CHAPTER-1

Study of seasonal diversity and ethnomedicinal uses of mushrooms in Gurguripal Ecoforest

1.1. Introduction

Ecoforestry has been defined as sustainable forestry or restoration forestry to maintain the productivity and ecological balance of a defined forest area on a sustainable basis (Rastogi 2003). An ecoforest emphasizes holistic approaches regarding sustainable harvesting to protect and restore ecosystems instead of maximizing economic productivity (Hammond 2003). Forest is considered as an ecosystem and it is dependent on all of the biotic and edaphic factors within itself. Forest soils are rich in organic carbon with other mineral nutrients favour the growth of fungi and soil-associated fungal flora plays a pivotal role in biodegradation of organic matters and nutrient cycling. Saprophytic fungi specially the macrofungi have been adapted for decomposing plant debris and leaf litter in forest ecosystem as they can produce enzymes capable of breaking down recalcitrant substances (Hyde et al. 2001). Thus they help to improve soil structure and fertility. Macrofungi has been categorized into many popular groups such as cup fungi, gilled fungi, bracket fungi, puffballs and truffles. These terms has coined according to their morphological uniqueness of the fruit body. According to ecological associations they can be classified into three groups namely saprophytes, parasites and symbionts (mycorrhizal). Most of the macrofungi occurring on terrestrial habitat are majorly saprophytic or mycorrhizal symbionts, whereas few are pathogenic on plants (Mueller et al. 2007). In particular, mushrooms are fleshy conspicuous fruit bodies of macrofungi that have been treasured over centuries because of their pleasant flavour and palatability (Da Silva 2005). Mushrooms grow on diverse habitats like fields, woods, forests, water channels, manure heaps, bunds and grassy grounds (Kues

and Liu 2000). Climatic and edaphic conditions favoured the occurrence and diversity of mushrooms in different seasons. Mushrooms are observed during the rainy season on the damp places having abundance of humus (Wisitrassameewong et al. 2014). Occurrence and abundance of mushroom species was found to be higher during August and September, while July and October displayed a lower number of mushroom in Eastern Uttar Pradesh (Singh and Prasad 2003). The varying number of mushroom species in different months is due to the variation in relative humidity, temperature range and amount of rainfall of the specific habitat. They are unique components of the biosphere and have been considered as one of the significant groups of plants concerned with human affairs throughout the development of civilization.

Concernness of mushrooms with the human society was begun from the prehistoric times. Earlier people considered fungi as gifts of God Osiris (Sharma 2003) and in ancient China, India and Iran mushrooms were specially used in ritualistic programs and performances (Lowy 1971). They have been used traditionally as folk medicine since the Neolithic and Palaeolithic eras (Samorini 2001). In Charaka Samhita (3000±500 BC), there are description about the utilization of mushrooms as food and medicine in India. Only a segment of total fungal prosperity has been subjected to scientific analysis and mycologists continue to unknot the unexplored treasure. Among the 14,000 known mushroom species throughout the world, nearly 7000 species are well-studied to possess varying degree of edibility, and over 3000 species belongs to 31 genera are considered as prime edible. So far only 200 species have been attempted for culture, among them 100 economically cultivated, approximately 60 commercially grown and nearly 10 achieved industrial importance (Chang and Miles 2004, Rai et al. 2005). The production of mushrooms has gained attention all over the world as cultivated mushrooms are available throughout the year and used in enormous quantities to serve with all kinds of table dishes. In India a substantial number of mushroom

species are sold in rural markets and some of them have been commercially utilised as food and medicine (Tanti et al. 2011). The number of poisonous mushrooms are reported as approximately 1%, but subsequently it has been estimated that approximately 10% may have poisonous effects and of these about 30 species are sorted out as lethal for human (Miles and Chang 1997, Deshmukh et al. 2006).

Mushrooms have been expansively studied in the western countries, while it is less explored in tropical country like India. Recent investigations from tropical forests revealed that mushroom diversity is greater in the tropical regions than temperate regions (Suryanarayanan et al. 2003). The Indian subcontinent possess several agro-climatic zones that influence the occurrence of divese mushroom flora. Approximately 850 mushrooms species were recorded in India (Deshmukh 2004). As per the recent studies it was evident that wild edible mushrooms are valuable sources of food as well as facilitates income generating livelihood in both developing and developed countries (Boa 2004). Purakayastha and Chandra (1985) have reported 283 edible mushrooms from India, out of which few are cultivated. The different types of wild mushrooms are consumed by the tribal communities as food or herbal medicines greatly vary with locality. India enhouses the largest tribal population (84.4 million) in the world and still these people are mostly dependent on forest. Still a large segment of tribal population depends on hunting and gathering of forest products for subsistence and survival of traditional folklore (Malhotra et al. 1993; Deb and Malhotra 1993). Wild edible mushrooms have both spiritual and socio- economic connections with tribal livelihood and the indigenous knowledge is a heritage that transmitted through generations (Pradhan et al. 2012).

Collection and scientific study of mushrooms in India really began during the 19th century (Kaul 2002). Traditional knowledge and ethnomycological aspects of mushrooms were studied by few workers in different regions of India such as Madhya Pradesh (Harsh et

al. 1993), Nagaland (Tanti et al. 2011), West Bengal (Dutta et al. 2013) and Northern Orissa (Panda and Tayung 2015). Study on wild edible mushrooms have also been reported from Assam (Baruah et al. 1971), Manipur (Sing and Sing 1993), Orissa (Sachan et al. 2013), Northwestern Himalaya (Semwal et al. 2014) and in Madhya Pradesh (Verma and Pandro 2018). Earlier, the use of wild mushrooms collected from Sal (*Shorea robusta)* forest by Santal tribes in lateritic segment of West Bengal was studied and documented by Pradhan et al. (2010; 2013). Several regional tribal communities like Santals, Lodha, Bhumija, Kol, Vil, Munda and Sabar live in and around Gurguripal ecoforest, Paschim Medinipur. They consumed and utilized wild mushrooms for sustaining their livelihood. The humid climatic condition in dense forest areas of Gurguripal, Paschim Medinipur, West Bengal favours the occurrence of mushrooms in natural habitat but no particular study about mushrooms in this region has been reported so far. In this regard, depending on the importance of mushrooms and chances of occurrence of valuable bioactive molecules, a continuous explorative study on mushrooms has been undertaken in Gurguripal ecoforest.

1.2. Materials and Methods

1.2.1. Study area

The study was conducted in and around Gurguripal ecoforest which is very much close to Medinipur municipal area of Paschim Medinipur district in West Bengal, India (Fig- 1.1). It is located at 22°25" - 35°8"N latitude, 87°13" - 42°4"E longitude and showing an altitude about 60 mt. This study area was represented as a sample area (16.3 sq. km) of the wole forest land of the district Paschim Medinipur due to similar type of forest flora, soil type and climatic conditions. The vegetation represents dry deciduous and semi-evergreen type of tropical forests, covered up predominantly by 'Sal' trees (*Shorea robusta* Roth.) and scrub jungles. Gurguripal ecoforest experiences a tropical

monsoon weather with distinct dry and wet seasons. The average temperature is 22 °C to 27 °C. In summer, the temperature remains within 30 °C to 40 °C whereas in winter it ranges from 10 °C to 16 °C. Gurguripal receives an average annual rainfall of 1500 mm as a result of the south west monsoon. This type of climate is quite favourable for production of fungi. This area is poorly developed and the major sources of livelihood for tribal people are hunting and gathering of natural products. The study was emphasized in and around tribal villages of deep forest pockets and weekly local markets (called 'hut') in different parts of Gurguripal. The tribal people collect fungi from this reserve forest for food and marketing purpose.

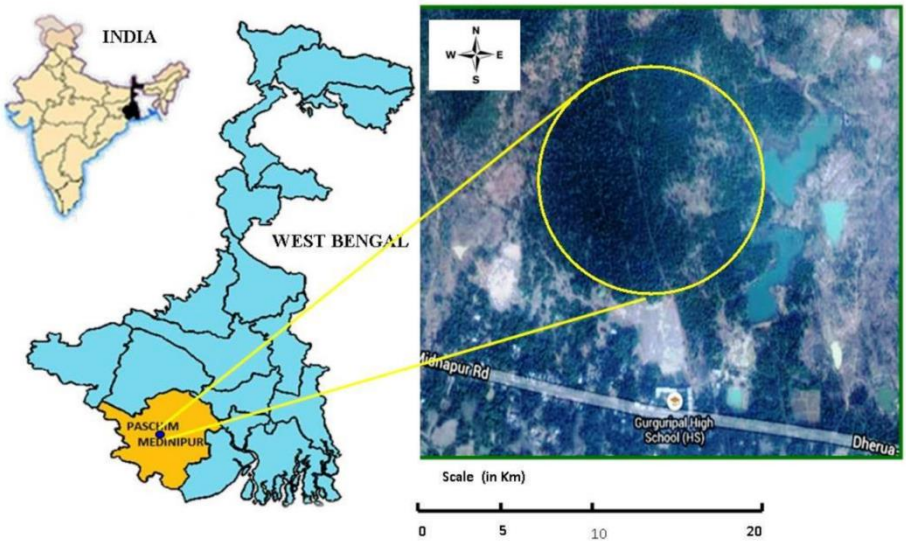


Fig 1.1 - Location of the study area (Gurguripal ecoforest, Paschim Medinipur, West Bengal, India)

1.2.2. Collection, identification and preservation of specimens

Systematic and periodical survey was undertaken during May 2015 to October 2017. For this survey, the opportunistic sampling of macrofungi protocol was followed (Mueller et al. 2004). The sampling method involved walking throughout the entire study area, recording

and collecting the mushroom specimens. Collection of the ground-dwelling mushrooms involved careful withdrawal of the fruit bodies from soil, while the tree-dwelling specimens were extracted by cutting off the basidiocarp from the substratum.

The specimens were collected under the supervision of local collectors and traditional healers from different habitats like damp pits, decaying woods, plant litters and termite nests in Gurguripal ecoforest. During the collection of specimens various equipments like hunting knife, digging tools and zipped polythene bags were used. Each macrofungal specimens was collected in separate specimen bags in order to avoid spore contamination among the different specimens and properly labelled with tags. Morphological features such as size, colour, shape and texture of the fruit bodies were recorded as these features might change with drying. Photographs of mushroom specimens from various angles were captured in their natural habitat.

During survey the morphological and ecological characteristics of mushroom specimens were properly noted by macroscopic and microscopic examinations and the identification were done through authentic identification manuals and standard literatures [Ransbottom (1965); Pegler (1983); Purkayastha and Chandra (1985); Singer (1986); Adhikari (2000); Acharya and Pradhan (2017); Robert et al. 2005]. Collected specimens were preserved in a mixture of liquid preservatives (rectified alcohol: formalin: distilled water = 25:5:70) and stored in the department of Microbiology, Vidyasagar University for further study.

