

UGC-MRP-PROJECT REPORT

1. INTRODUCTION

Mushrooms or macromycetes, a large group of fungi, belonging to kingdom Mycetae, are cosmopolitan heterotrophic organisms with distinct spore bearing fruiting bodies typically produced above ground on soil or other diverse substrates. These fruiting bodies or sporocarps acquire fleshy, subfleshy or sometimes leathery, umbrella like sporophores bearing their fertile surfaces either on lamellae or lining the tubes, opening out by means of pores (Chang and Miles, 1992; Rahi and Malik, 2015). They consist of an extensive network of microscopic thread-like filaments (hyphae), which under favourable conditions of temperature and moisture give rise to one or more fruit body (Roody, 2003). Reflecting the morphological diversity, mushrooms have been generally grouped as agarics, boletes, stinkhorns, cup fungi, bracket fungi, truffles, jelly fungi, puffballs, bird's nest fungi etc. (Karwa and Rai, 2010; Andrew *et al.*, 2013).

Based on substrate preferences, mushrooms are generally referred to as humicolous (growing on humus) e.g. *Russula* spp., *Lactarius* spp., *Lepiota* spp., *Agaricus* spp., lignicolous (i.e growing on wood) e.g *Laetiporus*, *Ganoderma*, *Auricularia*, *Schizophyllum* etc., coprophilous (growing on dung) e.g *Psilocybe* spp., *Coprinus* spp., while some others may show mycorrhizal associations with both broad-leaved forest trees and gymnospermous taxa e.g *Russula*, *Inocybe*, *Paxillus* (Toma *et al.*, 2013). Predominantly eventuating during rainy season and spring season or when snow melts, they occupy diverse niches in nature in the forest ecosystem (Pushpa and Purushothama, 2012).

Current estimated fungi on earth are ranged between 3.5 to 5.1 million species, of which 97,861 species belonging to 8283 genera have been described so far and in this statistics 27,046 are known to be macrofungi (O'Brien *et al.*, 2005; Kirk *et al.*, 2008). Taxonomically, majority of the mushrooms have been recently categorized into two subdivisions viz., Agaricomycotina and Pezizomycotina of the division Basidiomycota and Ascomycota respectively. In Agaricomycotina, Agaricomycetes constitute the largest group of fungi, distributed in 17 orders spread over 100 families whereas, in Pezizomycotina, order Pezizales of Pezizomycetes comprises of 16 families followed by Helotiales (Leotiomycetes) with 10 families.

The Agaricales or euagarics is the most diverse order of the class Agaricomycetes. In "The Agaricales of Modern Taxonomy", Singer (1986) classified Agaricales into three sub-

orders i.e. Agaricineae, Boletineae and Russulineae, having 17 families comprising of 230 genera with over 7000 species worldwide. Hawksworth *et al.* (1995) included 15 families, 297 genera and 6,000 species in the order Agaricales. However, recently Kirk *et al.* (2008) in the “Dictionary of the Fungi” mentioned 33 families consisting of 413 genera and 13, 233 species in this order. Many members of the order are either humicolous or lignicolous, sometimes muscicolous or fungicolous, saprobic, mycorrhizal and rarely parasitic on plants or fungi including several edible, poisonous and hallucinogenic forms (Kirk *et al.*, 2008). Earlier, the order was classified on the basis of presence of gills and umbrella shaped sporocarps, however, genetic and phylogenetic relatedness of different species led to widening of order Agaricales into many non gilled mushrooms also, especially gasteroids, in addition to gilled members (Binder *et al.*, 1997; Matheny and Bougher, 2006).

Boletales, another varied order of class Agaricomycetes contains about 1316 species with diverse array of fruit body types (Kirk *et al.*, 2008). It was earlier found to describe tube fungi but based on micro-morphological and molecular phylogenetic characteristics, a large number of non-tubular species including lamellate and gasteroid forms have recently been established to belong to this group as well (Binder and Hibbett, 2006). It differs from the poroid Aphylophorales in having a soft, fleshy basidiocarp similar to the Agaricales and in tubes being easily separable from the pileus, which usually have a central stipe (Hawksworth *et al.*, 1995). Russuloid group of fungi belonging to order Russulales, includes the agaric genera *Russula* and *Lactarius* and their polyporoid and corticioid relatives. The order is morphologically most distinct, comprising of remarkable variety of sporophore forms including resupinate, discoid, clavarioid, pileate or gasteroid and have smooth, poroid, hydroid to lamellate hymenophore. The members of this order are primarily saprotrophs but some are ectomycorrhizal and root parasites (Miller *et al.*, 2006; Kirk *et al.*, 2008). Hawksworth *et al.* (1995) considered 2 families (Elasmomycetaceae and Russulaceae) having 10 genera and 484 species in this order. Later, the number was raised to 1767 species belonging to 80 genera and 12 families (Kirk *et al.*, 2008).

Class Agaricomycetes also include funnel shaped or pileate sporocarps with smooth, wrinkled or folded hymenophores having smooth, hyaline and inamyloid basidiospores. Such macrofungi have been kept in the order Cantharellales comprising of 544 species belonging to 38 genera and 7 families including Aphelariaceae, Cantharellaceae, Clavulinaceae, Tulasnellaceae etc (Pine *et al.*, 1999; Kirk *et al.*, 2008). Besides, chanterelles (Cantharellaceae), some of the tooth-fungi (Hydnaceae), clavarioid forms (Aphelariaceae and Clavulinaceae) and corticioid mushrooms (Botryobasidiaceae) are also included in this order.

The clavarioid group of mushroom forming fungi belongs to the order Gomphales. Kirk *et al.* (2008) included 336 species spreading over 18 genera and 3 families (Clavariadelphaceae, Gomphaceae and Lentariaceae), whereas, Hawksworth *et al.* (1995) have mentioned about 133 species, 9 genera and 3 families (Gomphaceae, Lentariaceae and Ramariaceae). They are prominent in forest ecosystems as saprotrophs and mutualists and are recognized by their bright colour, coral-like or club-like sporophores that may be simple, cylindrical, clavate to truncate or much branched. The hymenophores are present only in the upper parts of the sporophores or branches.

In addition to basidiocarp forming macrofungi, a group of ascomycetous fungi having large, discoid, cupulate or globose apothecia, sometimes stalked, bearing elongated, thin walled, operculate asci opening by a lid or operculum at tip are included in Pezizales. The ascospores are usually ellipsoidal to occasionally fusoid, aseptate, hyaline to strongly pigmented and often ornamented. They are saprobic, mycorrhizal or parasitic on plants and comprise of 1029 species belonging to 177 genera and 17 families (Hawksworth *et al.*, 1995). But Kirk *et al.* (2008) raised the number of species to 1683 belonging to 199 genera and 16 families. The most common families of this order having the genera of fleshy fungi are Helvellaceae, Morchellaceae, Pezizaceae, Ascobolaceae, Pyronemataceae etc.

From ancient times, these diverse kinds of mushrooms have been considered as good source of food all over the world having high nutritional value almost twice as that of any vegetable (Chauhan *et al.*, 2014). Wild edible mushrooms not only provide high amount of proteins, carbohydrates, dietary fibre but also reported to be a good source of essential antioxidants. Mushroom protein contains all the nine essential amino acids required by humans. In addition, mushrooms are a relatively good source of phosphorus, iron and vitamins including thiamine, riboflavin, ascorbic acid, ergosterol and niacin. WEMs, thus, can be used in the prevention and treatment of various health ailments including modern lifestyle diseases and are also recommended for athletes. Moreover, it has been increasingly used as feed supplements to improve health or treat diseases of pets, domestic and spot animals (Pohleven *et al.*, 2016).

In recent times, mushrooms have drawn worldwide attention as the natural source of diverse and unique bioactive molecules with anti-bacterial, antiviral, anti-inflammatory, anti-cancer, anti-tumour, anti-HIV, hypocholesterolemic, anti-diabetic and hepatoprotective potential (Chang and Buswell, 1996; Ajith and Janardhanan, 2007; Das, 2010; Veena and Pandey, 2012).

The branch of science study of mushroom utilization by humans as food, medicine, in crafts and rituals is known as ethnomycology. The most obvious human interaction with fungi is their consumption as food. The early civilizations of the Greeks, Egyptians, Aryans, Chinese and Mexicans valued mushrooms for their therapeutic value, as delicacy and also used them in religious ceremonies. The Greeks believed mushrooms to provide strength for warriors in battle, Romans considered them as “Food of God” whereas Chinese regarded them as “Elixir of Life”. The Mexican Indians used mushrooms as hallucinogens in religious ceremonies and in witchcraft as well as for therapeutic purposes (Chang and Miles, 1988, 2004; Kumari *et al.*, 2012; Rahi and Malik, 2015).

The State of Jammu and Kashmir has been recognized as one of the hotspot of biodiversity including mushrooms as is evident from the literature (Cooke, 1870, 1876; Berkeley, 1876; Murrill, 1924; Watling and Gregory, 1980; Abraham *et al.*, 1981, 1984; Kaul, 1981; Abraham and Kaul, 1985, 1988; Watling and Abraham, 1986; Abraham, 1991; Dar *et al.*, 2010; Beig *et al.*, 2011; Pala *et al.*, 2014). Although Jammu region has been explored by several mycologists for studying distributional and taxonomical aspects of wild macrofungi (Rampal, 1988; Kumar and Sharma, 2007, 2008a, b, 2009, 2011; Sharma *et al.*, 2012; Kour *et al.*, 2013, 2015a, b, 2016), such studies are found wanting in KHANP.

Kishtwar High Altitude National Park of J&K, exhibits marked variation in topography, altitudinal range and extreme climatic conditions for most of the year thereby, hindering the growth and productivity of biomass. In spite of these, some interesting macrofungi exist in this unique region, but no such work has been done till date. Therefore, the present study was the first attempt to investigate the diversity and ethnomycology of wild macrofungi of Kishtwar High Altitude National Park.

Annexure I (a)

2. Following objectives were proposed and fulfilled during the course of investigation:

1. To collect, identify and enumerate the wild macrofungi of the study area.
2. To work out the distributional pattern of macrofungi with respect to altitude, topography, vegetation cover and anthropogenic activities.
3. To investigate the ethnomycological aspects for generating inventories of wild mushroom resources, documentation of ethno-mycotaxonomical knowledge and extent of exploitation of these fungi as a source of food and nutrition, traditional medicine etc.
4. To make pure cultures of the important wild mushroom species for future cultivation trials and biochemical studies.

Work Plan:

1st year

1. Appointment of research staff and procurement of equipments.
2. Up-gradation of the existing laboratory facilities.
3. Procurement of chemicals and glassware.
4. Identification of the collection sites in the study area and periodic field trips to the study area for the collection of macrofungi samples.
5. Obtaining preliminary data on the occurrence, habitat and diversity of macrofungi in the study area.

2nd year

1. Periodic field trips to the study area for the collection of macrofungal samples.
2. Identification of the collected macrofungal species by studying their macro- and microscopic features.
3. To explore and collect ethnomycological information from the local population and tribals living in the studying area.
4. Selection of taxa for obtaining pure cultures on defined media.

3rd year

1. Continuation of 2nd year plan of work.
2. Analysis of observations and compilation of results.

3. MATERIALS AND METHODS

Area of exploration

Location:

Kishtwar High Altitude National Park (KHANP) is situated in Kishtwar district of Jammu province of Jammu and Kashmir at an altitude of 1763 masl and with GPS coordinates (33°34'57.55"N, 75°59'26.55"E). KHANP is at a distance of 250 kms from Jammu and 160 kms from Kashmir, is rigid and most of the roads connecting the park are muddy and not well constricted. (Plate 1, Figure 1).



Figure 1: Map showing different sites of Kishtwar High Altitude National Park.

Climate:

The climate of the area is harsh, unpredictable and having a weak influence of monsoon. The upper reaches of the park are characterized by severe and prolonged winter followed by short summer season where as the climate becomes temperate and mild in the lower areas. Snowfall takes place mainly during December, January and sometimes even in February, March and November. Severe winter conditions are experienced owing to geographic features coupled with the influence of western disturbances. In the upper reaches and unexposed areas, snow remains deposited for at least nine months and which acts as source of water for different streams during dry summer months. While the average annual rainfall is about 920 mm, mean maximum and minimum temperatures are 16 °C and -2 °C in January and 22 °C and 9 °C in November respectively.

Vegetation:

The flora of Kishtwar High Altitude National Park is well represented by natural treasure of medicinal plants as well as some economically important shrubs and trees. Characterized by marked variation of topography, climate and altitude KHANP has different types of forest vegetation especially on the northern and eastern aspects. Due to a wide range of elevation, aspects, slopes and moisture regime, the national park supports a variety of temperate conifer forests.

The National Park has 13 vegetation types. In general, *Abies alba*, *A. pindrow* and *Pinus wallichiana* mixed with *Cedrus deodara*, *P. griffithii* are pre-dominant from 2400 m. to 3000 m. A small expanse of *P. gerardiana* is notable in the Dhachan range. Lower altitudes (1700m to 2400 m.) show the marked presence of nearly pure stands of cedar as well as blue pine and moist temperature deciduous forests represented by *Aesculus indica* (Himalayan horse chest nut), *Juglans regia*, *Populus ciliata*, *Prunus padus*, *Fraxinus* sp. and *Taxus wallichiana*. The sub-alpine zone from 3000 m, to the tree line at 3700 m supports mostly the forest of *Abies alba* and *Betula utilis* merging with *Rhododendron companulatum* scrub above which is the alpine pasture. The alpine regions are characterized by extensive alpine scrub, meadows, open rocks and glaciers. The lower catchment areas of all the four nallas namely Kibar, Nanth, Kiar and Renai support mixed forests.

Collection of wild mushrooms:

Regular field trips were conducted from 2015 to 2018 for the collection of wild mushrooms from the selected sites. During the survey, healthy and fresh sporocarps were removed carefully from ground. Habit, habitat, odour, texture, colour and various morphological features like shape and dimensions of pileus and stipe were observed and recorded in the field from fresh fruiting body. For colour terminology, Ridgeway (1912) was followed. Photographs of the specimen were taken in their natural habitat. Several chemical tests using KOH, FeSO₄ and NH₄OH were also performed on the pileus and stipe surface of fresh sporocarps in the field. The samples were wrapped individually in an aluminium foil and brown paper bags and each wrapped sample was labelled with specific code in order to avoid mixing with one another. The samples were then placed in wooden baskets or collection bag with heavier ones at the bottom. Spore prints were also taken whenever possible. The specimens were finally sundried and kept in brown paper bags containing naphthalene balls as an insect repellent.

Equipments used during collection of mushrooms.

- Wooden basket and collection bag.
- Small glass bottles for delicate macrofungi.
- Roll of aluminium foil and brown paper bags.
- Magnifying hand lens.
- Nikon DSLR camera for field photography.
- Notepad and ball pen.
- Spore print cards.
- Sharp hunting knife for digging fruiting bodies.
- Scissors, forceps and needles.
- Rubber gloves.
- Some chemicals for field test.

Macro-morphological details:

Various macroscopic characters of mushrooms were carefully noted at the time of collection which would help in the identification of mushroom species.

The following important macroscopic features were noted:

- Habit: solitary, scattered, gregarious, caespitose.
- Pileus: size, shape, colour, scaly, powdery, dry, wet, sticky, marginal characters (enrolled, plicate, uplifted) etc.
- Hymenium: Gills, pores and teeth.
- Stipe: size, shape, colour, position, smooth/scaly, striated/fibrillose, dry/viscid, solid/hollow.
- Lamellae: attachment (free, adnexed, decurrent, sub-decurrent), spacing (crowded, distant, sub-distant), colour, equal/unequal, colour changes, etc., if any.
- Context: colour, consistency, colour change on cutting and bruising, etc., if any.
- Presence or absence of annulus or volva.

Other important taxonomic characters noted in the field were:

- Taste and odour.
- Presence or absence of latex.

Spore print

Colour and pattern of spore prints is a very useful guide in the identification and classification of macrofungi. Therefore, spore prints of some of the gilled fungi were taken during field trips. Fully expanded and healthy fruit bodies were selected for this purpose. In each case, pileus was separated from its stipe at the point of attachment and placed on a white paper with its gills facing the paper and covered with a Petri plate in order to retain moisture. The whole arrangement was kept for two to several hours depending on the humidity and the freshness of the specimen. Colour of the spore print was recorded immediately after acquiring spore deposit.

Preservation of collected mushrooms

After recording all the important taxonomic characters, the collected specimens were preserved for further microscopic studies and also for keeping herbarium records. Two methods of preservation were followed.

A) Wet preservation

The smaller part of the collection was preserved in the liquid preservative formalin (5ml formaldehyde + 25ml rectified alcohol + 70ml distilled water), for future investigation and taxonomic identification (Hawksworth *et al.*, 1995)

B) Dry preservation

Freshly collected specimens were either sun dried or dried in mushroom dryer at 40-50°C. Sun drying was done by placing the fresh collected samples on a white paper or small tray in open sunlight. The time taken for drying the specimens in mushroom dryer, varied from half an hour to twelve hours depending upon the texture of material. After drying, the materials were kept in cellophane bags containing silica gel along with collection number and date. Crystals of naphthalene balls were added to each cellophane bag containing fruiting bodies to avoid any sort of insect infestation. The samples were deposited in the herbarium of the Department of Botany, University of Jammu, Jammu, (Jammu and Kashmir) with accession numbers.

Microscopic details

The microscopic description of specimens was done by reviving the dried specimens in 5% ethanol and then in 3% KOH for 10-15 minutes. The sections were made and stained with different dyes and reagents (1% Congo red, lactophenol, 3% KOH, 2% Iodine solution

and Melzer's reagent. Various features were then observed under 1000X, 400X and sometimes 100x magnification of compound microscope. The measurements were recorded for each character with the help of calibrated ocular micrometer for the description of average dimensions. Microscopic line drawings were made with the aid of camera lucida and microphotography was done using Sony N50 camera attached to an Olympus CH 20i binocular microscope.

Observation on the following microscopic structures was made:

- Basidia/Asci: size, shape, colour, wall thickness, sterigmata (number and length)/and arrangement of basidiospores on them, apical pore and arrangement of ascospores in ascus.
- Basidiospores/Ascospores: size, shape, colour, apiculation, truncation, wall thickness, smooth or ornamentation, guttulation and reaction to Melzer's reagent.
- Cystidia (cheilo, pleuro, pileo and caulo): shape, size, coloured/hyaline, thick/thin walled, ornamentation etc.
- Hyphae (pileus and stipe hyphae): width, hyaline/coloured, thin/thick walled, branched/unbranched, septate/aseptate, hyphal system (monomitic, dimitic, trimitic).
- Clamp connections: present/absent.

Chemical colour reactions

Since reaction of various parts of sporophores such as pileus and stipe surface, flesh, lamellae and spores on application of certain chemicals provide important information in the identification of macrofungi at generic as well as species level, following macroscopic chemical tests were performed in the field:

- 5 % Ammonium hydroxide (NH₄OH).
- 25% Ammonium hydroxide (NH₄OH).
- 5% Ferrous sulphate (FeSO₄).
- 3% KOH (3gm Potassium hydroxide + 97ml distilled water).
- 10% KOH (10gm Potassium hydroxide + 90ml distilled water).

Similarly, following microscopic chemical tests were performed in the laboratory:

- 1% Congo red (1gm Congo red + 99ml distilled water). 20

- Meltzer's reagent (1.5g Potassium iodide + 0.5g Iodine + 22g Chloral hydrate + 20ml distilled water).
- Sulphuric acid (H₂SO₄).

Identification of collected wild mushrooms

Identification of various macrofungal species was done by consulting relevant literature, keys, monographs and books (Smith, 1951; Dissing 1964, 1966; Dissing and Lange 1967; Kempton and Wells 1970; Corner, 1972, Zoberi, 1972; Purkayastha and Chandra, 1976, 1985; Pegler, 1977, 1986; Dennis, 1978; Christensen, 1981; Smith *et al.*, 1981; Natarajan and Raman, 1983; Arora, 1986; Singer, 1986; Kumar *et al.*, 1990; Guzman, 1995; Bessette *et al.*, 1997; Kaul, 1997; Yao *et al.*, 1998; Keirle *et al.*, 2004; Bates *et al.*, 2009; Bougher and Matheny, 2011; Mohanan, 2011; Liang *et al.*, 2011; Dias and Cortez, 2013; Jargeat *et al.*, 2014; Orstadius *et al.*, 2015). Several online available websites were also used for identification and related information (www.mycokokey.com, www.mushroomexpert.com and www.rogersmushrooms.com). Besides this publication including field guides and literature were also procured from the libraries of Indian Agricultural Research Institute (IARI), New Delhi, Panjab University, Chandigarh, Directorate of Mushroom Research, Chambaghat (Solan), Punjabi University, Patiala and Himachal Pradesh University, Shimla. To further authenticate the identification, several mycological experts were also consulted. The classification of macrofungi was done according to Kirk *et al.* (2008). Further CABI's Species fungorum, Libri fungorum and Sylloge fungorum, Hawksworth *et al.* (1995) and Kirk *et al.* (2008) were also consulted.

Ethnomycological studies

Ethnomycological information regarding wild macrofungal species was also incorporated in the present work. In order to gain mycological knowledge, several surveys were conducted in various locations in the peripheral areas of the National park. Information was gathered through semi-structured interviews, discussions and personal observations with tribals, old experienced persons, local informants and by distributing the questionnaire among local populace. They were interviewed in local languages Gojri, bakarwali, Kishtwari, Kashmiri and regional languages to determine their views on historical background, traditional usage, edibility status, folk taxonomy and methods of preservation and commercial importance etc. of the wild mushrooms. Additional data were collected by

showing the original specimens, printed photographs or by showing the photographs on laptop and mobile.

The data related to different recipes was analysed using quantitative indices i.e. use value (UV) and cultural significance index (CSI), quantitative measure for the relative importance of species in the study area. Use value was calculated by the formula:

$$UV = \sum U/n$$

Where, U is the number of use reports cited by each informant for a given species and n refers to the total number of informants.

And cultural significance index (CSI) was calculated by the formula:

$$EMCSI = (PAI + FUI + TSAI + MFFI + KTI + HI+EI) Q1$$

Statistical analysis

Total species richness (S). S was calculated as the cumulative number of macrofungal species recorded over the entire sampling period of two years (Zak et al 2004)

with formula

$$S = \sum Xi \quad \text{Equation 1,}$$

where X is the total species richness of each plot in forest type i.

Simpson's diversity index (D). D was computed using the equation of Simpson (Simpson et al 1949).

$$S = \sum Pi^2 \quad \text{Equation 2,}$$

where $Pi = Ni/N$, and $Ni = \sum ni$

Shannon-Wiener diversity index (H'). H' was calculated using the formula of Shannon and Weaver (Shannon 1949).

$$H' = -\sum Pi \ln Pi \quad \text{Equation 3, where}$$

Pi is the ratio of individuals found belonging to the ith species.

Evenness (E). E was calculated according to Pielou (Pielou et al 1969).

$$E = \frac{H'}{\ln S} \quad \text{Equation 4.}$$

Data analysis

The explanatory variables recorded once from each plot of KHANP were geographical coordinates, altitude, and soil carbon and pH. Additionally, we collected data of minimum and maximum temperature, precipitation, humidity and soil moisture on monthly basis. Climatic data (mean maximum and minimum temperature, precipitation, humidity) were extracted for each plot with the help of high-resolution interpolated database (Hijmans *et al.*, 2005) using ArcGIS software. Soil moisture was studied by collecting the soil samples in aluminium boxes and doing further estimation in the laboratory. For soil pH and carbon, three soil samples were collected from each quadrat at 0-15cm depth. Soil pH was estimated by Systronics pH meter and carbon analysis was done using the method given by Kalra and Maynard (1988). To normalise the data, all the attributes like altitude, soil moisture, pH and carbon were log transformed. In case of minimum temperature, the log transformation was done after adding a constant to each number to make the values positive and non-zero (McDonald, 2014). To down-weight the effect of rare species in the fungal community, the data was transformed using Hellinger equation (Legendre & Gallagher, 2001).

Richness of macro-fungal species was determined as the total number of species observed in each study site. Species richness was compared among the ten study sites using rarefaction curves with the Mao Tau function, reducing the samples to a common number of individuals. Diversity indices calculated as a measure of α -diversity - Fisher's α , Shannon's diversity index (H'), Simpson's diversity index (λ), Margalef's richness index (R_1), Menhinick's richness index (R_2), and Evenness index (E). Whittaker's β -diversity was calculated as a measure of habitat diversity and species turnover between sites. PAST 3.19 (Hammer *et al.* 2001) software was used to do this analysis.

Community ordination of macrofungal species

Hierarchical agglomerative cluster analysis was performed by using the abundance of species in matrix and with the Bray-Curtis distance measure and Flexible beta as linkage method to define different stand types (McCune and Grace 2002). A value of $\beta = -0.25$ was chosen for the group linkage method as this value produces results similar to those obtained using Ward's group linkage method (McCune and Grace 2002). The cluster analysis was executed using software PAST 3.19 (Hammer *et al.* 2001). The relationship between plant species and environmental variations was assessed using canonical correspondence analysis (CCA) (Ter Braak, 1986). In this analysis species scores are weighted averages of eigenvector sample

scores and biplot scores of environmental variables. The importance of each CCA axis is represented by the eigenvalue, which measures how much variation in the species data is explained by the combination of environmental variables for the axis (ter Braak 1995). Intra-set correlations from the CCAs are therefore used to assess the importance of the environmental variables (Abd El-Gani and Amer 2003). Statistical significance of environmental factors was tested by the Monte Carlo permutation test with 999 permutations (ter Braak and Šmilauer 1998). The gradient analysis was performed using the computer program CANOCO version 4.5 (ter Braak & Šmilauer 2002) and diagrams were drawn using CanoDraw 3.1 (Šmilauer 1997).

4. RESULTS:

During the period under report (30-10-2015 to 30-06-2018), systematic surveys were conducted and collection of wild macrofungi was made from 10 sites i.e., Sonder, Lopara, Janakpur, Palmar, Loharna, Deharna, Qedarna, Marwah, Nath, Ekhala of Kishtwar High Altitude National Park (Plate A) of Kishtwar district in Jammu and Kashmir state. The area is surrounded with alpine cover and snowcapped hilly mountains with steep hills and deep valleys occupied by small streams, pastoral lands and agricultural fields along the bottom. The KHANP is characterized by its harsh climate, wilderness, extreme cold that make the area an unusual habitat to live in.

During the survey, as many as 150 collections of macrofungi were made. Out of these, a total of 83 wild macrofungal species, belonging to 37 genera spread over in 23 families and 9 orders of 2 classes (Agaricomycetes and Pezizomycetes) were identified and illustrated (Table 1, Figure 1 and 2). Of the 83 macrofungi, 12 species comprising of *Gyromitra* (1 species), *Helvella* (3 species), *Morchella* (4 species), *Peziza* (3 species) and *Geopora* (1 species) belong to class Pezizomycetes. The class Agaricomycetes, on the other hand, comprised of 71 species viz., *Agaricus* (3 species), *Bovista* (4 species), *Apioperdon* (1 species), *Calvatia* (4 species), *Chlorophyllum* (1 species), *Coprinus* (1 species), *Lepiota* (1 species), *Cystolepiota* (1 species), *Leucoagaricus* (1 species), *Lycoperdon* (5 species), *Macrolepiota* (1 species), *Flammulina* (1 species), *Coprinellus* (2 species), *Coprinopsis* (1 species), *Pholiota* (2 species), *Gymnopilus* (2 Species), *Schizophyllum* (1 species), *Amanita* (4 species), *Pleurotus* (3 species), *Clavaria* (1 species), *Boletus* (4 species), *Suillus* (1 species), *Scleroderma* (3 species), *Cantharallus* (2 species), *Ramaria* (5 species), *Sparassis* (2 species), *Lactarius* (4 species), *Russula* (4 species), *Hericium* (1 species), *Auricularia* (1 species), and *Geastrum* (4 species).

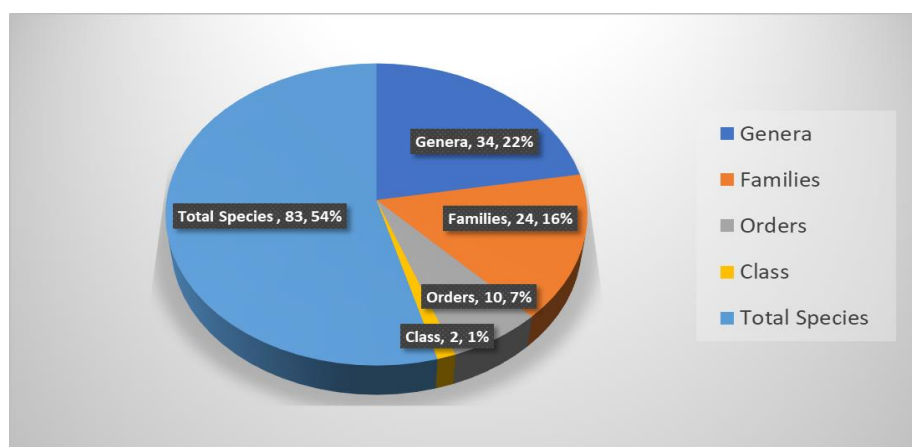


Figure 1: Percent representation of different groups of macrofungi.

Table 1: Members of wild macrofungi recorded from the study area.

S.No.	Names of macro fungal taxa	Area of collection	Habitat	Accession number
Class Pezizomycetes				
Order Pezizales				
Family Discinaceae				
1.	<i>Gyromitra esculenta</i> (Pers.) Fr.	A2, A7,A10	Humicolous	HBJU-583
Family Helvellaceae				
2.	<i>Helvella acetabulum</i> (L.) Quéf.	A1, A3,A7, A10	Ectomycorrhizal	HBJU-580
3.	<i>H. atra</i> J. König	A2,A3,A5, A8,A9,A10	Ectomycorrhizal	HBJU-581
4.	<i>H. macropus</i> (Pers.) P. Karst.	A1, A4, A7	Bryophilous	HBJU-582
Family Morchellaceae				
5.	<i>Morchella crassipes</i> (Vent.) Pers.	A3,A7,A9	Humicolous	HBJU-619
6.	<i>M. deliciosa</i> Fr.	A2,A5	Humicolous	HBJU-585
7.	<i>M. elata</i> Fr.	A2, A4,A5,A6, A9,	Humicolous	HBJU-584
8.	<i>M. esculenta</i> (L.) Pers.	A1, A3,,A7, A9	Humicolous	HBJU-586
Family Pezizaceae				
9.	<i>Peziza ampliata</i> Pers.	A2, A5, A10	Bryophilous	HBJU-587
10.	<i>P. badia</i> Pers.	A1, A3,A4,A8,A9,A10	Bryophilous	HBJU-588
11.	<i>P. succosa</i> Berk.	A4,A6, A8,A9,A10	Humicolous	HBJU-589
Family Pyronemataceae				
12.	<i>Geopora arenicola</i> (Lev.) Kers	A1,A2, A6, A7, A8, A10	Humicolous	HBJU-590
Class Agaricomycetes				
Order Agaricales				
Family Agaricaceae				
13.	<i>Agaricus arvensis</i> Schaeff	A6, A8,A9,A10	Humicolous	HBJU-591
14.	<i>A. californicus</i> Peck	A3, A5,A7,A10	Humicolous	HBJU-592
15.	<i>A. langei</i> (F.H. Moller) F.H. Moller	A4, A6	Humicolous	HBJU-620
16.	<i>Apioperdon pyriforme</i> (Schaeff.) Vizzini	A2,A5,A8	Humicolous	HBJU-618
17.	<i>Bovista colorata</i> (Peck) Kreisel	A5,A8	Humicolous	HBJU-621
18.	<i>B. minor</i> Morgan	A4,A5,A9	Humicolous	HBJU-595
19.	<i>B. plumbea</i> Pers.	A4,A7,A8	Humicolous	HBJU-622
20.	<i>B. pusilla</i> (Batsch) Pers.	A5,A8,A9	Humicolous	HBJU-623
21.	<i>Calvatia bovista</i> (L.) T. Macbr.	A6,A8,A10	Humicolous	HBJU-662
22.	<i>C. elata</i> (Massee) Morgan	A4,A6,A8	Humicolous	HBJU-624
23.	<i>C. lycoperdoides</i> Koscielný & Wojt	A1,A3,A4,A6	Humicolous	HBJU-625
24.	<i>Calvatia. sp.</i>	A4,A5,A9	Humicolous	HBJU-626
25.	<i>Chlorophyllum molybdites</i> (G. Mey.) Massee	A2,A4,A5,A10	Humicolous	HBJU-593
26.	<i>Coprinus comatus</i> (O.F. Mull.) Pers.	A4,A7,A10	Bryophilous	HBJU-596
27.	<i>Lepiota procera</i> (Scop.) Gray	A1,A7, A10	Humicolous	HBJU-627
28.	<i>Cystolepiota sistrata</i> (Fr.) Singer ex Bon & Bellù	A2, A5,A8,A10	Humicolous	HBJU-628
29.	<i>Leucoagaricus rubrotinctus</i> (Peck) Singer	A5, A7,A9	Humicolous	HBJU-629

30.	<i>Lycoperdon molle</i> Pers	A8,A9	Humicolous	HBJU-630
31.	<i>L. caudatum</i> J. Schrot.	A1,A7,A9,A10	Humicolous	HBJU-631
32.	<i>L. perlatum</i> Pers	A1,A5,A7,A8,A10	Humicolous	HBJU-632
33.	<i>L. rimulatum</i> Peck	A3,A6,A9	Humicolous	HBJU-633
34.	<i>L. umbrinum</i> Pers.	A5,A8,A9	Humicolous	HBJU-634
35.	<i>Macrolepiota procera</i> (Scop.) Singer	A1,A3,A6,A7,A8,A10	Humicolous	HBJU-594
Family Physalacriaceae				
36.	<i>Flammulina velutipes</i> (Curtis) Singer	A3,A5	Lignicolous	HBJU-599
Family Psathyrellaceae				
37.	<i>Coprinellus domesticus</i> (Bolton) Vilgalys, Hopple & Jacq. Johnson	A5,A9	Lignicolous	HBJU-636
38.	<i>C. micaceus</i> (Bolton) Vilgalys, Hopple & Jacq. Johnson	A1,A3,A8,A10	Coprophilous	HBJU-637
39.	<i>Coprinopsis atramentaria</i> (Bull.) Redhead Vilgalys & Moncalvo.	A1,A3,A6,A9	Humicolous	HBJU-597
Family Strophariaceae				
40.	<i>Pholiota squarrosa</i> (Vahl) P. Kumm.	A2,A4,A5,A9,A10	Humicolous	HBJU-600
41.	<i>Pholiota</i> sp.	A4,A7,A9	Humicolous	HBJU-638
42.	<i>Gymnopilus sapineus</i> Fries (Fr.) Murrill.	A2,A4, A5, A7,A9, A10	Lignicolous	HBJU-598
43.	<i>Gymnopilus</i> sp.	A7,A9	Lignicolous	HBJU-635
Family Shizophyllaceae				
44.	<i>Schizophyllum commune</i> Fr.	A1,A3,A5,A6,A7,A9	Lignicolous	HBJU-615
Family Amanitaceae				
45.	<i>Amanita flavoconia</i> G.F. Atk.	A1,A2,A5,A8	Humicolous	HBJU-601
46.	<i>A. pantherina</i> (DC.) Krobh.	A1,A5,A10	Humicolous	HBJU-639
47.	<i>A. phalloides</i> (Vaill. Ex Fr.) Link	A4,A10	Humicolous	HBJU-640
48.	<i>A. vaginata</i> (Bull.) Lam.	A3,A5,A9	Humicolous	HBJU-602
Family Pleurotaceae				
49.	<i>Pleurotus ostreatus</i> (Jacq. Ex. Fr.) P. Kumm	A3,A5	Lignicolous	HBJU-641
50.	<i>P. pulmonarius</i> (Fr.) Quel.	A1,A3	Lignicolous	HBJU-642
51.	<i>P. squarrosulus</i> (Mont.) Singer	A2,A4,A5,A8,A9	Lignicolous	HBJU-603
Family Clavariaceae				
52.	<i>Clavaria fragilis</i> Holmsk.	A5,A9	Humicolous	HBJU-649
Order Boletales				
Family Boletaceae				
53.	<i>Boletus edulis</i> Bull.	A3,A4,A7,A8	Humicolous	HBJU-604
54.	<i>B. formosus</i> Corner	A1,A5,A7	Humicolous, Mycorrhizal	HBJU-643
55.	<i>B. granulatus</i> (L.) Roussel	A5,A9	Humicolous, Mycorrhizal	HBJU-644
56.	<i>B. luridus</i> (Schaeff) Murrill	A1,A2,A5,A7,A8,A10	Ectomycorrhizal	HBJU-605
Family Suillaceae				
57.	<i>Suillus cavipes</i> (Klotzsch) A.H. Sm. & Thiers	A1,A5,A8,A10	Ectomycorrhizal	HBJU-645
Family Sclerodermataceae				
58.	<i>Scleroderma citrinum</i> Pers.	A2,A4,A6,A9	Ectomycorrhizal	HBJU-606

59.	<i>S. polyrhizum</i> (J. F. Gmel.) Pers.	A3,A6,A8	Humicolous	HBJU-646
60.	<i>S. verrucosum</i> (Bull.) Pers.	A5	Humicolous	HBJU-647
Order Cantharallales				
Family Cantharellaceae				
61.	<i>Cantharellus cibarius</i> Fr.	A1, A3, A6, A8	Humicolous	HBJU-607
62.	<i>Craterellus tubaeformis</i> (Fr.) Quel	A3	Humicolous	HBJU-648
Order Gomphales				
Family Gomphaceae				
63.	<i>Ramaria apiculate</i> (Fr.) Donk	A3,A7	Humicolous	HBJU-609
64.	<i>R. aurea</i> (Schaeff.) Quel	A1,A2,A6,A8, A10	Humicolous	HBJU-610
65.	<i>R. flava</i> (Schaeff.) Quél	A6,A8	Humicolous	HBJU-651
66.	<i>R. stricta</i> (Pers.) Quél.	A4,A5,A8	Humicolous	HBJU-652
67.	<i>R. formosa</i> (Pers.) Quel.	A7	Humicolous	HBJU-653
Order Polyporales				
Family Sparassidaceae				
68.	<i>Sparassis crispa</i> (Wulfen) Fr.	A2,A4,A5,A6,A10	Humicolous	HBJU-608
69.	<i>S. radicata</i> (Weir)	A4,A5,A6,A10	Humicolous	HBJU-650
Order Russulales				
Family Russulaceae				
70.	<i>Lactarius delicious</i> (L.) Gray	A1,A3,A7,A8,A9,A10	Humicolous	HBJU-612
71.	<i>L. deterrimus</i> Groger	A1,A4,A8	Humicolous	HBJU-654
72.	<i>L. vellerreus</i> (Fr.) Fr.	A4,A6	Humicolous	HBJU-655
73.	<i>L. volemus</i> (Fr.) Fr.	A2,A4,A7	Humicolous	HBJU-611
74.	<i>Russula annulata</i> var. <i>annulata</i> R. Heim	A5,A7	Humicolous	HBJU-656
75.	<i>R. squalida</i> Peck, Bull.	A1,A5,A8	Ectomycorrhizal	HBJU-657
76.	<i>R. cynoxantha</i> (Schaeff.) Fr.	A1,A3,A9	Humicolous	HBJU-658
77.	<i>R. rosea</i> Pers.	A1,A5	Ectomycorrhizal	HBJU-613
Family Hericiaceae				
78.	<i>Hericium erinaceus</i> (Bull.) Persoon	A2,A4,A7,A9	Lignicolous	HBJU-614
Order Auriculariales				
Family Auriculariaceae				
79.	<i>Auricularia auricula-judae</i> (Bull.) Quel	A2,A8,A10	Lignicolous	HBJU-616
Order Geastrales				
Family Geastraceae				
80.	<i>Geastrum campestre</i> Morgan	A7,A9	Humicolous	HBJU-659
81.	<i>G. saccatum</i> Fr.	A1,A4	Humicolous	HBJU-617
82.	<i>G. triplex</i> Jungh	A6,A7,A10	Humicolous	HBJU-660
83.	<i>G. velutinum</i> Morgan	A4,A6,A8	Humicolous	HBJU-661

A1 = Sonder, A2 = Lopara, A3 = Janakpur, A4 = Palmar, A5 = Loharna, A6 = Deharna, A7 = Qedarna, A8 = Marwah, A9 = Nath, A10 = Ekhala

All these identified taxa have been described illustrated along with habitat photographs and microscopic characteristics have been presented in the form of camera lucida drawings and microphotography.

4.1 Macro- and microscopic taxonomic description of the collected wild mushrooms.

Class Ascomycetes

Order Pezizales

4.1.1 Family Discinaceae

1. Gyromitra esculenta (Pers.) Fr., *Summa veg. Scand.*, Sectio Post. (Stockholm): 346 (1849)

Synonymy: *Helvella esculenta* Pers., *Comm. Schaeff. Icon. Pict.*: 64 (1800)

Gyromitra esculenta (Pers.) Fr., *Summa veg. Scand.*, Sectio Post. (Stockholm): 346 (1849) var. *esculenta*

Collection examined: Jammu and Kashmir, KHANP, Loopara, Qaderna and Ekhala area of KHANP, humicolous, scattered to gregarious, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-583, March 2016, August 2016. Altitude-1986m, (Plate IVa, Plate IVA1).

Carpophore: 6-11 cm high and pileate; **Pileus:** 3.1-4.5 cm long and 2.7-4.6 cm wide, subglobose, irregularly lobed and circumvolute, fused to stipe in several locations, brownish or sometimes reddish brown; **Stipe:** 2.9-3.7 cm. compressed, cream coloured or tinged with pink or violet, glabrous to pruinose in whole length, enlarged at the base; **Flesh:** whitish, fragile, waxy, strong mushroom odour; sweet flavoured; **Asci:** 156.8-280 x 14.4-17.6 μm wide at the top and middle and 11.2 μm wide at the base, cylindrical to sub-cylindrical, apex obtuse, eight spored; **Ascospores:** elliptical, 16.0-27.2 x 9.6-14.4 μm , smooth, biguttulate; **Paraphyses:** 145.6-174.4 x 9.6-14.4 μm wide at the top, 11.2-17.6 μm wide at the middle and 11.2 μm wide at the base, clavate, thin-walled; **Pubescent hairs:** septate, 6.4-12.8 μm wide, branched, hyaline.

Edibility: The species is edible in the study area.

Remarks: A new report from state and KHANP.

4.1.2 Family Helvellaceae

2. Helvella acetabulum (L.) Quél., *Hyménomycètes*, Fasc. Suppl. (Alençon): 102 (1874)

Synonymy: *Acetabula vulgaris* Fuckel, *Jb. nassau. Ver. Naturk.* 23-24: 330 (1870) [1869-70]

Macroscyphus acetabuliforme Gray, *Nat. Arr. Brit. Pl.* (London) 1: 772 (1821)

Collection examined: Jammu and Kashmir, KHANP, Sondar, Janakpur, Qaderna and Ekhala areas, ectomycorrhizal, scattered, mixed forests of *Cedrus deodara*, *Populus nigra* and *P.*

caspica, S.A.J. Hashmi and Y.P. Sharma, HBJU-580, May 2017, July 2016, (Plate IVb, Plate IVA2).

Carpophore: cup shaped, 3.2-3.9 cm in diameter, grey-brown (vintage walnut), buffy olive (pl.) towards outer, margins slightly splitted, smooth, ribs prominent, whitish to creamish, extending nearly to the margin of the cup; **Stipe:** short, 2.9-3.3 cm, short, white, broader at the apex and narrow towards end, interior chambered; **Asci:** cylindrical, 163.2-228.8 μm long, 12.8-14.4 μm wide at the distal end, 14.4-16.0 μm at the middle and 6.4-9.6 μm at the base, hyaline, thin walled, each ascus contain eight ascospores; **Ascospores:** sub-globose to oval, 11.2-17.6 \times 11.2-14.4 μm , thin walled, shiny white, smooth, mono to multiguttulate; **Paraphyses:** filiform, 3.2-4.8 μm wide, thin walled, hyaline, septate with swollen at the tip; **Pubescent hairs:** 6.4-18.4 μm wide, septate, branched.

Edibility: Not recommended (McClintock and Fuller, 1986)

Distribution: The species is well represented in North America, Europe, China and Japan (Orr and Orr, 1979; Nagao, 2002; Zhuang, 2004).

Remarks: First report from KHANP.

