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Wood-rotting Macrofungi of Kikruma Community Forest, Phek, Nagaland

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Abstract: Survey and documentation of wood-rotting macrofungi of Kikruma community forest, Phek, Nagaland was carried out for period of three years from January 2015 to December 2017. The identified wood-rotting macrofungi are classified under two phyla, sixteen families, thirty one genera and forty three species. Thirty six wood-rotting macrofungi belonged to phylum Basidiomycota and the remaining seven to phylum Ascomycota. Polyporaceae was the most dominating Family with fourteen wood-rotting macrofungi, followed by Stereaceae and Xylariaceae with five wood-rotting macrofungi each. For seasonal variation, Pre monsoon (March to April), Monsoon (may to august), Retreating Monsoon (September to November) and Dry Season (December to January) were considered. Majority of the species were sampled during retreating monsoon season followed by monsoon and pre monsoon seasons respectively. Three species, *Auricularia polytricha*, *Lopharia cinerascens* and *Schizophyllum commune* were found growing in all the four seasons. The species dominance index, species evenness and Shannon's diversity index were calculated to be 0.064, 0.517 and 3.077 respectively.

Keywords: Basidiomycota, Diversity, Edible wood-rotting macrofungi, Polyporaceae, Seasonal variation

Wood-rotting fungi comprised of a largely unexplored group of magnanimous macrofungi. Their role and mechanisms involved in wood biodegradation is studied in detail however, the full potential of majority of the species still remain unexplored. They are the only known group of living organism actively involved in wood biodegradation. Singh et al (2016) reported the ability of bacteria to degrade wood however their ability to degrade wood is much slower as compared to basidiomycete wood biodegradation. Wood-rotting fungi degrade the complex components of the plant cell wall employing various complex enzymatic degradation and reactive oxygen species (Riley et al 2014, Castano et al 2018, Goodell 2020). White rot fungi have the ability degrade a number of persistent environmental pollutants such as chlorinated aromatic compounds, hetero-cyclic aromatic hydrocarbons, dyes and synthetic polymers (Bennett 1994). In addition to biodegradation of wood, this group of macrofungi play important roles in balancing ecological services, improving soil fertility, in bioremediation and also many species are known for their medicinal and nutritive properties. It has been reported that lignicellulose hydrolytic enzyme machinery of Basidiomycota members makes low cost bioremediation projects more attractive (Sanchez 2008). Wood-rotting macrofungi are reported to be the only group of organism able to decompose all woody components and thus, they play an important role in both carbon and nitrogen cycles by degrading non-living organic substrates (Pinar and Rodriguez-Conto 2024). The use of polypore fungi such as *Ganoderma lucidum*, *Phellinus linteus* and *Trametes versicolor* in the treatment a number of diseases including hypertension, prostate cancer, as cancer chemotherapy agents and their antibacterial, antifungal and antiviral effects have been studied by many researchers and reported positive results (Hsieh and Wu 2001, Silva 2003, Liang et al 2010).

Kikruma village is well-known for its rich cultural and patriotic history. It is located under Phek administrative district of Nagaland, Northeast India. Studies on wood-rotting macrofungi in northeast India is still at its dormant phase and majority of the region is still unexplored. The forest canopy of Kikruma community forest is neither open nor dense but it is of moderate type. The present study provides a preliminary documentation of wood-rotting macrofungi from Kikruma village, Phek, Nagaland.

MATERIAL AND METHODS

Survey and documentation of wood-rotting macrofungi of Kikruma Community forest, Phek district, Nagaland was carried out for period of three years from January 2015 to December 2017 on seasonal basis. The village is located at an altitudinal range of 1,581 to 1,650 meters above sea level (masl) with the geographical coordinates 2537.38' N and 094º 13.71'E. The village is surrounded by broad-leave deciduous forest with a vegetation hugely dominated by