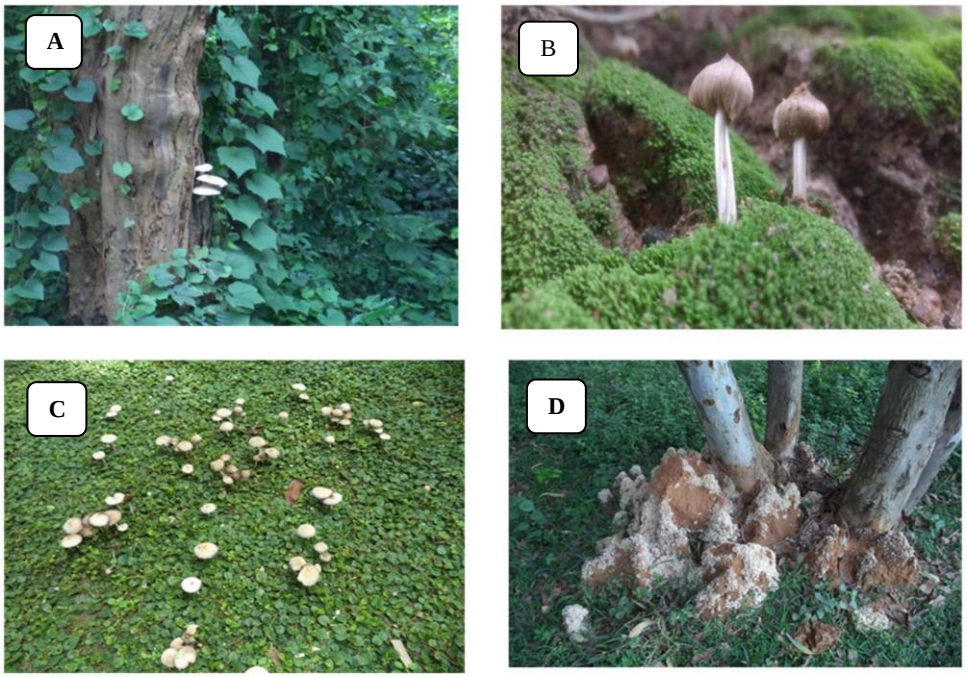


Fig 1.2- A, B, C, D- Occurrence of wild mushrooms in Gurguripal ecoforest

Fig 1.3 - A, B, C, D - Collection of mushroom specimens during field survey in Gurguripal ecoforest

Fig 1.4- A, B, C- Harvesting, D- Cooking of wild edible mushrooms by local tribal people in Gurguripal

Fig 1.5- Selling of mushrooms in markets nearby Gurguripal (A- *Termitomyces heimii*, B- *Astraeus hygrometricus*, C- *Volvariella volvacea*, D- *Amanita bisporigera*)

1.2.3. Statistical analysis of mushroom diversity

Statistical analysis of collected data was done using standard protocol to measure mushroom diversity indices of the study area.

- The occurrence frequency for each species was calculated by following formula (Aung et al. 2008).

Occurrence frequency of Taxon A = Taxon A / Total frequency of all species × 100

- Shannon diversity index for mushroom was calculated as proposed by Margalef (2008).

$H = - \Sigma (n/N) \log_e (n/N)$

[Where, H = diversity index, N = total number of individuals of all the species,

n = total number of individuals of the individual species.]

- Simpson Index of diversity was calculated as suggested by Simpson (1949).

Simpson Index of diversity =1-D

$D= \Sigma n (n-1)/N (N-1)$

[Where, n= Total number of organisms of a particular species, N= Total number of organism of all species]

- The evenness of the mushroom species was calculated according to Pielou (1996), considering the values of diversity index,

$E = H/\ln (S)$

[Where, E = species evenness, H = Shannon index, S = the number of species.]

1.2.4. Ethnomycological survey

An ethnomycological survey was conducted during the study and the information was collected through semi-structured questionnaires based on local names, habitat, abundance, edibility, medicinal applicability and spiritual beliefs if any of mushrooms among the different native tribal communities of this region separately. In total 166 peoples of 9 villages

belonging to different age groups were interviewed and the collected information were verified by cross questioning the informants like village elders, traditional healers of the same locality. Moreover, the healers of different tribal communities were asked to state the name, diagnosis and treatment of diseases along with the methods of preparation and administration of different medicinal mushrooms. The interpretations with tribal people have been analyzed and the responses grouped into classes expressing similar knowledge. The market transaction and business information regarding mushrooms were also noted through interactions with mushroom collectors and sellers. Moreover, the use value (UV) of each mushroom species was calculated by the formula UV= U/N, where, U= the number of citations of each species; N= number of informants (Trotter and Logan 1986).

1.3. Results and Discussions

1.3.1. Distribution frequency

In the present research work, a total number of 2031 of mushroom specimens (individuals) were observed in Gurguripal ecoforest after field studies. Altogether, 67 mushroom species in 44 genera belonging to 27 families under 10 orders (Hibbett et al. 2007) were noted (Table- 1.1). Among the studied mushroom species 34 were reported to be edible and 9 of them namely *Agaricus* sp., *Amanita bisporigera*, *Astraeus hygrometricus*, *Cantherallus* sp., *Termitomyces medius*, *Pleurotus ostreatus*, *Schizophyllum commune*, *Termitomyces heimii* and *Volvariella volvacea* found to be prime edible. Whereas 31 species were found to be non edible and 2 reported as poisonous. In addition, 19 species were medicinally important. The total mycota in this area are dominated by the family Russulaceae (16.4%) followed by Tricholomataceae (11.9%) and Boletaceae (8.95%) represented by 11, 8 and 6 species respectively (Fig. 1.6). Other species belonged to the families Hypocreaceae, Xylariaceae, Agaricaceae, Coprinaceae, Pleurotaceae, Schizophyllaceae, Amanitaceae, Pluteaceae, Lyophyllaceae, Mycenaceae, Marasmiaceae, Nidulariaceae, Sclerodermataceae,

Diplocystaceae, Suillaceae, Clavariaceae, Auriculariaceae, Cantharellaceae, Hymenochaetaceae, Polyporaceae, Coriolaceae, Ganodermataceae, Fomitopsidaceae and Auriscalpiaceae were listed in Table 1.1. In addition, during the survey the highest number of individuals were noted for *Astraeus hygrometricus* (311) followed by *Termitomyces microcarpus* (181) and *Termitomyces heimii* (177). According to FAO (2004), the genera like *Russula* and *Termitomyces* occur abundantly in tropical regions of the globe.

During the field survey the diversity and abundance of wild mushrooms were mostly observed during rainy season. Diversity of an area is greatly influenced by the environmental conditions which lead to the variation in occurrence of mushrooms in various seasons. In the nature mushrooms grow on variety of substrates, most oftenly those containing lignin and cellulose, generally abundant during the rainy season. In the months of July and August (mid rainy season) the environmental conditions are very favourable for the growth of various macrofungi. Some woody macrofungi were observed during the months of September and October (late rainy season) (Table- 1.2). According to their habitat, 9 were parasitic (grows on living trees), 34 saprophytic (terrestrial or on humus), 24 mycorrhizal (with trees and termite nests) (Fig-1.7). The occurrence and abundance of different mushroom species in different seasons revealed that the rate of decomposition of plant parts and products on forest floor greatly depends on climatic factors. Earlier, Kumar et al. (2013) has opined that the abundance of macrofungi on different substrate greatly depends upon the organic and nitrogenous content of the soil and also on the other nutrients factors which plays key role in the growth of fungi. Whereas leaf litters, dead and decayed plant residues provides the necessary organic carbon for the growth of wild fungi (Swer et al. 2011).

In 2011, Kumar and Sharma has reported 66 species belonging to 33 genera of 22 families in Jammu and Kashmir. A total number of 15 wild edible mushrooms of Nagaland, India were described by Kumar et al. (2013). Borkar et al. (2015) had found 29 mushroom

species from different families spread over Konkan region of Maharashtra, India. In Gorakhpur district, Uttar Pradesh, India 114 species belonging to 58 genera of 33 families were reported by Vishwakarma et al. (2017). Previously, Pradhan et al. (2013) has reported about mushroom diversity in different parts of West Bengal, Bagchi and Banerjee (2013), Bagchi (2018) mentioned the diversity of endophytic fungi from different forest regions in Paschim Medinipur.

In this regard, the present study explored the abundant occurrence of wild mushrooms in Gurguripal ecoforest and the species namely *Hypomyces chrysospermus* Tul & C.Tul, *Collybia tuberosa* (Bull) P.Kumm, *Lepista flaccida* (Sowerby) Pat., *Mycena* sp., *Tylopilus alboater* (Schwein.) Murrill, *Tylopilus violatinctus* T.J.Baroni & Both., *Scleroderma verrucosum* (Bull.) Pers, *Suillus* sp., *Lactarius piperatus* (L.) Pers., *Lentinellus cochleatus* (Pers.) P. Karst were first time reported from Paschim Medinipur, West Bengal.

Table 1.1 - Distribution of mushroom species in Gurguripal ecoforest (E= Edible,NE= Non edible, P= Poisonous)

Order	Family	Scientific Name	Ecological association	Fructification time	Edibility
Hypocreales	**1. Hypocreaceae**	1. *Hypomyces chrysospermus* Tul & C.Tul	Parasitic	Jun-Sep	NE
Xylariales	**1. Xylariaceae**	1.*Daldinia concentrica (*Bolton) Ces & De Not	Saprophytic	Jun-Sep	NE
		2. *Xylaria longipes* Nitschke	Saprophytic	Jun-Aug	NE
Agaricales	**1.Agaricaceae**	1. *Leucocoprinus brinbaumii* (Corda) Singer	Saprophytic	Jun-Sep	NE
		2. *Macrolepiota procera* (Scop.) Singer	Saprophytic	Jun-Sep	E
		3. *Lycoperdon pyriforme* Willd.	Parasitic	Jul-Sep	E
		4. *Agaricus* sp.	Saprophytic	Jun-Sep	E
	2.Coprinaceae	1. *Coprinopsis lagopus* (Fr.) Redhead, Vilgalys & Moncalvo	Saprophytic	Jun-Jul	NE
		2. *Coprinus* sp. (KGFM 08)	Saprophytic	Jun-Sep	NE
		3. *Coprinus* sp. (KGFM 75)	Saprophytic	Jun-Sep	NE
	3.Pleurotaceae	1. *Pleurotus ostreatus* (Jacq.) P. Kumm.	Saprophytic	Jun-Sep	E
	4.Schizophyllaceae	1. *Schizophyllum commune* Fr.	Saprophytic	Jun-Sep	NE
	5. Tricholomataceae	1. *Collybia tuberosa* (Bull) P.Kumm	Saprophytic	Jun-Sep	NE
		2. *Lepista flaccida* (Sowerby) Pat.	Saprophytic	Jun-Sep	E
		3. *Lepista* sp.	Parasitic	Jun-Aug	E
		4. *Calocybe indica* Purkayastha &A.Chandra	Saprophytic	Jun-Aug	E
		5. *Laccaria laccata* (Scop) Cooke	Mycorrhizal	Jun-Aug	NE
		6. *Hygrocybe* sp.	Parasitic	Jul-Aug	E
		7. *Clitocybe* sp.	Saprophytic	Jun-Sep	E
		8. *Clitocybe subconnexa* Murrill	Saprophytic	Jun-Sep	E
	6.Amanitaceae	1. *Amanita populiphila* Tulloss & E. Moses.	Mycorrhizal	Jul-Aug	P
		2. *Amanita* sp.	Mycorrhizal	Jun-Sep	P
		3. *Amanita bisporigera* G.F.Atk	Saprophytic	Jul-Aug	E

