

# DIVERSITY OF MACRO-FUNGI IN SAL FOREST OF KUMAUN REGION OF UTTARAKHAND STATE

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**Abstract:** Uttarakhand has a rich diversity of macrofungi. A number of wild edible mushrooms are a source of income for the local people. Which are collected mainly during the rainy season for consumption and sale. This paper represents the diversity of macrofungi found in five sites in Sal forest of Kumaun region. A total of more than 50 species were observed but only 34 of them could be identified as the rest of the species were either immature or deteriorated. Saprophytic fungi were more common than mycorrhizal and parasitic fungi. Fourteen species were reported to be edible.

**Key words:** Macrofungi, Saphrotroph, Wild edible, Sal.

**Introduction:** Fungi are one of the most heterogenous diversified group of organisms ranging from microscopic forms to large mushrooms. About 2.2 to 3.8 million fungal species have been reported worldwide (Microbiology spectrum- American Microbiology Press) while approximately 850 species of mushrooms are recorded in India (Deshmukh, 2004). As one of the prominent group of decomposers, Fungi are necessary for the survival of various other organisms in the ecosystem. By contributing to the nutrient cycle and the maintenance of ecosystems, fungi play an important role in soil formation, fertility, structure, and improvement of any habitat (Pan et al. 2008).

Macrofungi are the members of ascomycotina and basidiomycotina with large, easily observed spore-bearing structures i.e. ascus and the basidium respectively (Mueller et al. 2007) and are one of the major NTF resource as well as source of livelihood for the people in some areas. Mushrooms are fruiting bodies of macrofungi which are considered as the Nature's gift as they provide protein-rich food for human beings. The local tribal people have a very good knowledge of wild edible mushrooms which they have achieved through their experience and the knowledge is being passed on from generation to generation. Since these mushrooms are being sold in the market during monsoon by the local

**34 different species of macrofungi have been identified in major Sal forests of Kumaun in this study.**

people, the edibility of these mushrooms is now known to others also. The macrofungal species composition and diversity varies with nutrient content particularly nitrogen, moisture, pH of the soil, forest type, canopy cover, disturbance, climatic conditions, forest management activities and various anthropogenic activities can also play a crucial role in shaping macrofungal communities since they can modify macrofungal fructification, vegetation parameters and soil conditions. Sal (*Shorea robusta* Gaertn.) forest, play a significant role in biodiversity conservation, forest economy, and people's livelihood in the various regions of India, Nepal, Bhutan

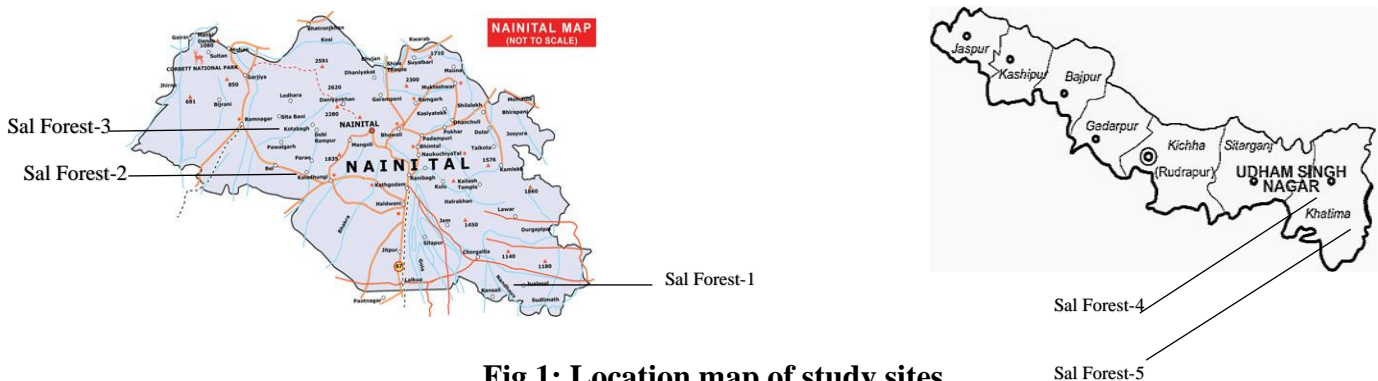
where *Shorea robusta* trees dominate forests in the lower Himalayan region. The present investigation is an attempt to study macrofungal diversity of Sal forest in Kumaun region of Uttarakhand.

