MUSHROOM DIVERSITY IN LUMLE (KASKI) AND STUDY OF CLAVARIALES FROM LUMLE AND VICINITY OF KATHMANDU VALLEY, NEPAL

A Dissertation submitted to
Central Department of Botany, Tribhuvan University
For the Partial Fulfillment of the Requirements for
Masters of Science in Botany

Submitted by
Shiva Devkota
Roll Number 39/058-059
Symbol No. 913
T.U. Regd. No. 23024-94

CENTRAL DEPARTMENT OF BOTANY
TRIBHUVAN UNIVERSITY
KIRTIPUR, NEPAL
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TRIBHUVAN UNIVERSITY

INSTITUTE OF SCIENCE AND TECHNOLOGY

CENTRAL DEPARTMENT OF BOTANY

Kirtipur, Kathmandu
Nepal

RECOMMENDATION

This is to certify that Mr. Shiva Devkota has carried out the dissertation work entitled **"MUSHROOM DIVERSITY IN LUMLE (KASKI) AND STUDY OF CLAVARIALES FROM LUMLE AND VICINITY OF KATHMANDU VALLEY, NEPAL"** under my supervision. The entire work is based on the collection of specimens as primary data by the student. This result has not been submitted elsewhere for any other academic degrees. I, therefore, recommend this dissertation to be accepted for the partial fulfillment of Masters Degrees in Botany from Tribhuvan University, Nepal.

Date: 21April 2005

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Kirtipur, Kathmandu, Nepal

LETTER OF APPROVAL

This is to certify that the dissertation work entitled **"MUSHROOM DIVERSITY IN LUMLE (KASKI) AND STUDY OF CLAVARIALES FROM LUMLE AND VICINITY OF KATHMANDU VALLEY, NEPAL"** submitted by Shiva Devkota has been accepted as a partial fulfillment of Masters Degree of Botany.

Date: 19 June 2005

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Acknowledgements

At first I would like to express my sincere gratitude to my supervisor Dr. R.D. Tiwari, Asso. Prof., Central Department of Botany, Kirtipur, whose continuous supervision and inspiration helped me to present thesis in this form.

I am very grateful to Prof. Dr. P.K. Jha, Head of the Central Department of Botany, T.U. for providing laboratory facilities and administrative help. I am also thankful to all the faculty members of C.D.B., T.U. for their suggestions and backup.

A debt of gratitude is owed to Dr. M.K. Adhikari, Chief, National Herbarium and Plant Laboratories, Godavary, Lalitpur for providing, guidance, suggestions, necessary literatures, laboratory facilities and for going through the manuscript. Without his generous encouragement I might never have had this moment. At the same time, this will be a strong source of inspiration for me further in the days to come.

My thanks are also due to Mrs. Vidhya Keshari Manandhar, Research Officer, National Herbarium and Plant Laboratories, Godavary for her kind help, guidance and a number of valuable insights during laboratory work. All the members of KATH are also thankful for their cooperation during laboratory works.

I would like to acknowledge with my gratitude to mycologist Prof. S. C. Singh, RECAST for his encouragement and suggestions.

I am indebted to Dr. K.C. Poudel, Joint Secretary, HMG / Nepal, MFSC, for his moral encouragement, critical suggestions and keen interest on my research work.

Grateful thanks are also due to Dr. Khem Raj Bhattarai, Research Officer, National Herbarium and Plant Laboratories, Godavary for his suggestions, inspirations, help in ordination analysis, necessary references and going through the manuscript of statistical analysis part. Mr. Kamal Aacharya is thankful for his timely suggestions and cooperation in data analysis and field works.

I am sincerely thankful to the local people of Lumle specially Asarey Dai, wild mushroom hunter who accompanied me during my field visits, Mr. Bishnuhari Devkota and Mr. Balaram Devkota of Australian Camp, Lumle for their help in accommodation during field trips. Mrs. Nirmala Adhikari of LARC, Lumle is thankful for her information. Mr. Bharat Tamang of Dakshinkali and Fuchhey Bhai of Nagarkot are memorable for their help in mushroom collection.

My friends Mr. Ananda Thapa, Dr. Ranjana Parajuli, Dr. Himalaya Parajuli, Mr. Binaya Raj Poudel, Mr. Ganesh Devkota, Mr. Krishna Devkota, Mr. Narayan Devkota, Mr. Bharat Gurung, Mr. Ramesh Basnet, Mr. Rajendra Ojha, Mr. Raghu Ram Parajuli, Mr. Jeevan Ranabhat, Mr. Rosan Poudel and many others helped me collecting the specimens and I am greatly indebted to them. Mr. Ashim Devkota of Mapple, Pulchowk is thankful for providing maps of study areas.

