MUSHROOM DIVERSITY OF BAJRABARAHI FOREST, CHAPAGAUN, LALITPUR, NEPAL

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RECOMMENDATION

This is to recommend that the dissertation entitled "Mushroom Diversity in Bajrabarahi Forest, Lalitpur, Nepal" has been carried out by Mrs. Neera Shrestha for the partial fulfilment of M.Sc. Degree in Botany.This original work was conducted under my supervision.To the best of my knowlwdge, this dissertation work has not been submitted for any other degree.

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LETTER OF APPROVAL

The dissertation paper submitted by Mrs. Neera Shrestha entitled "Mushroom Diversity in Bajrabarahi Forest, Lalitpur, Nepal" has been accepted as a partial fulfilment of M.Sc. Degree in Botany.

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Neera Shrestha

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SUMMARY

Mushrooms can be considered as one of the most important non-timber forest products, which are mostly used as nutritional food and as medicine. Present sudy was conducted during the year 2001-2002 in Bajrabarahi Forest, Lalitpur district. The collection of mushroom specimens was carried out during the rainy season from various habitats of the forest. Mushrooms were photographed in their natural habitat and specimens were preserved and identified using standard techniques and literatures.Questionnaire survey was done to local collectors to collect information on consumption and collection of wild edible mushrooms.

Altogether 58 species of mushroom were collected. Out of them 49 specimens were identified up to generic level. The largest family recorded was Russulaceae with 13 genera. The species like *Pleurotus, Russula, Lacaria, Amanita* etc are abundantly distributed along the study area. The largest number of mushroom were found growing on dead and decaying leaves (28 species), followed by 9 species on living tree and dead tree and decaying logs, 10 species on soil and 1 species on animal dung.

Among 49 species identified, 10 species were studied in details which are as follows *Auricularia auricula-judae, Pleurotus ostreatus, Fistulina hepatica, Laccaria laccata, Russula delica, R. olivacea, R. puellaris, Marasmius oreades, M. epiphyllus* and *M. androsacens.* Out of 10 species studied in detail, 3 species- *Russula olivacea, Marasmius epiphyllus* and *M. androsacens* were new record for Nepal.

Among the collected mushroom species, *Fistulina hepatica, Pleurotus,* and *Russula* are mostly preferred by the local people for comsumption. Local people are frightened to eat wild mushrooms as they have only little traditional knowledge they got from their ancestors.At present growing potential of wild mushrooms is very low as the grazing of animals inside the forest is strictly prohibited.

The fruitful forest should be maintained for the growth of the mushrooms. The natural habitat of mushroom should be protected; the commercial exploitation of the wild mushrooms should be regulated and they should be chemically tested.

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1.1 Introduction

1.1.1 General

Fungi are a very distinct group among the plants. The term fungi (syn: fungus) is commonly used for a group of achlorophyllous thallus. Fungi consists of great variety of shape and sizes ranging from the single cells of the yeast, through the thread fungi (Mucor, *Rhizopus*) and pin moulds (Mucor) on rotting food to the giant puff ball or the long lived large bracket (*Polyporus*) fungi and on tree trunks. The word “fungus” gives us an image of mushrooms and toadstools that are found growing in the woods and fields.

Fungi are not able to ingest their food like animals do, nor can they manufacture their own food the way plants do. Instead, fungi feed by absorption of nutrients from the environment around them. They accomplish this by growing through and within the substrate on which they are feeding. Numerous hyphae network through the wood, cheese, soil, or flesh from which they are growing. The hyphae secrete digestive enzymes which break down the substrate, making it easier for the fungus to absorb the nutrients which the substrate contains.

Most fungi are saprophytes, feeding on dead or decaying material. This helps to remove leaf litter and other debris that would otherwise accumulate on the ground. Nutrients absorbed by the fungus then become available for other organisms which may eat fungi. A very few fungi actively capture prey, such as *Arthrobotrys* which snares nematodes on which it feeds. Many fungi are parasitic, feeding on living organisms without killing them. Ergot, corn smut, Dutch elm disease, and ringworm are all diseases caused by parasitic fungi

The fruiting body of the fungi are compose of fine microscopic threads like structure known as 'hyphae' (Pl: hypha) which live and spread within substratum like soil, wood or other plant tissue. Each individual hypha is branched having cell wall

containing chitin. The hyphae may be coenocytic or divided by transverse wall into uni-nucleate or multi-nucleate cell according to Alexopolous and Mims, 1983.

Generally, the study of fungi is known as ‘mycology’ which is derived from Greek word 'mykes' (Mushrooms) and ‘logos’ (discourse). Not all the fungi are considered as mushroom. Only the fleshy species of higher fungi are known as mushrooms. Recently mushroom is becoming one of the income-generating crops commercially adapted by poor farmers by cultivating it either by using their crop residues or by collecting in the wild form.

Generally two types of reproduction can be found in this group of plant i.e. sexual and asexual. The asexual reproduction is carried out by the production of special type of reproductive cells for example by spores, fragmentation, budding etc.

Mostly in the fungi, the sexual reproduction includes the union of two compatible nuclei. The process of sexual reproduction in fungi consists of 3 different phase. The first phase is plasmogamy where there is union of two cells takes place but the nuclei remains free. After this, union of two nuclei (Karyogamy) is brought together followed by plasmogamy, resulting a binucleate cell (dikaryon) which later on produces fruiting body. In each fruiting body, meiotic division occurs and produce spores either with diploid or haploid nucleus. So species may be monoecious or homothallic and dioecious or heterothallic.

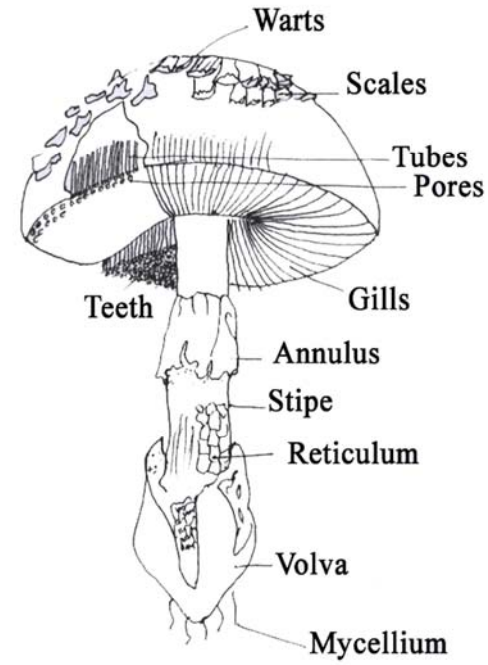
1.1.2 Essential parts of mushroom

Mushrooms have generally the umbrella like fruiting body representing the reproductive part of the organism. The development of fruiting body takes place through the binding of mycelia in availability of favourable condition. These fruiting bodies may vary greatly in shape and size.

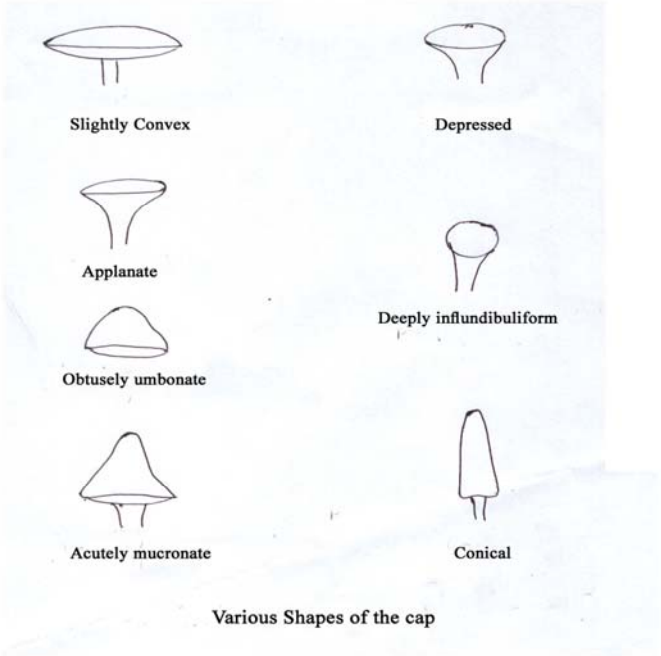
A typical mushroom generally consists of umbrella like fruiting body known as pileus or cap with central stalk or stipe also known as stem. The arrangement of pileus is usually central often eccentric or lateral. On the central side or lower side of the pileus there is numerous radially arranged gills while in some there is a spongy tissue pierced by numerous holes. At the basal end of stipe there is somewhat swollen rounded bulb like structure called ‘volva’ a remnant of universal veil. Most of the mushroom possess a ring called ‘annulus’ a remnant of partial veil towards the top of the stem.

Thus the important characters used in mushroom taxonomy are the presence or absence of pileus, stipe, annulus, volva along with their shape, size, color and texture. Thus the classification of mushrooms depends on their morphological structure hymenial surface and nature of fruiting body. The shape, size and colour of the spores are also an important character for the identification of the mushrooms. Spore colour is particularly important and is determined by making a spore print. The spore print is necessary as the colour of the spore is not always same as the colour of the gills.

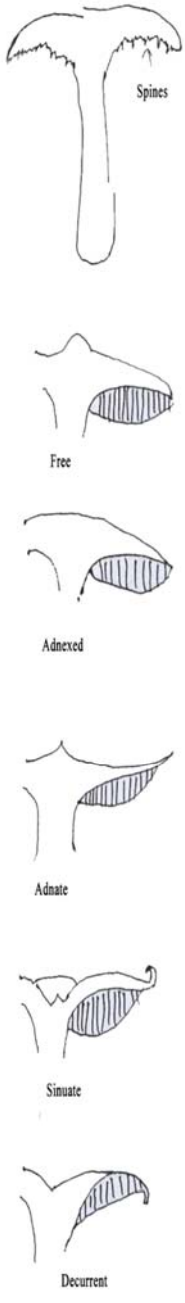
To make a spore print, the stipe of a fresh mushroom is cut off squarely with the edge of the gills and the pileus is placed on the piece of paper. Normally white paper is used to make a spore print but black paper can also be used in case of the white or light coloured spore. The pileus is then covered with a bell jar or similar cover to prevent it from quick drying. After few hours the pileus is lifted and the mass of spores, which has been deposited on the paper in the form of a spore print, is examined and the colour is determined.



Structure of Fungus with cap and stipe



Various Shapes of the cap



Types of Gills

Fig 1.1 Essential Parts of Mushrooms

1.1.3 Ecology and Habitat

General Mushrooms grow every where in the World. Mushrooms grow either on ground or on organic substrate under humid condition. They are generally found amongst grass, fallen leaves, on logs, tree stumps or woody debris, on drug or enriched soil, on burnt ground wood, on other fungi and even on living trees. According to Adhikari (1998), the appearance of mushrooms and their dominance are controlled by different factors like altitude, phytogeography, climate (particularly seasonal changes followed by thermal conditions) and other factors of the region.

Generally the growth of thallus is controlled by different environmental and ecological factors where they can retain the moisture and nutrition necessary for growth, fructification and reproduction. Although mushrooms constitute different mode of habitat but in general it can be summarized in three basic forms

Saprophytic e.g. *Coprinus, Agaricus, Boletus* etc.

Hyperparasite e.g. *Asterophora* on *Russula* etc.

Pertophyte e.g. *Pleurotus, Lentinus* etc.

Parasitic e.g. *Polyporous, Fomes* etc.

Mycorrhizae e.g. *Russula, Boletus, Amanita, Lactarius, Cantharellus* etc.

The tremendous growth of mushroom is possible only when there is suitable amount of temperature, humidity, moisture and other environmental conditions. The soil also plays one of the most important roles for the growth of the mushroom species. The growth of the mushroom appears in between May and October. They grow abundantly during July and August. Adhikari (1994) mentioned that for the growth of mushrooms the average climate temperature fluctuating between 15-30^{o}C in tropical, 12-30^{o}C in sub-tropical, 10-25^{o}C in temperate and 5-20^{o}C in sub alpine region.

Pacioni (1985) stated that the development of the fungal species broadly distributed along the darker and shaded area also grows on or under the soil surface some species form fruit in the complete darkness of mines and caves , whereas few fails to form fruit due to the requirement of sufficient adequate light, humidity, temperature.

According to Dickinson and Lucas (1979), the suitable condition for the occurrence of the massive production of carpophores depends on the presence of humidity, nutritional substrate and mild temperature in the atmosphere.

Temperature is the basic factor that changes the climate. For most of the mushroom species, the temperature of the substrate on which they develop is more important than the role of temperature in the formation of fruiting body. In the temperate climates the highest production of mushrooms occurs in late summer and early autumn when the atmospheric precipitation lowers the temperature and raises the humidity level of the ground according to Pacioni (1985).