	7.Pluteaceae	1. *Volvariella volvacea* (Bull) Singer	Saprophytic	Aug-Sep	E
	8.Lyophyllaceae	1. *Termitomyces medius* R heim & Grasse	Saprophytic	Jul-Aug	E
		2. *Termitomyces microcarpus* (Berk & Broome) R.Heim	Saprophytic	Jul-Aug	E
		3. *Termitomyces heimii* Natarajan	Saprophytic	Aug-Sep	E
		4. *Termitomyces clypeatus* R.Heim	Saprophytic	Jul-Aug	E
	9.Mycenaceae	1. *Mycena* sp.	Parasitic	Jun-Sep	E
	10.Marasmiaceae	1. *Marasmius* sp.	Saprophytic	Jul-Aug	NE
	11.Nidulariaceae	1. *Cyathus stiratus* (Huds) Willd.	Saprophytic	Jul-Sep	NE
Boletales	**1.Boletaceae**	1. *Boletus edulis* Bull.	Mycorrhizal	Jun-Sep	E
		2. *Porphyrellus malaccensis* (Pat. & C.F.Baker) Singer	Mycorrhizal	Jul-Sep	NE
		3. *Boletus* sp. (KGFM 47)	Mycorrhizal	Jun-Sep	E
		4. *Tylopilus alboater* (Schwein.) Murrill	Mycorrhizal	Jun-Sep	NE
		5. *Tylopilus violatinctus* T.J. Baroni & Both	Mycorrhizal	Jun-Sep	NE
		6. *Boletus* sp. (KGFM 110)	Mycorrhizal	Jun-Sep	E
	2.Sclerodermataceae	1. *Scleroderma verrucosum* (Bull.) Pers	Saprophytic	Jun-Sep	NE
		2. *Pisolithus arhizus* (Scop.) Rauschert	Saprophytic	Jun-Aug	NE
	3. Diplocystaceae	1. *Astraeus hygrometricus* (Pers) Morgan	Mycorrhizal	Jul-Aug	E
	4. Suillaceae	1. *Suillus* sp.	Mycorrhizal	Jun-Sep	NE
Gomphales	**1. Clavariaceae**	1. *Ramaria fumigata* (Peck.) Corner	Mycorrhizal	Jul-Aug	NE
		2. *Clavulina cristata* (Holmsk) J.Schrot	Mycorrhizal	Jun-Sep	E
		3. *Clavaria* sp.	Saprophytic	Jun-Aug	E
Auriculariales	**1. Auriculariaceae**	1. *Auricularia auricula* (Bull) J.Schrot	Saprophytic	Jul-Sep	E
Cantharellales	**1. Cantharellaceae**	1. *Cantharellus* sp.	Mycorrhizal	July-Aug	E
Hymenochaetales	**1. Hymenochaetaceae**	1. *Phellinus rimosus* (Berk.)Pilat.	Saprophytic	Jun-Aug	NE

Polyporales	**1. Polyporaceae**	1. *Coriolopsis occidentalis* (Klotzsch) Murrill	Saprophytic	Jul-Oct	NE
		2. *Polyporus* sp.	Parasitic	Jun-Sep	NE
		3. *Pycnoporus sanguineus* (L.) Murrill	Parasitic	Jul-Aug	E
	2. Coriolaceae	1. *Trametes* sp.	Parasitic	All Year	NE
		2. *Irpex* sp.	Saprophytic	Aug-Oct	NE
	3.Ganodermataceae	1. *Ganoderma* sp.	Saprophytic	Jun-Sep	NE
		2. *Ganoderma lucidum* (Curtis) P.Karst	Saprophytic	Jun-Aug	NE
	4. Fomitopsidaceae	1. *Grifola frondosa* (Dicks.:Fr.) S.F. Gray.	Saprophytic	Jul-Aug	E
Russulales	**1. Russulaceae**	1. *Russula rosea* (Pars.)	Saprophytic	Jun-Sep	NE
		2. *Lactarius gerardii* Peck.	Mycorrhizal	Jun-Sep	E
		3. *Russula emetica* (Schaeff.) Pers	Mycorrhizal	Jun-Sep	NE
		4. *Russula* sp.	Mycorrhizal	Jul-Sep	E
		5. *Russula albonigra* (Krombh) Fr.	Mycorrhizal	Jun-Sep	E
		6. *Russula laurocerasi* Melzer	Mycorrhizal	Jun-Sep	NE
		7. *Lactarius* sp.	Mycorrhizal	Jul-Sep	E
		8. *Russula senecis* S.Imai	Mycorrhizal	Jul-Sep	E
		9. *Lactarius piperatus* (L.) Pers.	Saprophytic	Jul-Aug	NE
		10. *Russula mairei* Singer	Mycorrhizal	Jun-Sep	NE
		11. *Russula cyanoxantha* (Schaeff.) Fr.	Mycorrhizal	Jul-Aug	E
	2.Auriscalpiaceae	1. *Lentinellus cochleatus* (Pers.) P. Karst.	Parasitic	Jul-Sep	E

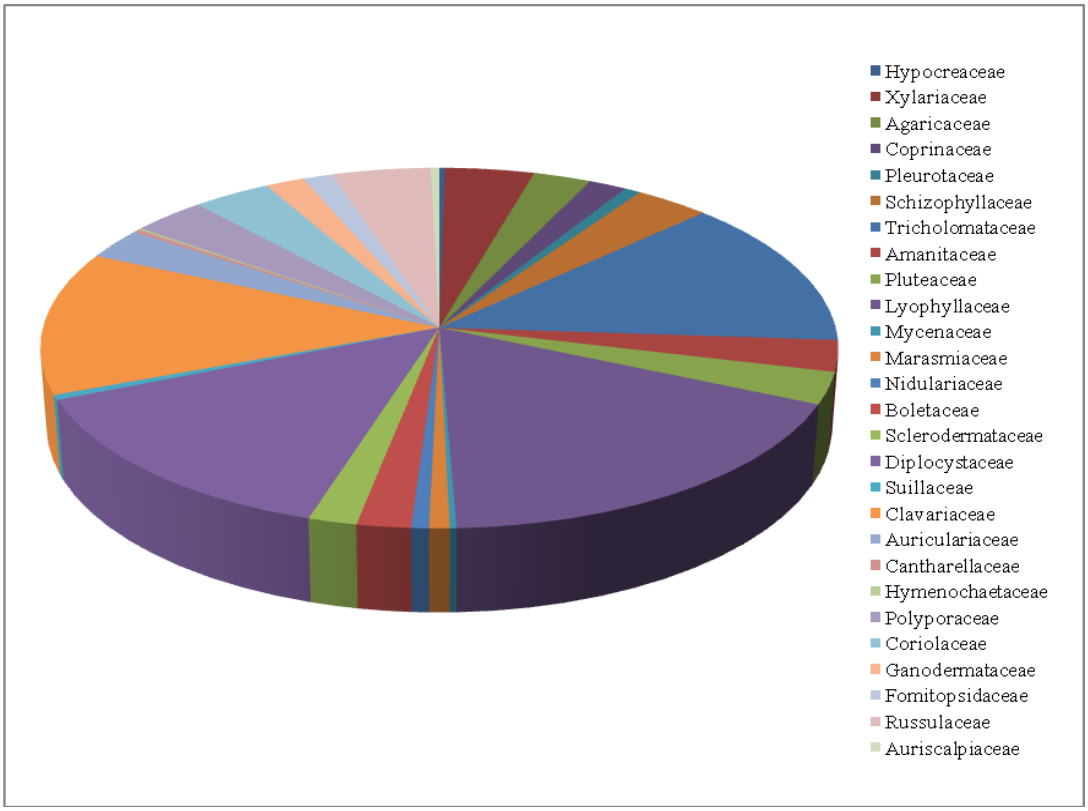


Fig 1.6 - Family wise distribution of mushroom in Gurguripal ecoforest

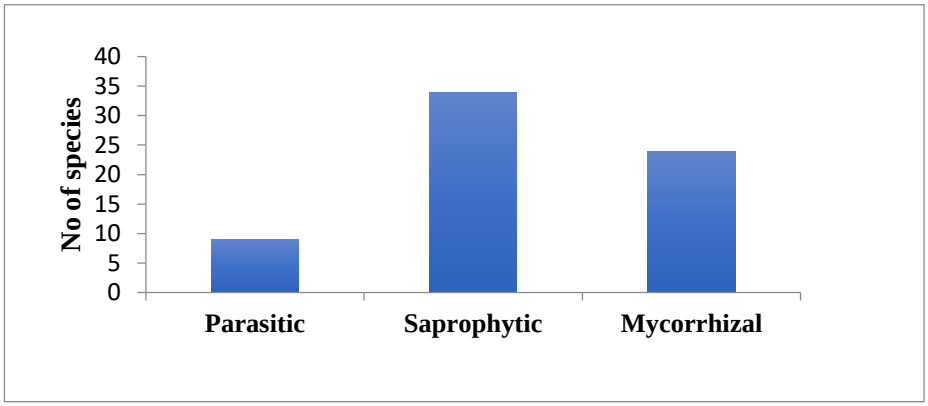


Fig 1.7 - Distribution of mushrooms on different habitat in Gurguripal ecoforest

Collection No. - KGFM 01

Scientific Name - *Amanita populiphila* Tulloss & E. Moses.

Family - Amanitaceae

Occurrence – Found in lateritic soil with association of *Shorea robusta* (Sal Tree).

Brief Description - The fruit body fleshy, consists of cap, gills and stalk and volva. Cap convex shaped, surface shiny when young becoming dull at maturity, smooth, striated margin, whitish to greyish in color, 25-50 mm in diameter. Gills also whitish, with minimum spacing, entire margin, 4.0-7.0 mm wide. Stalk centrally positioned, cylindrical, tapered towards apex, hollow, surface dull, 60-90 mm long. Volva white, membranous, covering stalk from base, saccate. Ring also found here, which membranous and persistent.