Quercus serrata distributed all along the altitudinal gradient interfered with few patches of *Pinus wallichiana* and *Prunus cerasoides.* Based on the prevailing seasons, samplings were conducted during Pre monsoon (March to April), Monsoon (May to August), Retreating Monsoon (September to November) and Dry Seasons (December to January). Depending on the slope of the areas, both transect (50x5m) and quadrat methods (50x50m) were used for sampling wood-rotting fungi following the protocol recommended by Mueller et al (2004). The transects and quadrats were laid randomly. The collected basidiocarps were bought to the laboratory and dried under light to moderate sunlight condition. The dried basidiocarps were then kept in clean and labelled polythene bags with naphthalene balls wrapped in cotton. For microscopic studies, 4% KOH, lactophenol cotton blue and Melzer's reagent were used for staining, observation and identification. Identification was done through comparative consultations from the available monograph and literatures (Bakshi 1971, Ryvarden and Johansen 1980, Gilbertson and Ryvarden 1987, Nunez and Ryvarden 2000, 2001, fungifromindia.com, mycobank.org and indexfungorum.org). Diversity indices such as Dominance index (D), Evenness (eˆH/S) and Shannon's diversity index (H') were used for calculating the diversity of wood-rotting fungi using PAST 1.93 software. All the identified wood-rotting fungi were deposited in Department of Botany, North-Eastern Hill University (NEHU), Shillong Campus, Meghalaya.

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RESULTS AND DISCUSSION

Forty three wood-rotting macrofungi were collected and identified. The identified wood-rotting macrofungi are classified under two phyla (Basidiomycota and Ascomycota) with a total of sixteen families, thirty one genera and forty three species. The phylum Basidiomycota comprised of fourteen families, twenty eight genera and thirty six wood-rotting macrofungi whereas, the phylum Ascomycota comprised of two families, three genera and seven species (Table 1). Polyporaceae was the most dominating Family with fourteen wood-rotting macrofungi, followed by Stereaceae and Xylariaceae with five wood-rotting macrofungi each (Fig. 1). Majority of the species were sampled during retreating monsoon season followed by monsoon and pre monsoon seasons respectively. Thirty six wood-rotting fungi were found growing during retreating monsoon, thirty two during monsoon, seventeen during pre-monsoon and only three during dry season.

Three species, *Auricularia polytricha*, *Lopharia cinerascens* and *Schizophyllum commune* were found growing in all the four seasons studied. Five species, *Auricularia auricula-judae*, *A. polytricha*, *Lentinussajor-caju*, *Pleurotus ostreatus, Schizophyllum commune* and one species belonging to the genus *Ramaria* are reportedly consumed by the localities of the village as edible macrofungi. The remaining wood-rotting fungal species are identified as non-edible. The species dominance index, species evenness and Shannon's diversity index were calculated to be 0.0638, 0.5165 and 3.077 respectively. Few selected photographs of wood-rotting macrofungi sampled from Kikruma community forest (reproduced from Chuzho 2021), are shown in Figure 2.

Study of wood-rotting macrofungi was for the first time documented from Kikruma village, Phek, Nagaland through the present study however, studies on wood-rotting macrofungi, particularly, members of Basidiomycota is well documented in India by many workers (Leelavathy and Ganesh 2000, Forutan and Jafary 2007, Swapna et al 2008, Ranadive et al 2011, Ranadive 2013, Lyngdoh 2014, Adarsh et al 2018, Vabeikhokhie et al 2019a,b, Ao and Deb 2019, Chuzho 2021, Chungreiliu 2023). The family Polyporaceae is the most dominant taxon at level as compared to the other families recorded in the present study. The dominance Polyporaceae members have also been reported by many researchers (Sharma 2007, Prasher and Ashok 2013, Tapwal et al 2013, Lyngdoh 2014, Chuzho 2021, Chungreiliu 2023). Most of the polyporaceae members are characterized by having rigid and corky basidiocarps and the rigidity of the basidiocarps have attributed to their persistence thereby increasing their chances of being frequently encountered unlike other ephemeral wood-rotting macrofungi with soft basidiocarps which persist only for one to few days. Lyngdoh and Dkhar (2018) study on the decay potential of four wood-rotting fungi on *Batula alnoides* and *Quercus dealbata* wood-blocks showed that polypore species have higher degradation ability as compared to non-polypore species. The ability of polypores to degrade lignin more effectively might have helped them to be better opportunist on wood degradation and thereby increasing their chance to colonize woody debris more effectively.