The appearance of mushrooms in particular region depends on the climate pattern (rainfall, temperature, CO_2 content in the air, soil type, light) as well as the type of vegetation as it affects on origin, growth frequency and dominance of different groups of fungi in different region and seasons. Development of fruiting body of mushroom depends upon the light, temperature, CO_2 concentration of the air. In the low light the development of pileus is poor but the elongation of stipes takes place. The high light also effects on ratio of stipe length to pileus diameter. The CO_2 of atmosphere have a profound influence on sporophore development normally at about 0.2% CO_2. The development of spororphore occurs about 5% that cause a reduction in diameter of pileus. CO_2 level within compost would stimulate stipe elongation which would carry the cap up to the region where the CO_2 concentration sufficiently low to allow cap expansion and spore release.

The mushroom species grows in different habitat of different places all the times throughout the year. The mycelium of fungus exists in the soil and wood or in any substratum throughout the year but the development and appearance of the fruiting bodies is restricted to certain period and varies within species. The fruiting capacity of fungus is influence by the wind. The ventilation in stipe causes quick evaporation of water present in the ground, which causes the dries out of the mycellium.

In Nepal, the complex geomorphology embraces the growth of different types of mushroom. Adhikari in (1988 b) mentioned that the distribution of mushrooms in a

particular locality depends on topography, soil types, rainfall, temperature and vegetation pattern. The growth of parasitic mushrooms is very much favoured by the humid tropical climate. The main months for their occurrence, growth and dominance lies in between mid June to Mid-September although few species start to appear from May up to November. As the cold season approaches, the fleshy mushroom starts to disappear. However the fruit bodies of some species appear in the spring example the morels (Morchella).

The coniferous forest of sub-tropical region is considered as favourable habitat for the growth of the mushrooms. The broad leaved forest of temperate zones (oak forest) is comparatively main canters for the growth of some species of mushrooms than the rain forest of tropical belt (sal forest).

Thus despite of ecological difference, high frequencies of mushrooms have been found to be concentrate in sub-tropical and temperate zones of the country. (Adhikhari, 1995).

1.1.4 Concept on mushrooms and toadstools

Mushrooms and toadstools are the macroscopic fungi that live on living or dead organic matters and their fruit bodies are often called basidiocarp, carpophore, sporocarp or sporophore. This fruit body is composed of anastomosing or interwoven mycelium and may be hard, fleshy, leathery, soft, gelatinous or almost of any texture. The fruit bodies may be short lived or may persist for many years.

From the time being different mycologists have stated different opinions about the concept of the mushrooms and toadstools. Generally the fungi which are edible are considered as mushroom whereas the poisonous or inedible one are considered as Toadstools. Toadstools as defined by Kreiger (1967) are “all the fleshy umbrella-shaped fungi, a small number of which are the best known inedible forms." The name "mushroom" is applied popularly in commerce for "the agaric" - any gill-bearing fungus.

A typical toadstool obviously serve as a resting place for sedentary batrachians, but it is peculiar that the association is mostly with toads and not with frogs, possibly the explanation is in the old belief that toads were venomous. In Brittany and neighbourhood there are local names meaning toad's hat or toad's bonnet; the most widespread in 'tour soc' or scabello tou soc' (escabeau de crapaud). The belief is that they are formed from the harmful substances of the earth and the venom of toads and that fungus always grow in places where toads abound and give shelter to them when they take the air (Ramsbottom, 1954).

Snell & Dick (1971) defined mushrooms as "a general term applied to the fleshy agarics & fleshy species of other groups- "a mushroom may be edible, poisonous, unpalatable etc. The popular usage of the term applies to the edible ones referring other 'toadstool", popular term for an inedible mushroom (Agaric or bolete) and the agaric as" one of the Agaricaceae or gill bearing fungi" a mushroom". Dickinson & Lucas (1979) and Phillips (1981) also accepted the same opinion "toadstool is a popular name for all fleshy, gill-bearing fungi which are quite different from the common mushrooms".

The dictionary (Hawksworth, Sutton & Ainsworth, 1983) defines mushrooms as "an agaric (or bolete) of "any agaric" and agaric as "one of the Agaricaceae". The term "Mushroom" applies only to the "agaric" which is commercially cultivated. According to Webster (1970), the general form of an agaric fruiting body is umbrella-shaped with a central stipe, supporting a cap or the pileus with numerous radially arranged gill or lamellae on the lower side of the cap.

According to the definition of Miller (1984) the term "mushroom" is applied to both edible & poisonous species and agaric to the gilled mushrooms. Similarly, Purkayastha and Chandra (1985) pointed out that the agarics of fleshy species of other groups of fungi are recognized as "mushroom" which may be edible, inedible, poisonous or non-poisonous.

The structures that are commonly known mushrooms are nothing else but the fruiting bodies of those organisms that the mycologists call higher fungi, or macrimycetes

(macromycetes=large fungi), even though the dimensions of the caps of some mushrooms might be only a few millimeters across. Rinaldi & Tynaldo (1972).

Pacioni (1985) made a clear distinction between “mushroom” considering only the edible species and “Toadstools” as inedible or poisonous species.

Different authors defined the mushrooms and toadstools in their own languages and included in the same group ‘Agaricales” i.e. gill fungi (Fries, 1838; Rea, 1992; Singer, 1986 etc). The word “toadstool” comes from the German Word ‘tod stuhl’ which means death-stool causing sickness and even death. The poisonous members are however popularly known as toadstools. Not all the genus of the same species closely related to them are not poisonous, some may be edible for instance, *Lepiota morgani* and *Amanita Muscaria* are poisonous while *Macrolepiota procera* and *Amanita caesarea* are edible (Adhikari, 1976).

Kreiger (1967) defined “Toadstools” as umbrella-shaped fleshy fungi of which only few numbers are known to be edible. Kibby (1979) defined “Toadstool” as the inedible or poisonous group. The toadstools are also gill bearing agarics but are mostly inedible and poisonous. The “Dictionary of Botany” (Tootill, 1983) defined the term “Toadstool” as an essentially synonymous with mushroom in both the narrow and broad senses, among them very few are edible but is more often used of inedible species.

Similarly, Purkayastha and Chandra (1985) pointed out that the agarics or fleshy species of other groups of fungi are recognized as “mushroom” which may be edible, inedible or poisonous or non-poisonous. The poisonous members are popularly known as “Toadstools”. But morphologically, it is very difficult to distinguish between “Mushrooms” and “Toadstools”. Pacioni (1985) made a clear distinction between “Mushroom” considering only the edible species and “Toadstools” as inedible or poisonous species.

Mushrooms and Toadstools both resembles with each other very closely. There is no hard and fast rule to distinguish them morphologically. Thus, in the popular mind it is

associated with the idea that the toadstools are poisonous but it has no scientific reason.

1.1.5 Difference between edible and poisonous mushrooms

The diversity of soil, variation in substrate (rotten logs, tree stumps and fallen leaves), climatic condition (temperature, rainfall, humidity) and other factors influence directly or indirectly on the growth of the fungal species. In Nepal, the wild edible species of mushrooms are collected from the forest and fields, but it is very difficult to identify the edible from the poisonous ones as there is no hard and fast rule to define the edible and toxic mushrooms. As a matter of fact, a mushroom hunting is an art where trial and error and 'Do it yourself' methods do not count. Moreover this is a skill where experience and patient prevails (Bhandary, 1991).

For the consumption of wild mushroom one must be able to recognize it properly. A number of assumption and flock lore or conceptions have been found to distinguish between poisonous, inedible and edible mushrooms. But yet, none of these are reliable. Some of the views followed all over the world are presented here as a general discussion (Rinaldi and Tyndalo, 1972, After Adhikari, 1993).

1. Growing season (Spring and Autumn)

A. Spring

   It is said that all the mushroom growing in spring are edible e.g. *Morchella*. But there are some other species like *Helvella sp.* which grows in spring is rather toxic to human health.

B. Autumn

C. It is said that all the mushrooms growing in late autumn are edible. But actually it is not so, even in the late fall we find the deadly agarics like *Amanita phalloides*, *Amanita muscaria* as well as *Entoloma lividum*.

2. The Substrate

A. On living tree

It is said that all the mushroom growing on living trees are edible e.g. *Pleurotus*, *Lentinus*, *Laetiporus* etc. But *Clitocybe olearia* grows on living trees like Oaks or on other fully living and healthy tree is poisonous (Rinaldi and Tyndalo, 1972).

B. On decaying straw or manure

It is said that all the mushrooms growing on decaying straw or mannure are poisonous but the species like *Coprinus comatus* (Copros in Greek means manure) which grows on dung and animal manure is found to be an excellent edible species of delicate flavour and easily digestible when young.

C. On soil

It is said that all the mushroom species growing on the soil are deadly poisonous such as *Amanita phalliodes*, *Amanita verna* etc. But actually it is not so, Many edible species like *Russula delica* and *Amanita caeseara* etc. also grow on the soil.

3. By vipers toads or poisonous plants

It is said that even the edible mushrooms can become poisonous through some strange influence exercised by viper's toads, poisonous plants and place, but it is false. The habitat of certain plants near by might inhibit the growth of the mushroom but are unable to change its chemical substance or content either from edible to poisonous or poisonous to edible. An edible mushroom becomes toxic only when it is rotting.

4. Colours

a. Violet colour

It is said that violet coloured mushrooms are poisonous. But the violet species like *Laccaria amethystina*, *Mycena pura* and *Cortinarius violaceus* are edible but *Rhodopaxillus nudus* is rather toxic. (Rinaldi and tyndalo, 1972)

b. Bright coloured or dark red coloured

All the bright coloured mushrooms *Amanita muscaria*, *Russula emetica*, *R. fragilis* (brownish purple), *Amanita pantherina* are poisonous. But it is not so, species like *Amanita caesarea* even though bright coloured is edible.

5. Rough warty cap

The species of mushroom with rough, warty cap, rough texture are said to be poisonous, eg. *Pholiota adipose* but the species like *Amanita rubescens, Microlepiota procera* are edible.

6. Smooth cap

Smooth capped species are said to be edible but some species of *Amanita*, *Hygrophorous* and *Lepiota* etc. are poisonous.

7. Colour changing species

The mushrooms whose flesh changes colour after touching or brushing are said to be poisonous (*Boletus luridus*). This fact is not true, the flesh of *Boletus cyanescens* even though change it's colour is edible.

8. Latex exudating

Mushroom that produce latex on being injured are said to be poisonous such as *Lactarius torminosus, L. sariflus, L. rufus* but some species such as *Lactarius deliciosus, L. volemus, L. corrugis* and *L. piperatus* are edible.

9. Taste and smell

a. Bitter, acrid or pungent taste and smell

It is said that the mushrooms with bitter, acrid or pungent taste are poisonous. But some of the species upon cooking lose these taste e.g. *Lactarius piperatus*.

b. Fruity smell and taste

It is said that all mushrooms having fruity smell are edible e.g. *Canthrellus spp*.

10. Boiled with or without salt or vinegar

It is said that all mushrooms loose their poison if boiled in water with or without salt or vinegar. Actually the deadly *Amanitas* retain their poisonous chemical even after prolonged and repeated boiling.

11. On exsiccation

It is said that all mushrooms lose their poison through exsiccation. This is true for *Gyromitra esculenta*, which when fresh cause serious intoxication but after exsiccation become completely harmless. However, this is not true for the deadly *Amanitas*, which remain deadly, even after exsiccation (Rinaldi and Tyndalo 1972).

12. Mushroom eaten by cats and dogs

It is said that mushrooms eaten by cats and dogs are harmless to human, which is not true. The physiological activities in cats and dogs are quite different from human beings. They can tolerate and digest the elements that are disgusting or completely inedible to human beings. In case of deadly *Amanitas*, the symptoms of the poisoning might be seen immediately after ingestion (Rinaldi and Tyndalo 1972).

13. Silver spoon test

It is said that the poisonous mushrooms when cooked discolour the silver spoon dipped into it and those which cannot discolour the silver spoon are considered as edible. Beside the silver pieces, people also use onion and garlic to confirm the poisonous nature of mushrooms. In case of deadly Amanitas like *Amanita phalloides*, *A.verna* and *A. muscaria*, the colour of silver spoon, onion and garlic does not change in colour while cooking.

14. Mushrooms eaten by insects

It is said that mushrooms eaten by snail, insects and other animals are edible. But the snails, which are quite fond of the *Amanita muscaria* and the insects which, are greatly attracted by the *Amanita phalloides*, both of them are deadly poisonous.

Mushrooms which causes milk or egg to coagulate are said to be poisonous. But it is reported that *Amanita caesarea* and *Boletus edulis* which give a similar reaction are edible.

Depending upon the places and countries, the above prejudices varies, for example with *Scleroderma* species. *Scleroderma citrinum, S. cepa, S. aurantium* and *S. verrucosum* are edible in Nepal. While these species according to Adhikari (1996, 1997 and 1998), are considered as poisonous in Europe and Japan. *Ramaria aurea* and *R. flava* are considered edible in Nepal but the same species have been reported poisonous in Japanese literature (Imazeki, Otani & Hongo, 1988).