Collection No. – KGFM 02

Scientific Name - *Lentinellus cochleatus* (Pers.) P. Karst.

Family - Auriscalpiaceae

Occurrence – Found upon wood logs, fallen woods.

Brief Description - The fruit bodies are fleshy, consists of cap, gills and stalk. Cap mainly reddish brown to light brown in color, irregular, funnel shaped, edged spiraled, 3-8 cm broad. Gill mainly cream colored, decurrent, very crowded. Stalk centrally placed, connate at base, hollow, reddish brown in color, 2-10 cm in long, flesh, leathery, thin, and tough.

Collection No. - KGFM 03

Scientific Name – *Amanita* sp.

Family - Amanitaceae

Occurrence – Found in lateritic soil, associated with various trees.

Brief Description - The fruit bodies are fleshy, consist of cap, gills and stalk. Cap is globose to subglobose become flattened persistent, wide, shiny, smooth, entire margin, 5-12 cm in diameter. Gills are soft, free from stem, crowded regular, pure white in color. Stalk is cylindrical, white, centrally placed, smooth, 10-20 cm long. Sack like volva are present buried in soil, spore white.

Collection No. - KGFM 04

Scientific Name- *Astraeus hygrometricus* (Pers.) Morgan

Family- Diplocystaceae

Occurrence – Found in lateritic soil with association of *Shorea robusta* (Sal).

Brief Description - The fruit bodies are subglobose, sessile, becoming star shaped and comes above ground at maturity. Fruit body 4.0-6.5 cm broad, 1-3 cm in diameter. The outer surface of fruit body white in color, hard and hygroscopic, rays arching downwards when in damp condition. The inner surface is also white in young condition, becoming greyish brown atmaturity. It dehisced epically by longitudinal slit.

Collection No. - KGFM 05

Scientific Name - *Clavaria* sp.

Family - Clavariaceae

Occurrence – Found in humus soil in clusters.

Brief Description -The fruit bodies are cylindrical, mainly unbranched or sometimes from bifurcake branches at the tip portion 2-20 cm in height, 1-5 mm wide. The branches are yellowish or pale brownish in color, dry or moist, often curved flattened and pointed out from ground level.

Collection No. - KGFM 06

Scientific Name - *Russula albonigra* (Krombh.) Fr.

Family - Russulaceae

Occurrence – Found in lateritic soil with association of *Shorea robusta* (Sal Tree).

Brief Description -The fruit bodies are convex shaped when young and later having central depression at maturity. Fruit body consists of Cap, Gill and Stalk. Cap creamy in color, up to 3-6 cm in diameter with entire margin. Gills are much erowded, 1-3 mm wide, creamy in color becoming blackish when exposed. Stalk straight, central 2-5.5 cm long, semi- solid, creamy white color, becoming blackish when mature.

Collection No. - KGFM 07

Scientific Name - *Collybia tuberosa* (Bull.) P. Kumm.

Family - Tricholomataceae

Occurrence – Found upon fallen wood logs.

Brief Description -The fruit bodies are fleshy, consist of cap, gill and stalk. Cap convex shaped, margin curved downwards, pure white in color, dry and silky, 1-4 cm broad. Gills very crowded, white to creamy in color, adnate. Stalk hollow, cylindrical, slightly curved, flexible, centrally placed, white, 4-10 cm long, and spore white.

Collection No. - KGFM 08

Scientific Name - *Coprinus* sp.

Family - Coprinaceae

Occurrence – Found in humus soil.

Brief Description - The fruit bodies are fleshy, consist of cap, gill and stalk. Cap cylindrical to bell shaped, whitish in color, with greyish centre, 5-15 cm in diameter. Gills free from the stem, whitish in color, placed very crowded. Stalk centrally placed, smooth, white. Hollow, 4-20cm long.

Collection No. - KGFM 11

Scientific Name - *Pisolithus arhizus* (Scop.) Rauschert

Family - Sclerodermataceae

Occurrence – Found in loamy lateritic soil associated with *Eucalyptus* and *Acacia*

Brief Description- The fruit bodies are globose to subglobose, solid to semisolid, 3-13 cm in diameter whitish to yellowish when young becoming brown at maturity. Fruit body with irregular false stalk, 1.5-6 cm, sterile with cap, smooth, arising from base with whitish and yellowish in color. Spore bearing gleba are firm becoming pulverulent with many chambered yellowish brown spore sacks.

Collection No. - KGFM 16

Scientific Name - *Lepista flaccida* (Sowerby) Pat.

Family - Tricholomataceae

Occurrence – Found upon ground litter.

Brief Description - The fruit bodies are consist of cap, gill and stalk. The caps are flattened, greyish in color, funnel shaped at maturity, developed darker spots with age, 3-10 cm in diameter, upper surface in malt and silky. Gills are decurrent crowded, pale brownish in color. Stalk upto 3-8 cm long, cylindrical, broad at fare, smooth.

Collection No. - KGFM 17

Scientific Name - *Calocybe indica* Purkayastha & A. Chandra

Family- Tricholomataceae

Occurrence – Found in coastal part, grows at base of palm tree.

Brief Description- The fruit bodies are at first convex shaped, later flattened, white in color. Fruit body consist of Cap, Gills and Stalk. Cap 8-18 cm in diameter with regular margin, incurved, smooth, non- striate. Gills white, unequal crowded, emarginated stalk cylindrical, hollow at base, upto 15 cm long, white, without ring and volva.

Collection No. - KGFM 18

Scientific Name - *Lactarius* sp.

Family - Russulaceae

Occurrence – Found in lateritic soil with association of *Shorea robusta* (Sal Tree).

Brief Description - The fruit bodies are fleshy, consist with cap, gill and stalk. Cap broadly convex shaped, smooth, margin also smooth, deep reddish to reddish orange in color, 3.5-6 cm broad. Gills regular, reddish to orange in color, edge entire, 3-4 mm width. Stalk centrally placed, cylindrical to subcylindrical, hollow, smooth, broad at the base, 4-7 cm long.

Collection No. - KGFM 19

Scientific Name - *Russula sp.*

Family - Russulaceae

Occurrence - Found in lateritic soil with association of *Shorea robusta* (Sal Tree), also grow in soil.

Brief Description-The fruit bodies are fleshy, consist of cap, gill and stalk. Cap creamy to yellowish white in color, smooth surface when young become cracked at maturity, 30-55 mm broad. Gills regular, also creamy in color, closely placed. Stalk centrally placed, cylindrical sub-cylindrical, straight to slightly curved, whitish- creamy in color, 25-35 mm long.

Collection No. - KGFM 20

Scientific Name - *Clavulina cristata* (Holmsk.) J. Schröt

Family- Clavariaceae

Occurrence - Found in lateritic soil with association of *Shorea robusta* (Sal Tree).

Brief Description-The fruit bodies are generally white to cream coloured, branched radially to polychotomous fashion, 2-6 cm tall with 0.5-3.5 cm broad with a basal trunk. The coral arms sparingly branched, smooth and sometimes wrinkled longitudinally. The branches are short and cristate, having small pointed projections, fleshy white to white in color.

Collection No. - KGFM 21

Scientific Name - *Laccaria laccata* (Scop.) Cooke

Family - Tricholomataceae

Occurrence - Found in lateritic soil with association of *Shorea robusta* (Sal Tree).

Brief Description - The fruit bodies are consist of cap, gill and stalk. Cap smooth, surface dry, infundibuliform in at maturity, 5-20 mm in diameter, creamy in color. Gills pinkish creamy in color, wavy margin, crisped, 1-2 mm wide. Stalk compressed and hollow, centrally situated, creamy in color with dull surface, without any ring and volva.

Collection No. - KGFM 23

Scientific Name - *Volvariella volvacea* (Bull.) Singer

Family - Pluteaceae

Occurrence – Found on rotten heap of straw.

Brief Description - The fruit bodies are fleshy, consist of cap, gill and stalk and volva. Cap convex or hemispheric, smooth margin striated, whitish in color. 3.5-5.5 cm diameter. Gills regular pinkish brown in color, crowded, up to 5 mm in width. Stalk centrally positioned. Slightly curved, whitish in color, smooth, tapered at base, 3.5- 6.5 cm long. Volva sac like membranous, persistent. Ring absent.

Collection No. - KGFM 24

Scientific Name - *Amanita bisporigera* G. F. Atk.

Family - Amanitaceae

Occurrence – Found in lateritic soil, on the floor of *Shorea robusta* dominated region

Brief Description - The fruit bodies are fleshy to brittle, consist of cap, gill and stalk and volva. Cap broadly convex to planar in age smooth pure white, discoloring becoming age, 5-13 cm in diameter. Gills free, white, closely placed, (stalk cylindrical, white, tapering at the apex) enlarged at base, 5.5- 2 cm long. Volva also white, membranous encasing the base, smooth.

Collection No. - KGFM 25

Scientific Name – *Suillus* sp.

Family - Suillaceae

Occurrence - Found in lateritic soil with association of *Shorea robusta* (Sal Tree).

Brief Description - The fruit body consist of convex shaped cap which is orange brown in color, scaly surface, dry, 5-15 cm in diameter. Small pores are brown to olive brown in color found underside of cap, 1 mm across stalk yellowish to brownish in color, club shaped, swollen in many places, solid smooth, 5-10 cm long. Spores brownish olive.

Collection No. - KGFM 26

Scientific Name- *Termitomyces microcarpus* (Berk & Broome) R. Heim

Family - Lyophyllaceae

Occurrence – Found in termite mounds, associate with termites.

Brief Description -The fruit bodies consist of cap, gill and stalk. Cap globose to subglobose, plain with slight knob, whitish, smooth and shiny upto 2-9 mm in diameter. Gills are also whitish, short with even margin, brittle, cylindrical. Smooth and shiny, bulbous at base without ring and volva.Volva free to partly adnexed. Stalk central , whitish , cylindrical, base with bulbous shape, surface smooth.

Collection No. - KGFM 27

Scientific Name- *Termitomyces clypeatus* R. Heim

Family- Lyophyllaceae

Occurrence - Found near the termite nests in group.

Brief Description - The fruit bodies are fleshy, consist of cap, gill and stalk. Cap with reflexed margin at maturity, greyish brown in color, smooth, silky, 4-9 cm in diameter. Gills white crowded, 2-5 mm wide. Stalk usually centrally placed, solid, white in color, become bulbous near soil surface, up to 10 cm long.

Collection No. - KGFM 28

Scientific Name - *Russula senecis* S. Imai

Family - Russulaceae

Occurrence – Found in lateritic soil association with *Shorea robusta* (Sal).