3. *HeIvella atra* J. Koenig: 20 (1770), in Olafsens & Povelsens, *Reisen ingien. Island*, Append.: 20 (1770)

Synonymy: *Leptopodia atra* (J. Koenig) Boud., (1907)

Collection examined: Jammu and Kashmir, KHANP, Loopara, Janakpur, Loharna, Marwah, Nath and Ekhala, ectomycorrhizal, scattered to gregarious, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-581, June 2017, July 2016 (Plate IVc, Plate IVA3).

Carpophore: 4.2 cm high; **Pileus:** 0.9-1.7 \times 1.2-2.5 cm with slightly incurved margins, dusky neutral gray (LIII. m), smooth; **Stipe:** 2.3-3.1 \times 1.9 cm, smooth. concolorous with pileus, slightly inflated, soft and hollow; **Asci:** 179.2- 243.2 μm long and upto 17.6 μm , eight-spored, cylindrical to sub-cylindrical, apex obtuse; **Ascospores:** 16.0-19.2 \times 11.2-12.8 μm , uniseriate, sometimes irregularly placed, sub-hyaline, ellipsoidal, smooth, guttulate with large central oil drops; **Paraphyses:** upto 196.8 \times 9.6 μm wide at the top and 4.8 μm at the base, septate, simple, thin-walled, sub-hyaline.

Edibility: Edible in study area.

Distribution: On humicolous soil from Solan and Kashmir (Sohi *et al.*, 1965; Kaul, 1971)

Remarks: A new report from KHANP.

4. *Helvella macropus* (Pers.) P. Karst., *Bidr. Känn. Finl. Nat. Folk* 19: 37 (1871)

Synonymy: *Helvella bulbosa* (Hedw.) Kreisel, *Boletus*, *SchrReihe* 1: 29 (1984)
Lachnea macropus (Pers.) W. Phillips, *Man. Brit. Discomyc.* (London): 207 (1887)
Macropodia macropus (Pers.) Fuckel, *Jb. nassau. Ver. Naturk.* 23-24: 331 (1870) [1869-70]

Collection examined: Jammu and Kashmir, Sondar, Palmar and Qedarna, bryophilous, scattered, marshy area dominated by mosses, S.A.J. Hashmi and Y.P. Sharma, HBJU-582, May 2017, July 2016. (Plate IVd, Plate IVA4)

Carpophore: saucer shaped, 1.3-2.9 cm in diameter, hymenium blackish, ribs usually absent, margins plane to slightly curved over the surface of the cup; **Stipe:** 1.4-2.8 cm long, slightly swollen near the base, upper part concolorous, paler below, smooth; **Asci:** cylindrical, 200.0-280.0 μm in length, 10.0-12.0 μm wide at the top, 12.0-16.0 μm at the middle and 6.4-9.6 μm at the base, hyaline, thin walled, eight spored; **Ascospores:** sub-globose to ellipsoidal, 14.7-17.6 \times 8.0-10.4 μm , thin walled, shiny white; **Paraphyses:** filiform, 4.0-6.4 μm wide, thin walled, hyaline, septate; **Pubescent hairs:** up to 26.0 μm wide, septate, furcate.

Edibility: Edible (Kaul *et al.* 1978) consumed in study area.

Distribution: Earlier reported from Kashmir (Kaul *et al.*, 1978) and Nainital (Joshi *et al.*, 1982)

Remarks: A new report from State and KHANP

4.1.3 Family Morchellaceae

5. *Morchella crassipes* (Vent.) Pers., *Syn. Meth. Fung.* (Gottingen) 2: 621 (1801).

Synonymy: *Mitrophora hybrida* var. *crassipes* (Vent.) Boud., *Bull. Soc. Mycol. Fr.* 13: 152 (1897)

Morchella esculenta var. *crassipes* (Vent.) Kreisel, *Boletus*, *SchrReihe* 1: 29 (1984)

Collection Examined: Jammu and Kashmir, KHANP, Janakpur, Qadarna and Nath, gregarious, fasciculate, humicolous, in cultivated fields, S.A.J. Hashmi and Y.P. Sharma, HBJU-619, March 2016, April 2017. (Plate IVe, Plate IVB1)

Apothecia: 4.4-7.6 cm long; **Pileus:** 1.5-3.4 cm wide, black in colour, elongated, sub-conic, pits large and shallow; **Stipe:** 1.7-2.6 cm wide, light cream in colour, hollow, soft, conspicuously swollen at the base; **Asci:** cylindrical to sub-cylindrical, 254.4-323.2 μm long and 17.6-25.6 μm wide at the apex, 19.2-22.4 μm in the middle and 16.0-19.2 μm at the base; **Ascospores:** 14.4-30.4 \times 10.4-16.0 μm , elliptical, hyaline, eguttulate but with few external

polar oil droplets at each end; **Pubescent hairs:** septate, branched, hyaline, 12.8-16.0 µm wide; **Stipe hyphae:** hyaline, septate, branched, 6.4-12.0 µm wide.

Edibility: Edible in the study area.

Distribution: Earlier reported from Himachal Pradesh (Lakhanpal and Shad, 1986-87) and Kashmir (Waraitch, 1976).

Remarks: A new report from KHANP

6. *Morchella deliciosa* Fr., *Syst. mycol.* (Lundae) 2(1): 8 (1822)

Synonymy: *Morchella deliciosa* var. *elegans* Boud., *Bull. Soc. mycol. Fr.* 13: 144 (1897)

Morilla deliciosa (Fr.) Quél., *Compt. Rend. Assoc. Franç. Avancem. Sci.* 20(2): 465 (1892)

Morchella conica var. *deliciosa* (Fr.) Cetto, *Enzyklopädie der Pilze*, Band 4: Täublinge, Milchlinge, Boviste, Morcheln, becherlinge u.a. (München): 403 (1988)

Collection examined: Jammu and Kashmir, KHANP, Lopara and Loharna, humicolous, scattered, *Populus nigra*, *Prunus armeniaca* and *Salix alba*, S.A.J. Hashmi and Y.P. Sharma, HBJU 585, March 2016, April 2017. (Plate IVf, Plate IVB2)

Carpophore: rounded to sub-globose, 7.3-9.2 × 3.7-5.3 cm, dark brown, pits irregular, pits up to 1.2 cm wide, irregular to rounded, ridges slight paler than furrows at early maturity but become more dark after drying; **Stipe:** 4.2-5.1 cm in length and 3.3-4.2 cm in width, white, equal to slightly broader towards base, smooth, irregular folded base; **Asci:** cylindrical, 82.4-110.4 µm long, 4.8-6.4 µm wide at top, 5.6-6.4 µm at middle and 1.6-3.2 µm at bottom, thin walled, hyaline; **Ascospores:** not formed; **Paraphyses:** 8.8-14.4 µm wide, thin walled, hyaline, branched, prominently septate, darkly stained; **Stipe hyphal elements:** oval, up to 34.4 µm wide, thin walled, hyaline, septa conspicuous. **Stipe hyphae:** up to 9.6 µm, thin walled, hyaline, branched, septate.

Edibility: Not consumed in study area.

Distribution: Earlier reported from Amritsar, Punjab, Kashmir (Cooke, 1870; Waraitch, 1976b; Kaul *et al.*, 1978).

Remarks: First record from KHANP of Jammu and Kashmir.

7. *Morchella elata* Fr., *Syst. mycol.* (Lundae) 2(1): 8 (1822)

Synonymy: *Boletus esculentus* var. *pinguis* (Thore) Pers., *Mycol. eur.* (Erlanga) 2: 131 (1825)

Morchella purpurascens (Krombh. ex Boud.) Jacquet., *Les Morilles* (Paris): 44 (1984)

Morchella elata var. *nivea* Konrad, *Bull. Soc. mycol. Fr.* 39(1): 45 (1923)

Collection examined: Jammu and Kashmir, KHANP, Lopara, Palmar, Loharna, Deharna and Nath, humicolous, gregarious, deciduous forests of *Populus nigra* and *Salix alba*, S.A.J. Hashmi and Y.P. Sharma, HBJU-584, March 2016. (Plate IVg, Plate IVB3).

Carpophore: conical, 10.9-14.2 cm in length, 2.7-3.3 cm wide, pits irregular to vertically elongated, up to 3.9 cm in length and 0.6 cm wide, grooves cinnamon brown, ridges are slightly paler when young turning dark brown at maturity; completely attached to stipe and hollow from inside; **Stipe:** cylindrical and elongated, 6.9-8.3 cm in length, 1.3-1.6 cm wide, slightly broad towards base (2.4-3.2 cm wide), white, smooth, fleshy and hollow; **Asci:** cylindrical, 230.4-296.0 μm long, 15.2-17.6 μm wide at the top, 16.0-19.2 μm at the middle and 10.4-14.4 μm at the base, thick walled, hyaline, 8-spored, uniseriate with external oil droplets adhering to spore ends; **Ascospores:** broadly elliptical, 16.0-19.2 \times 10.4-13.6 μm , thick walled, hyaline; **Paraphyses:** filiform, 4.0-8.8 μm at the base, thin walled, hyaline, septate, swollen (10.4-12.0 μm wide) at tip; **Inflated cells:** ovoid, globose to irregular, up to 163.2 μm in length and up to 57.6 μm wide, thin walled, hyaline, in chain; **Stipe hyphae:** 4.8-16.0 μm wide, thin walled, hyaline, branched, septa prominent.

Edibility: The species is edible in the study area.

Distribution: Earlier recorded from Jammu and Kashmir (Kotwal, 2010).

Remarks: A new report from KHANP

8.Morchella esculenta (L.) Pers., *Syn. Meth. Fung.* (Gottingen) 2: 618 (1801)

Synonymy: *Helvella esculenta* (L.) Sowerby, *Col. Fig. Engl. Fung. Mushr.* 1: pl. 51 (1797)

Morchella esculenta var. *vulgaris* (Pers.) A. Gennari, (2000)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Janakpur, Qedarna, and Nath, gregarious, humicolous, in forest of *Pinus roxburghii* and *P. wallichiana*, S.A.J. Hashmi and Y.P. Sharma, HBJU-586, March 2016, April 2017. (Plate IVh, Plate IVB4).

Apothecia: 4.2-10.1 cm long, pileate; **Pileus:** 1.6-3.7 cm wide, ovate, apex obtuse, pitted, pits irregular to somewhat regular, yellowish brown, becoming blackish on drying; **Stipe:** hollow, soft, concolorous with pileus or creamish brown, slightly enlarged at base; **Asci:** cylindrical to sub cylindrical, 228.8-369.6 \times 16.0-18.4 μm at top, 14.4-16.0 μm in the middle and 8.0-15.2 μm at the base, eight spored, obliquely placed, eguttulate but with external polar oil drops at each end; **Ascospores:** hyaline, 18.4-20.0 \times 9.6-13.6 μm , double walled, uniseriately placed; **Paraphyses:** elongated, septate, hyaline, 146.4-117.5 \times 8.0-12.4 μm ; **Pubescent hairs:** hyaline, septate, 23.2-106.4 μm wide; **Stipe hyphae:** 4.8-12.8 μm wide, hyaline, septate, branched, septa more dark.

Edibility: Eaten in the study area.

Distribution: Reported from various regions of India including Jammu and Kashmir, Punjab, Kumaon Himalaya (Cooke, 1876; Bose and Bose, 1940; Sohi *et al.*, 1965; Waraitch, 1976; Kaul, 1981).

Remarks: A new report from KHANP

4.1.4 Family Pezizaceae

9. *Peziza ampliata* Pers., in Pant, *Mycol. eur.* (Erlanga) 1: 227 (1822)

Synonymy: *Aleuria ampliata* (Pers.) Gillet, *Champignons de France*, Discom. (2): 47 (1879)

Aleuria palustris (Boud.) Le Gal, *Revue Mycol.*, Paris 6 (Suppl. Colon. no. 2): 71 (1941)

Galactinia ampliata var. *costifera* (Boud.) Le Gal, *Bull. Jard. bot. État Brux.* 29: 81 (1959)

Collection examined: Jammu and Kashmir, KHANP, Lopara, Loharna and Ekhala, bryophilous, scattered to gregarious, bryophilous, among mosses in deciduous forests of *Salix* species, S.A.J. Hashmi and Y.P. Sharma, HBJU-587, June 2016, August 2017. (Plate Va, Plate VA1).

Apothecia: cup or bowl shaped, 0.9-1.6 cm in diameter, sayal brown (XL k. 17". O-Y.) To brown (Nut-brown) inner surface, shiny, wet, smooth, margins entire, smooth, sessile, directly growing in the soil through small hair like rhizoids; **Asci:** elongated to cylindrical, 216.8-236.8 μm in length, 12.8-16.0 μm wide at the distal end, 14.4-17.6 μm at the middle and 8.8-12.8 μm at the bottom, thick walled, hyaline, eight spored, obliquely arranged; **Ascospores:** ellipsoidal to broadly ellipsoidal, 16.0-18.4 \times 10.4-12.8 μm , thick walled, hyaline; Paraphyses: filiform, 4.8-5.6 μm wide, thin walled, hyaline, septate, darker and swollen (8.0-10.4 μm wide) at the tip; Pubescent hairs: up to 11.2 μm wide, hyaline, branched, septate.

Edibility: Not edible in study area.

Distribution: The species was earlier reported from Europe (Dennis, 1978; Soothill and Fairhurst, 1978).

Remarks: A new report from Jammu province and KHANP

10. *Peziza badia* Pers., *Observ. mycol.* (Lipsiae) 2: 78 (1800) [1799]

Synonymy: *Galactinia badia* (Pers.) Arnould, *Bull. Soc. mycol. Fr.* 9: 111 (1893)

Helvella cochleata Bolton, *Hist. fung. Halifax* (Huddersfield) 3: 99, tab. 99 (1790)

Plicaria badia (Pers.) Fuckel, *Jb. nassau. Ver. Naturk.* 23-24: 327 (1870)

Scodellina badia (Pers.) Gray, *Nat. Arr. Brit. Pl.* (London) 1: 669 (1821)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Janakpur, Palmar, Marwah, Nath and Ekhala, bryophilous, scattered, among mosses, S.A.J. Hashmi and Y.P. Sharma, HBJU-588, June 2016. (Plate Vb, Plate VA2).

Apothecia: cup shaped when young changing to inverted hemispherical at maturity, 1.3-2.7 μm in diameter, sessile, natal brown from inside surface to light brown (honey comb) from outside, surface smooth, wet, dull; **Asci:** cylindrical with rounded ends, 256-287.2 μm in length, 8.0-12.8 μm wide at the top, 12.8-13.6 μm at the middle and 8.0-10.4 μm at the bottom, thin walled, hyaline, eight spored, obliquely arranged in uniseriate fashion; **Ascospores:** ellipsoidal, 14.4-17.6 \times 7.2-9.6 μm , thick walled, hyaline, bi-guttulate; **Paraphyses:** filiform, 4.0-5.6 μm wide, thin walled, hyaline, unfurcate, septate, swollen at tips; **Pubescent hairs:** up to 32.8 μm wide, thick walled, hyaline, branched, septate.

Edibility: Edible (Kumar, 2009) consumed in study area.

Distribution: The species has wide distribution in India (Thind and Batra, 1957; Kumar, 2009).

Remarks: First record from KHANP.

11. Peziza succosa Berk., *Ann. Mag. nat. Hist., Ser. 1* 6: 358 (1841)

Synonymy: *Galactinia succosa* (Berk.) Sacc., *Syll. Fung.* (Abellini) 8: 106 (1889)

Peziza infuscata Quél., *C. r. Assoc. Franç. Avancem. Sci.* 20(2): 465 (1892)

Collection examined: Jammu and Kashmir, KHANP, Palmar, Deharna, Marwah, Nath, and Ekhala, humicolous, scattered, deciduous forests, S.A.J. Hashmi and Y.P. Sharma, HBJU-589, June 2016, July 2017. (Plate Vc, Plate VA3).

Apothecia: upto 3.2 cm wide, shortly stalked, circular, slightly incurved margins, light brown, dark brown inside, flesh is juicy and the juice turn yellow in colour when exposed to air; **Asci:** cylindrical, 307.2-365.6 μm long, 14.4 -16.0 μm wide at the top, 16.0-23.2 μm wide at the middle, 8.0-10.4 μm wide at the base; 8- spored, uniseriate, oblique to irregularly placed, few are overlapping; **Ascospores:** ellipsoidal, 16.0-20.0 \times 10.4-12.8 μm , rough walled, pale yellowish, biguttulated; **Paraphyses:** 5.6-8.0 μm wide, 1-2 septate, unbranched; **Pubescent hairs:** 8.0-15.2 μm wide, septate and branched.

Edibility: Not edible in the study area but edibility reported elsewhere (Rinaldi and Tyndalo, 1974).

Distribution: Earlier reported on soil under mixed forests in Mussoorie, U.P (Thind and Batra, 1957).

Remarks: A new report from Jammu province and KHANP

4.1.5 Family Pyronemataceae

12. Geopora arenicola (Lév.) Kers, *Svensk Bot. Tidskr.* 68(3): 345 (1974)

Synonymy: *Peziza arenicola* Lév., *Annls Sci. Nat., Bot.*, sér. 3 9: 140 (1848)

Lachnea arenosa var. *bloxamii* (Cooke) Sacc. & Voglino (1886)

Sepultaria arenicola (Lév.) Masee, *British Fungus Flora. Agarics and Boleti* (London) 4:390 (1895)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Lopara, Deharna, Qedarna, Marwah and Ekhala, humicolous, growing scattered to gregarious on soil, temperate forest *Salix alba* and *Populus nigra*, S.A.J. Hashmi and Y.P. Sharma, HBJU-590, June 2016, September 2017. (Plate Vd, Plate VA4).

Apothecia: 1.1-4.2 cm in diameter, sessile, near about 3 cm deep inside soil; external surface buff brown, minutely roughened with flexuous hairs, which bind the substratum so that whole exterior of apothecium is encrusted with soil. The inner surface creamish to pure white; **Asci:** 213.6-306.4 μm long, 12.8-14.4 μm wide at the top, 10.4-17.6 μm wide in the middle and 10.4-12.0 μm wide at the base, cylindrical, apex rounded, narrow below; **Ascospores:** ellipsoid, 14.4-29.6 \times 8.0-12.8 μm , hyaline, smooth, ends narrow, bigutulate, uniseriate and obliquely placed; **Paraphyses:** 84.0-128.8 μm long, 3.2-4.0 μm wide, septate; **Pubescent hairs:** 4.8-12.0 μm wide, septate, branched.

Edibility: Consumed in study area.

Distribution: On soil from Himachal Pradesh (Ahmad, 1941; Sohi *et al.*, 1965), Jammu and Kashmir (Kaul, 1971; Kaul *et al.*, 1978).

Remarks: First record from KHANP.

Class Agaricomycetes

Order Agaricomycetes

4.1.6 Family Agaricaceae

13. Agaricus arvensis Schaeff., *Fung. bavar. palat. nasc.* (Ratisbonae) 4: 310 (1774)

Synonymy: *Psalliota leucotricha* F.H. Moller, *Friesia* 4: 159 (1952)

Phaeomarasmius exquisitus (Berk.) Raitelh., *Metrodiana, Sonderheft* 4: 14 (1990)

Collection examined: Jammu and Kashmir, KHANP, Deharna, Marwah, Nath and Ekhala, solitary, scattered, humicolous, in forest dominated by *Quercus semecarpifolia*, S.A.J. Hashmi and Y.P. Sharma, HBJU-591, July 2016. (Plate Ve, Plate VB1).

Pileus: conico-convex in shape, 5.6-8.1 cm wide, nutmeg coloured, darker at centre, smooth, margins incurved; **Gills:** free, crowded, equal, rosane pink initially turning to brownish at

maturity; **Veil:** present, persistent; **Stipe:** 5.3-7.2 cm long and 0.6-1.1 cm wide, cylindrical, solid, white, geniculate, centric, slightly bulbous at base; **Flesh:** white; **Odour:** agreeable; **Basidiospores:** apiculate, broadly ellipsoidal, hyaline, 4.8-6.4 x 3.2-5.6 µm, apiculus 1.6-2.4 µm long; **Basidia:** hyaline, guttulated, clavate, 16.8-21.6 x 5.6-8.8 µm; **Sterigmata:** 2 to 4 in number, 2.4-3.2 µm long; **Pileus cuticle hyphae:** hyaline, septate, branched, 6.4-19.2µm in width; **Pileus context hyphae:** septate, hyaline, branched, 8.8-22.4 µm in width; **Stipe hyphae:** hyaline, septate, scarcely branched, upto 32.8 µm wide.

Edibility: Not eaten in the study area but reported to be edible in Kishtwar (Kumar, 2009).

Distribution: Reported from West Bengal (Banerjee, 1947), Gujarat (Trivedi, 1972), Maharashtra (Chavan and Barge, 1978) and Jammu and Kashmir (Kumar, 2009).

Edibility: eaten in the study area

Remarks: First report from KHANP.

14. *Agaricus californicus* Peck, Bull. Torrey bot. Club 22: 203 (1895)

Synonymy: *Fungus californicus* (Peck) Kuntze, *Revis. gen. Pl.* (Leipzig) 3(2): 479 (1898)

Collection examined: India, Jammu and Kashmir, KHANP, Janakpur, Loharna, Qedarna, and Ekhala, humicolous, solitary, scattered, in gardens, under *Pyrus malus*, Rigzin Yangdol and Y. P. Sharma, HBJU-592, August 2017. (Plate Vf, Plate VB2).

Pileus: convex to applanate, 3.2-8.3 cm in diameter, silvery gray with brownish scales, surface dry, margin enrolled, flesh thick and white, surface staining yellow with KOH;

Lamellae: free, unequal, crowded, pinkish at young becoming brownish black at maturity;

Stipe: equal to slightly broader towards base, 2.2-4.2 x 0.4-0.9 cm, central, smooth, white;

Annulus: persistent, white; **Basidia:** clavate, 17.6-22.4 x 4.8-6.4 µm, hyaline, thin walled, sterigmata (1.6-3.2 µm in length); **Basidiospores:** broadly ellipsoidal, 5.6-8.8 x 4.0-5.6 µm, dark olive green (in Congo red), thick walled, apiculate, monoguttulate, inamyloid;

Spore print: chocolate brown; **Pileus hyphae:** 6.0-24.0 µm wide, hyaline, thin walled, septate, branched, clamp connections absent; **Stipe hyphae:** 10.0-20.0 µm wide, hyaline, thin walled, septate, unbranched, clamp connections absent; **Annular hyphae:** 4.0-6.4 µm wide, hyaline, thin walled, septate, branched.

Edibility: Not eaten in the study area

Distribution: The species is earlier reported from Jammu (Sharma, 2016)

Remarks: First report from KHANP.

15. *Agaricus langei* (F.H. Moller) F.H. Moller, *Friesia* 4(3): 203 (1952)

Synonymy: *Psalliota langei* F.H. Moller, *Friesia* 4(1-2): 28 (1950)
Agaricus langei var. *mediofuscus* (F.H. Moller) Wasser, *Ukr. Bot. Zh.* 35(5):516(1978)

Collection examined: Jammu and Kashmir, KHANP, Palmar and Deharna single, gregarious, in cultivated fields, humicolous, S.A.J. Hashmi and Y.P. Sharma, HBJU-620, July 2017. (Plate Vg, Plate VB3).

Pileus: 2.2-4.6 cm in diameter, creamy white with brownish scales on it; **Gills:** unequal, not forked, light pink later turned brown; **Stipe:** 0.4-0.7 cm in diameter, creamy white, slightly bulbous at base; **Annulus:** present but evanescent; **Basidiospores:** 7.2-9.6 x 5.6-6.4 μm , hyaline, thick walled, apiculate, uni- to biguttulated; **Basidia:** 20.8-36.8 x 8.0-11.2 μm , hyaline, less guttulated; **Sterigmata:** four in number, 2.4-4.8 μm long; **Pileus cuticle hyphae:** 7.2-24.0 μm wide, septate, branched, hyaline, clamp connections absent; **Pileus context hyphae:** 10.0-26.0 μm wide, hyaline, branched; **Stipe hyphae:** 8.0-24.0 μm wide, septate, branched, hyaline.

Edibility: Not eaten in the study area.

Remarks: A new record from KHANP.

16. *Apioperdon pyriforme* (Schaeff.) Vizzini, in Vizzini & Ercole, *Phytotaxa* 299(1): 81 (2017)

Synonymy: *Lycoperdon pyriforme* Schaeff., *Fung. bavar. palat. nasc.* (Ratisbonae) 4: 128 (1774)

Lycoperdon pyriforme var. *globosum* (Sosin) F. Šmarda, *Fl. ČSR*, B-1, Gasteromycetes: 341(1958)

Collection examined: Jammu and Kashmir, KHANP, Lopara, Loharna and Marwah, humicolous, scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-618, July 2016. (Plate Vh, Plate VB4).

Basidiocarp: pyriforme to sub-globose, 1.6-3.3 x 1.1-2.7 cm, attached to the substratum with short stipe, 0.6 cm long: initially smooth and intact breaking into particles at maturity:

Endoperidium: opening by a pore; **Gleba:** olivaceous brown; **Basidiospores:** globose, 2.4-3.2 x 2.4-4.0 μm , smooth, oil drops present; **Capillitium threads:** 1.6-3.2 μm wide, thick walled, aseptate, pale yellow (in 1% iodine).

Edibility: Not edible in study area but earlier reported to be edible (Christensen, 1955; Kreiger, 1967).

Distribution: On ground from Himachal Pradesh and Kashmir (Thind and Thind, 1982); on

dead wood from Sikkim (Ahmad, 1942; Cunningham 1942).

Remarks: A new report for KHANP.

17. *Bovista colorata* (Peck) Kreisel, *Feddes Repert.* 69: 201 (1964)

Synonymy: *Lycoperdon coloratum* Peck, *Ann. Rep. N.Y. St. Mus. nat. Hist.* 29: 46 (1878)

Collection examined: Jammu and Kashmir, KHANP, Loharna, and Marwah, humicolous, S.A.J. Hashmi and Y.P. Sharma, HBJU-621, July 2016, October 2017. (Plate VIa, Plate VIA1).

Carpophore: orange buff, 1.5-2.5 cm wide, turned to white in preservative, reticulate pattern on surface; **Gleba:** light yellow in colour, soft; **Stipe:** absent; **Basidiospores:** spherical, smooth and thick walled, monoguttulated, hyaline in Congo red, pale lemon in KOH and iodine, 4.8-6.4 x 4.8-6.4 μm , pedicel absent; **Basidia** hyaline, 11.2-19.2 μm ; **Capillitium threads:** branched, aseptate, 3.2-5.6 μm wide; **Exoperidial hyphae:** hyaline, septate, branched, 3.2-4.8 μm wide.

Edibility: Not known in the study area.

Remarks: A new report from State and KHANP

18. *Bovista minor* Morgan, *J. Cincinnati Soc. Nat. Hist.* 14: 147 (1892)

Collection examined: Jammu and Kashmir, KHANP, Palmar, Loharna and Nath, humicolous, solitary to scattered, deciduous forests of *Populus nigra* and *Salix alba*, S.A.J. Hashmi and Y.P. Sharma, HBJU-595, September 2016, November 2017. (Plate VIb, Plate VIA2).

Sporophore: spherical to sub-globose, 2.4-4.2 cm in diameter, 2.1-3.7 cm in height, slightly embedded in substratum with minute stipe, whitish in young turning dark brown at maturity, surface smooth to irregularly ridged at maturity; **Gleba:** white when young turning dark brown at maturity; **Odour:** no particular odour; **Basidia:** clavate, 8.8-14.4 x 7.2-10.4 μm , thin walled, hyaline, tetrasterigmate; sterigmata 10.4-15.2 μm in length; **Basidiospores:** globose to subglobose, 4.0-5.6 x 3.2-4.8 μm , thin walled, smooth, hyaline, mono- to biguttulate; pedicel (10.4-15.2 μm in length) attached to spore; **Capillitium threads:** 4.0-36.0 μm wide, thick walled, hyaline, highly ramified, septate, tapering towards tip; **Exoperidium hyphae:** 2.4-6.4 μm wide, thin walled, hyaline, filamentous, furcated, occasionally septate. **Reaction:** Spores turn light green but capillitium thread and exoperidium hyphae remains unchanged in KOH while in Iodine spore and capillitium thread turns pale green but exoperidium hyphae remains transparent.

Edibility: Not consumed in study area but edible in other areas (Smith, 1951).

Distribution: The species has wide distribution across the world (Smith, 1951; Smith *et al.*, 1981)

Remarks: A new record for KHANP.

19. *Bovista plumbea* Pers., *Ann. Bot. (Usteri)* 15: 4 (1795)

Synonymy: *Endonevrum suberosum* (Fr.) Czern., *Bull. Soc. Imp. nat. Moscou* 18(2, III): 151 (1845)

Globaria plumbea var. *suberosa* (Fr.) Quéél., *Mém. Soc. Émul. Montbéliard*, Sér. 2 5: 371

Collection examined: Jammu and Kashmir, KHANP, Palmar, Qedarna and Marwah, humicolous, scattered, open grassland, S.A.J. Hashmi and Y.P. Sharma, HBJU-622, July 2016. (Plate VIc, Plate VIA3).

Sporophore: spherical ball shaped, 2.3-3.6 cm in diameter and 2.4-3.5 cm in height, loosely attached to substratum by rhizoids, pure white when young turning into dark brown at maturity; surface becomes slightly cracked, exoperidium easily peels off at maturity exposing smooth endoperidium; **Gleba:** pure white and fleshy when young turning into brown powdery mass at maturity; **Basidiospores:** globose to sub-globose, 4.8-6.4 × 4.0-4.8 µm, pale green (in Congo red), thick walled, monoguttulate; pedicel (9.6-14.4 µm in length) attached to spore, pointed towards tip; **Capillitium thread:** 6.0-16.0 µm wide, thick and double walled, hyaline, branched dichotomously, aseptate; **Exoperidium hyphae:** 4.0-12.0 µm wide, thin walled, hyaline, branched, septate, sometimes swollen.

Edibility: Not edible in study area but reported to be edible from other areas (Phillips, 1981; Purkayastha and Chandra, 1985)

Distribution: Earlier reported from Uttar Pradesh, Himachal Pradesh and Jammu and Kashmir (Hennings, 1901; Ahmad, 1941; Kaul *et al.* 1978; Thind and Thind, 1982; Kumar, 2009)

Remarks: A new record from KHANP.

20. *Bovista pusilla* (Batsch) Pers., *Syn. meth. fung.* (Göttingen) 1: 138 (1801)

Synonymy: *Globaria pusilla* (Pers.) Quéél., *Mém. Soc. Émul. Montbéliard*, Sér. 2 5: 371 (1873)

Pseudolycooperdon pusillum (Pers.) Velen., *Novit. Mycol. Nov.*, (Op. Bot. Čech.): 93 (1947)

Lycoperdon polymorphum var. *pusillum* (Pers.) F. Šmarda, *Fl. ČSR*, B-1, Gasteromycetes: 238 (1958).

Collection examined: Jammu and Kashmir, KHANP, Loharna, Marwah and Nath, humicolous, scattered, open grassland, S.A.J. Hashmi and Y.P. Sharma, HBJU-623, August 2016. (Plate VIId, Plate VIA4).

Sporophore: spherical to subglobose, 2.1-3.4 cm in diameter, attached to substratum with few rhizomorphs, usually pure white coloured turning brownish and dries up after ages and release brown dusty spores; surface dry, smooth and devoid of any scales or spines; **Gleba:** whitish and then yellowish turning brown at maturity; **Basidiospores:** globose to subglobose, $2.4-4.8 \times 1.6-4.0 \mu\text{m}$, thin walled, hyaline, mono- to biguttulate, pedicellate, pedicel up to $8.0-12.8 \mu\text{m}$ in length, attached to spore; **Capillitium thread:** $2.4-11.2 \mu\text{m}$ wide, thin walled, hyaline, highly dichotomously branched, aseptate with tapering ends; **Exoperidium element:** $3.2-14.4 \mu\text{m}$ wide, thin walled, hyaline, furcated, septate; **Exoperidium hyphae:** $2.4-3.2 \mu\text{m}$ wide, thin walled, hyaline, occasionally furcated, septate.

Reaction: Both spores and capillitium thread turns green but exoperidium hyphae remains unchanged in KOH and Iodine.

Edibility: Not edible in study area but reported to be edible elsewhere (Garcha, 1980).

Distribution: Earlier reported from Dehradun, Pune and Jammu (Ahmad, 1941; Kumar, 2009).

Remarks: A new record from KHANP.

21. Calvatia bovista (L.) T. Macbr., in Macbride & Allin, *Bulletin Labs. nat. Hist. St. Univ. Ia* 4: 41 (1896)

Synonymy: *Lycoperdon bovista* L., *Sp. pl.* 2: 1183 (1753) Homotypic synonyms:

Collection examined: Jammu and Kashmir, KHANP, Deharna, Marwah and Ekhala, humicolous, scattered, temperate forests of *Salix alba* and *Populus nigra*, S.A.J. Hashmi and Y.P. Sharma, HBJU-662, July 2017, November 2017. (Plate VIe, Plate VIB1).

Sporophore: globose to subglobose with prominent stipe, 2.4-5.8 cm in diameter and 5.2-7.1 cm in length, purely white coloured; surface dry, shiny white, rough having small polygonal reticulations, reticulations less conspicuous towards stipe; **Gleba:** purely white when young and fresh turning dark brown at maturity; **Basidiospores:** globose to subglobose, $3.2-4.8 \times 2.4-4.0 \mu\text{m}$ in diameter, thin walled, hyaline, mono- to biguttulate; **Capillitium thread:** $4.0-8.0 \mu\text{m}$ wide, thin walled, hyaline, furcated, septate; **Endoperidium element:** globose to irregular, up to $44.0 \mu\text{m}$ wide, thin walled, hyaline, branched, highly septate; **Exoperidium hyphae:** $2.4-8.0 \mu\text{m}$ wide, thin walled, hyaline, branched, septate.

Reaction: Both spores and hyphae remain transparent in KOH and Iodine.

Edibility: Consumed in study area but only at young stage.

Distribution: Widely distributed around the world (Smith *et al.*, 1981).

Remarks: A new report from KHANP.

22. *Calvatia elata* (Masse) Morgan *J. Cincinnati Soc. Nat. Hist.* **12**: 172 (1890)

Synonymy: *Lycoperdon elatum* Masee 1887

Collection examined: Jammu and Kashmir, Kishtwar, KHANP, Palmar, Deharna and Marwah, humicolous, solitary to scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, HBJU-624, S.A.J. Hashmi and Y.P. Sharma, July 2016. (Plate VIf, Plate VIB2).

Fructification: globose to sub-globose, 1.4-4.2 x 3.5-3.7 cm, depressed, with a sterile base, 2.7 cm long, pale yellow to brown; **Exoperidium:** cracking into small warts, dark brown and composed of 5.6-17.6 µm wide hyphae; **Endoperidium:** thin, smooth, pale yellow, cracking into fragments and falling away at maturity; **Gleba:** dark brown; **Basidiospores:** globose, 4.0-7.2 µm in diameter, guttulate, smooth to minutely rough; **Capillitium threads:** 4.0-5.6 µm wide, thin-walled, branched, aseptate.

Edibility: Not edible in study area, but edibility reported from other parts (Phillips, 1981).

Distribution: Earlier reported from various regions of India including Kashmir valley (Ahmad; 1942; Kaul *et.al.*, 1978).

Remarks: A new report from State and KHANP.

23. *Calvatia lycoperdoides* Kościelny & Wojt., *Roczn. Nauk. rol.* 34: 141 (1935)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Janakpur, Palmar and Deharna, humicolous, solitary to scattered to gregarious, grassy area under temperate forests of *Salix excelsa*, S.A.J. Hashmi and Y.P. Sharma, HBJU-625, August 2017. (Plate VIg, Plate VI B3).

Sporophore: 2.2-3.1 cm long and 2.1-3.4 cm wide; **Exoperidium:** furfuraceous to spinulose or warted over the top; short base present, upto 1.7 cm long and 0.8 cm wide; **Gleba:** cottony, remaining intact for long time, dark brown; **Basidiospores:** subglobose, 4.8-6.4 × 2.4-5.6 µm, echinulate, guttulate; **Capillitium threads:** 3.2-5.6 µm wide, septate, branched, pale yellow with dark brown walls.

Edibility: Not edible.

Remarks: A new report from State and KHANP

24. *Calvatia* sp.

Collection examined: Jammu and Kashmir, KHANP, Palmar, Loharna and Nath, solitary, humicolous, S.A.J. Hashmi and Y.P. Sharma, HBJU-626, September 2016. (Plate VIIh, Plate VI B4).

Carpophore: whitish grey turning brown at later stage, 5.2-7.8 cm long and 8.2-9.8 cm wide, later turned to brown, margins thin, papery, dissected, pattern on the top; **Stipe:** 2.2-2.7 cm long; **Basidiospores:** globose, echinulated, 4.8-7.2 x 4.8-7.2 μm , yellow green in Congo red and pale yellow in iodine, monoguttulated; **Capillitium threads:** yellowish green, branched, thick walled, 3.2-5.6 μm in width; **Exoperidial hyphae:** pale yellow green, 4.8-8.0 μm wide, double walled; **Inflated elements:** 19.2-28.8 x 6.4-8.0 μm .

Edibility: Not eaten in study area.

Remarks: A new record for KHANP.

25. *Chlorophyllum molybdites* (G. Mey.) Masee, *Bull. Misc. Inf.*, Kew: 136 (1898)

Basionym: *Agaricus molybdites* G. Mey. 1818

Collection Examined: Collection examined: Jammu and Kashmir, KHANP, Lopara, Palmar, Loharna and Ekhala, humicolous, S.A.J. Hashmi and Y.P. Sharma, HBJU-593, September 2015 (Plate VIIa, Plate VII A1).

Pileus: surface white, dry soon breaking into brown scales that are more towards center oval to round, then becoming broadly cone to convex, upto 6.2 cm wide; **Gills:** greyish-white, unequal and free from stipe; **Stipe:** solid, sub-cylindrical, white, equal, 12.1 to 13.2 cm long and 0.7 to 1.4 cm wide; **Annulus:** present, greyish white, double edged; **Basidia:** clavate, 18.4-33.6 x 9.6-11.2 μm , hyaline; **Basidiospores:** elliptic, 3.2-9.6 x 3.2-6.4 μm , light green, apiculate, smooth, dextrinoid, apical pore present, thick walled, monoguttulated; **Spore print:** light greenish; **Cystidia:** 27.2-36.8 x 11.2-17.6 μm , broadly clavate, hyaline; **Pileus hyphae:** 3.2 to 20.8 μm , hyaline, septate and clamped; **Stipe and Annulus hyphae:** 2.4 to 16.0 μm and 4.8 to 11.2 μm wide respectively, hyaline, septate.

Edibility: Considered to be poisonous.

Remarks: The examined collection is proposed as a new variety.

26. *Coprinus comatus* (O.F. Müll.) Pers., *Tent. disp. meth. fung.* (Lipsiae): 62 (1797)

Synonymy: *Agaricus comatus* O.F. Müll., *Fl. Danic.* 5: tab. 834 (1780)

Agaricus fimetarius Bolton, *Hist. fung. Halifax* (Huddersfield) 1: 44, tab. 44 (1788)

Coprinus ovatus (Schaeff.) Fr., *Epicr. syst. mycol.* (Upsaliae): 242 (1838) [1836-1838]

Collection examined: Jammu and Kashmir, KHANP, Palmar, Qedarna and Ekhala, bryophilous, solitary, marshy areas with mosses, S.A.J. Hashmi and Y.P. Sharma, HBJU-596, May 2016, July 2017. (Plate VIIb, Plate VII A2).

Pileus: conical at young becoming expanded convex at maturity, 6.2-11.1 × 4.1-6.2 cm, white coloured at young turning blackish-brown from margins at extreme maturity because of auto-digestion; surface semi-dry with conspicuous shaggy scales on entire surface, scales more pale brown towards apical portion; margins entire when young but eroded, slight curved upward with ages; **Lamellae:** free, crowded, whitish when young and blackish at maturity, deliquescing; **Stipe:** cylindrical with conspicuous bulbous at base, 8.1-11.8 cm in length, white, smooth, central, hollow, fleshy; **Annulus:** evanescent; **Basidia:** clavate, 24.0-30.4 × 12.0-14.4 μm, thin walled, hyaline; sterigmata 3.2-4.8 μm in length; **Basidiospores:** ellipsoidal to broadly ellipsoidal, 7.2-16.0 × 5.6-8.0 μm, olive green to brown (in Congo red), coffee brown (in water mount) but grey with blackish wall (in H₂SO₄), thick walled, apiculate, truncated; **Cystidia:** obovoid pyriform to cymbiform, 84.0-120.0 × 22.4-38.4 μm, thin walled, hyaline; **Pileus hyphae:** 6.0-24.0 μm wide, thin walled, hyaline, rarely furcated, septate; **Stipe hyphae:** obovoid, up to 56 μm wide, thin walled, hyaline, septate, unbranched, tips of hyphae broader to narrower, enlarged, inflated.

Edibility: The species is edible in study area.

Distribution: The species is widely distributed in various parts of India (Berkeley, 1856; Banerjee, 1947; Ghosh *et al.*, 1974; Kumar, 2009)

Remarks: A new record from KHANP.

27. *Lepiota procera* (Scop.) Gray, Nat. Arr. Brit. Pl. (London) 1:601 (1821)

Synonymy: *Agaricus procerus* Scop., *Fl. carniol.*, Edn 2 (Wien) 2: 418 (1772)

Macrolepiota procera* var. *vezo Walley & Rammeloo, (1994)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Qedarna and Ekhala, gregarious, fasciculate, humicolous, mixed forest of *Pinus roxburghii* and *P. wallichiana*, S.A.J. Hashmi and Y.P. Sharma, HBJU-627, July 2016. (Plate VIIc, Plate VII A3).

Pileus: creamy white, 6.3-10.2 cm wide, soft spongy in texture, convex and sub-umbonate with brown appressed scales on it; **Gills:** creamy white, crowded, sinuate or free; **Stipe:** creamy white, 15.2-20.4 cm long and 1.7-2.6 cm wide, solid, brittle, equal, centric; **Basidiospores:** hyaline, ovate, thick walled, apiculate, 10.4-15.2 × 8.0-11.2 μm, **Basidia:** broad at apex and narrow towards base, hyaline, 30.4-40.0 × 11.2-14.4 μm; **Sterigmata:** 2-3 in number and 4.8-6.4 μm long; **Pileus hyphae:** hyaline, septate, branched occasionally, 6.4-

10.4 µm wide; **Stipe hyphae:** hyaline, septate, branched, clamp connections present, 7.2-28.0 µm in width.

Edibility: Edible in the study area.

Distribution: Earlier reported from Calcutta (Banerjee, 1947); Saharanpur (U.P) (Chopra and Chopra, 1955).

Remarks: A new record from KHANP.

28. *Cystolepiota sistrata* (Fr.) Singer ex Bon & Bellù, in Bon, *Docums Mycol.* 15 (no. 59): 51 (1985)

Synonymy: *Agaricus sistratus* Fr., *Syst. mycol.* (Lundae) 1: 24 (1821)

Lepiota sistrata (Fr.) Quél., *Mém. Soc. Émul. Montbéliard*, Sér. 2 5: 231 (1872)

Collection examined: Jammu and Kashmir, KHANP, Lopara, Loharna, Marwah and Ekhala, fasciculate, humicolous, in mixed forests of *Quercus semecarpifolia* and wild *Punica granatum*, S.A.J. Hashmi and Y.P. Sharma, HBJU-628, August 2016. (Plate VIIId, Plate VII A4).

Pileus: 1.7-3.1 cm in diameter, whitish yellow (white at margins and yellow in the centre), globose when very young and becoming campanulate later, hemispherical when mature;

Gills: creamy white, sub-distant, unequal; **Stipe:** 0.4 cm in diameter and 4.2-6.1 cm in length, brittle; **Veil:** present, web like fibres attached to stipe; **Basidiospores:** 4.0-7.2 x 4.0-4.8 µm, smooth, thick walled, uni- to multiguttulated, apiculate, broadly elliptical; **Apiculus:** 0.8-1.6 µm in length; **Basidia:** 15.2-27.2 x 5.6-8.0 µm, clavate, hyaline; **Sterigmata:** 3.2-4.8 µm long, four in number; **Pileus cuticle hyphae:** hyaline, 8.0-18.4 µm wide, septate, hyaline, branched; **Inflated hyphae:** 28.0-32.0 µm wide; **Pileus context hyphae:** 8.0-18.4 µm wide, hyphae branched, septate, hyaline; **Pileocystidia:** clavate to pyriform, 36.0-88.0 µm long; **Stipe hyphae:** 8.0-26.4 µm wide, hyaline, septate, less branched, clamp connections absent.

Edibility: Not eaten in the study area.

