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A checklist of gilled mushrooms (Basidiomycota: Agaricomycetes) with diversity analysis in Hollongapar Gibbon Wildlife Sanctuary, Assam, India

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Abstract: Hollongapar Gibbon Wildlife Sanctuary is comprised of five distinct compartments. A total of 138 species of gilled mushrooms belonging to 48 genera, 23 families, five orders of the class Agaricomycetes, division Basidiomycota, have been collected and analyzed. The order Agaricales was found with the highest number of species (113), followed by Russulales (14), Polyporales (5), Cantharellales (4) and Boletales (2). The species *Coprinellus disseminatus* and *Megacollybia rodmani* have shown the highest (8.26) and the lowest density (0.05), respectively. A total of 24 species, e.g., *Termitomyces albuminosus, Marasmius curreyi, Marasmiellus candidus, Leucocoprinus medioflavus, Mycena leaiana, Hygrocybe miniata, Collybia chrysoropha, Gymnopus confluens* were common with frequency percentage of 11.9, whereas *Megacollybia rodmani* with less frequency percentage (2.4) was found only in few quadrates of the sanctuary. The highly abundant species were *Termitomyces medius* (91.7) and *Coprinellus disseminatus* (86.8), and less abundant species were *Psilocybe wayanadensis* (1.0) and *Lepiota* sp. (1.0) in the study site. The order of the species richness index (*R*) compartment wise was 2>3>4>5>1. Both the Shannon diversity index and Simpson diversity index of agarics was maximum (1.88, 0.98) in compartment 2, whereas minimum (1.72, 0.95) in compartment 1 and 5, respectively. Moreover, the compartment 2 was found very much similar with compartment 3 and very less similar with compartment 1.

Keywords: Agaricomycetes, Agaricales, Boletales, Cantharellales, Polyporales, Russulales.

Mushroom is a general term used for the fruiting body of macrofungi (Ascomycota & Basidiomycota) and represents only a short reproductive stage in their lifecycle (Das 2010). Mushrooms can be epigeous or hypogeous, large enough to be seen with the naked eyes and can be picked by hand (Chang & Miles 1992). The fruiting bodies develop from the underground fungal mycelium. They mostly belong to different groups such as agarics, boletus, jelly fungi, coral fungi, stinkhorns, bracket fungi, puffballs and bird's nest fungi. They have a fertile surface either on lamellae or lining the tubes, opening out by means of pores. The lamellate members are often called agarics or gilled mushrooms and the tube bearing are called poroid mushrooms.

There are approximately 1.5 million species of fungi found on Earth (Hawksworth 1991, 2001, 2004). According to Sarbhoy et al. (1996) the number of fungi species recorded in India were over 27,000. The number of mushroom species alone, recorded in the world were 41,000 of which approximately 850 species were recorded from India (Deshmukh 2004) mostly belonging to gilled mushrooms. The first fungal list in India was published by Butler & Bisby (1931) and was revised by Vasudeva (1960). Later on many additional lists of

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Indian fungal species were published (Bilgrami et al. 1979, 1981, 1991). Indian Agaricales were first reviewed by Sathe & Rahalkar (1978) followed by Manjula (1983) who provided a very exhaustive list of Agaricoid and Boletoid fungi from India and Nepal. Sathe & Kulkarni (1987) published a checklist of 44 species of wild edible mushrooms from southwestern India. Natarajan et al. (2005a) published a checklist of Indian agarics and boletes. Moreover, Natarajan et al. (2005b) reported 195 species of agarics from Tamil Nadu and 28 species from Kerala. Brown et al. (2006) reported 163 morphotypes of macrofungi from Kodagu District of Karnataka. Swapna et al. (2008) enumerated 778 species of macrofungi from Shimoga District of Karnataka. Mani & Kumaresan (2009a, 2009b) recorded 18 and 39 macrofungal species from Tamil Nadu; Mohanan (2011) reported 550 species of macrofungi from Kerala. Pushpa & Purushothama (2012) reported 90 species of mushrooms in and around Bangalore (Karnataka). Usha (2012) reported 120 species and Usha & Janardhana (2014) reported 135 species of macrofungi from Western Ghats (Karnataka). Farook et al. (2013) compiled a literature-based checklist of agarics with 616 species occurring in Kerala State. Pradhan et al. (2013) reported 120 species of macrofungi in the lateritic region of West Bengal. Tiwari et al. (2013) reported 191 wood decaying macrofungi from central India. Verma et al. (2008) described forest fungi of central India. Verma (2014) again reported 282 species of basidiomycetes from central India. Recently, a total of 6,950 sporomas were collected and their diversity and distribution were reported from Chikmagalur District of Western Ghats in Karnataka (Krishnappa et al. 2014).

Northeastern India (a part of Indo Burma) is a biodiversity hotspot (Myers et al. 2000) of the world, a few number of wild macrofungi have been reported from this part by Gogoi & Parkash (2015a, 2015b, 2014), Khaund & Joshi (2013), Tanti et al. (2011), Boruah et al. (1997), and Sing & Sing (1993). A checklist is very important in order to know the distribution of a particular fungal species in different regions of a country or a state. The present study is an attempt for the first time to prepare a checklist of agaricomycetes along with their diversity analysis occurring in Hollongapar Gibbon Wildlife Sanctuary (HGWLS), Jorhat, Assam.

Materials and Methods

Study Area

The HGWLS (Fig. 1) lies between 26.40–26.45^{0}N latitude and 94.18–94.23^{0}E longitude, covering an area of 20.98km^2. The average annual rainfall is 249cm (Ghosh 2007) in the sanctuary and is situated at 100–120 m. As per Champion & Seth (1986), the forest type of the area is Assam plain alluvial semi evergreen forest with pockets of wet evergreen forest. The vegetation is typically a wet evergreen forest mixed with bamboos and canes.

