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RESEARCH ARTICLE

Study of Frequency, Density, Abundance and Diversity of Wild Mushrooms of Tropical Mixed Forest of Central India

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ABSTRACT

Central India is one of the richest floristic area with wide range of vegetation. Studies on diversity of wild mushrooms are of great value as many macrofungi are becoming extinct and facing threat of extinction because of anthropogenic actions. The current study deals with the diversity of mushrooms in mixed forests of District Umariya. Survey was conducted from July 2014 to September 2014 which includes forest of Barbaspur, Ghunghuti, Manpur, Nowrozabad and local Umaria. A total number of 52 mushroom species belonging to 37 genera, 13 families, and 10 orders were recorded. In this study it was found that order Agaricales was dominant with 26 species. Quantitative analysis of collected mushroom species revealed that *Leucoagaricus sp*. was most denser (8.83) while *Ganoderma lucidum* was most frequent species (86.87%). *Termitomyces heimii* was most abundant species (42.83). Species diversity of mushrooms by Shannon Index was found to be 1.6323A which indicates species richness of the study sites.

Keywords- Diversity, Agaricales, Macrofungi, Species Richness, Shannon Index.

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INTRODUCTION

Fungi are ubiquitous and worldwide in distribution. About 1.5 million fungi have been projected on earth surface (Hawksworth, 1991). Of these, approx 5-7% of the fungi are described till now (Hawksworth, 2004; Rossman, 1994). Garret (1951) classified macrofungi in 5 different groups on the basis of their host/substrate. First groups belong to saprophytic macro fungi which grow mainly on litter, terrestrial or humus. Second group belongs to wood Rotting macrofungi which are mainly cellulytic and Lignolytic. Third group have symbiotic macrofungi which act as ectomycorrhizal with trees or with termites. Fourth group contain all parasitic macrofungi. Fifth group belongs to coprophilous macro fungi, which grow mainly on animal dung.

Mushrooms are known to everyone as an edible form and their utilization as food is closely related with the history of mankind. Edible as well as medicinal properties of mushrooms were known in many of the ancient civilizations. Mushrooms predominantly are the members of class basidiomycetes and ascomycetes. They grow in nature on dead remains of plant parts. So they have saprophytic mode of nutrition which is general characteristics of fungi. They have been under cultivation from time immortal on substrates representing various categories of agriculture waste from nutritional supplements in our daily food material. The edible mushrooms thus provide very efficient methods of recycling renewable organic and agricultural waste. Mushrooms are saprophytic which help in the decomposition of the organic plant matter and return the carbon, hydrogen, nitrogen and minerals back to ecosystem.

MATERIAL AND METHOD

Study Area

Table-1: Geographical position of Sampling Sites of Umaria district (M.P.)

S.No	Sampling Sites	Longitude	Latitude
1	Barbaspur	$23^0$23’34”N	$81^0$01’11”E
2	Ghunghuti	$23^0$21’50”N	$81^0$09’30”E
3	Manpur	$23^0$38’38”N	$81^0$09’30”E
4	Nowrozabad	$23^0$23’15”N	$80^0$59’14”E
5	Umaria	$23^0$29’59”N	$81^0$48’29”E

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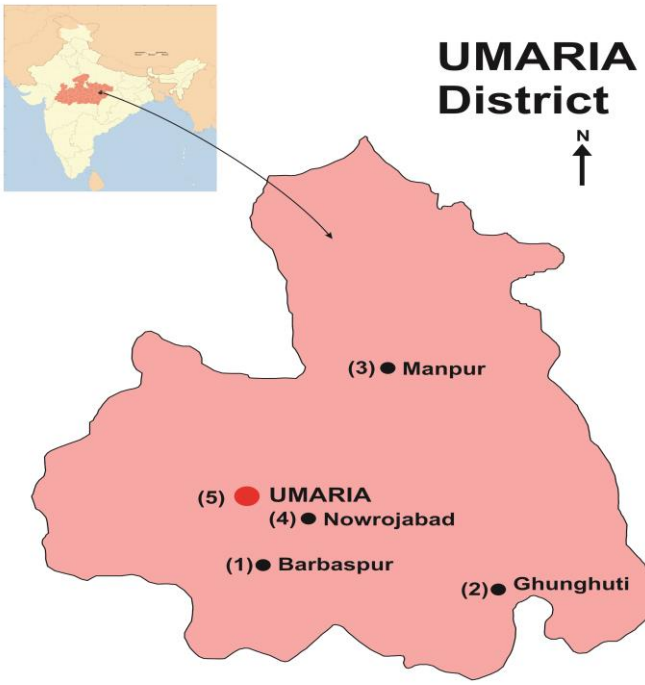

Fig-1: Map of sampling sites of Umaria District, Central India.