Occurrence of wood-rotting fungi varied with different seasons. Majority of wood-rotting fungi were recorded during retreating monsoon season followed by monsoon season, pre monsoon and dry season. Baptista et al (2010) also showed a bimodal pattern in fruiting phenology. They observed that basidiocarp formation occurred in two distinct seasons (retreating monsoon and pre-monsoon) with the higher number of species collected during retreating monsoon than during pre-monsoon. The present result showed that maximum wood-rotting fungi occurred during retreating monsoon followed by monsoon which slightly

Table 1. Wood-rotting fungi, their families and distribution at different seasons

Family	Specimen name	Season*			
		1	2	3	4
Phylum Ascomycota					
Hypoxylaceae	*Daldinia concentrica* (Bolton) Ces. & De Not.	+	+	+	-
	U1 01 Pul - Hypoxylaceae	+	-	-	-
Xylariaceae	*Kretzschmaria deusta* (Hoffm.) P. M. D. Martin	-	+	+	-
	Xylaria grammica (Mont.) Mont.	-	+	+	-
	X. hypoxylon (L.) Grev.	+	+	+	-
	X. longipes Nitschke	+	+	+	-
	X. polymorpha (Pers.) Grev.	+	+	+	-
Phylum Basidiomycota					
Agaricaceae	*Cyathus striatus* (Huds.) Willd.	+	+	-	-
Auriculariaceae	*Auricularia auricula-judae* (Bull.) J. Schrot.	-	+	+	-
	A. delicata (Mont.) Henn.	+	+	+	-
	A. polytricha (Mont.) Sacc.	+	+	+	+
Dacrymycetaceae	*Dacryopinax spathularia* (Schwein.) G.W. Martin	-	+	+	-
Fomitopsidaceae	*Daedalea quercina* (L.) Pers.	-	-	+	-
	Fomitopsis pinicola (Sw.) P. Karst.	+	+	+	-
Ganodermataceae	*Ganoderma lucidum* (Curtis) P. Karst.	-	+	+	-
Gloeophyllaceae	*Gloeophyllum sepiarium* (Wulfen) P. Karst.	-	+	-	-
Gomphaceae	*Ramaria* sp.	-	+	-	-
Hymenochaetaceae	*Hymenochaete tabacina* (Sowerby) S.H. He & Jiao Yang	-	-	+	-
	Phellinus gilvus (Schwein.) Pat.	-	+	+	-
	Phellinus sp.	-	-	+	-
Phanerocahetaceae	*Bjerkandera adusta* (Willd.) P. Karst	+	+	+	-
Pleurotaceae	*Pleurotus ostreatus* (Jacq.) P. Kumm.	-	+	+	-
Polyporaceae	*Coriolopsis polyzona* (Pers.) Ryv.	-	-	+	-
	Heterobasidion insulare (Murrill) Ryv.	-	+	-	-
	Hexagonia tenuis (Hook.) Fr.	-	+	+	-
	Lentinus sajor-caju (Fr.) Fr.	-	-	+	-
	Lopharia cinerascens (Schwein.) G. Cunn.	+	+	+	+
	Microporus xanthopus (Fr.) Kuntze	+	+	+	-
	Nigrofomes melanoporus (Mont.) Murrill	-	+	-	-
	N.vinosus (Berk.) Murrill	+	+	+	-
	Pycnoporus cinnabarinus (Jacq.) P. Karst.	-	-	+	-
	P. sanguineus (L.) Murrill	-	-	+	-
	Rigidoporus microporus (Sw.) Overeem	-	-	+	-
	Trametes hirsuta (Wulfen) Pil.	+	+	+	-
	T. versicolor (L.) Lloyd	+	+	+	-
	Trichaptum abietinum (Pers. ex. J.F. Gmel.) Ryv.	-	+	+	-
Psathyrellaceae	*Coprinellus micaseus* (Bull.) Fr.	+	+	+	-
Schizophyllaceae	*Schizophyllum commune* Fr.	+	+	+	+
Stereaceae	*Aleurodiscus ahmadii* (Biodin) Biodin	+	+	-	-
	Stereum complicatum (Fr.) Fr.	-	+	+	-
	S. gausapatum (Fr.) Fr.	-	-	+	-
	S. hirsutum (Willd.) Pers.	-	+	+	-
	S. ostrea (Blume& T. Nees)	-	-	+	-