Distribution: Reported on ground of botanical Garden, Saharanpur, U.P (Hennings, 1901).

Remarks: A new report for India, State and KHANP

29. *Leucoagaricus rubrotinctus* (Peck) Singer, *Sydowia* 2(1-6): 36 (1948)

Synonymy: *Agaricus rubrotinctus* Peck, *Ann. Rep. N.Y. St. Mus. nat. Hist.* 35: 155 (1884)

Lepiota rubrotincta Peck, *Ann. Rep. Reg. N.Y. St. Mus.* 44: 179 (1891)

Collection examined: Jammu and Kashmir, KHANP, Loharna, Qedarna and Nath, gregarious, humicolous, in leaf litter under *Prunus* sp., S.A.J. Hashmi and Y.P. Sharma, HBJU-629, July 2016, September 2017. (Plate VIIe, Plate VII B1).

Pileus: 2.2-3.7 cm wide, depressed umbonate, whitish orange in colour, white at margins, surface fibrillose, pellicle of the pileus easily removable; **Gills:** white, crowded, free; **Stipe:** 5.1 cm long, 0.4 cm thick, creamy white, veil present in the form of ring in upper region which is fairly persistent, more or less equal, bit bulbous at base, brittle, solid; **Spore print:** white; **Basidiospores:** hyaline, 7.2-10.4 x 4.8-6.4 μm , broadly elliptical, thick walled, dextrinoid, monoguttulated, apiculate, length of apiculus varies from 1.6-3.2 μm ; **Basidia:** pyriform, 15.2-32.0 x 6.4-10.4 μm , guttulated; **Sterigmata:** 2-3 in number, 3.2-5.6 μm ; **Pileus cuticle hyphae:** 8.0-16.0 μm wide, septate, hyaline, branched; **Pileus context hyphae:** septate, branched, 8.0-12.0 μm in width, inflated hyphae upto 40 μm ; **Stipe hyphae:** septate, hyaline, branched, 8.0-30.4 μm in width, clamp connections absent.

Edibility: Not eaten in the study area.

Distribution: Earlier reported on oak leaf litter and mixed broad leaved forests in North West Himalaya (Kumar and Lakhanpal, 1993).

Remarks: A new record from KHANP.

30. Lycoperdon molle Pers., Syn. Meth. Fung. (Göttingen) 1: 150 (1801)

Synonymy: *Lycoperdon gemmatum var. molle* (Pers.) De Toni, *Syll. fung. (Abellini) 7(1): 107 (1888)*

Lycoperdon umbrinum sensu auct.; fide Checklist of Basidiomycota of Great Britain and Ireland (2005).

Collection examined: Jammu and Kashmir, KHANP, Marwah and Nath, humicolous, scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-630, September 2016. (Plate VIIIf, Plate VII B2).

Basidiocarp: pear shaped, 2.6-4.2 x 1.6-2.9 cm, with stipe of 1.4-2.3 cm length and upto 2.1 cm wide; **Exoperidium:** initially white changes to brownish after age; **Endoperidium:** opening by a pore; **Gleba:** dark brown; **Basidiospores:** globose, 3.2-6.4 μm , echinulate with a central droplet; **Capillitium threads:** aseptate, upto 5.6 μm , thin to thick-walled, unbranched.

Edibility: Not edible

Remarks: A new report from State and KHANP

31. *Lycoperdon caudatum* J. Schröt., in Cohn 1889

Synonymy: *Bovistella pedicellata* Lloyd, *Mycol. Writ.* 2(Letter 23): 284, pl. 88, fig. 5-10 (1906) *Lycoperdon pedicellatum* Peck, *Bull. Buffalo Soc. nat. Sci.* 1(2): 63 (1873)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Qedarna, Nath and Ekhala, fasciculate, gregarious, humicolous, S.A.J. Hashmi and Y.P. Sharma, HBJU-631, August 2016. (Plate VIIg, Plate VII B3).

Carpophore: 1.6-3.2 cm in diameter, dresden brown in colour, soft, with aperture at apex;

Stipe: 4.3 cm long and 1.4 cm in diameter, fused at base to form groups, creamish;

Exoperidium: dark brown with an apical pore; **Basidiospores:** globose, 4.0-5.6 μm in diameter, echinulate, double walled, pale yellow in Congo red; **Pedicel:** 2.4-9.6 μm long, fallen pedicel;

Capillitium threads: hyaline to light yellow in color, branched; **Exoperidial**

hyphae: 4.0-7.2 μm wide, septate, double walled, branched; **Inflated hyphae:** 10.4-28.8 x 11.2- 22.4 μm , thin walled.

Edibility: Not known in the study area.

Distribution: Earlier reported from conifer dominated forests of Kashmir (Beig *et al.*, 2011).

Remarks: A new report from State and KHANP

32. *Lycoperdon perlatum* Pers., Obse, v. *Mycol. (Lipsiae)* 1: 145 (1796)

Synonymy: *Lycoperdon gemmatum* Batsch, *Elench. Fung. (Halle)*: 147(1783)

Lycoperdon gemmatum var. *perlatum* (Pers.) Fr., *Syst. Mycol. (Lundae)* 3(1):37(1 829)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Loharna, Qedarna, Nath and Ekhala, humicolous, solitary to scattered to gregarious, coniferous forests of *Pinus gerardiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-632, August 2016. (Plate VIIIh, Plate VII B4).

Fructification: turbinate, 1.6-3.8 x 1.1-2.9 cm, white when young becoming brownish with age; **Exoperidium:** dark brown, surrounded by dense spines which on shedding give reticulated appearance to the peridium, spines smaller towards the base, composed of globose, hyaline cells upto 12.8 μm wide; **Endoperidium:** yellowish-brown, opening through apical aperture and composed of aseptate and unbranched, thin to thick-walled

hyphae upto 2.4-4.0 μm wide; **Gleba:** brownish; **Basidiospores:** globose, 3.2-4.8 μm in diameter, smooth to minutely verrucose, with central vacuole, deep rusty brown (in iodine);

Capillitium threads: aseptate, 3.2-5.6 μm wide, dark brown, branched.

Edibility: Not edible in study area, although reported to be edible from other parts (Christensen, 1955; Krieger, 1967; Philrips, 1981; Purkayastha and Chandra, 1985).

Distribution: Earlier reported from North West Himalaya, Sikkim Himalayas, Himachal Pradesh (Ahmad, 1942; Purkayastha and Chandra, 1985).

Remarks: A new report from KHANP.

33. *Lycoperdon rimulatum* Peck, in Morgan, *Trans. Wis. Acad. Sci. Arts Lett.* 7: 117 (1888)

Synonymy: *Lycoperdon decipiens* var. *rimulatum* (Peck) F. Šmarda, *Fl. ČSR*, B-1, Gasteromycetes:354(1958)

Collection examined: Jammu and Kashmir, KHANP, Janakpur, Deharna and Nath, humicolous, scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, HBJU 080, S.A.J. Hashmi and Y.P. Sharma, HBJU-633, September 2016. (Plate VIIIa, Plate VIII A1).

Basidiocarp: 0.7-2.5 cm in diameter, globose at the top, narrow at the base, clavate, mikado brown (XXIXi 13".OY-O), apical pore present; **Gleba:** light yellow changes to brown after age; **Basidiospores:** globose to subglobose, aseptate, thin to thick-walled, 3.2-8.0 x 2.4-5.6 µm in diameter, verrucose, oil droplets present, stalk upto 2.4 µm long; **Capillitium threads:** simple, 1.6-3.2 µm occasionally branched, thin to thick walled, brown (in iodine).

Edibility: Not edible in study area but already reported to be edible (Gupta *et.al.*, 1974).

Distribution: Previously recorded from Himachal Pradesh (Gupta *et. al.*, 1974).

Remarks: A new report from State and KHANP.

34. *Lycoperdon umbrinum* Pers. *Syn. Fung.* (Göttingen) 1: 147, 180.

Synonymy: *Lycoperdon umbrinum* β *hirtum* Pers., *Syn. meth. fung.* (Göttingen) 1: 148 (1801)

Lycoperdon umbrinum f. *fissispinum* Kreisel, *Feddes Repert.* 64: 141 (1962)

Collection examined: Jammu and Kashmir, KHANP, Loharna, Marwah and Nath, humicolous, scattered, mixed forests of *Pinus wallichiana*, *Juglans regia* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-634, November 2017. (Plate VIIIb, Plate VIII A2).

Basidiocarp: 3.5 x 2.3 cm, globose, cinnamon **Endoperidium:** whitish opening by apical pore and composed of thin to slightly thick-walled hyphae, 2.4-4.0 µm wide; **Gleba:** brown; **Basidiospores:** globose, 5.6-6.4 µm in diameter, verrucose, short pedicellate upto 0.8 µm long.

Edibility: Not edible in the study area but edibility has been recorded by Worgan (1968).

Distribution: Reported earlier from Kashmir and Himachal Pradesh (Ahmad, 1942).

Remarks: A new report from KHANP.

35. *Macrolepiota procera* (Scop.) Singer, *Pap. Mich. Acad. Sc.* 32: 141 (1948) [1946]

Synonymy: *Agaricus annulatus* Lightf., *Fl. Scot.* 2: 1025 (1777) *Amanita procera* (Scop.) Fr., *Anteckn. Sver. At!. Svamp.:* 33 (1836) *Macrolepiota procera* (Scop.) Singer, *Pap. Mich. Acad. Sc.* 32: 141 (1948) [1946]

Collection examined: Jammu and Kashmir, KHANP, Sonder, Janakpur, Deharna, Qedarna, Marwah and Ekhala, humicolous, scattered, mixed forest of conifers and *Populus* sp., S.A.J. Hashmi and Y.P. Sharma, HBJU-594, July 2016, October 2017. (Plate VIIIc, Plate VIII A3).

Pileus: 7.2-14.8 cm in diameter, convex then flat, umbonate, surface whitish, marked with prominent brown scales on entire surface, snuff brown at centre, margins inrolled; **Gills:** upto 0.6 cm wide, free, crowded, unequal, wavy, concolorous with pileus; **Flesh:** white; **Odour:** agreeable; **Stipe:** 8.2-9.6 cm long and 0.6-1.4 cm wide, central, equal, solid, smooth, swollen at the base, concolorous with pileus; **Annulus:** present, superior, movable, evanescent, creamish; **Basidiospores:** ellipsoidal to subglobose, 6.4- 11.2 x 4.8-8.0 μm , with oil droplets, smooth, slightly thick walled, apiculus upto 1.6 μm ; **Basidia:** clavate, 14.4-38.4 x 9.6-16.0 μm , sterigmata 2 to 4, ranges upto 4.8 μm long, oil droplets present; **Cystidia:** not found; **Pileus and Stipe hyphae:** 1.6- 4.8 μm wide, septate, branched, clamped; **Pileus and Stipe context hyphae:** 2.4- 10.4 μm wide, septate, clamped.

Edibility: Edible in some parts of the study area. Earlier reported to be edible (Christensen, 1943, 1955; Atkinson, 1961; Krieger, 1967; Jong, 1978; Purkayastha and Chandra, 1985) from India and abroad.

Distribution: Reported from various regions of India including Calcutta, Uttar Pradesh, Himachal Pradesh, Karnataka and West Bengal (Banerjee, 1947; Chopra and Chopra, 1955; Ghosh and Pathak, 1965).

The examined specimens resembled in all respects with the details given by Purkayastha and Chandra (1985) and Teng (1988) except some minor differences in spore size.

Remarks: A new record from KHANP.

4.1.7 Family Physalacriaceae

36. *Flammulina velutipes* (Curtis) Singer, *Li/ba* 22: 307 (1951) [1949]

Synonymy: *Agaricus velutipes* Curtis, *Fl. Londin.* 2: tab. 213 (1782)

Gymnopus velutipes (Curtis) Gray, *Nat. Arr. Brit. Pl.* (London) 1: 605 (1821)

Co//yb/a ve/uticeps Rea, *Trans. Br. Mycol. Soc.* 1(4): 157 (1900)

Myxocollybia velutipes (Curtis) Singer, *Schweiz. Z. Pilzk.* 17: 72 (1939).

Collection examined: Jammu and Kashmir, KHANP, Janakpur and Loharna, lignicolous, caespitose, on wood of *Fraxinus excelsior*, in mixed orchards of *Juglans regia* and *Pyrus malus*, S.A.J. Hashmi and Y.P. Sharma, HBJU-599, March 2017. (Plate VIII d, Plate VIII A4).

Pileus: 0.3-3.8 cm, ochre-orange (XV-b,15.Y-O) yellowed at edges and dark at centre, convex then flat, irregular, lobate, cuticle smooth, viscid, with striate margins; **Gills:** Pale yellow tending light nut brown, slightly adnexed, unequal; **Stipe:** 1.6-7.1 x 0.3-0.6 cm, cylindrical and slightly tapered towards base, curved or twisted, yellow, velvety all over, quickly becoming blackish brown acropetally; **Annulus:** absent; **Flesh:** pale yellow, fine, watery and soft in the cap, leathery and fibrous in the stipe; odour and flavour insignificant; **Spore print:** off- white; **Basidiospores:** elliptical, 4.8-9.6 x 3.2-5.6 μm , hyaline, smooth; **Basidia:** clavate, 20.0-35.2 x 4.0-6.4 μm , tetrasporic; sterigmata 3.2-5.6 μm long; **Cystidia:** utriform to lageniform, 25.6-56.0 x 11.2-24.0 μm , hyaline. **Stipe hyphae:** 3.2-25.6 μm wide, septate, branched, clamped.

Edibility: Not edible in study area. However, earlier reported to be edible by many mycologists from India and elsewhere (Christensen, 1955; Atkinson, 1961; Krieger, 1967; Chandra and Purkayastha, 1973; Jong, 1978).

Distribution: Widely distributed in various regions of India including Calcutta, Darjeeling, Kulu (HP). Punjab, Pahalgam (Kashmir) and Sikkim (Banerjee, 1947; Anonymous. 1950; Berkeley, 1856; Ghosh *et. al.*, 1967; Watling and Gregory, 1980).

Remarks: A new report from KHANP.

4.1.8 Family Psathyrellaceae

37. *Coprinellus domesticus* (Bolton) Vilgalys, Hopple & Jacq. Johnson, in Redhead, Vilgalys, Moncalvo, Johnson & Hopple, *Taxon* 50(1): 233 (2001)

Synonymy: *Agaricus domesticus* Bolton, *Hist. fung. Halifax* (Huddersfield) 1: 26 (1788)

Coprinus domesticus (Bolton) Gray, *Nat. Arr. Brit. Pl.* (London) 1: 635 (1821)

Collection examined: Jammu and Kashmir, Loharna and Nath, solitary, gregarious, lignicolous, on decaying hard wood logs of *Pinus wallichiana*, S.A.J. Hashmi and Y.P. Sharma, HBJU-636, June 2016, September 2017 (Plate VIIIe, Plate VIII B1).

Pileus: sub-conic to campanulate, 3.4-4.1 cm wide, dark brown at the upper end, pale brown towards the margins, surface rough covered with scales, margins irregular, wavy; **Flesh:** white; **Gills:** creamish at first turning brown to black at later stages, equal, soft, fleshy; **Stipe:** 2.7-4.3 cm long, 0.3 cm wide, striated, creamish with a bulbous base, hollow, arising from a mat of orange coloured fibres called ozonium; **Annulus:** absent; **Basidia:** not seen perhaps disintegrated; **Basidiospores:** oval to ellipsoidal, 4.8-7.2 x 3.2-4.0 μm , mono- to multiguttulated, double walled with a prominent germ pore; **Stipe hyphae:** 4.0-24.0 μm , hyaline, unbranched, septate, clamp connections absent.

Edibility: Edible in the study area.

Remarks: A new report from KHANP.

38. *Coprinellus micaceus* (Bull.) Vilgalys, Hopple & Jacq. Johnson 2001

Synonymy: *Agaricus micaceus* Bull., *Herb. Fr.* 6: tab. 246 (1786)

Coprinus micaceus (Bull.) Fr., *Epicr. syst. mycol.* (Upsaliae): 247 (1838)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Janakpur, Marwah and Ekhala, fasciculate, coprophilous, S.A.J. Hashmi and Y.P. Sharma, HBJU-637, July 2016. (Plate VIII f, Plate VIII B2).

Carpophore: 4.7-5.1 cm long; **Pileus:** oval when young, expanding to convex or bell shaped, creamish, 1.4 cm long and 2.1-2.4 cm wide, creamish brown with mica like particles on it, margins grooved or lined, usually halfway towards the centre; **Gills:** black, crowded, deliquescing but not completely; **Stipe:** white, centric; **Annulus:** present, persistent; **Spore print:** black; **Basidiospores:** light brown in Congo red, 6.4-8.8 x 4.8-6.4 μm , broadly ellipsoidal, smooth with central pore, mono- to multiguttulated; **Basidia:** hyaline, clavate, 17.6-38.4 x 4.8-6.4 μm ; **Pileus hyphae:** hyaline, septate, 4.0-10.4 μm wide; **Inflated hyphal elements:** 16.0-44.0 μm wide; **Pileocystidia:** 72.0-144.0 μm long, clavate to pyriform; **Stipe hyphae:** septate, hyaline, unbranched, 4.0-8.0 μm wide.

Edibility: Not eaten in the study area but reported to be edible by Christensen (1955); Kaul and Kachroo (1974) and Soothill and Fairhurst (1978).

Distribution: Earlier reported on trees, stumps and fence posts from West Bengal (Banerjee, 1947), Lucknow, U.P (Ghosh *et al.*, 1974) and Jammu and Kashmir (Watling and Gregory, 1980; Sharma, 2009a).

Remarks: A new record from KHANP.

39. *Coprinopsis atramentaria* (Bull.) Redhead, Vilgalys & Moncalvo, in Redhead, Vilgalys, Moncalvo, Johnson & Hopple, *Taxon* 50(1): 226 (2001)
Synonymy: *Agaricus atramentarius* Bull., *Herb/er de Ia France*: tab. 164 (1786)
Coprinus atramentarius (Bull.) Fr., *Ep/cr. syst. mycol.* (Upsaliae): 243 (1838)
Pselliophora atramentaria (Bull.) Fr., *B/dr. Kënn. F/ni. Nat. Folk* 32: 528 (1879)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Janakpur, Deharna and Nath, humicolous, gregarious to caespitose, mixed orchards of *Pyrus malus* and *Jugians regia*, HBJU 020, S.A.J. Hashmi and Y.P. Sharma, HBJU-597, June 2016, September 2017 (Plate VIIIg, Plate VIII B3).

Pileus: conical, 1.4-3.7 x 1.1-3.2 cm, lobed, split apart with age, fleshy, smooth, mouse-gray with cinnamon scales, margins involuted, whitish; **Flesh:** white, thin, watery; **Gills:** free, densely crowded, white, blackish with age; **Stipe:** 3.0-5.5 x 0.3-0.5 cm, central, hollow, white, delicate; **Spore print:** almost black; **Basidiospores:** ellipsoid, 7.2-10.4 x 5.6-6.4 μm , dark brown, thick-walled, some what truncate; **Basidia:** clavate, 19.2-30.4 x 8.0-9.6 μm , 4-spored, sterigmata upto 2.4 μm long; **Cheilocystidia:** 55.2-71.2 x 7.2-14.4 μm , ventricose, thin-walled, hyaline; **Pleurocystidia:** cylindrical to clavate, 40.0-60.8 x 7.2-19.2 μm , thinwalled, hyaline; **Pileus and Stipe hyphae:** 3.2-5.6 μm wide, septate, hyaline.

Edibility: Edible in some parts of study area. Previously reported to be edible by various authors (Atkinson, 1961; Krieger, 1967; Kaul, 1971; Jong, 1978; Soothill and Fairhurst, 1978).

Distribution: On ground from Uttar Pradesh (Vasudeva, 1962), on mushroom compost from Himachal Pradesh (Munjal *et. al.*, 1974); on ground near the base of wtlow trees from Kashmir (Kaul, 1971; Kaul and Kachroo, 1974; Abraham *et. al.*, 1981; Watling and Gregory, 1980).

Remarks: A new report from KHANP.

Family Strophariaceae

40. *Pholiota squarrosa* (Vahl) P. Kumm., Führ. Pilzk. (Zerbst): 83 (1871)

Synonymy: *Agaricus squarrosus* Vahl, in Oeder, *Fl. Danic.* 3(9): tab. 491 (1770)

Stropharia squarrosa (Vahl) Morgan, J. Mycol. 14(2): 73 (1908)

Collection examined: Jammu and Kashmir, KHANP, Lopara, Palmar, Loharna, Nath and Ekhala, humicolous, gregarious to caespitose, mixed orchards of *Pyrus malus* and *Jugians regia*, S.A.J. Hashmi and Y.P. Sharma, HBJU-600, July 2016. (Plate VIIIh, Plate VIII B4).

Cap 3.8-9.4 cm, bluntly rounded when young with an incurved margin, becoming rounded with broad knob or nearly flat; except for edge which is almost bald, pale yellow surface covered with light cinnamon to clay-colored scales which turn dark yellow-brown in age; flesh yellowish, thick, soft; **Odour:** none; **Taste:** mild or slightly rancid. **GILLS** bluntly adnate and with a decurrent line to tooth, close, narrow, pale yellowish when young, soon +/- sordid greenish yellow, aging sordid rusty-brown. **STEM** 4-10 x 0.4-1.2 cm, equal or nearly so, at times tapered to a long hairy pointed base; covered with pale yellowish brown upturned scales; dry; solid; yellowish within; ring often disappearing but is sometimes membranous and persistent. **HABIT** and **Spores** 6.4-7.2 x 4.0-4.8 μ m; pleurocystidia present as chrysocystidia, 30.4-48 x 8-16 μ m. **HABITAT** clustered at the base of living or dead hardwood or conifer trees or on logs or stumps; summer and fall. **EDIBILITY** There are conflicting reports of gastro-intestinal upsets from older fruiting bodies from the Rocky Mts. of Colorado.

Edibility: Edible in the study area.

Remarks: A new report from State and KHANP

41. Pholiota sp.

Collection examined: Jammu and Kashmir, KHANP, Palmar, Qedarna and Nath, Humicolous, single or clustered on trunks and stumps of hardwood trees i.e., *Cedrus deodara* and *Abies pindrow*, S.A.J. Hashmi and Y.P. Sharma, HBJU-638, August 2016. (Plate IXa, Plate IX A1).

Cap 3-7 cm, conic to flat retaining a broad knob, whitish when young; edge fringed with veil remnants; surface sticky beneath the recurved dry, tan to yellowish tan scales which are scattered over the margin and become more crowded on the center; flesh thick, whitish, soft. **Odor** and **Taste:** not distinctive. **Gills:** adnate to sharply adnexed, close to almost crowded, broad near stem and tapering narrower near edge; whitish, aging to dull rusty brown, sometimes with brighter rusty stains. **Stipe:** 5-10 x 0.5-1.0 cm, dry, top whitish and silky, lower portion covered by coarse, upturned yellowish tan persistent scales; staining rusty-brown near base; stuffed or solid; pallid superior thready ring often disappears. **Spores** 4-6.4 x 3.2-4 μ m; **Pleurocystidia** abundant, 30.4-48 x 8-15.2 μ m.

Edibility: edible.

Remarks: A new report from KHANP

42. *Gymnopilus sapineus* Fries. (Fr.) Murrill, *Mycologia* 4(5): 254 (1912)

Synonymy: *Agaricus sapineus* Fr., *Syst. mycol.* (Lundae) 1: 239 (1821)

Collection Examined: Jammu and Kashmir, KHANP, Lopara, Palmar, Loharna, Qedarna, Nath and Ekhala, lignicolous, gregarious, found among ferns, S.A.J. Hashmi and Y.P. Sharma, HBJU-598 July 2016. (Plate IXb, Plate IX A2).

Pileus: ochraceous orange (XV b. 15'. Y-O.), 3.2 to 4.8 cm wide, smooth to silky, convex to broadly convex, surface dry; **Gills:** concolorous, adnate, crowded, unequal; **Stipe:** upto 3.3 cm in length, 1.1 cm wide, solid, firm, coloured like the cap but developing rusty stains with age, usually with fragile ring; **Basidia:** clavate, 12.8-17.6 × 3.2-4.0 µm, hyaline; **Sterigmata:** 2 in number per basidium, 1.6 to 2.4 µm long; **Basidiospores:** ellipsoid, echinulate, 6.4-9.6 × 4.8-6.4 µm, apiculate, monoguttulated, reddish brown in KOH; **Pileus and Stipe hyphae:** 2.0-8.0 µm and 2.0-12.0 µm wide respectively, hyaline, septate, branched, clamped.

Edibility: Psychoactive, not edible in the study area.

Remarks: New report for India.

43. *Gymnopilus* sp.

Collection examined: Jammu and Kashmir, KHANP, Qedarna, and Nath, lignicolous, solitary, scattered in forests of *Pinus roxburghii* and *P. wallichiana*, S.A.J. Hashmi and Y.P. Sharma, HBJU-635, August 2016. (Plate IXc, Plate IX A3).

Pileus: 3.4-4.7 cm, rust brown; **Gills:** 0.9cm wide, yellowish brown, adnate, unequal, wavy; **Flesh:** pale yellow, changes on exposure; **Spore print:** brownish; **Stipe:** 3.4-5.3 x 0.4-1.3cm, concolorous with pileus, equal; **Annulus:** absent; **Odour:** agreeable; **Basidiospores:** broadly ellipsoidal, 6.4-9.6 x 5.6-6.4 µm, appearing slightly rough and double walled, uni- to multiguttated; **Basidia:** clavate, 26.4- 33.6 x 6.4-8.0 µm, guttulated, **Sterigmata:** 2 to 4, 4.8-7.2 µm; **Pileus cuticle hyphae:** 4.8-11.2 µm, septate, thin-walled, stains in congo red only; **Pileus context hyphae:** hyaline, 6.4-12.8 µm, branched, clamp connections present; **Stipe hyphae:** septate, 4.8-12.8 µm, thin walled and clamp connections present; **Pileocystidia:** yellowish, guttulated, 38.4-59.2 x 17.6-27.2 µm.

Edibility: Not eaten in the study area.

Remarks: A new record from KHANP.

Family Schizophyllaceae

44. *Schizophyllum commune* Fr. *Observ. Mycol.* (Havniae) 1: 103 (1815)

Synonymy: *Agaricus alneus* Reichard, *Sp. Pl., Edn 4*: 605 (1780)

Schizophyllum alneus (L.) Kuntze, *Revis, Gen. Pt.* (Leipzig) 3: 478 (1898)

Merulius communis (Fr.) Spirin & Zmitr., *Nov. Sist. Niz. Rast.* 37: 182 (2004)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Janakpur, Loharna, Deharna, Qedarna, and Nath, lignicolous, found growing on *Cedrus* stumps, solitary to scattered, coniferous forest, S.A.J. Hashmi and Y.P. Sharma, HBJ-615, August 2017 (Plate IXd, Plate IX A4).

Fructification: annual, sessile, leathery, imbricate; **Pileus:** 1.2-3.2 x 0.8-2.9 cm, fan to shell-like, broadly convex to plane, very coarsely fibrillose, fibrils laterally agglutinated making pileus surface rimose, white to slightly grey, margins wavy, slightly incurved; Hymenium surface pink-tinged; **Gills:** radiating from the point of attachment, thick, edge pubescent, splitting length wise, split being shallow forms a groove and divides each gill into two halves;

Context: thick, leathery to subcoriaceous **Basidiospores:** oblong, ends obtuse, 5.6-7.2 x 1.6-2.4 μm , hyaline, smooth,, inamyloid; **Basidia:** clavate, 9.6-19.2 x 3.2-4.8 μm , 4- spored;

Pileus cuticle and context hyphae: septate, 2.4-4.8 μm wide, thin to thick walled, clamped.

Edibility: Not edible but reported to be edible from elsewhere (Worgan, 1968; Zoberi, 1972; Quimio, 1981).

Distribution: Reported on dead wood from Darjeeling, Bihar, Sikkim, Andaman Islands, Mussoorie, Maharashtra (Berkeley, 1856; Hennings, 1901; Llyod, 1904- 1919), Calcutta, Allahabad, Ludhiana and Kashmir (Banerjee, 1947; Anonymous, 1950; Watling and Gregory, 1980).

Remarks: A new report from KHANP.

Family: Amanitaceae

45. *Amanita flavoconia* G.F. Atk., *J. Mycol.* 8(3): 110 (1902)

Synonymy: *Amplariella flavoconia* (G.F. Atk.) E.-J. Gilbert, in Bresadola, *Iconogr. mycol.*, Suppl. I (Milan) 27: 79 (1940)

Venenarius flavoconius (G.F. Atk.) Murrill, *Lloydia* 11: 101 (1948)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Lopara, Palmar, and Marwah, humicolous, solitary to scattered, mixed and coniferous forests, S.A.J. Hashmi and Y.P. Sharma, HBJU-601, July 2017. (Plate IXe, Plate IX B1).

Pileus: 3.5-6.8 cm in diameter, convex to flat, faintly umbonate, honey yellow, surface covered with yellowish scales, more dense in the centre, smooth, margins regular, pileus context changes to reddish (in 2% aqueous phenol); **Gills:** free, crowded, yellowish-cream, edges entire; **Context:** white, light yellow just below the cuticle, unchanging; **Taste and Odour:** indistinct; **Stipe:** 4.3-13.2 cm, central, cylindrical, narrower at the apex, bulbous at the base, light yellow on upper side and darker at the base; **Annulus:** present. thin membranous, yellowish white, superior; **Volva:** yellow, friable, in the form of yellow patches on the bulbous base; **Spore print:** white; **Basidiospores:** ellipsoidal, 5.6- 8.8 x 4.8-9.6 μm , smooth, monoguttulate; **Basidia:** clavate, 16.0-27.2 x 4.0-8.8 μm , 4-spored, sterigmata 3.2-4.8 μm long; **Universal veil:** branched, occasionally septate hyphae, upto 5.6 μm wide, interspersed with large inflated cells, upto 14.4 μm ; **Pileus hyphae:** aseptate, 2.4-8.0 μm wide, hyaline; **Stipe hyphae:** 2.4-10.4 μm wide, septate, branched; **Caulocystidia:** upto 48.0 μm long and upto 8.0 μm wide.

Edibility: Not edible in study area.

Distribution: Earlier reported from Kashmir (Abraham, 1991).

Remarks: A new report from KHANP.

46. *Amanita pantherina* (DC.) Krobh., Naurgetr. Abbild. Beschr. Schwämme (Prague) : 29(1846)

Synonymy: *Amanitaria pantherina* (Gonn. & Rabenh.) E.-J. Gilbert, Icon. Mycol. (Paris) 27: 70-76 (1941)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Loharna and Ekhala, humicolous, solitary to scattered in coniferous forests, S.A.J. Hashmi and Y.P. Sharma, HBJU-639, July 2016. (Plate IXf, Plate IX B2).

Pileus: 2.4-4.3 cm wide, convex then plano-convex, drab gray margin entire and plane, smooth; **Gills:** free, sub-crowded, concolorous with pileus; **Stipe:** 2.8-5.3 x 0.4-1.0 cm, central, fleshy, initially solid becoming hollow at maturity, slightly bulbous with volva; **Annulus:** superior, movable, concolorous with pileus; **Flesh:** white, turns yellow orange in 10% KOH; **Spore print:** white; **Volva:** whitish, adhering to the basal bulb of the stalk; **Basidiospores:** ellipsoidal to oblong, 8.0-12.8 x 7.2-9.6 μm , hyaline, thin-walled, smooth, apiculate, apiculus upto 0.8 μm , non-amyloid; **Basidia:** clavate, 24.8-36.8 x 8.0-12.8 μm , sterigmata 2 to 4, upto 4.0 μm long; **Universal veil:** septate, branched hyphae, upto 6.4 μm wide, interspersed with inflated cells upto 30.4 μm in diameter, ovoid or spherical; **Pileus**

hyphae: 1.6-3.2 μm wide, aseptate, unbranched, hyaline; **Stipe hyphae:** 3.2-4.8 μm wide, septate, unbranched, hyaline.

Edibility: Not edible in the study area. Reported to be poisonous (Soothill and Fairhurst, 1978).

Distribution: Reported from Andhra Pradesh, Tamil Nadu and Kashmir (Sathe and Sasangam, 1977; Natarajan, 1978; Watling and Gregory, 1980).

Remarks: A new report from KHANP.

47. *Amanita phalloides* (Vaill. ex Fr.) Link, Handbuck zur Erkennung der Nutzbarsten und am Haufigsten Vorkommenden Gewachse 3: 272 (1833)

Synonymy: *Agaricus phalloides* Vaill. ex Fr., *Syst. Mycol.* (Lundae) 1: 13 (1821)
Venenarius phalloides (Vaill. ex Fr.) Murrill, *Mycologia* 4(5): 240 (1912)

Collection examined: Jammu and Kashmir, KHANP, Palmar and Ekhala, predominated by *Quercus semecarpifolia*, solitary, humicolous, S.A.J. Hashmi and Y.P. Sharma, HBJU-640, July 2016. (Plate IXg, Plate IX B3).

Pileus: 7.5 cm long and 4.6 cm wide, dusty trail in colour, surface smooth and shiny; **Gills:** creamy white, crowded, free; **Stipe:** 5.1 cm long (including volva) and 3.2 cm thick, volva 3.5 cm wide, white, soft; **Basidiospores:** hyaline, apiculate, broadly elliptical, 8.0-11.2 x 6.4-8.0 μm ; **Basidia:** hyaline, elongated, 35.2-38.4 x 8.0-12.8 μm , 2 sterigmata, 4.8 μm long; **Pileus hyphae:** hyaline, septate, branched, 1.6-19.2 μm wide; **Stipe cuticle hyphae:** 4.0-6.4 μm in width, thin, hyaline, septate, branched, clamp connections absent; **Stipe context hyphae:** hyaline, septate, less branched, 8.0-20.0 μm in width; **Caulocystidia:** hyaline, clavate, upto 148.0 μm long and 14.4-16.0 μm in width.

Edibility: Not eaten in the study area.

Distribution: Earlier reported on soil from Himachal Pradesh, Uttar Pradesh (Sohi *et al.*, 1964; Ghosh *et al.*, 1974) and Western Ghats (Vrinda *et al.*, 2005).

Remarks: A new report from KHANP.

48. *Amanita vaginata* (Bull.) Lam., *Encycl. Méth. Bot.* (Paris) 1(1): 109 (1783) *Encycl. Meth. Bot.* (Paris) 1: 109 (1783)

Synonymy: *Agaricus plumbeus* Schaeff., *Fung. Bavar. Palat.* 4: 37 (1774)
Amanita vaginata f. *battarrae* (Boud.) Vesely, *Annl. Mycol.* 31(4): 279(1933)

Collection examined: Jammu and Kashmir, KHANP, Janakpur, Loharna, and Nath,

predominated by *Quercus semecarpifolia*, solitary, humicolous, S.A.J. Hashmi and Y.P. Sharma, HBJU-602, July 2016, October 2017. (Plate IXh, Plate IX B4).

Pileus: 3.3-4.6 cm wide, plane, smooth, grayish white with white patches on pileus, whitish at the margins; margins plicate-sulcate, thin, crenate, entire; **Gills:** free, close to sub-distant, entire, whitish; **Stipe:** 4.3-6.2 x 0.8-1.0 cm, central, cylindrical, smooth, white, slightly bulbous at the base, volva forming a cup at the base of stipe, soft, brittle, solid, becoming hollow at maturity; **Spore print:** white; **Annulus:** absent; **Basidiospores:** globose to slightly ellipsoidal, 8.0-11.2 x 7.2-12.0 μm , $a_vL= 9.6$, $a_vW= 9.6$, $Q= 1.1-0.9$, smooth, oil drops present, biguttulate, hyaline (3% KOH), amyloid with prominent apiculus; **Basidia:** clavate, 30.4-51.2 x 17.6-19.2 μm , sterigmata 2 to 4 in number, ranges upto 3.2 μm long; **Pileus hyphae:** 2.4-4.8 μm wide, thick-walled; **Stipe hyphae:** 4.8-8.0 μm wide, septate, hyaline, unbranched.

Edibility: Not eaten in study area. However, its edibility has been reported across the world (Christensen, 1955; Purkayastha and Chandra, 1985).

Distribution: On soil from Chattisgarh, Himachal Pradesh, Assam, Nagpur, Uttar Pradesh, Tamil Nadu and from Kashmir region (Trivedi, 1972; Ghosh *et al.*, 1974; Sathe and Sasangan, 1977; Watling and Gregory, 1980; Shukla *et al.*, 2009). 54.

Remarks: A new report from KHANP.

Family Pleurotaceae

49. *Pleurotus ostreatus* (Jacq.) P. Kumm., Führ. Pilzk. (Zerbst): 104 (1871)

Synonymy: *Pleurotus ostreatus* f. *subalutaceus* Malençon & Bertault, Trav. Inst. Sci. Chérifien, Sér. Bot. Biol. Veg. 33: 467 (1975)

Pleurotus ostreatus f. *florida* Cetto, Funghi dal Vero (Trento) 5: 419 (1987)

Pleurotus ostreatus var. *appalachiensis* O. Hilber, Mitteilungen der Versuchsanstalt für Pilzanbau der Landwirtschaftskammer Rheinland Krefeld-Grosshüttenhof 16: 60 (1993)

Pleurotus ostreatus var. *praecox* E. Ludw., Pilzkompodium (Eching) 1([2]): 567 (2001)

Collection examined: Jammu and Kashmir, KHANP, Janakpur and Loharna, in groups, lignicolous, S.A.J. Hashmi and Y.P. Sharma, HBJU-641, July 2016, August 2017. (Plate Xa, Plate X A1).

Pileus: 2.4-6.3 cm wide, creamish, depressed infundibuliform, dark brown at centre and slightly brown at margins, dimitate, margins inrolled; **Gills:** sub-decurrent, unequal, crowded at the margins, sub-distant at the base, wavy, concolorous; **Stipe:** eccentric to centric, 2.2-3.6 cm in length and 0.4-0.9 cm thick, short, slightly obclavate, concolorous with pileus;

Basidiospores: 4.8-7.2 x 4.8 µm, apiculate, light greenish (in Congo red); **Basidia:** hyaline, 19.2-35.2 x 4.8-7.2 µm, clavate in shape, guttulated; **Pileus hyphae:** hyaline, 8.0-18.4 µm wide, branched, septate, clamp connections present; **Stipe hyphae:** hyaline, 8.0-20.0 µm wide, septate, branched, clamp connections present.

Edibility: Eaten in the study area.

Remarks: A new report from KHANP.

50. *Pleurotus pulmonarius* (Fr.) Quél., Mém. Soc. Émul. Montbéliard, Sér. 2 5: 11 (1872).

Synonymy: *Pleurotus araucariicola* Singer, Lilloa 26: 141 (1954)

Pleurotus pulmonarius var. *lapponicus* E. Ludw., Pilzkompodium (Eching) 1([2]): 570 (2001)

Pleurotus pulmonarius var. *stechangii* Wasser & Zmitr., in Zmitrovich & Wasser, International Journal of Medicinal Mushrooms (Redding) 18(7): 584 (2016)

Collection examined: Jammu and Kashmir, KHANP, Sonder and Janakpur, lignicolus, S.A.J. Hashmi and Y.P. Sharma, HBJU-642, July 2016. (Plate Xb, Plate X A2).

Pileus: 3.4-5.2 cm long, dark bluish violet (57.VB-V.m), depressed convex, surface smooth,

Consistency: gelatinous; **Gills:** light purple, sinuate; **Stipe:** solid, juicy geniculate, 3.1-3.3 cm long, 1.3-1.7 cm in diameter; **Annulus:** absent; **Odour:** good; **Spore print:** white;

Basidiospores: 4.8-7.2 x 2.4-3.2 µm, pear shaped, apiculate, monoguttulated; **Basidia:** clavate, 17.6-25.6 x 4.8-7.2 µm; **Sterigmata:** 2 to 4 in number and 3.2-5.6 µm long; **Pileus hyphae:** hyaline, branched, septate, 6.4-16.0 µm wide, clamp connections present; **Stipe hyphae:** 3.2-8.0 µm wide, hyaline, septate, branched, clamp connections frequent.

Edibility: Eaten in the study area.

Remarks: A new report from KHANP

51. *Pleurotus squarrosulus* (Mont.) Singer, *Sydowia* 15(1-6): 45 (1962)

Synonymy: *Lentinus squarrosulus* Mont., *Annls Sci. Nat., Bot., sér. 2* 18: 21 (1842)

Lentinus tigrinus f. *squarrosulus* (Mont.) Pilát, *Annls mycol.* 34(1/2): 130 (1936)

Collection examined: Jammu and Kashmir, KHANP, Lopara, Palmar, Loharna, Marwah and Nath, lignicolous, found growing on stumps of *Cedrus deodara* and *Juglans regia*, gregarious to caespitose, S.A.J. Hashmi and Y.P. Sharma, HBJU-603, July 2017. (Plate Xc, Plate X A3).

Fruiting body: white to cream coloured; **Pileus:** 1.6-7.2 cm in diameter, sub-infundibuliform, depressed at the centre, smooth, antimony yellow buff (XVb 17'.O-Y), margins inrolled, splitting at several places; **Gills:** decurrent, crowded, unequal, easily

separable from pileus, flexible, white to cream, edges serrate; **Stipe:** 1.5-5.2 cm long and upto 1.6 cm wide, central to eccentric, cylindrical, smooth, without ring and volva, basal portion fused to form solid upto 5.9 cm wide; **Flesh:** white; **Odour:** pleasant; **Latex:** watery; **Spore print:** whitish; **Basidiospores:** elliptical to sub-cylindrical, 4.8-8.0 x 1.6-3.2 μm , smooth, hyaline, thin-walled; **Basidia:** clavate, 17.6-30.4 x 3.2-5.6 μm , 2 to 4-spored, sterigmata 1.6-6.4 μm long; **Cystidia:** 33.6-43.2 x 4.8-7.2 μm ; **Pileus hyphae:** 4.8-9.6 μm wide, septate, branched, clamped; **Stipe hyphae:** 3.2-11.2 μm wide, septate, branched, clamped, swollen, upto 16.0 μm wide.

Edibility: It is widely edible in the area. Edibility reported by other workers also (Bose and Bose, 1940; Chopra and Chopra, 1955; Zoberi, 1972; Purkayastha and Chandra, 1976).

Distribution: Earlier reported from Bombay, Tamil Nadu and West Bengal (Bose and Bose, 1940; Chopra and Chopra, 1955; Pegler, 1975).

Remarks: A new report from State and KHANP

Family Clavariaceae

52. Clavaria fragilis Holmsk., *Beata Ruris Otia FUNGIS DANICIS* 1: 7 (1790)

Synonymy: *Clavaria cylindrica* Gray, *Nat. Arr. Brit. Pl.* (London) 1: 656 (1821)

Collection examined: Jammu and Kashmir, KHANP, Loharna and Nath, humicolous, scattered gregarious, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-649, August 2017. (Plate Xd, Plate X A4).

Fructification: 2.2-3.4 cm long and 0.3-0.5 cm wide, erect, mostly simple, fleshy, smooth, whitish, longitudinally grooved in the middle on maturity; **Trunk:** upto 1.2 cm broad, concolorous; **Flesh:** white, delicate; **Odour:** none; **Basidiospores:** broadly ellipsoid to sub-globose, 4.0-6.4 x 3.2-4.8 μm , hyaline, papillate, smooth, aguttulate; **Basidia:** clavate to elongate, 30.4-40.0 x 5.6-6.4 μm , multi-guttulate, 4-spored, sterigmata upto 4.8 μm long; **Hyphae:** monomitic, 2.4- 9.6 μm wide, thin-walled, branched, septate and without clamp connections.

Edibility: Edible in study area.

Distribution: On soil under oak forest from Uttar Pradesh (Thind, 1961).

Remarks: A new report from State and KHANP.

Order Boletales

Family Boletaceae

53. *Boletus edulis* Bull., *Herbierde ía France* 2: tab, 60(1782) [1 781-82]

Synonymy: *Boletus solidus* Sowerby, *Coloured figures of English Fungi or Mushrooms* (London)3:419 (1809)

Boletus edulis var. *arcticus* (Vassilkov) Hlaváãek, *Mykologickj' Sbornik* 71(1) 9(1994)

Collection examined: Jammu and Kashmir, KHANP, Janakpur, Palmar, Qedarna and Marwah, humicolous, scattered, coniferous forest of *Pinus walllichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-604, August 2016. (Plate Xe, Plate X B1).