It is possible that certain geographical races of mushrooms may be poisonous, while other may not be so. Possibly a species may be edible when it is young and fresh and may be poisonous when it is over matures and has started decaying (Svreck, 1975).

We have not yet found a universal safe test to distinguish the edible mushroom from the poisonous ones.

1.1.6 Mushroom Poisoning

Mushrooms, which are free from any health hazards, are much consumed in the form of vegetable. All the wild edible mushrooms are harvested from its natural habitat. The collection and consumption practices of mushroom have been continuing since time immemorial by different ethnic groups. Due to the lack of scientific knowledge in local ethnic groups they utilize only few species identifying on the basis of their own traditional knowledge. The mushroom grows on the season have its own importance on the biotic as well as abiotic environment. The mushroom found in the forest are not only edible but they are medicinal as well as toxic to human being causing various health disorders and even death of human beings and other animals if eaten raw or after cooking.

Generally those species are treated as poisonous, which have bright color, bitter in taste and emit bad odours. Fundamentally the poisonous species are grouped into deadly poisonous species, less poisonous species and hallucinogenic species

In general several kinds of alkaloids and acids have been found in mushrooms which are toxic to human. There are 8 types of toxins recognize till now, Adhikari (1991 b). They are Amatoxin; Phallotoxin; Ibotenic acid, Trichlomic, Muscimol acid; Muscarine; Psilocybin and Psilosin; Coprine; Helvellic acid and Gyromitrine; Ergotoxin

During mushroom poisoning many symptoms are seen in consumer (patient) such as firstly irritation, intensive vomiting and diarrhea followed by urine disorders, high fever etc. In few cases, sudden unconsciousness and even death of the person take place with liver failure and sometimes of brain tumescence (Svrcek 1975).

1.1.7 Uses of Mushrooms

Inspite of their toxicity, the mushrooms are used for various purposes. They are used for remedies of different diseases, for decoration, for commercial trade etc. In rural areas of Nepal, use of different speceis of mushroom is still in practice as healing wounds, cuts, burn during high fever, and tumor etc.

Grifola frondosa , *Meripilus giganteus* used for tumor, high fever; *Lentinus* sp. for high blood pressure,diabetes, tumor; *Coriolus versicolor* used for decreasing tumor; *Fistulina hepatica* for healing cuts and wounds; *Pleurotus ostratus* for minimizing cancer, *Amanita muscaria* for curing neural disorders.

Few species of mushroom like *Schizophyllum commune, Ganoderma lucidum, Polyporus picipes, P. arcularis, Ganoderma applanatum* etc. are playing for signifinance role in cultural system. Among them *Schizophyllum commune* is one of the most essential wild fungus used as the sign of fortune (Sagun) by Newar and Tamang during marriage ceremony.

Some species *like Ganoderma lucidum,* and *G. applanatum* are used for room decoration in various countries. Similarly *Polyporus picipes* and *P. arcularis* are used to sketch arts and so on. (Adhikari, 1988, 1996)

The species like *Cordyceps* and *Morchella* are used for commercial trade in the context of Nepal.

Mushroom species from Polyporaceae are the important agents for decaying of trees and timber. Therefore, the mushrooms (in broad sense “fungi”) are one of the most important agents in providing organic matter for the virgin forest.

1.2. Objectives and Limitation of the study

1.2.1 Objectives of the study

- To analyze the mushroom diversity of the forest
- To conduct detail study on the structure of some important edible mushrooms from the area

1.2.2 Justification

In Nepal very few studies related to Nepalese mycoflora are found in comparison with higher plants. Nepal has expressed its commitment to develop a national strategy for conservation and sustainable use of biological resources. So, it needs to have detailed information and knowledge about its natural resources and potentialities (Dobremez, 1971). Among the study sites the west and east region need extensive exploration irrespective to central sector of Nepal (Adhikari, 2000).

There is a belief that if somebody brings anything from the forest of Bajrabarahi temple the wind took back those things to the forest area. However people prefer collecting mushroom from the forest. In the study area, a frequent fatal case by mushroom poisoning is another issue. Detail exploration of mushrooom from the forest seems necessary. Therfore the present study would provide valuable information on mushrooms present in the forest.

1.2.3 Limitation of the study

- The study is a part of partial fulfillment of Master's Degree.
- All the collected specimens of mushroom couldnot be preserved due to the poor condition especially *Boletus* species.
- This information is based on investigation done in two years time in between 6 months (April-August) in the forest of Bajrabarahi.
- Some of the collected specimens could be identified upto generic level as most of the species is in immature and over matured stage of specimens.
- Spore print of mushrooms couldnot be taken as only few specimens of each mushroom species were collected.

CHAPTER TWO

2.1 Literature Review

2.1. **Historical review**

Several Nepalese have investigated the mushroom flora of Nepal and foreign botanist of the world form the very beginning of the 18th century. The publication are scattered in different journals in different languages. “Bibliography on Fungi of Nepal” (Singh & Joshi, 1997), “History of mycological explorations in Nepal” (Adhikari, 1990), “Research trends in Nepalese mycoflora” (Adhikari, 1991d), “Fungi of Nepal” (Adhikari & Manandhar, 1995) and “Biodiversites des Basidiomycetes au Nepal: etude systematique at biogeographique” (Adhikari, 1996a) provide vivid historical accounts and aspects of investigations carried in this Himalayan belt.

The investigation and study on mushroom of Nepal was first done by J.D.Hooker (1848-1885), who explored east Nepal. His collected specimen were studied and published by M.J.Berkeley (1845a,b,c and d). Berkeley reported 44 Nepalese higher fungi from those collections in “Indian Fungi”. The paper includes 18 new species of mushrooms viz. *Irpec zonatus, Lentinus nepalensis, L. inquinans, Lycoperdon elongatum, L.emodense, Polyporous cereus, P. elatinus, P. flavidus, P. florideus, P. neplensis, P. pictilis, P. vivax, Radulum spongiosym, Scleroderma nitidum, Sphaeria nepalensis, Storeum endocrocinum, Trametes tepharolenca, T. versatilis, Ustilago ocrearum* and *Xylaria fistuca*.

Cooke (1888) reported only one species of agarics from Nepal without mentioning place and date of its collection.

After 1947 no investigation is done in the mushrooms in context to Nepal. Balfour-Browne(1955) in “Some Himalayan Fungi” enlisted 9 genera and 9 species of fleshy larger Ascomycetes, 17genera and 24species of Hymenocytes and 5 genera and 7 species of Gasteromycetes from the collection of O.Polunin, W.R sykes and L.H.J. Williams whose botanical expedition was carried out in the Jumla area (at an altitude

of 1800-5400 m) in the western region of Nepal. Some new species described by herself and corner were also added in this list. There is *Ramaria fuscobrunnea corner, Pleurotus nepalensis corner*. The newly described monotypic genus *Amylaria; A. himalayensis* Corner, was also included in the same paper.

Balfour Browne (1968) published "Fungi of recent Nepal expedition" which consists of mushroom species collected from western and central Nepal by Stainton (1952-56), Norkett (1961-62), Polunin (1949) and Stainton, Sykes & Wiliams (1954). This paper included 12 species of larger Ascomycetes, 73 species of Hymenomycetes and 6 species of Gasteromycetes. In this paper *Clavulina alata* Corner and *Lentaria macrospora* Corner were added as new species to mushroom world. Two new names viz. *Panus polychrous* (Lev.) Singer: Balfour Browne (=*Lentinus polychrous*) were also proposed in the same paper.

Thind (1861) included 3 species in "The Clavariaceae of India" which were reported earlier by Balfour Browne (1995)

Kobayashi (1865) recorded the occurrence of *Calostoma*, a Gasteromycetes species, from east Nepal.

Imazeki et al. (1966) reported 3 genera and 3 species (1 Ascomycotina, & 2 basidiomycotina) collected in botanical expedition organized by National Science Museum, Tokyo, Japan.

Singh was the first Nepalese to report some fungi from Nepal. His collections and publications were concentrated mainly on the species from Kathmandu valley and adjoining area. He (1966) reported 18 wild edible mushrooms sold at Kathmandu market in bamboo package.

Singh (1968) reported 4 species of Hymenomycetes from Kathmandu Valley.

Singh & Nisha (1974-1976b) they recorded the occurrence of three species of *Exobasidium*. Among them *Exobasidium butleri* from Dhulikhel was new to Nepal. In 1976 b&c they listed 5 species of larger Ascomycetes, 68 species of Hymenomycetes and 8 species of Gasteromycetes.

Adhikari (1976) listed about 30 wild edible species of fleshy fungi from Manichur, Kathmandu Valley.

Singh & Upadhya in 1978 mentioned 5 fungi from Suryavinayak (Kathmandu Valley, Jomsom and Tukuche, central Nepal). Species were new records to Nepal viz. *Morchella smithiana, Amanita citrine, Asterophora lycoperdoides, Russula nigricans* and *Peridermium ephedrae*.

Kreisel (1964/1967/19691976) listed 15 species of Gasteromycetes collected by J. Poelt from Khumbu Himal and adjoining areas. In this paper *Bovistella Poeltii and Lycoperdon nireum* and *L. yetisodale* were included as new species. In 1976 he again recorded *Bovista substerilis*, *B. Vascelloides*, *Disciseda alpine*, *D. Ochrochaleea*, *Lycoperdon altimontanum*, *L. Lambinoii var. quercetorum* and *L. Perlatum var dobremezianum*.

Pandey (1976) published a list of 314 specimens of Basidiomycotina collected from different regions (central and eastern) of Nepal. This paper consists of the list of the specimens which were identified up to generic level only.

Pegler (1977), while studying the specimens deposited in Kew gathered from Indian subcontinent by J.D. Hooker, Cooke and Polunin Sykes and Williams, listed two *Pleurotus* species from Nepal.

Adhikari (1976) listed about 30 wild edible species of mushrooms collected daily as food during (in season) by local people at Manichur (Kathmandu Valley). In 1984 he reported *Russula* species perasitized by Nyctalis (=Asterophora) species. In (1987) he threw light on different ethnic groups associated with wild mushroom collection and consumption in different phytogeographic belts. In 1988, in a conference held at Kathmandu organized by RONAST, he reported 9 species of higher fungi gathered in a botanical expedition from Langtang and adjoining areas with brief notes on their description, distribution and the key to facilitate the identification of Gasteromycete species. His paper “Polypores of Nepal” (1988) consists of checklists with additions, distribution and economic uses of the Polypores reported from Nepal.

The “History of mycological explorations in Nepal” (1990) written by him traces out in brief the historical attempts of investigation by different explorers and experts since the period of J. D. Hooker till 1986. In 1991 (a & b) he briefly highlighted the knowledge of wild Nepalese mushrooms (their collections, consumptions, list of edible and poisonous species). In another paper of the same year (1991c) he recorded 24 species of higher fungi gathered from Manichur to Gosainkunda and Royal Botanical Garden, Godawari. In 1992 a, he published a list of all newly described species, since 1854 till now, from Nepal. In 1994 he provided an introduction to 4 wild mushrooms stamps (*Amanita caesarea*, *Cordyceps sinensis*, *Russula nepalensis* and *Morchela conica*) issued by HMG Postal Service Department. In 1995 (a) he listed the toxic and medicinal mushrooms of Nepal. In 1995 (b) he published 2 species of fleshy fungi found in Kathmandu Valley. In 1996 (b) he recorded 9 species of Hymenomycetes from Kathmandu Valley. In 1996 (a) he was awarded doctorate degree from the University Paul Sabatier, Toulouse, France, the first Nepalese Citizen to receive the doctorate on “Bioversite’des Basiodiomycetes au Nepal: etude systematique et biogeographique.” This thesis deals with the Mycobiodiversity of Basidiomycetes flora (821sps). It highlights on phytogeographical aspects, historical account of mycological explorations, taxonomic and floristic studies on Uredinales, Gasteromycetes, Hymenomycetes with special attention to the genera like *Amanita, Russula*, Gasteromrcetes and Lactarius. It includes 40 species new to Nepalese mycoflora with 7 species new to science.

Joshi in 1977 reported 4 species of basidiomycotina from Kathmandu valley. Lama (1976, 1977) reported the occurrence of 8 species of Basidiomycotina from the Pokhara valley (Central Nepal)

Ranjitkar and Bhatt (1976) described one *Craterellous cornucopioides* on ground from Sundarijal (Kathmandu Valley).

Singh, S.C. and Nisha 1976 c. Some fleshy fungi of Nepal. *Ibid*. **6**(1) :73-88.

Sacherer (1979), in an ethnobotanical study of Rolwaling Sherpas, listed about 14 species of mushrooms in their local names without proper taxonomic identification.

Bhandary (1980) collected 13 species of fungi from Pokhara valley. In 1984/1985 he prepared a checklist of mushrooms (edible & poisonous) along with their local names. In 1991, he reported 25 species of edible and medicinal fungi from Dumre to Manang, Mustang and Pokhara areas.

Manjula (1983) included 4 species of Nepalese Hymenomycetes in the list of agaricold and boletoid fungi from India and Nepal.