*1 – Pre monsoon (March to April); 2 – Monsoon (May to August); 3 – Retreating Monsoon (September to November); 4 – Dry Season (December to January) differs from the observation made by Baptista et al (2010), however, in both cases, maximum number of wood-rotting macrofungi occurred during retreating monsoon. Ho et al (2002), Pouska et al. (2010) and Adarsh et al. (2015) also reported the maximum occurrence of basidiocarps of agarics and polypores during August to October which supports the present finding. Basidiocarp formation of wood-rotting fungi required high level of water supply and seasonal drought can limit fruiting of wood-rotting fungi to a great extent (Olou et al 2019). Three wood-rotting fungi viz., *A. polytricha*, *L. cinerascens* and *S. commune* were sampled from all the four seasons studied. This finding indicated that these species have wide range of seasonal adaptation. Nagadesi and Arya (2014a) and Lyngdoh (2014) also reported the wide range of seasonal adaptation of certain wood-rotting fungal species including *S. commune*. Apart from seasonal variations and precipitation, occurrence of wood-rotting macrofungi depends on other environmental factors such as altitude, type of forest vegetation, presence of host tree species and other micro- and macro-environmental factors (Chuzho and Dkhar 2019a,b). The lower number of wood-rotting macrofungi sampled in three years survey may be because Kikruma village is dominated by *Q. serrata* and thus it mostly harbours those species that grow on *Q. serrata*. Northeast India is a major storehouse for biodiversity. The exploring into wood-rotting macrofungal communities from Nagaland and other North-eastern states of India, the actual figure macrofungal bioresources of Northeast India is expected to increase drastically.

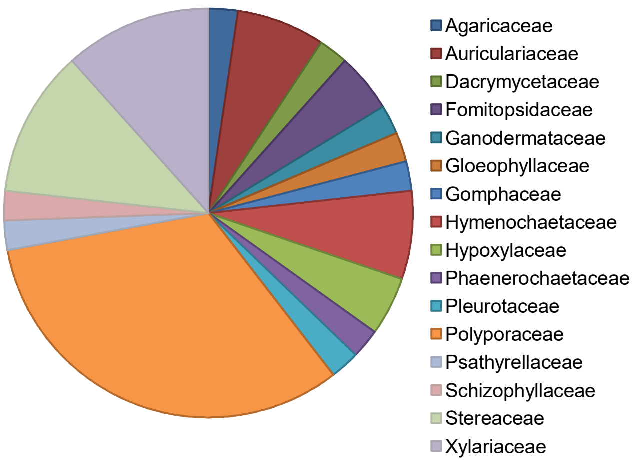

Fig. 1. Wood-rotting fungi belonging to different families

Fig. 2. Selected photographs of wood-rotting macrofungi sampled from Kikruma community forest (Photographs reproduced from Chuzho 2021)

CONCLUSION

The present study provided a preliminary documentation of wood-rotting macrofungi from Kikruma village, Phek, Nagaland. Forty three wood-rotting macrofungi, classified under two phyla, sixteen families, thirty one genera were collected and identified from the present study. Majority of the species were sampled during retreating monsoon season followed by monsoon and pre monsoon seasons respectively. The Shannon's diversity index with a value of 3.077 showed that Kikruma community forest harboured high wood-rotting macrofungal diversity.

REFERENCES

Adarsh CK, Kumar V, Vidyasagaran K and Ganesh PN 2015. Decomposition of wood polypore fungi in the tropics - biological, ecological and environmental factors: A case study. *Research Journal of Agricultural and Forestry Sciences* **3:** 15-37.

Adarsh CK, Vidyasagran K and Ganesh PN 2018. A checklist of polypores of Kerela state, India. *Studies in Fungi* **3**(1): 202-228.

Ao T and Deb CR 2019. Wild mushrooms of Nagaland: An important bio-resource. *Studies in Fungi* **4**(1): 61-78.

