

**DISTRIBUTION AND SPECIES LISTING OF WILD MACROFUNGI IN
GABALDON, NUEVA ECIJA, PHILIPPINES**

FRANZ SEYHAN R. CORPUZ

An Undergraduate Thesis Submitted to the Faculty of the Department of Biological
Sciences, College of Science, Central Luzon State University,
Science City of Muñoz, Nueva Ecija, Philippines
in Partial Fulfillment of the Requirements
for the Degree of

**BACHELOR OF SCIENCE IN BIOLOGY
(Major in Microbiology)**

JULY 2023



Republic of the Philippines
CENTRAL LUZON STATE UNIVERSITY
Science City of Muñoz, Nueva Ecija

COLLEGE OF SCIENCE
Department of Biological Sciences

ACCEPTANCE SHEET

This undergraduate thesis entitled "**DISTRIBUTION AND SPECIES LISTING OF WILD MACROFUNGI IN GABALDON, NUEVA ECIJA, PHILIPPINES**" prepared and submitted by **FRANZ SEYHAN R. CORPUZ**, in partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN BIOLOGY (MICROBIOLOGY)**, is hereby accepted.


RICH MILTON R. DULAY, PhD
Adviser


06-27-2023

Date Signed


ANGELES M. DE LEON, PhD
Critic

06-27-2023

Date Signed


KRISTINE GRACE D. WAING, MSc
Department Research Coordinator

June 29, 2023

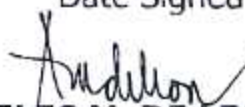
Date Signed

Accepted as partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN BIOLOGY (MICROBIOLOGY)**.


ARMAN M. PARAYAO, PhD
Head, Department of Biological Sciences

06/29/23

Date Signed


ANGELES M. DE LEON, PhD
Dean, College of Science

JUN 29 2023

Date Signed

BIOGRAPHICAL SKETCH

Franz Seyhan R. Corpuz was born on June 28, 2000 in Bitas, Cabanatuan City. She is the youngest of Mr. Francisco C. Corpuz and Mrs. Susan R. Corpuz's two children.

In 2013, she completed her elementary education at Faith Christian Academy in La Torre, Talavera, Nueva Ecija, as valedictorian. She then completed her junior high school education under the Science, Technology, Engineering, and Math (STE) program at Talavera National High School, Pag-Asa, Talavera, Nueva Ecija, with honors in 2016, and her senior high school education under the STEM track at Talavera Senior High School, Pag-Asa, Talavera, Nueva Ecija, as valedictorian in 2019.

In 2019, she enrolled at Central Luzon State University in Science City of Muñoz, Nueva Ecija, where she completed her four-year degree in the Bachelor of Science in Biology with a specialization in Microbiology.

ACKNOWLEDGMENT

The student researcher would like to send her most profound gratitude to the following people who supported her throughout the whole project:

To her adviser, Dr. Rich Milton R. Dulay, who has been guiding her from the start until the end. The researcher considers it an honor to work with him.

To her critic, Dr. Angeles M. De Leon, for all the ideas and suggestions to improve her work and to the Department Research Coordinator for Microbiology, Ma'am Kristine Grace D. Waing, for all the help polishing her manuscript.

To Mr. Nino Alberto, Engineer Ernesto Santos, Engr. Marlon Hernandez, Mr. Emmanuel Santiago, Engr. Alfredo Atraje, Engr. Jojo Santos, Mr. Nelson Santiago, RMT, Mr. Walsy Dela Cruz, Mrs. Bleszilda F. Casas, Ms. Gracia Rowena F. Dela Cruz, and Mrs. Nimfa G. Bulanan for supporting and funding her thesis study.

To the local government of Sawmill in Gabaldon, Nueva Ecija, to the owner of Melgar Farm, Mr. Melchor Garcia, the owner of Omegon Farm, Mr. Jerome Gonzales, and Mr. Rex Alcasabas for allowing her to conduct her research in their vicinity and accompanying her.

To Sir Paul Henric Gojo-Cruz and Ma'am Janice Aguilar for all the help and assistance they provided.

To her friends for being her support system.

To her family, Mr. Francisco C. Corpuz, Mrs. Susan R. Corpuz, Ms. Francheska Maco R. Corpuz, Mrs. Lucia Dg. Rubia, Ms. Neil Jane M. Rubia, and Gummy for all the support they've given, morally, financially, and emotionally.

Finally, praise be to God Almighty, who made it all possible.