No words can express my heartful gratitude to my parents, sister Sabitri and brother Nirmal, whose help for collection of mushrooms and their inspiration, patience and care has always made me motivated and dedicated to my study and career building.

Date: 21 April 2005 **Shiva Devkota**

LIST OF ABBREVIATIONS

%	-	percentage
µm	-	micron meter
^{0}C	-	degree Centigrade
ABC	-	Annapurna Base Camp
ACAP	-	Annapurna Conservation Area Project
asl	-	above sea level
CCA	-	Cannonical Correspondence Analysis
CDB, TU	-	Central Department of Botany, Tribhuvan University
DCA	-	Detrended Correspondence Analysis
FAO	-	Food and Agriculture Organization
GO	-	Government Office
ICBN	-	International Code of Botanical Nomenclature
INGO	-	International Non Government Office
KATH	-	National Herbarium, Godavary
LARC	-	Lumle Agriculture Research Center
MBC	-	Machhapuchre Base Camp
NGO	-	Non Government Office
PCA	-	Principal Component Analysis
Pl. n.	-	Plate number
SD	-	Standard Deviation
spp.	-	species (Plural)
TUCH	-	Tribhuvan University Central Herbarium, Kirtipur, Kathmandu
VDC	-	Village Development Committee

ABSTRACT

Present study was made during the year 2002-2004 in the vicinity of Lumle VDC (maximum rainfall area of Nepal) Kaski, Gandaki, and Kathmandu (Nagarkot, Suryavinayak, Godavari, Matatirtha and Dakshinkali) Nepal. The different species of mushrooms were collected. Only Clavariales and allied species were collected from vicinity of Kathmandu. The detailed study of Clavariales collected from both of fields, were made.

Altogether 76 wild mushroom specimens belonging to 36 families and 49 genera were collected between the altitudes of 1700-2200m from Lumle. Among these 40 were identified upto species levels. Twenty three species were found to have culinary value while 6 have medicinal value. The deadly poisonous *Amanita cokeri* was collected. The largest families recorded were Polyporaceae and Xylariaceae (7 species in each) and the largest genus was *Russula* (6spp.). 16 species were found at all (Six) altitudinal levels and 52 species were found only at their definite altitude. *Alnus nepalensis* found to bear a maximum number of mushroom species (17 species), followed by 16 species from soil, nine species in *Quercus semecarpifolia*, three species from leaf and single species on buffalo dung were recorded.

Indexes of similarity across different altitudinal levels ranges from 50.79% to 59.25%. Multivariate analysis was performed by using ordination based Canoco Software and it was found that there was a gradient of species distribution along the altitude with low spatial turnover.

Nine species of Clavariales were collected from the vicinity of Lumle and Kathmandu valley. Among them six species – *Clavaria acuta, C. rosea, C. vermicularis, Clavulinopsis fusiformis, Lentaria mucida* and *Ramaria flaccida* were collected from Lumle. *Clavaria fumosa* from Godavari, *Ramaria botrytis* and *Aphelaria tuberosa* from Dakshinkali were collected and their detailed studies were made.

The genus *Meruliapsis* from Lumle and *Aphelaria* from Dakshinkali were recorded as new to Nepal. The species *Ascobolus magnificus, Lentaria mucida, Xylaria plebeja, X. filliformis* and *X. nigresescens* from Lumle area; *Clavaria fumosa* from Godavary and *Aphelaria tuberosa* from Dakshinkali, were also recorded as new to Nepal. *Schizophyllum commune* in Lumle was found to be treated as medicinal value. Two rare species *Auriscalpium vulgare* and *Clavaria rosea* were collected from Lumle.

The ethnomycological knowledge of local people was also incorporated in this study.

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CHAPTER - ONE

1. 1 Introduction

1.1.1 General

1.1.1.1 General glimpse on classification

The classification of the fungi presents innumerable difficulties (Alexopolous & Mims, 1963). Taxonomically fungi are classified on the basis of their vegetative characters, reproductive structures and spore characters (Sharma, 1989). Different opinions on concept of classification of fungi have been found. Among them some concepts are as follows –

In 1623, Bauhin (1560 – 1624) described 81 species under the name fungus, which are now distributed among Agaricaceae, Boletaceae, Polyporaceae, Clavariaceae, Lycoperdaceae, Pezizaceae and other families.