Survey, Preservation and Examination

The survey was conducted during April 2012 to September 2014 in HGWLS, Jorhat for collection and diversity analysis of gilled mushrooms as suggested by Largent (1977). The Sanctuary is comprised of five compartments (Fig. 1) (Hazarika & Gupta 2005; Chetia & Kalita 2012; Gogoi & Parkash 2014) and these compartments show some heterogeneity in terms of size, vegetation composition, canopy density, anthropogenic pressure, topography, soil moisture and soil nutrients (Ghosh 2007). Stratified random sampling technique was used to collect data from different compartments of the sanctuary. Each compartment was considered as a stratum and again each stratum was divided into many sub-strata, based on their vegetation composition, soil nutrients, altitude, slope, aspect, termite mound, disturbance gradient (highly disturbed area, mildly disturbed area, and undisturbed) (Krishnappa et al. 2014). A transect has been made in each sub-stratum measuring 50×20 m and a total 42 transects have been studied in the whole sanctuary in order to extrapolate the total number of agarics species and the number of fruit bodies in each compartment as well as in the whole sanctuary (Table 1 & 2). Important characters require d for identification of gilled mushrooms, such as habit, habitat, substratum, odour, colour and size of the pileus, stipe and volva, presence or absence of veil were noted from the fresh material in the field and photographed in its natural habitat. Photographs of mushrooms collected from the sanctuary, is given in the Images 1–138 (Table 1). The agarics fruit bodies were dried in a hot air oven at 40–50 ^{0}C and stored in air-tight plastic containers with some naphthalene balls and samples of the same species were also preserved in FAA (formalin acetic acid) for further microscopic studies. Identification of the specimens was carried out by standard microscopic methods and also taking various morphological and anatomical features into account (Smith 1963; Ainsworth et al. 1973; Miller 1977; Natarajan 1978; Smith et al. 1979; Afyon et al. 2005). Besides these identification keys, some authentic websites were accessed like www.mushroomobserver.org (accessed on 03 January 2015), www.mushroomexpert.com (accessed on 05 January 2015), www.rogersmushrooms.com (accessed on 06

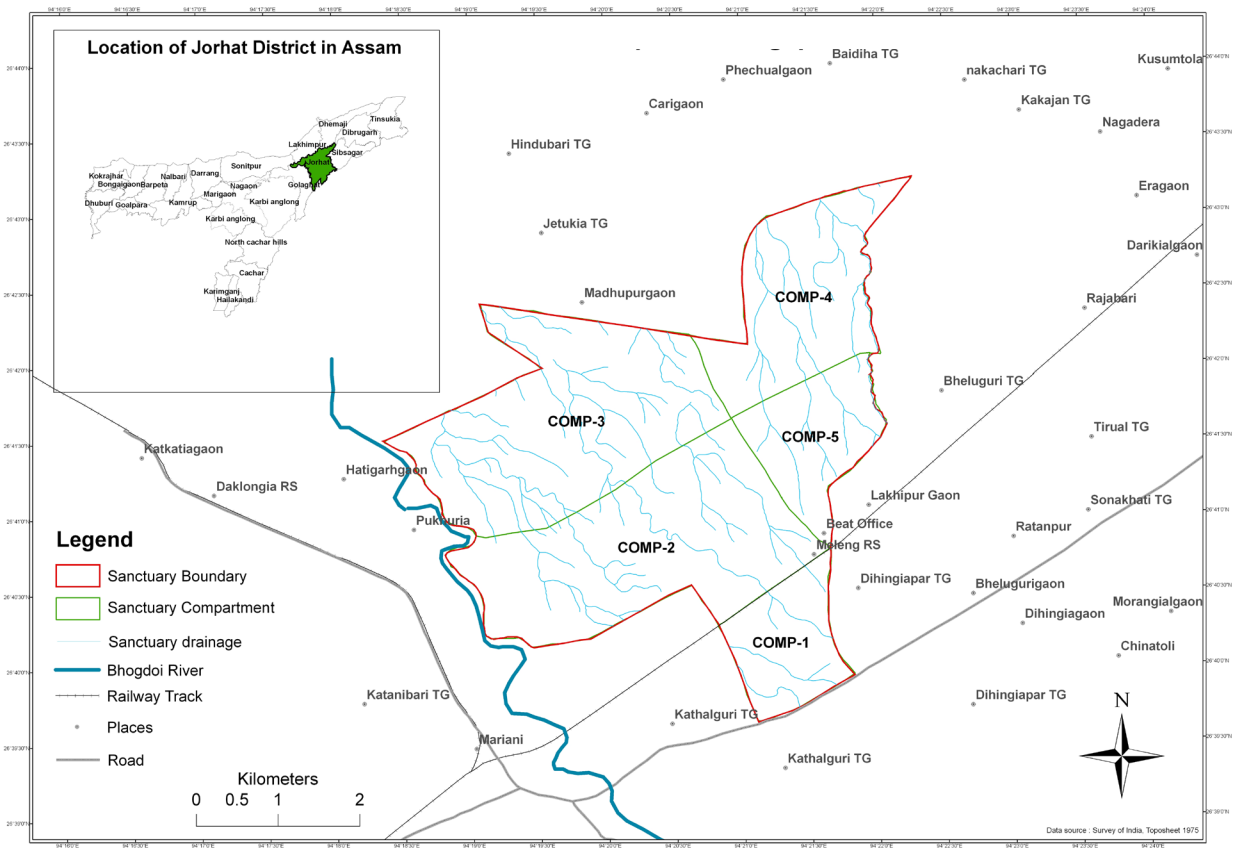

Figure 1. Location map of Hollongapar Gibbon Wildlife Sanctuary - study site

January 2015) in order to identify the collected gilled mushrooms. After proper identification, the current names of the identified mushrooms and their taxonomic details were accessed from the website: www.mycobank.org (accessed on 07 January 2015).

In order to compare the diversity of agarics among the five compartments of the HGWLS, Shannon-Weiner diversity Index *H_* (Shannon & Weaver 1963) and Simpson's Diversity Index (*D*) (Simpson 1949) were used.

Shannon-Weiner Diversity Index (*H_*) = - (*Pi* ×*ln Pi*)

Where, '*i*th' species = one of all the enumerated species,

Pi = *Ni*/*N* (Proportion of the *i*th or each species in the sample), where *Ni*=is individual number of the *i*th or each species, *N*=is individual number of all species, *lnPi* = natural logarithm of this proportion.

$$\textbf{Simpson's Diversity Index (}D\textbf{)} = 1 - \sum \frac{ni(ni-1)}{N(N-1)}$$

Where, *ni*= Individual number of the *i*th or each species.

Margalef's Richness Index (*R*) = *S–1/lnN* (Magurran 1988; Margalef 2008).

Where, *S* is the total number of species in each sample, *lnN* = natural logarithm of *N*

This research method used by a few scholars

Similarity Index was calculated using Sorensen's formula (1948).