**Material and Method:**

**Study Site:** The study was conducted in 5 different sites in Sal forests of Kumaun region of Uttarakhand state. Out of the 5 sites 3 sites were in Nainital district and the other two were in Udham Singh Nagar district. All the study sites were within the altitudinal range of 245- 485 amsl. The details of these sites are as under:

**Table 1: Details of the study sites**

S.No.	Forest Area	GPS coordinates	Altitude amsl
1	Sal forest near Nandhaur Wildlife Sanctuary Chorgaliya	N29° 14' 02.23'' E79° 68' 76.44''	333.36m
2	Sal forest in Basani Fatehpur	N29° 16' 48.69'' E79° 25' 56.84''	472m
3	Sal forest in Musabandar, Kotabagh	N29° 19' 08.93'' E079° 19' 03.82''	485m
4	Sal forest in Surai, Khatima	N29° 12' 55.95'' E079° 31' 06.79''	355 m
5	Sal forest Baggha, Khatima	N28° 47' 08.06'' E80° 02' 23.0.6''	245m



**Fig 1: Location map of study sites**

**Collection of macrofungi:** Fruiting bodies of macrofungi from 5 different sites selected in Sal forests of Kumaun region from their natural habitats in the month of July and August. Macromorphological and ecological features were examined and noted in the field. Specimens were collected and photographed in the sampling sites using Nikon D5600 camera. Soil samples were also collected for analysis.

The collected macrofungal samples were examined in the campus for their proper identification and edibility with the help of standard literatures. Identification of fungi has been done with the help of experts, published literature, monographs, books, keys, etc.

**Results and Discussions:** Total 41 different species of macrofungi were

collected from 5 different sites in Sal forests of Kumaun region (Table:1). Out of these 41 species 33 species have been identified and 8 species could not be identified as these were immature. Fourteen species were reported to be edible. The most common edible species collected by the locals in each site was of *Termitomyces* sp. *Xylaria hypoxylon* was present in all the 5 sites in abundance. Sal forest in Baggha, Khatima showed maximum diversity of macrofungi followed by the Sal forest in Musabandar. On the basis of soil analysis, it was observed that the nitrogen as well as the moisture content was highest in the Baggha Sal forest followed by Sal forest near Nandhaur wildlife sanctuary. Whereas the moisture content was almost equivalent in all the sites.