TABLE OF CONTENTS

	PAGE
LIST OF TABLES	vii
LIST OF FIGURES	viii
LIST OF APPENDICES	xiii
LIST OF APPENDIX TABLE	xiv
LIST OF APPENDIX FIGURES	xv
ABSTRACT	xvi
INTRODUCTION	
Background of the Study	1
Objectives of the Study	3
Significance of the Study	3
Scope and Limitation of the Study	4
Time and Place of the Study	6
REVIEW OR RELATED LITERATURE	
Wild Macrofungi	7
Distribution of Wild Macrofungi	9
Wild Macrofungi along the Forest Ecosystems of the Philippines	12
Wild Macrofungi along the Forest Ecosystems of Nueva Ecija	15
Wild Macrofungi along the Forest Ecosystems of Gabaldon	18
Methods in Characterizing and Identifying Wild Macrofungi	18
Morphological Identification of Wild Macrofungi	19
Tissue Culture of Wild Macrofungi	20
METHODOLOGY	
Study Site	21
Field Sampling of Wild Macrofungi	21
Preservation of Wild Macrofungi	23
Morphological Identification of Wild Macrofungi	23

Preparation of Tissue Culture of Wild Macrofungi	24
Preparation of Potato Sucrose Gulaman	24
Rescue of Secondary Mycelia of Wild Macrofungi	24
Data Gathered	25
Data Analysis	25
RESULTS AND DISCUSSION	
Natural Habitats of Wild Macrofungi	27
Physical Distribution of Wild Macrofungi	37
Taxonomic Listing of Wild Macrofungi	42
Morphological Characteristics of Wild Macrofungi	44
SUMMARY, CONCLUSION, AND RECOMMENDATIONS	
Summary	75
Conclusion	76
Recommendations	77
LITERATURE CITED	78
APPENDICES	85

LIST OF TABLES

TABLE		PAGE
1	The growth habit and ecological parameters in the natural habitats of wild macrofungi	30
2	Distribution of 89 collected wild macrofungi in the three collection sites, three collection months, and five elevation ranges	38
3	Taxonomic positions of the 44 species of wild macrofungi	43

LIST OF FIGURES

FIGURE		PAGE
1	Google earth map showing the location of Barangay Sawmill, Gabladon, Nueva Ecija	21
2	The three collection sites situated in Mt. Mingan, Barangay Sawmill, Gabaldon, Nueva Ecija	28
3	The three collection sites situated in Mt. Mingan, Barangay Sawmill, Gabaldon, Nueva Ecija, Philippines; (A) collection site A, (B) collection site B, and (C) collection site C	28
4	The average temperature in the three collection sites and collection months	35
5	The average relative humidity in the three collection sites and collection months	36
6	The total amount of rainfall during the collection months of February, March, and April. (Source: PAGASA – CLSU Complex Station)	36
7	Distribution of 89 collected wild macrofungi in the three collection sites (A, B, and C), in the months of February (blue), March (red), and April (green)	42
8	Macroscopic features of <i>A. sarcoides</i> ; (A) top view revealing its cap and (B) ground view revealing its undersurface	45
9	Macroscopic features of <i>B. citrina</i> ; (A) top view revealing the fruiting body's upper surface and (B) ground view revealing its undersurface	46
10	Macroscopic features of <i>B. sulfurina</i>	46
11	Macroscopic features of <i>C. tricholoma</i>	47
12	Macroscopic and microscopic features of <i>D. childiae</i> ; (A) top view revealing the fruiting body and (B) spores under the microscope	47

13	Macroscopic and microscopic features of <i>Agaricus</i> sp.; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	48
14	Macroscopic and microscopic features of <i>L. ianthinus</i> ; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	49
15	Macroscopic and microscopic features of <i>A. auricula-judae</i> ; (A) top view revealing its fruiting body's outer surface and (B) ground view revealing its inner surface	50
16	Macroscopic and microscopic features of <i>A. polytricha</i> ; (A) top view revealing its fruiting body's outer surface and (B) ground view revealing its inner surface	50
17	Macroscopic and microscopic features of <i>Lentinellus</i> sp.; (A) Top view revealing its upper surface, (B) ground view revealing its gills, and (C) spores under the microscope	51
18	Macroscopic features of <i>G. applanatum</i> ; (A) top view revealing the fruiting body's upper surface and (B) ground view revealing its undersurface	51
19	Macroscopic features of <i>Ganoderma</i> sp.; (A) top view revealing the fruiting body's upper surface and (B) ground view revealing its undersurface	52
20	Macroscopic and microscopic features of <i>Gymnopilus</i> sp.; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	53
21	Macroscopic and microscopic features of <i>Psilocybe</i> sp.; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	53
22	Macroscopic and microscopic features of <i>Marasmiellus</i> sp.; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	54
23	Macroscopic and microscopic features of <i>M. siccus</i> ; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	55