$S^{/}$=2C/ (A+B) Where, $S^{/}$ = Degree of similarity, A and B = No. of species at two different sites, C= No. of species common to both the sites.

Results and Discussion

There were 138 species of agarics enumerated in the whole wildlife sanctuary (Table 1 & Images 1–138) belonging to 48 genera, 23 families and five orders of the class Agaricomycetes. The order Agaricales was found with the highest number of species (113), followed by Russulales (14), Polyporales (5), Cantharellales (4) and Boletales (2). The family Agaricaceaewas was found with the highest number of species (27), followed by Tricholomataceae (15), Russulaceae (14), Marasmiacaeaee (11) Lyophyllaceae (9), Psathyrellaceae

(7), Omphalotaceae (6), Strophariaceae (6), Mycenaceae (5), Amanitaceae, Cantharellaceae, Cortinariaceae, Polyporaceae (4 each), Bolbitiaceae, Entolomataceae, Physalacriaceae, Pluteaceae (3 each), Hydnangiaceae, Paxillaceae, Pleurotaceae, Shizophyllaceae (2 each), Inocybaceae and Sparassidaceae (1 each). The species *Coprinellus disseminates*and *Megacollybia rodmani* have shown the maximum density (8.26) and the minimum density (0.05) respectively in the study site. A total of 24 species (Table 1) like *Mycena leaiana, Armillaria* sp., *Collybia cirrhata, Marasmius curreyi, Gymnopus confluens*, *Collybia chrysoropha, Termitomyces albuminosus, Volvariella volvacea, Gymnopilus dilepis, Leucocoprinus medioflavus, Hymenagaricus sp.*-2, *Lepiota clypeolaria, Gymnopus impudicus, Marasmiellus candidus, Hygrocybe lanecovensis, Tricholoma terreum, Hebeloma* sp., *Hygrocybe miniata, Marasmius anomalus, Panaeolus olivaceus, Conocybe sordescens, Tubaria furfuracea, Lepiota erythrosticta, Gymnopilus aeruginosus* with maximum frequency percentage (11.9) were found more frequently, whereas *Megacollybia rodmani* with the minimum frequency percentage (2.38) was found only in some quadrates of the sanctuary.

The abundant species were *Termitomyces medius* (91.67) and *Coprinellus disseminatus* (86.75) and less abundant species like *Psilocybe wayanadensis* (1.00), *Lepiota* sp. (1.00), *Volvariella murinella* (1.33), *Lactarius resimus* (1.33), *Lactarius argillaceifolius* var. *megacarpus* (1.5), *Macrolepiot*a sp. (1.5), *Marasmiellus* sp.-1 (1.67), *Inocybe petchii* (1.67) and *Chlorophyllum molybdites* (1.67) were found in the study (Table 1).

The compartment wise decreasing order for species number (*S*) was 2 > 3 > 4 > 5 > 1, whereas numbers of fruit bodies (*N*) was 2 > 3 > 4 >1 > 5 (Table 2 & Fig. 2). The species richness index (*R*), was in the following trend: 2 > 3 > 4 > 5 > 1, while Shannon diversity index (*H*) 2 > 3 ≥ 4 > 5 ≥ 1 and Simpson diversity index (*D*)2> 3 ≥ 4 > 5 ≥ 1 respectively (Table 2, Fig. 2). The species number, number of fruit bodies, species richness index, Shannon diversity index and Simpson diversity index were maximum in compartment 2 due to lack of anthropogenic pressure, close canopy density, thick litter deposition and decomposition, sufficient soil moisture and rich organic matter. Mason & Last (1986) suggested that the fruit bodies' formation of agarics would be enhanced by litter accumulation and decomposition and extracellular microbial enzymes (Vogt et al. 1983). Li et al. (2012) also found higher value of diversity indices in such type of habitats. Swapna et al. (2008) also found quite low diversity index of macrofungi in the moist deciduous forests in comparison to semi evergreen

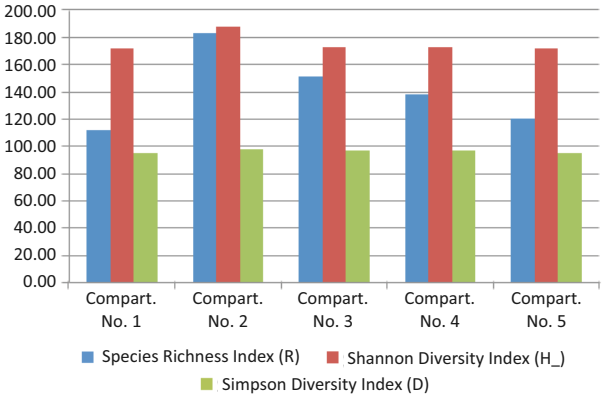

Figure 2. Graphical presentation of diversity analysis in five compartments.
(Note: Data of Species Richness, Shannon Diversity Index, Simpson Diversity Index are multiplied by 100 for easy visual interpretation).

forests of Karnataka. In compartment 1 and 5 the value of diversity indices were minimum, this may be due to the position of these compartments, which are located on the roadside and have frequent human and cattle interferences. Compartment 5 is located towards human habitation (Fig. 1) where interference caused by illegal felling, grazing and browsing is very frequent.

Compartment 2 was considered as a representative compartment of the whole HGWLS because all the agarics species found in the sanctuary were present in this compartment. Therefore, similarity index of the other four compartments was compared with it (Table 3). Compartments 2 & 3 have shown the closest similarity (0.89) and compartment 2 & 1 have shown the minimum similarity (0.72) due to differences and similarities of vegetation composition, canopy density, anthropogenic pressure, habitat fragmentation, litter deposition and decomposition on the forest floor, soil moisture and compartment size.

Conclusion

Agaric mushrooms like *Psilocybe wayanadensis*, *Lepiota* sp., *Volvariella murinella*, *Lactarius resimus*, *Lactarius argillaceifolius* var. *megacarpus*, *Inocybe petchii* and *Chlorophyllum molybdites* are very rare and less abundant in the Hollongapar Gibbon Wildlife Sanctuary, Jorhat, Assam. Therefore, proper in situ and ex situ conservation is required for these agarics. Most of the species of agarics especially, *Termitomyces, Russula* and *Pleurotus* (oyster mushrooms) are edible. It is necessary to conduct more extensive surveys in other protected areas like reserved forests, wildlife sanctuaries and national parks of Assam in order to explore more macrofungi that will be helpful to make updated checklists of the fungi present in the state.

