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Diversity and frequency of macrofungi associated with wet ever green tropical forest in Assam, India

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ABSTRACT

Tapwal A, Kumar R, Pandey S. 2013. Diversity and frequency of macrofungi associated with wet ever green tropical forest in Assam, India. Biodiversitas 14: 73-78. A study was conducted in Jeypore Reserve Forest located in Assam, India to investigate the diversity of macrofungi associated with different tree species. The diversity of broad leaves trees and high humidity during monsoon period favours ideal growth of diverse group of macrofungal fruiting bodies. Thirty macrofungal species representing 26 genera belonging to 17 families were collected from six different sites in the study area. Out of these maximum six genera assignable to family Polyporaceae, five genera to Russulaceae, three genera to Agaricaceae, two genera to Ganodermataceae and Cantharellaceae each and rest of the families were represented by single genus only. The ecological preference of the species reveled that maximum (17) species were saprophyte, living on dead substrates or decaying wood debris, ten species were found associated with roots of higher trees, while three species were found parasitic. Overall 20 species were found edible including some species having medicinal utilization. The present study revealed that maximum frequency of occurrence was exhibited by *Trametes versicolor* and *Schizophyllum commune* (83.33%), followed by *Microporus xanthopus*, *Pycnoporus sanguineus* (66.67%) and *Coprinus disseminates* (50%). The rest of the species exhibited the frequency distribution ranging between 16.67-33.33%. The maximum density was recorded for *Schizophyllum commune* (126.67%) followed by *Trametes versicolor* (120%) and *Xylaria polymorpha* (93.33%) . The density of rest of the species were ranged between 3.33- 6.67%. The key objective of the present study was to generate a database on macrofungal diversity of Jeypore Reserve Forest along with their ecological preferences and utilization, which is not earlier documented.

Key words: Jeypore Reserve Forest, macrofungi, mycorrhiza

INTRODUCTION

The Jeypore Reserve Forest is an important wet ever green tropical forest patch of eastern Assam which constitutes a part of the Eastern Himalaya biodiversity hotspot region. This reserve forest is relatively less disturbed by humans beings in comparison to other protected areas of the state (Saikia and Devi 2011). The major tree species of the area are *Dipterocarpus retusus, Shorea assamica, Baccaurea ramiflora, Begonia roxburghii, Gmelina arborea, Litsea salicifolia, Mesua ferrea, Syzygium cumini, Terminalia myriocarpa, Vatica lanceaefolia* etc in addition to diverse population of herbs and shrubs. Plantations provide a habitat for diverse macro fungal communities, which vary markedly in composition from site to site. Fungi are some of the most important organisms in the world, because of their vital role in ecosystem function, influence on humus and human-related activities (Mueller and Bill, 2004). Mushrooms are cosmopolitan heterotrophic organisms that are quite specific in their nutritional and ecological requirements. They can grow in soil or degrading plant residues as saprophytes, wood decaying and many live in symbiotic association with the roots of higher plant species. They play important role in nutrient recycling; growth and establishment of seedlings in forest floor. While some fungal species forms parasitic association with trees and cause considerable damage. The peak season for the formation of fruit body of macrofungi is different for each ecological climate (Arora 1991). Defining the exact number of fungi on the earth has always been a point of discussion and several studies have been focused on enumerating the world's fungal diversity (Crous 2006). Current studies have estimated about 1.5 million species of fungi on globe (Hawksworth 2004). One-third of which exists in India and of this only 50% are characterized till date (Manoharachary et al. 2005). More than 27,000 fungal species are recorded from India, which is the largest biotic community after insects (Sarbhoy et al. 1996).

Despite the great bio-geographic significance of the Jeypore Reserve Forest, it remains poorly documented in terms of macrofungal diversity. This broad leaf forest presumably possesses great diversity not only in plant species but also in macrofungi. Some selected pockets of this forest have been surveyed for the diversity of macrofungi. The macrofungi observed in the study area are either edible, medicinal, saprophyte or wood rotting fungi. These fungal species vary in their abundance and phenology of fruiting. Most of the macrofungal species producing hypogeous/ epigeal sporocarp are thought to be

ectomycorrhizal (Trappe 1962; Lakhanpal 1997; Beig et al. 2008).

The importance of macrofungi has been well established since ancient times. Many Asian countries use traditionally wild edible mushrooms as delicious and nutritional foods and medicine. Wild edible mushrooms are appreciated not only for texture and flavor but also for their chemical and nutritional characteristics (Manzi et al. 1999; Sanmee et al. 2003). Mushrooms provide minerals, vitamins and proteins with high nutritional value as do the best local legumes (Buyck 1994). Mushrooms are also reported as therapeutic foods, useful in preventing diseases such as hypertension, hypercholesterolemia and cancer (Bobek and Galbavy 1999; Bobek et al. 1991). These functional characteristics are mainly due to the presence of dietary fiber and in particular chitin and beta glucans (Manzi et al. 2001). Studies have also shown antitumor, antiviral, antithrombotic and immunomodulating effects of mushrooms (Mau et al. 2002). The aim of present investigation was to generate base-line information on prevailing macrofungi of Jeypore Reserve Forest with their ecological relationship and utilization.