24	Macroscopic and microscopic features of <i>Marasmius</i> sp.; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	55
25	Macroscopic and microscopic features of <i>Pleurotus</i> sp. 1; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	56
26	Macroscopic and microscopic features of <i>Pleurotus</i> sp. 2; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	56
27	Macroscopic and microscopic features of <i>Favolaschia</i> sp.; (A) top view revealing its cap; (B) ground view revealing its gills and stipe; and (C) spores under the microscope	57
28	Macroscopic and microscopic features of <i>Mycena</i> sp. 1; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	58
29	Macroscopic and microscopic features of <i>Mycena</i> sp. 2; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	59
30	Macroscopic and microscopic features of <i>Mycena</i> sp. 3; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	59
31	Macroscopic and microscopic features of <i>C. striatus</i> ; (A) top view revealing its fruiting body and (B) spores under the microscope	60
32	Macroscopic features of <i>C. unicolor</i> ; (A) top view revealing the fruiting body's upper surface and (B) ground view revealing its undersurface	60
33	Macroscopic and microscopic features of <i>L. tigrinus</i> ; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	62
34	Macroscopic features of <i>M. xanthopus</i> ; (A) top view revealing the fruiting body's upper surface and (B) ground view revealing its undersurface	62

35	Macroscopic and microscopic features of <i>P. arcularius</i> ; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	62
36	Macroscopic and microscopic features of <i>P. sanguineus</i> ; (A) top view revealing the fruiting body's upper surface and (B) ground view revealing its undersurface	63
37	Macroscopic features of <i>Trametes</i> sp.; (A) top view revealing the fruiting body's upper surface and (B) ground view revealing its undersurface	64
38	Macroscopic features of <i>T. versicolor</i> ; (A) top view revealing the fruiting body's upper surface and (B) ground view revealing its undersurface	64
39	Macroscopic features of <i>Tyromyces</i> sp.; (A) top view revealing the fruiting body's upper surface and (B) ground view revealing its undersurface	64
40	Macroscopic features of <i>O. canarii</i> ; (A) top view revealing its cap and (B) ground view revealing its gills and stipe	65
41	Macroscopic and microscopic features of <i>C. disseminatus</i> ; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	66
42	Macroscopic and microscopic features of <i>C. plicatilis</i> ; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	67
43	Macroscopic and microscopic features of <i>C. lagopus</i> ; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	67
44	Macroscopic and microscopic features of <i>Lactarius</i> sp.; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	68
45	Macroscopic features of <i>Russula</i> sp.; (A) top view revealing its cap and (B) ground view revealing its gills and stipe	68
46	Macroscopic and microscopic features of <i>S. commune</i> ; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	69

47	Macroscopic and microscopic features of <i>Pholiota</i> sp.; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	70
48	Macroscopic and microscopic features of <i>R. alboniger</i> ; (A) top view revealing its cap, (B) ground view revealing its gills and stipe, and (C) spores under the microscope	71
49	Macroscopic and microscopic features of <i>D. spathularia</i> ; (A) ground view revealing its fruiting body and (B) spores under the microscope	71
50	Macroscopic and microscopic features of <i>P. frondosa</i> ; (A) top view revealing its fruiting body and (B) spores under the microscope	72
51	Macroscopic and microscopic features of <i>T. fuciformis</i> ; (A) top view revealing its fruiting body and (B) spores under the microscope	73
52	Tissue cultures of (A) <i>B. sulfurina</i> , (B) <i>Marasmiellus</i> sp., (C) <i>O. canarii</i> , and (D) <i>P. arcularius</i>	74

LIST OF APPENDICES

APPENDIX		PAGE
I	Letters of Requests	86
II	Documentation	89
III	Data for the Amount of Rainfall (mm) from February to April 2023 obtained from PAGASA CLSU Complex Station	94
IV	GPS Coordinates and Elevation of 89 Collected Wild Macrofungi	97
V	Certification for Turnitin Similarity	102
VI	ERC Certificate	103

LIST OF APPENDIX TABLE

APPENDIX TABLE	PAGE
1 GPS coordinates and elevation of 89 collected wild macrofungi	97

LIST OF APPENDIX FIGURES

APPENDIX FIGURE		PAGE
1	Collection of wild macrofungi and recording the biotic and abiotic parameters in the natural habitat of each macrofungal species	89
2	Preservation of the collected wild macrofungal specimens	89
3	Measurement of the macroscopic features of collected wild macrofungal specimens	90
4	Measurement of the substrates' pH level for each of the collected wild macrofungal species	90
5	Making spore prints and spore suspensions	91
6	Observation of spores under the microscope	91
7	Preparation of potato sucrose gulaman slants and plates	92
8	Rescuing the cell lines of under-utilized collected wild macrofungi	93

ABSTRACT

CORPUZ, FRANZ SEYHAN R., Department of Biological Sciences, College of Science, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines, **JULY 2023, DISTRIBUTION AND SPECIES LISTING OF WILD MACROFUNGI IN GABALDON, NUEVA ECIJA, PHILIPPINES**