Brief Description - The fruit bodies are fleshy consist of cap, gills and stalk. Cap convex shaped in young stage, becoming planar with maturity, yellow brownish to brick color with smooth surface.Striated margin, 3-7 cm in diameter. Gills are forked, creamy becoming yellowish at maturity with 1-2 mm in spacing. Stalk centrally situated fleshy, hollow, cream to brownish in color, 3-8 cm long.

Collection No. - KGFM 29

Scientific Name - *Xylaria longipes* Nitschke

Family- Xylariaceae

Occurrence – Found in decaying wood logs.

Brief Description- Fruit bodies are club shaped, with round tip, greyish when young, blackish at maturity, 3-10 cm tall. Fruit bodies are having stalk, it is long or short, 2-6 cm tall. The top is rounded.The colour of the fruit body surface varies with age. Fruit body has slender and distinct stalk.

Collection No. - KGFM 33

Scientific Name - *Cantharellus* sp.

Family - Cantharellaceae

Occurrence – Found in lateritic soil.

Brief Description- The fruit bodies are small, trumpet like structure, umbilicate, margin expanded, curled, and orange to deep orange in color. 2-6 cm in diameter. Hymenium from cap edge, smooth, shallow venetion, pale orange in color. Stalk short, pale yellow, hollow, shiny, 5-8 cm long.

Collection No. - KGFM 34

Scientific Name - *Lactarius piperatus* (L.) Pers.

Family - Russulaceae

Occurrence – Found in rotten wood.

Brief Description- The fruit bodies are fleshy, consist of cap, gills and stalk. Cap whitish, convex, when young, flattening at maturity, surface dry, entire margin, 5-14 cm in diameter. Gills white to pinkish in color. Slightly decurrent, forked near stipe. Stalk is also whitish in color cylindrical, smooth, 3-8 cm long.

Collection No. - KGFM 37

Scientific Name - *Ganoderma* sp.

Family- Ganodermataceae

Occurrence – Found in the base of trunks and roots of hard woods.

Brief Description - The fruit bodies are planner, fan shaped, laterally stalked, orange red to dark reddish brown in color, upper surface with thin varnished crushed, acute margin, 8-17 cm broad, the stalk generally short up to 5-11 cm, woody, dark purple brown in color.

Collection No. - KGFM 39

Scientific Name - *Clitocybe* sp.

Family - Tricholomataceae

Occurrence – Found on forest ground litter

Brief Description -The fruit bodies are consist of cap, gills and stalk. The cap pure white in color, convex, becoming flattened in maturity, margin in curved, 3-8 cm in diameter. Gills white to pinkish in color found quite distinctly, decurrent regular. Stalk also whitish in color, cylindrical, centrally placed, broad at base, 4-8 cm long, sparse white.

Collection No. - KGFM 41

Scientific Name - *Russula cyanoxantha* (Schaeff.) Fr

Family- Russulaceae

Occurrence – Found in lateritic soil association with *Shorea robusta* (Sal).

Brief Description - The fruit bodies are fleshy, consist of cap, gills and stalk. Cap convex shaped, purple to dark purple in color, margin splits at maturity, 5-16 cm in diameter. Gills white, bifroked at base, closely situated. Stalks centrally situated white, cylindrical, yellowish to whitish in color, 10-30 mm tall.

Collection No. - KGFM 42

Scientific Name - *Russula rosea* (Pars.)

Family - Russulaceae

Occurrence – Grow in humus soil.

Brief Description -The fruit bodies are fleshy, consist of cap, gills and stalk. Cap is mostly bright red to carmine red in color, edge entire convex shaped, flattened when mature, 3-12 cm in diameter. Gills are pale straw yellow in color, brittle, crowded, forked near stripe. Stalk also white hard, cylindrical, broad at base, 3-9 cm, long.

Collection No. - KGFM 44

Scientific Name - *Hygrocybe* sp.

Family - Tricholomataceae

Occurrence – Found on the lateritic soils.

Brief Description - The fruit bodies are consist of cap, gills and stalk. Caps are yellowish to reddish Orange in colour, initially convex shaped, later flattened at maturity, margin in curved, 1-3.5 cm in diameter. Gills regular, crowded, and whitish in color becoming yellowish. Stalk is long, cylindrical. Then orange to yellowish in color, 4-7 cm long. Spores are white.

Collection No. - KGFM 45

Scientific Name - *Phellinus rimosus* (Berk.) Pilat

Family - Hymenochaetaceae

Occurrence – Found in dead and living woods.

Brief Description- The fruit bodies are perennial, woody, semi-circular shaped. The margin is sharp to rounded, upper surface dark brown in color up to 8-15 cm wide and 2-7 cm thick. The upper surface of fruit body cracks up into irregular polygon. Pores are present, thin walled when young and gradually becoming dense and thicker.

Collection No. - KGFM 47

Scientific Name - *Boletus* sp.

Family - Boletaceae

Occurrence – Found in association with various trees on lateritic soil.

Brief Description - The fruit bodies are consist of bun shaped cap, which is smooth, greasy, orange yellow in color, margin smooth, 2-8 cm broad. Pores are yellow olive in color, forming tubes found underside of the cap. Pores are fine and rounded. Stalk yellow to orange in color, smooth, cylindrical to barrel shaped, solid, 5-9 cm long, spores olive brown.

Collection No. - KGFM 48

Scientific Name- *Lactarius gerardii* Peck.

Family- Russulaceae

Occurrence – Found in lateritic soil, association with *Shorea robusta* (Sal).

Brief Description - The fruit bodies are fleshy, consist of cap, gills and stalk. Cap smooth, creamy to whitish in color, margin smooth, 1.5-3.5 mm thick. Gills also creamish in color, milky to watery latex oozes out through broken gill, edged entire with 2.5-4.5 mm spacing. Stalk centrally positioned, slightly curved, hollow, flesgy, smooth, greyish to whitish in color, 3-6.5 cm long.

Collection No. - KGFM 49

Scientific Name - *Tylopilus alboater* (Schwein.) Murrill

Family - Boletaceae

Occurrence - Found in lateritic soil, association with *Shorea robusta* (Sal).

Brief Description - The cap is convex shaped, becoming flattened at maturity, velvety black to dark greyish brown, 3-18 cm in diameter, pores are found underside of the cap are small and pinkish. Spores are produced in basidia in layer of tubes on the underside of cap creates pores. Stalk blackish in color, cylindrical, swollen at center, solid, smooth, 3-10 cm long.

Collection No. - KGFM 51

Scientific Name - *Macrolepiota procera* (Scop.) Singer

Family - Agaricaeae

Occurrence – Found on humus soil upon fallen woods.

Brief Description -The fruit body consist of cap, gills and stalk. Cap whitish in color which break up into large scales, margin slightly inwords, oval shaped, 8-22 cm broad. Gills whitish turning darker at maturity, free crowded, soft, stalk also white in color, solid, cylindrical, smooth, 4-10 cm long, spores white.

Collection No. - KGFM 52

Scientific Name - *Ganoderma lucidum* (Curtis) P.Karst

Family - Ganodermataceae

Occurrence – Found in the base of trunks and roots of hard woods.

Brief Description - The fruit body is planar, fan shaped, laterally stalked, orange red to dark reddish brown in color upper surface with thin varnished crushed, acute margin, 8-17 cm broad. The hymenium layer creamy white at first becoming light buff in color, poroid, pure circular to angular, 3-6 per mm. stalk generally short up to 8 cm, woody, dark purple brown in color.

Collection No. - KGFM 54

Scientific Name - *Leucocoprinus birnbaumii* (Corda) Singer

Family - Agaricaceae

Occurrence – Found upon dead and decaying plants, grow solitarily.

Brief Description - The fruit bodies are fleshy, consist of cap, gills and stalk. Cap globose to subglobose, conical wit smooth surface, yellow colored, grooved margin, 2.5*2 cm in diameter. Gills also yellow in color. Even margin, up to 15 mm broad. Stalk hollow, smooth, cylindrical with swollen base, yellow in color. Ring found here membraneous. Color like attached to upper part of stalk. Volva absent.

Collection No. - KGFM 55

Scientific Name - *Termitomyces medius* R. Heim & Grasse

Family - Lyophyllaceae

Occurrence – Found near soil of termite nests.

Brief Description -The fruit bodies are fleshy, consist of cap, gills and stalk. Cap convex shaped, creamy in color, striated margin, knob like structure, 1-2.6 cm broad. Gills creamy to whitish in color, close with wavy edges. Salk centrally positioned, cylindrical, hollow, broader at base up to 8 cm long.

Collection No. - KGFM 57

Scientific Name- *Lycoperdon pyriforme* Willd.

Family- Agaricaceae

Occurrence – Found on leaf litter soil.

Brief Description -The fruit bodies are round to semi round in shape, with small sterile base, whitish to pale brown color when young later yellowish to rusty brown at age, smooth, becoming several cracked to form small patches. Sterile base well developed, spongy, small, 1.5-4.5 cm long.

Collection No. - KGFM 61

Scientific Name - *Russula laurocerasi* Melzer

Family - Russulaceae

Occurrence – Associated with soft wood and hard wood tree.

Brief Description The fruit bodies are consist of cap, gills and stalk. Cap has fleshy, convex shaped, orange brown in color, greasy in wet weather, 7-14 cm in diameter. Gills are crowded white to creamy in color, fragile. Stalk up to 15 cm long, brown, barrel shaped, hollow, smooth, centrally placed, spores are creamy in color.

Collection No. - KGFM 63

Scientific Name - *Ramaria fumigata* (Peck.) Corner

Family - Clavariaceae

Occurrence - Found in lateritic soil, association with *Acacia* & *Eucalyptus.*

Brief Description - The fruit bodies are appearing velvety smooth, pale violaceous coloured, velvety smooth surface, highly branched in polychotomous fashion, greyish purple to violaceous in color, crowded branched, dichotomous only in upper portion,1.5-5.5 cm in height. Stalk solid, having basal whitish mycelia, 2-5 mm broad, mycelia attached with the solid surface.

Collection No. - KGFM 65

Scientific Name - *Termitomyces heimii* Natarajan

Family - Lyophyllaceae

Occurrence – Found near termite nests in group.

Brief Description -The pileus is convex to planoconvex, 10 cm diameter. Surface smooth, margin incurved, white with umboregion grey. Lamellae free, incurved, white, becoming pink, margin serrate. Stipe up to 19-22 cm long, white, smooth. Cylindrical, thick annulus. Basidia clavate. Spores ellipsoid, smooth, hyaline.

Collection No. - KGFM 68

Scientific Name - *Mycena* sp.

Family - Mycenaceae

Occurrence – Found on woodlands

Brief Description -The fruit bodies are consist of cap, gills and stalk. Cap whitish to brownish in color, conical in shape, dry and smooth, 2-6 cm broad. Gills whitish to pinkish in color, decurrent, crowded. Stalk smooth, slightly curved with hairy base, white to greyish in color, cylindrical, 6-15 cm long, spores are white.