In1984 Ryvarden's collection (1977) from Pokhara and Annapurna region (central Nepal) was jointly studied with Hjortstam (1984). They published a list of 60 genera and 95 species of Aphyllophozaceous fungi in "Some new and Noteworthy Basidiomycetes from Nepal". This article included newly described species such as *Grammothele bambusicola, Innotus hemisetulus, Peniophora bicarnis, Phlebia albo-fibillosa* and *Phellinus acontextus*. They also proposed new combinations *Daedalea incanana* (Lev.) Ryv. (=*Trametes incana*) and *Innotus flavidus* (Bark.) Ryv (=*Polyporus flavidus* Berk.)

Singer, R. 1986. *The Agaricales in Modern Taxonomy*. Koeltz Sc. Germany.

Under the leadership of Dr. Y. Otani, the National Science Museum Tsukuba, Japan, Organised 2 microbiological expedition to central Nepal to explore, investigate and study the Nepalese Cryptogams. The result of this expedition was published as "Reports on the Cryptogamic study in Nepal." in (1982) which includes two new species *Spathularia bifurcata* Otani and *Leotia himalayaensis* Otani. Headed by Dr. M. Watanabe (Algologist) in 1986, the National Science Museum organized third Cryptogamic studies Expedition in Central Nepal. The result of this expedition was published as "Cryptogams of the Himalayas, Vol. 1: The Kathmandu Valley" (1988). It includes the studies of fungal materials gathered from the Kathmandu Valley and the adjoining areas. In this report Adhikari (1988b) recorded 10 species of fleshy fungi with their brief descriptions. In another paper he provided brief monographic studies on 10 *Russula* species.

The second volume of the "Cryptogams of the Himalayas" Vol. 2 : Central and Eastern Nepal" was published in 1990which was the result of fourth the botanical

expedition(October 1988) and previous collections organized by National Science Museum, Tsukuba Japan in collabration with Department of Forestry and Plant Research(Recently named Department of Plant Resources). In this report Adhikari provided detailed monographic studies of eleven *Russula* species including *R. nepalensis* new to science.

Cotter (1987) received his doctorate degree in a mycorrhizal research carried in the pine forest at different phytogeographic belt. During the investigation he gathered 18 samples of *Suillus* species.

Cotter and Miller (1987) reported the ectomycorrhizal association of the *Boletus* genus *Suillus* in Nepal.

Miller and Cotter (1988) studied the ultra structure of the basidiospores and tissue morphology of Nepalese *Calostoma Junghuhuii*.

Bill and Cotter (1989) jointly studied the Nepalese *Lactarius* (4 including one new species *L. thakalorum*) species collected by Cotter (1985) from *Abies, Larix, and Pine* and *Rhododendron* forest.

Adhikari & Parajuli (1993) provided the checklist of Amanita.

Adhikari et al. (1994) reported the occurrence of *Amanita rubrovoivata* in Nepal.

Adhikari (1995 b) reported 2 species of fleshy fungi *Hygrocybe nigrescens* and *Termitomyces eurhizus* from Kathmandu Valley.

Manandhar and Adhikari (1995 a&b) reported 4 species of *Lepiota* from Kathmandu valley.

Tullons, Hongo and Bhandary (1992) reported one species of Amanita from Nala (Kathmandu valley).

Tullons and Bhandary (1992) reported one new species of Amanita: *A. chepangiana* from Jugedi, Chitwan used as food by Chepangs.

Adhikari (1995-1996) reported 10 wild mushroom species in and around the Kathmandu valley. Newly reported species were *Amanita hemibapha, A. pseudoporphyria, A. vittadini, Cantharellus subalbidus, C. tubiformis, Clavulina cinerea* (*Clavaria cinerea*), *C. cristata, Clavaria cristata* and *Clavaria rosea*.

Adhikari (1996 b) recorded 9 species of Hymenomycetes from Kathmandu valley.

Adhikari & Durrieu (1996) studied the ethnomycological approaches with the Ayurvedic concepts about the mushrooms.

Adhikari & Manandhar (1996) provided the monographic study of *Lactarius* genus which deals with 6 species among them one species (L. *confroversus*) was new to Nepal and 5 species were new to Himalayan ranges of Indian subcontinent.

Adhikari & Parajuli (1996) reported the occurrence of ectomycorrhizal fungi (27 species) prevailing in the pine forest of Kathmandu Valley.

Adhikari & Manandhar (1998) recorded the occurrence of *Calvatia gigantia* from Kathmandu valley.

Zang & Kinjo (1998) gave an account of 33 species of the genus *Cordyceps* collected from the alpine areas of China and Nepal. Among these *Cordyceps nepalensis* was described as new to science gathered from Kanchanjunga (4300 m) and Kathmandu Valley market.

Adhikari (1999 b) in the third National Conference on Science and Technology organized by RONAST, highlighted the status of wild potential mushrooms found in Nepal. He (1999 c) there published a list of Gasteromycetes species with additions of 9 species from book.

Adhikari (1999 c) published a list of Gasteromycetes with additions of 9 species and the keys for their identification. New species recorded were *Bovista gunnii, Lycoperdon invidum, Rhizopogon luteolus, R. roseolus, Scleroderma areolatum, S. cepa* and *Vascelum pretense*.

Adhikari (1999 d) reported 15 species and two varieties of the genus *Russula* from in and around the Kathmandu Valley and were new to Nepal or to India Subcontinent. Species were – *Russula adulterine, R. alboarelata, R. alutacea, R. amoena, R. chloroides var. chloroides, R. chloroides var. godavariensis, R. claroflava, R. delica var. dobremezii, R. gracilis, R. kathmanduensis, R. laurocerasi, R. lilacea, R. puellaris, R. senecis, R. velenovskyi* and *R. vesca*.

Joshi & Joshi (1999) in their ethnobotanical study presented the ethnobotany of 36 species of wild mushrooms collected from different parts of Kathmandu and Pokhara.

Mass (1992) reported *Xeromphalina aspera*, a new species, from Kaligandaki.

Kharel (1999) reported *Lentinellus ursinus* an edible mushroom from Bhardeo VDC, Lalitpur.

Adhikari (2000) brought the first definite reference for the mycroflora of Nepal, providing result of investigations done on alpine, sub alpine, temperate, sub temperate and Nepalese mycoflora.

Adhikari (2000e) reported 9 genera of Ascomycotina and 28 genera of Basodiomycotina from Maipokhari, East Nepal which were new to that area.

Adhikari (2001) reported 11 wild mushrooms species from Kathmandu valley, viz. *Hypomyces sp., Lecinum rugosiceps, Pleurotus cornucopiae, Polyporellus varius, Ramaria aurea, R. flava, R. Formosa, Sarcodon laevigatus* and *Suillus bovines*.

Adhikari & Adhikari (2003) collected 12 species of fleshy fungi from the vicinity of Duradanda, Lamjung. Among the collection, one species *Daedalea dickinsii* was recorded for the first time from Nepal.

Maharjan & Budhathoki (2003) collected 28 polypores specimens from Raniban, Pokhara. Among collection 3 species viz. *Coriolus hirsutus, Mocroporus xanthopus* and *Pycnoporus cinnabarinus* were studied in detail.

Pandey & Budhathoki (2003) reported *Rhizinia undulate* a wild inedible mushroom from the coniferous Pinus dominant forests of Champadevi, Kirtipur, Kathmandu.

Adhikari (2004) studied the mushroom poisoning and its state in Nepal. He found the annual casualty rate was between 15 and 30 in the urban areas.

Adhikari & Manandhar (2004a) recorded 2 species of *Amanita japonica* and *A. suchnopyramis* fron central Nepal.

Adhikari & Manandhar (2004b) recorded 4 species of wood rotting mushrooms. They were *Pleurotus sapidus, Fomes pomaceus, Panellus mitis* and *Fomitopsis rhodophaea*.

CHAPTER THREE

3. Description of study Area

3.1 Background of Study Area

The study area Bajrabarahi forest is located at Chapagaun VDC of Lalitpur district of Kathmandu Valley. Hanumante Khola, Manohara Khola and Bagmati River bound Lalitpur district at north and west. In the east lie Triveni hill, Phulchoki hill, Nagi hill and Dhuiling Khola. The study area is located between the latitudes 27^{o} 32' 13" and 27^{o} 49' 10" North and longitudes 85^{o} 11' 31" and 85^{o} 31' 38" East. The study area lies at a mean elevation of about 1350-1400 m. above sea level. There is a dry season from October to May and there's the wet season, the monsoon, from June to September. It has hot, dry and warm season from mid April to mid October. There is a very famous temple of Bajrabarahi in the centre of the forest. People visit this place for various purposes like for puja, for celebrating picnics and just for visiting the place.

3.2 Climate

The study area is characterized by a typical monsoon climate with rainy summer and dry winter. The rainfall pattern can best be described as variable both seasonally and geographically. Heavy rainfall occurs during the monsoon from early June to late September. The remaining eight months are more or less dry. The average annual rainfall exceeds more than 1600 mm. The meteorological data shows that the temperature of the valley varies from below 0 ^{0}C to beyond 30^{0}C during summer. This may be the reason why the valley shows successful growth of species, which are supposed to grow naturally in low land and also in highland though it is situated at 1300 m above sea level. The climatic records of the study area are shown in Fig 3.1. and 3.2.