MATERIALS AND METHODS

Study site

The Jeypore Reserve Forest is located in Dibrugarh District of Assam, India (Figure 1) lies between 27°06′-27°16’ N and 95°21’-95°29’E longitude at an elevation of 1100-2600 m. The climate of the study site is humid

Figure 1. Study sites at Jeypore Reserved Forests (○) in Dibrugarh district of Assam, India

tropical characterized by high rainfall and high humidity (up to 90%). The annual mean precipitation in the last three years ranged from 3600 to 5500 mm of which 82% is received during the monsoon season from May to August and 17% during dry periods from September to March. The mean ambient temperature is 27°C.

Sample collection and diversity analysis

Periodic surveys were made to the study area for the collection of macrofungi during rainy season (June to September) and winter (October to December) in 2010-2011. Six sites in Jeypore Reserve Forest (JRF) have been surveyed in winter and rainy season for the collection of macrofungi. The collected samples were wrapped in wax paper and brought to the laboratory for identification.

The macroscopic characters like shape, size, color, texture, attachment of stipe, smell, spore print, habit and habitat has documented during the survey and collection work. The taxonomy has been worked on the basis of macro and microscopic characteristic following available literatures (Zoberi 1973; Alexopoulos et al. 1996; Purakasthya 1985). The soft textured specimens were preserved in 2% formaldehyde and leathery textured were preserved in 4% formaldehyde. The utilization of different mushroom species for food and as medicine has been documented from the available literature. The frequency and density of different species has been determined by the following formulas:

$$\text{Freq. of fungal sp. (\%)} = \frac{\text{No. of site in which the sp. is present}}{\text{Total no. of sites}} \times 100$$

$$\text{Density} = \frac{\text{Total no. of individual of a particular species}}{\text{Total no. of species}} \times 100$$

RESULTS AND DISCUSSIONS

Species diversity of macrofungi is related to their particular habitats. The factors like geographic location, elevation, temperature, humidity, light and surrounding flora greatly influence the growth and development of macrofungi. Thirty macrofungal species representing 26 genera belonging to 17 families were collected from the study area (Figure 1).

Maximum six genera assignable to family Polyporaceae, five genera to Russulaceae, three genera to Agaricaceae, two genera to Ganodermataceae and Cantharellaceae each and rest of the families were represented by single genus only. The diversity analysis revealed that maximum frequency occurrence was exhibited by *Trametes versicolor* and *Schizophyllum commune* (83.33%), followed by *Microporus xanthopus* (66.67%), *Pycnoporus sanguineus* (66.67%) and *Coprinus disseminates* (50%). The frequency distribution of rest of the species was ranged between 16.67-33.33%. Almost in a similar trend maximum density was recorded for *Schizophyllum commune* (126.67%) followed by *Trametes versicolor* (120.00%), *Xylaria polymorpha* (93.33%) and the rest were ranged between 3.33- 76.67% (Table 1).

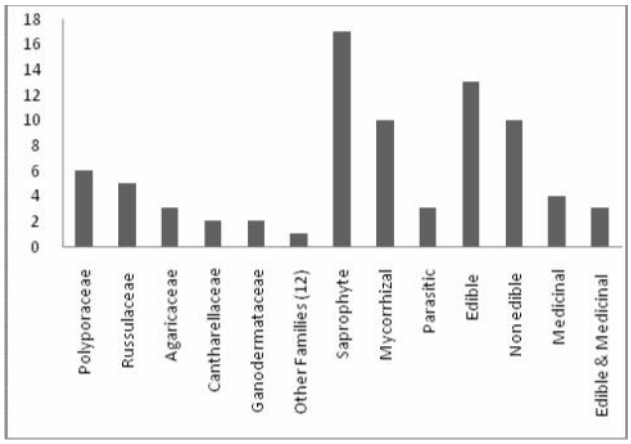

Figure 1. Macrofungal distribution in families, ecological relationship and utilization

