Auricularia sp.1	X			
		Auricularia sp.2		X		
		Auricularia sp.3	X			
		Auricularia sp.4			X	
		Auricularia sp.5		X		
Cantharellales						
	Cantharellaceae					
		Cantharellus aureus (Berk. & M.A. Curtis) Bres.	X			X
Dacrymycetales						
	Dacrymycetaceae					
		Dacryopinax spathularia (Schwein.) Martin	X			
Pezizales						
	Pyronemataceae					
		Octospora humosa (Fr.) Dennis		X	X	
	Sarcoscyphaceae					
		Cookeina sulcipes (Berk.) Kuntze		X	X	
		Cookeina tricholoma (Mont.) Kuntze		X	X	

	Sarcosomataceae					
		Galiella rufa (Schwein.) Nannf. & Korf.			X	
Phallales						
	Phallaceae					
		Dictyophora duplicata (Bosc.) E. Fisch.	X			
Polyporales						
	Coriolaceae					
		Lenzites sp.1		X		X
		Lenzites sp.2	X		X	
		Trametes corrugata (Pers.) Bres.	X		X	
		Trametes versicolor (Linn.) Lloyd.	X	X		
		Trametes sp.	X		X	
	Ganodermataceae					
		Ganoderma applanatum (Pers.) Pat.	X	X		X
		Ganoderma lucidum (Leys.) Karst.		X	X	
	Meruliaceae					
		Cymatoderma elegans Jungh.	X	X		
	Polyporaceae					
		Daedalea quercina (Linn.) Pers.		X	X	
		Daedaleopsis confragosa (Bolt.) J. Schroter.	X			X
		Fomes gilvus (Shwein.) Lloyd.	X		X	
		Fomes sp.1		X	X	
		Fomes sp.2	X	X		
		Microporus affinis (Blume & T. Nees.) Kuntze		X		
		Microporus vernicipes (Berk.) Kuntze	X		X	
		Microporus xanthopus (Fr.) Kuntze	X			X

		Microporus sp.		X		
		Polyporus grammocephalus Berk.	X			
		Polyporus pinsitus Fr.		X	X	
		Polyporus sp.1	X			
		Polyporus sp.2		X		
		Polyporus sp.3	X			
		Polyporus sp.4			X	
		Polyporus sp.5		X		
		Polyporus sp.6				X
		Polyporus sp.7	X			
		Polyporus sp.8	X			
		Polyporus sp.9		X	X	
		Poria sp.	X			
		Pycnoporus sanguineus (Fr.) Murr.		X	X	
Russulales						
	Russulaceae					
		Lactarius trivialis (Fr.) Fr.	X			
		Lactarius sp.		X		
		Russula sp.			X	
	Stereaceae					
		Stereum insignatum Blume	X		X	
		Stereum sp.			X	
Xylariales						
	Xylariaceae					
		Daldinia concentrica (Fr.) Ces.& de Not.		X	X	
		Xylaria cornu-damae (Shwein.) Berk.	X			
		Xylaria filiformis (Alb. & Schwein.) Fr.		X	X	
		Xylaria hypoxylon (Linn.) Grev.	X			X
		Xylaria longiana Rehm.	X		X	

		Xylaria longipes Nitschke		X		
		Xylaria polymorpha (Pers.) Grev.	X		X	

Factors affecting the growth of fungi

Climate, which has been a limiting factor in the diversity of fungi in the forest of Batangas, falls within the first type in accordance with the classification based on rainfalls. There are two pronounced seasons, dry from November to April and wet from May to October. Maximum rain period is from June to September (Lancion, 1995). The area is generally exposed to the southwest monsoon and gets a fair share of the rainfall brought about by the tropical cyclones occurring especially during the maximum rain period.

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 since they depend greatly on moisture of their growth. 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.

Temperature variation within TVPL Batangas is very slight. The mountainous eastern areas, where TVPL Talisay is confined, is a little bit cooler than the western plain and coastal areas, an effect being caused by the elevation and vegetation. This explains the considerable richness of the fungal flora in TVPL Talisay compared to the other areas. The temperature was measured in all study sites using thermometer. This was taken during throughout the duration of study.

Wind velocity with a speed of over 20 kph plays a role in the distribution of fungi. A high velocity is usually brought about by the tropical cyclones and thunderstorms. This wind force has been sufficient enough to break branches of trees and even make them fall, thus providing more substrata for the wood decay fungi.

Table 2. The total number of families, genera, and species belong to Class Ascomycetes and Basidiomycetes

Class	Family	Genus	Species
Ascomycetes	4	5	11
Basidiomycetes	19	31	64
TOTAL	**23**	**36**	**75**

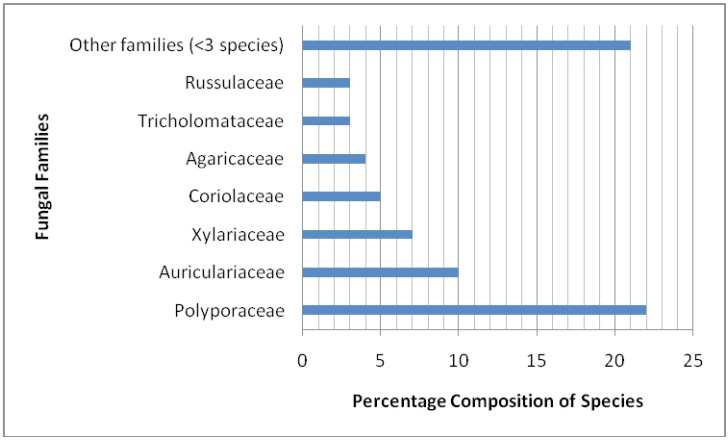


Fig. 5. Percentage composition of families in two classes with abundant species (n=75)

CONCLUSIONS

The six-month rainy period (May-October) favored the luxuriant growth of fungi in the Landscape in Talisay, Batangas. Using transect, quadrat, and opportunistic sampling methods, this study accounted for 23 families and 77 species of fungi.