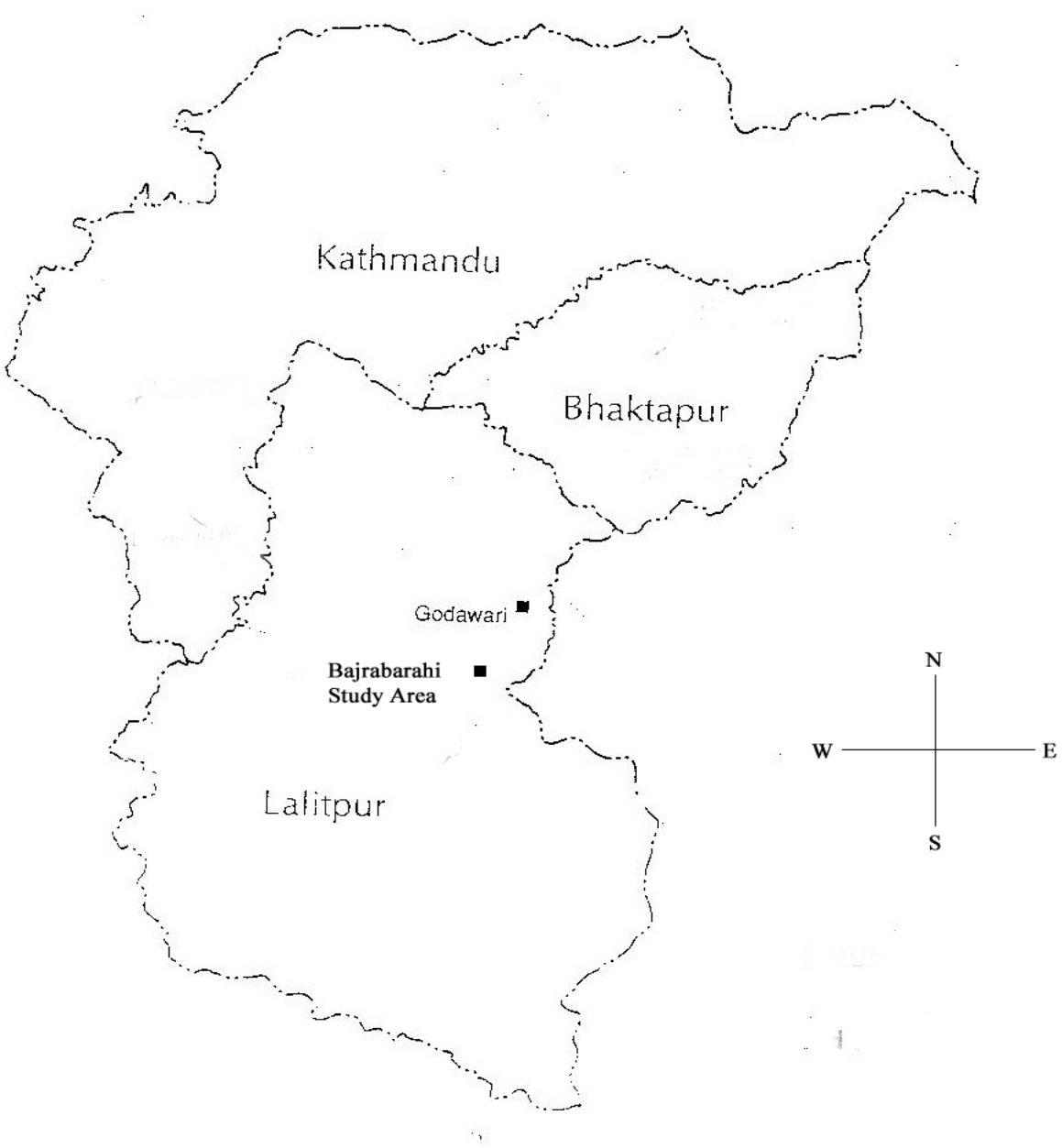


Fig 3.1 Map Showing the Study Area

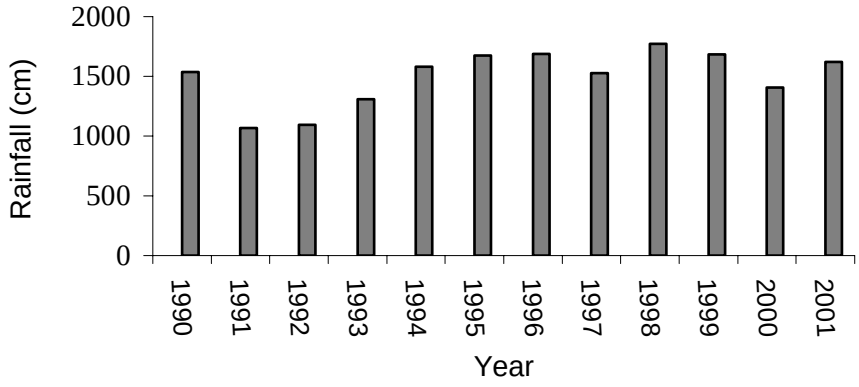


Fig 3.2 Annual rainfall in the year 1990-2002

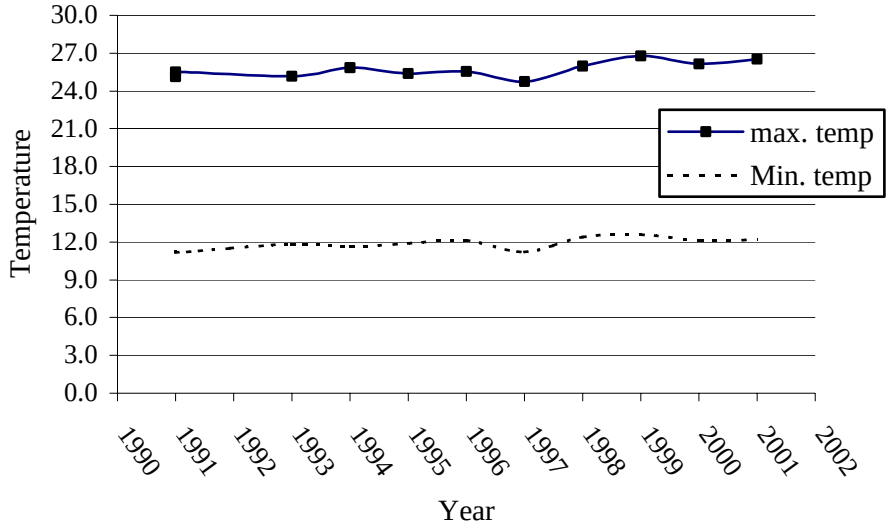


Fig 3.3 Maximum and minimum temperature in the year 1990-2002.

Source: HMG/Dept. of Climatology

3.3 Vegetation

Bajrbarahi forest is comprised of mixed evergreen forest of *Schima wallichii* and *Castanopsis indica* are the main forest components. The associated trees are *Alnus nepalensis, Albizzia* sp, *Ardisia marcrocarpa, Castanopsis tribuloides, Choerospondias axillaries, Eugenia* sp., *Myrica esculenta, Prunus cerasoids, Pyrus pashia, Quercus glauca, Rhododendron arboreum etc.* The common shrubs are *Arundinaria* sp, *Berberis aristata, Cassia occidentalis, Justicia adhatoda, Lantana camara, Vitex nigunde etc.* Common herbs *Boenninghusia albiflora, Cyanoglossum zeylanicum, Oxalis* sp, *Urtica dioca etc.*

3.4 Local community

Newar community mainly inhabits Chapagaun VDC. Most of the people depend on the agricultural products for their livelihood. They depend upon the forest products for various purposes such as for food and fire wood. They collect the twigs and fallen branches for firewood but there is a belief that one cannot take forest products like leaves, litters and seedlings because of curse. Most of these people go to the forest to search the wild edible mushrooms as it is delicious, but due to the lack of proper knowledge on edibility of mushrooms they have to face the problems like death, disease, allergy etc. They are suffering from these problems as they have only traditional knowledge, which is transferred to them through their ancestors. Due to this reason most of the valuable and delicious wild edible mushrooms are wasted in the forest due to lack of the proper knowledge on them.

CHAPTER FOUR

4. Material and methods

4.1 Equipments used

- Maps, compass, collecting permits etc
- Small notebook for recording data in the field.
- Pocketknife for unearthing whole entire specimens.
- Truffle, forks for finding hypogenous fungi.
- Warm and waterproof clothing, sturdy shoes, food water, first aid etc.
- Wooden basket (Bamboo) or cotton bag.
- Wax paper roll.
- Camera with macro (close up) lens.
- Color film.
- Grey colored board as background for photographs.
- Fungus dryer.
- Standardized data sheet for detailed notes
- Envelop for storing dried specimens
- Hand lens (10-20x magnification)
- Pens/Pencils
- Ruler for measuring mushrooms.
- White paper for spore prints.
- Thread.
- Brush for cleaning specimens.
- Reference books (field guide type

4.2 Collection of mushrooms

The collection of mushrooms was carried out during the rainy season and collection of specimen was made from various habitats. The collection period was from April to August 2001 and from April to August 2002. But, the collection of mushrooms at that time was quite difficult due to the leeches.

The fruiting bodies of mushrooms are produced in response to seasonal changes in environmental stimuli of natural forest such as rainfall and temperature. Information from local people was also used as reference for deciding the collection period. However, the site was visited frequently to check whether mushroom started growing or not. While collecting the mushrooms all parts and many specimens of same species were collected and photographed in their natural habitat before collection.

At the time of collection, field data on mushrooms and their environment specially the substrate on which they grow and the associated vegetation were recorded. For identifying mushrooms the morphological character such as colour, texture, shape and size of pileus, stipe were recorded in data sheets.

The mushrooms were immediately kept in a wax paper bar or in tissue paper after harvesting in fresh condition. Plastic bags were not used as it changes fungi into liquid mess on which bacteria and wound will develop. Each collected specimens from the same place or different place were tagged and placed in separate bags. Bamboo baskets were used for carrying the mushrooms collected in the field. In the absence of bamboo basket sometimes, plastic bags were used but all the collected mushrooms species were kept in wax paper bag or wrapped in a tissue paper.

4.3 Preservation of specimens

As we know that mushrooms are very delicate and possess maximum amount of moisture, they undergo rapid decay. So air-drying was considered as the best method for preserving mushrooms specimens. Few mushroom species *like Agaricus*, *Rusulla*, are very sensitive to insects. So in order to protect these specimens from insect and other fungal contaminaton species they were dried as soon as possible immediately

after collection. Species of *Boletus* may undergo rapid decay so they were dried immediately with the help of electric radiator. The processes of drying were done as follows:

- From the solar radiator or solar fryer.
- From an electric radiator.

After complete drying the mushroom specimens were kept in paper bags sprayed with fungicide and insecticides like carbon-bisulphate and small Napthalene bulbs are also kept inside to prevent it from insects. For the jelly species, the mixture of distilled water, alcohol and formalin or distilled water and formalin with 70:25:5 or 95:5 concentration was used.

4.4 Microscopic studies in laboratory

The well dried mushrooms species were brought to the laboratory for the microscopic studies. During this operation, the following process were done

First of all the dried mushrooms were taken and sections were prepared with the help of razor-blade. The selected thin sections were kept in distilled water for few minutes. Then the fine sections were selected and mounted in different glass-slide with a drop of 10% KOH solution (this solution revives the section to its original size for the measurement). Then the sections were covered with microscopic cover-slip and gently tapped with a blunt end of the needle and observed under 15x10 and 15x40 powers for the detailed study of the internal structures of the collected mushrooms. The specimens were studied at National Herbarium and Plant Laboratories, Godawari.

Primary data collection

The people working for the maintenance of the forest area actively participated during the mushroom collection. Data mainly included the local name, habit and habitat. The study area was densely inhabited by the Newar community. The local people used to visit the forest for collecting the wild edible mushrooms in the past but

nowadays there is the reduction in the production of mushroom. The local people due to the lack of proper knowledge about the edibility of wild mushrooms, they don't prefer to collect the mushrooms. The knowledge about the collected mushrooms was gained with the help of questionnaire survey from the local collectors. (Annex- 1)

Identification

In the field

The collection and certain morphological data of wild edible mushrooms were collected in the field as mentioned in the processing of fungal specimens above.

In the lab

The dried specimens were identified through their taxonomic character, studied in the lab (Godawari) with the help of Scientific Officer Mrs. Vidya Keshari Manandhar (National Herbarium and Plant Laboratory, Godawari). The preserved specimens were identified with the help of standard literatures(Adhikari, 2000; Bhandari(1991); Cotter (1998); Dickison, C. and Lucas, J. 1679; Imazeki,R., Otani,Y. and Hongo, T. 1988; Imazeki, R., Kobayashi,Y. and Aoshima, K. 1966; Rea,C. 1922; Kibby,G. 1979; Millar, O.K. 1984; Pegles, D. & Spooner, B.1997; Pacioni, G.1985; Phillips, R.,1981; Rinaldi,A.,Tyndalo,V.,1972; Singer R., 1986).

CHAPTER FIVE

5. FINDINGS

5.1 List of mushroom collected from the study site (Bajrabarahi forest, Chapagaun VDC, Lalitpur).

The total number of mushroom collected from the study area was 58. Among them 49 species were identified upto generic level and about 21 species were indentified upto species level. The list of mushrooms collected from the study area are as follows.

5.1 List of mushrooms collected from Bajrabarahi forest, Chapagaun VDC, Lalitpur.

S.N.	Col. No.	Col. Date	Genus	Local Name	Family	Edibility
1	0001NS	2057.2.07	*Marasmius rotula*		Tricholomataceae	Not edible
2	0002NS	2057.2.07	*Auricularia auricula-judae*	Kanne chyau	Auriculariaceae	Edible
3	0003NS	2057.2.07	*Isaria japonica*	Thaku mukha	Calvicipitaceae	Not edible
4	0004NS	2057.2.07	*Marasmius* sp.		Tricholomataceae	Edible
5	0005NS	2057.2.09	*Russula puellaris*		Russulaceae	Edible
6	0006NS	2057.2.09	*Trametes* sp.	Kathye chyau	Polyporaceae	Not edible
7	0007NS	2057.2.09	*Russula* sp.		Russulaceae	Edible
8	0008NS	2057.2.09	*Russula senecis*		Russulaceae	Not edible
9	0009NS	2057.2.09	*Russula solaris*		Russulaceae	Not edible
10	0010NS	2057.2.09	*Russula* sp.		Russulaceae	Edible
11	0011NS	2057.2.09	*Russula violeipes*		Russulaceae	Not edible
12	0012NS	2057.2.15	*Cantharellus* sp.		Cantharellaceae	Not edible
13	0013NS	2057.2.15	*Lepiota procera*		Amanitaceae	Not edible
14	0014NS	2057.2.15	*Russula foetens*		Russulaceae	Not edible
15	0015NS	2057.2.15	*Amanita* sp.		Amanitaceae	Not edible
16	0016NS	2057.2.15	*Russula* sp.		Russulaceae	Not edible
17	0017NS	2057.2.22	*Russula delica*		Russulaceae	edible
18	0018NS	2057.2.22	*Marasmius oreades*		Tricholomataceae	edible
19	0019NS	2057.2.22	*Clitocybe* sp.		Tricholomataceae	edible
20	0020NS	2057.2.22	*Russula* sp.		Russulaceae	edible
21	0021NS	2057.2.22	*Russula* sp.		Russulaceae	
22	0022NS	2057.2.22	*Russula* sp.		Russulaceae	edible
23	0023NS	2057.3.03	*Russula olivacea*	Duru Mukhan	Russulaceae	edible
24	0024NS	2057.3.03	*Pleurotus ostreatus*	Kanya chyau	Tricholomataceae	edible
25	0025NS	2057.3.03	*Fuscoboletinus* sp.		Boletaceae	Not edible
26	0026NS	2057.3.03	*Tremella* sp.		Tremellaceae	Not edible
27	0027NS	2057.3.03	*Cantharellus* sp.		Cantharellaceae	edible
28	0028NS	2057.3.03	*unidentified*		Boletaceae	Not edible
29	0029NS	2057.3.16	*Amanitopsis* sp.		Amanitaceae	Not edible
30	0030NS	2057.3.16	*unidentified*			Not Known
31	0031NS	2057.3.16	*Suillus grevilli*		Boletaceae	Not known
32	0032NS	2057.3.16	*unidentified*	Wangu mukhan		edible
33	0033NS	2057.3.16	*Polyporus* sp.	Kathye chyau	Coriolaceae	Not edible
34	0034NS	2057.3.28	*unidentified*			edible