Table 1. List of mushrooms species and their families, orders, density, frequency and abundance in the Hollongapar Gibbon Wildlife Sanctuary, Jorhat, Assam, India

Serial & Image no.	Name of Species	Families	Orders	Density	Frequency	Abundance
1	*Agaricus arvensis* Schaeff.	Agaricaceae	Agaricales	0.45	9.52	4.75
2	*Agaricus aspratus* Berk.	Agaricaceae	Agaricales	0.24	9.52	2.50
3	*Agaricus crocopeplus* Berk. & Broome.	Agaricaceae	Agaricales	0.26	7.14	3.67
4	*Agaricus siccus* Schwein.	Agaricaceae	Agaricales	0.40	9.52	4.25
5	*Agaricus silvaticus* Schaeff.	Agaricaceae	Agaricales	1.45	9.52	15.25
6	*Agaricus* sp.	Agaricaceae	Agaricales	0.12	4.76	2.50
7	*Amanita angustilamellata* (Höhn.) Boedijn	Amanitaceae	Agaricales	0.29	9.52	3.00
8	*Amanita* sp.-1	Amanitaceae	Agaricales	0.24	9.52	2.50
9	*Amanita sp.*-2	Amanitaceae	Agaricales	1.00	9.52	10.50
10	*Amanita vaginata* (Bull.) Lam.	Amanitaceae	Agaricales	0.31	9.52	3.25
11	*Armillaria mellea* (Vahl) P.Kumm.	Physalacriaceae	Agaricales	1.07	9.52	11.25
12	*Armillaria* sp.	Physalacriaceae	Agaricales	3.12	11.90	26.20
13	*Cantharellus cibarius* Fr.	Cantharellaceae	Cantharellales	1.52	7.14	21.33
14	*Cantharellus flavus* M.J. Foltz & T.J.Volk	Cantharellaceae	Cantharellales	2.83	9.52	29.75
15	*Cantharellus* sp.-1	Cantharellaceae	Cantharellales	0.36	4.76	7.50
16	*Cantharellus* sp-2.	Cantharellaceae	Cantharellales	2.17	4.76	45.50
17	*Chlorophyllum hortense* (Murrill) Vellinga	Agaricaceae	Agaricales	1.81	9.52	19.00
18	*Chlorophyllum molybdites* (G. Mey.) Massee	Agaricaceae	Agaricales	0.12	7.14	1.67
19	*Chlorophyllum olivieri* (Barla) Vellinga	Agaricaceae	Agaricales	0.24	9.52	2.50
20	*Clarkeinda trachodes* (Berk.) Singer, Lilloa	Agaricaceae	Agaricales	0.29	9.52	3.00
21	*Clitocybe flaccida* (Sowerby) P. Kumm.	Tricholomataceae	Agaricales	0.71	7.14	10.00
22	*Clitocybe phyllophila* (Pers.) P. Kumm.	Tricholomataceae	Agaricales	1.40	9.52	14.75
23	*Collybia chrysoropha* Berk. & Broome	Tricholomataceae	Agaricales	1.76	11.90	14.80
24	*Collybia cirrhata* (Schumach.) Quél.	Tricholomataceae	Agaricales	3.12	11.90	26.20
25	*Conocybe lactea* f. lactea	Bolbitiaceae	Agaricales	0.36	9.52	3.75
26	*Conocybe sordescens* P.D. Orton	Bolbitiaceae	Agaricales	0.43	11.90	3.60
27	*Coprinellus disseminates* (Pers.) J.E. Lange	Sathyrellaceae	Agaricales	8.26	9.52	86.75
28	*Cortinarius violaceus* (L. Fr.) Gray	Cortinariaceae	Agaricales	0.19	9.52	2.00
29	*Entoloma holoconiotum* (Largent & Thiers) Noordel. & Co-David,	Entolomataceae	Agaricales	0.31	7.14	4.33
30	*Entoloma theekshnagandhum* Manim., A.V.	Entolomataceae	Agaricales	0.36	9.52	3.75
31	*Entoloma vernum* S. Lundell, Svensk bot.	Entolomataceae	Agaricales	1.21	9.52	12.75
32	*Gerronema* sp.	Marasmiaceae	Agaricales	0.26	4.76	5.50
33	*Gerronema strombodes* (Berk. & Mont.) Singer	Marasmiaceae	Agaricales	0.60	7.14	8.33
34	*Gerronema viridilucens* Desjardin, Capelari & Stevani	Marasmiaceae	Agaricales	1.69	9.52	17.75
35	*Gymnopilus aeruginosus* (Peck) Singer	Strophariaceae	Agaricales	0.29	11.90	2.40
36	*Gymnopilus dilepis* (Berk. & Broome) Singer	Strophariaceae	Agaricales	1.45	11.90	12.20
37	*Gymnopilus luteofolius* (Peck) Singer	Strophariaceae	Agaricales	0.17	4.76	3.50
38	*Gymnopus confluens* (Pers.) Antonín	Tricholomataceae	Agaricales	1.88	11.90	15.80
39	*Gymnopus impudicus* (Fr.) Antonin.	Omphalotaceae	Agaricales	0.64	11.90	5.40
40	*Hebeloma* sp.	Strophariaceae	Agaricales	0.55	11.90	4.60
41	*Hemimycena cephalotricha* (Joss. ex Redhead) Singer	Tricholomataceae	Agaricales	3.57	7.14	50.00
42	*Hygrocybe lanecovensis* A.M. Young	Tricholomataceae	Agaricales	0.57	11.90	4.80
43	*Hygrocybe miniata* (Fr.) P. Kumm.	Tricholomataceae	Agaricales	0.55	11.90	4.60
44	*Hymenagaricus* sp.-1	Agaricaceae	Agaricales	1.26	4.76	26.50