Collection No. - KGFM 71

Scientific Name - *Polyporus* sp.

Family - Polyporaceae

Occurrence – Found in damp woodland.

Brief Description -This sp. has a smooth and shiny, funnel shaped to flattened cap which in grey brown in color, margin curved. 4-18 cm broad, pores tiny, creamy white in color become yellowish brown found underside of cap forming tube layer. Stalks are small brown to black, 2-5 cm long, off center, spores are white.

Collection No. - KGFM 73

Scientific Name - *Schizophyllum commune* Fr.

Family - Schizophyllaceae

Occurrence – Found in grooves, over hard woods, fallen bamboos etc.

Brief Description- Fruit bodies are fleshy, consist of cap, gills and sometime with stalk. Cap from shaped with narrow base, white to greyish in color, small hairs covered the upper surface and lower surface having gill like folds, 1.5- 2 cm long, margins lobed and inrolled. Gills found at the point of attachment, appearing grooved like. Stalks are absent if present they are short, snub like.

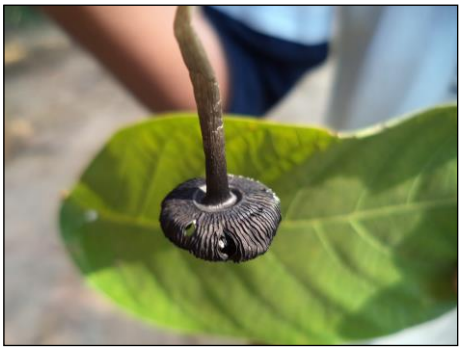
Collection No. - KGFM 74

Scientific Name - *Irpex* sp.

Family - Coriolaceae

Occurrence – Found on surface of hard wood.

Brief Description -The fruit bodies are consist of cap, gills and stalk. Cap ovoid in structure becoming conical and planar at maturity, margin generally splitting in age, brown to blackish in color, 15-35 cm in diameter. Gills surrounding the point of stalk attachment, narrow, white colored when young becoming black, 0.5-2.5 mm broad. Stalk white colored, slightly bulbous, fragile, hollow, 40-70 mm long. Ring volva absent.



Collection No. - KGFM 75

Scientific Name - *Coprinus* sp.

Family - Coprinaceae

Occurrence – Found in humus soil.

Brief Description- The fruit bodies are fleshy, consist of cap, gills and stalk. Cap rounded, blackish in color, dry, margin generally recurved, whitish to brownish center, 2.5- 12 cm broad. Gills turns blackish in maturity, crowded to each other. Free from the stem. Stalk mainly whitish in color, hollow, centrally placed, smooth, 5-20 cm long.

Collection No. - KGFM 76

Scientific Name - *Coprinopsis lagopus* (Fr.) Redhead, Vilgalys & Moncalvo

Family - Coprinaceae

Occurrence – Found in old wood chip piles.

Brief Description -The fruit bodies are consist of cap, gills and stalk. Cap ovoid in structure becoming conical and planar at maturity, margin generally splitting in age, brown to blackish in color, 15-35 cm in diameter. Gills surrounding the point of stalk attachment, narrow, white colored when young becoming black, 0.5-2.5 mm broad. Stalk white colored, slightly bulbous, fragile, hollow, 40-70 mm long. Ring volva absent.

Collection No. - KGFM 79

Scientific Name - *Pycnoporus sanguineus* (L.) Murrill

Family - Polyporaceae

Occurrence – Found upon dead logs and fallen woods

Brief Description- The fruit bodies are sessile, leathery found in groups, become dry at maturity. Cap rigid, smooth bright red to orange in color, margin, acute, 1-6 cm in diameter. Hymenium poroid, single layered also reddish in color, consist of several pores which are 0.5-1.5 mm long.

Collection No. - KGFM 80

Scientific Name - *Grifola frondosa* (Dicks.:Fr.) S.F. Gray.

Family - Fomitopsidaceae

Occurrence – Found over dead woody stumps.

Brief Description - The fruit bodies are branched, composed of multiple cap, 10-70 cm broad. Cap greyish brown in color, velvety with wavy margin, fan shaped, 3.5-12 cm across. Poroid hymenium running down the stalk, whitish to yellowish in color with angular pores. Stalk severally branch, tough, whitish to greyish, not centrally positioned.

Collection No. – KGFM 81

Scientific Name - *Coriolopsis occidentalis (*Klotzsch) Murrill

Family - Polyporaceae

Occurrence – Found upon fallen and decaying wooden logs.

Brief Description - Fruit bodies are woody, planar, sessile, fan to kidney shaped, up to 15 cm long and 6 cm broad, upper surface having hairs, brownish to greyish brown in color. Poroid hymenium is present with sub angular pores which having brown surface, presence of flesh which creamy and spongy.

Collection No. - KGFM 87

Scientific Name - *Scleroderma verrucosum* (Bull.) Pers.

Family - Sclerodermataceae

Occurrence – Found in lateritic soil, association with *Acacia* & *Eucalyptus.*

Brief Description -The fruit bodies are globose to sub globose, sessile, dark brown to yellowish in color, 1-3 cm high and 2-4 cm broad. Internal wall of fruit body is rigid and becoming thinner at maturity with cores cracked and minute dark hair, fruit bodies ruptured apically and liberate spores. Spores are small brown in color.

Collection No. - KGFM 90

Scientific Name - *Marusmius sp.*

Family - Marasmiaceae

Occurrence – Found on litters of dry leaves.

Brief Description - The fruit bodies are fleshy, consist of cap, gills and stalk. Cap very smooth, viscous, light brown to greyish in color, convex shaped, 25- 30 mm in diameter. Gills regular, forked at margin, creamy in color, regular. Stalks centrally placed, cylindrical, thin, hollow, slightly curved at lower portion creamy to grey in color, 40-70 mm long.

Collection No. - KGFM 92

Scientific Name - *Auricularia auricula* (Bull.) J. Schort

Family - Auriculariaceae

Occurrence – Found upon moist fallen logs and bamboos.

Brief Description- The fruit bodies are fleshy, broad, ear shaped,or cup shaped gather together at their central position with wavy and irregular margin, 4-13 cm broad, upper surface is brown in color, slightly veined, smooth and lower surface, whitish in color, fertile spores are white. It is normally attached to the substrate laterally and sometimes by a very short stalk, sometimes wrinkled with folds.

Collection No. – KGFM 93

Scientific Name - *Daldinia concentrica* (Bolton) Ces & De Not

Family- Xylariaceae

Occurrence - Found upon dead trunks and logs of wood

Brief Description - The fruit bodies are spherical to hemi-spherical in shape, reddish brown when young becoming blackish to pale brown at maturity, shiny outer surface, hard. Perithecia appearing as a single layer bellow the outer crust, 3-6 cm in diameter. Minute pores formed by ostioles of perithecium.

Collection No. - KGFM 94

Scientific Name - *Cyathus striatus* (Huds.) Willd

Family - Nidulariaceae

Occurrence – Found on dead logs, hard wood or soft wood.

Brief Description - The fruit bodies are nest like structure. On outside the nest are covered by brown fur, carpophore bell shaped, dark brown in color, initially covered by diaphragm, 10-18 mm high, peridioles whitish to grey, circular, compressed, sessile, found inside the carpophore about 2-3 mm in diameter.

Collection No. - KGFM 95

Scientific Name - *Boletus edulis* Bull.

Family - Boletaceae

Occurrence - Found in lateritic soil, association with *Shorea robusta* (Sal).

Brief Description- The fruit bodies are semiwoody, consist of cap, gills and stalk. Cap convex shaped, then flattened at maturity, hemispherical, whitish to brown in color, smooth, slightly viscous in dam weather, 5-20 cm in diameter. Gills brownish to light brown, crowded regular. Stalk cylindrical, solid, swollen at centre, whitish to pale brown, 10-17 cm in long.

Collection No. - KGFM 98

Scientific Name - *Lepista* sp.

Family - Tricholomataceae

Occurrence – Found in woodland, especially near soft wod trees.

Brief Description - The fruit bodies are fleshy, consist of cap, gills and stalk. Cap flattened when matured, pure white in color, often funnel shaped with in rolled margin, 4-12 cm in diameter. Gills free from the stalk, more or lea equal crowded white to pale yellow in color. Stalk thin, cylindrical, white, centrally placed, hollow, 5-20 cm long.

Collection No. - KGFM 100

Scientific Name - *Agaricus* sp.

Family – Agaricaceae

Occurrence – Found in groups on wood chips.

Brief Description - The fruit bodies are fleshy, consist of cap, gills and stalk. Cap soft, hemispherical when young and become flattened at maturity. Sometime scaly at maturity, margin entire, 6-8 cm in diameter. Gills are pinkish, smooth, free from the stalk crowded. Stalk more or less cylindrical with a white ring at the upper part of the stalk, persistent, 7-9 cm long.

Collection No. - KGFM 102

Scientific Name - *Porphrellus malaccensis* (Pat. & C. F. Baker) Singer

Family – Boletaceae

Occurrence – Found in lateritic soil, association with *Shorea robusta* (Sal).

Brief Description - The fruit body consist of cap, hymenium and stalk. Cap planar to shallow depressed when nature brown to creamy brown colored, without hair fleshy with entire margin, 3.5- 7.5 mm in diameter presence of poroid hymenium with angular pores with bright yellow color. Stalk subcylindrical, bulbous base, centrally, 3-6 cm long, dark brown in color.

Collection No. - KGFM 105

Scientific Name - *Russula emitica* (Schaeff.) Pers.

Family - Russulaceae

Occurrence – Found in lateritic soil associated with *Shorea robusta* (Sal).

Brief Description - The fruit body consist of cap, gills and stalk. The cap is normally bright red with no violet or pale purple or reddish in color. Sometimes may be white, pinkinsh globose, margin this, depressed, sulcate, shiny, 3-8 cm in diameter. Gills creamish to white in color, thin, rounded at stipe, almost free. Stipe varies in length, 7-11 can hight, club shaped, solid, cylindrical to subcylindrical, centrally placed.

Collection No. - KGFM 106

Scientific Name - *Russula mairei* Singer

Family - Russulaceae

Occurrence – Found in lateritic soil association with various trees.

Brief Description - The fruit bodies are consist of cap, gills and stalk. Cap smooth, red or rosy in color, convex to flat, sticky, upper surface rarely damaged by slugs, 4-8 cm. gills creamish in color, brittle medium spaced, crowded. Stalk centrally placed, white, club shaped, smooth, 2-6 cm long, spores white.

Collection No. - KGFM 107

Scientific Name - *Trametes* sp.