Micheli (1679 – 1737) was the first man to use microscope for the study of fungi and is the founder of Mycology. In his work *Nova Plantarum Genera* (1729), he gave the usable keys for the identification of genera and the species. Some of the keys were so excellent that can be used even today (*Clavaria, Lycoperdon, Geaster).*

Linnaeus (1707 – 1778), advanced the knowledge on fungi. In his great work *Species Plantarum* (1753), placed all fungi in 24th class "Cryptogamia". This consists all Basidiomycetes, *Auricularia* and one more species of *Tremella*. All the Agaricaceae were included in the genus *Agaricus*.

Fries (1794 – 1837) in his *Systema Mycologicum* made greatest contribution to the knowledge of the Hymenomycetes.

Gwynne - Vaughan & Barnes (1937) divided the fungi into three main classes (Phycomycetes, Ascomycetes and Basidiomycetes) on the basis of septation of mycelium and characters of spores.

Bessey (1950) organized the fungi under the following categories:

Fungi I Aseptate mycelium (Phycomycetes)

II Septate mycelium (a. Ascomycetes b. Basidiomycetes c. Deuteromycetes)

Smith (1955) proposed to include all fungi in two divisions and seven classes.

Division I: Myxomycophyta

Classes:

1. Myxomycetae (Slime molds)
2. Plasmodiophorine
3. Acrasieae

Division II: Eumycophyta

Classes:

1. Phycomycetae (Algae fungi)
2. Ascomycetae (Sac fungi)
3. Basidiomycetae (Club fungi)
4. Deuteromycetae (Imperfect fungi)

Hawker (1966) preferred to divide all fungi into *Lower Fungi* and *Higher Fungi*. All lowe fungi are treated under *Phycomycetes* whereas all higher fungi are separated into two classe on the basis of the presence of characteristic endogenous ascospores (Ascomycetes) o exogenous basidiospores (Basidiomycetes).

Stevenson (1970) placed all fungi in division Mycota, which includes six classe (Chytridiomycetes, Oomycetes, Zygomycetes, Ascomycetes, Basidiomycetes, Deuteromycete or Fungi Imperfecti)

Webster (1979-80) adopted following classification of fungi:

Mycota

Myxomycota (Myxomycotina)

i. Eumycota (Mastigomycotina)
ii. Zygomycotina
iii. Basidiomycotina
iv. Deuteromycotina

Ainsworth (1973) purposed the mode of classification for fungi following *Dictionary of Fungi* (1971). In this system the fungi with plasmodia or pseudoplasmodia are classified in the division *Myxomycota*, whereas most of the remaining, usually filamentous fungi which do not have any plasmodium or pseudoplasmodium are classified in division *Eumycota*.

In accordance with the recommendations of the committee on International Rules of Botanical Nomenclature, which mycologists endorse, the names of the divisions of fungi should end in –mycota, subdivisions in –mycotina, classes in –mycetes, and subclass in –mycetidae. Names of orders end in –ales, and of families in –aceae. Genera (sing, genus; L. genus = race) and species (both s. and pl. species: L. species = concept) have no standard endings. The name of an organism in a binomial (L. *bi* = two + *nomen* = name) that is, it is composed of two

words. The first is a noun designating the genus in which the organism has been classified and the second is often an adjective, describing the noun, which denotes the species. The genus name is always capitalized (Alexopolous & Mims, 1979).

Alexopoulos & Mims (1979) placed all fungi, including the slime molds, in Kingdom *Myceteae* of Super kingdom *Eukaryonta* following the suggestions of Whittaker and Margulis (1979), about the existence of Superkingdom as the largest taxonomic rank. Kingdom Myceteae, as proposed by Alexopolous and Mims (1979), includes 3 Divisions, 8 Subdivisions, 11 Classes, 1 Form-Class, 3 Subclasses and 3 Form –Subclasses.