Pileus: 1.4-3.6cm wide, convex, smooth, deep olive buff (XLb. 21".O.YY);

Pores: small, round, initially white finally turning greenish; **Stipe:** central, 3.3-7.1 x 1.6-2.7 cm, obclavate, solid, brownish with slight tinge of carrot red (XI'/b.7'.R-O) at the base;

Flesh: white, unchanging; **Basidiospores:** ellipsoidal, 4.8-11.2 x 3.2-4.8 µm, smooth, bi-guttulate (yellowish in lactophenol); **Basidia:** clavate, 35.2 x 14.4 µm; **Pileus hyphae:** 4.0-12.0 µm, wide, septate; **Caulocystidia:** 30.4-56.0 x 9.6-14.4 µm.

Edibility: Edible in study area. Earlier reported to be edible (Atkinson, 1961; Krieger, 1967: Garcha, 1980).

Distribution: India (Garcha, 1980).

Remarks: A new report from KHANP.

54. *Boletus formosus* Corner, *Trans. Br. Mycol. Soc.* 59(3): 118 (1972)

Synonymy: *Boletus neoformosus* E. Horak, *Malayan Forest Records* 51: 139 (2011)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Loharna, and Qedarna, humicolous and mycorrhizal, scattered, coniferous forests of *Pinus walllichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-643, July 2017. (Plate Xf, Plate X B2).

Pileus: upto 3.4 cm in diameter, prout's brown, convex then plane, smooth, margins slightly inrolled; **Flesh:** white, becomes dull after plucking; **Stipe:** upto 4.8 cm long and 0.8 cm wide, central, smooth, concolorous with pileus, slightly bulbous at the base; **Pores:** rectangular, brownish; **Basidiospores:** cylindrical to elliptical, 9.6-14.4 x 4.8-7.2 µm, smooth, bi-to multiguttulate; **Basidia:** clavate, 14.4-46.4 x 7.2-16.8 µm, sterigmata 2 to 4, ranges from 3.2-5.6 µm long; **Cystidia:** upto 56.0 x 14.4 µm wide; **Pileus hyphae:** 4.8-16.0 µm wide, septate, branched, occasionally clamped; **Stipe hyphae:** 4.8-11.2 µm, wide, septate; **Context**

hyphae: 3.2-11.2 μm , wide, septate.

Edibility: Edible in the study area.

Remarks: A new report from State and KHANP.

55. *Boletus granulatus* (L.) Roussel, *F. Calvados*: 1796.

Synonymy: *Boletus granulatus* L., *Sp. pl.* 2: 1177 (1753)

Agaricus granulatus (L.) Lam., *Encycl. Méth. Bot.* 1(1): 51 (1783)

Collection examined: Jammu and Kashmir, KHANP, Loharna and Nath, humicolous as well mycorrhizal, scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-644, July 2016. (Plate Xg, Plate X B3).

Pileus: 3.2—3.3 cm in diameter, convex then plane, smooth, yellowish brown; **Stipe:** 3.1-6.3 x 0.7 cm, central, equal, antimony yellow, apex is covered with small yellow granules;

Pores: small, angular, yellowish; **Flesh:** antimony yellow (XVb17'.o-y), unchanging on exposure; **Odour:** mild; **Basidiospores:** elongated to elliptical, 6.4-12.8 x 3.2-4.8 μm , guttulate, smooth; **Basidia:** clavate, 16.0-24.0 x 4.0-9.6 μm , sterigmata 2 to 4; **Cystidia:** clavate, 40.0-65.6 x 4.8-5.6 μm ; **Pileus hyphae:** septate, 3.2-6.4 μm wide, branched; **Stipe hyphae:** 8.0-16.0 μm wide, septate.

Edibility: Although edible in other parts of the country but not found to be edible in the study area.

Remarks: A new report from State and KHANP.

56. *Boletus luridus* (Schaeff.) Murrill 1909

Synonymy: *Boletus luridus* Schaeff., *Fung. bavar. palat. nasc.* (Ratisbonae) 4: 78 (1774)

Leccinum luridum (Schaeff.) Gray, *Nat. Arr. Brit. Pl.* (London) 1: 648 (1821)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Lopara, Loharna, Qedarna, Marwah, and Ekhala, ectomycorrhizal, scattered, coniferous forest of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJ-605, August 2017. (Plate Xh, Plate X B4).

Pileus: 6.3-10.1 cm, convex then flat, cuticle smooth velvety, dragon's blood red; **Stipe:** 2.3-10.3 cm, smooth, slightly furrowed, obclavate, concolorous with pileus, narrowed at apex, swollen at the base with a tinge of alizarin pink colour; **Pores:** brownish-red; odour mild; **Basidiospores:** ellipsoid to slightly fusiform, 6.4-10.4 x 3.2-4.8 μm ; **Basidia:** clavate, 16.0-40.8 x 2.4-11.2 μm , 2 to 4-spored; sterigmata 6.4 μm long; **Pieleipellis:** 2.4-4.8 μm , septate without clamp connection; **Pileus context:** 4.8-8.0 μm , fusiform; **Stipitipellis:** 9.4-11.2 x

4.8-6.4 µm, branched, septate; **Caulocystidia:** clavate to cymbiform, 25.6-46.4 x 5.6-10.4 µm.

Edibility: It is widely consumed in the area.

Remarks: A new report from KHANP.

Family Suillaceae

57. *Suillus cavipes* (Klotzsch) A.H. Sm. & Thiers, *Monogr. North Amer. Species Suillus*: 30 (1964)

Synonymy: *Boletus cavipes* Klotzsch, in *Fries & Hök, Boleti, Fungorum generis, illustratio*: 7 (1835)

Boletinus cavipes (Klotzsch) Kalchbr., *Icon. Sel. Hymenomyc. Hung.* (Budapest) 25: 52 (1867)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Loharna, Marwah and Ekhala, ectomycorrhizal, coniferous forest of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-645, August 2016, November 2017. (Plate XIa, Plate XI A1).

Pileus: 3.1-6.3 cm in diameter, convex then flat, antimony yellow (XVb17'. O-Y), surface covered with brown appressed scales; **Pores:** primulin yellow (XVlb 19'.YO-Y), round; **Flesh:** Pale yellow turning to brown on cutting; **Stipe:** 4.1-7.2 x 1.1-3.2 cm, solid, ochre yellow with brownish tinge; **Taste:** acidic; **Basidiospores:** elliptical to oblong, 4.0-9.6 x 2.4-4.8 µm, smooth, bi-guttulate; **Basidia:** 16.0-32.0 x 4.8-6.4 µm, clavate; **Cystidia:** 22.4-64.0 x 3.2-11.2 µm; **Pileus hyphae:** 3.2-14.4 µm, wide, septate; **Stipe hyphae:** 2.4-12.8 µm, wide, septate, branched; **Pileus context hyphae:** 4.8-24.0 µm, wide, septate.

Edibility: Not consumed in the study area.

Remarks: A new report from State and KHANP

Family Sclerodermataceae

58. *Scleroderma citrinum* Pers., *Syn. Meth. Fung.* (Gottingen) 1: 153 (1801)

Synonymy: *Scleroderma vulgare* Hornem., *Syst. Mycol.* (Lundae) 3: 46 (1829)

Collection examined: Jammu and Kashmir, KHANP, Lopara, Palmar, Deharna and Nath, ectomycorrhizal, S.A.J. Hashmi and Y.P. Sharma, HBJU-606, July 2016. (Plate XIb, Plate XI A2).

Carpophore: 1.2-1.5 cm wide, light brown in colour with reticulate pattern on it, profusely branched rhizomorphs present; **Gleba:** dark black (in preservative); **Stipe:** short;

Basidiospores: 6.4-10.4 x 6.4-9.6 µm, light brown (in Congo red), yellowish green in KOH and iodine, echinulated, double walled; **Pedicle:** absent; **Exoperidial hyphae:** 4.8-8.8 µm in width, septate, branched; **Endoperidial hyphae:** hyaline, thin, 4.0- 5.6 µm wide.

Edibility: Not eaten in the study area.

Distribution: Earlier recorded from the forests of Kashmir (Beig *et al.*, 2011).

Remarks: A new record for KHANP.

59. *Scleroderma polyrhizum* (J. F. Gmel.) Pers., *Syn. Meth. Fung.* (Göttingen) 1: 156 (1801)

Synonymy: *Lycoperdon polyrhizon* J.F. Gmel., *Syst. Nat.* 2: 1464 (1796)

Scieroderma geaster Fr., *Syst. Mycol.* (Lundae) 3(1): 46 (1829)

Collection examined: Jammu and Kashmir, KHANP, Janakpur, Deharna and Marwah, humicolous, solitary to scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-646, December 2015. (Plate XIc, Plate XI A3).

Gasterocarp: globose to sub-globose, 0.8-1.3 cm in diameter, almost sessile, attached by a short and poorly developed rooting base, whitish when young changes colour on maturity;

Peridium: soft and smooth when young but becomes hard and scaly after age, composed of branched, septate and hyaline hyphae of 4.0-5.6 µm width, clamped; **Gleba:** brownish;

Basidiospores: globose to subglobose, 8.0-11.2 µm in diameter, smooth to minutely roughed, yellowish brown (in iodine); **Endoperidium hyphae:** upto 8.0 µm wide, branched, septate, thin walled, clamped.

Edibility: Not edible.

Distribution: Earlier reported from UP. and Assam (Berkeley, 1856 and Bakshi, 1974).

Remarks: A new report from State and KHANP

60. *Scleroderma verrucosum* (Bull.) Pers., *Syn. Math. Fung.* (Göttingen) 1: 154 (1801)

Synonymy: *Lycoperdon verrucosum* Bull., *Hist. Champ. France* (Paris) 1: 24 (1791)

Lycoperdon defossum sensu Sowerby; tide Check list of Basidiomycota of Great Britain and Ireland (2005).

Collection examined: Jammu and Kashmir, KHANP, Loharna, humicolous, solitary to scattered, mixed forests predominantly of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-647, September 2015 (Plate XIId, Plate XI A4).

Gasterocarp: globose to depressed globose with a well developed mycelial base, 1.3-2.2 cm in diameter, light brownish, profusely branched rhizomorphs, grey coloured; **Peridium:** thin,

squamose with warts, dehiscing irregularly comprising two zones: outer representing warts, comprised of pale yellow hyphae, septate, upto 7.2 μm wide, inner zone pale yellow, comprised of intricate hyphae, sub-hyaline, aseptate, upto 5.6 μm wide; **Gleba:** pulverulent, light brown becoming dark brown; **Basidiospores:** globose, 5.6-9.6 μm in diameter, echinuate; Exoperidium hyphae: branched, upto 6.4 μm wide, hyaline; **Endoperidium hyphae:** septate to aseptate, upto 5.6 μm wide, unbranched.

Edibility: Not edible in study area but reported to be edible by several others (Ramsbottom, 1953; Soothill and Fairhurst, 1978).

Distribution: On ground from Uttar Pradesh and Himachal Pradesh (Hennings, 1901; Bakshi, 1974).

Remarks: A new record for KHANP.

Order Cantharallales

Family Cantharellaceae

61. Cantharellus cibarius Fr., *Syst. mycol.* (Lundae) 1: 318 (1821)

Synonymy: *Merulius cibarius* (Fr.) Westend., *Herb. crypt. Belg.:* no. 340 (1849)

Craterellus cibarius (Fr.) Quél., *Fl. mycol.* France (Paris): 37 (1888)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Janakpur, Deharna and Marwah, humicolous, gregarious to caespitose, coniferous forest of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-607, July 2016. (Plate XIe, Plate XI B1).

Pileus: irregular in shape, 4.1-6.3 cm wide, depressed in the center, surface smooth with involuted margins yellowish (Canary yellow); **Gills:** decurrent, unequal, distant, not in series, concolorous, edges blunt; **Hymenophoral trama:** irregular; **Stipe:** 3.1-8.2 x 0.9-1.4 cm, central, somewhat glabrous, tapering towards the base; **Flesh:** creamish, thick; odour mild; **Basidiospores:** ellipsoidal and apiculate, 4.8-9.6 x 4.0-6.4 μm , globular oil droplets present; **Basidia:** clavate with 2-4 sterigmata, 14.4-33.6 x 4.0-5.6 μm ; **Pileipellis:** 3.2-8.0 μm wide, branched, hyaline, septate, clamp connections present; **Stipitipellis:** septate, 6.4-12.8 μm wide, clamped; **Pileus context:** septate, upto 5.6 μm clamped, branched.

Edibility: The edibility status of this species is doubtful in the study area.

Distribution: On soil with dead organic matter, on ground under *Pinus longifolia*, in open patches on humus and rocky soil from Solan (H.P.), Mussoorie UP., Shillong (Assam), Kashmir and West Bengal (Hennings, 1901; Bose and Bose, 1940; Chopra and Chopra, 1955; Ghosh *et al.*, 1974; Abraham *et al.*, 1980).

Edibility: consumed in the study area.

Remarks: A new report from State and KHANP.

62. *Craterellus tubaeformis* (Fr.) Quél., *Fl. mycol.* France (Paris): 36 (1888))

Synonymy: *Cantharellus tubaeformis* Fr., *Syst. mycol.* (Lundae) 1: 319 (1821)

Agaricus cantharelloides Bull., *H/st. Champ. France* (Paris): tab. 505 (1792)

Collection examined: Jammu and Kashmir, KHANP, Janakpur, humicolous, gregarious, coniferous forest of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-648, July 2017. (Plate XIf, Plate XI B2).

Pileus: wide, 1.3-3.4 cm, convex then flat, decurved inrolled margin, finally becoming arched or wavy with age, smooth to wrinkled, dark yellow-brown to dark brown, rough to slightly scaly; **Flesh:** greyish yellow; **Odour and Taste:** mild; **Gills:** decurrent to sub-decurrent, distant, yellowish to grey finally brown, solid; **Stipe:** 3.1-5.3 cm long and upto 0.5 cm wide, cylindrical to compressed, smooth to slightly furrowed, yellowish to greyish orange, solid; **Spore print:** pale yellow; **Basidiospores:** broadly elliptical, 9.6-12.0 x 6.4-8.0 µm, smooth, thin-walled, inamyloid, apiculate, oil droplets present; **Basidia:** clavate, 39.2-60.8 µm long and upto 10.4 µm wide, 2 to 4-spored, thin-walled, sterigmata measured 6.4-9.6 µm long; **Pileus and stipe hyphae:** 2.4-5.6 µm wide, hyaline, septate, clamp connections present; **Pileus context:** 8.8-11.2 µm wide, hyaline, pale yellow (in Congo red), septate, branched; **Cystidia:** not observed.

Edibility: Not edible in study area and Jammu and Kashmir but reported to be edible by many workers worldwide (Christensen, 1955; Krieger, 1967; Phillips, 1981).

Distribution: on ground from Khasi hills in Assam (Berkeley, 1856).

Remarks: A new report from State and KHANP.

Order Gomphales

Family Gomphaceae

63. *Ramaria apiculata* (Fr.) Donk, *Bibliotheca Mycol.* 21: 105 (1933)

Synonymy: *Clvaria apiculata* Fr, *Qbserv. Mycol.* (Havniae) 2: 288 (1818)

Clavariella apiculata (Fr.) P. Karst., *Revue Mycol.*, Toulouse 3(9): 21(1881)

Clavaria densissima Peck, *Bull. Torrey Bot. Club* 30: 98 (1903)

Collection examined: Jammu and Kashmir, KHANP, Janakpur and Qedarna, humicolous, solitary, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-609, August 2015. (Plate XIg, Plate XI B3).

Fructification: 4.1-7.1 cm long and 4.9-6.3 cm wide, erect, profusely branched, fleshy, smooth, pale pinkish buff, polychotmous below and dichotomous above, unequal; Primary branches upto 0.3 cm wide, radial; terminal branchlets in equal to unequal pairs and clustered, upto 0.2 cm long; **Flesh:** light colour in lower part, unchanging; **Basidiospores:** narrowly ellipsoid to cylindric, 12.0-16.0 x 4.0-5.6 μm , pale brown, papillate, papilla upto 0.8 μm long, smooth to minutely rough, multi-guttulate; **Basidia:** clavate, upto 20.8 x 6.4 μm wide, 4-spored, sterigmata upto 4.8 μm long; **Hyphae:** monomitic, 3.2-8.0 μm wide, hyaline to sub-hyaline, thin to thick-walled, clamped.

Edibility: *Ramaria apiculata* is extensively edible. Earlier also reported to be edible in India (Thind, 1961). 6)

Distribution: Growing in Himalayan region near the base of tree in mixed forest from Ratanagiri (M.S.), Shimla (HP.) (Thite *et. al.*, 1976; Sharma and Jandaik, 1978).

Remarks: A new report from State and KHANP.

64. *Ramaria aurea* (Schaeff.) Quél., *Fl. Mycol. France* (Paris): 467 (1888)

Synonymy: *Clavaria aurea* Schaeff., *Fung. Bavar. Palat. 4*: 121 (1774)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Lopara, Deharna, Marwah and Nath, humicolous, solitary, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, Kalinaag area, S.A.J. Hashmi and Y.P. Sharma, HBJU-610, August 2017. (Plate XIIh, Plate XI B4).

Fructification: upto 7.1 cm long and upto 8.3 cm wide, fleshy, erect, light ochraceous buff ; **Trunk:** present, upto 3.3 cm long, creamish, profusely branched, polychotmous below and dichotomous above; primary branches upto 1.1 cm wide, creamish; Ultimate branchlets short, dichotomous, yellow; **Flesh:** white to pale; **taste and odour:** not noticeable; **Basidiospores:** ellipsoid, 8.0-12.8 x 3.2-5.6 μm , smooth to slightly rough, uni- to multiguttulate, papillate; **Basidia:** clavate, upto 25.6 x 5.6 μm ; **Hyphae:** monomitic, 2.4-11.2 μm wide, branched, septate, hyaline, occasionally clamped, swollen at the top, upto 12.8 μm wide.

Edibility: *Ramaria aurea* is highly edible.

Distribution: Earlier reported from Mussoorie (U.P.) and Shimla (H.P.) (Thind, 1961; Sharma and Jandaik, 1978).

Remarks: A new report from KHANP.

65. *Ramaria flava* (Schaeff.) Quél., 1888

Synonymy: *Clavaria flava* Schaeff., *Fung. bavar. palat. nasc.* (Ratisbonae) 4: 118 (1774)

Ramaria flavobrunnescens var. *aurea* (Coker) Corner, Monograph of Clavaria and allied Genera, (*Annals of Botany Memoirs No. 1*): 581 (1950)

Collection examined: Jammu and Kashmir, KHANP, Deharna and Marwah, humicolous, scattered to gregarious, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-651, July 2016. (Plate XIIa, Plate XII A1).

Fructification: 5.1-6.2 x 3.2-5.2 cm, erect, fleshy, smooth, orange with yellowish tips becoming brown after age. profusely branched, polychotmous below, dichotomous above, unequal, irregular, crowded; Primary branches upto 0.6 cm wide, ultimate branchlets very short upto 1.1 cm long, apices yellow; **Flesh:** white; **Odour and Taste:** mild; **Basidiospores:** ellipsoid to elongate, 8.0-10.4 x 4.0-5.6 μm , pale brown, verrucose, aguttulate; **Basidia:** clavate, 28.0-30.4 x 7.2-8.8 μm , oil drops present, sterigmata-4, upto 4.0 μm long; **Hyphae:** monomitic, 4.0-10.4 μm wide, thick-walled, septate, clamped.

Edibility: *Ramaria flavobrunnescens* var. *aurea* is edible.

Distribution: Earlier reported from Mussoorie (Thind and Sukhdev, 1957).

Remarks: A new report from KHANP.

66. *Ramaria stricta* (Pers.) Quél., F. Mycol. (Paris): 464 (1888) .

Synonymy: *Clavaria stricta* Pers., *Ann. Bot.* (Usteri) 15: 33 (1795)

Merisma strictum (Pers.) Spreng., *Syst. veg.*, Edn 16 4(1): 495 (1827)

Collection examined: Jammu and Kashmir, KHANP, Palmar, Loharna and Marwah, humicolous, solitary to scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-652, July 2017. (Plate XIIb, Plate XII A2).

Fructification: upto 6.9 x 4.1 cm wide, erect, profusely branched, fleshy, smooth, yellowish brown; **Branches:** profuse, polychotmous below and dichotomous above, unequal; Primary branches upto 0.1 cm wide; ultimate branchlets equal to unequal, in pairs of clusters, crowded and cristate due to very close and irregular dichotomy, apices dark coloured, concolorous and blunt; **Flesh:** concolorous; **Basidiospores:** ellipsoid, 9.6-12.8 x 3.2-5.6 μm , pale brown, papillate, papilla upto 0.8 μm long, smooth to minutely rough, aguttulate to guttulate; **Basidia:** clavate, 30.4-56.0 x 6.4-8.0 μm , pale brown, 4-spored, sterigmata 1.6-3.2 μm long; **Hyphae:** monomitic, 2.0-12.0 μm wide, hyaline to sub-hyaline, thin to thick-walled, septate, clamped.

Edibility: *Ramaria stricta* is edible in the area.

Distribution: On rotting stumps and logs of trees in Oak forest from Uttar Pradesh and Shimla (H.P.) (Thind and Anand, 1956; Thind, 1961; Sharma and Jandaik, 1978).

Remarks: A new report from KHANP.

67. *Ramaria formosa* (Pers.) Quél., Fl. Mycol. France (Paris): 466 (1888)

Synonymy: *Clavaria formosa* Pers., *Comment. Fungis Clavaeform:* 41 (1797)

Merisma formosum (Pers.) Lenz, *Nütz. schäd. Schwämme:* 95 (1831)

Collection examined: Jammu and Kashmir, KHANP, Qedarna, humicolous, scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-653, July 2016. (Plate XIIc, Plate XII A3).

Fruiting body: 4.4-10.1 x 3.2-6.1 cm, erect; trunk prominent, 1.7-3.1 cm wide, profusely branched, smooth: antimony yellow; branches polychotmous below and dichotomous above, unequal; primary branches measured 0.4-1.7 cm wide, yellowish; **Flesh:** white; **taste** bitter; **odour** distinct; **Basidiospores:** ellipsoidal to cylindrical, 8.0-14.4 x 3.2-6.4 µm, smooth to slightly rough, papillate, upto 1.6 µm long papilla, multi-guttulate; **Basidia:** clavate, 16.0-32.0 x 6.4-9.6 µm, 2 to 4-spored, sterigmata upto 6.5 µm long; **Hyphae:** 3.2-9.6 µm wide, septate, branched, infrequently clamped, swollen at the top forming saclike structure upto 14.4 µm wide.

Edibility: *Ramaria formosa* is edible, Earlier also reported to be edible (Corner, 1950; Atkinson, 1961).

Distribution: *Ramaria formosa* was earlier reported from Murree Hills (Thind, 1961) and Khasi hills, Assam, (Butler and Bisby 1960).

Remarks: A new report from KHANP.

Order Polyporales

Family Sparassidaceae

68. *Sparassis crispa* (Wulfen) Fr., *Syst. Mycol.* (Lundae) 1:465(1821)

Synonymy: *Manina crispa* Scop., *Diss. Sd. Nat. (Plant. subterr.)* 2: 99 (1772)

Masseola crispa (Wulfen) Kuntze, *Revis. Gen. Pl.* (Leipzig) 2: 859 (1891)

Clavaria crispa (Scop.) Sacc., *Syll. Fung.* (Abellini) 19: 331 (1910)

Collection examined: Jammu and Kashmir, KHANP, Lopara, Palmar, Loharna, Deharna and Ekhala, humicolous, scattered, coniferous forests of *Pinus wallichiana* and *Cedrus*, S.A.J. Hashmi and Y.P. Sharma, HBJ-608, August 2017. (Plate XIIId, Plate XII A4).

Basidiocarp 12.0-20.0 cm wide and 8.0-13.0 cm high large, rounded, cauliflower-like, sessile, composed of several broad flattened crimped like branches usually wavy, warm buff; **Branches:** fleshy, 2.3-4.0 cm wide, irregularly lobbed. **Basidiospores:** 7.2 μ m, snuff brown, smooth, guttulate; **Basidia:** clavate, 30.4-34.4 x 8.0-10.4 μ m, 4-spored, sterigmata upto 4.8 μ m long; **Pleurocystidia:** absent; **Cheilocystidia:** cylindrical to clavate, 19.2-40.0 x 9.6-12.0 μ m, hyaline; Hymenophoral trama compact and composed of parallel hyphae; Pileus and Stipe hyphae: 3.2-8.0 μ m wide, septate, hyaline, thick-walled.

Edibility: edible

Distribution: Earlier reported from Jammu and Kashmir and Maharashtra (Sathe and Sansangam, 1977; Watling and Gregory, 1980).

Remarks: A new report from KHANP.

69. Sparassis radicata Weir, *Phytopathology* 7: 166 (1917)

Collection examined: Jammu and Kashmir, KHANP, Palmar, Loharna, Deharna and Ekhala, humicolous, scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-650, July 2017. (Plate XIIe, Plate XII B1).

Basidiocarp: 9.0-16.0 x 10.0 – 18.0 cm, cauliflower or lettuce-like, undulating branches, warm buff, each branch 10-20 mm wide, varying in length: flesh: white; odour: unpleasant; **Basidiospores:** oval to subglobose, 7.2-11.2 x 7.2-10.4 μ m, smooth hyaline with oil droplets, guttulate; **Basidia:** clavate, 16.0-30.4 x 5.6-8.0 μ m; **Hyphal system:** monomitic, septate, 6.4-19.2 μ m, hyaline, branched and clamped.

Edibility: locally edible

Remarks: A new report from KHANP.

Order Russulales

Family Russulaceae

70. Lactarius deliciosus (L.) Gray, *Nat. Arr. Brit. Pl.* (London) 1: 624 (1821)

Synonymy: *Agaricus deliciosus* L., *Sp. pl.* 2: 1172 (1753)

Galorrheus deliciosus (L.) P. Kumm., *Führ. Pilzk.* (Zerbst): 126 (1871)

Lactifluus deliciosus (L.) Kuntze, *Revis. gen. pl.* (Leipzig) 2: 856 (1891)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Janakpur, Qedarna, Marwah, Nath and Ekhala, gregarious in *Pinus roxburghii* forests, fasciculate, humicolous, S.A.J. Hashmi and Y.P. Sharma, HBJU-612 August 2017. (Plate XIIf, Plate XII B2).

Pileus: 1.7-2.6 cm wide, depressed convex in young specimens later becoming infundibuliform, Grenadine pink colour, margins inrolled when young; **Gills:** grenadine pink in colour, arcuate, unequal, sub-distant, gives greenish on exposure to air; **Stipe:** 2.1-2.4 cm long and 0.4-1.2 cm wide, equal, smooth, concolorous, solid, geniculate; **Odour:** mushroomy, agreeable; **Basidiospores:** 8.0-11.2 x 7.2-8.0 μm , globose to sub-globose, thick walled, forms partial reticulate pattern, uni- to multiguttulated; **Basidia:** 48.0-55.2 x 10.4-13.6 μm , hyaline, guttulated; **Sterigmata:** 4 in number, 4.8-9.6 μm long, some sterigmata contained guttations; **Pileus hyphae:** 10.0-18.0 μm wide and inflated upto 44.0 μm ; **Stipe hyphae:** upto 24.0 μm , septate, branched, hyaline, clamp connections absent.

Edibility: Not eaten in the study area.

Distribution: It has earlier been reported from Sikkim (Butler and Bisby, 1931) Himachal Pradesh, Uttar Pradesh (Saini and Atri, 1982) and other places of India.

Remarks: A new report from KHANP.

71. Lactarius deterrimus GrOger, Westfälische Pilzbriefe 7:10 (1968)

Synonymy: *Lactarius deliciosus* var. *deterrimus* (Groger) Hesler & A.H. Sm., North American Species of *Lactarius* (Ann Arbor): 94 (1979)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Palmar and Marwah, humicolous, solitary, coniferous and mixed forest, S.A.J. Hashmi and Y.P. Sharma, HBJU-654, August 2017. (Plate XIIg, Plate XII B3).

Pileus: 4.2-6.1 cm, broad, convex then plane, with slight depression in the centre, moist, warm buff, cuticle movable, margins incurved, smooth, entire; **Flesh:** white, thick; **Latex:** present, yellow to orange colour; **Taste:** mild; **Odour:** apricot-like; **Gills:** sub-decurrent, close, entire, easily separable from flesh, brittle, orange with greenish tinge; **Stipe:** 2.5-4.5 x 0.5-0.9 cm, central, slightly bulbous at the base, solid becoming hollow with age, orange to pale orange; **Spore print:** cream colour; **Basidiospores:** sub-globose to radially ellipsoid, 8.0-9.6 x 7.2-8.0 μm , apiculate with warted or reticulate ornamentation, apiculus upto 1.6 μm long; **Basidia:** clavate, 40.0-65.6 x 11.2-13.6 μm , 2 to 4- spored; **Pleurocystidia and Cheilocystidia:** fusiform, 30.4-52.0 x 4.0-6.0 μm , tapering apex, hyaline, thin-walled; **Pileus hyphae:** gelatinized; **Stipe hyphae:** upto 4.0 μm wide, septate, branched, hyaline, pale yellow; **Caulocystidia:** fusiform to clavate, 30.4-52.8 x 5.6-12.8 μm ; **Hymenophoral trama:** intermixed with lactiferous hyphae, branched, septate, upto 14.4 μm wide.

Edibility: Doubtful edibility in the study area but edible in some areas of Kashmir region (Abraham et.al., 1980).

Distribution: Earlier reported on ground amongst pine litter from Gulmarg, Jammu and Kashmtr (Abraham et.al., 1980).

Remarks: A new report from KHANP.

72. *Lactarius vellereus* (Fr.) Fr., *Epicr. Syst. Mycol.* (Upsaliae): 340 (1838)

Synonymy: *Agaricus vellereus* Fr., *Syst. mycol.* (Lundae) 1: 76 (1821)

Galorrheus vellereus (Fr.) P. Kumm., *Führ. Pilzk.* (Zerbst): 125 (1871)

Lactifluus vellereus (Fr.) Kuntze, *Revis. gen. pl.* (Leipzig) 2: 857 (1891)

Collection examined: Jammu and Kashmir, KHANP, Palmar and Deharna, humicolous, solitary, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-655, August 2017. (Plate XIIh, Plate XII B4).

Pileus: upto 12.7 cm in diameter, infundibuliform, smooth, deeply indented, irregular, depressed, Royal ivory at centre, margins uplifted; **Gills:** decurrent, whitish, margins even, regular; **Stipe:** upto 7.4 cm long and 2.2 cm wide, central, smooth, solid, whitish; **Annulus:** absent; **Flesh:** white; **Odour and Taste:** mild; **Latex:** present, milky, unchanging; **Basidiospores:** subglobose to ovoid, 8.0-11.2 x 8.0-9.6 µm, rough, echinulate, oil droplets present, apiculus upto 3.2 µm; **Basidia:** 28.8-44.8 x 9.6-16.0 µm, clavate, sterigmata 2 to 4-spored, measured 3.2-14.4 µm; **Cystidia:** 48.0-72.0 x 9.6-16.0 µm; **Pileus hyphae:** septate, 3.2-9.6 µm wide.

Edibility: Not edible in the study area

Distribution: On wood from Sikkim (Berkeley, 1856).

Remarks: A new report from State and KHANP.

73. *Lactarius volemus* (Fr.) Fr., *Epicr. Syst. Mycol.* (Upsaliae): 344 (1838)

Synonymy: *Lactarius ichoratus* (Batsch) Fr., *Epicr. Syst. Mycol.* (Upsaliae): 345(1838)

Lactarius lactifluus (L.) Burl., *Mem. Torrey Bot. Club* 14: 90 (1908)

Lactarius volemus var. *subrugatus* Neuhoff, *Pilze Mitteleuropas* (Stuttgart): 188 (1956)

Collection examined: Jammu and Kashmir, KHANP, Lopara, Palmar and Qedarna, humicolous, solitary, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*. S.A.J. Hashmi and Y.P. Sharma, HBJU-611, August 2017. (Plate XIIIa, Plate XIII A1).

Pileus: upto 4.8 cm in diameter, convex then flat, depressed at the centre, ochraceous orange (XVb 15'. Y-O), smooth; **Gills:** free, creamish, regular, even; **Stipe:** upto 4.0 cm long, central, cylindrical, solid, smooth, concolorous with gills; **Flesh:** white; **Odour and Taste:** mild; **Latex:** present, milky, unchanging; **Basidiospores:** subglobose, 4.8-9.6 x 5.6-

8.0 µm, rough, echinulate, guttulate, when treated with iodine shows blue black ornamentation; **Basidia:** clavate, 28.8- 48.0 x 7.2-11.2 µm, sterigmata ranges upto 8.0 µm in length; **Cheilocystidia:** 48.0-72.0 x 8.0-11.2 µm; **Pleurocystidia:** 36.8-70.4 x 13.6-11.2 µm; **Pileocystidia:** 20.8-67.2 x 6.4-11.2 µm; **Pileus hyphae:** 3.2-4.8 µm wide, septate, branched. **Edibility:** Not reported from the study area. However, edibility reported to be edible in other regions (Christensen, 1955; Krieger, 1967; Phillips, 1981). **Distribution:** Reported from India (Garbha, 1980). **Remarks:** A new report from State and KHANP.

74. *Russula annulata* var. *annulata* R. Heim, Candollea 7: 392 (1938)

Collection examined: Jammu and Kashmir, KHANP, Loharna and Qedarna, humicolous, scattered, mixed forests of *Alnus nepalensis* and *Juglans regia*, S.A.J. Hashmi and Y.P. Sharma, HBJU-656, September 2016. (Plate XIIIb, Plate XIII A2).

Pileus: 2.2-4.1 cm in diameter, campanulate then flat, with obtuse raised umbo, whitish, fibrillose, with adpressed buckthorn brown scales that cover the disc; **Gills:** free, creamish, crowded, smooth, unequal, normal; **Stipe:** 3.1-5.9 cm long and 2.2 cm wide, solid, whitish, fibrillose tending to be pale yellow or pale reddish brown, equal, slightly enlarged at the base, smooth; **Annulus:** present, white, evanescent; **Flesh:** white; **Odour and Taste:** placid; **Spore print:** creamish; **Basidiospores:** sub-globose to ovoid with apiculus upto 2.4 µm long, rough, thick-walled, echinulate, 6.4-11.2 x 6.4-9.6 µm, oil drops present, **Basidia:** clavate, 17.6-56.0 x 6.4-14.4 µm wide at the top and 3.2-5.6 µm wide at the base, sterigmata 2 to 4, ranges upto 4.8 µm long; **Cheilocystidia:** 40.0-70.4 x 8.8-11.2 µm; **Pleurocystidia:** 30.4-72.0 x 8.8-11.2 µm wide; **Caulocystidia:** clavate, 33.6- 54.4 µm x 14.4-16.0 µm; **Stipe hyphae:** 2.4-6.4 µm wide, septate.

Edibility: Not edible in the study area.

Remarks: The collection differs from *Russula annulata* in having evanescent nature of annulus and hence is being proposed as new variety.

75. *Russula squalida* Peck, *Bull. N.Y. St. Mus.* 116: 80 (1907)

Synonymy: *Russula atropurpurea* Peck, *Rep. (Annual) Trustees State Mus. Nat. Hist.*, New York 41: 75 (1888)

Collection Examined: Jammu and Kashmir, KHANP, Sonder, Loharna and Marwah, ectomycorrhizal, gregarious, S.A.J Hashmi and Y.P. Sharma, HBJU-657, October 2016, September 2017 (Plate XIIIc, Plate XIII A3).

Pileus: 4.5 to 8.5 cm wide, purple, pure white context, smooth, slightly depressed from the centre, margins turned upwards; **Gills:** creamish, attached, crowded, wide; **Stipe:** upto 12 cm long and upto 3.5 cm wide, equal, creamish, fibrillose and hollow; **Basidia:** 32-48 × 14.4-16.0 μm, clavate having many oil bodies inside, hyaline; **Sterigmata:** 4.8 to 6.4 μm long; **Basidiospores:** 6.4-9.6 × 4.8-8.8 μm, $a_vL=8.0$, $a_vW=6.8$, $Q= 1.3-1.1$, apiculate, hyaline ornamented; **Cystidia:** 41.6-72 × 14.4-15.2 μm, hyaline; **Pileus hyphae:** 4.0 to 6.4 μm, hyaline, septate, branched, cytoplasm clearly visible; **Stipe hyphae:** 3.2 to 6.4 μm, hyaline, septate and branched; **Stipe elements:** 29.6-44.8 × 22.4-30.4 μm, inflated and hyaline.

Edibility: unknown in the study area but known to be edible in other parts.

Distribution: Earlier reported from coniferous forest of Kashmir (Dar et al. 2013)

Remarks: Reported from the first time from Jammu province and KHANP.

76. *Russula cyanoxantha* (Schaeff.) Fr., Monogr. Hymen- omyc. Suec. (Upsaliae) 2(2): 194 (1863)

Synonymy: *Agaricus cyanoxanthus* Schaeff., Fung. Bavar. Pa/at. 4: 40 (1774)

Russula furcata sensu auct.; fide Checklist of Basidiomycota of Great Britain and Ireland (2005)

Collection examined: Jammu and Kashmir, KHANP, Sonder, Janakpur and Nath, humicolous, scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-658, October 2016, September 2017 (Plate XIII d, Plate XIII A4).

Pileus: 8.2-8.4 cm in diameter, smooth, anthracene violet, slightly depressed at the centre, darker, margins plane; **Gills:** adnate, creamish (like coral shell), margins even, regular; **Stipe:** 4.1-6.3 cm long and 1.7-1.9 cm wide, central, clavate, equal, creamish with shade .of purple; **Flesh:** white; **Odour and Taste:** agreeable; reaction with $FeSO_4$ negative on context; **Spore print:** white; **Basidiospores:** globose, rough, echinulate, 6.4-9.6 × 6.4-8.0 μm, oil droplets present, apiculus 2.4-3.2 μm; **Basidia:** clavate, 20.8-68.8 × 11.2-16.0 μm wide at top and 3.2-6.4 μm wide at the base, sterigmata 2 to 4, ranges between 6.4-8.8 μm in length; **Cheilocystidia:** 44.0-84.8 × 8.0-17.6 μm; **Pleurocystidia:** upto 83.2 × 12.8 μm; **Pileus hyphae:** septate, 3.2-8.0 μm wide, branched, unclamped; **Stipe hyphae:** septate, 3.2-6.4 μm wide, branched, clamped.

Edibility: Not edible in the study area. However, earlier reported to be edible (Kuhner and Romagnesi, 1953; Delmas, 1978; Soothill and Fairhurst, 1978; Purkayastha and Chandra, 1985).

Distribution: Sinchal Lake, Darjeeling, Sikkim Himalayas, 8,500 ft. (Berkeley, 1856).

Remarks: A new report from KHANP.

77. Russula rosea Pers., *Observ. mycol.* (Lipsiae) 1: 100 (1796)

Synonymy: *Agaricus lacteus* Pers., *Syn. meth. fung.* (Göttingen) 2: 439 (1801)

Russula lepida Fr., *Anteckn. Sver. Ätl. Svamp.:* 50 (1836)

Collection examined: Jammu and Kashmir, KHANP, Sonder and Loharna, ectomycorrhizal, scattered, coniferous forest of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-613, July 2017. (Plate XIIIe, Plate XIII B1).

Pileus: 5.8 cm in diameter, convex then flat, slightly depressed at the centre, smooth, margins inrolled, jasper red, **Gills:** adnexed, crowded, creamish; **Stipe:** central, 4.2 cm long, fleshy, solid, whitish, smooth; **Flesh:** white, changes to purplish when treated with FeSO₄ **Taste:** mild; **Trama:** intermixed; **Basidiospores:** subglobose to globose, 6.4-8.8 x 6.4-8.0 µm, echinulate; **Basidia:** clavate, 15.2-51.2 x 9.6-14.4 µm, sterigmata 2 to 4, ranges upto 8.0 µm length, oil drops present; **Cystidia:** clavate, 30.4-80.0 x 12.8-16.0 µm; **Pileus hyphae:** septate, 3.2-9.6 µm wide; **Pileus context:** septate, branched, 2.4-6.4 µm wide; **Stipe hyphae:** septate, 2.4-4.8 µm wide, branched; **Stipe context:** septate, 4.8-6.4 µm wide, branched; **Caulocystidia:** broadly clavate, upto 75.2 x 32.0 µm.

Edibility: Not edible in study area but reported to be edible elsewhere (Vasilkov, 1948).

Distribution: Earlier described from Darjeeling and Madras (Berkeley, 1856; Ramakrishnan *et al.*, 1952).

Remarks: A new report from KHANP.

Family Hericiaceae

78. Hericium erinaceus (Bull.) Pers., *Comm. fung. clav.* (Lipsiae): 27 (1797)

Synonymy: *Clavaria conferta* Paulet, *Traité champ.* (Paris) 2(Index): 427 (1793)

Hericium hystrix Pers., *Comm. fung. clav.* (Lipsiae): 27 (1797)

Collection examined: Jammu and Kashmir, KHANP, Lopara, Palmar, Qedarna and Nath, lignicolous, found growing on *Cedrus* stumps, solitary to scattered, coniferous forest, S.A.J. Hashmi and Y.P. Sharma, HBJU-614, July 2016. (Plate XIIIf, Plate XIII B2).

Habitat: single or rarely several together on wounds of living hardwoods or cut ends of recently felled hardwood logs, **Fruitbody** unbranched, consisting of a tough piece of tissue from which spines 2-4 cm long hang down, growing on hardwoods, **Cap** 8-40 cm across, an unbranched mass of long, closely-packed, parallel spines hanging from a tough piece of

tissue, the spines white, discoloring yellowish to brownish when old. Teeth 2-5 cm long, soft when fresh. Fruiting on wounds of living hardwoods or cut ends of recently felled hardwood logs. **Spores** 5.6-6.4 x 4-5.6 µm, nearly round, smooth to minutely punctate-roughened, amyloid.

Edibility: excellent when fresh, but tougher than other *Hericium* species and sometimes developing a rather sour unpleasant taste when old, (Arora)

Remarks: A new report from KHANP.

Order Auriculariales

Family Auriculariaceae

79. Auricularia auricula-judae (Bull.) Quél., *Enchir. fung.* (Paris): 207 (1886)

Synonymy: *Tremella auricula-judae* Bull., *Herbier de la France* 9: tab. 427, fig. 2 (1789)

Hirneola auricularis (Gray) Donk Bull. *Jard. Bot. Buitenz.* 3Sér.18:89(1949)

Hirneola auricula-judae var. *lactea* (Quél.) D.A. Reid, *Trans. Br. mycol. Soc.* 55(3):440(1970).

Collection examined: Jammu and Kashmir, KHANP, Lopara, Qedarna and Ekhala, lignicolous, gregarious, mixed and coniferous forests, S.A.J. Hashmi and Y.P. Sharma, HBJU-616, August 2016, October 2017. (Plate XIIIg, Plate XIII B3).

Fruiting body: jelly-like or gelatinous, sessile, slightly flattened and ear shaped, 1.6-3.2 cm wide, pecan brown, flexible; **Basidiospores:** allantoid, 9.6-14.4 x 5.6-6.4 µm, bi- to multi-guttulate; **Basidia:** cylindrical, 28.8- 64.0 x 4.0-5.6 µm, transversely septate; **Pileus and context hyphae (Zona pilosa):** septate to aseptate, upto 7.2 µm wide, branched and unbranched.

Edibility: Not edible in study area but reported to be edible from other regions (Christensen, 1955; Worgan, 1968; Cheng and Tu, 1978; Soothill and Fairhurst, 1978; Jong, 1978; Crisan and Sands, 1978).

Distribution: Earlier reported from various regions of India (Banerjee, 1947; Vasudeva, 1960).

Remarks: A new report from KHANP.

Family Geastraceae

80. Geastrum campestre Morgan *Am. Nat.* 21: 1027 (1887)

Synonymy: *Geastrum campestre* f. *ochraceum* V.J. Staněk, *Fl. ČSR*, B-1, Gasteromycetes: 467, 791 (1958)

Geastrum campestre f. violaceum V.J. Staněk, Fl. ČSR, B-1, Gasteromycetes: 467, 791 (1958)

Geastrum campestre var. *famatinum* Kuhar & Papin., in Kuhar, *Castiglia & Papinutti, Mycotaxon* 122: 149 (2013) [2012]

Collection examined: Jammu and Kashmir, KHANP, Qedarna and Nath, humicolous, solitary to scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-659, August 2016, October 2017. (Plate XIIIh, Plate XIII B4).