Family - Coriolaceae

Occurrence – Found on dead and living trunks and woods.

Brief Description-The fruit bodies are carpophores, flattened or slightly depressed at the attachment, thin, join together forming a rose like appearance, smooth. Various color, Zonation, 2-6 cm wide. Tubes whitish becoming brownish at maturity, short, pores small, light brown in color. Flesh leathery, whitish and thin.

Collection No. - KGFM 108

Scientific Name - *Hypomyces chrysospermus* Tul & C. Tul

Family- Hypocreaceae

Occurrence – Found in hard woods, soft woods etc.

Brief Description-The fruit bodies are fleshy, consist of cap, gills and small stalk. Cap oval shaped, smooth, whitish to creamy in color, margin entire, 5-15 cm in diameter. Gills not prominent, yellowish in color, regular and crowded. Stalk is short not centrally placed, solid, pale yellowish in color, often curved, 3-8 cm in long.

Collection No. - KGFM 109

Scientific Name - *Clitocybe subconnexa* Murrill

Family - Tricholomataceae

Occurrence – Found in the lateritic soil, also found in groups on litter.

Brief Description - The fruit bodies are flesly consist of cap, gills and stalk. Cap convex when young then flat depressed after maturity, creamish in color, forming uneven speckling with age, 5-10 cm in diameter. Gills are also creamish to white in color, turning yellowish when mature, regular, crowdedly arranged. Stalk fleshy, white, thin, cylindrical, 4-8 cm long.

Collection No. - KGFM 110

Scientific Name - *Boletus* sp.

Family - Boletaceae

Occurrence – Found in association with various trees on lateritic soil.

Brief Description- The fruit body of the sp. Consist of bun shaped cap, Smokey grey or grey in color, somewhat veined, smooth, margin overhangs at edge, 8-18 cm broad. It has pale yellow net pattern pores, forming tubes, 0.5-2 cm long, pores are lemon yellow in color. Stalk are cylindrical tapering to barrel shaped of base, smooth, soild, brownish, 6-11 cm long, centrally placed, spores olive brown.

Collection No. - KGFM 114

Scientific Name - *Tylopilus violatinctus* T.J. Baroni & Both

Family - Boletaceae

Occurrence – Found in lateritic soil associated with *Shorea robusta* (Sal).

Brief Description-The fruit bodies are consist of cap and stalk. Cap hemispherical to convex in shape becoming flattened at maturity, velvety. Light brown to pinkish in color, 6-16 cm broad. These semi free whitish to cream color, pores rounded, quite small. Stalk solid, slightly club shaped, light brown in color, velvety, centrally placed, 3-14 cm long.

Collection No. - KGFM 115

Scientific Name – *Pleurotus ostreatus* (Jacq.) P. Kumm.

Family - Pleurotaceae

Occurrence – Found on dying hardwood trees.

Brief Description- Fruit bodies with cap, gills and stalk. Cap broad convex, 4-6 cm long, creamy in colour. Margin entire, inrolled and clay buff in colour. Gills are slightly adnexed to decurrent, 1 mm at base, 6 mm at margin, 4 mm width, regular. Gill margin concolourous with stalk. Short gills three tiered. Stalk attachment with cap eccentric to lateral, solid, cartilage like.

Table 1.2- Seasonal occurrence of mushroom in Gurguripal ecoforest

Order	Family	Scientific Name	ERS (May-Jun)			MRS (Jul-Aug)			LRS (Sep-Oct)		
			2015	2016	2017	2015	2016	2017	2015	2016	2017
Hypocreales	**1. Hypocreaceae**	1. *Hypomyces chrysospermus* Tul & C.Tul	-	-	-	-	-	-	-	2	3
Xylariales	**1. Xylariaceae**	1. *Daldinia concentrica* (Bolton) Ces& De Not	-	-	-	-	-	-	13	7	22
		2. *Xylaria longipes* Nitschke	9	12	8	-	6	5	-	-	-
Agaricales	**1. Agaricaceae**	1. *Leucocoprinus brinbaumii* (Corda) Singer	-	-	-	2	-	3	-	-	-
		2. *Macrolepiota procera* (Scop.) Singer	-	-	-	1	2	-	-	-	-
		3. *Lycoperdon pyriforme* Willd.	-	-	-	12	17	14	-	-	-
		4. *Agaricus* sp.	-	-	-	-	2	-	-	-	-
	2.Coprinaceae	1. *Coprinopsis lagopus* (Fr.) Redhead, Vilgalys & Moncalvo	-	-	-	-	-	-	7	9	-
		2. *Coprinus* sp. (KGFM 08)	-	-	-	5	7	7	-	-	-
		3. Coprinus sp. (KGFM 75)	-	-	-	6	4	5	-	-	-
	3. Pleurotaceae	1. *Pleurotus ostreatus* (Jacq.) P. Kumm.	-	-	-	7	11	4	-	9	5
	4. Schizophyllaceae	1. *Schizophyllum commune* Fr.	-	-	-	-	-	-	32	-	38
	5. Tricholomataceae	1. *Collybia tuberosa* (Bull) P.Kumm	-	-	-	23	14	19	-	-	-
		2. *Lepista flaccida* (Sowerby) Pat.	-	-	-	7	4	-	-	-	-
		3. *Lepista* sp.	-	-	-	-	-	-	-	4	9
		4. *Calocybe indica* Purkayastha &A.Chandra	-	-	-	3	5	2	-	-	-
		5. *Laccaria laccata* (Scop) Cooke	-	-	-	29	35	18	-	-	-
		6. *Hygrocybe* sp.	-	-	-	31	27	43	-	-	-
		7. *Clitocybe* sp.	-	-	-	4	2	-	-	-	-
		8. *Clitocybe subconnexa* Murrill	-	-	-	1	-	-	-	-	-
	6. Amanitaceae	1. *Amanita populiphila* Tulloss & E. Moses.	-	-	-	-	3	1	-	-	-
		2. *Amanita* sp.(KGFM 03)	-	-	-	16	22	14	-	-	-
		3. *Amanita bisporigera* G.F.Atk	-	-	-	1	-	-	-	-	-
	7. Pluteaceae	1. *Volvariella volvacea* (Bull) Singer	-	-	-	-	-	-	32	25	16
	8. Lyophyllaceae	1. *Termitomyces medius* R.Heim & Grasse	-	-	-	14	17	9	-	-	-
		2. *Termitomyces microcarpus* (Berk & Broome) R.Heim	-	-	-	58	51	72	-	-	-
		3. *Termitomyces heimii* Natarajan	-	-	-	-	-	-	43	54	80
		4. *Termitomyces clypeatus* R.Heim	-	-	-	7	-	3	-	-	-
	9. Mycenaceae	1. *Mycena* sp.	-	-	-	-	-	-	5	-	-
	10. Marasmiaceae	1. *Marasmius* sp.	-	-	-	9	-	6	-	-	-
	11. Nidulariaceae	1. *Cyathus stiratus* (Huds) Willd.	-	-	-	13	-	-	-	-	-

Boletales	**1. Boletaceae**	1. *Boletus edulis* Bull.	-	-	-	-	2	-	-	-	-
		2. *Porphyrellus malaccensis* (Pat. & C.F.Baker) Singer	-	-	-	7	-	3	-	-	-
		3. *Boletus* sp.(KGFM 47)	-	-	-	8	3	6	-	-	-
		4. *Tylopilus alboater* (Schwein.) Murrill	-	-	-	2	-	-	-	-	-
		5. *Tylopilus violatinctus* T.J.Baroni & Both.	-	-	-	4	1	-	-	-	-
		6. *Boletus* sp. (KGFM 110)	-	-	-	-	-	4	-	-	-
	2. Sclerodermataceae	1. *Scleroderma verrucosum* (Bull.) Pers	-	-	-	6	5	9	-	-	-
		2. *Pisolithus arhizus* (Scop.) Rauschert	-	-	-	7	8	1	-	-	-
	3. Diplocystaceae	1. *Astraeus hygrometricus* (Pers) Morgan	43	35	42	61	54	76	-	-	-
	4. Suillaceae	1. *Suillus* sp.	-	-	-	-	-	-	5	4	-
Gomphales	**1. Clavariaceae**	1. *Ramaria fumigata* (Peck.) Corner	-	-	-	10	7	14	-	-	-
		2. *Clavulina cristata* (Holmsk) J.Schrot	-	-	-	-	-	-	34	41	37
		3. *Clavaria* sp.	-	-	-	46	33	39	-	-	-
Auriculariales	**1. Auriculariaceae**	1. *Auricularia auricula* (Bull) J.Schrot	-	-	-	-	-	-	23	29	24
Cantharellales	**1. Cantharellaceae**	1. *Cantharellus* sp.	-	-	-	6	-	-	-	-	-
Hymenochaetales	**1. Hymenochaetaceae**	1. *Phellinus rimosus* (Berk.) Pilat.	-	-	-	3	-	-	-	-	-
Polyporales	**1. Polyporaceae**	1. *Coriolopsis occidentalis* (Klotzsch) Murrill	-	-	-	-	9	6	-	-	-
		2. *Polyporus sp.*(KGFM 71)	-	-	-	-	-	-	3	-	-
		3. *Pycnoporus sanguineus* (L.) Murrill	-	-	-	32	-	26	-	-	-
	2. Coriolaceae	1. *Trametes* sp.	-	-	-	24	-	-	-	-	-
		2.*Irpex* sp.	-	-	-	-	-	-	25	23	-
	3. Ganodermataceae	1. *Ganoderma* sp.	-	-	-	4	-	-	-	-	-
		2. *Ganoderma lucidum* (Curtis) P. Karst.	-	-	-	9	12	11	-	-	-
	4. Fomitopsidaceae	1. *Grifola frondosa* (Dicks.:Fr.) S.F. Gray.	-	-	-	8	7	12	-	-	-
Russulales	**1. Russulaceae**	1. *Russula rosea* (Pars.)	-	-	-	12	6	10	-	-	-
		2. *Lactarius gerardii* Peck.	-	-	-	2	-	-	-	-	-
		3. *Russula emetica* (Schaeff.) Pers	-	-	-	5	4	7	-	-	-
		4. *Russula* sp.	-	-	-	9	5	3	-	-	-
		5. *Russula albonigra* (Krombh) Fr.	-	-	-	3	4	2	-	-	-
		6. *Russula laurocerasi* Melzer	-	-	-	2	3	-	-	-	-
		7. *Lactarius* sp.	-	-	-	7	8	4	-	-	-
		8. *Russula senecis* S.Imai	-	-	-	3	-	-	-	-	-
		9. *Lactarius piperatus* (L.) Pers.	-	-	-	-	2	3	-	-	-
		10. *Russula mairei* Singer	-	-	-	2	5	-	-	-	-
		11. *Russula cyanoxantha* (Schaeff.) Fr.	-	-	-	4	-	3	-	-	-
	2. Auriscalpiaceae	1. *Lentinellus cochleatus* (Pers.) P. Karst	-	-	-	8	-	-	-	-	-

1.3.2. Diversity index

The diversity index is a mathematical representation of species diversity in a community. It reveals the number of species present (species richness), as well as the abundance of each species. In Gurguripal ecoforest, according to Simpson's diversity index the value of species richness was 0.941. Simpson's diversity index is a specific method to measure species diversity in a defined community. Here the calculated value is nearly 1.0 which indicated greater mushroom diversity of this area. According to Shannon's diversity index, the relative abundance of mushroom species was calculated as 3.687. This value has supported the abundant occurrence of mushrooms in this region. The calculated value for evenness of the mushrooms was found to be 0.87. This result referred that all the 67 mushroom species belonging to 27 families were not evenly distributed numerically in the community.