35	0035NS	2057.3.28	*Coprinus* sp.	Gobre chyau	Coprinaceae	Not edible
36	0036NS	2057.3.28	*Marasmius* sp.		Tricholomataceae	Not edible
37	0037NS	2057.3.28	*Pseudocoprinus disseminates*	Gobre chyau	Coprinaceae	Not edible
38	0038NS	2057.3.28	*Coniphora puteana*			Not known
39	0039NS	2057.3.28	*Mycena* sp.		Tricholomataceae	edible
40	0040NS	2057.3.28	*Collybia* sp.		Tricholomataceae	edible
41	0041NS	2057.4.06	*Mycena* sp.		Tricholomataceae	Not edible
42	0042NS	2057.4.06	*unidentified*			Not known
43	0043NS	2057.4.06	*Tricholoma scalypluralum*		Tricholomataceae	Not edible
44	0044NS	2057.4.06	*Amanita* sp.		Amanitaceae	Not known
45	0045NS	2057.4.06	*unidentified*			edible
46	0046NS	2057.4.06	*Marasmius epiphyllus*		Tricholomataceae	edible
47	0047NS	2057.4.06	*Marasmius androsaceus*		Tricholomataceae	edible
48	0048NS	2057.4.06	*Laccaria laccata*	Jhari chyau	Lactariaceae	edible
49	0049NS	2057.4.06	*Mycena* sp.		Tricholomataceae	Not edible
50	0050NS	2057.4.06	*unidentified*			Not known
51	0051NS	2057.4.06	*Fustulina hepatica*	Cwella Mukhan	Fistulinaceae	edible
52	0052NS	2057.4.06	*Scleroderma verrucosum*		Lycoperdaceae	Not edible
53	0053NS	2057.4.12	*Agaricus* sp.		Agaricaceae	Not edible
54	0054NS	2057.4.12	*unidentified*			edible
55	0055NS	2057.4.12	*unidentified*			Not known
56	0056NS	2057.4.12	*unidentified*			Not known
57	0057NS	2057.4.12	*unidentified*			Not known
58	0058NS	2057.4.12	*Panellus* sp.		Tricholomataceae	edible

5.2 Key to the Enumerated Family, Genus and Species

Basidiocarp with somewhat thickened base and a prominent ring when young with attached gills.....*Trichlomataceae*

(a) Presence of small short stipe or lacking stipe.....*Pleurotus*

(b) Presence of thin stalk.....*Marasmius*

(c) Presence of thin stalk with papery basidiocarp.....*Mycena*

Basidiocarp usually coloured, stipe thick and short, attached gills.....*Russulaceae*

1(a) Mushrooms exudating latex.....*Lactarius*

1(b) Mushrooms not exudating latex.....2

2(a) Hymenium with sphaerocysts.....*Russula*

2(b) Hymenial surface lamellate.....3

3(a) Lamellae poorly developed.....*Cantharellus*

3(b) Lamellae well developed.....4

4(a) Volva present.....*Amanita*

4(b) Volva absent.....*Laccaria*

2(b) Hymenial surface enclosed in a cavity.....5

5(a) exoperidium splitting into rays.....*Geastrum*

5(b) exoperidium not splitting into rays.....*Scleroderma*

2(c) Hymenium lining interior of pits or tubes.....6

6(a) Tubes deep or if shallow, sterile on ridges; texture not soft and putrescent…….. *Polyporus*

5.3 Detailed studies on collected mushroom species.

5.1 *Auricularia auricula- judae* (Bull.:Fr.) Wettst.

-S.C. Teng, *Higher fungi of China*, 292, 1998

-R. Phillips, *Mushrooms and other fungi of Great Britain & Europe*, 224, 1981

Basidiocarp cuplike found in-groups. Receptacle 2-13 cm, grey or brownish, black when dried, cup shaped, hemispherical, and concave then ear shaped, flexuose.

Hymenium pale, whitish gelatinous (hyaline) loose and irregularly arranged septate hyphae.

Spores hyaline oblong or cylindrical, curved, 10-20 X 5-8 um

Smell pleasant like meat.

Colour grey or brownish.

Edible. Locally known as Kane chyau.

Specimen collected from old and rotten logs rarely on living trees, Bajrabarahi forest, Chapagaun,Lalitpur. Altitude 1400 m.-2057/2/07 No. 002NS.

April –June

Distribution – Britain, India, China, Europe, Nepal

2. *Pleurotus ostreatus* (Jacquin.:Fr.) Kummer

-Rea C., *British Basidiomycetes*, 445, 1980.

-R. Purkayastha, *Manual of Indian Edible Mushroom*, 111, 1985.

-R. Phillips, *Mushroom and other fungi of Great Britain & Europe*, 183, 1981.

Basidiocarp usually grows in clusters in dead tree trunks or branches rarely on living trees.

Pileus 8-11 cm or more broad, kidney shaped, golden brown later turns black on drying, surface smooth , margin incurved. Epicutis upto 120-140um, brownish, composed of 3-4um broad. Pileocystidia none. Subcutis 210-230 um thick, composed of hyaline, thin walled irregularly arranged, compactly interwoven hyphae of 5-7 um broad.

Stipe 7-7.5 X 2.5-3cm, white hollow Outer layer of stipe up to 50 um broad copmposed of smooth, septate, hyaline, compactly woven 3-3.5 um broad hyphae. Inner layer of stipe composed of hyaline, septate loosely interwoven hyphae of 3-4 um broad.

Lamellae 250-300 um thick, white later turns to brownish. Trama 130-160 um broad composed of hyaline, septate, compactly arranged 2.5-3 um broad hyphae. Subhymenium not distinct. Hymenium up to 80 um broad.

Basidia 4 spored, hyaline compactly arranged, 35-40 X 4.5-5 um

Spores 10-12 X 5 um, elliptic, hyaline, thin walled, smooth.

Smell similar to that of meat. Taste pleasant. Flesh white to creamy white.

Edible.

Specimen colleted from the trunk of *Castonopsis* tree, Bajrabarahi forest, chapagaun, Lalitpur. Altitude 1400m.- 2057/03/03 No. 0024NS.

April –June

Distribution – Britain, India, Europe,Nepal

3. *Laccaria laccata* (Scop.: Fr.) Cooke

Syn: ***Clitocybe laccata*** (Scop. ex Fr.) Kummer.

-R. Phillips, *Mushrooms and other fungi of Great Britain & Europe*, 52, 1981.

-Rea C., *British Basidiomycetes*, 290, 1980.

Basidiocarp usually grows in clusters on the soil where there is lots of humus.

Pileus 4-8 cm in diameter, flesh colour when moist later turns brown on drying,surface somewhat smooth, margin incurved. Epicutis upto 50um, light brown and composed of compactly arranged hyphae. Subcutis 150um, composed of compactly arranged hyphae, psileocystidia none.

Stipe 3-6x1.5-2 cm, light brown, central, cylindrical. Outer layer of the stipe upto 40-50um broad composed of hyaline, septate, smooth and compactly arranged 3-4um

broad hypahe. Inner layer of the stipe upto 120-150um broad composed of hyaline, septate, smooth and loosely arranged 3-5um broad hyphae.

Lamellae 250- 280um thick, light brown, not crowded, free. Trama 150-170 um broad, composed of hyaline, compactly arranged hyphae. Hymenium upto 60um broad. Sub-hymenium not distinct.

Basidia four spored,club shaped, hyaline, smooth, thin-walled,25-30 x 7-9 um. Sterigmata and cystidia not distinct. Spores 7-8 x 5-6 um, rounded, reticulate, hyaline, spiny.

Smell pleasant. Flesh light brown.

Edible. Eaten after boiling in the water.

Specimen collected from soil with dead and decaying leaves, Bajrabarahi forest, Chapagaun, Lalitpur. Altitude 1390m. – 2057/04/06 No. 0048NS

June -August

Distribution – Britain, America, Japan, Nepal.

4. *Fistulina hepatica* (Schaeff.) Fr.

-Rea.C., *British Basidiomycetes*, 629, 1980.

-R. Phillips, *Mushrooms and other fungi of Great Britain & Europe*, 224, 1981.

Sporophores solitary or in groups growing in a shelving fashion from dead tree trunks or stumps and rarely on living trees.10-20 cm high, 8-15 cm broad, very soft, juicy, dark red colour, semicircular or kidney shaped. When young the surface is sticky, moist and covered with darker minute elevations on the under surface.

Stipe lateral, very short and thick sometime the stipe almost lacking but often upto 15 cm. Outer layer of the stipe upto 80um, dark red colour and composed of hyaline, smooth, septate, 3-4um broad hyphae. Inner layer of the stipe upto 200um and composed of hyaline, septate, compactly arranged hyphae of 3-4um broad. The pore tubes in the hymenial surface at first oval angular somewhat circular.

Smell pleasant like meat.

Locally known as cwella mukhan.

Edible.

Specimen collected from the tree trunk, Bajrabarahi forest, Chapagaun, Lalitpur. Altitude 1370 m. -2057/04/06 No. 0051NS

July- August

Distribution –Britain, Europe, India, Nepal

5. *Russula delica* Fr.

-R. Phillips, *Mushrooms and other fungi of great Britain & Europe*, 91, 1981.

-S.C. Teng, *Higher fungi of China*, 459, 1998

Basidiocarp usually grows solitary on decaying leaves.

Pileus 17-18 cm or more broad, funnel shaped, creamy white later turns into chocolate brown on drying, surface smooth, margin strongly enrolled flesh thick. Epicutis 70-100 um, hyaline, composed of irregularly arranged hyphae. Subcutis 30-35 um thick, composed of creamy white, thin walled irregularly arranged hyphae of 5-6 um broad.

Stipe 8-9 x5-6 cm, creamy white, short, cylindrical, hollow. Outer layer of stipe upto 100um broad, composed of smooth, septate, hyaline 5um broad hyphae. Inner layer of stip composed of hyaline, septate, irregularly arranged hyphae of 5 um broad.

Lamellae 180-200um thick, white, free, very crowded. Trama 60-80 um broad, composed of hyaline, compactly arranged hyphae. Hymenium upto 40um broad. Sub-hymenium not distinct.

Basidia four spored,club shaped, hyaline, smooth, thin-walled,8-12 x 2-3 um. Sterigmata pointed 3-4 x 2-3 um. Cystidia 4-5um, club shaped, swollen base, apex rounded, hyaline thin walled.Spores 7-8 x7-8 um, smooth, oval, hyaline, thin walled.

Smell like meat. Flesh white.

Edible.

Specimen collected from dead and decaying leaves, Bajrabarahi forest, Chapagaun, Lalitpur. Altitude 1400 m. -2057/02/22 No. 0017NS

May-June

Distribution- Britain, China, Europe, India, Nepal.

6. *Russula puellaris* Fr.

-S.C. Teng, *Higher fungi of China*, 468, 1998

-R. Purkayastha, *Manual of Indian Edible Mushroom*, 119, 1985.

Basidiocarp usually grows solitary on soils where there is lot of humus. Mostly eaten by insects.

Pileus 7-8 cm or more broad, expanded and flattened, white (milky colour) later turns into brown on drying, surface smooth. Epicutis 30-50 um, hyaline, composed of irregularly arranged hyphae of 5 um. Subcutis 40-65 um thick, composed of creamy white, irregularly arranged hyphae of 5 um broad.

Stipe 4.5- 5 x 5.5-6 cm, white, short, cylindrical, hollow, club shaped. Outer layer of stipe upto 100um broad, composed of smooth, septate, hyaline compactly woven 5um broad hyphae. Inner layer of stipe composed of hyaline, septate, irregularly arranged hyphae of 5 um broad.

Lamellae 50-100um thick, white, free, very crowded but turns into brownish on drying. Trama 120-140 um broad, composed of hyaline, septate, loosely arranged hyphae of 2.5-3 um broad. Hymenium upto 50-70 um broad. Sub-hymenium not distinct.

Basidia four spored, club shaped, hyaline, smooth, 12-20 x 3-4 um. Sterigmata pointed, smooth, hyaline, 2.5-3 x 1-1.5 um. Cystidia not distinct. Spores 5-7.5 x 5-7.5 um, oval, spiny, hyaline, thin walled.

Smell pleasant. Flesh white.

Edible(eaten as raw as well as cooked).

Specimen collected from dead and decaying leaves, Bajrabarahi forest, Chapagaun, Lalitpur. Altitude 1400m. -2057/02/09 No.005NS

May-June

Distribution- China, India, Nepal

7. *Marasmius oreades* (Bolt:Fr.) Fr.

-R. Phillips. *Mushrooms and other fungi of Great Britain & Europe*, 66, 1981.

-G. Pacioni. *The Mcdonald's encyclopedia of Mushrooms and Toadstools*, 31, 1985.

-C. Dickinson & J. Lucas. The Encyclopedia of Mushrooms, 223, 1979.

Basidiocarp usually grows in clusters on tree trunk.