45	*Hymenagaricus* sp.-2	Agaricaceae	Agaricales	0.76	11.90	6.40
46	*Inocybe aurantiifolia* Beller Doc.	Cortinariaceae	Agaricales	0.43	9.52	4.50
47	*Inocybe fastigiata* subsp. umbrinella (Bres.) Dermek & J. Veselský	Cortinariaceae	Agaricales	0.67	9.52	7.00
48	*Inocybe petchii* Boedijn	Cortinariaceae	Agaricales	0.12	7.14	1.67
49	*Laccaria amethystina* (Huds.) Cooke.	Hydnangiaceae	Agaricales	0.24	9.52	2.50
50	*Laccaria laccata* (Scop.) Cooke	Strophariaceae	Agaricales	1.62	9.52	17.00
51	*Laccaria* sp.	Hydnangiaceae	Agaricales	0.50	4.76	10.50
52	*Lactarius argillaceifolius* var. megacarpus Hesler & Smith	Russulaceae	Russulales	0.07	4.76	1.50
53	*Lactarius resimus* (Fr.) Fr.	Russulaceae	Russulales	0.10	7.14	1.33
54	*Lentinus polychrous* Lév.	Polyporaceae	Poyporales	1.36	9.52	14.25
55	*Lentinus sajor-caju* (Fr.) Fr.	Polyporaceae	Poyporales	3.31	9.52	34.75
56	*Lentinus squarrosulus* Mont.	Polyporaceae	Poyporales	1.24	9.52	13.00
57	*Lentinus tigrinus* (Bull.) Fr.	Polyporaceae	Poyporales	1.05	9.52	11.00
58	*Lepiota apatelia* Vellinga & Huijser	Agaricaceae	Agaricales	0.48	9.52	5.00
59	*Lepiota clypeolaria* (Bull.) P. Kumm.	Agaricaceae	Agaricales	0.69	11.90	5.80
60	*Lepiota erythrosticta* (Berk. & Broome) Sacc.	Agaricaceae	Agaricales	0.31	11.90	2.60
61	*Lepiota* sp.	Agaricaceae	Agaricales	0.07	7.14	1.00
62	*Leucoagaricus leucothites* (Vittad.) Wasser	Agaricaceae	Agaricales	0.31	9.52	3.25
63	*Leucocoprinus birnbaumii* (Corda) Singer	Agaricaceae	Agaricales	0.50	7.14	7.00
64	*Leucocoprinus brebissonii* (Godey) Locq.	Agaricaceae	Agaricales	0.48	4.76	10.00
65	*Leucocoprinus cepistipes* (Sowerby) Pat.	Agaricaceae	Agaricales	0.31	7.14	4.33
66	*Leucocoprinus cretatus* Lanzoni	Agaricaceae	Agaricales	0.40	9.52	4.25
67	*Leucocoprinus flavescens* (Morgan) H.V. Sm.	Agaricaceae	Agaricales	0.48	9.52	5.00
68	*Leucocoprinus fragilissimus* (Berk. & M.A.Curtis) Pat.	Agaricaceae	Agaricales	1.29	9.52	13.50
69	*Leucocoprinus medioflavus* (Boud.) Bon.	Agaricaceae	Agaricales	1.36	11.90	11.40
70	*Leucocoprinus* sp.	Agaricaceae	Agaricales	3.07	9.52	32.25
71	*Leucopaxillus albissimus* (Peck) Singer	Tricholomataceae	Agaricales	0.21	9.52	2.25
72	*Macrolepiota dolichaula* (Berk. & Broome)	Agaricaceae	Agaricales	1.29	9.52	13.50
73	*Macrolepiota* sp.	Agaricaceae	Agaricales	0.14	9.52	1.50
74	*Marasmiellus candidus* (Fr.) Singer	Omphalotaceae	Agaricales	0.60	11.90	5.00
75	*Marasmiellus ramealis* (Bull.) Singer	Omphalotaceae	Agaricales	0.95	7.14	13.33
76	*Marasmiellus* sp.-1	Omphalotaceae	Agaricales	0.12	7.14	1.67
77	*Marasmiellus* sp.-2	Omphalotaceae	Agaricales	1.55	7.14	21.67
78	*Marasmius anomalus* Lasch, Herb.	Marasmiaceae	Agaricales	0.48	11.90	4.00
79	*Marasmius calhouniae* Singer	Marasmiaceae	Agaricales	3.98	9.52	41.75
80	*Marasmius capillaris* Morgan	Marasmiaceae	Agaricales	5.69	9.52	59.75
81	*Marasmius curreyi* Berk. & Broome	Marasmiaceae	Agaricales	2.55	11.90	21.40
82	*Marasmius haematocephalus* (Mont.) Fr.	Marasmiaceae	Agaricales	0.88	4.76	18.50
83	*Marasmius pulcherripes* Peck	Marasmiaceae	Agaricales	4.69	7.14	65.67
84	*Marasmius siccus* (Schwein.) Fr.	Marasmiaceae	Agaricales	0.33	9.52	3.50
85	*Marasmius sullivantii* Mont.	Omphalotaceae	Agaricales	0.64	7.14	9.00
86	*Marasmius wynnei* Berk. & Broome	Marasmiaceae	Agaricales	3.45	9.52	36.25
87	*Megacollybia rodmani* J.L. Mata, Aime & T.W. Henkel	Tricholomataceae	Agaricales	0.05	2.38	2.00
88	*Mycena interrupta* (Berk.) Sacc.	Mycenaceae	Agaricales	0.40	7.14	5.67
89	*Mycena leaiana* (Berk.) Sacc.	Mycenaceae	Agaricales	4.07	11.90	34.20
90	*Mycena leptocephala* (Pers.) Gillet.	Mycenaceae	Agaricales	1.86	9.52	19.50
91	*Mycena maculata* P. Karst.	Mycenaceae	Agaricales	1.19	9.52	12.50