For identification of taxa one must go through a key, which is given in different books of taxonomic treatments. Recently, Adhikari (2004) made compilation of taxa in taxonomy on fungi along with the higher plants

Taxonomic groups	**fungi end in**	**flowering plants end in**
Divison-	-mycota	-phyta
Subdivison-	-mucotina	-mae
Class-	-mycetes	-neae
Subclass-	-mycetidae	-deae
Order-	-ales	-ales
Suborder-	-ineae	-ineae
Families-	-aceae	-aceae
Tribe-	-eae	-eae
Subtribe-	-inae	-inae
Genus		
Subgenus		
Section		
Subsections/series		
Species		
Subspecies		
Variety/forma		

1.1.2 Essential parts of a typical mushroom

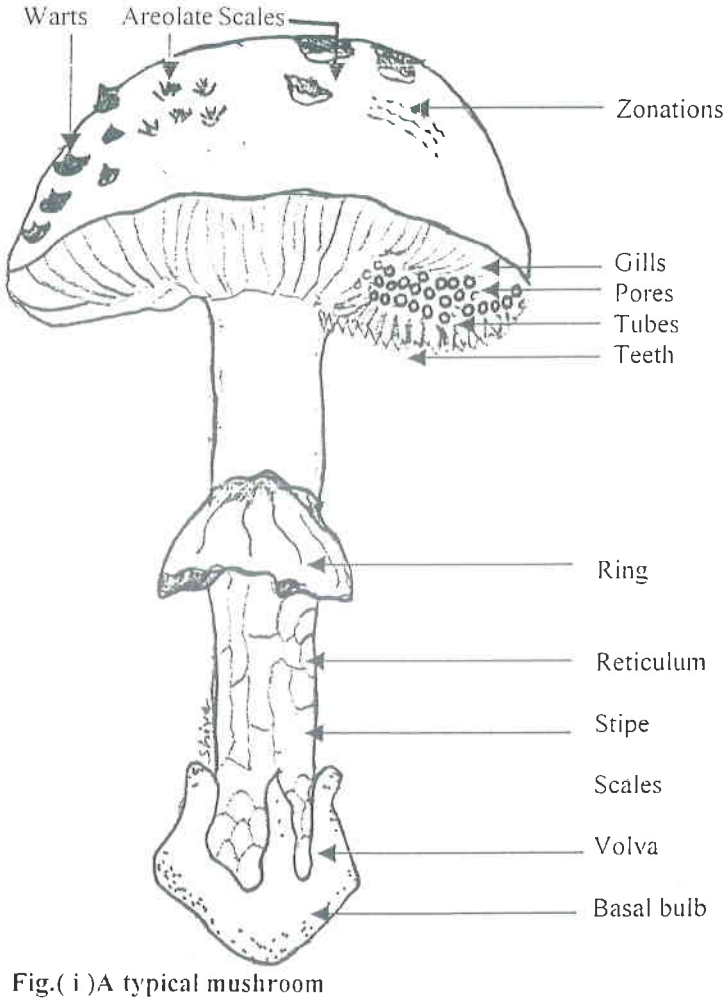
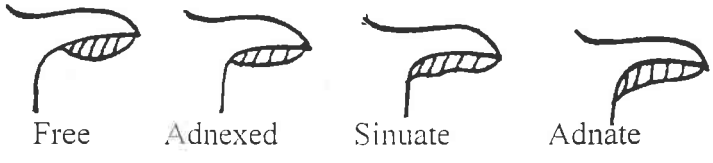