Pileus 3-4 cm broad, expanded and flattened, creamy brown, surface rough papery. Epicutis 30-40 um, hyaline, composed of compactly arranged hyphae. Subcutis 140-160 um thick, hyaline, composed of irregularly arranged hyphae of 5-6 um broad.

Stipe 7-7 x 1-2 cm, white, thin, cylindrical, hollow. Outer layer of stipe upto 50um broad, composed of straight, brownish, septate, 2.5-3um broad hyphae. Inner layer of stipe composed of hyaline, straight, septate, 2.5-3.5 um broad hyphae.

Lamellae 100-150um thick, white, later turns into brownish on drying, free not crowded, simple. Trama 80-100 um broad, composed of hyaline, smooth, irregularly arranged 3-5 um broad hyphae. Hymenium upto 30-50 um broad. Sub-hymenium not distinct.

Basidia four spored, club shaped, hyaline, smooth, 15-20 x 3-5 um. Sterigmata and Cystidia not distinct. Spores 4-6 x 7-8 um, oval, somewhat elongated, hyaline, thin walled.

Smell pleasant. Flesh creamy brown.

Edible.

Specimen collected from the dead and decaying logs, Bajrabarahi forest, Chapagaun, Lalitpur. Altitude 1380 m. 2057/02/22 No. 0018NS

May-June

Distribution- Europe, Britain, India, Nepal

8. *Marasmius epiphyllus* (Pers. ex Fr.) Fr.

Syn. *Androsacens epiphyllus* (Pers. ex Fr.) Fr.

-R. Phillips, *Mushrooms and other fungi of great Britain & Europe*, 66, 1981.

Basidiocarp usually grows in groups on dead and decaying logs.

Pileus 2-3 cm broad, expanded and flattened, white to creamy white, membranous, radially wrinkled, slightly fleshy. Epicutis and Subcutis not distinct but composed of pale yellowish, septate loosely arranged 2.5-4 um broad hyphae. Pileocystidia absent.

Stipe 1.8-2 x 0.4-1 cm, brown, cylindrical, hollow, central. Outer layer of stipe upto 80-100um broad, composed of hyaline, septate, hyphae. Inner layer of stipe upto 120-150 um composed of hyaline, septate, longotudinally arranged hyphae.

Lamellae 100-150 um thick, creamy white, free, not crowded , simple. Trama 100-120 um broad, composed of hyaline, septate, loosely interwoven hyphae of 2-3 um broad. Hymenium and sub-hymenium not distinct.

Basidia four spored, club shaped, hyaline, thin walled, 15-20 x 3-5 um. Sterigmata and Cystidia not distinct. Spores 3-5 x 7.5-10 um, oval broadly elliptical, smooth walled.

Smell pleasant. Flesh creamy white.

Edible. Grows in cluster.

Specimen collected from the dead and decaying logs, Bajrabarahi forest, Chapagaun, Lalitpur. Altitude 1370m. 2057/04/06 No. 0046NS

June –July

Distribution- Britain, Europe, India, Nepal.

9. *Russula olivacea*

- G. Pacioni. *The Macdonald's, encyclopedia of Mushrooms and Toadstools*, 144, 1985.

Basidiocarp usually grows solitary on dead and decaying leaves.

Pileus 10-15 cm broad, expanded and flattened, greenish white, surface smooth, flesh thick. Epicutis 100-150 um, hyaline, composed of irregularly arranged hyphae. Subcutis 150- 170 um thick, composed of hyaline, thin walled irregularly arranged hyphae of 2.5-4 um broad. Pileocystidia absent.

Stipe 8-10 x 5-7 cm, creamy white, cylindrical, hollow. Outer layer of stipe upto 100um broad, composed of smooth, septate, hyaline hyphae. Inner layer of stipe upto 130 um, composed of hyaline, septate, loosely arranged hyphae of 5 um broad.

Lamellae 180-200um thick, white, free, very crowded. Trama 120-150 um broad, composed of hyaline, septate, loosely arranged hyphae. Hymenium upto 50um broad. Sub-hymenium not distinct.

Basidia four spored, club shaped, hyaline, 20- 25 x 3-5 um, compactly arranged. Sterigmata pointed, thin walled 2.5-3 x .75-1 um. Cystidia not found. Spores 5- 7.5 x 5-7.5 um, smooth, oval, hyaline, thin walled.

Smell pleasant. Flesh white.

Edible. Eaten as raw by local collectors just by peeling off the pileus.

Specimen collected from dead and decaying leaves, Bajrabarahi forest, Chapagaun, Lalitpur. Altitude 1390m. 2057/03/03 No. 0023NS

June-August

Distribution- India, China, Nepal

10. *Marasmius androsacens* (L.) Fries

-G. Pacioni. The Macdonald, *Encyclopedia of mushrooms and Toadstools*, 28, 1985.

-R. Phillips. *Mushrooms and other fungi of Great Britain and Europe*, 66, 1981.

Basidiocarp usually grows in group on dead and decaying logs. Pileus 4.4-1 cm. Broad, fairly umblicate, radially striate, whitish or washing to (or entirely) pinkish brown or cocoa brown. Gills fairly distant, cap coloured.

Epicutis and sub cutis composed of broad hyaline, loosely arranged hyphae of 5 mm broad.

Stipe 3-6 x 0.1 cm, filiform, strong, black, glabrous, straight twisted and striate. Outer layer of stipe upto 80-90 um broad, composed of hyaline, septate hyphae brownish in colour arranged in parallel to each other.

Lamellae 150-170um thick, white, free, very crowded. Trama 70-85um broad, composed of hyaline, septate, loosely arranged hyphae. Hymenium upto 40um broad. Sub-hymenium not distinct.

Basidia four thin walled, hyaline, 20- 22.5 x 2.5-3 um, compactly arranged. Sterigmata not distinct. Cystidia not distinct. Spores 4- 4.5 x 5-5.5 um, smooth, oval, brownish, thin walled.

Smell pleasant. Flesh white.

Edible but edibility of no value because of its small size.

Specimen collected from dead and decaying leaves and grows in large number, Bajrabarahi forest, Chapagaun, Lalitpur. Altitude 1380m. 2057/04/06 No. 0047NS

Found in autumn.

Distribution- Britain, Europe, China, India, Nepal

CHAPTER SIX

Result and Discussion

6.1 Result

The present study is based on the information available from the questionnaires asked to the local collector and consumer of wild edible mushrooms of Bajrabarahi. The field survey visit was accompanied with the forest keeper. Various specimens from different genus and species were gathered in the forest. During the collection the identifying characters and their habitat were also noted. Along the collection, local people were interviewed in order to get their knowledge about the mushrooms. But unfortunately very few people have the traditional knowledge about the edibility of the wild mushrooms which they received from their ancestors.

The most favourable season for the growth of the wild mushrooms starts from the beginning of the rainy season (April to till September). All the collected species like *Marasmius, Auricularia, Isaria, Russula, Amanita, Cantharellus* were the mushrooms having short life period where as *Pleurotus*, some species of *Scleroderma*, *Polyporus* have long life period and can be found till the end of September. The area consists of oak forest and mixed broadleaved forest. Many species on wood habitat like *Pleurotus*, *Fistulina*, *Polyporus* etc were abundantly distributed along the forest.

A total of 58 species were collected from the forest. Out of them 48 species were identified up to generic level belonging to 15 families. The largest families were Russulaceae and Trichlomataceae including 14 species in each; followed by Amanitaceae- 4 species; Boletaceae- 3 species, Cantharellaceae, and Coprinaceae 2 species in each and 1 species each in Auriculariaceae, Agaricaceae, Calvicipitaceae, Coriolaceae, Fistulinaceae, Lactariaceae, Lycoperdaceae, Polyporaceae and Tremellaceae. (Fig 6.1)

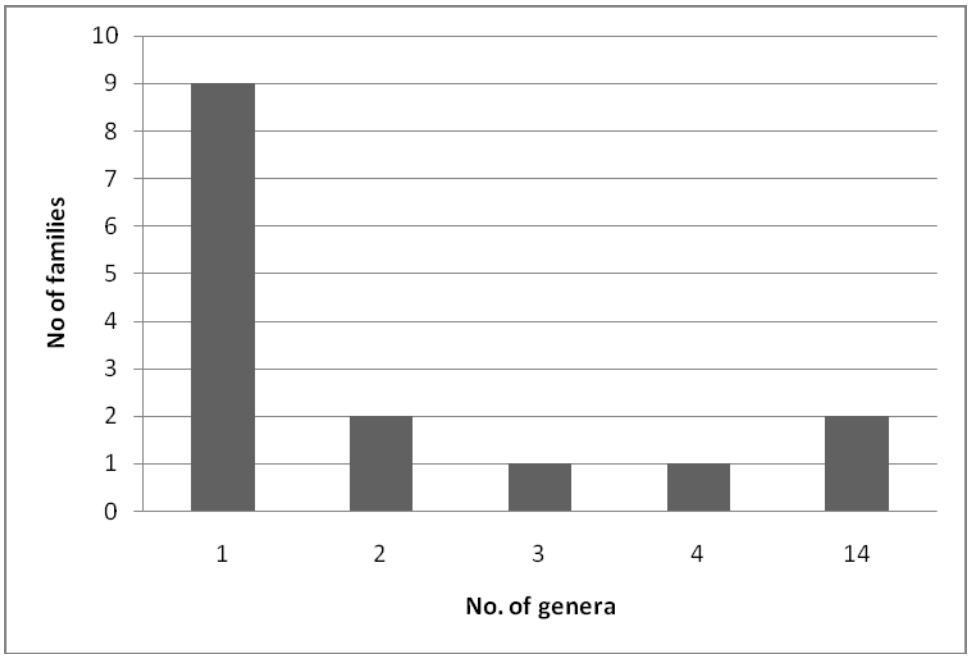


Fig 6.1 The number of Families with their respective genera in Bajrabarahi Forest

Russula was the largest genus consisting 14 species, which is followed by *Marasmius*- 6 species; *Mycena*- 3; *Amanita* and *Cantharellus* -2 species; remaining 21 genera with 1 species and the rest 10 species were unidentified. All the species enumerated in the present study area have been reported previously by different mycologists from different areas. The present study couldnot find any mushroom of cultural and religious value.

Out of 48 species, 10 species were studied in details which are as follows. *Auricularia auricula-judae, Pleurotus ostreatus, Fistulina hepatica, Laccaria laccata, Russula delica, R. olivacea, R. puellaris, Marasmius oreades, M. Epiphyllus and M. androsacens*. Out of these 10 species, *R. olivacea*, *Marasmius epiphyllus* and *M. androsacens* were reported new to Nepal. Out of these collected specimens *Russula puellaris, Marasmius oreades, Pleurotus, Laccaria, Polyporus* were found high at every type of habitat in the study area.

The mushrooms were found to be growing on dead logs, decayed leaves, and the trunk covered with thick layers of algal compounds. The number of species found growing on dead and decaying leaves were 28, on the living tree were 9, on the dead tree and decaying logs were 9, on the soil were 10 and on the animal dung was 2 (Fig

6.2). According to the climatic condition, the mushroom starts growing from the month of April up to end of September.

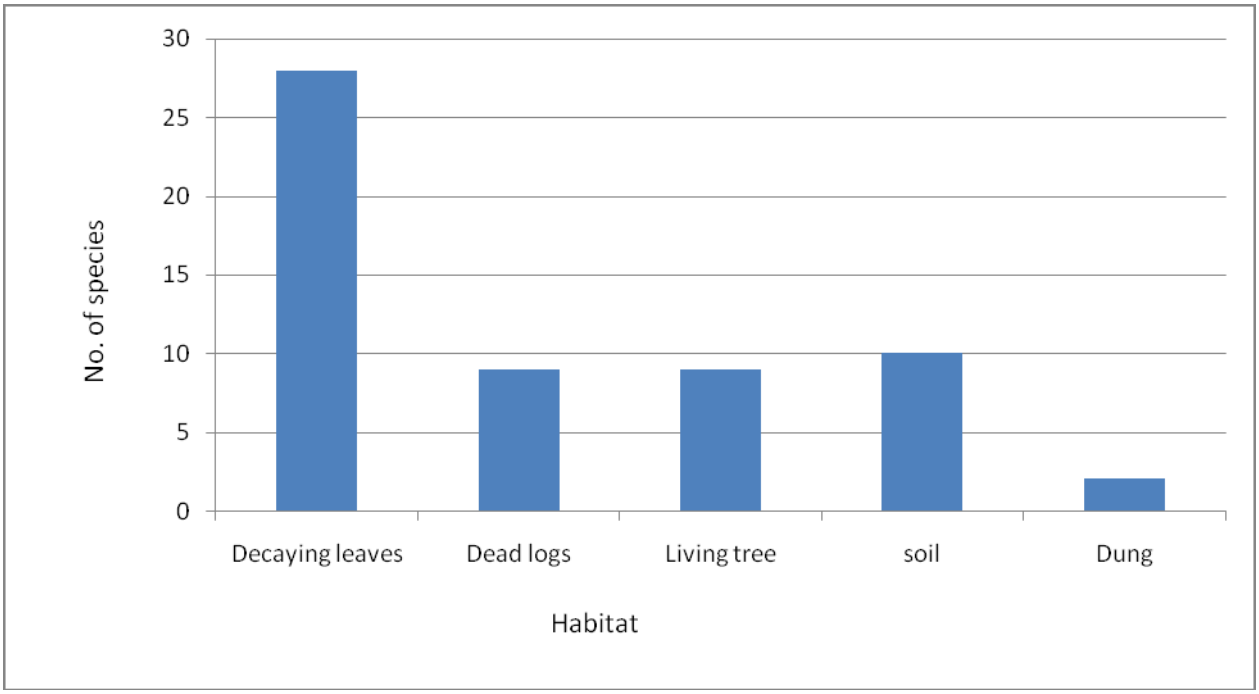


Fig 6.2 Distribution of mushroom on the basis of their habitat in Bajrabarahi forest

It was observed that most of the people in the study area were fond of collection and consumption of wild mushrooms. The present study area was once very famous for the wild mushrooms. Most of the collectors collect edible mushrooms from the natural habitat. Most of the recorded species found were edible. Among the total species enumerated, 23 species were found to be edible (Table 5.1).