92	*Oudemansiella canarii* (Jungh.) Höhn.	Physalacriaceae	Agaricales	0.40	9.52	4.25
93	*Panaeolus acuminatus* (Schaeff.) Quél.,	Psathyrellaceae	Agaricales	0.31	9.52	3.25
94	*Panaeolus olivaceus* H.F. Moller	Psathyrellaceae	Agaricales	0.45	11.90	3.80
95	*Panaeolus papilionaceus* (Bull.) Quél.	Psathyrellaceae	Agaricales	0.26	4.76	5.50
96	*Panaeolus subbalteatus* (Berk. & Broome) Sacc.	Psathyrellaceae	Agaricales	0.83	4.76	17.50
97	*Panellus stipticus* (Bull.) P. Karst.	Mycenaceae	Agaricales	2.69	9.52	28.25
98	*Paxillus involutus* (Batsch) Fr	Paxillaceae	Boletales	1.36	9.52	14.25
99	*Paxillus panuoides* (Fr.) Fr.	Paxillaceae	Boletales	0.57	7.14	8.00
100	*Pholiotina cyanopus* (G.F. Atk.) Singer	Bolbitiaceae	Agaricales	0.76	4.76	16.00
101	*Pleurotus pulmonarius* (Fr.) Quél.	Pleurotaceae	Agaricales	0.10	4.76	2.00
102	*Pleurotus* sp.	Pleurotaceae	Agaricales	0.31	7.14	4.33
103	*Pluteus salicinus* (Pers.) P. Kumm.	Pluteaceae	Agaricales	0.17	7.14	2.33
104	*Psathyrella candolleana* (Fr.) Maire, Bull.	Psathyrellaceae	Agaricales	0.36	7.14	5.00
105	*Psathyrella trechispora* (Petch)	Psathyrellaceae	Agaricales	2.12	9.52	22.25
106	*Psilocybe wayanadensis* K.A. Thomas	Strophariaceae	Agaricales	0.10	9.52	1.00
107	*Resupinatus applicatus* (Batsch) Gray	Tricholomataceae	Agaricales	3.02	7.14	42.33
108	*Russula albidula* Peck	Russulaceae	Russulales	0.31	7.14	4.33
109	*Russula atropurpurea* (Krombh.)	Russulaceae	Russulales	0.38	9.52	4.00
110	*Russula burlinghamiae* Singer	Russulaceae	Russulales	0.38	9.52	4.00
111	*Russula compacta* Frost.	Russulaceae	Russulales	0.10	4.76	2.00
112	*Russula cremoricolor* Earle.	Russulaceae,	Russulales	0.33	9.52	3.50
113	*Russula emetica* (Schaeff.) Pers.	Russulaceae	Russulales	0.29	7.14	4.00
114	*Russula fragilis* (Pers.) Fr. (L.) J. Favre	Russulaceae	Russulales	0.31	9.52	3.25
115	*Russula ochroleuca* Pers.	Russulaceae	Russulales	0.26	4.76	5.50
116	*Russula sanguinea* (Bull.) Fr.	Russulaceae	Russulales	0.17	7.14	2.33
117	*Russula subfoetens* W.G.	Russulaceae	Russulales	0.60	7.14	8.33
118	*Russula velutipes* Velen.	Russulaceae	Russulales	0.79	7.14	11.00
119	*Russula* sp.	Russulaceae	Russulales	0.38	9.52	4.00
120	*Schizophyllum commune* Fr.	Shizophyllaceae	Agaricales	5.29	9.52	55.50
121	*Schizophyllum* sp.-1	Shizophyllaceae	Agaricales	1.69	9.52	17.75
122	*Sparassis* sp.-1	Sparassidaceae	Poyporales	0.24	9.52	2.50
123	*Termitomyces albuminosus* (Berk.) R. Heim	Lyophyllaceae	Agaricales	1.69	11.90	14.20
124	*Termitomyces clypeatus* R. Heim	Lyophyllaceae	Agaricales	1.83	7.14	25.67
125	*Termitomyces heimii* K. Natarajan	Lyophyllaceae	Agaricales	0.17	4.76	3.50
126	*Termitomyces medius* R. Heim & Grassé.	Lyophyllaceae	Agaricales	6.55	7.14	91.67
127	*Termitomyces* R. Heim	Lyophyllaceae	Agaricales	1.14	9.52	12.00
128	*Termitomyces* sp.-1	Lyophyllaceae	Agaricales	1.05	7.14	14.67
129	*Termitomyces* sp.-2	Lyophyllaceae	Agaricales	1.67	9.52	17.50
130	*Termitomyces* sp.-3	Lyophyllaceae	Agaricales	2.10	9.52	22.00
131	*Termitomyces* sp.-4	Lyophyllaceae	Agaricales	0.76	7.14	10.67
132	*Tricholoma columbetta* (Fr.) P. Kumm.	Tricholomataceae	Agaricales	0.64	9.52	6.75
133	*Tricholoma strictipes* Karst.	Tricholomataceae	Agaricales	0.40	9.52	4.25
134	*Tricholoma sulphureum* (Bull.) P. Kumm.	Tricholomataceae	Agaricales	0.71	7.14	10.00
135	*Tricholoma terreum* (Schaeff.) P.Kumm.	Tricholomataceae	Agaricales	0.57	11.90	4.80
136	*Tubaria furfuracea* (Pers.: Fr.) Gillet	Inocybaceae	Agaricales	0.38	11.90	3.20
137	*Volvariella murinella* (Quél.) M.M. Moser ex Dennis	Pluteaceae	Agaricales	0.10	7.14	1.33
138	*Volvariella volvacea* (Bull.) Singer	Pluteaceae	Agaricales	1.57	11.90	13.20

Table 2. Diversity analysis in five compartments of HGWLS (*R*: species richness, *H_*: Shannon diversity index, *D*: Simpson diversity index).

	Compartment-1	Compartment- 2	Compartment- 3	Compartment- 4	Compartment- 5
Total number of species (*S*)	78	138	110	100	84
Total number of fruit bodies (*N*)	994	1801	1346	1313	965
Species richness index (*R*)	11.16	18.28	15.13	13.79	12.08
Shannon diversity index (*H*)	1.72	1.88	1.73	1.73	1.72
Simpson diversity index (*D*)	0.95	0.98	0.97	0.97	0.95

Table 3. Degree of similarity between Compartment 2 with other compartments of HGWLS

	Comp. - 2 & 1	Comp. - 2 & 3	Comp. - 2 & 4	Comp. - 2 & 5
Nos. of Species common to both	78	110	100	84
Similarity index	0.72	0.89	0.84	0.76

References

Afyon, A., M. Konuk, D. Yagiz & S. Helfer (2005). A study of wood decaying macrofungi of the Western Black Sea region of Turkey. *Mycotaxon* 93: 319–322.

Ainsworth, G.G., F.K. Sparrow & A.S. Sussman (eds.) (1973). *The Fungi: An Advanced Treatise*. *A Taxonomic Review with Keys*. Academic Press: New York, Vol. IVA & IVB, 621pp & 504pp.