The results of this survey indicate that TVPL Talisay watershed is species rich with more than half of the total species recorded in the province of Batangas and around 8% of the entire Philippine mycoflora. The Talisay watershed, still support a large percentage of the country's fungal flora. Hence, it deserves continuous research to gain more information on Philippine fungal diversity.

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LITERATURE CITED

Barnett, H.L. and B.B. Hunter
1972 Illustrated genera of imperfect fungi. Minneapolis Burgess Publ. p. 225.

Bernicchia, A.P.
2001 Aphyllophoraceous Wood Inhabiting Fungi of Lanaitu Valley. Sardinia. Mycotaxon 77: 15-23.

Bresadola, G. and H. Sydow
1914 Enumeration of Philippine Basidiomycetes. Philip. Journal Sci. 9(4): 345-352.

Dai, Y. C, X. Q. Zhang and T. X. Zhou
2000 Changbai Wood-rotting Fungi: Species of Hymenochaete (Basidiomycota). Mycotaxon 76: 445-450.

Eusebio,M.A
1998 Pathology in Forestry. Ecosystem Research and Development Bureau. Department of Environment and Natural Resources. College, Laguna pp. 270-235.

Fergus, C.L
1960 Illustrated Genera of Wood-decay Fungi. Burgess Publishing Company. Minneapolis, Minnesota.

Graff, P.W
1913 Additions to the Basidiomycetes Flora of the Philippines. Philip. Journal Sci. 8, Bot. pp. 229-307.

Hawksworth, D.L and P.W. James
1971 Ainsworth & Bisby's Dictionary of the Fungi. The Sixth Edition. Commonwealth Mycological Institute. Kew Surrey.

Hyde,K.D
1998 Where is the missing fungi? Tropical Microbial Biodiversity. University of the Philippines Visayas, Iloilo.

Knopf, A.A
1995 National Audubon Society Field Guide to North American Mushrooms. Chanticleer Press Edition, New York.

Laessoe, T.F
1998 Handbook of Mushrooms. Dorling Kindersley Limited, London.

Lancion, C.M
1995 Fast facts about Philippine Environment. Tahanan Books, Manila pp. 28-29.

Quimio, T.H
1997 Fungal Diversity and teachings in the Philippines. Vicente Cinco Professional Lecture. University of the Philippines. College, Los Banos, Laguna.

Quimio, T.H
2001 Common Mushroom of Mt. Makiling, Museum of Natural History. University of the Philippines Los Banos, College, Laguna.

Quimio, T.H and A. C. Capilit
1983 Enumeration and bibliography of Philippine fungi (1936-1977). National Institute of Microbiology and Biotechnology,

University of the Philippines, College, Los Banos, Laguna.

Quimio, T.H and F.R. Uyenco
1975 Keys to the identification of fungi: A compilation. University of the Philippines.

Reinking, O.A
1921 Higher Basidiomycetes from the Philippines and their Hosts. Philip. Journal Sci. pp. 479-480.

Ricker, P.L
1906 A List of Known Philippine Fungi. Philip. Journal Sci., Suppl. pp. 277-294.

Tadiosa,E.R
2012 The Growth and Development of Mycology in the Philippines. Fungal Conservation, Journal of the International Society for Fungal Conservation, Issue 2, April 2012 Germany.

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.

Tadiosa, E.R, J.S. Arsenio and M.C. Marasigan
2007 Macroscopic fungal diversity of Mount Makulot, Cuenca, Batangas, Philippines. Journal of Nature Studies 6 (1 & 2): 111-124.

Tadiosa, E.R. and E.P. Militante
2006 Identification of Important Wood decaying Fungi Associated with some Philippine dipterocarps at the Makiling Forest. Sylvatrop, The Technical Journal of Philippine Ecosystems and Natural Resources. 16 (1&2) January – December 2006.

Tadiosa,E.R, J.S Arsenio and M.M Mojica
2005 Macrofungal Diversity of Mts. Palaypalay-Mataas na Gulod National Park, Ternate, Cavite, Philippines. Proceedings on the Mycological Society of the Philippines (MSP) 7th Annual Scientific Meeting and Symposium. Ecosystem Research and Development Bureau. College, Laguna.

Tadiosa,E.R and E. P Militante
2005 Basidiomycetous Fungi Associated with Decay of Some Philippine Dipterocarps at the Makiling Forest. Sulo Newsletter (a Newsletter of Philippine-American Academy of Science and Engineering) Indiana, USA 11(1) September 2005.

Tadiosa, E.R and A. P. Soriano
2004 Wood-decaying Fungi at the Eastern Slope of Sierra Madre Mountain Range in Cagayan Province. Proceedings on the Mycological Society of the Philippines (MSP) 6th Annual Scientific Meeting and Symposium. Ecosystem Research and Development Bureau, Los Banos, Laguna.

Tadiosa, E.R
2002 Techniques in the Collection, Preservation, and Maintenance of Fungi for the Herbarium and Museum Displays. National Museum (NM) Paper 12 (1).

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. 25 (2) 55-58.

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.

Uyenco, F.R
1974 Checklist of Philippine Fungi. Myxomycetes and Basidiomycetes. Technical Report No. 32. UP Natural Science Research Center, Diliman, Quezon City

Wen, H. A and S. X. Sun
1999 Fungal Flora of Tropical Guangxi, China: Macrofungi. Mycotaxon. 32: 359-369.