The study area was highly popular in yielding edible mushrooms of different categories. The traditional indigenous people in the area were exploring and providing ethnomycological knowledge to their descendants. Through their knowledge only few people were benefited by obtaining nutritional food, which is highly competitive to other vegetables. The protein contents within the wild mushrooms eliminate the thirst of meat. Among the collected species it was found that *Pleurotus*, *Fistulina*, *Russula* were much preferred by the local people. All these collected species are one of the most important minor forest products and locally

traded. The Newars and Tamangs of the study area were solely dependent upon the wild mushrooms for vegetables. They also trade these mushrooms few years ago but nowadays the growth of the mushrooms is very low.

Beliefs about the edibility of wild mushrooms found on the study areas other than Rinaldi & Tyndalo, 1985; Adhikari, 1993 were as follows:

- Mushrooms species eaten by the insects are edible.
- Mushrooms which are peeled off easily are edible.
- Mushrooms growing on dead logs, fodder plants are generally edible.
- Mushrooms with sharp bright colour are poisonous.
- Mushroom growing on the dung are poisonous.

The younger people are not allowded to collect wild mushrooms as they have little knowledge on the wild edible mushrooms. So they may misidentify the mushrooms and may get serious problems causing to death.

6.2 Discussion

The present study has the following perspectives of study. First major objective was to collect, identify and enumerate the mushrooms growing in the forest of Bajrabarahi forest; second objective was to conduct detail study on the structure of some important edible mushrooms from that area. For the identification of specimens of mushroom common methods of collection, preservation and microscopic study was applied.The study area was visited more than 8 times through out the mushroom growing season with the local collectors. Though the result of this study cannot predict the total number of mushroom growing in that study area, it will help one to see the diversity of wild mycoflora.

Local people have belief that if anyone took the plants from the Bajrabarahi forest the wind would take them back to the forest. So the forest is very dense and not destroyed although it is surrounded by agricultural land and residential area. The thick layer of fallen leaves and twigs has helped to develop suitable environment for the growth of the wild mycoflora. Out of 58 specimens of mushroom collected, 48 species were identified upto generic levels belonging to 15 families. The families are Auriculariaceae, Amanitaceae, Agaricaceae, Boletaceae, Cantharellaceae, Coprinaceae, Coriolaceae, Calvicipitaceae, Fistulinaceae, Lactariaceae, Lycoperdaceae, Polyporaceae, Russulaceae, Tricholomataceae and Tremellaceae.

Out of 48 species, 10 species were studied in detail. So the spore prints of the collected mushroom were not taken. None of the mushrooms collected from the study area were religious. The genus *Russula* comprises the larger number of species. Among the species of *Russula*; *R. delica*, *R. puellaris*, *R. senecis* have been reported from the present study were also reported by Adhikari (1999d) from in and around the Kathmandu Valley. 15 species and 2 varieties of the genus *Russula* have been reported from in and around Kathmandu valley (Adhikari, 1999d).

The edible species *Laccaria laccata* (Scop.:Fr.) Cooke. reported from the present study has also been reported by Cooke from Arun Valley (Balfour-Browne, 1968), Bajrabarahi and Nagarjun (Pandey, 1976) and Godawari (Singh and Nisha, 1976)

which supports the present findings but not from tropical belts where as *L. amethystine* has been reported only from Hetauda by Pandey in 1976.

The edible species *Auricularia auricula-judae* reported from the present study has been already reported from Manichur (Adhikari, 1976, 1991c); market (Adhikari, 1987); Kalleitar (Bhandary, 1991) and on stump of Grevelia robusta, in front of Narayanhity, Kathmandu (Adhikari, 1996b; Adhikari et al., 1996b).

Pleurotus ostreatus commonly known as kanya chyau has been reported from Nagarjoon (Pandey, 1976); market & Manichur (Adhikari, 1976) and Gorepani (Bhandary, 1991). Other species of *Pleurotus* such as *P. ostrestus* var *magnificus* has been reported on stump of *Q. semicarpifolia*, Phulchoki (Singh & Nisha, 1976); *Pleurotus* sp. from Kakani, Lele (Pandey, 1976); Manichur (Adhikari, 1976); Ghoretabela (Cotter, 1987).

The edible species of *Fistulina hepatica* found in the study area has been previously reported from Surya Vinayak by Singh, S. C. and Nisha (1976), C.Rea (1980) and R. Phillips (1981) which is also listed in edible mushrooms of Nepal by Bhandary 1999, Adhikari 2000.

The *Marasmius oreades* found in the study area has been previously reported from Phulchowki by Singh, S. C. and Nisha (1976), R. Phillips (1981), G. Pacioni (1985), C. Dikinson & J. Lucas (1979), Ramsbottom (1954), Miller (1972) and listed as edible mushroom by Bhandary 1999, Adhikari 2000.

Out of 10 detail studied species from Bajrabarahi, 3 species-*Russula olivacea*, *Marasmius epiphyllus* and *M. androsacens* have not been reported from Nepal. These species have been identified on the basis of the measurement of pileus, stipe and the characteristic feature of pileus, stipe and gill following measurements given by G. Pacioni(1985), R. Phillips(1981). Therefore these species are new record for Nepal. All the 58 species have been deposited in TUCH Herbarium at Central Department Botany with collection No. 0001NS to 0058NS.

All the mushroom specimens were collected from the habitat of mixed forest of *Castonopsis indica* and *Schima wallichii*. Out of these collected specimens *Pleurotus, Laccaria, Polyporus* were dominant at every type of habitat in the study area. All these species are parasitic to the host plants. Most of the recorded species are found to be growing on dead logs, decayed leaves, and the trunk covered with thick layers of algal compounds. The study area was a religious forest. The dead and fallen logs are not allowed to collect. Thus, the abundant dead and fallen logs have provided a good substratum for the growth of wild mycoflora.

In the past year serious mushroom poisoning was reported causing death of whole family living nearby the Bajrabarahi forest. As a matter of fact, mushroom hunting is an art where trial and error and 'Do it yourself" methods do not count. Moreover this is a skill where experience and patient prevails (Bhandary, 1999). The mushroom consumers should follow some safely rules in order to get rid of mushroom poisoning one should collect familiar specimens only, consume the freshly picked only, should not take young children during collection of mushrooms, should collect the species of mushrooms separately, should consume small amount at first.

Local people usually add vinegar while cooking mushroom to minimize the poisonous effect of mushroom. Some use garlic and silver spoon or coin to see the toxicity of the mushroom but sometime it doesnot work. Adding vinegar is a worldwide method to minimize mushroom poisoning. Many mycologist such as Ramsbottom, (1954); Rinaldi and Tynaldo (1972); Purukayastha and Chandra (1985); Bhandary (1984) and Adhikari (2000) mentioned about the use of vinegar. One interesting thing observd was that one of the old woman named 'Neel Agi' used to collect all types of mushroom growing in the forest and dried them in the sun. She used to consume the dried mushrooms in winter boiling in water adding spices. The mushroom when dried in the sun may be its toxicity is reduced through exsiccation and it doesnot effect the human. (Rinaldi and Tyndalo 1972).

CHAPTER SEVEN

CONCLUSION

The area under investigation is sub-tropical type. The mushroom diversity was found to be rich in the study area. Altogether 58 species of mushroom were collected, 48 species were identified upto generic level belonging to 15 families. The largest families were Russulaceae and Tricholomataceae including 14 species each.

Out of 48 species only 10 species were studied in details which are as follows. *Auricularia auricula-judae, Pleurotus ostreatus, Fistulina hepatica, Laccaria laccata, Russula delica, R. olivacea, R. puellaris, Marasmius oreades, M. epiphyllus and M. androsacens*.

Out of the 10 species studied in detail, 3 species-*Russula olivacea, Marasmius epiphyllus* and *M. androsacens* were new record for Nepal. 23 of the recorded species found were edible. The number of mushroom species found growing on dead and decaying leaves were 28, on the living tree were 9, on the dead tree and decaying logs were 9, on the soil were 10 and on the animal dung was 2.

Most of the collected specimens were found to be recorded by the previous mycologists. On the basis of interview it was found that the mushroom diversity was high in the study area in the past years but not the mushroom diversity is low due to the probihibition of cattle grazing inside the forest.

According to the mushroom collectors none of the mushrooms collected were used for religious and cultural purpose.

Hence everybody should be responsible for the preservation of mushrooms as it is one of the most important products of the forest.

RECOMMENDATION

It is recommended that the fruitful forest should be maintained for the growth of the mushrooms. According to the villagers the growth of mushrooms is decreased due to the the prohibition of cattle grazing inside the forest. The cattle dungs also play an important role for the growth of the mushrooms. The grazing of the cattle inside the forest should be allowded once a week. So that the traditional occupation will remain and the economic status of the ethnic group like Tamang and Newar will engaged in mushroom trade and consumers from all sights will be up-lifted directly as well as indirectly. Local people are facing risks such as danger of wild animals like snake, boar, leeches; accidents during climbing dead and decaying trees and for identification of wild mushrooms.

Many mushrooms are rich source of nutrition, some are medicinal and many fungal flora help to maintain the ecological balance, yet there has been hardly any attempt to conserve them. So their natural habitat should be protected; the commercial exploitation of the wild mushrooms should be regulated and they should be chemically tested.

Thus the investigation on the wild edible mushrooms should be given priority by encouraging researchers and strengthening the institutes involved in such works.

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ANNEXES

Annex 1 **Questionnaire**

Date :
Name :
Address:
Sex: Age: Occupation: Caste:

1. How often do you go for mushroom collection?
2. Why do you collect mushroom?
3. What do you think about consuming mushroom?
4. Which season do you go for collection?
5. Do you know local names of the mushroom?
6. How do you know the local names?
7. How do you differentiate between the edible and poisonous mushroom?
8. How do you collect mushroom? With hands or the tools.
9. Do you use it as soon as you harvest it?
10. If not how do you store the mushroom?
11. Do you know the method to minimize the poisonous nature of the mushroom?
12. Have you ever sold mushrooms?
13. Can you name the mushrooms which are mostly preferred by the consumers?
14. Do you know the mushroom having any religious, cultural and historical value?
15. Do you know some other values or the mushroom used for special occasion?
16. Have you faced any problem during the mushroom collection?
17. What kind of problems you have to face?

PLATES

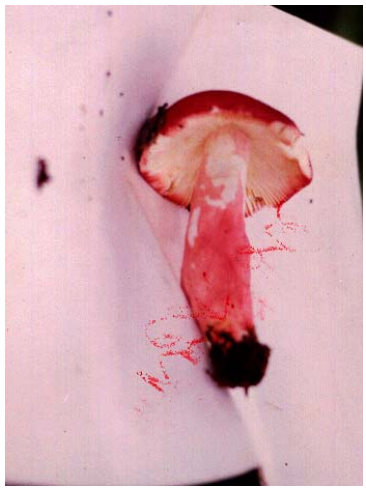
Marasmius oreades

Lepiota procera

Cantharellus sp.

Russula solaris

Rusulla senecis



Rusulla puellaris

Marasmius rotula

Coniphora puteana

Mycena galericulata

Dorsal view

Ventral view

Pleurotus ostreatus

Isaria japonica

Russula olivacea

Marasmius epiphyllus

Marasmius androsacens

Dorsal view

Ventral view

Fistulina hepatica

Laccaria laccata

Ventral view

Dorsal view

Russula delica

Suillus grevillei

Pseudocoprinus disseminatus

Scleroderma verrucosum

Auricularia auricula-judae

Russula violeipes

Ventral view

Dorsal view

Tricholoma scalypluralum

Ventral view

Dorsal view

Clitocybe sp.

Fuscoboletinus

Mycena sp.

Russula sp.

Marasmius sp.

Russula sp.

Russula sp.

Wangu mukhan (local name)

Russula sp.