Community analysis: Mushroom community analysis was carried out during rainy season when majority of the mushrooms were at the peak of their growth. In every study sites, 75 quadrates of 10 m X 10 m (100 sq m) size were randomly laid to study mushroom species.

Quantitative analysis: The important quantitative analysis such as density, frequency, and abundance of mushroom species were determined as per Curtis and McIntosh (1950).

(a) **Density:** Density is an expression of the numerical strength of a species where the total number of individuals of each species in all the quadrates is divided by the total number of quadrates studied. Density is calculated by the equation:

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrates}}{\text{Total number of quadrates studied}}$$

(b) **Frequency (%)**: This term refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage occurrence. It was studied by sampling the study area at several places at random and recorded the name of the species that occurred in each sampling units. It is calculated by the equation:

$$\text{Frequency (\%)} = \frac{\text{Number of quadrates in which the species occurred}}{\text{Total number of quadrates studied}} \times 100$$

(c) Abundance: It is the study of the number of individuals of different species in the community per unit area. By quadrates method, samplings are made at random at several places and the number of individuals of each species was summed up for all the quadrates divided by

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the total number of quadrates in which the species occurred. It is represented by the equation:

$$\text{Abundance} = \frac{\text{Total number of individuals of a species in all quadrates}}{\text{Total number of quadrates in which the species occurred}}$$

Species diversity indices

Shannon–Weaver (1963) index of diversity:

The formula for calculating the Shannon diversity index is $H' = -\sum pi \log pi$

Where, H' = Shannon index of diversity

*p*i = the proportion of important value of the species

N = is the important value index of all the species

Table-2: Distribution of species in their respective order in the year 2013

S. No	Name of Species	Order	Family
1	*Agaricus bisporus*	Agaricales	Agaricaceae
2	*Agaricus campestris*	Agaricales	Agaricaceae
3	*Amanita caesarea*	Agaricales	Amanitaceae
4	*Amanita pantherina*	Agaricales	Amanitaceae
5	*Amanita phalloid*	Agaricales	Amanitaceae
6	*Amanita milky white*	Agaricales	Amanitaceae
7	*Amanita white*	Agaricales	Amanitaceae
8	*Amanita veginata*	Agaricales	Amanitaceae
9	*Auricularia sp.*	Auriculariales	Auriculariaceae
10	*Boletus edulis*	Boletales	Boletaceae
11	*Boletus sp.*	Boletales	Boletaceae
12	*Chlorophyllum molybdites*	Agaricales	Agaricaceae
13	*Clitocybe sp.*	Tricholomatales	Tricholomataceae
14	*Coprinus comatus*	Agaricales	Coprinaceae
15	*Coprinus sp.*	Agaricales	Coprinaceae
16	*Daedalea sp.*	Polyporales	Polyporaceae
17	*Ganoderma applanatum*	Ganodermatales	Ganodrmataceae
18	*Ganoderma lucidum*	Ganodermatales	Ganodrmataceae
19	*Ganoderma sp.I*	Ganodermatales	Ganodrmataceae
20	*Ganoderma sp.*	Ganodermatales	Ganodrmataceae
21	*Ganoderma white*	Ganodermatales	Ganodrmataceae
22	*Geastrum sp.I*	Geastrales	Geastraceae
23	*Geastrun triplex*	Geastrales	Geastraceae
24	*Lentinus sp.*	Polyporales	Polyporaceae
25	*Lepiota sp.*	Agaricales	Lepiotaceae
26	*Lepista nuda*	Agaricales	Agaricaceae
27	*Leucoagaricus sp*	Agaricales	Agaricaceae