Exoperidium: splitted into 5 rays, i.e., 7.6 cm long and upto 2.2 cm wide at the base, strongly hygroscopic, smooth on exterior; mycelial layer thin to thick, smooth, paler and composed of aseptate, hyaline hyphae of 3.2-5.6 μm width; **Fibrillose layer:** 2.4-4.0 μm wide, thick, paler, septate, unbranched, clamped; **Fleshy layer:** 3.2-5.6. μm wide, dark brown, septate, clamped, breaking into irregular area by deep grooves; **Endoperidium:** globose, forming spore sac, open by irregularly torn aperture, sessile, depressed, composed of septate hyphae, upto 3.2 μm wide; **Gleba:** dark brown; Columella: absent; **Basidiospores:** globose, dark brown, verrucose, 8.0-12.8 μm in diameter; **Capillitium threads:** 4.0-7.2 μm wide, septate, branched, clamped, hyaline.

Edibility: Not consumed in the area.

Distribution: Earlier reported from Kashmir (Abraham1991).

Remarks: A new report from KHANP.

81. Geastrum saccatum Fr., *Syst. mycol.* (Lundae) 3(1): 16 (1829)

Synonymy: *Geastrum lloydianum* Rick *Brotéria*, Rev. scienc. nat. Colleg. S. Fiel 5: 27 (1906)

Geastrum saccatum var. *lloydianum* (Rick) Rick, *Iheringia*, Sér. Bot. 9: 470 (1961)

Collection examined: Jammu and Kashmir, KHANP, Sonder and Palmar, humicolous, solitary to scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-617, August 2016, October 2017. (Plate XIVa, Plate XIV A1).

Gasterocarp: sub-globular with pointed beak and cup enclosing base of endoperidium, reddish brown; **Exoperidium:** 3.0-4.8 x 1.2-1.8 cm broad at the base, split beyond middle into 4-8 rays, each ray narrowly, acuminate; **Mycelial layer:** papery, smooth consisting of septate, branched, yellowish, hyaline hyphae upto 5.6 μm wide; **Fibrillose layer:** leathery, thin and composed of aseptate, unbranched hyphae upto 6.4 μm wide; **Fleshy layer:** forming

colour at the base of endoperidium, rust coloured, composed of texture upto 30.4 μm wide, splitting and cracking with cracked edges tending to curve away from fibrillose layer; **Endoperidium:** forming spore sac, sub-globular, pale brown, consisting of interwoven hyphae, aseptate, unbranched, 3.2-5.6 μm wide; **Peristome:** broad with fimbriate margin lighter than rest of the endoperidium; **Gleba:** amber coloured, ferruginous; **Basidiospores:** globose, 4.0-5.6 μm in diameter, verrucose, oil drops present; **Capillitium threads:** 3.2-7.2 μm wide, yellowish, unbranched, septate, encrusted with debris. **Remarks:** A new report from KHANP.

Edibility: not consumed

Remarks: A new report from KHANP.

82. *Geastrum triplex* Jungh. *Tijdschr. Nat. Gesch. Physiol.* 7: 287 (1840)

Synonymy: *Geastrum tunicatus* var. *michelianus* (W.G. Sm.) Sacc. *Erb. critt. Ital. Ser.* 1 no.879(1862)

Geastrum michelianum W.G. Sm. *Gard. Chron.*, London 18: 608 (1873)

Collection examined: Jammu and Kashmir, KHANP, Deharna, Qedarna and Ekhala, on humus among pine litter, solitary to scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-660, August 2016, November 2017. (Plate XIVb, Plate XIV A2).

Gasterocarp: sub-globular with pointed beak and cup enclosing base of endoperidium, reddish brown; **Exoperidium:** 2.0-3.5 x 1.0-1.5 cm broad at the base, split beyond middle into 5-6 rays, each ray narrowly, acuminate; **Mycelial layer:** papery, smooth consisting of septate, branched, yellowish, hyaline hyphae upto 5.6 μm wide; **Fibrillose layer:** leathery, thin and composed of aseptate, unbranched hyphae upto 6.4 μm wide; **Fleshy layer:** forming colour at the base of endoperidium, rust coloured, composed of texture upto 30.4 μm wide, splitting and cracking with cracked edges tending to curve away from fibrillose layer; **Endoperidium:** forming spore sac, sub-globular, pale brown, consisting of interwoven hyphae, aseptate, unbranched, 3.2-5.6 μm wide; **Peristome:** broad with fimbriate margin lighter than rest of the endoperidium; **Gleba:** amber coloured, ferruginous; **Basidiospores:** globose, 4.0-5.6 μm in diameter, verrucose, oil drops present; **Capillitium threads:** 3.2-7.2 μm wide, yellowish, unbranched, septate, encrusted with debris.

Edibility: Not edible

Distribution: on ground from from Western Himalaya, U.P. and H.P. (Ahmad, 1941; Cunningham, 1942).

Remarks: A new report from KHANP.

83. *Geastrum velutinum* Morgan, *J. Cincinnati. Soc. Nat. Hist.* 18:38(1895)

Geastrum velutinum var. *caespitosum* Lloyd *The Geastrae* (7): 36 (1902)

Geastrum caespitosum (Lloyd) Lloyd, *Mycol. Writ.* 6 (Letter 63): 960 (1920)

Collection examined: Jammu and Kashmir, KHANP, Palmar, Deharna and Marwah, humicolous, solitary to scattered, coniferous forests of *Pinus wallichiana* and *Cedrus deodara*, S.A.J. Hashmi and Y.P. Sharma, HBJU-661, November 2015. (Plate XIVc, Plate XIV A3).

Exoperidium: small, 0.8-1.2 x 0.2-0.6 cm at the base, splitted into 5-7 rays; **Mycelial layer:** smooth, encrusted with debris, papery and composed of interwoven, unbranched hyphae and 2.4-3.2 μm wide; **Fibrillose layer:** pale yellow, thick, leathery and composed of hyaline, aseptate, unbranched hyphae of 2.4-3.2 μm width; **Fleshy layer:** cracked and ornamented to exoperidium hence exposing fibrous layer and composed of septate, yellowish, hyaline hyphae measuring 2.4-4.0 μm wide; **Endoperidium:** forming spore sac, globose and composed of septate, branched, hyaline hyphae of 3.2-5.6 μm width; **Peristome:** apical, broadly oval, concolorous with rest of endoperidium; **Gleba:** dark brown; **Columella:** present; **Basidiospores:** globose, 3.2-4.8 μm in diameter, smooth to minutely verrucose; **Capillitium threads:** thick walled, 5.6-7.2 μm wide, encrusted with debris.

Edibility: Not edible

Distribution: On humicolous soil from Shimla (Thind and Thind, 1982).

Remarks: A new report from KHANP.

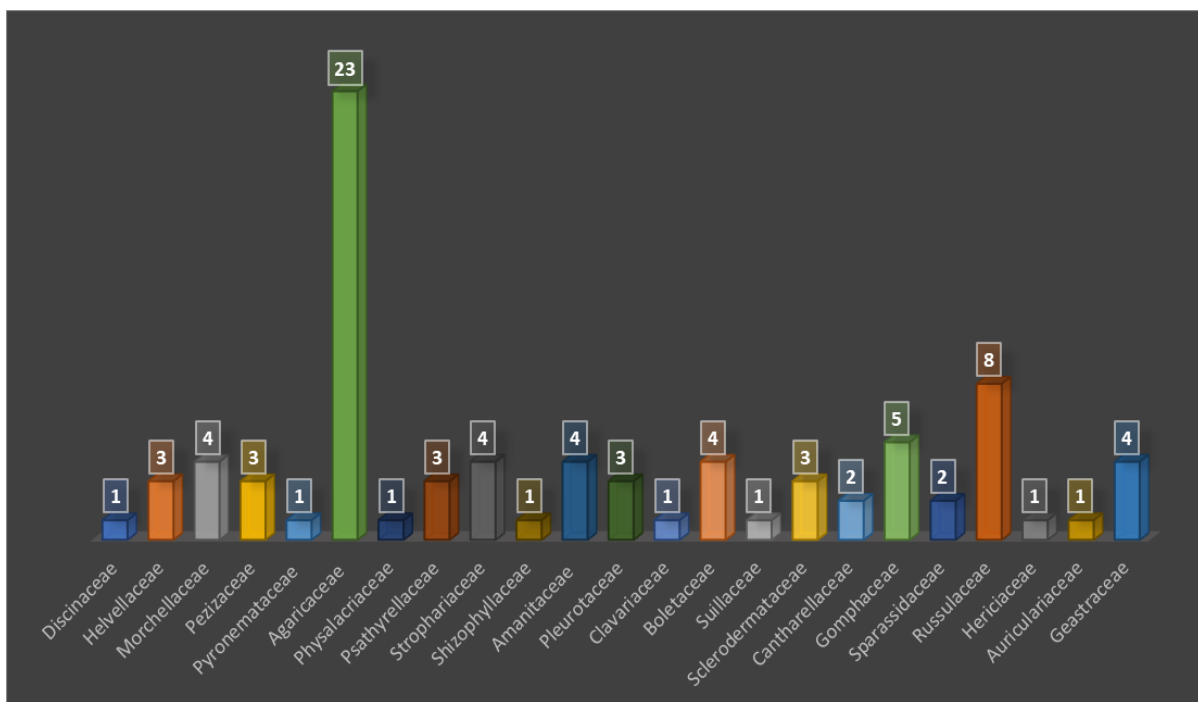


Figure 2: Showing the number of species in different families of KHANP.

4.2 Distribution of Wild macrofungi in the study area

Distribution pattern of wild fleshy macrofungi was compared and compiled for the selected areas (Sonder, Lopara, Janakpur, Palmar, Loharna, Deharna, Qedarna, Marwah, Nath, Ekhala) of KHANP and the data are presented in the table 1. Perusal of data demonstrates that the number of macrofungi collected from different locations of study area vary significantly with the place of collection. Macrofungal richness was found to be highest in Loharna (37 species) followed by Marwah (32 species), Ekhala and Nath (31 species each), Qedarna (29 species), Palmar (28 species), Sonder (27 species), Janakpur (23 species) Deharna (22 species) and Lopara (20 species). Among all the recorded taxa, the most frequently encountered species were *Boletus luridus*, *Geopora arenicola*, *Gymnopilus sapineus*, *Helvella atra*, *Lactarius delicious*, *Macrolepiota procera*, *Peziza badia* and *Schizophyllum commune* that were collected from six sites each. Species that were exclusively recorded from different sites of Kishtwar High Altitude National Park with GPS readings are mentioned in table 2, 3.

Relatively, a greater number of macrofungal taxa in Loharna followed by Marwah, Ekhala, Nath, Qedarna, Palmar, Sonder, Janakpur, Deharna and Lopara were due to various agro-climatic conditions. Dominance of rich vegetation, organic substrates like leaf litter, fallen logs and branches, moist soil, low anthropogenic interference and the dense alpine forest with beautiful meadows in the natural habitat at the various sites of KHANP might have facilitated the conducive environment for the emergence of diverse macrofungal forms in these areas.

These findings reflect that species richness is almost uniform in all the sites, with little difference in various sites that correlates with the vegetation communities and agro-climatic conditions of the respective sites, which affect the diversity and distribution of macrofungi as observed in the present study.

4.3 Substrate (Habitat) specificity of wild macrofungi

Macrofungal species can utilize a wide range of substrates for their growth. In view of this, an attempt was made to distinguish the diverse habitats of the gathered macrofungi. Results presented in the table 1 reveal that out of total eighty (83) wild macro fungal species recorded, fifty nine (59) species were found to be humicolous and showed their specific preference for humic soil, ten (10) species produced their sporocarps on both living and dead wood stumps, seven (7) species were in ectomycorrhizal association, two species are having humicolous and mycorrhizal association with *Pinus wallichiana*, *Cedrus deodara* and *Abies* sp. of coniferous forest of KHANP. Furthermore, four wild macrofungi entered into specific association with bryophytes (bryophilous) and one coprophilus species.

Table 2: Distribution of wild macrofungi in different collection sites of KHANP.

S.No	Name of the species	Sonder	Lopara	Janakpur	Palmar	Loharna	Deharna	Qedarna	Marwah	Nath	Ekhala
1.	<i>Gyromitra esculenta</i> (Pers.) Fr.	-	+	-	-	-	-	+	-	-	+
2.	<i>Helvella acetabulum</i> (L.) Quél.	+	-	+	-	-	-	+	-	-	+
3.	<i>H. atra</i> J. König	-	+	+	-	+	-	-	+	+	+
4.	<i>H. macropus</i> (Pers.) P. Karst.	+	-	-	+	-	-	+	-	-	-
5.	<i>Morchella crassipes</i> (Vent.) Pers.	-	-	+	-	-	-	+	-	+	-
6.	<i>M. deliciosa</i> Fr.	-	+	-	-	+	-	-	-	-	-
7.	<i>M. elata</i> Fr.	-	+	-	+	+	+	-	-	+	-
8.	<i>M. esculenta</i> (L.) Pers.	+	-	+	-	-	-	+	-	+	-
9.	<i>Peziza ampliata</i> Pers.	-	+	-	-	+	-	-	-	-	+
10.	<i>P. badia</i> Pers.	+	-	+	+	-	-	-	+	+	+
11.	<i>P. succosa</i> Berk.	-	-	-	+	-	+	-	+	+	+
12.	<i>Geopora arenicola</i> (Lev.) Kers	+	+	-	-	-	+	+	+	-	+
13.	<i>Agaricus arvensis</i> Schaeff	-	-	-	-	-	+	-	+	+	+
14.	<i>A. californicus</i> Peck	-	-	+	-	+	-	+	-	-	+
15.	<i>A. langei</i> (F.H. Moller) F.H. Moller	-	-	-	+	-	+	-	-	-	-
16.	<i>Apioperdon pyriforme</i> (Schaeff.) Vizzini	-	+	-	-	+	-	-	+	-	-
17.	<i>Bovista colorata</i> (Peck) Kreisel	-	-	-	-	+	-	-	+	-	-
18.	<i>B. minor</i> Morgan	-	-	-	+	+	-	-	-	+	-
19.	<i>B. plumbea</i> Pers.	-	-	-	+	-	-	+	+	-	-
20.	<i>B. pusilla</i> (Batsch) Pers.	-	-	-	-	+	-	-	+	+	-
21.	<i>Calvatia bovista</i> (L.) T. Macbr.	-	-	-	-	-	+	-	+	-	+
22.	<i>C. elata</i> (Masse) Morgan	-	-	-	+	-	+	-	+	-	-
23.	<i>C. lycoperdoides</i> Koscielny & Wojt	+	-	+	+	-	+	-	-	-	-
24.	<i>Calvatia. sp.</i>	-	-	-	+	+	-	-	-	+	-
25.	<i>Chlorophyllum molybdites</i> (G. Mey.) Massee	-	+	-	+	+	-	-	-	-	+
26.	<i>Coprinus comatus</i> (O.F. Mull.) Pers.	-	-	-	+	-	-	+	-	-	+
27.	<i>Lepiota procera</i> (Scop.) Gray	+	-	-	-	-	-	+	-	-	+
28.	<i>Cystolepiota sistrata</i> (Fr.) Singer ex Bon & Bellù	-	+	-	-	+	-	-	+	-	+
29.	<i>Leucoagaricus rubrotinctus</i> (Peck) Singer	-	-	-	-	+	-	+	-	+	-

30.	<i>Lycoperdon molle</i> Pers	-	-	-	-	-	-	-	+	+	-
31.	<i>L. caudatum</i> J. Schrot.	+	-	-	-	-	-	+	-	+	+
32.	<i>L. perlatum</i> Pers	+	-	-	-	+	-	+	+	-	+
33.	<i>L. rimulatum</i> Peck	-	-	+	-	-	+	-	-	+	-
34.	<i>L. umbrinum</i> Pers.	-	-	-	-	+	-	-	+	+	-
35.	<i>Macrolepiota procera</i> (Scop.) Singer	+	-	+	-	-	+	+	+	-	+
36.	<i>Flammulina velutipes</i> (Curtis) Singer	-	-	+	-	+	-	-	-	-	-
37.	<i>Coprinellus domesticus</i> (Bolton) Vilgalys, Hopple & Jacq. Johnson	-	-	-	-	+	-	-	-	+	-
38.	<i>C. micaceus</i> (Bolton) Vilgalys, Hopple & Jacq. Johnson	+	-	+	-	-	-	-	+	-	+
39.	<i>Coprinopsis atramentaria</i> (Bull.) Redhead Vilgalys & Moncalvo.	+	-	+	-	-	+	-	-	+	-
40.	<i>Pholiota squarrosa</i> (Vahl) P. Kumm.	-	+	-	+	+	-	-	-	+	+
41.	<i>Pholiota</i> sp.	-	-	-	+	-	-	+	-	+	-
42.	<i>Gymnopilus sapineus</i> Fries (Fr.) Murrill.	-	+	-	+	+	-	+	-	+	+
43.	<i>Gymnopilus</i> sp.	-	-	-	-	-	-	+	-	+	-
44.	<i>Schizophyllum commune</i> Fr.	+	-	+	-	+	+	+	-	+	-
45.	<i>Amanita flavoconia</i> G.F. Atk.	+	+	-	-	+	-	-	+	-	-
46.	<i>A. pantherina</i> (DC.) Krobh.	+	-	-	-	+	-	-	-	-	+
47.	<i>A. phalloides</i> (Vaill. Ex Fr.) Link	-	-	-	+	-	-	-	-	-	+
48.	<i>A. vaginata</i> (Bull.) Lam.	-	-	+	-	+	-	-	-	+	-
49.	<i>Pleurotus ostreatus</i> (Jacq. Ex. Fr.) P. Kumm	-	-	+	-	+	-	-	-	-	-
50.	<i>P. pulmonarius</i> (Fr.) Quel.	+	-	+	-	-	-	-	-	-	-
51.	<i>P. squarrosulus</i> (Mont.) Singer	-	+	-	+	+	-	-	+	+	-
52.	<i>Clavaria fragilis</i> Holmsk.	-	-	-	-	+	-	-	-	+	-
53.	<i>Boletus edulis</i> Bull.	-	-	+	+	-	-	+	+	-	-
54.	<i>B. formosus</i> Corner	+	-	-	-	+	-	+	-	-	-
55.	<i>B. granulatus</i> (L.) Roussel	-	-	-	-	+	-	-	-	+	-
56.	<i>B. luridus</i> (Schaeff) Murrill	+	+	-	-	+	-	+	+	-	+
57.	<i>Suillus cavipes</i> (Klotzsch) A.H. Sm. & Thiers	+	-	-	-	+	-	-	+	-	+
58.	<i>Scleroderma citrinum</i> Pers.	-	+	-	+	-	+	-	-	+	-
59.	<i>S. polyrhizum</i> (J. F. Gmel.) Pers.	-	-	+	-	-	+	-	+	-	-
60.	<i>S. verrucosum</i> (Bull.) Pers.	-	-	-	-	+	-	-	-	-	-
61.	<i>Cantharellus cibarius</i> Fr.	+	-	+	-	-	+	-	+	-	-

62.	<i>Craterellus tubaeformis</i> (Fr.) Quel	-	-	+	-	-	-	-	-	-	-
63.	<i>Ramaria apiculata</i> (Fr.) Donk	-	-	+	-	-	-	+	-	-	-
64.	<i>R. aurea</i> (Schaeff.) Quel	+	+	-	-	-	+	-	+	-	+
65.	<i>Ramaria flava</i> (Schaeff.) QuéL	-	-	-	-	-	+	-	+	-	-
66.	<i>Ramaria stricta</i> (Pers.) QuéL.	-	-	-	+	+	-	-	+	-	-
67.	<i>R. formosa</i> (Pers.) Quel.	-	-	-	-	-	-	+	-	-	+
68.	<i>Sparassis crispa</i> (Wulfen) Fr.	-	+	-	+	+	+	-	-	-	+
69.	<i>S. radicata</i> (Weir)	-	-	-	+	+	+	-	-	-	+
70.	<i>Lactarius delicious</i> (L.) Gray	+	-	+	-	-	-	+	+	+	+
71.	<i>L. deterrimus</i> Groger	+	-	-	+	-	-	-	+	-	-
72.	<i>L. vellerreus</i> (Fr.) Fr.	-	-	-	+	-	+	-	-	-	-
73.	<i>L. volemus</i> (Fr.) Fr.	-	+	-	+	-	-	+	-	-	-
74.	<i>Russula annulata</i> var. <i>annulata</i> R. Heim	-	-	-	-	+	-	+	-	-	-
75.	<i>Russula squalida</i> Peck, Bull.	+	-	-	-	+	-	-	+	-	-
76.	<i>R. cynoxantha</i> (Schaeff.) Fr.	+	-	+	-	-	-	-	-	+	-
77.	<i>R. rosea</i> Pers.	+	-	-	-	+	-	-	-	-	-
78.	<i>Hericium erinaceus</i> (Bull.) Persoon	-	+	-	+	-	-	+	-	+	-
79.	<i>Auricularia auricula-judae</i> (Bull.) Quel	-	+	-	-	-	-	-	+	-	+
80.	<i>Geastrum campestre</i> Morgan	-	-	-	-	-	-	+	-	+	-
81.	<i>G. saccatum</i> Fr.	+	-	-	+	-	-	-	-	-	-
82.	<i>G. triplex</i> Jungh	-	-	-	-	-	+	+	-	-	+
83.	<i>G. velutinum</i> Morgan	-	-	-	+	-	+	-	+	-	-
		27	20	23	28	37	22	29	32	31	31

Table3: Distribution of wild fleshy fungi in different collection sites with GPS locations in Kishtwar High Altitude National Park, Jammu and Kashmir.

S.No	Name of the species	Sonder (Lat./Long.)	Lopara (Lat./Long.)	Janakpur (Lat./Long.)	Palmar (Lat./Long.)	Loharna (Lat./Long.)	Deharna (Lat./Long.)	Qedarna (Lat./Long.)	Marwah (Lat./Long.)	Nath (Lat./Long.)	Ekhala (Lat./Long.)
1.	<i>Gyromitra esculenta</i> (Pers.) Fr.	-	33°28'54.92"N 75°46'10.96"E	-	-	-	-	33°38'6.72"N 75°42'15.63"E	-	-	33°26'41.61"N 75°44'38.92"E
2.	<i>Helvella acetabulum</i> (L.) Quéf.	33°28'22.46"N 75°49'19.22"E	-	33°30'27.64"N 75°48'20.38"E	-	-	-	33°38'9.64"N 75°42'11.47"E	-	-	33°27'0.71"N 75°44'23.56"E
3.	<i>H. atra</i> J. König	-	33°29'12.49"N 75°46'53.76"E	33°30'25.26"N 75°48'26.63"E	-	33°31'33.72"N 75°47'51.57"E	-	-	33°40'9.87"N 75°42'1.95"E	33°33'36.56"N 75°47'24.76"E	33°27'8.54"N 75°44'16.44"E
4.	<i>H. macropus</i> (Pers.) P. Karst.	33°28'15.79"N 75°49'36.73"E	-	-	33°27'24.39"N 75°41'7.11"E	-	-	33°38'10.22"N 75°42'18.89"E	-	-	-
5.	<i>Morchella crassipes</i> (Vent.) Pers.	-	33°28'51.86"N 75°46'14.53"E	-	-	-	-	33°35'30.32"N 75°44'1.77"E	-	33°33'35.88"N 75°47'27.37"E	-
6.	<i>M. deliciosa</i> Fr.	-	33°28'58.05"N 75°46'55.65"E	-	-	33°31'30.07"N 75°47'51.75"E	-	-	-	-	-
7.	<i>M. elata</i> Fr.	-	33°28'13.50"N 75°49'29.95"E	-	33°30'25.92"N 75°48'11.27"E	33°38'12.96"N 75°42'12.50"E	33°33'42.30"N 75°47'21.32"E	-	-	33°33'35.42"N 75°47'23.35"E	-
8.	<i>M. esculenta</i> (L.) Pers.	33°30'22.10"N 75°48'13.24"E	-	33°30'22.02"N 75°48'13.13"E	-	-	-	33°38'12.93"N 75°42'9.12"E	-	33°33'33.77"N 75°47'25.49"E	-
9.	<i>Peziza ampliata</i> Pers.	-	33°29'3.55"N 75°46'48.34"E	-	-	33°31'20.44"N 75°47'59.33"E	-	-	-	-	33°26'54.91"N 75°44'51.12"E
10.	<i>P. badia</i> Pers.	33°28'17.86"N 75°49'20.28"E	-	33°30'21.91"N 75°48'19.41"E	33°27'20.88"N 75°41'15.85"E	-	-	-	33°40'11.48"N 75°41'56.68"E	33°33'38.49"N 75°47'24.32"E	33°27'3.84"N 75°44'7.61"E
11.	<i>P. succosa</i> Berk.	-	-	-	33°27'16.56"N 75°41'16.01"E	-	33°35'28.99"N 75°44'7.69"E	-	33°39'55.05"N 75°41'59.79"E	33°33'33.37"N 75°47'22.30"E	33°27'5.38"N 75°44'19.30"E
12.	<i>Geopora arenicola</i> (Lev.) Kers	33°28'19.80"N 75°49'24.03"E	33°29'10.25"N 75°46'34.33"E	-	-	-	33°35'37.12"N 75°43'36.69"E	33°38'12.00"N 75°42'15.15"E	33°40'6.94"N 75°42'2.87"E	-	33°26'56.94"N 75°44'16.22"E
13.	<i>Agaricus arvensis</i> Schaeff	-	-	-	-	-	33°35'36.20"N 75°43'38.70"E	-	33°39'54.77"N 75°42'2.71"E	33°33'33.75"N 75°47'27.97"E	33°26'57.68"N 75°44'22.08"E
14.	<i>A. californicus</i> Peck	-	-	33°30'23.90"N 75°48'7.05"E	-	33°31'22.30"N 75°48'6.35"E	-	33°38'8.77"N 75°42'13.40"E	-	-	33°26'48.00"N 75°44'19.08"E
15.	<i>A. langei</i> (F.H. Moller) F.H. Moller	-	-	-	33°27'20.88"N 75°41'9.82"E	-	33°35'33.08"N 75°43'41.07"E	-	-	-	-
16.	<i>Apioperdon pyriforme</i> (Schaeff.) Vizzini	-	33°28'50.47"N 75°46'32.17"E	-	-	33°31'29.65"N 75°48'14.09"E	-	-	33°40'13.14"N 75°41'58.24"E	-	-
17.	<i>Bovista colorata</i> (Peck) Kreisel	-	-	-	-	33°31'20.48"N 75°48'3.76"E	-	-	33°39'58.48"N 75°42'6.86"E	-	-

18.	<i>B. minor</i> Morgan	-	-	-	33°27'21.38"N 75°41'0.40"E	33°31'30.72"N 75°48'5.66"E	-	-	-	33°33'42.78"N 75°47'28.50"E	-
19.	<i>B. plumbea</i> Pers.	-	-	-	33°27'15.75"N 75°40'52.41"E	-	-	33°38'23.42"N 75°42'8.39"E	33°40'0.52"N 75°42'4.48"E	-	-
20.	<i>B. pusilla</i> (Batsch) Pers.	-	-	-	-	33°31'54.08"N 75°47'52.60"E	-	-	33°40'10.24"N 75°41'58.12"E	33°33'31.89"N 75°47'22.94"E	-
21.	<i>Calvatia bovista</i> (L.) T. Macbr.	-	-	-	-	-	33°35'38.91"N 75°44'54.19"E	-	33°40'18.60"N 75°41'53.22"E	-	33°26'42.44"N 75°44'52.65"E
22.	<i>C. elata</i> (Masse) Morgan	-	-	-	33°27'16.36"N 75°41'5.43"E	-	33°35'27.80"N 75°44'0.71"E	-	33°40'3.33"N 75°42'6.09"E	-	-
23.	<i>C. lycoperdoides</i> Koscielný & Wojt	33°28'10.21"N 75°49'41.73"E	-	33°30'24.24"N 75°48'4.75"E	33°27'20.22"N 75°40'56.65"E	-	33°35'41.63"N 75°44'35.94"E	-	-	-	-
24.	<i>Calvatia. sp.</i>	-	-	-	33°27'15.96"N 75°41'0.46"E	33°31'28.29"N 75°47'50.50"E	-	-	-	33°33'45.82"N 75°47'31.46"E	-
25.	<i>Chlorophyllum molybdites</i> (G. Mey.) Massee	-	33°29'4.21"N 75°46'31.56"E	-	33°27'16.69"N 75°41'8.61"E	33°31'27.27"N 75°47'56.06"E	-	-	-	-	33°26'46.79"N 75°44'24.26"E
26.	<i>Coprinus comatus</i> (O.F. Mull.) Pers.	-	-	-	33°27'19.45"N 75°40'54.03"E	-	-	33°38'17.83"N 75°42'17.09"E	-	-	33°26'41.89"N 75°44'48.00"E
27.	<i>Lepiota procera</i> (Scop.) Gray	33°28'14.45"N 75°49'10.26"E	-	-	-	-	-	33°38'21.28"N 75°42'17.13"E	-	-	33°26'47.45"N 75°44'13.08"E
28.	<i>Cystolepiota sistrata</i> (Fr.) Singer ex Bon & Bellù	-	33°28'42.55"N 75°46'9.41"E	-	-	33°31'47.10"N 75°47'43.91"E	-	-	33°40'4.92"N 75°42'4.41"E	-	33°26'44.70"N 75°44'31.85"E
29.	<i>Leucoagaricus rubrotinctus</i> (Peck) Singer	-	-	-	-	33°31'22.57"N 75°48'12.45"E	-	33°38'19.92"N 75°42'15.09"E	-	33°33'32.10"N 75°47'30.35"E	-
30.	<i>Lycoperdon molle</i> Pers	-	-	-	-	-	-	-	33°40'10.14"N 75°42'4.26"E	33°33'27.88"N 75°47'30.08"E	-
31.	<i>L. caudatum</i> J. Schrot.	33°28'25.74"N 75°49'10.97"E	-	-	-	-	-	33°38'22.13"N 75°42'13.39"E	-	33°33'31.25"N 75°47'27.99"E	33°26'46.17"N 75°44'41.58"E
32.	<i>L. perlatum</i> Pers	33°28'24.75"N 75°49'51.60"E	-	-	-	33°31'30.34"N 75°47'45.89"E	-	33°38'18.53"N 75°42'7.44"E	33°40'2.41"N 75°42'0.48"E	-	33°26'35.41"N 75°44'40.27"E
33.	<i>L. rimulatum</i> Peck	-	-	33°30'18.62"N 75°48'19.46"E	-	-	33°35'40.45"N 75°44'34.25"E	-	-	33°33'45.08"N 75°47'42.02"E	-
34.	<i>L. umbrinum</i> Pers.	-	-	-	-	-	-	-	33°40'0.65"N 75°42'7.84"E	33°33'32.96"N 75°47'32.31"E	-
35.	<i>Macrolepiota procera</i> (Scop.) Singer	33°28'23.42"N 75°49'45.03"E	-	33°30'19.29"N 75°48'23.73"E	-	-	33°35'25.63"N 75°44'13.51"E	33°38'19.81"N 75°42'9.43"E	33°40'11.81"N 75°42'2.67"E	-	33°26'41.76"N 75°44'6.83"E
36.	<i>Flammulina velutipes</i> (Curtis)	-	-	33°30'23.14"N 75°48'5.66"E	-	33°31'29.24"N 75°48'1.42"E	-	-	-	-	-

	Singer										
37.	<i>Coprinellus domesticus</i> (Bolton) Vilgalys, Hopple & Jacq. Johnson	-	-	-	-	33°31'35.44"N 75°47'47.96"E	-	-	-	33°33'43.22"N 75°47'39.96"E	-
38.	<i>C. micaceus</i> (Bolton) Vilgalys, Hopple & Jacq. Johnson	33°28'25.70"N 75°49'13.44"E	-	33°30'14.27"N 75°48'1.84"E	-	-	-	-	33°40'0.50"N 75°42'1.79"E	-	33°26'54.99"N 75°45'3.40"E
39.	<i>Coprinopsis atramentaria</i> (Bull.) Redhead Vilgalys & Moncalvo.	33°28'23.15"N 75°49'12.58"E	-	33°30'17.54"N 75°48'7.69"E	-	-	33°35'35.10"N 75°43'37.70"E	-	-	33°33'42.52"N 75°47'38.69"E	-
40.	<i>Pholiota squarrosa</i> (Vahl) P. Kumm.	-	33°28'56.40"N 75°46'53.06"E	-	33°27'16.49"N 75°41'11.57"E	33°31'58.12"N 75°47'54.34"E	-	-	-	33°33'41.47"N 75°47'40.87"E	33°26'52.37"N 75°45'1.81"E
41.	<i>Pholiota</i> sp.	-		-	33°27'13.15"N 75°40'53.98"E	-	-	33°37'51.87"N 75°41'47.52"E	-	33°33'44.53"N 75°47'38.73"E	-
42.	<i>Gymnopilus sapineus</i> Fries (Fr.) Murrill.	-	33°28'53.66"N 75°46'27.38"E	-	33°27'14.78"N 75°40'57.75"E	33°31'26.31"N 75°47'52.48"E	-	33°38'21.07"N 75°42'10.49"E	-	33°33'31.42"N 75°47'32.71"E	33°26'47.47"N 75°45'6.77"E
43.	<i>Gymnopilus</i> sp.	-	-	-	-	-	-	33°38'0.30"N 75°41'45.24"E	-	33°33'39.21"N 75°47'39.39"E	-
44.	<i>Schizophyllum commune</i> Fr.	33°28'22.48"N 75°48'59.30"E	-	33°30'45.44"N 75°47'57.15"Es	-	33°31'44.13"N 75°47'58.67"E	33°35'37.76"N 75°44'57.92"E	33°38'38.10"N 75°41'31.96"E	-	33°33'46.68"N 75°47'28.69"E	-
45.	<i>Amanita flavoconia</i> G.F. Atk.	33°28'19.98"N 75°49'13.94"E	33°28'54.42"N 75°46'52.04"E	-	-	33°31'58.63"N 75°47'56.71"E	-	-	33°40'6.86"N 75°41'59.20"E	-	-
46.	<i>A. pantherina</i> (DC.) Krobh.	33°28'21.35"N 75°49'9.85"E	-	-	-	33°32'2.17"N 75°47'53.91"E					33°26'55.09"N 75°44'58.96"E
47.	<i>A. phalloides</i> (Vaill. Ex Fr.) Link	-	-	-	33°27'7.36"N 75°40'54.85"E						33°26'52.63"N 75°45'6.26"E
48.	<i>A. vaginata</i> (Bull.) Lam.	-	-	33°30'20.35"N 75°48'0.90"E	-	33°32'1.63"N 75°47'55.98"E	-	-	-	33°33'44.06"N 75°47'36.70"E	-
49.	<i>Pleurotus ostreatus</i> (Jacq. Ex. Fr.) P. Kumm	-	-	33°30'41.42"N 75°48'5.67"E	-	33°31'55.63"N 75°47'55.33"E	-	-	-	-	-
50.	<i>P. pulmonarius</i> (Fr.) Quel.	33°28'11.04"N 75°49'22.45"E	-	33°30'45.28"N 75°48'0.07"E	-	-	-	-	-	-	-
51.	<i>P. squarrosulus</i> (Mont.) Singer	-	33°28'58.99"N 75°46'18.21"E	-	33°27'3.95"N 75°40'51.65"E	33°31'56.36"N 75°47'57.88"E	-	-	33°40'8.88"N 75°41'59.95"E	33°26'59.25"N 75°45'1.76"E	-
52.	<i>Clavaria fragilis</i> Holmsk.	-	-	-	-	33°31'36.10"N 75°47'45.76"E	-	-	-	33°33'33.78"N 75°47'37.11"E	-
53.	<i>Boletus edulis</i> Bull.	-	-	33°30'37.13"N 75°47'59.86"E	33°27'3.54"N 75°40'54.32"E	-	-	33°37'56.03"N 75°41'45.93"E	33°40'10.64"N 75°42'0.54"E	-	-
54.	<i>B. formosus</i> Corner	33°28'19.85"N 75°49'31.28"E	-	-	-	33°32'2.93"N 75°47'58.05"E	-	33°37'59.43"N 75°41'48.04"E	-	-	-

55.	<i>B. granulatus</i> (L.) Roussel	-	-	-	-	33°32'0.37"N 75°47'58.11"E	-	-	-	33°33'47.07"N 75°47'38.36"E	-
56.	<i>B. luridus</i> (Schaeff) Murrill	33°28'13.82"N 75°49'22.16"E	33°28'45.64"N 75°46'46.46"E	-	-	33°32'3.99"N 75°47'53.32"E	-	33°37'55.76"N 75°41'49.05"E	33°40'5.53"N 75°42'1.18"E	-	33°27'1.30"N 75°44'56.53"E
57.	<i>Suillus cavipes</i> (Klotzsch) A.H. Sm. & Thiers	33°28'9.53"N 75°49'35.10"E	-	-	-	33°31'30.34"N 75°47'48.60"E	-	-	33°40'14.18"N 75°42'1.42"E	-	33°26'58.90"N 75°44'53.94"E
58.	<i>Scleroderma citrinum</i> Pers.	-	33°28'43.97"N 75°46'40.85"E	-	33°27'0.04"N 75°40'51.96"E	-	33°35'35.57"N 75°44'43.57"E	-	-	33°33'29.64"N 75°47'34.01"E	-
59.	<i>S. polyrhizum</i> (J. F. Gmel.) Pers.	-	-	33°30'41.82"N 75°47'59.63"E	-	-	33°35'35.42"N 75°44'37.02"E	-	33°40'14.82"N 75°41'52.76"E	-	-
60.	<i>S. verrucosum</i> (Bull.) Pers.	-	-	-	-	33°31'33.12"N 75°47'45.81"E	-	-	-	-	-
61.	<i>Cantharellus cibarius</i> Fr.	33°28'21.03"N 75°49'37.42"E	-	33°30'46.52"N 75°48'6.09"E	-	-	33°35'35.61"N 75°44'34.05"E	-	33°40'17.30"N 75°41'51.43"E	-	-
62.	<i>Craterellus tubaeformis</i> (Fr.) Quel	-	-	33°30'37.62"N 75°48'2.98"E	-	-	-	-	-	-	-
63.	<i>Ramaria apiculate</i> (Fr.) Donk	-	-	33°30'45.82"N 75°48'3.14"E	-	-	-	33°37'59.96"N 75°41'50.67"E	-	-	-
64.	<i>R. aurea</i> (Schaeff.) Quel	33°28'12.82"N 75°49'38.34"E	33°29'8.57"N 75°46'38.37"E	-	-	-	33°35'34.49"N 75°43'44.67"E	-	33°40'20.75"N 75°41'48.44"E	-	33°33'32.89"N 75°47'34.87"E
65.	<i>Ramaria flava</i> (Schaeff.) QuéL	-	-	-	-	-	33°35'38.05"N 75°43'43.14"E	-	33°40'17.50"N 75°41'55.60"E	-	-
66.	<i>Ramaria stricta</i> (Pers.) QuéL.	-	-	-	33°26'56.56"N 75°40'50.20"E	33°31'34.30"N 75°47'58.53"E	-	-	33°40'18.20"N 75°41'47.22"E	-	-
67.	<i>R. formosa</i> (Pers.) Quel.	-	-	-	-	-	-	33°38'17.21"N 75°42'15.31"E	-	-	-
68.	<i>Sparassis crispa</i> (Wulfen) Fr.	-	33°28'51.99"N 75°46'20.12"E	-	33°26'58.37"N 75°40'48.59"E	33°31'27.16"N 75°47'48.08"E	33°35'39.65"N 75°44'39.92"E	-	-	-	33°26'51.93"N 75°44'55.45"E
69.	<i>S. radicata</i> (Weir)	-	-	-	33°27'0.18"N 75°40'54.13"E	33°31'39.13"N 75°47'56.12"E	33°35'39.60"N 75°44'44.29"E	-	-	-	33°26'57.00"N 75°44'56.70"E
70.	<i>Lactarius deliciosus</i> (L.) Gray	33°28'22.48"N 75°49'33.74"E	-	33°30'37.66"N 75°48'6.56"E	-	-	-	33°38'19.27"N 75°42'18.37"E	33°40'20.99"N 75°41'50.85"E	33°33'29.65"N 75°47'31.95"E	33°27'11.62"N 75°44'12.92"E
71.	<i>L. deterrimus</i> Groger	33°28'17.09"N 75°48'56.88"E	-	-	33°27'2.94"N 75°40'48.75"E	-	-	-	33°40'19.32"N 75°41'50.72"E	-	-
72.	<i>L. vellerreus</i> (Fr.) Fr.	-	-	-	33°27'1.11"N 75°40'47.15"E	-	33°35'33.69"N 75°44'57.77"E	-	-	-	-
73.	<i>L. volemus</i> (Fr.) Fr.	-	33°29'15.97"N 75°46'24.22"E	-	33°26'58.68"N 75°40'56.00"E	-	-	33°38'48.51"N 75°41'25.70"E	-	-	-
74.	<i>Russula annulata</i> var. <i>annulata</i> R.	-	-	-	-	33°31'41.74"N	-	33°38'47.03"N	-	-	-

	Heim					75°47'58.62"E		75°41'34.75"E			
75.	<i>Russula squalida</i> Peck, Bull.	33°28'18.95"N 75°48'59.99"E	-	-	-	33°31'39.65"N 75°47'58.96"E	-	-	33°40'20.80"N 75°41'53.06"E	-	-
76.	<i>R. cynoxantha</i> (Schaeff.) Fr.	33°28'13.80"N 75°49'3.93"E	-	33°30'38.93"N 75°48'8.32"E	-	-	-	-	-	33°33'35.21"N 75°47'33.53"E	-
77.	<i>R. rosea</i> Pers.	33°28'17.71"N 75°49'4.98"E	-	-	-	33°31'38.26"N 75°48'0.27"E	-	-	-	-	-
78.	<i>Hericium erinaceus</i> (Bull.) Persoon	-	33°28'55.53"N 75°46'32.76"E	-	33°26'58.04"N 75°40'52.41"E	-	-	33°38'38.38"N 75°41'23.08"E	-	33°33'48.76"N 75°47'30.77"E	-
79.	<i>Auricularia auricula-judae</i> (Bull.) Quel	-	33°28'48.76"N 75°46'23.93"E	-	-	-	-	-	33°40'16.26"N 75°41'53.63"E	-	33°27'5.65"N 75°44'23.99"E
80.	<i>Geastrum campestre</i> Morgan	-	-	-	-	-	-	33°38'40.44"N 75°41'38.04"E	-	33°33'48.68"N 75°47'33.04"E	-
81.	<i>G. saccatum</i> Fr.	33°28'24.17"N 75°49'4.96"E	-	-	33°27'2.36"N 75°40'56.07"E	-	-	-	-	-	-
82.	<i>G. triplex</i> Jungh	-	-	-	-	-	33°35'35.12"N 75°45'1.37"E	33°38'48.62"N 75°41'29.57"E	-	-	33°26'40.43"N 75°44'38.81"E
83.	<i>G. velutinum</i> Morgan	-	-	-	33°27'2.14"N 75°40'50.37"E	-	33°35'35.35"N 75°44'53.36"E	-	33°40'18.37"N 75°41'56.96"E	-	-
Total		27	20	23	28	37	22	29	32	31	31

Humicolous forms included *Apioperdon pyriforme*, *Gyromitra esculenta*, *Morchella crassipes*, *M. deliciosa*, *M. elata*, *M. esculenta*, *Peziza succosa*, *Geopora arenicola*, *Agaricus arvensis*, *A. californicus*, *A. langei*, *Bovista colorata*, *B. minor*, *B. plumbea*, *B. pusilla*, *Calvatia elata*, *C. lycoperdoides*, *C. bovista* *Calvatia. sp.*, *Chlorophyllum molybdites*, *Lepiota procera*, *Cystolepiota sistrata*, *Leucoagaricus rubrotinctus*, *Lycoperdon molle*, *L. caudatum*, *L. perlatum*, *L. rimulatum*, *L. umbrinum*, *Macrolepiota procera*, *Coprinopsis atramentaria*, *Pholiota squarrosa*, *Pholiota sp.*, *Amanita flavoconia*, *A. pantherina*, *A. phalloides*, *A. vaginata*, *Boletus edulis*, *Scleroderma geaster*, *S. verrucosum*, *Cantharellus cibarius*, *Craterellus tubaeformis*, *Clavaria fragilis*, *Sparassis crispa*, *S. radiata*, *Ramaria apiculata*, *R. aurea*, *R. flava*, *Ramaria stricta*, *R. formosa*, *Lactarius deliciosus*, *L. deterrimus*, *L. vellerreus*, *L. volemus*, *Russula annulata* var. *annulata*, *R. cynoxantha*, *Geastrum campestre*, *G. saccatum*, *G. triplex* and *G. velutinum*.