Boruah, P., P. Kailta, D. Bordoloi, P. Gogoi & R.K. Adhikary (1997). Some fleshy fungi of ethnobotanic use from north east India. *Advances in Forestry Research in India* 16: 165–171.

Bilgrami, K.S., Jamaluddin & M.A. Rizvi (1979). *The Fungi of India. Part I (List and Reference)*, Today and Tomorrow's Printers and Publishers, New Delhi, 467pp.

Bilgrami,K.S., Jamaluddin & M.A. Rizvi (1981). *The Fungi of India. Part II (Host Index and Addenda)*, Today and Tomorrow's Printers and Publishers, New Delhi, 128pp.

Bilgrami,K.S., Jamaluddin & M.A. Rizvi (1991). *The Fungi of India. Part III (List and References)*, Today and Tomorrow's Printers and Publishers, New Delhi, 798pp.

Brown, N.S., S. Bhagwat & Watkinson (2006). Macrofungal diversity in fragmented and disturbed forests of the Western Ghats of India. *Journal of Applied Ecology* 43(1): 11–17.

Butler, E.J. & G.R. Bisby (1931). *The Fungi of India. Imperical Council of Agricultural Ressearch India*, Science Monograph 1, XVIII. Calcutta, 237pp.

Butler, E.J. & G.K. Bisby (1960). *The Fungi of India* (Revised by R.S. Vasudeva 1960). ICAR Publication, New Delhi, 552pp.

Champion, S.H.G. & S.K. Seth (1986). *A Review of The Forest Types of India*, Government of India, New Delhi, xxvii+404pp.

Chang, S.T. & P.G. Miles (1992). Mushroom biology - a new discipline. *Mycologist* 6: 64–65.

Chetia, P. & D.K. Kalita (2012). Diversity and distribution of spiders from Gibbon Wildlife Sanctuary, Assam, India. *Asian Journal of Conservation Biology* 1(1): 5–15.

Das, K. (2010). Diversity and conservation of wild mushrooms in Sikkim with special reference to Barsey Rhododendron Sanctuary. *NeBIO* 1(2): 1–13.

Deshmukh, S.K. (2004). Biodiversity of tropical basidiomycetes as sources of novel secondary metabolites, pp. 121–140. In: Jain, P.C. (ed.). *Microbiology and Biotechnology for Sustainable Development*. CBS Publishers and Distributors, New Delhi.

Farook, V.A., S.S. Khan & P. Manimohan (2013). A checklist of agarics (gilled mushrooms) of Kerala State, India. *Mycosphere* 4(1): 97–131; http://dx.doi10.5943 /mycosphere/4/1/6

Ghosh, K. (2007). *Birds of Hoollongapar Gibbon Sanctuary.Newsletter for Birdwatchers* 47(3): 35–40.

Gogoi, G. & V. Parkash (2014). Some New Records of Stinkhorns (Phallaceae) from Hollongapar Gibbon Wildlife Sanctuary, Assam, India. *Journal of Mycology* 2014: 8; http://dx.doi.org/10.1155/2014/490847

Gogoi, G. & V. Parkash (2015a). Diversity of Gasteroid Fungi (Basidiomycota) in Hollongapar Gibbon Wildlife Sanctuary, Jorhat, Assam, India. *Current Research in Environmental & Applied Mycology* 5(3): 202–212; http://dx.doi 10.5943/cream/5/3/5

Gogoi, G. & V. Parkash (2015b). *Lysurus habungianus* sp. nov. (Phallaceae) - A new stinkhorn fungus from India.*Current Research in Environmental & Applied Mycology* 5(3): 248–255; http://dx.doi 10.5943/cream/5/3/7

Hawksworth, D.L. (1991). The fungal dimension of biodiversity: Magnitude, significance, and conservation. *Mycological Research* 95: 641–655.

Hawksworth, D.L. (2001). The magnitude of fungal diversity: The 1.5 million species estimate revisited. *Mycological Research* 105: 1422–1432.

Hawksworth, D.L. (2004). Fungal diversity and its implications for genetic resource collections. *Studies in Mycology* 50: 9–18.

Hazarika, R. & A.K. Gupta (2005). Resource Sharing by Hoolock Gibbon (Bunopithecus hoolock) with two primate species in Gibbon Wildlife Sanctuary, Assam, India, pp. 233–257. *Conservation of Hoolock Gibbon (Bonopithecus hoolock) in Northeast India*. Wildlife Institute of India, Dehradun.

Khaund, P. & S.R. Joshi (2013). Wild edible Macrofungal species consumed by the Khasi tribes of Meghalaya, India. *Indian Journal of Natural Products and Resources* 4(2): 197–204.

Krishnappa, M., S. Swapna & A. Syed (2014). Diversity of macrofungal communities in chikmagalur District of Western Ghats, India. Proceedings of the 8th International Conference on Mushroom Biology and Mushroom Products (ICMBMP8) 71– 82pp.

Largent, D.L. (ed.) (1977). *How to identify mushrooms to genus I: macroscopic features*. Mad River Press, Eureka, 86pp.

Li, S., T. Zhu, G. Liu & H. Zhu (2012). Diversity of macrofungal community in Bifeng Gorge: the core giant panda habitat in China. *African Journal of Biotechnology* 11(8): 1970–1976.

Magurran, A.E. (1988). *Ecological Diversity and its Measurement*. Croom Helm Limited, London, 179pp.

Mani, S. & V. Kumaresan (2009a). Diversity and distribution of macrofungi in the man-made Pitchandikulam Forest of Tamil Nadu, southern India. *Journal of Threatened Taxa* 1(6): 340–343; http://dx.doi.org/10.11609/JoTT.o2129.340-3

Mani, S. & V. Kumaresan (2009b). Occurrence of macrofungi on the Coromandel coast of Tamil Nadu, southern India. *Journal of Threatened Taxa* 1(1): 54–57; http://dx.doi.org/10.11609/JoTT.o1773.54-57

Manjula, B. (1983). *A* revised list of the Agaricoid and Boletoid basidiomycetes from India and Nepal. *Proceedings of the Indian Academy of Sciences (Plant science)* 92: 81–213.