Twenty species were found edible, out of which some have medicinal properties. Mushrooms are delicious food due their high quality protein, vitamins and minerals. Fresh mushrooms contain about 90% moisture and 10% dry matter. Dry mushrooms contain about 90% dry matter and 10% moisture (Chang and Buswell 1996). For local populations, mushrooms are usually considered as substitutes for animal protein, and are known as meat for the poor (Buyck 1994). Most common edible macrofungi found in JRF are the species of *Agaricus, Lactarius, Lycoperdon, Russula, Scleroderma, Cantharellus, Pleurotus, Lentinus, Schizophyllum* etc. In India, mushrooms are a non wood forest produce and popular as food among the ethnic people of North east India. Some of the edible species like *Termitomyces eurrhizus, Lentinus conatus, Schizophyllum commune, Tricholoma giganteum* and *Pleurotus* are sold in the markets of Kohima district of Nagaland by the local people (Tanti et al. 2011). In addition to these Kumar et al. (2013) described 15 edible fungi along with their macronutrient content collected from different forest areas of Nagaland.

The ecological preference of the species revealed that maximum number of (17) species were saprophyte and 10 species were found associated with higher trees. The mycorrhizal fungi basically serves as an extension of the plant root system, exploring soil far beyond the roots and transporting water and nutrients to the roots. The fungus grows from the colonized roots into the surrounding soil. Mycelial colonization of the soil varies among ectomycorrhizal fungi; some may only grow a few centimeters into the soil and others can grow several meters from the ectomycorrhiza. Some fungi produce dense, hyphal mats that strongly bind the soil and organic matter (Molina 1994). Mycorrhizae increase the survival, growth and development of associated plants by performing essential physiological processes i.e. increased absorption surface, selective ion absorption and accumulation

(Jorgenson and Shoulders 1967; Marks and Kozlowski 1973), and help seedlings to resist infection by certain feeder root pathogens (Marx 1971). A single tree can host different species of mycorrhizal fungi and one fungus can be associated with different trees at the same time. Such type of multiple association forms an underground network of hyphae to connect fungi, trees and shrubs in the forest to share water and nutrients. In the present study, ten species were found associated with roots of higher trees forming mycorrhizal association while three species were found parasitic. High population of mycorrhizal and saprophytic species indicated the good health of the forest.

Table 1. List of macrofungi recorded in Jeypore reserve forest with uses and ecological relationship

Fungi	Family	Ecological relationship	Utilization	Frequency of occurrence	Density
Agaricus arvensis	Agaricaceae	Saprophyte	Edible	33.33	10.00
Lycoperdon pyriforme	Agaricaceae	Mycorrhizal	Edible	16.67	13.33
Coprinus disseminatus	Agaricaceae	Saprophyte	Non edible	50.00	66.67
Amanita pantherina	Amanitaceae	Mycorrhizal	Non edible	16.67	23.33
Auricularia auricula-judae	Auriculaceae	Dead wood	Edible, Medicinal	33.33	43.33
Boletus badius	Boletaceae	Mycorrhizal	Non edible	33.33	13.33
Cantharellus lateritius	Cantharellaceae	Saprophyte	Edible	33.33	20.00
Craterellus sp.	Cantharellaceae	Saprophyte, dead wood	Edible	33.33	20.00
Clavaria sp.	Clavariaceae	Saprophyte, dead & decaying wood	Non edible	16.67	6.67
Ganoderma lucidum	Ganodermataceae	Parasitic	Medicinal	16.67	6.67
Ganoderma applanatum	Ganodermataceae	Parasitic	Medicinal	16.67	10.00
Ramaria sp.	Gomphaceae	Saprophyte, dead wood	Edible	16.67	3.33
Laccaria bicolor	Hydnangiaceae	Mycorrhizal	Non edible	33.33	16.67
Phellinus gilvus	Hymenochaetaceae	Parasitic	Non edible	16.67	6.67
Marasmius androsaceus	Marasmiaceae	Saprophyte, plant debris	Non edible	16.67	10.00
Pleurotus sp.	Pleurotaceae	Dead wood	Edible	16.67	56.67
Panus fulvus	Polyporaceae	Dead and decaying wood	Edible	16.67	3.33
Earliella scabrosa	Polyporaceae	Dead wood	Non edible	33.33	16.67
Lentinus sp.	Polyporaceae	Dead wood stumps	Edible, medicinal	33.33	6.67
Microporus xanthopus	Polyporaceae	Dead wood	Medicinal	66.67	76.67
Pycnoporus sanguineus	Polyporaceae	Saprophyte, Dead wood	Non edible	66.67	20.00
Trametes versicolor	Polyporaceae	Wood decaying	Medicinal	83.33	120.00
Lactarius hygrophoroides	Russulaceae	Mycorrhizal	Edible	16.67	10.00
Russula amoena	Russulaceae	Mycorrhizal	Edible	33.33	36.67
R. delica	Russulaceae	Mycorrhizal	Edible	16.67	20.00
R. pectinata	Russulaceae	Mycorrhizal	Edible	33.33	13.33
R. nobilis	Russulaceae	Mycorrhizal	Edible	16.67	3.33
Schizophyllum commune	Schizophyllaceae	Dead wood	Edible, medicinal	83.33	126.67
Scleroderma sp.	Sclerodermataceae	Mycorrhizal	Edible	16.67	13.33
Xylaria polymorpha	Xylariaceae	Dead wood	Non edible	16.67	93.33