Amongst the lignicolous fungi, *Gymnopilus sapineus*, *Gymnopilus sp.*, *Flammulina velutipes*, *Coprinellus domesticus*, *Pleurotus ostreatus*, *P. pulmonarius*, *P. squarrosulus*, *Hericium erinaceus*, *Schizophyllum commune* and *Auricularia auricula-judae* were observed to grow exclusively on trunks and fallen logs of different tree species. Of these, *Auricularia auricula-judae*, and *Schizophyllum commune* were found growing on dead tree stumps of *Juglans regia* and *Pylus malus* respectively while as *Flammulina velutipes*, *Coprinus atramentarius*, *Gymnopilus sapineus* and *Hericium erinaceus* emerged out of living trees of *Populus nigra*, *Pinus wallichiana*, *Abies pindrow* and *Quercus sp.* respectively.

In the present study, *Helvella acetabulum*, *H. atra*, *Boletus luridus*, *Suillus cavipes*, *Scleroderma citrinum*, *Russula squalida* and *R. rosea* were ectomycorrhizal, found growing in association with *Populus sp.*, *Pinus wallichiana* and other coniferous trees. However, no attempt was made to collect root samples to know the ectomycorrhizal nature of these species. Few macrofungal taxa *Hevella macropus*, *Peziza ampliata*, *P. badia* and *Coprinus comatus* were bryophilous, grows among the mosses. *Boletus formosus* and *B. granulatus* are having both mycorrhizal and humicolous nature.

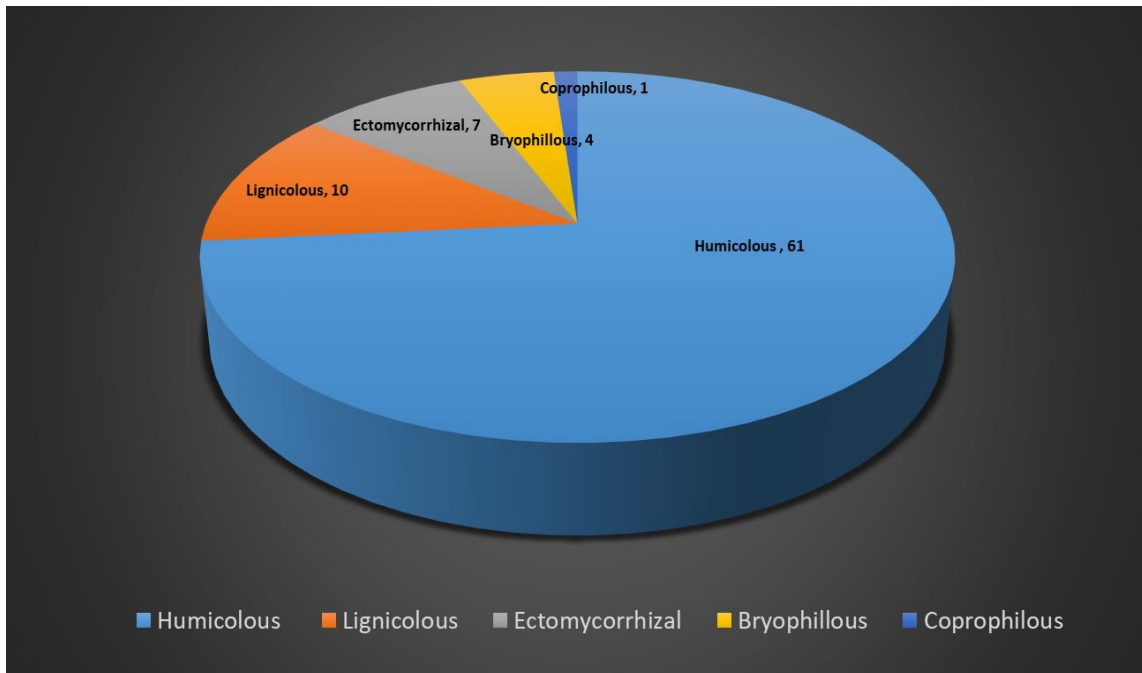


Figure 3: Percentage abundance of wild macrofungi in different habitats.

Incidence of high diversity of humicolous species (fig. 3) validates the fact that humic soil serves as a reservoir of minerals and nutrients required for the proliferation of the mycelium and sporophores of macro fungi. Precisely the preference of macrofungi towards particular habitat was driven mostly by their ecological role.

4.4 Phenology and seasonal variation in wild macrofungi

Occurrence of wild macrofungi differs from year to year and within seasons of a year. Thus, some species begin to form sporophores earlier while others prop up later. The seasonal period of life-history events of organisms, generally depends on climatic conditions and has wide implications for species communication, ecosystem processes and ecological communal structure. The timing of phenological events can be quite sensitive to environmental conditions and is thought to be determined by substrate moisture and temperature. Thus, for comparing the fungal phenological events, the observations of the present study over a period of twelve months were divided into four intervals i.e January-March, April-June, July-September and October-December.

Data presented in the table 4 and figure 4, predictably show the maximum fruiting body production during July to September. The species recorded during this period included *Gyromitra esculenta*, *Helvella acetabulum*, *H. atra*, *H. macropus*, *Peziza ampliata*, *P. succosa*, *Geopora arenicola*, *Agaricus arvensis*, *A. californicus*, *A. langei*, *Apioperdon pyriforme*, *Bovista colorata*, *B. minor*, *B. plumbea*, *B. pusilla*,

Calvatia Bovista, *C. elata*, *C. lycoperdoides*, *Calvatia. sp.*, *Chlorophyllum molybdites*, *Coprinus comatus*, *Lepiota procera*, *Cystolepiota sistrata*, *Leucoagaricus rubrotinctus*, *Lycoperdon molle*, *L. caudatum*, *L. perlatum*, *L. rimulatum*, *Macrolepiota procera*, *Gymnopilus sapineus*, *Gymnopilus sp.*, *Coprinellus domesticus*, *C. micaceus*, *Coprinopsis atramentaria*, *Pholiota squarrosa*, *Pholiota sp.*, *Amanita flavoconia*, *A. pantherina*, *A. phalloides*, *A. vaginata*, *Pleurotus ostreatus*, *P. pulmonarius*, *P. squarrosulus*, *Boletus edulis*, *B. formosus*, *B. granulatus*, *B. luridus*, *Suillus cavipes*, *Scleroderma citrinum*, *S. verrucosum*, *Cantharellus cibarius*, *Craterellus tubaeformis*, *Clavaria fragilis*, *Sparassis crispa*, *S. radiata*, *Ramaria apiculate*, *R. aurea*, *R. flava*, *R. stricta*, *R. formosa*, *Lactarius delicious*, *L. deterrimus*, *L. vellerreus*, *L. volemus*, *Russula annulata var. annulata*, *R. squalida*, *R. cynoxantha*, *R. rosea*, *Hericium erinaceus*, *Schizophyllum commune*, *Auricularia auricula-judae*, *Geastrum campestre*, *G. saccatum* and *G. triplex*. The prevalence of adequate soil moisture, favourable temperature and relative humidity which augment the decomposition of organic matter by the macrofungi might have allowed the incidence of maximum sporocarp formation during this period.

During the months of April to June, only thirteen (13) species few of them are *Helvella acetabulum*, *H. atra*, *H. macropus*, *Morchella elata*, *M. deliciosa*, *M. crassipes*, *Peziza ampliata*, *P. badia*, *P. succosa*, *Geopora arenicola*, *Coprinus comatus*, *Coprinellus domesticus* and *Coprinopsis atramentarius* were recorded. The reason for comparatively lesser number of macrofungi can be ascribed to usually drier conditions as temperature and moisture are generally low during these months. Similarly, species like *Bovista colorata*, *B. minor*, *Calvatia Bovista*, *Leucoagaricus rubrotinctus*, *Lycoperdon umbrinum*, *Macrolepiota procera*, *Amanita vaginata*, *Suillus cavipes*, *Scleroderma geaster*, *Russula squalida*, *R. cynoxantha*, *Auricularia auricula-judae*, *Geastrum campestre*, *G. saccatum*, *G. triplex* and *G. velutinum* were found to occur during the months of October to December owing to sudden drop of temperature at the beginning of October. Further, during January to March, the emergence of sporophores gradually declined as extreme cold inflict adverse influence on the initiation of fruiting of macrofungi thus only five (6) species *Gyromitra esculenta*, *Morchella crassipes*, *M. deliciosa*, *M. elate* *M. esculenta* and *Flammulina velutipes* were recorded during these months (Figure 4)

Generally, the phenology of fleshy macrofungi observed in the present study displayed considerable temporal differences with respect to the inception of

fructifications among the species and the timing of seasonal fruiting and response to weather conditions were also influenced by site specific factors.

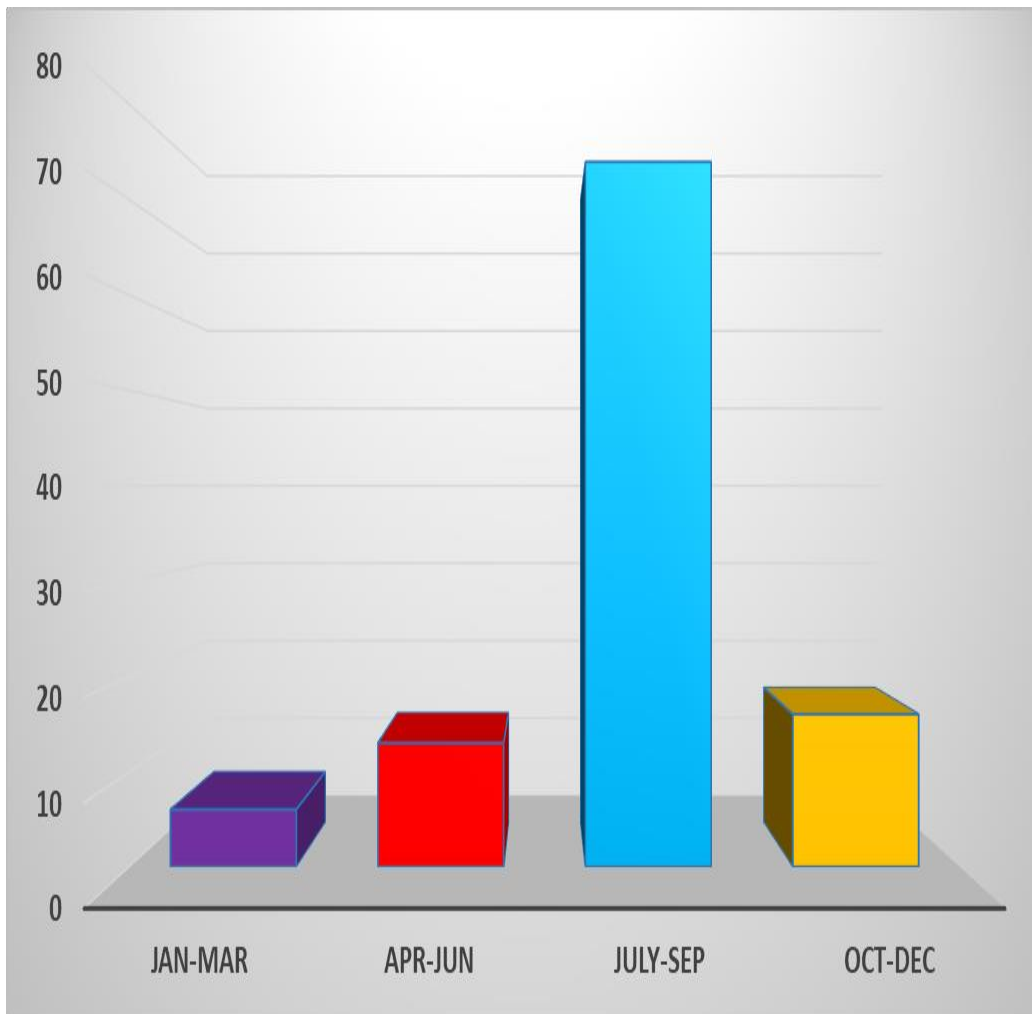


Figure 4: Bar diagram showing incidence of macrofungi in KHANP.

Table 4: Seasonal variations in the occurrence of wild macrofungi recorded from the study area

S.No.	Name of the species	Jan-Mar	Apr-Jun	July-Sep	Oct-Dec
1.	<i>Gyromitra esculenta</i> (Pers.) Fr.	■		■	
2.	<i>Helvella acetabulum</i> (L.) Quéf.		■	■	
3.	<i>H. atra</i> J. König		■	■	
4.	<i>H. macropus</i> (Pers.) P. Karst.		■	■	
5.	<i>Morchella crassipes</i> (Vent.) Pers.	■	■		
6.	<i>M. deliciosa</i> Fr.	■	■		
7.	<i>M. elata</i> Fr.	■			
8.	<i>M. esculenta</i> (L.) Pers.	■	■		
9.	<i>Peziza ampliata</i> Pers.		■	■	
10.	<i>P. badia</i> Pers.		■		

11.	<i>P. succosa</i> Berk.				
12.	<i>Geopora arenicola</i> (Lev.) Kers				
13.	<i>Agaricus arvensis</i> Schaeff				
14.	<i>A. californicus</i> Peck				
15.	<i>A. langei</i> (F.H. Moller) F.H. Moller				
16.	<i>Apioperdon pyriforme</i> (Schaeff.) Vizzini				
17.	<i>Bovista colorata</i> (Peck) Kreisel				
18.	<i>B. minor</i> Morgan				
19.	<i>B. plumbea</i> Pers.				
20.	<i>B. pusilla</i> (Batsch) Pers.				
21.	<i>Calvatia bovista</i> (L.) T. Macbr.				
22.	<i>C. elata</i> (Masse) Morgan				
23.	<i>C. lycoperdoides</i> Koscielny & Wojt				
24.	<i>Calvatia. sp.</i>				
25.	<i>Chlorophyllum molybdites</i> (G. Mey.) Masee				
26.	<i>Coprinus comatus</i> (O.F.Mull.) Pers.				
27.	<i>Lepiota procera</i> (Scop.) Gray				
28.	<i>Cystolepiota sistrata</i> (Fr.) Singer ex Bon & Bellù				
29.	<i>Leucoagaricus rubrotinctus</i> (Peck) Singer				
30.	<i>Lycoperdon molle</i> Pers				
31.	<i>L. caudatum</i> J. Schrot.				
32.	<i>L. perlatum</i> Pers				
33.	<i>L. rimulatum</i> Peck				
34.	<i>L. umbrinum</i> Pers.				
35.	<i>Macrolepiota procera</i> (Scop.) Singer				
36.	<i>Flammulina velutipes</i> (Curtis) Singer				
37.	<i>Coprinellus domesticus</i> (Bolton) Vilgalys, Hopple & Jacq. Johnson				
38.	<i>C. micaceus</i> (Bolton) Vilgalys, Hopple & Jacq. Johnson				
39.	<i>Coprinopsis atramentaria</i> (Bull.) Redhead Vilgalys & Moncalvo.				
40.	<i>Pholiota squarrosa</i> (Vahl) P. Kumm.				
41.	<i>Pholiota sp.</i>				
42.	<i>Gymnopilus sapineus</i> Fries (Fr.) Murrill.				
43.	<i>Gymnopilus sp.</i>				
44.	<i>Schizophyllum commune</i> Fr.				
45.	<i>Amanita flavoconia</i> G.F. Atk.				
46.	<i>A. pantherina</i> (DC.) Krobh.				
47.	<i>A. phalloides</i> (Vaill. Ex Fr.) Link				
48.	<i>A. vaginata</i> (Bull.) Lam.				
49.	<i>Pleurotus ostreatus</i> (Jacq. Ex. Fr.) P. Kumm				
50.	<i>P. pulmonarius</i> (Fr.) Quel.				

51.	<i>P. squarrosulus</i> (Mont.) Singer				
52.	<i>Clavaria fragilis</i> Holmsk.				
53.	<i>Boletus edulis</i> Bull.				
54.	<i>B. formosus</i> Corner				
55.	<i>B. granulatus</i> (L.) Roussel				
56.	<i>B. luridus</i> (Schaeff) Murrill				
57.	<i>Suillus cavipes</i> (Klotzsch) A.H. Sm. & Thiers				
58.	<i>Scleroderma citrinum</i> Pers.				
59.	<i>S. polyrhizum</i> (J. F. Gmel.) Pers.				
60.	<i>S. verrucosum</i> (Bull.) Pers.				
61.	<i>Cantharellus cibarius</i> Fr.				
62.	<i>Craterellus tubaeformis</i> (Fr.) Quel				
63.	<i>Ramaria apiculate</i> (Fr.) Donk				
64.	<i>R. aurea</i> (Schaeff.) Quel				
65.	<i>R. flava</i> (Schaeff.) Quél				
66.	<i>R. stricta</i> (Pers.) Quél.				
67.	<i>R. formosa</i> (Pers.) Quel.				
68.	<i>Sparassis crispa</i> (Wulfen) Fr.				
69.	<i>S. radicata</i> (Weir)				
70.	<i>Lactarius deliciosus</i> (L.) Gray				
71.	<i>L. deterrimus</i> Groger				
72.	<i>L. vellerreus</i> (Fr.) Fr.				
73.	<i>L. volemus</i> (Fr.) Fr.				
74.	<i>Russula annulata</i> var. <i>annulata</i> R. Heim				
75.	<i>R. squalida</i> Peck, Bull.				
76.	<i>R. cynoxantha</i> (Schaeff.) Fr.				
77.	<i>R. rosea</i> Pers.				
78.	<i>Hericium erinaceus</i> (Bull.) Persoon				
79.	<i>Auricularia auricula-judae</i> (Bull.) Quel				
80.	<i>Geastrum campestre</i> Morgan				
81.	<i>G. saccatum</i> Fr.				
82.	<i>G. triplex</i> Jungh				
83.	<i>G. velutinum</i> Morgan				
TOTAL		6	13	74	16

4.5 Dominant Classes and Families

Scrutiny and comparative analysis of the identified fleshy fungi (Figure 2 and 4) revealed that Agaricomycetes (85%) constituted the most dominant class with as many as 71 species belonging to 32 genera spread over in 18 families and 8 orders while Pezizomycetes (15%) followed it with 12 species and 5 genera distributed in 5 families and a single order Pezizales.

Table 5: Dominant families of wild fleshy fungi in terms of genera and species.

S.No	Family	Genera	Species
Pezizomycetes			
Pezizales			
1.	Discinaceae	1	1
2.	Helvellaceae	1	3
3.	Morchellaceae	1	4
4.	Pezizaceae	1	3
5.	Pyronemataceae	1	1
Agaricomycetes			
Agaricales			
6.	Agaricaceae	10	23
7.	Physalacriaceae	1	1
8.	Psathyrellaceae	2	3
9.	Strophariaceae	2	4
10.	Shizophyllaceae	1	1
11.	Amanitaceae	1	4
12.	Pleurotaceae	1	3
13.	Clavariaceae	1	1
Boletales			
14.	Boletaceae	1	4
15.	Suillaceae	1	1
16.	Sclerodermataceae	1	3
Cantharalles			
17.	Cantharellaceae	1	2
Gomphales			
18.	Gomphaceae	1	5
Polyporales			
18.	Sparassidaceae	1	2
Russulales			
19.	Russulaceae	2	8
20.	Hericiaceae	1	1
Auriculariales			
21.	Auriculariaceae	1	1
Geastrales			
22.	Geastraceae	1	4
Total		35	83

The results presented in Table 5 demonstrate that among Pezizomycetes, Morchellaceae was predominant with as many as 4 species representing a single genus *Morchella*. Helvellaceae and Pezizaceae followed it with 3 species each while Pyronemataceae and Discinaceae was represented by 1 species each. Within Agaricomycetes, family Agaricaceae was dominant with (23 species and 10 genera), followed by Russulaceae (8 species and 2 genera), Strophariaceae (4 species and 2 genera), Psathyrellaceae (3 species and 2 genera), Gomphaceae (5 species and 1

genera), Amanitaceae, Boletaceae and Geastraceae (4 species and 1 genera), Pleurotaceae and Sclerodermataceae (3 species and 1 genera), Cantharellaceae and Sparassidaceae (2 species and 1 genera), Physalacriaceae, Shizophyllaceae, Clavariaceae, Suillaceae, Hericiaceae and Auriculariaceae (1 species and 1 genera), were leading with respect to the diversity of species. Dominant nature of these families shows their unique geographical character and diverse climatic conditions of study area. However, ectomycorrhizal association with both conifers and deciduous trees may also lead their predominance in the park.

4.6 Ethnomycological Studies in Kishtwar High Altitude National Park.

Mushroom foraging or hunting is an ancient practice, which predates the emergence of ethnomycology as a discipline in many parts of the world. It refers to the habit of picking edible mushrooms from the wild and surrounding forest for food and other purposes. (Plate XV).

Surveys related to collection of wild edible mushrooms were undertaken in various localities of Kishtwar High Altitude National Park during the year 2015 - 2018 in order to extract the valuable information concerning the use of fleshy macrofungi by the people of various settlements. Village head, key informants and elderly residents of the study area were interviewed using especially self-designed questionnaire in their local languages. The details regarding the collection, usage, folk knowledge and vernacular names of the species were recorded.

It was observed that the gathering of edible mushrooms was usually done three or four days after an excessive rainfall in the months of June, July and August. The chances of getting variable macrofungal fruiting bodies was much higher during these months as congenial temperature and relative humidity would favour fructification during this period due to rainfall and moisture content, indicating significance of glacial water and rainfall in fungal phenology in the study area. During investigation, it was also realised that locals prefer to collect the available edible mushrooms early in the morning, as the fruiting bodies of macrofungi were fresh and intact in the morning. While rural women and children from different villages and in the periphery of KHANP were frequently engaged in this activity, men folk only occasionally accompanied and assisted them.

Traditional knowledge and folk taxonomy of wild macrofungi in the study area

Present study was based on regular forays and personal interviews conducted in different parts of the study area during the year 2015 to 2018 in order to extract the valuable information concerning the use of wild macrofungi by the people of various settlements. Key persons and residents of the study area were interviewed using specially designed semi-structured questionnaire in their local languages (Kishtwari, Kashmiri, Gojri and Boddhi). The pertinent details regarding the occurrence, identification, collection, usage and vernacular names of the species were recorded (Table 4).

Research was carried out with a total of 50 informants covering different locations of Kishtwar High Altitude National Park in local dialects. A total of 50 informants (24 male and 26 female) were consulted and questioned. Informants of different age groups ranging from 18 to 80 years were selected for interviewing. Maximum of informant (68.00%) were of middle age people, followed by elderly people (28.00%) and young informants constituted only 4%. An average 40 to 50% of the mushroom species were recognized by informants, below 25 years, and middle-aged respondent of above 25 and below 50 years. It was revealed that elderly informants were able to distinguish most of the collected macrofungi implying that they had relatively more traditional knowledge about larger fungi.

Status of the wild edible macrofungi (WEM)

Initially little information regarding edibility of WEM fungi were recorded from the study area. During the investigation, the native inhabitants of the study area regarded mushrooms as preferred food and showed good preference for consumption of wild edible macrofungi (WEM). Perusal of data presented in table 6 and 7 reveals that out of the total (83) wild mushrooms collected from the different locations of study area, 37 taxa were of known to be potential edibility. These include *Gyromitra esculenta*, *Helvella acetabulum*, *H. atra*, *H. macropus*, *Morchella crassipes*, *M. deliciosa*, *M. elate*, *M. esculenta*, *Peziza badia*, *Geopora arenicola*, *Agaricus arvensis*, *Calvatia Bovista*, *Coprinus comatus*, *Macrolepoita procera*, *Gymnopilus sapineus*, *Gymnopilus sp.*, *Flammulina velutipes*, *Coprinopsis atramentaria*, *Pleurotus ostreatus*, *P. pulmonarius*, *P. squarrosulus*, *Boletus edulis*, *B. granulatus*, *B. luridus*, *Cantharellus cibarius*, *Craterellus tubaeformis*, *Clavaria fragilis*, *Sparassis crispa*, *S.*

radiate, *Ramaria apiculate*, *R. aurea*, *R. flava*, *R. stricta*, *R. formosa*, *Hericium erinaceus*, *Schizophyllum commune* and *Auricularia auricula-judae*.

Data revealed that various vernacular names were used for 37 wild edible macrofungi in different dilets i.e., Kashmiri, Kishtwari, Gojri and Bodhi. The folk taxonomical information gathered from the inhabitants also reveals that several prefixes or epithets based on colour, habit, shape, plant association etc are added to differentiate mushrooms within a folk genus group. These descriptive epithets are used to create folk species name. The importance of colour within some of the mushroom folk genera is noteworthy. For example; *Gyromitra esculenta* in Kashmiri and Kishtwari known as Wazul kan “red ear” in Gojri “Lal Thunthoo” and in Bodhi “Shamo” *Coprinus comatus* in Kashmiri as Makur header and in Kishtwari known as “Kalu hader” Shamo shi in bodhi. and *Calvatia bovista* known as Shapaidh thool as white egg in Kahmiri; Ophands in Gojri and Kishtwari; Kat Shamo in Bodhi. Morels such as *Morchella crassipes*, *M. deliciosa*, *M. elate*, *M. esculenta* are known as Kutch in Kashmiri and Shamo tetu in bodhi. Most of the macrofungi in Bodhi known as Shamo which means mushroom like taste i.e., *Gyromitra esculenta*, *Helvella acetabulum*, *H. atra*, *Peziza badia*, *Geopora arenicola*, *Agaricus arvensis*, *Macrolepoita procera*, *Flammulina. velutipes*, *Coprinopsis atramentaria*, *Pleurotus ostreatus*, *P. pulmonarius*, *P squarrosa*, *Boletus edulis*, *B. granulatus*, *B. luridus*, *Clavaria fragilis*, *Sparassis crispa*, *S. radicata*, *Ramaria apiculate*, *R. aurea*, *R. flava*, *R. stricta*, *R. formosa*, *Hericium erinaceus*, *Schizophyllum commune*, *Auricularia auricula-judae* others are known as Shamo li, Shamo tetu, Shantu & Shistu (Table 6). Species having different vernacular name in different dilects are shown below.

Table 6: Record of wild edible fleshy fungi commonly consumed and sold in market and their vernicular names.

S.No.	Species of fleshy fungi	Vernacular name	Consumed fresh/dried	Market sale price in Rs/Kg
1	<i>Gyromitra esculenta</i>	Wazul kan (1,2), Lal Thunthoo (3), Shamo (4)	Fresh	---
	<i>Helvella acetabulum</i>	Kan marde (1,2), Thunthoo (3), Shamo (4)	Fresh	70-80
3	<i>H. atra</i>	Kan marde (1,2), Thunthoo (3), Shamo (4)	Fresh	---
4	<i>H. macropus</i>	Kanpade (1,2) Thunthoo (3), Shamo Li (4)	Fresh	70-80
5	<i>Morchella crassipes</i>	Kutch (1,2,3) Shamo Tetu (4)	Dried and fresh	8000-12000
6	<i>M. deliciosa</i>	Kutch (1,2,3), Shamo Tetu (4)	Dried and fresh	8000-12000

7	<i>M.elate</i>	Kutch (1,2,3), Shamo Tetu (4)	Dried and fresh	8000-12000
8	<i>M. esculenta</i>	Kutch (1,2,3), Shamo Tetu (4)	Dried and fresh	8000-12000
9	<i>Peziza badia</i>	Kann Kutch (1,2,3), Shamo (4)	Fresh	---
10	<i>Geopora arenicola</i>	Kundli(1), Padur(2), Khuduz(3), Shamo (4)	Dried and fresh	100-120
11	<i>Agaricus arvensis</i>	Header (1), Chaltee (2,3), Shamo (4)	Fresh	60-80
12	<i>Coprinus comatus</i>	Makur header (1), Kalu hader (2), Kal head (3) Shamo shi (4)	Fresh	20-30
13	<i>Macrolepoita procera</i>	Tope header (1), Chaltee (2,3), Shamo (4)	Fresh	70-80
14	<i>Gymnopilus sapineus</i>	Kul muith (1, 3), Kantho (2), Shantu (4)	Fresh	70-80
15	<i>Gymnopilus sp.</i>	Kul muith (1, 3), Kantho (2), Shantu (4)	Fresh	70-80
16	<i>Flammulina velutipes</i>	Tele header (1), Dailoo (2), Bhutoo (3), Shamo (4)	Fresh	60-70
17	<i>Coprinopsis atramentaria</i>	Kirhun Haeder (1), Chaltee (2,3), Shamo (4)	Fresh	70-80
18	<i>Pleurotus ostreatus</i>	Sirjli (1), Saroori (2,3) Shairee (3), Shamo (4)	Fresh	120-140
19	<i>P. pulmonarius</i>	Sirjli muith (1), Saroori (2,3) Shairee (3), Shamo (4)	Fresh	120-140
20	<i>P squarrosa</i>	Sirjli (1), Saroori (2,3) Shairee (3), Shamo (4)	Fresh	120-140
21	<i>Boletus edulis</i>	Booto Header (1), Dailoo (2), Bhutoo (3), Shamo (4)	Fresh and dried	70-80
22	<i>B. granulatus</i>	Booto Header (1), Dailoo (2), Bhutoo (3), Shamo (4)	Fresh	70-80
23	<i>B. luridus</i>	Lal Booto, Dailoo (2, 3), Shamo (4)	Fresh	70-80
24	<i>Cantharellus cibarius</i>	Ruth header (1), Haldee chaltee (2,3), Shistu (4)	Fresh and dried	80-90
25	<i>Craterellus tubaeformis</i>	Ruth header (1), Haldee chaltee (2,3), Shistu (4)	Fresh and dried	80-90
26	<i>Clavaria fragilis</i>	Sheikhii (1), Shairee (2,3), Shamo (4).	Fresh	60-70
27	<i>Sparassis crispa</i>	Bhau shairee (1), Roa Gabur (1,2,3), Shamo (4)	Fresh and dried	100-120
28	<i>S. radicata</i>	Bhau shairee (1), Roa Gabur (1,2,3), Shamo (4)	Fresh and dried	100-120
29	<i>Ramaria apiculata</i>	Shairee (1,2,3), Shamo (4)	Fresh	80-90
30	<i>R. aurea</i>	Shairee (1,2,3) Shamo (4)	Fresh	80-90
31	<i>R. flava</i>	Lab Shairee (1,2,3) Shamo (4)	Fresh	80-90
32	<i>R. stricta</i>	Shairee (1,2,3) Shamo (4)	Fresh	80-90
33	<i>R. formosa</i>	Shairee (1,2,3) Shamo (4)	Fresh	80-90
34	<i>Hericium erinaceus</i>	Shairee (1,2,3) Shamo (4)	Fresh	50-60
35	<i>Schizophyllum commune</i>	Lulde khas (1, 2), dhando shak (3), Shamo (4)	Fresh and dried	20-30
36	<i>Auricularia auricula-judae</i>	Kan kulis (1,2), Kan padu (3) Shamo (4)	Fresh	55-65
37	<i>Calvatia bovista</i>	Shapaidh thool (1), Ophands (2,3), Kat Shamo (4)	Fresh	20-30

Languages: 1 = Kashmiri, 2 = Gojri, 3 = Kishtawari, 4 = Bodhi

Traditionally, local populace uses wild edible macrofungal species for consumption as their traditional food. Negligible commercialisation of these macrofungi was known in the study area, except *Morchella* (Gucchi). During surveys, it was revealed that few wild edible macrofungi were usually available in the market for sale in monsoon season at different rates (Table 6). The market sale price of different WEM fungi was also recorded in which, *Morchella* sps. were reported to be the most expensive with Rs. 8000-12000/Kg, followed by *Pleurotus species* with Rs. 120-140 and others mentioned.

Use Value:

Use value are high when there are many use reports for a macrofungi, implying that the macrofungi is important and approach zero when there are few reports related to its use. The use value, however doesn't not distinguished whether a macrofungi is used for single or multiple purposes

The result of the study has been presented in table 7 which indicated that the use value ranged from 1.54 to 0.3. On the basis of its use value the most important species of the present study included *Morchella crassipes*, *M. elata*, *M. deliciosa* and *M. esculenta* (1.54) each. Minimum use value of (0.3) *Cantharellus cibarius* and *Peziza badia*. Thus, it clearly reflects that *Morchella* sps. were frequently used by the people while as other species was used very less frequently (Table 7).

Of all the wild edible macrofungi recorded from the study area morels are prime edibles with immense commercial importance and their strong demand makes them an important non timber forest produce (NTFP). Morels are one of the major source of economy to rural people of KHANP. Local populace specially make collection of Morels in the months of March to May and August to September. As the morels are considered luxurious mushrooms in the market, people always remain in search of them and sometimes even loose their life (3 deaths are reported from 2010 to 2018 in KHANP).

Table 7: Showing Use Value of wild edible macrofungi commonly consumed in KHANP.

S.No.	Species of fleshy fungi	Vernacular name	Citations					Use Value	
			C	M	S	$\sum u$	N	$uv = \sum u/n$	
1.	<i>Gyromitra esculenta</i>	Wazul kan (1,2), Lal Thunthoo (3), Shamo (4)	20	3	0	23	50	0.46	
2.	<i>Helvella acetabulum</i>	Kan marde (1,2), Thunthoo (3), Shamo (4)	21	2	1	24	50	0.48	
3.	<i>H. atra</i>	Kan marde (1,2), Thunthoo (3), Shamo (4)	20	0	0	20	50	0.4	
4.	<i>H. macropus</i>	Kanpade (1,2) Thunthoo (3), Shamo Li (4)	23	8	1	32	50	0.64	
5.	<i>Morchella crassipes</i>	Kutch (1,2,3) Shamo Tetu (4)	50	27	2	77	50	1.54	
6.	<i>M. deliciosa</i>	Kutch (1,2,3), Shamo Tetu (4)	50	27	2	77	50	1.54	
7.	<i>M. elate</i>	Kutch (1,2,3), Shamo Tetu (4)	50	27	2	77	50	1.54	
8.	<i>M. esculenta</i>	Kutch (1,2,3), Shamo Tetu (4)	50	27	2	77	50	1.54	
9.	<i>Peziza badia</i>	Kann Kutch (1,2,3), Shamo (4)	11	3	1	15	50	0.3	
10.	<i>Geopora arenicola</i>	Kundli(1), Padur(2), Khuduz(3), Shamo (4)	36	7	2	45	50	0.9	
11.	<i>Agaricus arvensis</i>	Header (1), Chaltee (2,3), Shamo (4)	36	7	2	45	50	0.9	
12.	<i>Coprinus comatus</i>	Makur header (1), Kalu hader (2), Kal head (3) Shamo shi (4)	33	7	2	42	50	0.84	
13.	<i>Macrolepoita procera</i>	Tope header (1), Chaltee (2,3), Shamo (4)	36	7	2	45	50	0.9	
14.	<i>Gymnopilus sapineus</i>	Kul muith (1, 3), Kantho (2), Shantu (4)	26	2	0	28	50	0.56	
15.	<i>Gymnopilus sp.</i>	Kul muith (1, 3), Kantho (2), Shantu (4)	22	1	0	23	50	0.46	
16.	<i>Flammulina velutipes</i>	Tele header (1), Dailoo (2), Bhutoo (3), Shamo (4)	21	2	0	23	50	0.46	
17.	<i>Coprinopsis atramentaria</i>	Kirhun Haeder (1), Chaltee (2,3), Shamo (4)	20	1	0	21	50	0.42	
18.	<i>Pleurotus ostreatus</i>	Sirjli (1), Saroori (2,3) Shairee (3), Shamo (4)	14	5	0	19	50	0.38	
19.	<i>P. pulmonarius</i>	Sirjli muith (1), Saroori (2,3) Shairee (3), Shamo (4)	15	2	0	17	50	0.34	
20.	<i>P. squarrosa</i>	Sirjli (1), Saroori (2,3) Shairee (3), Shamo (4)	18	4	2	24	50	0.48	
21.	<i>Boletus edulis</i>	Booto Header (1), Dailoo (2), Bhutoo (3), Shamo (4)	16	2	4	22	50	0.44	

22.	<i>B. granulatus</i>	Booto Header (1), Dailoo (2), Bhutoo (3), Shamo (4)	12	1	4	17	50	0.34
23.	<i>B. luridus</i>	Lal Booto, Dailoo (2, 3), Shamo (4)	24	4	5	33	50	0.66
24.	<i>Cantharellus cibarius</i>	Ruth header (1), Haldee chaltee (2,3), Shistu (4)	12	1	2	15	50	0.3
25.	<i>Craterellus tubaeformis</i>	Ruth header (1), Haldee chaltee (2,3), Shistu (4)	25	2	5	32	50	0.64
26.	<i>Clavaria fragilis</i>	Sheikhii (1), Shairee (2,3), Shamo (4).	15	3	2	20	50	0.4
27.	<i>Sparassis crispa</i>	Bhaud shairee (1), Roa Gabur (1,2,3), Shamo (4)	35	4	5	44	50	0.88
28.	<i>S. radicata</i>	Bhaud shairee (1), Roa Gabur (1,2,3), Shamo (4)	12	5	8	25	50	0.5
29.	<i>Ramaria apiculata</i>	Shairee (1,2,3), Shamo (4)	15	2	5	22	50	0.44
30.	<i>R. aurea</i>	Shairee (1,2,3) Shamo (4)	12	5	4	21	50	0.42
31.	<i>R. flava</i>	Lab Shairee (1,2,3) Shamo (4)	19	2	0	21	50	0.42
32.	<i>R. stricta</i>	Shairee (1,2,3) Shamo (4)	22	2	0	24	50	0.48
33.	<i>R. formosa</i>	Shairee (1,2,3) Shamo (4)	25	4	0	29	50	0.58
34.	<i>Hericium erinaceus</i>	Shairee (1,2,3) Shamo (4)	22	3	0	25	50	0.50
35.	<i>Schizophyllum commune</i>	Lulde khas (1, 2), dhando shak (3), Shamo (4)	21	2	1	24	50	0.48
36.	<i>Auricularia auricula-judae</i>	Kan kulis (1,2), Kan padu (3) Shamo (4)	21	4	0	25	50	0.50
37.	<i>Calvatia bovista</i>	Shapaidh thool (1), Ophands (2,3), Kat Shamo (4)	25	2	1	28	50	0.56

uv = number of use reports cited for a species by all the informants.

n = number of informants.

Languages: 1 = Kashmiri, 2 = Gojri, 3 = Kishtawari, 4 = Bodhi

In KHANP the annual production of morels from 2003 to 2016 is decreasing considerably due to overexploitation, environmental and anthropogenic activities in the KHANP. (figure 5). As mentioned in below figure, the annual production of morels in 2003 was 46.50 quintals (dried) and in 2016 it is 15.62 quintals. The highest production is in 2005-06 (54.21 quintals) respectively (DFO Kishtwar, Marwah

Range). However, the actual production of morel seems far higher than that depicted by the forest department. The morel collection was banned for the local populace except the contractors who had a leased agreement (contract basis) with the forest department. But, local inhabitants are also collecting and selling morels illegally, thereby inflicting loss to the state exchequer every year.

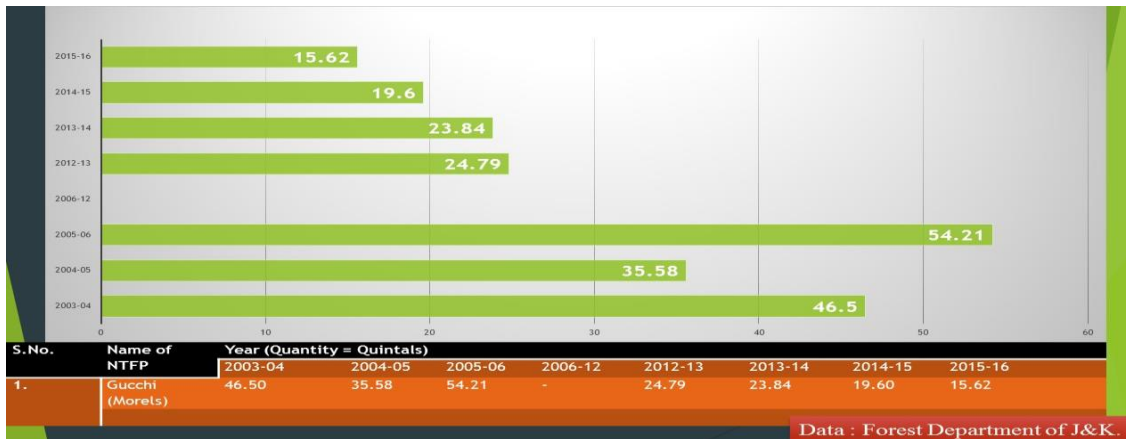


Figure 5: Showing the Production of Morels in KHANP.

4.7 Cultural Significance Index of wild edible macrofungi in KHANP:

Based on ethnomycological survey and considering the immense importance of wild edible mushrooms in the study area, the Cultural significance index (CSI) of 37 wild edible mushrooms were studied. Various indices of (CSI) in Table 8.

Table 8: Showing different values of CSI.

S.No.	Coded Name	Name of the Species	M	MI	PAI	TASFI	HI	KTI	MFFI	EI	FUI	EMCSI
1.	GE	<i>Gyromitra esculenta</i>	55	4.622	5.500	2.482	0.182	2.785	6.318	0.000	6.091	107.958
2.	HA	<i>Helvella acetabulum</i>	40	3.361	1.750	0.000	0.333	1.082	1.625	0.000	1.250	20.303
3.	HAT	<i>H. atra</i> J. König	35	2.941	2.500	0.190	0.555	1.142	1.429	0.190	2.286	24.387
4.	HM	<i>H. macropus</i>	30	2.521	2.500	0.111	3.330	0.444	1.083	0.111	1.167	22.049
5.	MC	<i>Morchella crassipes</i>	110	9.244	7.705	9.152	9.651	9.637	8.909	9.152	9.000	584.259
6.	MD	<i>M. deliciosa</i>	105	8.824	8.952	9.049	9.250	9.619	9.262	9.049	9.262	568.613
7.	ME	<i>M. elate</i>	111	9.328	9.122	8.890	9.520	9.700	9.054	8.890	9.775	605.840
8.	ME	<i>M. esculenta</i>	112	9.412	8.973	9.138	8.690	9.524	8.795	9.138	8.661	592.173
9.	PB	<i>Peziza badia</i>	38	3.193	1.645	3.155	6.288	2.103	1.711	3.155	1.842	63.541
10.	GA	<i>Geopora arenicola</i>	105	8.824	5.976	7.177	5.790	6.256	6.167	4.350	6.881	375.862
11.	AA	<i>Agaricus arvensis</i>	91	7.647	7.033	5.744	2.613	5.497	6.676	5.744	6.181	301.966
12.	CC	<i>Coprinus comatus</i>	65	5.462	3.346	2.305	0.322	2.613	4.731	2.305	4.000	107.183
13.	MP	<i>Macrolepota procera</i>	31	2.605	1.210	0.000	0.537	0.000	1.452	0.000	2.500	14.845
14.	GS	<i>Gymnopilus sapineus</i>	30	2.521	2.500	0.852	0.555	0.999	1.583	0.852	2.500	24.808
15.	GS	<i>Gymnopilus</i> sp.	35	2.941	2.500	0.754	2.379	1.427	1.571	0.754	1.000	30.546
16.	FV	<i>Flammulina velutipes</i>	56	4.706	5.000	1.606	3.330	3.330	4.464	1.606	4.330	111.368
17.	CA	<i>Coprinus atramentarius</i>	71	5.966	1.549	2.345	4.978	3.330	1.444	2.345	0.915	100.870
18.	PO	<i>Pleurotus ostreatus</i>	80	6.723	6.219	6.670	6.336	6.336	6.094	6.670	5.031	291.467
19.	PP	<i>Pleurotus pulmonarius</i>	80	6.723	5.938	4.792	5.084	4.835	6.438	4.792	5.250	249.605
20.	PS	<i>Pleurotus squarrosulus</i>	75	6.303	7.267	6.047	2.886	6.225	5.600	6.047	5.500	249.393
21.	BE	<i>Boletus edulis</i>	62	5.210	1.210	2.793	2.148	3.330	2.097	2.793	2.500	87.897
22.	BG	<i>B. granulatus</i>	61	5.126	2.377	2.238	2.620	3.112	1.721	2.238	1.721	82.162
23.	BL	<i>B. luridus</i>	52	4.370	1.923	2.113	2.946	3.330	1.587	2.113	2.260	71.103
24.	CC	<i>Cantharellus cibarius</i>	81	6.807	4.105	3.001	0.411	3.166	4.444	3.001	4.198	151.966
25.	CI	<i>Cantharellus infundibuliformis</i>	85	7.143	1.647	0.705	1.962	0.431	2.000	0.705	1.941	67.081
26.	CV	<i>Clavaria vermicularis</i> Scop.	26	2.185	0.000	0.000	6.670	0.000	0.385	0.000	0.769	17.094
27.	SC	<i>Sparassis crispa</i>	89	7.479	6.067	5.695	4.827	5.470	5.730	5.695	6.601	299.809
28.	SR	<i>Sparassis radiata</i>	71	5.966	5.176	4.134	3.097	6.670	6.444	4.134	6.444	215.371
29.	RA	<i>Ramaria apiculata</i>	66	5.546	2.765	2.876	4.342	3.330	4.735	2.876	3.977	138.108
30.	RA	<i>R. aurea</i>	68	5.714	1.875	3.330	4.509	2.840	1.618	3.330	1.544	108.834
31.	RF	<i>R. flavobrunnescens</i> var. <i>aurea</i>	65	5.462	1.423	2.920	3.281	1.793	2.115	2.920	1.538	87.346
32.	RFL	<i>R. flavobrunnescens</i> var. <i>longisperma</i>	52	4.370	2.067	3.330	2.305	2.433	1.875	3.330	1.298	72.709
33.	RF	<i>R. formosa</i>	60	5.042	3.083	2.498	5.835	2.109	4.958	2.498	4.167	126.793
34.	HE	<i>Herichium erinaceus</i>	88	7.395	6.051	5.493	0.870	6.366	5.511	5.493	6.903	271.318
35.	SC	<i>Schizophyllum commune</i>	41	3.445	1.341	0.406	1.218	0.731	1.829	0.406	2.500	29.052
36.	AA	<i>Auricularia auricula-judae</i>	39	3.277	0.000	1.366	0.342	1.195	0.641	1.366	0.897	19.034
37.	CB	<i>Calvatia bovista</i>	59	4.958	1.271	0.000	1.242	0.677	1.441	0.000	2.203	33.884

The Frequency of mention (MI):

MI was highest in *Morchella esculenta* (112 mentions), *M. elate* (111 mentions), *M. crassipes* (110 mentions), *M. deliciosa* (105 mentions), *Geopora arenicola* (105 mentions) and lowest by *Clavaria fragilis* (26 mentions). Out of 37 species 22 mushrooms species were mentioned by more than 50% of interviewees, followed by 7 species mentioned by more than 30% of interviewees and 8 species mentioned by less than 30% of interviewees.