Margalef, R. (2008). Correspondence between the classic types of

Image 1-20. Gilled mushrooms of Hollongapar Gibbon WS. Names of species are given in the Table 1 according to the serial numbers 1-20

Image 21-40. Gilled mushrooms of Hollongapar Gibbon WS. Names of species are given in the Table 1 according to the serial numbers 21-40

Image 41–60. Gilled mushrooms of Hollongapar Gibbon WS. Names of species are given in the Table 1 according to the serial numbers 41–60

Image 61–80. Gilled mushrooms of Hollongapar Gibbon WS. Names of species are given in the Table 1 according to the serial numbers 61–80

Image 81–100. Gilled mushrooms of Hollongapar Gibbon WS. Names of species are given in the Table 1 according to the serial numbers 81–100

Image 101–120. Gilled mushrooms of Hollongapar Gibbon WS. Names of species are given in the Table 1 according to the serial numbers 101–120

Image 121–138. Gilled mushrooms of Hollongapar Gibbon WS. Names of species are given in the Table 1 according to the serial numbers 121–138

lakes and the structural and dynamic properties of their population. *Verhandlungen der Internationalen Vereinigun fur Theoretische und Angewandte Limnologie* 15: 169–170.

Mason, P.A. & F.T. Last (1986). Are the occurrence of sheathing mycorrhizal Fungi in new and regenerating forests and woodlands in Scotland predictable, pp. 63–70. In: Jenkins, D. (ed.). *Tree and Wildlife in Scotish uplands*. Institute of Terrestrial Ecology, Huntingdon.

Miller, O.K. (1977). *Mushrooms of North America*. E.P. Dutton, New York, 368pp.

Mohanan, C. (2011). *Macrofungi of Kerala*. Kerala Forest Research Institute, Hand Book # 27, Kerala, India, 597pp.

Myers, N., R.A. Mittermeler, C.G. Mittermeler, G.A.B. da Fonseca & J. Kent (2000). Biodiversity hotspots for conservation priorities. *Nature* 403(6772): 853–858.

Natarajan, K. (1978). South Indian Agaricales - IV. *Kavaka* 6: 65–70.

Natarajan, K., V. Kumerasan & K. Narayanan (2005a). A checklist of Indian Agarics and Boletes (1984–2002). *Kavaka* 33: 61–128.

Natarajan, K., V. Kumaresan & K. Narayanan (2005b). Biodiversity of agarics from Nilgiri Biosphere Reserve, Western Ghat, India. *Current Science* 88(12): 1890–1892.

Pradhan, P., A. K. Dutta, A. Roy, S.K. Basu & K. Acharya (2013). Macrofungal diversity and habitat specificity: a case study. *Biodiversity* 14(3): 147–161; http://dx.doi.org/10.1080/14888386.2013.805660

Pushpa, H. & K.B. Purushothama (2012). Biodiversity of Mushrooms in and Around Bangalore (Karnataka), India. *American-Eurasian Journal of Agricultural & Environmental Sciences* 12(6): 750–759.

Sarbhoy, A.K., D.K. Agarwal & J.L. Varshney (1996). *Fungi of India* (1982–1992). CBS Publishers and Distributors, New Delhi, 350pp.

Sathe, A.V. & S.R. Rahalkar (1978). Agaricales from South-West India. *Biovigyanam* 3:119 –121.

Sathe, A.V. & S.M. Kulkarni (1987). A check list of wild edible mushrooms from South-West India, pp. 411–413. In: Kaul, T.N. & B.M. Kapur (eds.). *Indian Mushroom Science II.* Regional Research Laboratory, Jammu, India.

Shannon, C.E. & W. Weaver (1963). *The Mathematical Theory of Communication*. University of Illinois Press, Urbana, Illinois, 144pp.

Simpson, E.H. (1949). Measurement of diversity. *Nature* 163: 688.

Sing, N.I. & S.M. Sing (1993). Edible flesh fungal flora of Manipur, *Bioveel* 4(2): 153–158.

Smith, A.H. (1963). *The Mushroom Hunter's Field Guide*. University of Michigan Press, Annarbor, 67pp.

Smith, A.H., H.V. Smith & N.S. Weber (1979). *How to Know the Gilled Mushrooms.* Wm. C. Brown Co. Dubuque, 334pp.

Sorenson, T. (1948). A method of establishing groups of equal amplitude in plant sociology based on similarity of species and its application to analyses of the vegetation on Danish commons. *Kongelige Danske Videnskabemes Selskab* 5(4): 1–34.

Swapna, S., A. Syed & M. Krishnappa (2008). Diversity of Macrofungi in Semi-Evergreen and Moist Deciduous Forest of Shimoga District - Karnataka. *Indian Journal of Mycology and Plant Pathology* 38(1): 21–26.

Tanti, B., L. Gurung & G.C. Sarma (2011). Wild edible fungal resources used by ethnic tribes of Nagaland, India. *Indian Journal of Traditional Knowledge* 10(3): 512–515.

Tiwari, C.K., J. Parihar, R.K. Verma & U. Prakasham (2013). *Atlas of Wood Decaying Fungi of Central India.* Tropical Forest Research Institute, Jabalpur, Madhya Pradesh, 166pp.

Usha, N. (2012). Diversity of Basidiomycetes in different regions of Karnataka (India). *Journal of Ecosystem and Ecography* 2:4 –196; http://dx.doi.org/10.4172/2157-7625.S1.009

Usha, N. & G.R. Janardhana (2014). Diversity of macrofungi in Western Ghats of Karnataka (India). *Indian Forester* 140(5): 531–536.

Verma, R.K., N. Sharma, K.K. Soni & Jamaluddin (2008). *Forest Fungi of Central India.* International Book Distributing Company, Lucknow, India, 418pp.

Verma, R.K. (2014). Biodiversity and Conservation of Forest Fungi of Central India, pp. 543–559. In: Kharwar, R.N., R.S. Upadhyay, N.K. Dubey & R. Raghuwanshi (eds.). *Microbial Diversity and Biotechnology in Food Security*. Springer, India.

Vogt, K.A., E.E. Moore, D. Vogt, M.J. Redlin & R.L. Edmonds (1983). Conifer fine root and mycorrhizal root biomass with in the forest floors of Douglas-fir stands of different ages and site productivity. *Canadian Journal of Forestry Research* 13: 429–437.

www.mushroomobserver.org (accessed on 03 January 2015).

www.mushroomexpert.com (accessed on 05 January 2015).

www.rogersmushrooms.com (accessed on 06 January 2015).

www.mycobank.org (accessed on 07 January 2015).