Earlier, a total number of 90 species from 48 genera belonging to 19 families were recorded in Bangalore, Karnataka and the Simpson and Shannon biodiversity index was found to be 0.8 and 1.24 respectively (Pushpa and Purushothoma 2012). Vishwakarma et al. (2017) has reported the values of Simpson diversity index, Shannon diversity index and species evenness as 0.97, 3.61 and 0.90 respectively in Sahjanwan tehsil, Uttar Pradesh. In this context the results of the present study revealed that Gurguripal ecoforest comprises rich and diverse mushroom flora. It may be due to the diverse climatic conditions of Gurguripal ecoforest which make this area a natural habitat for the occurrence of a large number of mushroom species. It is further speculated that the diversity of mushrooms varies greatly because of different ecological habitats viz., decaying woody logs, termite nests, humus, leaf litters, humid soil etc.

1.3.3. Ethnomycology

In monsoon period local tribes of Guguripal usually hunt for mushrooms along with other non-timber forest products in groups of 5-6 peoples preferably belonging to same family or community. The findings of the present investigation revealed that 19 mushroom genera have medicinal potentials, amongst 7 genera namely *Volvariella volvacea*, *Pleurotus ostreatus*, *Auricularia auricula*, *Astraeus hygrometricus*, *Schizophyllum commune*, *Termitomyces heimii* and *Ganoderma lucidum* are majorly used as medicine against different human disorders (Table 1.3). Santal, Munda and Sabar are the dominating scheduled tribes of Gurguripal consuming wild mushrooms as food or dietary supplement (Fig-1.8). They generally prepare indigenous mushroom dishes with spices and mustard oil. The ethnomycological survey revealed that some wild mushrooms of this region are effectively used in solving liver problems, curing cold and cough, lowering blood pressure and also applied against burns, itching and inflammations (Table 1.3). *Volvariella volvacea* (Khor chattu/ Powal chhatu) is used in lowering the blood pressure and as blood purifier. *Ganoderma lucidum* (Shukna chhatu) is used as an antimicrobial agent and immune enhancer. *Pleurotus ostreatus* (Jhinuk chhatu) is used in the treatment of asthma and high blood pressure. The fruit body of *Termitomyces heimii* (Durga chattu / Sik chhatu) is pasted and applied to the affected area for wound healing and also helps in lowering the blood pressure. Uncommonly local tribes of Gurguripal consume a rare wild edible species of *Amanita* (*A. bisporigera*) as a special recipe with tamarind. Earlier, a total of 30 different species of wild mushrooms were reported as being used by Santals in West Bengal (Pradhan et al. 2010). Dutta et al. (2013) had reported 34 macrofungi from West Bengal, out of which 31 are used as food and altogether 5 applied for medicinal purposes. Panda et al. (2015) documented 19 medicinally important mushrooms from Northern Orissa, India.

It was observed that traditional knowledge regarding the medicinal uses of wild mushrooms was generally confined to elderly aged persons of the village and in most of the cases; mode and dose of administration were determined by local traditional healers (vernacularly known as 'Vaidya'). The knowledge of utility and edibility of wild mushrooms are passed from one generation to next generation among the tribal communities of Gurguripal ecoforest. The most remarkable fact emerged in this ethnomycological study was that a large portion of the local ethnic population do not include animal protein in their diet, rather wild edible mushrooms are frequently collected, consumed and considered as a substitute of meat by them. So, in this regard wild mushrooms serve as a vital food supplement especially in solving the protein demand in regular diet of economically backward people of this region. The knowledge about consumption and utilization of wild mushrooms (mycophilic) was inherited from forefathers (Wason and Wason 1957). This attitude is confined within the family members. But interestingly few people do not consume wild mushrooms or they have a fear against them (mycophobic). The reason may be that some edible species are very similar in morphological appearance with poisonous one and even found in the same habitat. Another common myth possessed by the tribal people is that all wild mushrooms in forest are tasted by snakes, thus rendered as poisonous. Many people still think that as mushrooms grow in dirty places, they are unhygienic (Semwal et al. 2014). The local ethnic tribes could distinguish between edible and poisonous mushrooms. As per their experience when animals or insects feed on a mushroom it is edible while after the rubbing of a mushroom on sensitive areas of the human body it itches then it is poisonous.

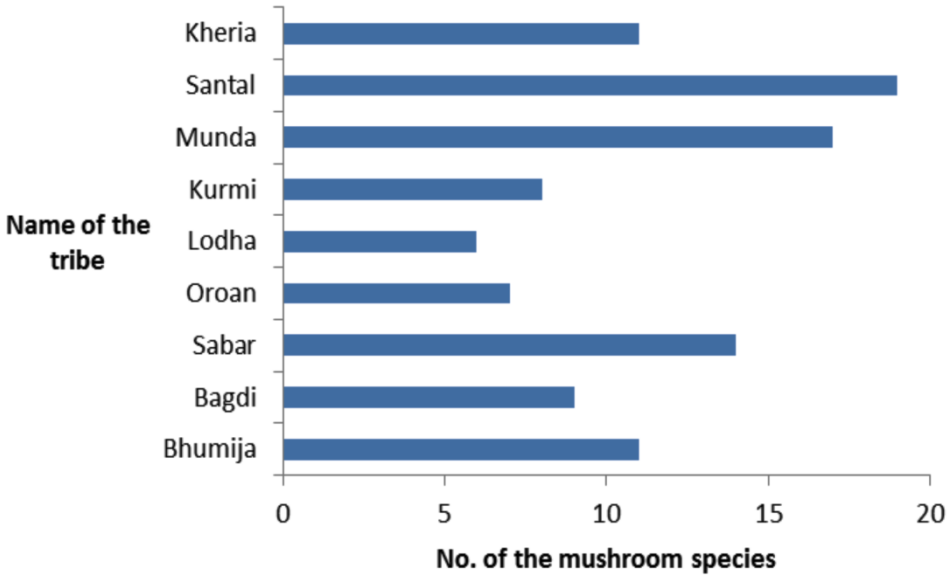


Fig 1.8 - Mushroom species used by the tribal communities in Gurguripal

Table 1.3 - Ethnomedicinal uses of some wild mushrooms in Gurguripal

Sl.no	Scientific Name	Local Name	Ethno medicinal Uses	Use Value
1	*Volvariella volvacea*	Khor chhatu/ Powal chhatu	Lowering the blood pressure and blood purifier, used against fever	0.174
2	*Russula cyanoxantha*	Jam chhatu	Controlling low and high blood pressure	0.096
3	*Astraeus hygrometricus*	Putka chhatu/ Kurkure chhatu	The spore mass is blended with mustard oil and used as a salve against burns	0.172
4	*Termitomyces clypeatus*	Parabana/Ada chhatu	Used to reduce staunch bleeding & reduce swelling	0.106
5	*Russula emetica*	Murgi chhatu	Used in rheumatism and lowering blood pressure	0.144
6	*Lactarius* sp.	Pitha chhatu/ Atha chhatu	Used to lowering high blood pressure	0.108
7	*Lycoperdon pyriforme*	Dhula/ Gua chhatu	Used to cure wound as an antimicrobial agent	0.116
8	*Auricularia auricula*	Kan chhatu	Earache to cure ear infections, cardiovascular diseases, diabetes and hypertension.	0.204

9	*Cantharellus* sp.	Kamla chhatu	Treating liver problems	0.132
10	*Ganoderma lucidum*	Shukna chhatu	Used as an antimicrobial agent curing wounds, immune enhancer	0.192
11	*Russula senecis*	Jhal chhatu	Treatment of wounds against microbial infection and cuts	0.060
12	*Daldinia concentrica*	Kath chhatu	Getting relief from burning itching and healing minor skin infections	0.144
13	*Schizophyllum commune*	Pakha chhatu	Used as a tonic for regaining energy	0.168
14	*Termitomyces heimii*	Durga chhatu / Sik chhatu	Fruit body is pasted and applied to the affected area for wound healing, lowering the blood pressure	0.228
15	*Coprinus* sp.	Jiban chhattu	Fruit body is taken in tea and soups	0.144
16	*Polyporus* sp.	Sonajhuri/ Khop chhatu	Powder mixed with coconut oil and applied to skin against poisonous insect bite	0.072
17	*Russula delica*	Jhor chhatu	Curing malnutrition, weakness, and nutritional disorders, skin diseases and wound healing	0.072
18	*Russula albonigra*	KaloPatra	Controlling cold and cough	0.060
19	*Pleurotus ostreatus*	Jhinuk chhatu	Asthma and lowering blood pressure and antitumor agent	0.216

1.4. Conclusion

The wild mushroom flora of Gurguripal ecoforest showed significant abundance and diversity of species. The findings of the present study also revealed that the tribal communities of this area consider that nearly 50% of wild mushrooms occurring in Gurguripal ecoforest are edible. Moreover, they have substantial knowledge regarding the ethnomedicinal uses of wild mushrooms and provided useful information about their medicinal applications. In this scenario, strong conservation policies must be taken to ensure the occurrence, abundance and sustainable utilisation of macrofungi for forest management and their longterm effect on income generation and food security in Gurguripal ecoforest. Since, mushrooms do not only have socio-economic benefits but also play functional roles in maintaining the ecosystem, sustainable government laws and forest policies should be implemented to ensure their conservation.

Appendix I - Demographic profile of informants live in Gurguripal

Criteria	Frequency
Sex	
Men	80.72
Women	19.28
Education	
Illiterate	13.25
Primary education	49.39
Secondary Education	27.71
Graduate	6.02
Servicemen	3.61
Age Group	
10-25 years	22.89
25-50 years	25.3
50-75 years	38.55
Above 75 years	13.25
Religion	
Hindu	83.13
Christian	16.87
Ethnicity	
Santal	20.48
Munda	12.04
Lodha	13.25
Kherai	10.84
Bhumija	9.63
Oraon	8.43
Sabar	10.84
Bagdi	7.22
Kurmi	7.22