Frequency of Use Index (FUI)

The species consumed more than once a year included *Morchella elate*, *M. deliciosa*, *M. crassipes* and *M. esculenta*, (FUI > 8.0 for all four) as well as *Hericium erinaceus*, *Geopora arenicola*, *Sparassis crispa*, *S. radicata*, *Agaricus arvensis*, *Gyromitra esculenta*, *Pleurotus squarrosulus*, *P. pulmonarius*, *P. ostreatus* (FUI < 5.0). *Geopora arenicola* and *Sparassis* sps. has a distinctive and peculiar taste compared to the other mushrooms collected, and the KHANP community preferred this species over the others. The least used mushrooms are *Coprinus atramentarius*, *Auricularia auricula-judae* and *Clavaria fragilis* (FUI < 2.5).

Multi-functional Food Index (MFFI)

Morchella elate, *M. deliciosa*, *M. crassipes* and *M. esculenta*, (MFFI > 7.5) were preferred for cooking alone with highest MFFI values. *Auricularia auricula-judae* and *Clavaria fragilis* (MFFI < 2.5) gives mixed response from the informants; most of them don't know and few used to mix them with different dishes.

Knowledge Transmission Index (KTI)

Seventeen macrofungal species in the KHANP community with the deepest generational roots with involvement of five generations included: *Morchella elate*, *M. crassipes*, *M. deliciosa*, *M. esculenta*, *Sparassis radicata* (KTI > 6.67) and *Hericium erinaceus*, *Pleurotus ostreatus*, *Geopora arenicola*, *Pleurotus squarrosulus*, *Agaricus arvensis*, *Sparassis crispa*, *Pleurotus pulmonarius*, *Flammulina velutipes*, *Coprinus atramentaria*, *Boletus edulis*, *B. luridus*, *Ramaria apiculate* (KTI > 3.37) .*Morchella elate* had the highest KTI value (9.7), making these mushrooms the most significant in this sub-index.

Health Index (HI)

Morchella crassipes, *M. elate*, *M. deliciosa*, *M. esculenta* (HI > 6.67) were the most significant species in this sub-index. The next most frequently eaten mushrooms with health benefits were *Peziza badia*, *Ramaria formosa*, *R. aurea*, *R. apiculate*, *Geopora arenicola*, *Pleurotus pulmonarius*, *P. ostreatus*, *Coprinus atramentarius*, *Sparassis crispa*, *H. macropus* (HI > 3.37). Other mushrooms were considered healthy but had lower HI values (Table 8); these included *Ramaria flava*, *R. stricta*, *Sparassis radicata*, *Boletus edulis*, *B. luridus*, *B. granulatus*, *Pleurotus squarrosulus*, *Agaricus arvensis*, *Gymnopilus sp.*, *Craterellus tubaeformis*, *Calvatia Bovista*, *Schizophyllum commune*, *Hericium erinaceus*, *Helvella acetabulum*, *H. atra*, *Gymnopilus sapineus*, *Macrolepoita procera*, *Cantharellus cibarius*, *Auricularia auricula-judae*, *Coprinus comatus* and *Gyromitra esculenta*. Most interviewees agreed that there were no known incidences of poisoning associated with eating forest-grown mushrooms.

Perceived Abundance Index (PAI)

The mushrooms considered the most abundant included *Morchella elate*, *M. esculenta*, *M. deliciosa*, *M. crassipe* (PAI >7.5). Mushrooms that were rarer were with lower (PAI < 1) are *Boletus edulis*, *B. granulatus*, *B. luridus*, *Ramaria stricta*, *R. aurea*, *R. flava*, *Helvella acetabulum*, *Craterellus tubaeformis*, *Peziza badia*, *Coprinus atramentaria*, *Schizophyllum commune*, *Calvatia Bovista*, *Macrolepoita procera*, *Clavaria fragilis*, *Auricularia auricula-judae*.

Taste Score Appreciation Index (TSAI)

Highest in *Morchella crassipes*, *M. esculenta*, *M. deliciosa*, *M. elate*, *Geopora arenicola*, *Pleurotus ostreatus* (TSAI > 6.67); *Pleurotus squarrosulus*, *P. pulmonarius*, *Agaricus arvensis*, *Sparassis crispa*, *Hericium erinaceus*, *Sparassis radicata*, *Ramaria stricta*, *R. aurea*, (TSAI > 3.33); Mushrooms with reportedly simpler tastes were *Peziza badia*, *Cantharellus cibarius*, *Ramaria apiculate*, *R. flava*, *R. formosa*, *Boletus edulis*, *Gyromitra esculenta*, *Coprinus atramentarius*, *Coprinus comatus* (TSAI > 3.0).

Edible Mushrooms CS Index (EMCSI)

The EMCSI values ranged from 14.845 to 605.840. Mushrooms with the most CS included *Morchella esculenta*, *M. elate*, *M. crassipes*, *M. deliciosa*, *Geopora arenicola*, which are all valued for taste and nutritional value. The species with the least

CS included *Auricularia auricula-judae*, *Boletus edulis*, *B. luridus*, *B. granulatus*, *Ramaria flava*, *R. stricta*, *Clavaria fragilis*, *Craterellus tubaeformis*, *Peziza badia*, *Calvatia bovista*, *Gymnopilus sp.*, *Gymnopilus sapineus*, *Schizophyllum commune*, *Helvella acetabulum*, *H. atra* and *H. macropus*.

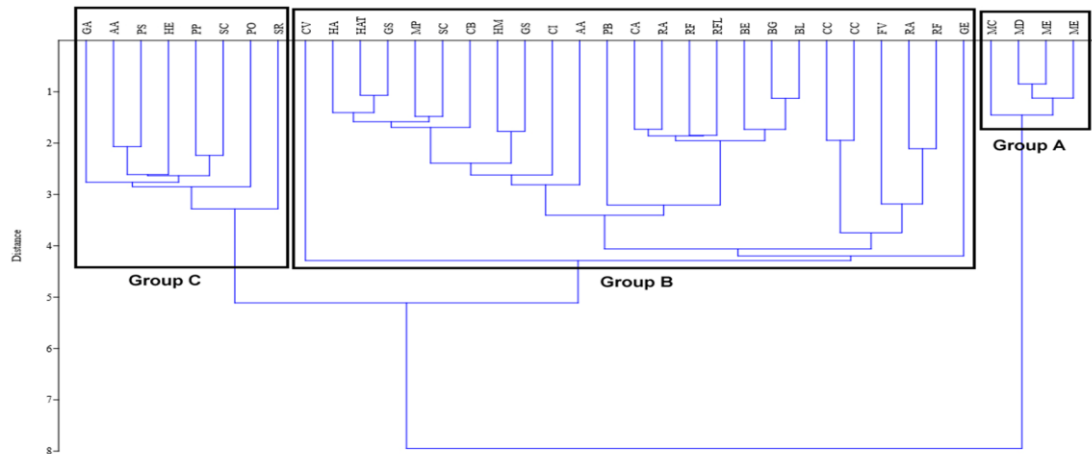


Figure 6: Similarities between wild edible mushroom species according to their cultural significance in KHANP.

Similarity analysis:

The phenogram in Figure 6 shows two groups of species (Euclidian distance of 8.01). Group A is comprised of the species with the most CS based on the diverse variables included in the analysis. Group B is divided into two sub-groups (Euclidian distance of 5.3) are most similar with identical values in four sub-indices (HI, PAI, TSAI, and EMCSI).

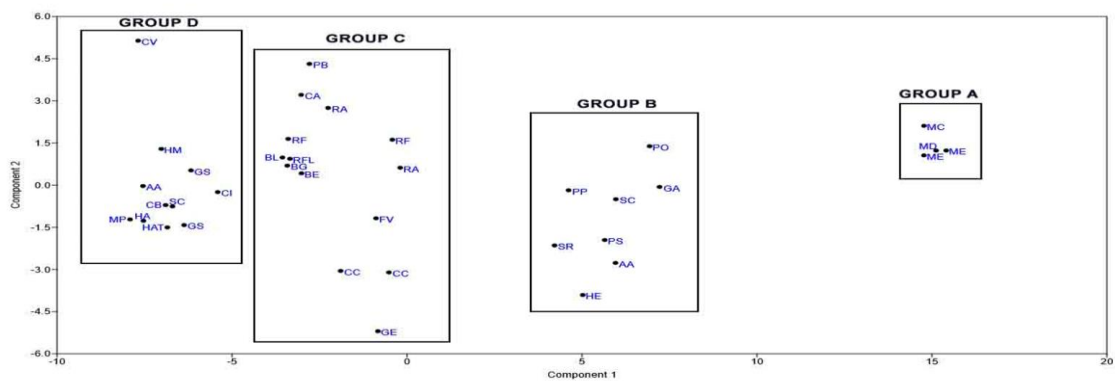


Figure 7: Similarities between wild edible mushrooms using the principal component analysis and the cultural significance values obtained in KHANP.

Multivariate analyses (PCA)

A PCA was used for multivariate analyses (Figure 7). Comparisons between principal component 1 (PC 1) vs. PC 2 resulted in four main groups of mushrooms.

Group A: *Morchella elate* (15.408), *M. deliciosa* (15.119), *M. crassipes* (14.775), *M. esculenta* (14.77) with most significant values;

Group B: *Geopora arenicola* (7.2165), *Pleurotus ostreatus* (6.9329), *Sparassis crispa* (5.9688), *Agaricus arvensis* (5.9565), *Pleurotus squarrosulus* (5.6495), *Hericium erinaceus* (5.024), *Pleurotus pulmonarius* (4.6155), *Sparassis radicata* (4.2164);

Group C: *Ramaria apiculata* (-0.19446), *R. formosa* (-0.41831), *Cantharellus cibarius* (-0.51654), *Gyromitra esculenta* (-0.83211), *Flammulina velutipes* (-0.88651), *Coprinus comatus* (-1.8989), *R. aurea* (-2.255), *Peziza badia* (-2.7888), *Boletus edulis* (-3.0155), *Coprinus atramentarius* (-3.0239), *Ramaria stricta* (Pers.) Quél. (-3.3428), *Ramaria flava* (-3.3952), *Boletus granulatus* (-3.423), *Boletus luridus* (-3.5588);

Group D: *Craterellus tubaeformis* (-5.4103), *Gymnopilus* sp. (-6.1738), *Gymnopilus sapineus* (-6.3707), *Schizophyllum commune* (-6.703), *H. atra* (-6.8477), *Calvatia bovista* (-6.898), *Helvella macropus* (-7.0214), *Helvella acetabulum* (-7.5323), *Auricularia auricula-judae* (-7.5442), *Clavaria fragilis* (-7.6841), *Macrolepoita procera* (-7.9161). The different species were grouped based on similar values obtained in the different sub-indices. The first three components explained 91.57% of the variation using Eigen analyses.

The most important variables that affected grouping were the MI (8.8), FUI (3.2), MFFI (2.7) and PAI (2.2) in PC 1; the MI (7.7) and HI (7.2) in PC 2; and the EI (3.6), TASFI (2.8), MI (2.5), and KTI (2.1) in PC 3. These species were hierarchically arranged based on their significance to the KHANP community, which was reflected in the sub-indices values. The PCA, which compared the sub-indices, showed that the HI and MI did not group; EI, TSAI, and KTI; PAI, MFFI, and FUI grouped together (Figure 8).

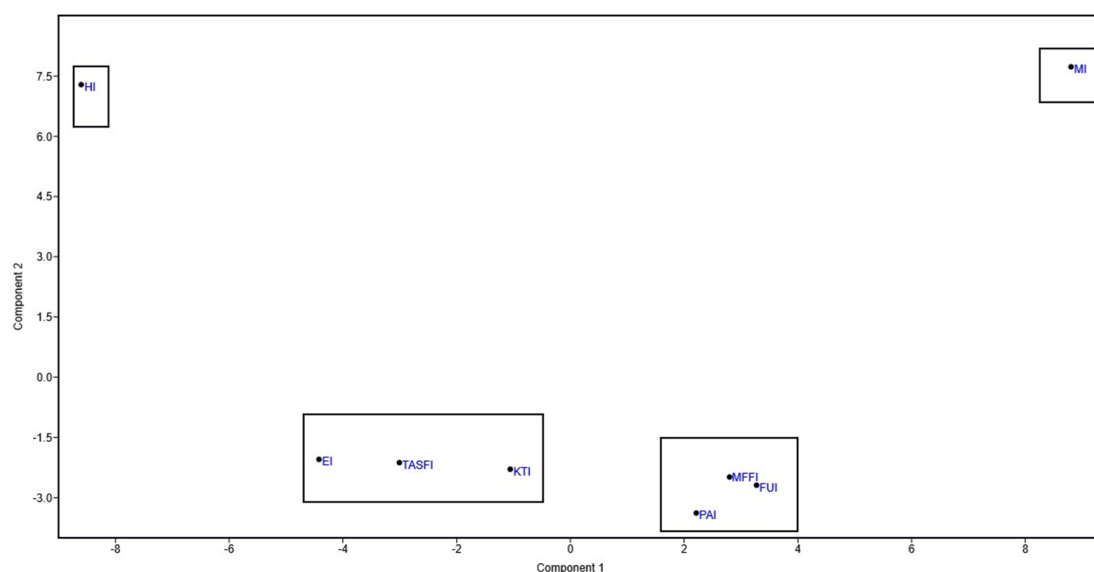


Figure 8: Principal component analysis results after comparing the sub-indices used to determine the cultural significance of wild mushrooms in KHANP.

Eleven mushroom species explained the observed variation in PC 1 *Craterellus tubaeformis* (-5.4103), *Gymnopilus* sp. (-6.1738), *Gymnopilus sapineus* (-6.3707), *Schizophyllum commune* (-6.703), *Helvella atra* (-6.8477), *Calvatia Bovista* (-6.898), *Helvella macropus* (-7.0214), *Helvella acetabulum* (-7.5323), *Auricularia auricula-judae* (-7.5442), *Clavaria fragilis* (-7.6841), *Macrolepoita procera* (-7.9161) and PC 2 (*Russula* species and *Boletus* species; values > 0.90). The first three components explained 96.8% of the variation.

These results are consistent with those obtained from the sub-indices. *Morchella elate* was the most significant mushroom species due to its abundance (PAI), Economic (EI), nutritional value (HI), and generational knowledge (KTI); similarly, other morel species was also significant due to its frequent use (FUI), taste (TSAI), and reputation (MI).

The multidimensional scaling analysis in Figure 9 results consistent with those of the PCA for grouping some species at the maximum number of iterations.

Group A: *Morchella esculenta* (-0.3307), *M. crassipes* (-0.3325), *M. deliciosa* (-0.33843), *M. elate* (-0.34501);

Group B: *Sparassis radicata* (-0.09465), *Pleurotus pulmonarius* (-0.10299), *Hericium erinaceus* (-0.11728), *Pleurotus squarrosulus* (-0.13039), *Sparassis crispa* (-0.13397), *Agaricus arvensis* (-0.13463), *Pleurotus ostreatus* (-0.15885), *Geopora arenicola* (-0.16864);

Group C: *Boletus luridus* (0.083693) *Boletus granulatus* (0.079846), *Ramaria stricta* (0.077424) *Ramaria flava* (0.077119), *Boletus edulis* (0.070847), *Coprinus atramentarius* (0.069123), *Peziza badia* (0.063234), *Ramaria aurea* (0.054663), *Coprinus comatus* (0.043779), *Gyromitra esculenta* (0.023031), *Flammulina velutipes* (0.018816), *Cantharellus cibarius* (0.012107), *Ramaria apiculata* (0.005962), *Ramaria formosa* (5.50E-05);

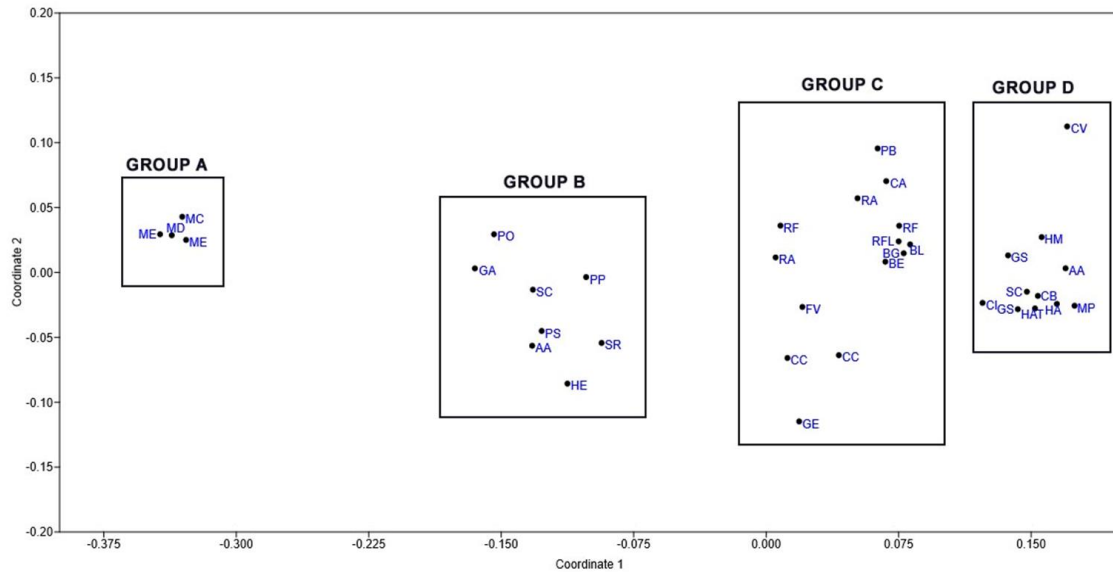


Figure 9: Similarities between wild edible mushrooms according to the multidimensional scaling analysis and CS values obtained in KHANP.

Group D: *Clavaria fragilis* (0.18256), *Macrolepoita procera* (0.1776), *Auricularia auricula-judae* (0.16883) *Helvella acetabulum* (0.1636), *Helvella macropus* (0.16084), *Helvella atra* (0.15459), *Calvatia bovista* (0.14947), *Schizophyllum commune* (0.14765), *Gymnopilus sapineus* (0.14626), *Gymnopilus* sp. (0.13716) and *Craterellus tubaeformis* (0.11977).

All sub-indices had similar contributions to the CS of the mushroom species, and no significant differences were observed. However, morels remained the most significant, and the different groups formed by both analyses contained species with similar significance values.

4.8 Macrofungi Species Richness and Diversity in KHANP.

Macrofungi play fundamental roles in forest ecosystems. Measuring the macrofungal species richness and diversity helps to monitor the ecological health of given natural system. Since macrofungal diversity is closely correlated with the total biodiversity of a given site, its quantification also helps for assessing priorities in sites of conservation.

Macrofungi of the Kishtwar High Altitude National Park were assessed by establishing transect plots of 1000×1000 m. Ten sites were selected from the KHANP based on their accessibility. Hence, a total of ten permanent transect plots of 1000×1000 m sizes were established in Sonder, Lopara, Janakpur, Palmar, Loharana, Deharna, Qedarna, Marwah, Nath, Ekhala of Kishtwar High Altitude National Park of Kishtwar district in Jammu and Kashmir state. All the plots were surveyed for the incidence of macrofungi and the data was recorded during (2015-2018).

The data was correlated with different diversity indices which revealed that the species richness of Kishtwar High Altitude National Park is 83 and the highest Simpson's diversity index (D) was obtained (Table 9, Fig. 10) in Loharana (0.9663) and lowest in Loopara (0.9416). Higher the D values, higher is the macrofungal species diversity. Therefore, distribution of macrofungal diversity is highly diversified and not dominated by few species. Similarly, the Shannon Wiener diversity indices (H') varied across different sites (Table 9, Fig. 11); the highest in Loharana (3.489) and Marwah (3.353) indicates the higher the diversity of the macrofungal species distribution and lowest in Loopara (2.913) shows low macrofungal distribution. This exception could be explained in terms of the presence of more decaying woods as substrate for the macrofungal species Lopara and Ekhala. The calculated E (evenness) values ranged from 0.8647 to 0.9488 (Table 9, Fig. 12.). These values are near to 1 indicating even distribution of the macrofungal species in the all sites of KHANP. The species distribution was relatively more in Qaderna (0.9488) than the other sites. When the sites were compared, E value of Loopara was less than E value of Qaderna (0.9488) indicating that distribution of macrofungal species in Janakpur is more evenly distributed than the Nath. The comparison of all the three indices are shown in figure 13.

Table 9: Showing the different values of diversity indices of KHANP.

	Sonder	Loopara	Janakpur	Palmar	Loharana	Deharna	Qaderna	Marwah	Nath	Ekhala
Taxa_S	27	20	23	28	37	22	29	32	31	31
Individuals	117	96	109	126	143	75	84	109	103	129
Dominance_D	0.04799	0.05838	0.05463	0.04699	0.03369	0.05636	0.03827	0.03914	0.0444	0.03876
Simpson_1-D	0.952	0.9416	0.9454	0.953	0.9663	0.9436	0.9617	0.9609	0.9556	0.9612
Shannon_H	3.161	2.913	3.011	3.19	3.489	2.984	3.315	3.353	3.289	3.33
Evenness_e^H/S	0.8742	0.9209	0.8826	0.8677	0.8851	0.8987	0.9488	0.893	0.8647	0.901

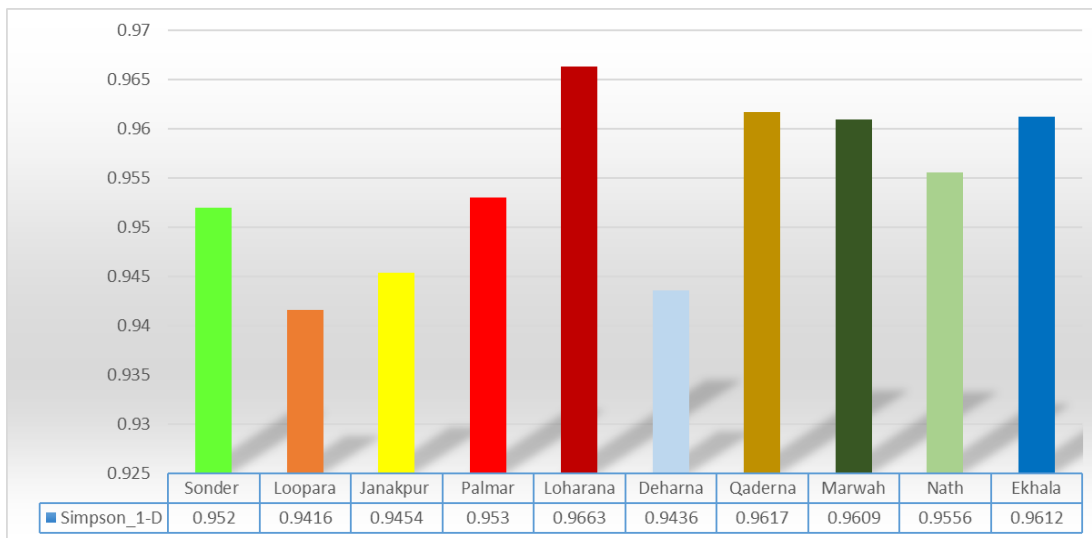


Figure 10: Bar diagram of Simpsons Index of Diversity of different sites of KHANP.

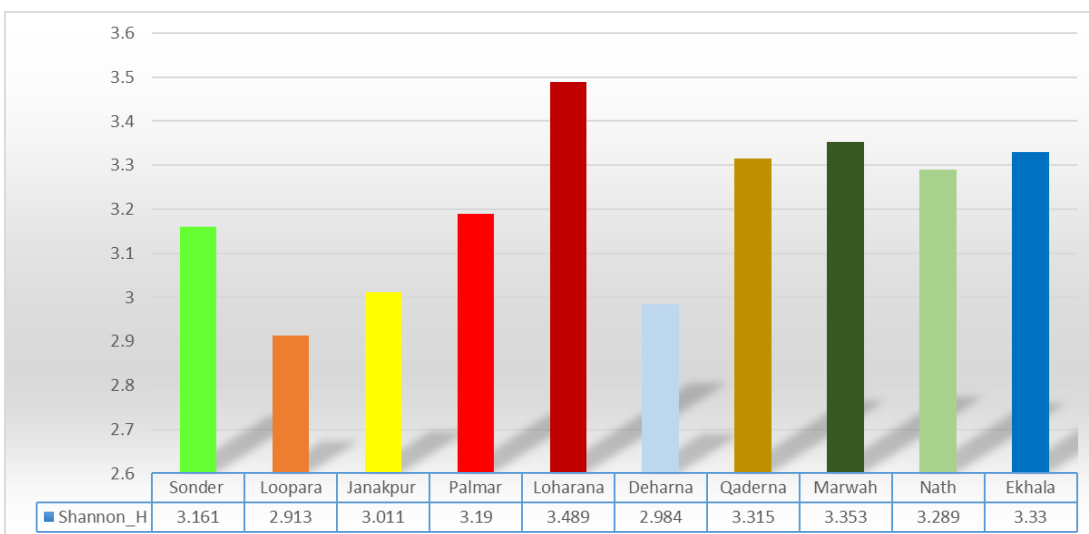


Figure 11: Bar diagram of Shannon-Wiener Index of Diversity of different sites of KHANP.

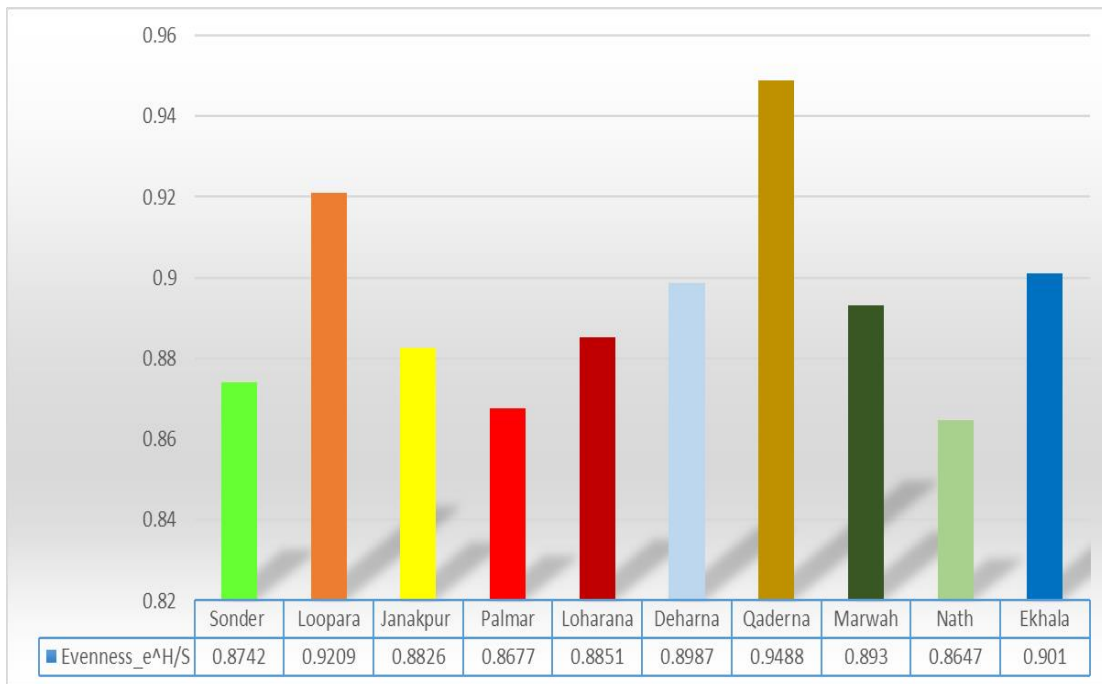


Figure 12: Bar diagram of Evenness Index of Diversity of different sites of KHANP.

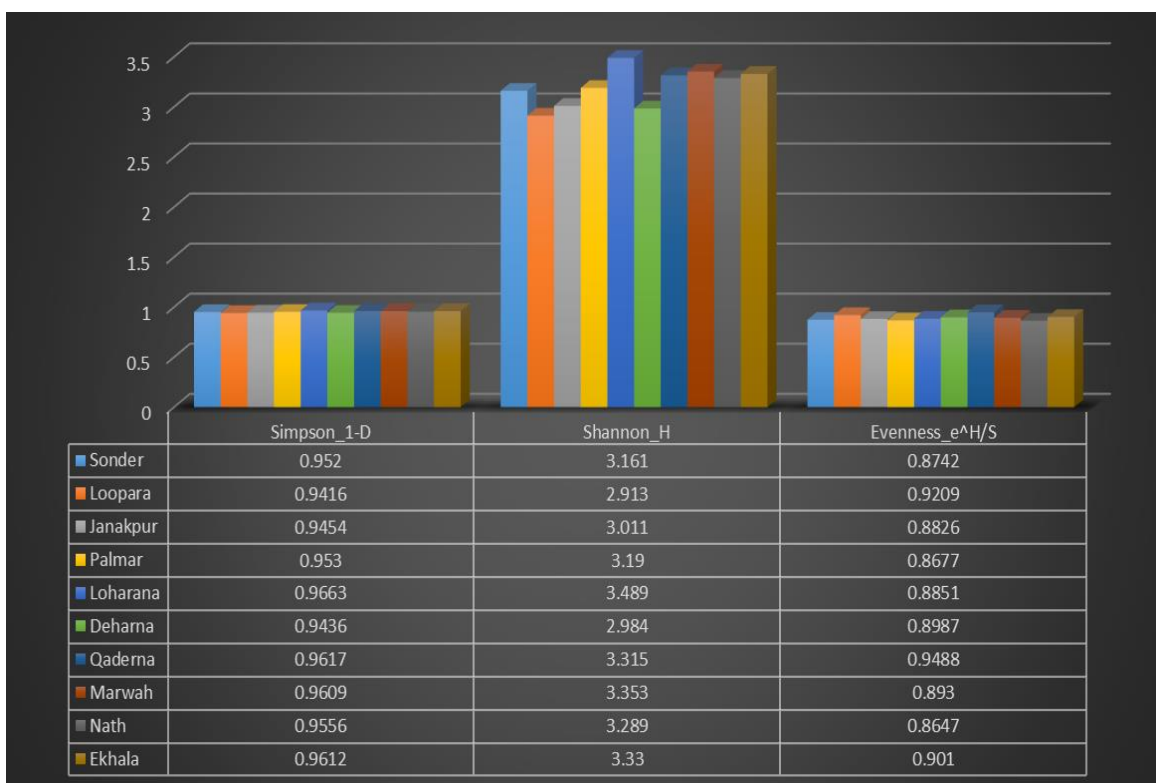


Figure 13: Bar diagram of Comparison of Diversity indices of different sites of KHANP.

Species composition and distribution

A total of 83 macrofungal species were identified from the Kishtwar High Altitude National Park (Table 11&14). These species were distributed among 35 genera spread over 24 families and 9 orders of 2 classes (Agaricomycetes and Pezizomycetes). Most of the macrofungal species identified belonged to the order Agaricales (44%) which was followed by the Pizizales (14%), Russulales (10%), Boletales (9%), Cantharalles, Gomphales, Geastrales (6% each) and Schizophyllales, Auriculariales (1% each). The most represented families were Asteraceae (23 species, 27.7%) and Russulaceae (8 species, 9.6%). Other important fungal families (Fig. 3) were Boletaceae (2 genera and 5 species), Ramariaceae (1 genera and 5 species), and Amanitaceae, Geastraceae, Morchellaceae (1 genera and 4 species each). The nature of most of the macrofungal species collected was humicolous (71.8%) followed by lignicolous (11.8%) and ectomycorrhizal (10.8%) (Fig. 4). The macrofungal species were mainly distributed in aggregated arrangement (75.9%) and the only other distribution pattern was random (24.2%). Distribution of most of the ectomycorrhizal fungus (77.8%) was in aggregate pattern.

Table 10: Location and environmental parameters of various sites of KHANP.

Site	Latitude	Longitude	Altitude (masl)	Mean Temp (°C)	Humidity	Rainfall (mm)
Sonder	33°28'19.11"N	75°49'29.05"E	2056.6 (±105.5)	17.9 (±0.9)	63.1 (±2.2)	83.2 (±4.3)
Loopara	33°28'32.71"N	75°45'59.67"E	3134.2 (±125.2)	16.6 (±0.4)	54.1 (±1)	77.3 (±5.4)
Janakpur	33°30'7.08"N	75°48'4.49"E	2133.6 (±154.5)	15.1 (±0.2)	61.3 (±3.1)	79.3 (±3.7)
Palmar	33°27'20.01"N	75°41'5.65"E	2438.8 (±82.1)	14.7 (±0.1)	60.1 (±5.4)	81.8 (±5.6)
Loharna	33°31'24.70"N	75°48'5.34"E	2420.1 (±187)	14.6 (±0.4)	55.9 (±3.5)	81.2 (±8.2)
Deharna	33°35'41.32"N	75°44'2.46"E	2253.4 (±61.5)	14 (±0.5)	58.4 (±4.8)	81.6 (±6.0)
Qaderna	33°38'18.65"N	75°42'12.39"E	2403.6 (±213.3)	12.9 (±0.3)	55.8 (±4.2)	77.6 (±5.7)
Marwah	33°40'12.17"N	75°42'1.00"E	2497.8 (±55.5)	11.9 (±0.5)	54.8 (±0.6)	78.4 (±4.6)
Nath	33°33'33.15"N	75°47'16.71"E	2256 (±84.3)	11.5 (±0.6)	56.1 (±3.6)	82.8 (± 7.2)
Ekhala	33°27'38.67"N	75°43'56.52"E	1847.1 (±100.3)	10.8 (±0.3)	57.6 (±5.2)	71.7 (±0)

Table 11: Macrofungal description, habitat and distribution in KHANP.

Names of macro fungal taxa	Family	Accession number	Habitat	Distribution
<i>Gyromitra esculenta</i> (Pers.) Fr.	Discinaceae	HBJU-583	Humicolous	Aggregated
<i>Helvella acetabulum</i> (L.) Quél.	Helvellaceae	HBJU-580	Ectomycorrhizal	Random
<i>H. atra</i> J. König	Helvellaceae	HBJU-581	Ectomycorrhizal	Aggregated
<i>H. macropus</i> (Pers.) P. Karst.	Helvellaceae	HBJU-582	Bryophilous	Aggregated
<i>Morchella crassipes</i> (Vent.) Pers.	Morchellaceae	HBJU-619	Humicolous	Aggregated
<i>M. deliciosa</i> Fr.	Morchellaceae	HBJU-585	Humicolous	Random
<i>M. elata</i> Fr.	Morchellaceae	HBJU-584	Humicolous	Aggregated
<i>M. esculenta</i> (L.) Pers.	Morchellaceae	HBJU-586	Humicolous	Aggregated
<i>Peziza ampliata</i> Pers.	Pezizaceae	HBJU-587	Bryophilous	Aggregated
<i>P. badia</i> Pers.	Pezizaceae	HBJU-588	Bryophilous	Aggregated
<i>P. succosa</i> Berk.	Pezizaceae	HBJU-589	Humicolous	Aggregated
<i>Geopora arenicola</i> (Lev.) Kers	Pyrenomataceae	HBJU-590	Humicolous	Random
<i>Agaricus arvensis</i> Schaeff	Agaricaceae	HBJU-591	Humicolous	Random
<i>A. californicus</i> Peck	Agaricaceae	HBJU-592	Humicolous	Aggregated
<i>A. langei</i> (F.H. Moller) F.H. Moller	Agaricaceae	HBJU-620	Humicolous	Aggregated
<i>Apioperdon pyriforme</i> Pers	Agaricaceae	HBJU-618	Humicolous	Aggregated
<i>Bovista colorata</i> (Peck) Kreisel	Agaricaceae	HBJU-621	Humicolous	Random
<i>B. minor</i> Morgan	Agaricaceae	HBJU-595	Humicolous	Random
<i>B. plumbea</i> Pers	Agaricaceae	HBJU-622	Humicolous	Random
<i>B. pusilla</i> (Batsch) Pers.	Agaricaceae	HBJU-623	Humicolous	Random
<i>Calvatia bovista</i> (L.) T. Macbr.	Agaricaceae	HBJU-662	Humicolous	Aggregated
<i>C. elata</i> (Masse) Morgan	Agaricaceae	HBJU-624	Humicolous	Aggregated
<i>C. lycoperdoides</i> A.H.Sm.	Agaricaceae	HBJU-625	Humicolous	Aggregated
<i>Calvatia. sp.</i>	Agaricaceae	HBJU-626	Humicolous	Aggregated
<i>Chlorophyllum molybdites</i> (G. Mey.) Masee	Agaricaceae	HBJU-593	Humicolous	Aggregated
<i>Coprinus comatus</i> (O.F.Mull.) Pers.	Agaricaceae	HBJU-596	Bryophilous	Random
<i>Lepiota procera</i> (Scop.) Grey	Agaricaceae	HBJU-627	Humicolous	Aggregated
<i>Cystolepiota sistrata</i> (Scop.) Grey	Agaricaceae	HBJU-628	Humicolous	Aggregated
<i>Leucoagaricus rubrotinctus</i> (Peck) Singer	Agaricaceae	HBJU-629	Humicolous	Aggregated
<i>Lycoperdon molle</i> Pers	Agaricaceae	HBJU-630	Humicolous	Aggregated
<i>L. caudatum</i> Batsch	Agaricaceae	HBJU-631	Humicolous	Random
<i>L. perlatum</i> Pers	Agaricaceae	HBJU-632	Humicolous	Aggregated
<i>L. rimulatum</i> Peck	Agaricaceae	HBJU-633	Humicolous	Aggregated
<i>L. umbrinum</i> Pers.	Agaricaceae	HBJU-634	Humicolous	Aggregated
<i>Macrolepiota procera</i> (Scop.) Singer	Agaricaceae	HBJU-594	Humicolous	Aggregated
<i>Flammulina velutipes</i> (Curtis) Singer	Physalacriaceae	HBJU-599	Lignicolous	Aggregated
<i>Coprinellus domesticus</i> (B.) Vilg., Hop. & Jacq. John.	Psathyrellaceae	HBJU-636	Lignicolous	Aggregated
<i>C. micaceus</i> (Bull) Fr.	Psathyrellaceae	HBJU-637	Coprophilous	Aggregated
<i>Coprinopsis atramentaria</i> (Bull.)Fr.	Psathyrellaceae	HBJU-597	Humicolous	Aggregated
<i>Pholiota squarrosa</i> (Oeder) Kumm.	Strophariaceae	HBJU-600	Humicolous	Aggregated
<i>Pholiota sp.</i>	Strophariaceae	HBJU-638	Humicolous	Random
<i>Gymnopilus sapineus</i> Fries	Cortinariaceae	HBJU-598	Lignicolous	Random
<i>Gymnopilus sp.</i>	Cortinariaceae	HBJU-635	Lignicolous	Aggregated
<i>Schizophyllum commune</i> Fr.	Shizophyllaceae	HBJU-615	Lignicolous	Random
<i>Amanita flavoconia</i> G.F. Atk.	Amanitaceae	HBJU-601	Humicolous	Aggregated

<i>A. pantherina</i> (DC) Krombh	Amanitaceae	HBJU-639	Humicolous	Aggregated
<i>A. phalloides</i> Secr.	Amanitaceae	HBJU-640	Humicolous	Aggregated
<i>A. vaginata</i> (Bull.) Lam.	Amanitaceae	HBJU-602	Humicolous	Aggregated
<i>Pleurotus ostreatus</i> (Jacq. Ex. Fr.) P. Kumm	Pleurotaceae	HBJU-641	Lignicolous	Aggregated
<i>P. pulmonarius</i> (Fr.) Quel.	Pleurotaceae	HBJU-642	Lignicolous	Aggregated
<i>P. squarrosulus</i> (Mont.) Singer	Pleurotaceae	HBJU-603	Lignicolous	Aggregated
<i>Clavaria fragilis</i> Scop.	Clavariaceae	HBJU-649	Humicolous	Aggregated
<i>Boletus edulis</i> Bull	Boletaceae	HBJU-604	Humicolous	Aggregated
<i>B. formosus</i> Corner	Boletaceae	HBJU-643	Humicolous, Mycorrhizal	Random
<i>B. granulatus</i> L.	Boletaceae	HBJU-644	Humicolous, Mycorrhizal	Aggregated
<i>B. luridus</i> Schaeff	Boletaceae	HBJU-605	Ectomycorrhizal	Aggregated
<i>Suillus cavipes</i> (Opat.) A.H. Sm. & Thiers	Boletaceae	HBJU-645	Ectomycorrhizal	Aggregated
<i>Scleroderma citrinum</i> Pers.	Sclerodermataceae	HBJU-606	Ectomycorrhizal	Aggregated
<i>S. polyrhizum</i> (J. F. Gmel.) Pers.	Sclerodermataceae	HBJU-646	Humicolous	Aggregated
<i>S. verrucosum</i> (Bull.) Pers.	Sclerodermataceae	HBJU-647	Humicolous	Random
<i>Cantharellus cibarius</i> Fr.	Cantharellaceae	HBJU-607	Humicolous	Random
<i>Craterellus tubaeformis</i> (Scop.) Fr.	Cantharellaceae	HBJU-648	Humicolous	Aggregated
<i>Ramaria apiculate</i> (Fr.) Donk	Ramariaceae	HBJU-609	Humicolous	Aggregated
<i>R. aurea</i> (Schaeff.) Quel	Ramariaceae	HBJU-610	Humicolous	Aggregated
<i>R. flava</i> (Schaeff.) Quel	Ramariaceae	HBJU-651	Humicolous	Aggregated
<i>R. stricta</i> (Pers.) Quel.	Ramariaceae	HBJU-652	Humicolous	Aggregated
<i>R. formosa</i> (Pers.) Quel.	Ramariaceae	HBJU-653	Humicolous	Aggregated
<i>Sparassis crispa</i> (Wulfen) Fr.	Sparassidaceae	HBJU-608	Humicolous	Aggregated
<i>S. radicata</i> (Weir)	Sparassidaceae	HBJU-650	Humicolous	Aggregated
<i>Lactarius deliciosus</i> (L.) Gray	Russulaceae	HBJU-612	Humicolous	Aggregated
<i>L. deterrimus</i> Groger	Russulaceae	HBJU-654	Humicolous	Aggregated
<i>L. vellerreus</i> (Fr.) Fr.	Russulaceae	HBJU-655	Humicolous	Aggregated
<i>L. volemus</i> (Fr.) Fr.	Russulaceae	HBJU-611	Humicolous	Random
<i>Russula annulata</i> var. <i>annulata</i> R. Heim	Russulaceae	HBJU-656	Humicolous	Random
<i>R. squalida</i> (Krombh.) Britzelm.	Russulaceae	HBJU-657	Ectomycorrhizal	Aggregated
<i>R. cynoxantha</i> (Schaeff.) Fr.	Russulaceae	HBJU-658	Humicolous	Random
<i>R. rosea</i> Fr.	Russulaceae	HBJU-613	Ectomycorrhizal	Aggregated
<i>Hericium erinaceus</i> (Bull.) Persoon	Hericiaceae	HBJU-614	Lignicolous	Aggregated
<i>Auricularia auricula-judae</i> (Bull.) Quel	Auriculariaceae	HBJU-616	Lignicolous	Aggregated
<i>Geastrum campestre</i> Morgan	Geastraceae	HBJU-659	Humicolous	Aggregated
<i>G. saccatum</i> Fr.	Geastraceae	HBJU-617	Humicolous	Aggregated
<i>G. triplex</i> Jungh	Geastraceae	HBJU-660	Humicolous	Aggregated
<i>G. velutinum</i> Morgan	Geastraceae	HBJU-661	Humicolous	Aggregated

Species diversity

Loharna, with 37 species and 7.25 Margalef index value, was the site with maximum number of species richness. Least species richness (20 species and 4.16 Margalef index value) was recorded for Loopara. According to Menhinick value, the most and least species rich sites were Qaderna (3.16) and Loopara (2.04), respectively (Table 12).