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28	*Lycoperdon sp.*	Lycoperdales	Lycoperdaceae
29	*Macrolapiota procera*	Agaricales	Agaricaceae
30	*Marasmius sp.*	Tricholomatales	Marasmiaceae
31	*Megacollybia platyphylla*	Tricholomatales	Marasmiaceae
32	*Meripilus giganteus*	Polyporales	Polyporaceae
33	*Mycena sp.*	Tricholomatales	Mycenaceae
34	*Panaeolus semioratus*	Cortinariales	Bolbitiaceae
35	*Panaeolus foeniseii*	Cortinariales	Bolbitiaceae
36	*Pisolithus tinctorius*	Sclerodermatales	Sclerodermataceae
37	*Pleurotus sp.*	Tricholomatales	Pleurotaceae
38	*Psilocybe*	Agaricales	Strophariaceae
39	*Ramaria sp.*	Clavariales	Ramariaceae
40	*Russula aquosa*	Russullales	Russulaceae
41	*Russula solaris*	Russullales	Russulaceae
42	*Russula sp.*	Russullales	Russulaceae
43	*Russula violacea*	Russullales	Russulaceae
44	*Schizophyllum sp.*	Shizophyllales	Schizophyllaceae
45	*Scleroderma sp.*	Sclerodermatales	Sclerodermataceae
46	*Suilus spraguei*	Boletales	Boletaceae
47	*Termitomyces heimii*	Agaricales	Lyophyllaceae
48	*Termitomyces microcarpus*	Agaricales	Lyophyllaceae
49	*Trametes sp.*	Polyporales	Polyporaceae
50	*Wood Rot Fungus*	Polyporales	Polyporaceae
51	*Xerocomus chrysentron*	Boletales	Boletaceae
52	*Xylaria polymorpha*	Xylariales	Xylariaceae

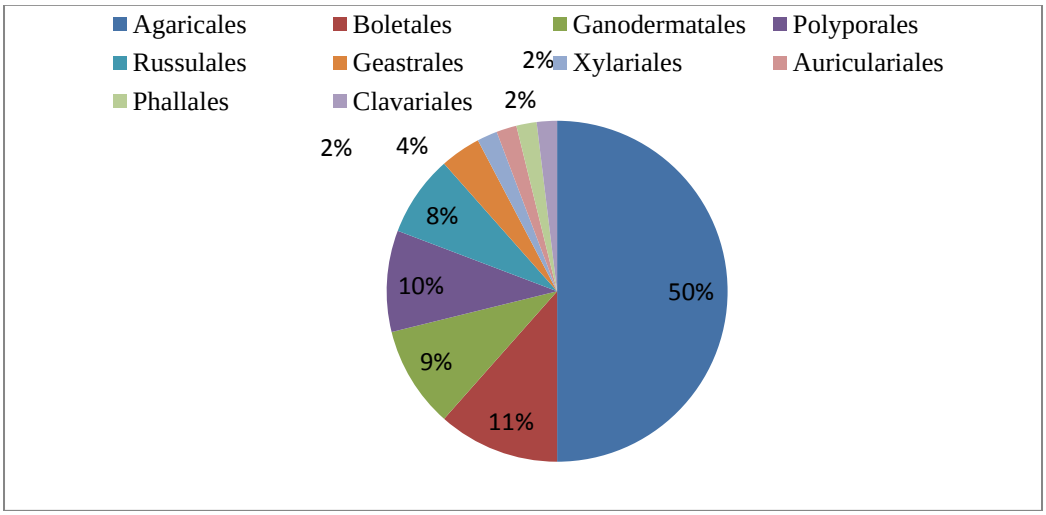

Fig-2: Distribution of mushrooms in different order.

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Table-3: Density, Frequency and Abundance of Mushrooms of Umaria District in year 2013.

S.No.	Name of Species	Density	Frequency %	Abundance
1.	*Agaricus bisporus*	5.13	77.33	6.638
2.	*Agaricus campestris*	5.68	73.33	7.745
3.	*Amanita caesarea*	1.39	66.67	2.08
4.	*Amanita pantherina*	0.85	53.33	***1.6***
5.	*Amanita phalloid*	0.69	38.67	1.793
6.	*Amanita sp. Milky white*	0.64	26.67	2.4
7.	*Amanita sp. white*	***0.56***	30.67	1.826
8.	*Amanita veginata*	1.79	66.67	2.68
9.	*Auricularia sp.*	3.31	38.67	8.552
10.	*Boletus edulis*	1.25	25.33	4.947
11.	*Boletus sp.*	0.77	29.33	2.636
12.	*Chlorophyllum molybdites*	8.03	65.33	12.29
13.	*Clitocybe sp.*	4.56	36	12.67
14.	*Coprinus comatus*	4.57	40	11.43
15.	*Coprinus sp.*	4.05	40	10.13
16.	*Daedalea sp.*	2.99	26.67	11.2
17.	*Ganoderma applanatum*	3.31	73.33	4.509
18.	*Ganoderma lucidum*	6.11	***86.67***	7.046
19.	*Ganoderma sp.I*	3.4	26.67	12.75
20.	*Ganoderma sp.*	3.25	40	8.133
21.	*Ganoderma white*	1.41	29.33	4.818
22.	*Geastrum sp.II*	3.24	60	5.4
23.	*Geastrun triplex*	4.61	29.33	15.73
24.	*Lentinus sp.*	3.89	80	4.867
25.	*Lepiota sp.*	4.32	32	13.5
26.	*Lepista nuda*	2.97	64	4.646
27.	*Leucoagaricus sp.*	***8.83***	85.33	10.34
28.	*Lycoperdon sp.*	4.64	40	11.6
29.	*Macrolapiota procera*	2.05	29.33	7
30.	*Marasmius sp.*	2.04	14.67	13.91
31.	*Megacollybia platyphylla*	1.17	46.67	2.514
32.	*Meripilus giganteus*	4.29	29.33	14.64
33.	*Mycena sp.*	7.25	26.67	27.2
34.	*Panaeolus semioratus*	4.29	40	10.73
35.	*Panaeolus foeniseii*	4.16	30.67	13.57
36.	*Pisolithus tinctorius*	3.19	20	15.93
37.	*Pleurotus sp.*	1.15	26.67	4.3
38.	*Psilocybe sp.*	1.15	58.67	1.955
39.	*Ramaria sp.*	3.15	64	4.917
40.	*Russula aquosa*	4.67	56	8.333
41.	*Russula solaris*	1.87	62.67	2.979