Adviser: RICH MILTON R. DULAY, PhD

The profile of natural habitat, physical distribution, and taxonomic listing of naturally occurring macrofungi on Mt. Mingan, Barangay Sawmill, Gabaldon, Nueva Ecija, Philippines, are presented in this paper. Purposive and opportunistic sampling was conducted once a month at the three collection sites from February to March 2023. Most macrofungi were found to be gregarious and forest-dwelling, which grew and thrived on decomposing tree trunks, branches, stumps, and fallen logs, with a pH level ranging from 3.81 to 8.01. The macrofungi's physical distribution was significantly influenced by the collection site, collection month, and elevation, including varying vegetation as substrates, climatic conditions including temperature, humidity, and precipitation, and human disturbances. Among the three collection sites and three collection months, collection site C (65.91%) and April (59.09%) recorded the highest percentage composition of macrofungal species. Macrofungi grew at the lowest elevation of 212 masl to the highest elevation of 324 masl. However, most macrofungi were located at 291 – 320 masl (61.36%). The 89 collected macrofungi were morphologically identified and taxonomically classified under six classes, 21 families, 36 genera, and 44 species. Out of 44 species, 19 were morphologically identified down to the genus level only, while 25 were identified down to the species level. Most macrofungi species belong to the class

Agaricomycetes, wherein Polyporaceae had the most number of species. *Microporus xanthopus* (Fr.) Kuntze and *Schizophyllum commune* (Fr.) were observed consecutively in all collection sites and collection months. Four macrofungi were successfully tissue-cultured. Thus, Mt. Mingan harbors many macrofungal species with prospective applications.

Keywords: Distribution and species listing; wild macrofungi; morphological identification

LITERATURE CITED

- Alberti, M., Niveiro, N., Zied, D. C., & Albertó, E. (2020). Identification of *Oudemansiella canarii* and *O. cubensis* (Basidiomycota, Physalacriaceae) in Argentina using morphological, culture and molecular analysis. *Harvard Papers in Botany*, 25(2), 131-143. <https://doi.org/10.3100/hpib.v25iss2.2020.n1>
- Andrew, E. E., Kinge, T. J., Tabi, E. M., Thiobal, N., & Mih, A. M. (2013). Diversity and distribution of macrofungi (mushrooms) in the Mount Cameroon Region. *Journal of Ecology and the Natural Environment*, 5(10), 318-334. <https://doi.org/10.5897/JENE2013.0379>
- Angeles, L. P., Arma, E. J. M., Basaca, C. W., Biscocho, H. E. H., Castro, A. E., Cruzate, S. M., Garcia, R. M., Maghari, L. M. E., Pagadora, R. S., & Tadosa, E. R. (2016). Basidiomycetous fungi in Mt. Palay-Palay Protected Landscape, Luzon Island, Philippines. *Asian Journal of Biodiversity*, 7(1), 79-94. <https://doi.org/10.7828/ajob.v7i1.867>
- Arenas, M. C., Tadosa, E. R., & Reyes, R. G. (2018). Taxonomic inventory based on physical distribution of macrofungi in Mt. Maculot, Cuenca, Batangas, Philippines. *International Journal of Biology, Pharmacy and Allied Sciences*, 7(5), 672-687. <https://doi.org/10.31032/ijbpas/2018/7.5.4420>
- Arnolds, E. (1992). The role of macrofungi in environmental conservation. *Giornale Botanico Italiano*, 126(6), 779-795. <https://doi.org/10.1080/11263509209428173>
- Bhatt, R. N., Singh, U., & Uniyal, P. (2018). Healing mushrooms of Uttarakhand Himalaya, India. *Current Research in Environmental & Applied Mycology (Journal of Fungal Biology)*, 8(1), 1-23. <https://doi.org/10.5943/cream/8/1/1>
- Bolhassan, M. H., Abdullah, N., Sabaratnam, V., Tsutomu, H., Abdullah, S., Rashid, N. M. N., & Musa, Y. (2012). Diversity and distribution of Polyporales in Peninsular Malaysia. *Sains Malaysiana*, 41(2), 155-161. https://www.researchgate.net/publication/279591178_Diversity_and_Distribution_of_Polyporales_in_Peninsular_Malaysia?enrichId=rgreq-0bf4c08d1d9b108684afa6b6c10cf7a3XXX&enrichSource=Y292ZXJQYWdlOzI3OTU5MTE3ODtBUzo5OTQyMjQyNTg0NDEyMTdAMTYxNDA1Mjk0MzYzMWw%3D%3D&el=1_x_3&_esc=publicationCoverPdf
- Brazas, F. P., Taglinao, L. P., Revilla, A. G. M., Javier, R. F., & Tadosa, E. R. (2020). Diversity and taxonomy of basidiomycetous fungi at the Northeastern Side of Quezon Protected Landscape, Southern Luzon, Philippines. *Journal of Agricultural Science & Technology A*, 10(1), 1-11. <https://doi.org/10.17265/2161-6256/2020.01.001>