Fig.(i)A typical mushroom



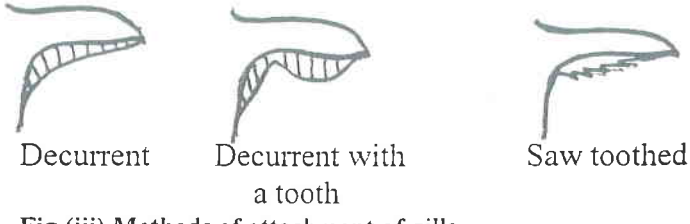


Fig.(iii) Methods of attachment of gills

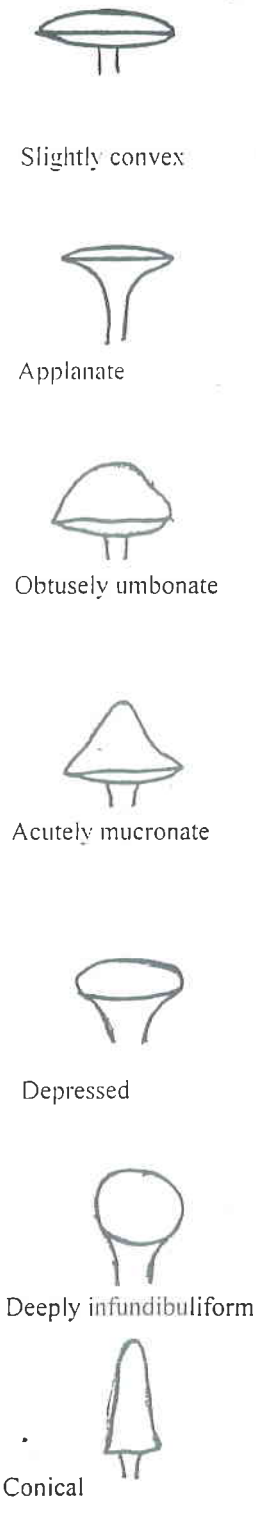


Fig. (ii)Various shapes of the cap

Fig. 1.1: Essential parts of a typical mushroom

1.1.2 Concepts of Mushrooms and Toadstools

1.1.2.1 General Concept

The general belief that only one or at most a very few species are safe to eat, has led to the words mushrooms and toadstools being used to denote edible and poisonous fungi respectively. This differentiation takes no account of the large number of species which are so leathery that they are inedible though not poisonous.

The grete herball (1526) says, "*Fungi ben mussherons*....There be two manners of them, one manner is deadly and sleeth them that eatheth of them and be called Tode stoles and the other doeth not": but all are mushrooms. A phrase like "Mushrooms as is toadstools" still prevails in some part of the North America (Ramsbottoom, 1954).

The terms mushrooms and toadstools as defined by Snell & Dick (1971) as "Generally applied on those species, which are fleshy gill bearing agarics species that are either edible or poisonous. In the same case, unpalatable and inedible are referred mushrooms and toadstools simultaneously."

Mushrooms and toadstools both resembles with each other very closely. So there are no exact rules and tests which have been found to distinguish or differentiate morphologically. Mushrooms would thus be regarded as special kinds of toadstools and no confusion could arise about the meaning.

1.1.2.1.1 Mushrooms

The word mushroom is usually thought to be derived from French *Mousseron (Mucerom)* from *mousse*, moss but it is not used in quite the same sense. It has been said that "Mousseron is barbarous name which has caused endless confusion. *Tricholoma gambossum* the St. Geeorge's mushroom and its varieties is "mousseron"; *Clitopilus prunulus* is "mousseron"; *Marasmius oreades*, the Fairy - Ring Champignon is "mousseron". Further the name appears to be used commercially for all fungi sold in a dried state. It may be recalled that according to Rabelais, Dido did sell "mousserons" in (Ramsbottom, 1954).

Dickinson & Lucas (1979) and Philips (1981) agreed that the mushrooms are generally terme as the edible or poisonous gill bearing fleshy agarics. Generally agaricus or fleshy species o other groups of fungi bearing cap and gills on the underside producing spores are recognized a mushrooms. The term "Mushroom" applies only to the "Agaric" which is commerciall cultivated. The general form of an agaric fruiting body is umbrella shaped with a central stipe supporting a cap or pileus with numerous radially arranged gill or lamellae on the lower side of th cap (Webster, 1970).

Miller (1984) defined mushrooms as the term applied to both edible and poisonous species o agarics as the gilled mushrooms. Similarly, Purukayastha and Chandra (1985) pointed out tha agarics or fleshy species of other groups of fungi are recognized as "Mushrooms" which ma be edible, inedible, poisonous or non-poisonous. Pacioni (1985) made a clear distinctio between "Mushrooms" considering only the edible species and "Toadstools" as inedible o poisonous species. According to the "Dictionary of Fungi" mushroom was defined as an agaric any agaric like or agaric as from Agaricaceae having edible value.

Rinaldi & Tyndalo (1972) defined as, The structures that are commonly known mushrooms are nothing else but the fruiting bodies of those organisms that the mycologists call highe fungi, or macromycetes (macromycetes = large fungi) , even though the dimensions of the caps of some mushrooms might be only a few millimeters across.

The MANUSMRITI (written by Manu: the son of Brahma and the ancestor of humankind) listed the names of mushrooms in Sanskrit and advised not to eat the mushrooms growing anywhere. The mushrooms are generally known as "Kavak" (general name for mushrooms) "Chhatrak" (head with umbrella), "Chhatrika" (with small umbrella or cap), "Shilindhram" (which grows on organic materials), "Swedajam" (Which grows on warm and humid place), "Prithavikandam" (which grows on soil). Actually these names do not provide detailed characters or ideas for the identification of the mushrooms (Adhikari, 2000).