The highest Simpson's index (D) was obtained in Deharna and Loopara (0.06) and lowest in Loharna (0.03). Shannon Wiener diversity indices (H) varied between 2.91 (Loopara) and 3.49 (Loharna). Fisher's alpha recorded the maximum values in Loharna (16.19) whereas Berger-Parker values were highest for Nath (0.12). The values of evenness (E) ranged from 0.86 (Nath) to 0.95 (Qaderna).

Dominance-Diversity curves of the ten sites illustrate that in all the sites, except Loharna and Ekhala, the top species were following the geometric pattern and rest of the species shows broken-stick model. In Loharna and Ekhala, only broken-stick model was exhibited by the macrofungal species (Fig. 15 & 16).

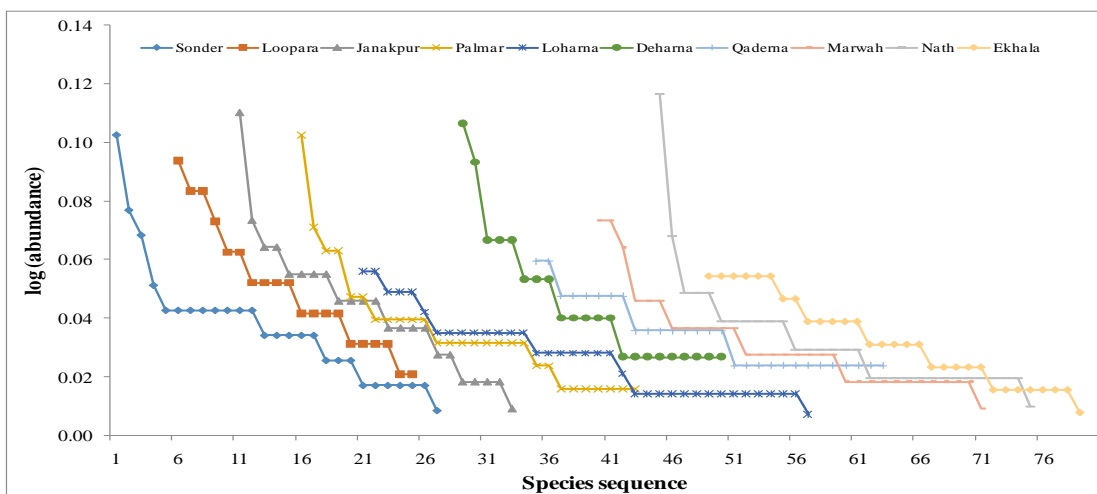


Figure 15: Dominance-Diversity curves of the ten sites.

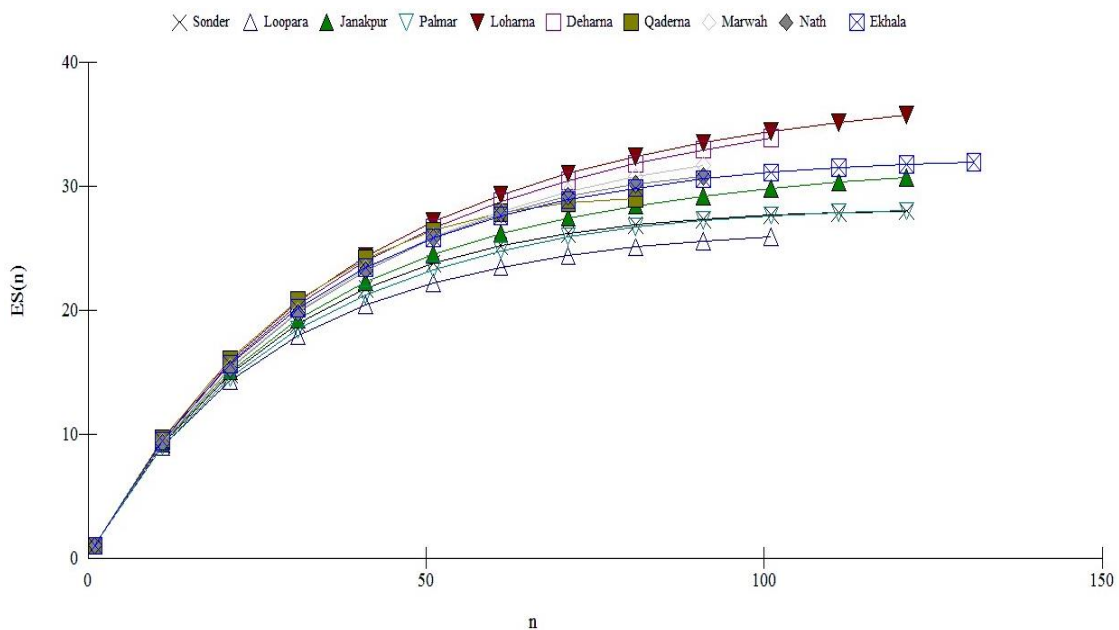


Figure 16: Dominance-Diversity curves of the ten sites.

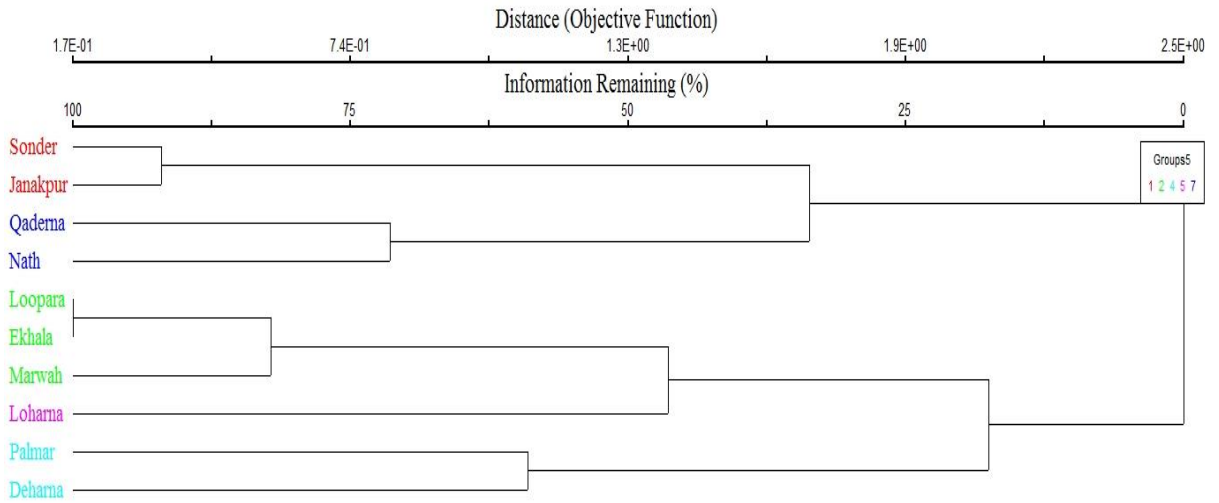


Figure 17: Hierarchical agglomerative cluster analysis of sites of KHANP.

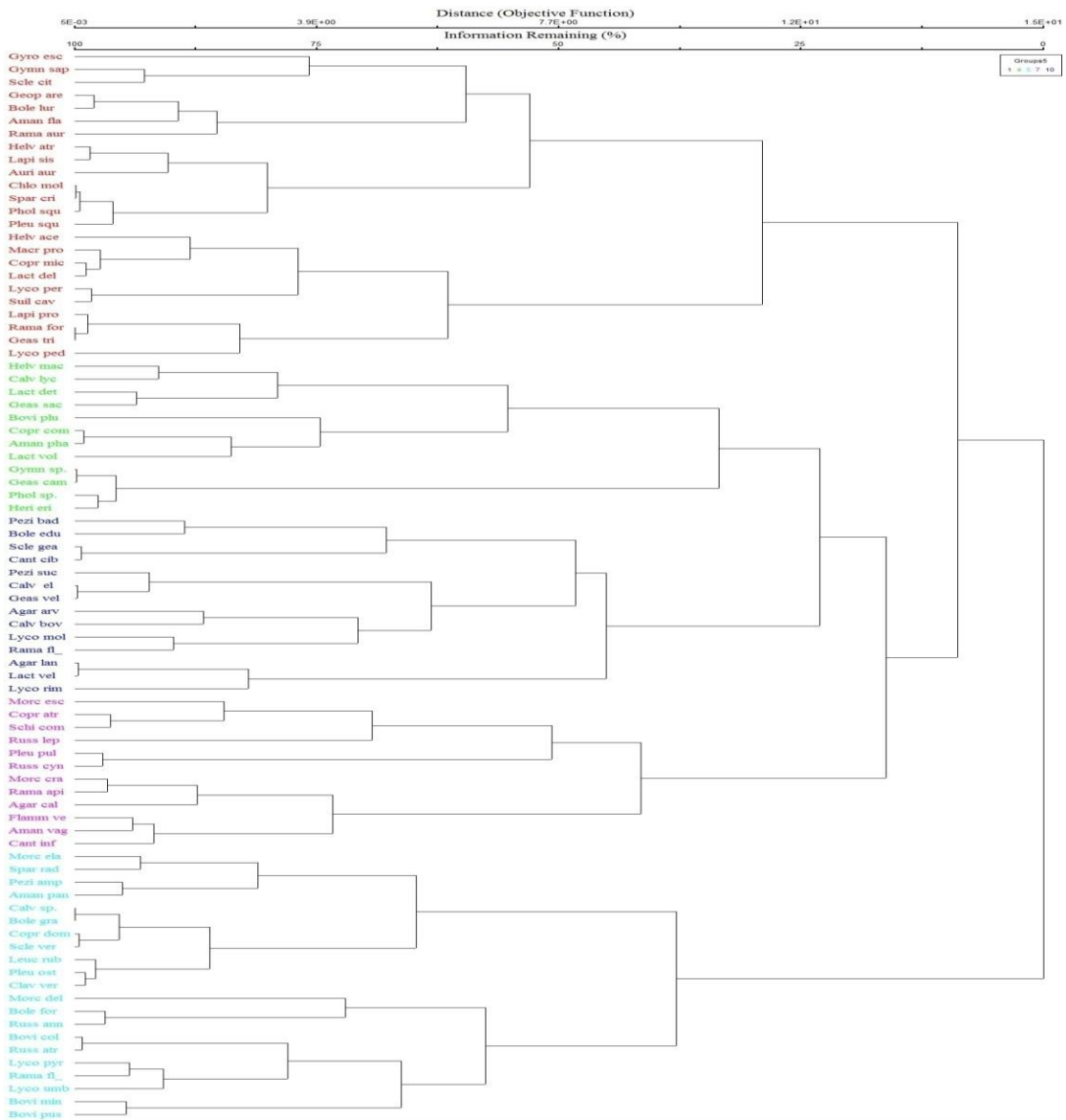


Figure 18: Hierarchical agglomerative cluster analysis between species of KHANP.

Community ordination

Whittaker's β -diversity analysis shows that maximum similarity of 95% existed between Janakpur and Loopara. Other important associations and species turnovers were found between Janakpur and Palmar (88%) and Loharna and Deharna (86%). Least percentage of association (52% each) was found between Janakpur and Sonder and Marwah and Ekhala (Table 13).

Hierarchical agglomerative cluster analysis depicts that both sites (Fig. 17) and macrofungal species (Fig. 18) of KHANP was segregated into 5 groups. The first group of sites clustered was having Sonder and Janakpur, second group had Qaderna and Nath, third group was the largest cluster comprised of three sites viz. Loopara, Ekhala and Marwah whereas fourth group had only one site Loharna, and the fifth and final cluster had Palmar and Deharna. The five groups of microfungal diversity were related with the site aggregations and first group was the largest with 24 species closely followed by fifth group having 21 species, other three groups' viz. second, third and fourth had 12, 14 and 12 species, respectively.

Table 12: Species richness and diversity indices of ten different sites of KHANP.

Sites	Richness	Menhinick	Margalef	D	H	Evenness	Fisher-alpha	Berger-Parker
Sonder	27	2.50	5.46	0.05	3.16	0.87	11.00	0.10
Loopara	20	2.04	4.16	0.06	2.91	0.92	7.69	0.09
Janakpur	23	2.20	4.69	0.05	3.01	0.88	8.90	0.11
Palmar	28	2.49	5.57	0.05	3.20	0.88	11.11	0.10
Loharna	37	3.09	7.25	0.03	3.49	0.89	16.19	0.06
Deharna	22	2.54	4.86	0.06	2.98	0.90	10.48	0.11
Qaderna	29	3.16	6.32	0.04	3.32	0.95	15.68	0.06
Marwah	32	3.07	6.61	0.04	3.35	0.89	15.26	0.07
Nath	31	3.06	6.47	0.04	3.29	0.86	15.05	0.12
Ekhala	31	2.73	6.17	0.04	3.33	0.90	12.95	0.05

Table 14: Distribution of macrofungal species in ten sites of KHANP

Species	Species Abbreviations	Species Abbreviations									
		Sonder	Loopara	Janakpur	Palmar	Loharna	Deharna	Qaderna	Marwah	Nath	Ekhala
<i>Gyromitra esculenta</i> (Pers.) Fr.	<i>Gyro escu</i>		9					2			3
<i>Helvella acetabulum</i> (L.) Quél.	<i>Helv acet</i>	4		3				2			2
<i>Helvella atra</i> J. König	<i>Helv atra</i>		5	4		4			3	2	5
<i>Helvella macropus</i> (Pers.) P. Karst.	<i>Helv macr</i>	4			3			3			
<i>Morchella elata</i> Fr.	<i>Morc elat</i>		3		4	6	3			3	
<i>Morchella deliciosa</i> Fr.	<i>Morc deli</i>		2			2					
<i>Morchella esculenta</i> (L.) Pers.	<i>Morc escu</i>	9		4				2		12	
<i>Morchella crassipes</i> (Vent.) Pers.	<i>Morc cras</i>			8				4		4	
<i>Peziza ampliata</i> Pers.	<i>Pezi ampl</i>		3			7					3
<i>Peziza badia</i> Pers.	<i>Pezi badi</i>	5		12	8				3	2	2
<i>Peziza succosa</i> Berk.	<i>Pezi succ</i>				9		2		4	2	2
<i>Geopora arenicola</i> (Lev.) Kers	<i>Geop aren</i>	5	5				3	3	2		2
<i>Agaricus arvensis</i> Schaeff	<i>Agar arve</i>						2		2	3	3
<i>Agaricus californicus</i> Peck	<i>Agar cali</i>			3		3		5			1
<i>Agaricus langei</i> (F.H. Moller) F.H. Moller	<i>Agar lang</i>				2		3				
<i>Bovista colorata</i> (Peck) Kreisel	<i>Bovi colo</i>					2			2		
<i>Bovista minor</i> Morgan	<i>Bovi mino</i>				3	2				2	
<i>Bovista plumbea</i> Pers	<i>Bovi plum</i>				2			2			
<i>Bovista pusilla</i> (Batsch) Pers.	<i>Bovi pusi</i>					2			1	2	
<i>Calvatia elata</i> (Masse) Morgan	<i>Calv elat</i>				4		2		2		
<i>Calvatia lycoperdoides</i> A.H.Sm.	<i>Calv lyco</i>	5		2	4		2				
<i>Calvatia. sp.</i>	<i>Calv sp.</i>				2	5				4	
<i>Chlorophyllum molybdites</i> (G. Mey.) Massee	<i>Chlo moly</i>		5		5	2					7
<i>Coprinus comatus</i> (O.F.Mull.)	<i>Copr coma</i>				4			3			2
<i>Lepiota procera</i> (Scop.) Grey	<i>Lapi proc</i>	2						2			6
<i>Lepiota sistrata</i> (Scop.) Grey	<i>Lapi sist</i>		4			5			3		4
<i>Leucoagaricus rubrotinctus</i> (Peck) Singer	<i>Leuc rubr</i>					7		2		1	
<i>Lycoperdon molle</i> Pers	<i>Lycop moll</i>								3	2	
<i>Lycoperdon caudatum</i> Batsch	<i>Lycop pedi</i>	1						4		2	3
<i>Lycoperdon perlatum</i> Pers	<i>Lycop perl</i>	3				2		2	2		5
<i>Apioperdon pyriforme</i> Pers	<i>Lycop pyri</i>		3			4			3		
<i>Lycoperdon rimulatum</i> Peck	<i>Lycop rimu</i>			2			5			2	
<i>Lycoperdon umbrinum</i> Pers.	<i>Lycop umbr</i>					5			5	2	
<i>Macrolepiota procera</i> (Scop.) Singer	<i>Macr proc</i>	5		5			7	4	2		5
<i>Gymnopilus sapineus</i> Fries	<i>Gymn sapi</i>		6		6	2		5		5	3
<i>Gymnopilus sp.</i>	<i>Gymn sp.</i>							3		4	
<i>Flammulina velutipes</i> (Curtis) Singer	<i>Flamm velu</i>			6		5					
<i>Coprinellus domesticus</i> (Bolton) Vilgalys, Hopple & Jacq. Johnson	<i>Copr dome</i>					5				2	
<i>Coprinellus micaceus</i> (Bull) Fr.	<i>Copr mica</i>	5		4					3		5
<i>Coprinopsis atramentaria</i> (Bull.)Fr.	<i>Copr atra</i>	6		6			5			3	
<i>Pholiota squarrosa</i> (Oeder) Kumm.	<i>Phol squa</i>		6		4	4				2	7
<i>Pholiota sp.</i>	<i>Phol sp.</i>				2			3		3	
<i>Amanita flavoconia</i> G.F. Atk.	<i>Aman flavo</i>	8	8			1			7		
<i>Amanita pantherina</i> (DC) Krombh	<i>Aman pant</i>	2				5					4
<i>Amanita phalloides</i> Secr.	<i>Aman phal</i>				4						2
<i>Amanita vaginata</i> (Bull.) Lam.	<i>Aman vagi</i>			5		2				3	
<i>Pleurotus ostreatus</i> (Jacq. Ex. Fr.) P. Kumm	<i>Pleu ostr</i>			1		8					
<i>Pleurotus pulmonarius</i> (Fr.) Quel.	<i>Pleu pulm</i>	3		2							
<i>Pleurotus squarrosulus</i> (Mont.) Singer	<i>Pleu squa</i>		3		5	2			5		7
<i>Boletus edulis</i> Bull	<i>Bole edul</i>			7	6			4	8		

<i>Boletus formosus</i> Corner	<i>Bole form</i>	2				2		3			
<i>Boletus granulatus</i> L.	<i>Bole gran</i>					5				4	
<i>Boletus luridus</i> Schaeff	<i>Bole luri</i>	5	8			2		3	4		4
<i>Suillus cavipes</i> (Opat.) A.H. Sm. & Thiers	<i>Suil cavi</i>	4				4			4		6
<i>Scleroderma citrinum</i> Pers.	<i>Scle citr</i>		7		5			4		7	
<i>Scleroderma polyrhizum</i> (J. F. Gmel.) Pers.	<i>Scle geas</i>			5				3		5	
<i>Scleroderma verrucosum</i> (Bull.) Pers.	<i>Scle verru</i>					5					
<i>Cantharellus cibarius</i> Fr.	<i>Cant ciba</i>	3		4				3		4	
<i>Craterellus tubaeformis</i> (Scop.) Fr.	<i>Cant infu</i>			7							
<i>Clavaria fragilis</i> Scop.	<i>Clav verm</i>							8			3
<i>Sparassis crispa</i> (Wulfen) Fr.	<i>Spar cris</i>		5		4	2	4				7
<i>Sparassis radicata</i> (Weir)	<i>Spar radi</i>				5	7	2				4
<i>Ramaria apiculata</i> (Fr.) Donk	<i>Rama apic</i>			5					4		
<i>Ramaria aurea</i> (Schaef.) Quel	<i>Rama aure</i>	4	4					4		4	4
<i>Ramaria flavobrunnescens</i> var aurea (Fr.) Donk	<i>Rama fl_au</i>							2		3	
<i>Ramaria flavobrunnescens</i> var. longisperma	<i>Rama fl_lo</i>				2	4				2	
<i>Ramaria formosa</i> (Pers.) Quel.	<i>Rama form</i>								2		7
<i>Lactarius deliciosus</i> (L.) Gray	<i>Lact deli</i>	5		6					4	3	2
<i>Lactarius deterrimus</i> Groger	<i>Lact dete</i>	5			8					2	
<i>Lactarius vellerreus</i> (Fr.) Fr.	<i>Lact vell</i>				2		5				
<i>Lactarius volemus</i> (Fr.) Fr.	<i>Lact vole</i>		4		4				3		
<i>Russula annulata</i> var. annulata R. Heim var. nov	<i>Russ annu</i>					2			2		
<i>Russula squalida</i> (Krombh.) Britzelm.	<i>Russ atro</i>	2				2				2	
<i>Russula cynoxantha</i> (Schaeff.)Fr.	<i>Russ cyno</i>	2		2							2
<i>Russula rosea</i> Fr.	<i>Russ lepi</i>	12				4					
<i>Hericium erinaceus</i> (Bull.) Persoon	<i>Heri erin</i>		2		2				2		5
<i>Schizophyllum commune</i> Fr.	<i>Schi comm</i>	4		6		4	2	2			4
<i>Auricularia auricula-judae</i> (Bull.) Quel	<i>Auri auri</i>		4							8	5
<i>Geastrum campestre</i> Morgan	<i>Geas camp</i>								2		5
<i>Geastrum saccatum</i> Fr.	<i>Geas sacc</i>	2			13						
<i>Geastrum triplex</i> Jungh	<i>Geas trip</i>						2	2			7
<i>Geastrum velutinum</i> Morgan	<i>Geas velu</i>				5		2		4		

Discussion

Eighty-three macrofungal species were identified from the Kishtwar High Altitude National Park (KHANP) and more than 2/3 of these species belonged to the orders Agaricales (44%), Pezizales (14%) and Russulales (10%). Asteraceae and Russulaceae were the most represented fungal families. The dominance of these macrofungal orders and families assured the dominance of humicolous (71.8%) and lignicolous (11.8%) in KHANP. The high percentage of humicolous and lignicolous macrofungus shows that KHANP has (i) good amount of litter and lignin containing confers, (ii) an undisturbed forest floor, and (iii) less anthropogenic interferences. This could also be explained in terms of the biodegrading ability of macrofungi for many intractable substrates found in the forests.

The pattern of dispersion of a species is indicative of habitat heterogeneity, distribution of nutrients and environmental conditions of an ecosystem. Plants growing in forests generally follow aggregate and random patterns. In the present study, the macrofungal species followed aggregate (75.9%) and random (24.1%) patterns. The aggregate distribution of mycelia in forest stands could be a response to the heterogeneous nature of the environment, the mycelia proliferating only when they encounter nutrient-rich patches (Horton and Bruns 2001). Higher percentage of aggregate pattern among ECM fungi may be indicative of a higher local activity of mycelia and mycorrhizae in relation to soil heterogeneity and (or) host root distribution (Richard *et al.* 2004). Kent and Dress (1979, 1980) explained various models of spatial patterns in natural forest stands and have stated that both random and aggregated spatial patterns are preserved over time and a regular pattern also tends to change into a random pattern.

In most of the sites, the species with maximum abundance were showing geometric distribution and hence utilizing bulk of the available resources without any competition. The other species were following broken-stick model depicting high completion for space, nutrients and associated environmental factors.

Many macrofungal species encountered during the studies were not identified and are still under observation. Two-year survey could not give an assurance of comprehensive analysis of the macrofungi in the KHANP. A complete knowledge of the fungi for any locality requires continuous observation and collection over many years. Species diversity and occurrence increased with the increasing number of visits over a longer period (Bolhassan *et al.* 2012 and Lopez-Quintero *et al.*, 2012). Moreover, the collection of environmental data from these far-flung areas is also a big challenge for the researchers. Hence, studies should be carried on longer duration to record adequate data on macrofungal richness, diversity and distribution and environmental data of the Kishtwar High Altitude National Park.

5. SUMMARY

Macrofungi are the cosmopolitan group of organisms proliferating in diverse variety of habitats, from the arctic to the tropics. Exhibiting sharp preferences for specific substrates in ecosystem, some are limited to specific areas, while others grow in diverse geographical niches. Thus, they are assorted as humicolous, coprophilous, lignicolous, parasitic and fungicolous. Wild mushrooms in association with higher plants amplify a plethora of cardinal ecological processes like water absorption, cleaning up the environment through bioremediation, global cycling of nutrients, carbon sequestration and even the prevention of desertification in some drought-prone regions of the world. Besides afore mentioned roles, they are also included as most untapped non-timber forest resources amongst a number of non-conventional food stuffs. The nutritional status of wild edible mushrooms uncurtails the fact that they are extremely rich in high quality proteins and carbohydrates, low in fat content and contains a moderate amount of crude fibre. In addition, these vegetal organisms have been known to possess various important secondary bioactive metabolites including phenolics, ascorbic acid, flavonoids, ergothioneine and glutathione that mitigate oxidative stress and confer them promising antihypertensive, antidiabetic and immunomodulating attributes. Also, due to their efficacious mechanism to solubilise and accumulate different minerals, they are easily accessible source of some key minerals, thus, justifying their status as “nutraceutical” and “functional food”.

Appraising the immense significance of wild mushrooms, the present investigation was undertaken to study the diversity and ethnomycology of wild macrofungi of Kishtwar High Altitude National Park, Jammu and Kashmir. During the survey, a total 150 different macrofungal collections were made from various locations of the study area. Out of these, 83 taxa belonging to 35 genera, 23 families and 9 orders were identified and enumerated and described macro-morphologically and microscopically. The identified taxa include:

Peizizomycetes

<i>Gyromitra</i>	:	<i>G. esculenta</i> .
<i>Helvella</i>	:	<i>H. acetabulum</i> , <i>H. atra</i> , <i>H. macropus</i> .
<i>Morchella</i>	:	<i>M. crassipes</i> , <i>M. deliciosa</i> , <i>M. elata</i> , <i>M. esculenta</i> .

<i>Peziza</i>	:	<i>P. ampliata</i> , <i>P. badia</i> , <i>P. succosa</i> .
<i>Geopora</i>	:	<i>G. arenicola</i> .
Agaricomycetes		
<i>Agaricus</i>	:	<i>A. arvensis</i> , <i>A. californicus</i> , <i>A. langei</i> .
<i>Apioperdon</i>	:	<i>A. pyriforme</i> .
<i>Bovista</i>	:	<i>B. colorata</i> , <i>B. minor</i> , <i>B. plumbea</i> , <i>B. pusilla</i> .
<i>Calvatia</i>	:	<i>C. Bovista</i> , <i>C. elata</i> , <i>C. lycoperdoides</i> . <i>Calvatia. sp.</i>
<i>Chlorophyllum</i>	:	<i>C. molybdites</i> .
<i>Coprinus</i>	:	<i>C. comatus</i> .
<i>Lepiota</i>	:	<i>L. procera</i> .
<i>Cystolepiota</i>	:	<i>C. sistrata</i> .
<i>Leucoagaricus</i>	:	<i>L. rubrotinctus</i> .
<i>Lycoperdon</i>	:	<i>L. mole</i> , <i>L. caudatum</i> , <i>L. perlatum</i> , <i>L. rimulatum</i> , <i>L. umbrinum</i> .
<i>Macrolepiota</i>	:	<i>M. procera</i> .
<i>Flammulina</i>	:	<i>F. velutipes</i> .
<i>Coprinellus</i>	:	<i>C. domesticus</i> , <i>C. micaceus</i> .
<i>Coprinopsis</i>	:	<i>C. atramentaria</i> .
<i>Pholiota</i>	:	<i>P. squarrosa</i> . <i>Pholiota sp.</i>
<i>Gymnopilus</i>	:	<i>G. sapineus</i> , <i>Gymnopilus sp.</i>
<i>Schizophyllum</i>	:	<i>S. commune</i>
<i>Amanita</i>	:	<i>A. flavoconia</i> , <i>A. pantherina</i> , <i>A. phalloides</i> , <i>A. vaginata</i> .
<i>Pleurotus</i>	:	<i>P. ostreatus</i> , <i>P. pulmonarius</i> , <i>P. squarrosulus</i> .
<i>Clavaria</i>	:	<i>C. fragilis</i> .
<i>Boletus</i>	:	<i>B. edulis</i> , <i>B. formosus</i> , <i>B. granulatus</i> , <i>B. luridus</i> .
<i>Suillus</i>	:	<i>S. cavipes</i>
<i>Scleroderma</i>	:	<i>S. citrinum</i> , <i>S. polyrhizum</i> , <i>S. verrucosum</i> .
<i>Cantharellus</i>	:	<i>C. cibarius</i> .
<i>Craterellus</i>	:	<i>C. tubaeformis</i> .
<i>Ramaria</i>	:	<i>R. apiculata</i> , <i>R. aurea</i> , <i>R. flava</i> , <i>R. stricta</i> . <i>R. formosa</i> .
<i>Sparassis</i>	:	<i>S. crispa</i> , <i>S. radicata</i> .
<i>Lactarius</i>	:	<i>L. deliciosus</i> , <i>L. deterrimus</i> , <i>L. vellerreus</i> ,

		<i>L. volemus</i> .
Russula	:	<i>R. annulata</i> var. <i>annulate</i> , <i>R. squalida</i> , <i>R. cynoxantha</i> , <i>R. rosea</i> .
Hericium	:	<i>H. erinaceus</i> .
Auricularia	:	<i>A. auricula-judae</i> .
Geastrum	:	<i>G. campestre</i> , <i>G. saccatum</i> , <i>G. triplex</i> , <i>G. velutinum</i> .

Of the 83 macrofungi, 12 species comprising of *Morchella* (4 species), *Peziza* (3 species), *Helvella* (3 species), *Geopora* (1 species) and *Gyromitra* (1 species) belong to class Pezizomycetes. The class Agaricomycetes, on the other hand, comprised of 71 species viz., *Lycoperdon* (5 species), *Ramaria* (5 species), *Amanita* (4 species), *Boletus* (4 species), *Bovista* (4 species), *Calvatia* (4 species), *Geastrum* (4 species), *Russula* (4 species), *Lactarius* (4 species), *Scleroderma* (3 species), *Pleurotus* (3 species), *Agaricus* (3 species), *Cantharallus* (2 species), *Coprinellus* (2 species), *Gymnopilus* (2 Species), *Pholiota* (2 species), *Sparassis* (2 species), *Chlorophyllum* (1 species), *Coprinus* (1 species), *Lepiota* (1 species), *Cystolepiota* (1 species), *Leucoagaricus* (1 species), *Macrolepiota* (1 species), *Flammulina* (1 species), *Schizophyllum* (1 species), *Coprinopsis* (1 species), *Suillus* (1 species), *Clavaria* (1 species), *Hericium* (1 species) and *Auricularia* (1 species).

Interestingly, of all the identified taxa, 83 taxa belonging to 35 genera, 23 families and 9 orders were recorded for the first time from KHANP and out of these 25 new records for state which includes *Gyromitra esculenta*, *Helvella macropus*, *Peziza ampliata*, *P. succosa*, *Bovista colorata*, *Calvatia elata*, *C. lycoperdoides*, *Cystolepiota sistrata*, *Lycoperdon mole*, *L. caudatum*, *L. rimulatum*, *Pholiota squarrosa*, *Pleurotus squarrosulus*, *Clavaria fragilis*, *Boletus formosus*, *B. granulatus*, *Suillus cavipes*, *Scleroderma polyrhizum*, *Cantharellus cibarius*, *Craterellus tubaeformis*, *Ramaria apiculate*, *Lactarius vellerreus*, *L. volemus*, *Russula squalida*, *Hericium erinaceus* and 3 new records for India are *Helvella macropus*, *Cystolepiota sistrata* and *Suillus cavipes*.

Comparison of the distributional pattern of wild mushrooms in the study area was also worked out and the number of macrofungal species collected from different collection sites was observed to vary with the place of collection. Maximum number of wild mushrooms (74) were collected in the months of July-September followed by

(16) species from April to June and 13 species from October to December. Further, during January to March, the emergence of sporophores gradually declined as extreme cold inflicts adverse influence on the initiation of fruiting of macrofungi thus only five (6) species were collected during this period.

In the present investigation, substrate habitat specificity of the collected species was also studied. Out of total 83 identified wild mushrooms recorded from the study area, majority 71.8% of fruiting bodies were found to be humicolous growing on terrestrial and moist soil followed by, 11.8 % growing as lignicolous forms, 4.7 % of bryophilous mushroom and 1.2% as coprophilous forms. Also, 10.6 % of ectomycorrhizal mushrooms were found growing in association with roots of different trees. Furthermore, a total of 13 macrofungal taxa were recorded growing on dead wood logs and wood stumps.

In the survey related to ethnomycological knowledge in different sites of the study area 37 wild mushrooms were recorded along with their vernacular names. The data collected through interviews of informants was analysed using different quantitative and qualitative analyses. Of these 37 wild edible macrofungi, various vernacular names in different dialects i.e., Kashmiri, Kishtwari, Gojri and Bodhi were recorded; several prefixes or epithets based on colour, habit, shape, plant association etc are added to differentiate mushrooms within a folk genus group. Morels such as *Morchella crassipes*, *M. deliciosa*, *M. elate*, *M. esculenta* are known as Kutch in Kashmiri and Shamo tetu in Bodhi. Most of the macrofungi in Bodhi known as Shamo which means mushroom like taste i.e., *Gyromitra esculenta*, *Helvella acetabulum*, *H. atra*, *Peziza badia*, *Geopora arenicola*, *Agaricus arvensis*, *Macrolepoita procera*, *Flammulina velutipes*, *Coprinopsis atramentaria*, *Pleurotus ostreatus*, *P. pulmonarius*, *P. squarrosa*, *Boletus edulis*, *B. granulatus*, *B. luridus*, *Clavaria fragilis*, *Sparassia crispa*, *S. radicata*, *Ramaria apiculata*, *R. aurea*, *R. flava*, *R. stricta*, *R. formosa*, *Hericium erinaceus*, *Schizophyllum commune*, *Auricularia auricula-judae* others are known as Shamo li, Shamo tetu, Shantu & Shistu.

In the study, species diversity was also investigated and study site viz. Loharna was recorded as the site with maximal occurrence of species (37 species) with highest 7.25 Margalef index value. Least species richness (20 species and 4.16 Margalef index value) was recorded for Loopara. According to Menhinick value, the most and least species rich sites were Qaderna (3.16) and Loopara (2.04), respectively.

The highest Simpson's index (D) was obtained in Deharna and Loopara (0.06) and lowest in Loharna (0.03). Shannon Wiener diversity indices (H) varied between 2.91 (Loopara) and 3.49 (Loharna). Fisher's alpha index recorded the maximum values in Loharna (16.19) whereas Berger-Parker values were highest for Nath (0.12). The values of evenness (E) ranged from 0.86 (Nath) to 0.95 (Qaderna). Whittaker's β -diversity analysis showed maximum similarity of 95% to exist between Janakpur and Loopara. Other important associations and species turnovers were found between Janakpur and Palmar (88%) and Loharna and Deharna (86%). Least percentage of association (52% each) was found between Janakpur and Sonder and between Marwah and Ekhala. Multivariate analyses (PCA) resulted in four main groups of mushrooms, wherein Group A with species *Morchella elata* (15.408), *M. deliciosa* (15.119), *M. crassipes* (14.775), *M. esculenta* (14.77) were recorded with most significant values.

Overall, the present study has comprehensively added on to the earlier investigations on the study of macrofungal diversity and biochemical characterization which is still lacking in our state. Based on the findings of present investigation, it can be concluded that the study area represents a vast ecological niche to diverse mushroom flora. Considering the potential of these wild green edibles as a source of nutrition, thus calls for more detailed biochemical study to tap these natural fungal resources for nutraceutical and pharmaceutical usage. Thus, there is an ardent need for the documentation, bio-innovation, technological dissemination and organized marketing of these understudied and underutilized vegetal organisms so as to make them potential and promising superfood of future. Our study is just a part of a story that continues into the present day, the notion of macrofungi as miniature factories that can produce valuable chemical and biological compounds that is going to form the bedrock of future modern biotechnology.

Annexure I (c)

6. Difficulties:

1. Since the study area was at high altitude, often problems were faced reaching out for wild macrofungi.
2. Local people in certain regions of the study area didn't respond well in dispersing the knowledge regarding wild edible mushrooms.
3. Due to heavy snowfall in the KHANP it was a difficult task to collect macrofungal species.

7. Achievements:

1. The present work entitled “Diversity and ethnomycology of wild mushrooms of Kishtwar High Altitude National Park” uncurtailed the rich diversity of macrofungi in the study area. Exhibiting sharp preferences for specific substrates in ecosystem, wild mushrooms were found flourishing forest floor amplifying plethora of ecological processes in the study area.
2. The area was investigated for the very first time for the macrofungal diversity, ecology and ethnomycology. Local people, nomadic tribes and elderly people were consulted for the edibility status and usage of wild mushrooms.
3. During the course of investigation, many new records of wild mushrooms were made in which, 25 new records for state which includes *Gyromitra esculenta*, *Helvella macropus*, *Peziza ampliata*, *P. succosa*, *Bovista colorata*, *Calvatia elata*, *C. lycoperdoides*, *Cystolepiota sistrata*, *Lycoperdon mole*, *L. caudatum*, *L. rimulatum*, *Pholiota squarrosa*, *Pleurotus squarrosulus*, *Clavaria fragilis*, *Boletus formosus*, *B. granulatus*, *Suillus cavipes*, *Scleroderma polyrhizum*, *Cantharellus cibarius*, *Craterellus tubaeformis*, *Ramaria apiculate*, *Lactarius vellerreus*, *L. volemus*, *Russula squalida*, *Hericium erinaceus* and 3 new records for India are *Helvella macropus*, *Cystolepiota sistrata* and *Suillus cavipes*.
4. Moreover, ethnomycological survey besides supplementing the monotonous stapled diet, these mushrooms have direct and indirect socioeconomic traditional and cultural significance in this study area.
5. Several publications related to macrofungi are under communication.
6. Mycofloristically, KHANP revealed high diversity which can be intricately linked to the abundance of thick forest system/area, that provided vast ecological niche to diverse macrofungi, depicting a healthy ecosystem.
7. Some of the wild mushrooms which were discovered/founds processing high edible value/potential (viz., *Pleurotus pulmonarius*) have been subjected to culturing to obtain their pure culture for future preservation and conservation.

8. Our present study recommends domestication sustainable utilisation and conservation of this bioresource in this study area for posterity. Such an endeavour would not only open avenues for their national consumption to elevate protein deficiency but will also help draw out the major applications that provide societal benefits.
9. As a livelihood diversification option our work recommends that mushrooms can also be brought under cultivation to further improve food security and income generation, that in turn will boost rural and periurban economic growth in India.
10. Regional investigation in KHANP revealed that certain wild mushrooms were used for medicinal purposes by locals and can be incorporated in routine drugs and medicines at industrial level.
11. The data described in our work could preferably attract researchers and corporates to indulge their interest for the exploration of underline scientific, economic or biological prospects.

8. Contribution:

1. Knowledge of the macrofungal resources including their source and their use is important to each culture and environment. As a result, the proposal of sustainable use has increasing importance. Overall, the present study has comprehensively added on to the earlier investigations on the study of macrofungal diversity which is still lacking in our state. Based on the findings of present investigation, it can be concluded that the study area represents a vast ecological niche to diverse mushroom flora.
2. There is a paucity of documented information on the indigenous use of mushrooms for food, medicine and other purposes by the local people in Kishtwar. This work is, therefore, an attempt to highlight and document the indigenous knowledge and usage of mushrooms among this people. It is also to encourage the cultivation and commercialization of mushrooms to improve food security
3. From the information obtained in this investigation, it is recommended that more research should be done on the ethnomycology of edible and medicinal mushrooms in the area as information on these mushrooms are fast getting extinct, since it is mostly people in the older age bracket that have this information. Cultivation of these mushrooms especially the ones with nutraceutical potentials should be done.
4. In conclusion, mycophagy should be encouraged to promote food security and reduce the protein and mineral deficiencies prevalent in the area. This will also go a long way to improve the economic wellbeing of the local and that can further be used in the production of nutraceuticals, mycodisinfectants and myco-coagulants.
5. Local people were made aware about the identification of poisonous mushrooms as many cases of mushroom poisoning prevails in the world.
6. Our work interestinly revealed that within the same study area, some ethnomycological perceptions differed across different study sites while some perception were widely accepted. The findings could serve as the foundation for further research on domestication of wild mushrooms.

7. Our investigation has opened up new vistas for the study of wild macrofungi that occupy an important position component of ecosystem. As concerns, our study recommends conservation of wild macrofungi to prevent their overexploitation by forestry and pharmaceutical industry.
8. Our work reported several contributions inherent to the relationship between wood decaying fungi, edible and non-edible mushrooms and their potential exploitations.
9. In addition, present investigations elaborate the facts that the wild mushrooms inhabit varied type of substrates in ecosystem and thus can contribute in the process of bioremediation and thus can be judiciously exploited in tackling the issue of pollution.
10. Keeping in view this gigantic mushroom treasure it is high time to save this natural bioresource, to turn to sane biodiversity. Also, few of the wild mushrooms were known for processing antiviral, anticancer and antidiabetic properties by tribals. However, numerous mushrooms still stay unexplored and their healthful and in addition medical advantages are obscure to us, thus calls for more detailed study in the study area.
11. The outcome of the present study elaborates the information on the fact and figures of diversity of macrofungi of the study area.
12. Our work recommends culturing of mushrooms using different medium for their preservation and their usage in different ways.

9. ETHNOMYCOLOGICAL DATA QUESTIONNAIRE:

Ecological level:

Settlement:

Number of family members:

Name:

Age:

Religion:

Caste:

Sub Caste:

Language:

Mother tongue:

Village:

District:

State:

Educational Qualification:

Occupation:

Income:

Questions

1. Do you know Macrofungi/Mushroom? Yes/No
2. Do you know the names of any Mushroom/Macrofungi that you eat? Yes/No
3. Do you or anyone in your family brings Mushroom/macrofungi to the home? Yes/No.
4. Have you eaten Mushroom/Macrofungi? Yes/No
5. Do you like eating mushrooms? Yes/No
6. Mushrooms are a special meal, that you really like? Yes/No
7. Do you know how to cook? Yes/No
8. What do you feel when you go to the field and finds Mushroom/Macrofungi into the field? Feeling special/No particular feeling.
9. Is there Mushroom/Macrofungi that hurt human? Yes/No
10. How do you know that Mushroom/Macrofungi hurt human?
11. Are you worried or afraid to touch fungi? Yes/No
12. Have you heard about sayings or stories of mushrooms? Yes/No
- Do you know if Mushroom/Macrofungi have another use? Yes/No
13. Do you know, if there are people here in the community who know a lot of mushrooms and who will look often? Yes/No
14. What do the mushrooms do in the forest? What will serve the forest mushrooms?

15. Are there animals who come to fungi? What and why? Yes/No
16. Have you seen if the children in the community or your children know mushroom?
allow them the grab, play with them or take home? Yes/No
17. What do you think when you find Mushroom? Feeling special/No particular feeling.
18. How do you feel when you go to the field and found macrofungi/Mushroom?
Feeling special/No particular feeling
19. Mushroom/Macrofungi are important? Why?
20. Is there any Mushroom/Macrofungi which you think is edible by just looking at it?
21. How many mushrooms you have seen in your lifetime?
22. Have you ever differentiated Mushroom/Macrofungi? If, then on what basis? Colour,
size, shape, structure or any other.
23. Have you ever smelled mushroom? Yes/No
24. Will you please draw mushroom on paper which you had seen?