- Cababan, M. A. L., Jaranilla, A. K. O., Bastatas, M. C., Salvane, C. F. C., & Toldo, U. C. (2021). Diversity and distribution of bracket fungi in Mt. Kilakiron, Bukidnon, Philippines. *Biosaintifika: Journal of Biology & Biology Education*, 13(1), 41–50. <https://doi.org/10.15294/biosaintifika.v13i1.24064>
- Chen, Y., Svenning, J. C., Wang, X., Cao, R., Yuan, Z., & Ye, Y. (2018). Drivers of macrofungi community structure differ between soil and rotten-wood substrates in a temperate mountain forest in China. *Frontiers in Microbiology*, 9(37), 1–9. <https://doi.org/10.3389/fmicb.2018.00037>
- Culala, J. M., & Dulay, R. M. R. (2018). Species listing of naturally occurring mushrooms in Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines. *International Journal of Biology, Pharmacy and Allied Sciences*, 7(10), 1890–1899. <https://doi.org/10.31032/ijbpas/2018/7.10.4565>
- De Castro, M. E. G., & Dulay, R. M. R. (2014). Macrofungi in multistorey agroforestry systems in Mt. Makiling Forest Reserve, Los Baños, Laguna, Philippines. *Journal of Chemical, Biological and Physical Sciences*, 5(2), 1646–1655. https://www.jcbpsc.org/admin/get_filebio.php?id=394
- De Leon, A. M., Luangsa-ard, J. J. D., Karunarathna, S. C., Hyde, K. D., Reyes, R. G., & Dela Cruz, T. E. E. (2013). Species listing, distribution, and molecular identification of macrofungi in six Aeta tribal communities in Central Luzon, Philippines. *Mycosphere*, 4(3), 478–494. <https://doi.org/10.5943/mycosphere/4/3/4>
- De Leon, A. M., Kalaw, S. P., Dulay, R. M., Undan, J. R., Alfonzo, D. O., Undan, J. Q., & Reyes, R. G. (2016). Ethnomycological survey of the Kalanguya indigenous community in Caranglan, Nueva Ecija, Philippines. *Current Research in Environmental & Applied Mycology (Journal of Fungal Biology)*, 6(2), 61–66. <https://doi.org/10.5943/cream/6/2/1>
- De Leon, A. M., Pagaduan, M. A., Panto, B., & Kalaw, S. P. (2021). Species listing of macrofungi found in Paracelis Mountain Province, Philippines. *CLSU International Journal of Science and Technology*, 5(2), 22–40. <https://doi.org/10.22137/ijst.2021.v5n2.03>
- Deepalakshmi, K., & Mirunalini, S. (2011). *Pleurotus ostreatus*: an oyster mushroom with nutritional and medicinal properties. *Journal of Biochemical Technology*, 5(2), 718–726. <http://jbiochemtech.com/index.php/jbt/article/download/jbt529/294>
- Dulay, R. M. R., Arenas, M. C. R., Kalaw, S. P., Reyes, R. G., & Cabrera, E. C. (2014). Proximate composition and functionality of the culinary-medicinal tiger sawgill mushroom, *Lentinus tigrinus* (higher basidiomycetes), from the Philippines. *International Journal of Medicinal Mushrooms*, 16(1), 85–94. <https://doi.org/10.1615/intjmedmushr.v16.i1.80>