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S.No.	Name of Species	Density	Frequency %	Abundance
42.	*Russula sp.*	3.01	60	5.022
43.	*Russula violacea*	4.45	26.67	16.7
44.	*Schizophyllum sp.*	2.03	16	12.67
45.	*Scleroderma sp*	1.61	74.67	2.161
46.	*Suilus spraguei*	5.15	45.33	11.4
47.	*Termitomyces heimii*	6.85	16	***42.83***
48.	*Termitomyces microcarpus*	2.8	14.67	19.09
49.	*Trametes sp.*	1.85	***13.33***	13.9
50.	*Wood Rot Fungus*	2.08	22.67	9.176
51.	*Xerocomus chrysentron*	3.25	25.33	12.84
52.	*Xylaria polymorpha*	1.15	26.67	4.3

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Table-4: Species diversity of mushrooms by Shannon Weaver Index of Umaria district in the year 2013.

S.No	Name of Species	Density	Pi*ln Pi
1.	*Agaricus bisporus*	5.13	-0.0455
2.	*Agaricus campestris*	5.68	-0.0489
3.	*Amanita caesarea*	1.39	-0.0169
4.	*Amanita pantherina*	0.85	-0.0114
5.	*Amanita phalloid*	0.69	-0.0096
6.	*Amanita sp. Milky white*	0.64	-0.009
7.	*Amanita sp. white*	***0.56***	-0.0081
8.	*Amanita veginata*	1.79	-0.0206
9.	*Auricularia*	3.31	-0.033
10.	*Boletus edulis*	1.25	-0.0155
11.	*Boletus sp.*	0.77	-0.0105
12.	*Chlorophyllum molybdites*	8.03	-0.0621
13.	*Clitocybe sp.*	4.56	-0.0418
14.	*Coprinus comatus*	4.57	-0.0419
15.	*Coprinus sp.*	4.05	-0.0383
16.	*Daedalea sp.*	2.99	-0.0306
17.	*Ganoderma applanatum*	3.31	-0.033
18.	*Ganoderma lucidum*	6.11	-0.0515
19.	*Ganoderma sp.I*	3.4	-0.0337
20.	*Ganoderma sp.I*	3.25	-0.0326
21.	*Ganoderma white*	1.41	-0.0171
22.	*Geastrum sp.II*	3.24	-0.0325
23.	*Geastrun triplex*	4.61	-0.0421
24.	*Lentinus sp.*	3.89	-0.0372