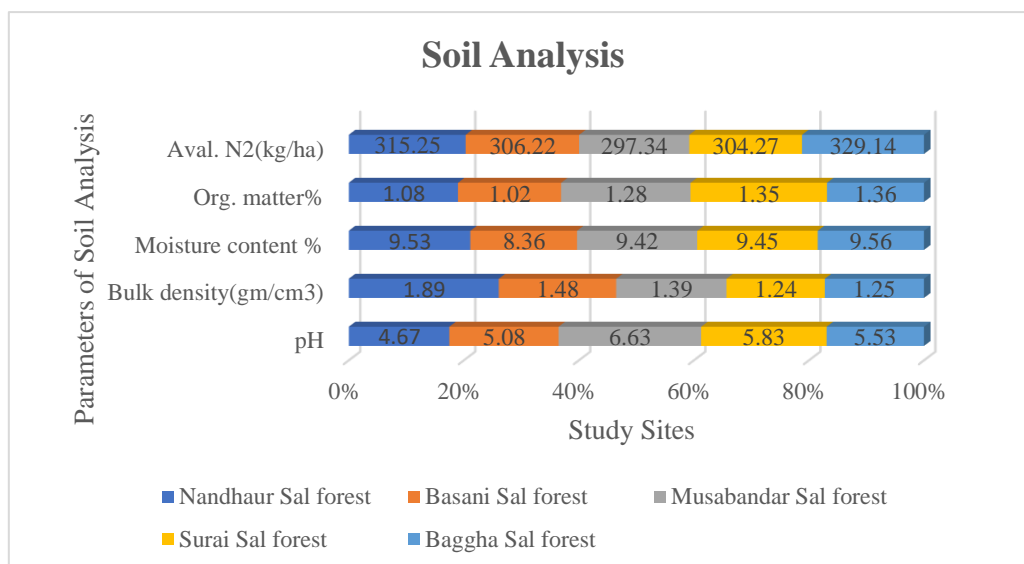


Fig 2: Graph showing soil analysis of different sites

**Table 2: List of macrofungi:**

<b>Sal forest near Nandhaur Wildlife Sanctuary Chorgaliya</b>			
<b>S.No.</b>	<b>Scientific Name</b>	<b>Family</b>	<b>Habitat; Ecology</b>
1.	<i>Xylaria hypoxylon</i> (L.) Grev	Xylariaceae	On decaying hardwood; Saprotroph
2.	<i>Rigidoporus lineatus</i> (Pers.) Ryvarden	Meripilaceae	On tree trunks; Pathogenic
3.	<i>Coprinellus disseminates</i> (Pers.)	Psathyrellaceae	On decaying wood in clusters; Saprotroph
4.	<i>Microporus xanthopus</i> (Fr.) Kuntze.	Polyporaceae	On wooden logs; Saprotroph
5.	<i>Daldinia concentrica</i> (Bolton) Ces. & De Not.	Hypoxylaceae	On wooden log; Saprotroph
6.	<i>Filoboletus manipularis</i> (Berk.) Singer	Mycenaceae	On wooden log; Saprotroph
7.	<i>Coprinus commatus</i> (O.F.Müll.) Pers.	Agaricaceae	On soil; Saprotroph
8.	<i>Xylaria</i> sp.	Xylariaceae	On wood; Saprotroph
9.	<i>Termitomyces</i> sp.	Lyophyllaceae	On soil; Symbiotic with Termites.
<b>Sal forest in Basani</b>			
1.	<i>Phellinus</i> sp.	Hymenochaetaceae	Saprotroph
2.	<i>Filoboletus manipularis</i> (Berk.) Singer	Mycenaceae	On dead wooden log; Saprotroph
3.	<i>Ganoderma lucidum</i> (Curtis) P. Karst.	Ganodermataceae	At the base of tree stumps; Parasitic
4.	<i>Lactiflus volemus</i> (Fr.) Kuntze	Russulaceae	On soil; Ectomycorrhizal symbiotic
5.	<i>Xylaria hypoxylon</i> (L.) Grev.	Xylariaceae	On Soil; Saprotroph

- |    |                                  |             |                             |
|----|----------------------------------|-------------|-----------------------------|
| 6. | <i>Russula silvicola</i> Shaffer | Russulaceae | On soil;<br>Ectomycorrhizal |
|----|----------------------------------|-------------|-----------------------------|

**Sal forest in Musabandar, Kotabagh**

- |     |   |                |                                      |
|-----|---|----------------|--------------------------------------|
| 1.  | <i>Microporus xanthopus</i> (Fr.)<br>Kuntze.    | Polyporaceae   | On wooden log;<br>Saprotroph         |
| 2.  | <i>Xylaria hypoxylon</i> (L.) Grev              | Xylariaceae    | On soil;<br>Saprotroph;              |
| 3.  | <i>Hexagonia tenuis</i> (Hook.)                 | Polyporaceae   | On tree trunk;<br>Saprotroph         |
| 4.  | Hygrocybe Cantharellus<br>(Schwein.) Murrill    | Hygrophoraceae | On tree trunk;<br>Saprotroph         |
| 5.  | <i>Amanita constricta</i> Thiers &<br>Ammirati  | Amanitaceae    | On soil;<br>Ectomycorrhizal          |
| 6.  | <i>Pycnoporus sanguineus</i> (L.)<br>Murrill    | Polyporaceae   | On decaying wood;<br>Saprotroph      |
| 7.  | <i>Amanita vaginata</i> (Bull.) Lam.            | Amanitaceae    | On soil;<br>Ectomycorrhizal          |
| 8.  | <i>Amantia</i> sp.                              | Amanitaceae    | On soil                              |
| 9.  | <i>Russula silvicola</i> Shaffer                | Russulaceae;   | On soil;<br>Ectomycorrhizal          |
| 10. | <i>Termitomyces</i> sp.                         | Lyophyllaceae; | On soil;<br>Symbiotic with termites. |
| 11. | <i>Clavulina coralloides</i> (L.) J.<br>Schröt. | Clavulinaceae  | On ground;<br>Ectomycorrhizal        |

**Sal forest in Surai, Khatima**

- |    |   |                |                                      |
|----|---|----------------|--------------------------------------|
| 1. | <i>Leucocoprinus birnbaumii</i><br>(Corda) Singer | Agaricaceae    | On wooden log;<br>Saprotroph         |
| 2. | <i>Armillaria tabescens</i> (Scop.)<br>Emel       | Physalaciaceae | On wooden log;<br>Pathogenic         |
| 3. | <i>Termitomyces</i> sp.                           | Lyophyllaceae; | On soil;<br>Symbiotic with termites. |

**Sal forest Baggha, Khatima**

- |    |   |                  |  |
|----|---|------------------|--|
| 1. | <i>Aurificaria shoreae</i> (Wakef.)<br>Ryvarden | Hymenochaetaceae | On wooden log;<br>Saprotroph sometimes parasitic |
| 2. | <i>Rusulla brevipes</i> Peck                    | Russulaceae      | On soil;   |