- Dulay, R. M. R., & Magsalang, C. C. (2017). Species listing of naturally occurring mushrooms in agroecosystem of Barangay Bambanaba, Cuyapo, Nueva Ecija, Philippines. *International Journal of Biology, Pharmacy, and Allied Sciences (IJBPAS)*, 6(8), 1459–1472. https://ijbpas.com/pdf/2018/October/MS_IJBPAS_2018_4565.pdf
- Dulay, R. M. R., Carandang, J. S., Kalaw, S. P., & Reyes, R. G. (2020). Distribution and species listing of wild macrofungi in Sitio Canding, Barangay Maasin, San Clemente, Tarlac Province, Philippines. *Journal of Applied Biology and Biotechnology*, 8(5), 7–15. <https://doi.org/10.7324/jabb.2020.80502>
- Ediriweera, A. N., Karunaratna, S. C., Yapa, P. N., Schaefer, D. A., Ranasinghe, A. K., Suwannarach, N., & Xu, J. (2022). Ectomycorrhizal mushrooms as a natural bio-indicator for assessment of heavy metal pollution. *Agronomy*, 12, 1041. <https://doi.org/10.3390/agronomy12051041>
- Ekanayaka, E., Hyde, K. D., & Zhao, Q. (2016). The genus *Cookeina*. *Mycosphere*, 7(9), 1399–1413. <https://doi.org/10.5943/mycosphere/7/9/13>
- Guerrero, J. M., Bañares, E. N., & Imperial, J. T. (2020). Rapid survey of macrofungi within an urban forest fragment in Bicol, eastern Philippines. *Austrian Mycological Society*, 28, 37–43. https://www.myk.univie.ac.at/wp-content/uploads/2020/09/Guerrero_OZP28_macrofungi.final_.pdf
- Guzman, C. D. M., Baltazar, M. M., Sanchez, A. J. I., Linsangan, M. G., & Dulay, R. M. R. (2018). Molecular identification of four wild higher basidiomycetes collected in Mt. Mingan, Gabaldon, Nueva Ecija, Philippines. *Journal of Biodiversity and Environmental Sciences (JBES)*, 13(6), 46–51. <https://innspub.net/molecular-identification-of-four-wild-higher-basidiomycetes-collected-in-mt-mingan-gabaldon-nueva-ecija-philippines/>
- Ho, J. (2020). *Pycnoporus sanguineus* - tropical cinnabar bracket fungus - taxo4254 - Wiki.nus. wiki.nus. Retrieved February 26, 2023, from <https://wiki.nus.edu.sg/display/TAX/Pycnoporus+sanguineus+-Tropical+Cinnabar+Bracket+Fungus#:~:text=Spore%20prints%20of%20Pycnoporus%20sanguineus,2%E2%80%932.5um%20in%20width%20>
- Kalaw, S. P., Alfonso, D., Dulay, R. M. R., De Leon, A. M., Undan, J. Q., Undan, J. R., & Reyes, R. G. (2016). Optimization of culture conditions for secondary mycelial growth of wild macrofungi from selected areas in Central Luzon, Philippines. *Current Research in Environmental & Applied Mycology (Journal of Fungal Biology)*, 6(4), 277–287. <https://doi.org/10.5943/cream/6/4/5>
- Khatun, S., Islam, A., Cakilcioglu, U., & Chatterjee, N. S. (2012). Research on mushroom as a potential source of nutraceuticals: a review on Indian perspective. *American*

Journal of Experimental Agriculture, 2(1), 47–73.
<https://doi.org/10.9734/ajea/2012/492>

- Kinge, T. R., Apalah, N. A., Nji, T. M., Acha, A. N., & Mih, A. M. (2017). Species richness and traditional knowledge of macrofungi (mushrooms) in the Awing forest reserve and communities, Northwest Region, Cameroon. *Journal of Mycology (Hindawi)*, 2017, 1–9. <https://doi.org/10.1155/2017/2809239>
- Kuo, M. (2007a). *Cerrena unicolor*. Retrieved from the *MushroomExpert.Com* Web site: http://www.mushroomexpert.com/cerrena_unicolor.html
- Kuo, M. (2007b). The genus *Gymnopilus*. Retrieved from the *MushroomExpert.Com* Web site: <http://www.mushroomexpert.com/gymnopilus.html>
- Kuo, M. (2007c). The genus *Pholiota*. Retrieved from the *MushroomExpert.Com* Web site: <http://www.mushroomexpert.com/pholiota.html>
- Kuo, M. (2008a). *Coprinopsis lagopus*. Retrieved from the *MushroomExpert.Com* Web site: http://www.mushroomexpert.com/coprinopsis_lagopus.html
- Kuo, M. (2008b). *Tremella fuciformis*. Retrieved from the *MushroomExpert.Com* Web site: http://www.mushroomexpert.com/tremella_fuciformis.html
- Kuo, M. (2009). *Resupinatus alboniger*. Retrieved from the *MushroomExpert.Com* Web site: http://www.mushroomexpert.com/resupinatus_alboniger.html
- Kuo, M. (2010). Mycenoid mushrooms Retrieved from the *MushroomExpert.Com* Web site: <http://www.mushroomexpert.com/mycenoid.html>
- Kuo, M. (2011). The genus *Lactarius*. Retrieved from the *MushroomExpert.Com* Web site: <http://www.mushroomexpert.com/lactarius.html>
- Kuo, M. (2012). *Marasmius siccus*. Retrieved from the *MushroomExpert.Com* Web site: http://www.mushroomexpert.com/marasmius_siccus.html
- Kuo, M. (2013). *Ascocoryne sarcoides*. Retrieved from the *MushroomExpert.Com* Web site: http://www.mushroomexpert.com/ascocoryne_sarcoides.html
- Kuo, M. (2015). *Polyporus arcularius*. Retrieved from the *MushroomExpert.Com* Web site: http://www.mushroomexpert.com/polyporus_arcularius.html
- Kuo, M. (2017). *Lentinus tigrinus*. Retrieved from the *MushroomExpert.Com* Web site: http://www.mushroomexpert.com/lentinus_tigrinus.html
- Kuo, M. (2018a). The genus *Agaricus*. Retrieved from the *MushroomExpert.Com* Web site: <http://www.mushroomexpert.com/agaricus.html>