Bakshi BK 1971. *Indian Polyporaceae (on trees and timber).* ICAR, New Delhi, pp. 1-246.

Baptista P, Martins A, Tavares RM and Lino-Neto T 2010. Diversity and fruiting pattern of macrofungi associated with chestnut (*Castinea sativa*) in the Tras-os-Montes region (Northeast Portugal). *Fungal Ecology* **3:** 9-19.

Bennet JW 1994. Prospectus for fungal bioremediation of TNT munition wastes. *International Bio-deterioration and Biodegradation* **34:** 21-24.

Castano JD, Zhang J, Anderson CE and Schilling JS 2018. Oxidative damage control during decay of wood by brown rot fungus using oxygen radicals. *Applied & Environmental Microbiology* **84**(22): e10937-18.

Chungreiliu AK 2023. *Studies on Diversity of wood-rotting fungi with special emphasis on seleted edible fungi in different forest stands of Manipur*. Ph. D. Thesis. North-Eastern Hill University, Shillong, India.

Chuzho K and Dkhar MS 2019a. Diversity of Ascomycetous wood-rotting fungi along an altitudinal gradient in forests of Nagaland and first report of *Jackrogersella minutela* from India. *Journal of The Indian Academy of Wood Sciences* **16**(1): 36-43.

Chuzho K and Dkhar MS 2019b. Ecological determinants of wood-rotting fungal diversity and first report of *Favolaschia calocera*, an invasive species from India. *Proceedings of The National Academy of Sciences, India Section B – Biological Sciences* **89**(4): 1177-1188.

Chuzho K 2021. *Altitudinal variation in diversity of wood-rotting fungi from forests of Nagaland*. Ph. D. Thesis. North-Eastern Hill University, Shillong, India.

Foroutan A and Jafary N 2007. Diversity of heart and root rot fungi on parks and roadside trees in Maharashtra, India. *Journal of Applied Science and Environment Management* **11**(4): 55-58.

Gilbertson RL and Ryvarden L 1987. *North American Polypores. Fungiflora*, Oslo.

Goodell B 2020. Fungi involved in the biodeterioration and bioconversion of lignocellulose substrates. *The Mycota II* Chap. 15. doi.org/10.1007/978-3-030-49924-2_15.

Ho WH, Yanna, Hyde KD and Hodgkiss IJ 2002. Seasonality and sequential occurrence of fungi on woods submerged in Tai Po Kau forest stream, Hong Kong. *Fungal Diversity* **10**: 21-43.

Hsieh T and Wu JM. 2001. Cell growth and gene modulatory activities of *Yunzhi* (Windsor Wunxi) from mushroom *Trametes versicolor* in androgen-dependent and androgen-insensitive human prostate cancer cells. *International Journal of Oncology* **18**: 81-88.

Kaarik A 1974. Decomposition of wood. *Biology of Plant Litter Decomposition* 1: 129-174.

Leelavathy KM and Ganesh PN 2000. *Polypores of Kerela*. Daya Publishing House, Delhi, pp. 1-165.

Liang C, Tsai S, Huang S, Liang Z. 2010. Taste quality and anti-oxidant properties of medicinal mushroom *Phellinus lenteus* and *Sparassis crispa* mycelia. *International Journal of Medicinal Mushrooms* **12**(2): 141-150.

Lyngdoh A 2014. *Diversity of wood-rotting macrofungi of East Khasi Hills and decay potential of some selected species*. Ph. D. Thesis. North-Eastern Hill University, Shillong, India.

Lyngdoh A and Dkhar MS 2018. Decay potential of four wood-rot fungi on *Batula alnoides* and *Quercus dealbata* wood-blocks. *Asian Journal of Microbiology, Biotechnology & Environmental Sciences* **20**(3): 935-942.

Mueller GM, Schmit JP, Leacock P, Buyck B 2004. Global diversity and distribution of macrofungi. *Biodiversity and Conservation* **16**: 37-48.

Nagadesi PK and Arya A 2014a. Timber degrading fungi in sawmills of Gujarat, India. *International Letters of Natural Sciences* **2**: 13-22.