3.	<i>Rusulla silvicola</i> Shaffer	Russulaceae	Ectomycorrhizal On soil; Ectomycorrhizal
4.	<i>Xylaria hypoxylon</i> (L.) Grev	Xylariaceae	On decaying hardwood; Saprotroph
5.	<i>Phellinus carophylli</i> (Racib.) G. Cunn.	Hymenochaetaceae	On tree trunks; Pathogenic
6.	<i>Macrolepiota procera</i> (Scop.) Singer	Agaricaceae	On soil; Saprotroph
7.	<i>Ganoderma applanatum</i> (Pers.) Pat.	Ganodermataceae;	On tree stump; Parasitic
8.	<i>Termitomyces</i> sp.	Lyophyllaceae	On soil of termite mount;
9.	<i>Geastrum triplex</i> Jungh.	Geastraceae	On soil; Ectomycorrhizal
10.	<i>Clitocybe nuda</i> (Bull.) H.E.Bigelow & A.H.Sm.	Tricholomataceae	On soil; Saprotroph
11.	<i>Polyporus grammacephalus</i> Berk.	Polyporaceae	On wooden log; -
12.	<i>Coprinellus micaceus</i> (Bull.:Fr.) Vilgalys, Hopple & Jacq. Johnson	Psathyrellaceae	On tree trunk; Saprotroph

**Table 3: List of Edible species**

List of edible species		
S.No.	Scientific Name	Caution
1.	<i>Coprinellus disseminatus</i>	It is reported to be edible, but it is insubstantial and not highly regarded.
2.	<i>Coprinus commatus</i>	It is an excellent edible species.
3.	<i>Hygrocybe cantharellus</i>	It is reported to be edible but as these are small so it is difficult to collect sufficient quantity.
4.	<i>Amanita constricta</i>	Although not poisonous, but should be consumed only after proper identification.
5.	<i>Amanita vaginata</i>	Although not poisonous, but should be consumed only after proper identification.
6.	<i>Rusulla brevipes</i>	It is a non-descript edible species
7.	<i>Armillaria tabescens</i>	It is edible but should be consumed in small quantity.
8.	<i>Macrolepiota procera</i>	It is regarded as a good edible, but may cause reaction in sensitive individuals.
9.	<i>Clitocybe nuda</i>	It is regarded as a good edible, but they are known to cause allergic reactions in sensitive individuals.
10.	<i>Geastrum triplex</i>	Edible when immature.
11.	<i>Coprinellus micaceus</i>	It is considered ideal for omelettes, and as a flavour for sauces.
12.	<i>Termitomyces</i> sp.	It is regarded as one of the best edibles by the locals.
13.	<i>Termitomyces</i> sp.	It is regarded as one of the best edibles by the locals.
14.	<i>Ganoderma lucidum</i>	It is an edible medicinal mushroom.





*Rigidoporus lineatus*



*Coprinellus disseminatus*



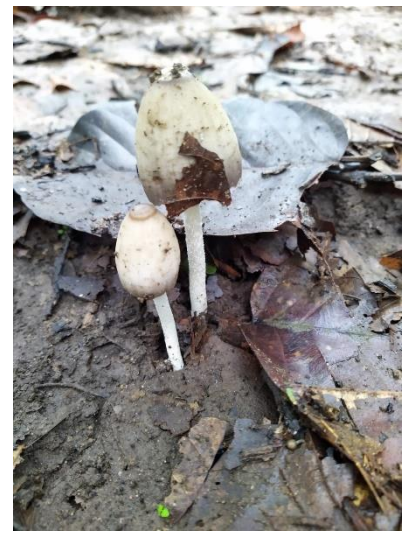
*Microporous xanthopus*



*Daldinia concentrica*



*Termitomyces* sp.



*Coprinellus commatus*



*Filoboletus manipularis*



*Xylaria hypoxylon*





*Hexagonia tenuis*



*Hygrocybe cantharellus*



*Amanita constricta*



*Termitomyces* sp.



*Leucocoprinus birnbaumii*



*Armillaria tabescens*



*Aurificaria shoreae*



*Rusulla brevipes*





*Phellinus carophylli*



*Geastrum triplex*



*Macrolepiota procera*



*Ganoderma applanatum*



*Polyporus grammacephalus*



*Clitocybe nuda*

**Conclusion:** This is the first ever study on the macrofungal diversity of species found on soil as well as wood in Sal forest of Kumaun region. The findings of this study will be a reference database of wild mushroom of the state and will help in future research works. Total 34 species have been identified. Most of the species studied were saprotrophic and a few were

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parasitic as well. Xylariaceae is the most represented family followed by Russulaceae, Polyporaceae. Lyophyllaceae, Agaricaceae, Amanitaceae.

*Termitomyces* sp. and *Geastrum triplex* were found to be the most abundantly found species.

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