- Kuo, M. (2018a). The genus *Agaricus*. Retrieved from the *MushroomExpert.Com* Web site: <http://www.mushroomexpert.com/agaricus.html>
- Kuo, M. (2018b). *Phaeotremella frondosa*. Retrieved from the *MushroomExpert.Com* Web site: http://www.mushroomexpert.com/phaeotremella_frondosa.html
- Kuo, M. (2019). *Daldinia childiae*. Retrieved from the *MushroomExpert.Com* Web site: http://www.mushroomexpert.com/daldinia_childiae.html
- Kuo, M. (2021). *Bisporella citrina*. Retrieved from the *MushroomExpert.Com* Web site: http://www.mushroomexpert.com/bisporella_citrina.html
- Li, S., Zhu, T., Liu, G., & Zhu, H. (2012). Diversity of macrofungal community in Bifeng Gorge: the core giant panda habitat in China. *African Journal of Biotechnology*, 11(8), 1970–1976. <https://doi.org/10.5897/ajb11.3232>
- Liwanag, J. M. G., Santos, E. F., Flores, F. R., Clemente, R. F., & Dulay, R. M. R. (2017). Species listing of macrofungi in Angat Watershed Reservation, Bulacan Province, Luzon Island, Philippines. *International Journal of Biology, Pharmacy, and Allied Sciences (IJBPAS)*, 6(5), 219–225. https://www.researchgate.net/publication/317597219_species_listing_of_macrofungi_in_angat_watershed_reservation_Bulacan_province_Luzon_Island_Philippines
- Lodge, D. J., Ammirati, J. F., O'dell, T. E., Mueller, G. M., Huhndorf, S. M., Wang, C. J., Stokland, J. N., Schmit, J. P., Ryvardeen, L., Leacock, P. R., Mata, M., Umaña, L., Wu, Q., & Czederpiltz, D. L. (2004). Terrestrial and lignicolous macrofungi. In G.M. Mueller, G. F. Bills & Mercedes F.S. (Eds.) *Biodiversity of Fungi: Inventory and Monitoring Methods* (pp. 128-157). Cambridge, Massachusetts: Elsevier Academic Press.
- Marzana, A., Aminuzzaman, F. M., Chowdhury, M. S. M., Mohsin, S. M., & Das, K. (2018). Diversity and ecology of macrofungi in Rangamati of Chittagong Hill Tracts under tropical evergreen and semi-evergreen forest of Bangladesh. *Advances in Research*, 13(5), 1–17. <https://doi.org/10.9734/air/2018/36800>
- Mueller, G. M., Miller, K. M., Leacock, P. R., Buyck, B., Cifuentes, J., Desjardin, D. E., Halling, R. E., Hjortstam, K., Iturriaga, T., Larsson, K., Lodge, D. J., May, T. W., Minter, D. E., Rajchenberg, M., Redhead, S. A., Ryvardeen, L., Trappe, J. M., Watling, R., & Wu, Q. (2007). Global diversity and distribution of macrofungi. *Biodiversity and Conservation*, 16(1), 37–48. <https://doi.org/10.1007/s10531-006-9108-8>
- Niego, A. G., Rapior, S., Thongklang, N., Raspé, O., Jaidee, W., Lumyong, S., & Hyde, K. D. (2021). Macrofungi as a nutraceutical source: promising bioactive

compounds and market value. *Journal of Fungi*, 7(5), 397. <https://doi.org/10.3390/jof7050397>