Table 2. List of mushroom species having medicinal uses

Mushroom species	Utilization	Reference
Ganoderma lucidum	Promotes health and longevity, lowers the risk of cancer and heart disease and boosts the immune system.	Wachtel-Galor et al. (2004)
Ganoderma applanatum	Antioxidant, hypoglycemic and antihypertension	Oyetayo (2011)
Microporus xanthopus	To stop a child from breast feeding	Chang and Lee (2004)
Xylaria polymorpha	To stop a child from bed wetting	Chang and Lee (2004)
Schizophyllum commune	Anti-candida, anti-tumor and anti-viral properties, antitumor, anticancer and immunomodulating activities	Wasser (2002); Kidd 2000
Auricularia auricula-judae	anti-diabetic, antitumor, antihypertensive, anti-inflammatory, immunomodulatory and antibacterial agents	Gurusamy and Arthe (2012)
Trametes versicolor	immunomodulatory and anti-cancer effects	Ramberg et al. (2010).
Pycnoporus sanguineus	Biodegrading textile dyes and lignosulphonates arthritis, gout, styptic, sore throats, ulcers, tooth aches, fevers, hemorrhages and antibacterial	Trovaslet et al. (2007); Eugenio et al. (2008)
Phellinus gilvus	Antiinflammatory, antitumor, antioxidant, antihepatotoxicity	Kim et al. (2011)
Marasmius androsaceus	Tendon relaxation, pain alleviation and antihypertension	Zhang et al. (2009)
Lentinus sp.	Protect from cancer, environmental allergies, fungal infection, frequent flu and colds, bronchial inflammation, heart disease, hyperlipidemia, hypertension, infectious disease, diabetes, hepatitis and regulating urinary inconsistancies	Bisen et al. (2010)

Figure 2. A. *Ganoderma lucidum*, B. *Ganoderma applanatum*, C. *Pycnoporus sanguineus*, D. *Auricularia auricula-judae*, E. *Schizophyllum commune*, F. *Microporus xanthopus*, G. *Trametes versicolor*, H. *Marasmius androsaceus*, I. *Xylaria polymorpha*

Only three species viz. *Ganoderma applanatum, G. lucidum* and *Phellinus gilvus* recorded in JRF were parasitic in nature. The pathogenic fungi directly kill or weaken the forest plants and decline the forest health and productivity. But fungal diseases also have positive influences on ecosystem productivity and biodiversity (Trappe and Luoma 1992). For example, the trees killed by diseases open the forest for the growth of light demanding plants. Standing dead trees also provide habitat for cavity-nesting birds and mammals. In boarder sense it is important to realize that pathogens below the threshold population are a natural component of the forest ecosystem and contribute to landscape diversity (Molina 1994).

Although the species of *Ganoderma* and *Phellinus* were recorded in some tree species but their population was very less. Beside their pathogenic nature, they are being used for the manufacture of various drugs by pharmaceutical companies. *G. lucidum* is well known to promote health and longevity, lowers the risk of cancer and heart disease and boosts the immune system (Wachtel-Galor et al. 2004) while the *G. applanatum* have antioxidant, hypoglycemic and antihypertension activity (Oyetayo, 2011). *P. gilvus* has been reported to have antiinflammatory, antitumor, antioxidant, antihepatotoxicity potential (Kim et al. 2011). Other medicinal mushrooms recorded in JRF includes *Microporus xanthopus, Pycnoporus sanguineus, Xylaria polymorpha, Schizophyllum commune, Auricularia auricula-judae, Trametes versicolor, Marasmius androsaceus* and *Lentinus* sp. (Table 2; Figure 2). Mushrooms in North eastern India sold in traditional markets or commercially exploited for food or medicines (Tanti et al. 2011). Gogoi and Sarma (2012) documented 12 macrofungal species from Dhemaji district of Assam with their ethnomycological utilization. Kumar et al.

(2013) described four medicinal mushrooms from Nagaland along with their nutrient contents.

CONCLUSION

The mushrooms grown in the wild plays an important role to maintain the forest health besides their medicinal importance and nutritional value. Therefore, it becomes quite necessary to explore, document and conserve this natural wealth. The present study provides a database on macrofungal diversity of Jeypore Reserve Forest, Assam, India along with their ecological preferences and utilization, which was not documented earlier.

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