Nunez M and Ryvarden L 2000. *East Asian Polypores* - Volume 1 (Ganodermataceae and Hymenochaetaceae). Synopsis fungorum 13. Fungiflora, Oslo, pp. 1-168.

Nunez M and Ryvarden L 2001. East Asian Polypores - Volume 2 (Polyporaceae). Synopsis fungorum 14. Fungiflora, Oslo, pp. 170-522.

Olou BA, Yorou NS, Striegel M, Bassler C and Krah F 2019. Effects of microclimate and diversity of tropical wood-inhabiting fungi. *Forest Ecology and Management* **437**: 79-87.

Pinar O, Rodriguez-Conto S 2024. Biologically active secondary metabolites from white rot fungi. *Frontiers in Chemistry* **12**: 1363354.

Pouska V, Svoboda M and Lepsova A 2010. The diversity of wood-decaying fungi in relation to changing site condition in an old growth mountain spruce forest, Central Europe. *European Journal of Forest Research* **129**(2): 219-231.

Prasher IB and Ashok D 2013. A checklist of wood rotting fungi (non-gilled Agaricomycotina) of Himachal Pradesh. *Journal of New Biological Reports* **2**(2): 71-98.

Ranadive KR 2013. An overview of Aphyllophorales (wood-rotting fungi) from India. *International Journal of Current Microbiology and Applied Sciences* **2**(12): 112-139.

Ranadive KR, Viadya JG, Jite PK, Ranade VD, Shosale SR, Rabba AS, Hakimi M, Deshpande GS, Rathod MM, Forutan A, Kaur S, Naik-Vaidya CD, Bapat GS, and Lamrood P 2011. Checklist of Aphyllophorales from the Western Ghats of Maharashtra state, India. *Mycosphere* **2**(2): 91-114.

Riley R, Salamov AA, Brown D, Nagy LG, Floudas D, Held BW, Levasseur A, Lombard V, Morin E, Otilar R, Lindquist E, Sun H, LaButti KM, Schmutz J, Jabbour D, Luo H, Baker SE, Pisabarro AG, Walton JD, Blanchette RA, Henrissat B, Martin F, Cullen D, Hibbett DS and Grigoriev IV 2014. Extensive sampling of basidiomycete genomes demonstrates inadequacy of the white-brown-rot paradigm of wood decay fungi. *Proceedings of The National Academy of Sciences,* USA **111**(27): 9923-9928.

Ryvarden L and Johansen I 1980. A Preliminary Polypore Flora of East Africa. *Fungiflora*, Oslo.

Sanchez C 2008. Lignocellulosic residues: Biodegradation and bioconversion by fungi. *Biotechnology Advances* **27**(2): 185-194.

Sharma JR 2007. *Wood rotting fungi of temperate Himalaya*. In: Mukerji KG and Manoharachary C. (eds), Current concepts in Botany, IK International Publishing House Pvt. Ltd., New Delhi, pp. 101-120.

Silva D. 2003. *Ganoderma lucidum* (Reishi) in cancer treatment. *Integrative Cancer Therapies* **2:** 358-364.

Singh AP, Kim YS and Singh T 2016. Bacterial degradation of wood. In: *Secondary Xylem Biology*. doi.org/10.1016/B978-0-12-802185-9.00009-7.

Swapna S, Sye A and Krishnappa M 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.

Tapwal A, Kumar R and Pandey S 2013. Diversity and frequency of macrofungi associated wet evergreen tropical forest in Assam, India. *Biodiversitas* **14**(2): 73-78

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Vabeikhokhie JMC, Zohmangaiha, Zothanzama J and Lalrinawmi 2019a. Taxonomic study of wood inhabiting fungi of Reiek Reserved Forest, Mizoram, India. *Journal of Emerging Technologies and Innovative Research* **6**(4): 698-702.

Vabeikhokhie JMC, Zohmangaiha, Zothanzama J and Lalrinawmi 2019b. Diversity of wood rotting fungi from two different forests in Mizoram, India. *International Journal of Current Microbiology and Applied Sciences* **8**(4): 2775-2785.

www.fungifromindia.com/fungifromindia/buildPage.php?page=databases

www.indexfungorum.org

www.mycobank.org