- Okereke, O. E., Akanya, H. O., Ogbadu, G. H., Egwim, E. C., Etim, V. A., & Akande, S. A. (2022). Development and optimization of a surface sterilization protocol for the tissue culture of *Pleurotus tuber-regium* (Fr) Sing. and *Auricularia auricula-judae*. *International Journal of Biochemistry, Bioinformatics and Biotechnology Studies*, 7(2), 1–10. <https://doi.org/10.37745/ijbbbs.15/vol7n2110>
- Paguirigan, J. a. G., David, B. a. P., Elsisura, R. N. M. S., Gamboa, A. J. R., Gardaya, R. F. P., Ilagan, J. P. N., Mendiola, J. P. L., Pineda, P. B., Samelin, R. N., & Pangilinan, M. V. (2020). Species listing and distribution of macrofungi in Consocep Mountain Resort, Tigaon and Mount Isarog National Park, Goa, Camarines Sur. *Philippine Journal of Systematic Biology*, 14(1), 1–9. <https://doi.org/10.26757/pjsb2020a14005>
- Paquit, J. C., & Pampolina, N. M. (2017). Tree and macrofungal diversity of the two different habitat types in Mt. Makiling forest reserve. *Social Science Research Network*, 10(4), 1–8. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3595912
- Patel, Y., Naraian, P., & Singh, V. K. (2012). Medicinal properties of *Pleurotus* species (oyster mushroom): a review. *World Journal of Fungal and Plant Biology*, 3(1), 1–12. <https://doi.org/10.5829/idosi.wjfpb.2012.3.1.303>
- Prasad, S., Rathore, H., Sharma, S., & As, Y. (2015). Medicinal mushrooms as a source of novel functional food. *International Journal of Food Science, Nutrition and Dietetics*, 4(5), 221–225. <https://doi.org/10.19070/2326-3350-1500040>
- Rubina, H., Aminuzzaman, F. M., Chowdhury, M. M. U., & Das, K. (2017). Morphological characterization of macrofungi associated with forest tree of National Botanical Garden, Dhaka. *Journal of Advances in Biology & Biotechnology*, 11(4), 1–18. <https://doi.org/10.9734/jabb/2017/30970>
- Sibounnavong, P., Cynthia, C. D., Kalaw, S. P., Reyes, R. G., & Soyong, K. (2008). Some species of macrofungi at Puncan, Carranglan, Nueva Ecija in the Philippines. *Journal of Agricultural Technology*, 4(2), 105–115. https://www.researchgate.net/publication/237735204_Some_species_of_macrofungi_at_Puncan_Caranglan_Nueva_Ecija_in_the_Philippines
- Sonchita, D. R. B., Aminuzzaman, F. M., Joty, A. A., Tanni, J. F., Islam, M. S., & Rahaman, M. A. (2020). Diversity, distribution and morphological characterization of wild macrofungi from Gajni Forest. *Asian Journal of Biology*, 9(12), 19–32. <https://doi.org/10.9734/ajob/2020/v9i230084>

- Swapna, S., Abrar, S. S., & Krishnappa, M. R. (2008). Diversity of macrofungi in semi-evergreen and moist deciduous forest of Shimoga District-Karnataka, India. *Journal of Mycology and Plant Pathology*, 38(1), 21–26. https://www.researchgate.net/publication/268358248_Diversity_of_Macrofungi_in_Semi-Evergreen_and_Moist_Deciduous_Forest_of_Shimoga_District-Karnataka_India
- Tadosa, E. R., & Arsenio, J. J. (2014). A taxonomic study of wood-rotting basidiomycetes at the molave forest of San Fernando City, La Union Province, Philippines. *Asian Journal of Biodiversity*, 5(1), 69–88. <https://doi.org/10.7828/ajob.v5i1.483>
- Tadosa, E. R., Arenas, M. C. R., & Reyes, R. G. (2015). Macroscopic fungi of Mts. Banahaw-San Cristobal Protected Landscape Northwestern side, with a description of *Nidula banahawensis* sp. nov. (Basidiomycota). *Asian Journal of Biodiversity*, 6(2), 69–88. <https://doi.org/10.7828/ajob.v7i1.838>
- Tadosa, E. R., & Lubos, L. C. (2020). Common macroscopic fungi and mosses of North Central Mindanao. *Asian Journal of Biodiversity*, 10(1), 26–137. <https://doi.org/10.7828/ajob.v10i1.1281>
- Tang, X., Mi, F., Zhang, Y., He, X., Cao, Y., Wang, P., Liu, C., Yang, D., Dong, J., Zhang, K., & Xu, J. (2015). Diversity, population genetics, and evolution of macrofungi associated with animals. *Mycology*, 6(2), 94–109. <https://doi.org/10.1080/21501203.2015.1043968>
- Téllez-Téllez, M. (2016). Mycosphere Essay 11: Fungi of *Pycnoporus*: morphological and molecular identification, worldwide distribution and biotechnological potential. *Mycosphere*, 7(10), 1500–1525. <https://doi.org/10.5943/mycosphere/si/3b/3>
- Torres, M. L., Tadosa, E. R., & Reyes, R. G. (2020). Species listing of macrofungi on the Bugkalot tribal community in Alfonso Castañeda, Nueva Vizcaya, Philippines. *Current Research in Environmental & Applied Mycology (Journal of Fungal Biology)*, 10(1), 475–493. <https://doi.org/10.5943/cream/10/1/37>
- Venturella, G., Ferraro, V., Cirlincione, F., & Gargano, M. L. (2021). Medicinal mushrooms: bioactive compounds, use, and clinical trials. *International Journal of Molecular Sciences*, 22(2), 634. <https://doi.org/10.3390/ijms22020634>
- Zotti, M., Persiani, A. M., Ambrosio, E., Vizzini, A., Venturella, G., Donini, D., Angelini, P., Di Piazza, S., Pavarino, M., Lunghini, D., Venanzoni, R., Polemis, E., Granito, V. M., Maggi, O., Gargano, M. L., & Zervakis, G. I. (2013). Macrofungi as ecosystem resources: Conservation versus exploitation. *An International Journal Dealing With All Aspects of Plant Biology: Official Journal of the Societa Botanica Italiana*, 147(1), 219–225. <https://doi.org/10.1080/11263504.2012.753133>