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S.No	Name of Species	Density	Pi*ln Pi
25.	*Lepiota sp.*	4.32	-0.0402
26.	*Lepista nuda*	2.97	-0.0304
27.	*Leucoagaricus sp.*	***8.83***	-0.0662
28.	*Lycoperdon sp.*	4.64	-0.0423
29.	*Macrolapiota procera*	2.05	-0.0229
30.	*Marasmius sp.*	2.04	-0.0228
31.	*Megacollybia platyphylla*	1.17	-0.0147
32.	*Meripilus giganteus*	4.29	-0.04
33.	*Mycena sp.*	7.25	-0.058
34.	*Panaeolus semioratus*	4.29	-0.04
35.	*Panaeolus foeniseii*	4.16	-0.0391
36.	*Pisolithus tinctorius*	3.19	-0.0321
37.	*Pleurotus sp.*	1.15	-0.0145
38	*Psilocybe sp.*	1.15	-0.0145
39	*Ramaria sp.*	3.15	-0.0318
40	*Russula aquosa*	4.67	-0.0425
41	*Russula solaris*	1.87	-0.0213
42	*Russula sp.*	3.01	-0.0307
43	*Russula violacea*	4.45	-0.0411
44	*Schizophyllum sp.*	2.03	-0.0228
45	*Scleroderma sp*	1.61	-0.019
46	*Suilus spraguei*	5.15	-0.0456
47	*Termitomyces hemmi*	6.85	-0.0557
48	*Termitomyces microcarpus*	2.8	-0.0291
49	*Trametes sp.*	1.85	-0.0212
50	*Wood Rot Fungus*	2.08	-0.0232
51	*Xercomus chrysentron*	3.25	-0.0326
52	*Xylaria polymorpha*	1.15	-0.0145
		-∑ Pi*ln Pi=	**1.6323**

RESULTS AND DISCUSSION

A reconnaissance survey was carried out in five sampling sites of Barbaspur, Ghunghuti, Manpur, Nowrozabad and local Umaria. A total number of 52 mushroom species belonging to 37 genera, 13 families, and 10 orders were recorded. In this study it was found that order Agaricales was dominant (26 species) followed by boletales (6 species), ganodermatales and polyporales each (5 species), Geastrales (3 species). Clavariales, Auriculariales, Phallales and Xylariales were represented only by 1 species each (Table 2). Results observed under present investigation, particularly for dominance of Agaricales are in agreement

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with the results obtained in different forest of India (Swapna *et al.*, 2008; Tapwal et al., 2013; Kumar et al., 2014).

Dominance of Agaricales was also reported by Pushpa and Purusthoma (2012) who reported Agaricales dominated by 90% in their study conducted in and around Bangalore. Senthilarasu (2014) also reported highest number of agaric species in Agaricales (123) followed by Polyporales (4) and Russulales (3) from Maharashtra. Senthilarasu and Kumaresan (2016) also studied diversity of agaric mycota of Western Ghats of Karnataka, India. Gogoi and Parkash, (2015**)** also reported dominance of Agaricales over other orders in their biodiversity studies. They reported 113 mushroom species belonging to Agaricales in their study in Hollongapar Gibbon Wildlife Sanctuary, Assam**.** Anand et al. (2014) and Parihar et al. (2015) also reported highest number of Agaricales in their biodiversity studies conducted in different parts of India.

Comparative study of Frequency, Density and Abundance of individual mushroom species revealed that Maximum density was exhibited by *Leucoagaricus sp* (8.83). *Ganoderma lucidum* was most frequent species (86.87%) while *Termitomyces heimii* was most abundant species 42.83 in present study (Table 3**).**

Tapwal et al. (2013) reported *Trametes versicolor* and *Schizophyllum commune* with maximum frequency (83.33%), *Microporus xanthopus, Pycnoporus sanguineus* (66.67%) as a second most frequent species. Frequency of *Coprinus disseminates* was 50%. Frequencey of other species was ranging between 16.67-33.33%. *Schizophyllum commune* showed the highest density (126.67%) followed by *Trametes versicolor* (120%) and *Xylaria polymorpha* (93.33%) in his study.

Species diversity of mushrooms by Shannon Index which was found to be 1.6323(Table 4) indicate less interference of human activities and more availability of degradable materials. Eggenschwiler and Barlocher (1985) reported that on worldwide scale, temperature, together with humidity influence on vegetation in different climatic zones, determines the fungal distribution pattern. Pushpa and Purusthoma (2012), reported Shannon diversity Indices in the range of 0.32 - 0.95. Swapna *et al.* (2008) reported Shannon diversity Indices in Moist Deciduous Forest, 5.42 while in Semi Ever Green Forest she recorded 5.57 respectively.

CONCLUSION

The present study is an attempt to give a broad picture of the biodiversity of macrofungi of Umariya district which occupy diverse niches in nature in the forest ecosystem. They predominantly occur during the rainy season and also during spring when the snow melts. Wild mushrooms have a profound biological and economic impact. They have had a long association with human kind. This rich biodiversity of Umaria needs further exploration to widen the nutritional and medicinal base of the rural population who depend on the mushrooms through conservation, cultivation and commercialization activities. The rich diversity of mushrooms in Umaria district of Vindhyan region, offers huge socio-economic potentials. However, they need to be properly documented for optimum application. Hence, this study is an important first step towards producing a checklist of mushrooms of Umaria region.

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