In the mean time it is observed that there is a general structure used in the language to distinguish the mushrooms in Nepal. In practical in all types of languages chyau (Nepali), Bammhukan (Newari), Shymo or Shyamu (Tamang), Shamu (Sherpa), Chyabo (Gurung), Mugan (Magar), Pat (Limbu), Chhani (Tharu) and Kukurmutta (Hindi) are being used (Adhikari,1979 ,2000).

1.1.2.1.2. Toadstools

A typical toadstool obviously might 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 neighborhood 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).

Different authors define the mushrooms and toadstools in their own languages and included in the same group "Agaricales" i.e. gill fungi (Fries, 1838; Rea, 1922; Singer, 1986). The word "toadstool" comes from the German word "toad stuhl" which means death-stool causing sickness and even death. The poisonous members are however popularly known as toadstools. Even closely related species of the same genus are not all poisonous or edible for instance *Lepiota morgani* and *Amanita muscaria* are poisonous while *Macrolepiota procera* and *Amanita caesarea* are edible (Adhikari, 1976).

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" defined the term "Toasdstool" as an essentially synonymous with the mushroom in both the narrow and broad senses, among them very few are edible but is more often used in inedible species. Pacioni (1985) made a clear distinction between "Mushroom" considering only the edible species and "Toadstools" as inedible or poisonous species. Krieger (1967) defined toadstool as "all the fleshy umbrella shaped fungi and to a small number of the best known edible forms".

1.2.2.2 Difference between Edible and Poisonous mushrooms

In many parts of the world wild edible species have a special significance in terms of catastrophic crop failures, by protecting local population from starvation (Joshi, *et al.*, 2003) Man hunt for food dates back to his origin on earth. He had tasted a large variety of food plants in the past when he wandered from place to place in search of food. Thus, in course of time, he came across a wide variety of wild plants which could be used as items of food. To this long list he added such forest products as mushrooms (Das, 2001).

The wild edible species in Nepal are collected from the forests and fields, but it is difficult t differentiate the edible mushrooms from poisonous ones because there are no hard and fas rules to define toxic and edible mushrooms. As a matter of fact, a mushroom hunting is an ar where trial and error and "do it yourself" methods do not count. Moreover this is a skill wher experience and patiens prevails (Bhandary, 1999).

To know whether a fungus is safe to eat we must be able to recognize it and know its provec reputation. There is no general rule for the identification of poisonous and nonpoisonou mushrooms. There are many traditional methods for testing these fungi but they are no reliable. Views related to the consumption of wild mushrooms are as follows (Rinaldi & Tyndalo. 1985; Adhikari. 1993):

Table: 1.1 Edible vs. Poisonous – True or False

S.N.	General belief	Status	Edible species	Poisonous Species
1.	Spring mushrooms are edible.	False	*Morchella* sp.	*Helvella* sp.
2	Autumn mushrooms are edible.	False		*Amanita palloides, A. muscaria*
3	All mushrooms growing on live trees are edible.	False	*Pleurotus* sp. *Lentinus* sp. *Laetiporus* sp.	*Clitocybe olearia.*
4	All the mushrooms growing on decaying straw or manure are poisonous.	False	*Coprinus comatus*	*Stropharia* sp. *Psilocybe Paneolus* sp. *Copr disseminatus*
5	All soil inhabiting species are deadly poisonous	False	*Morchella conica, Russula delica. Amanita caeseara, fulva*	*Amanita ve A. phalloides*
6	Violet coloured mushrooms are poisonous	False	*Laccaria amethystine, Mycena pura, Cortinarius violaceus*	*Rhodopaxillus nudus*
7	Bright coloured mushrooms are poisonous	False	*Amanita caesarea. Cantharellus cibarius Tricholoma nuduns*	*Amanita pantherina, A.. muscaria, Rus emetica. R. fragilis*
8	Mushrooms with rough warty cap and texture are poisonous	False	*Amanita rubescens, Microlepiota procera*	*Pholiota adipose*
9	Mushroom with smooth capped species are edible.	False		*Amanita* sp. *Hygrophorous* sp. *Lepiota* sp.

10	Mushrooms whose flesh changes after touching and brushing are said to be poisonous	False	*Boletus cyanescens*	*Boletus luridus*
11	Mushrooms bearing annulus are edible.	False	*Agaricus bisporus, Amanita caesarea, Armillariella mellea*	*Amanita citrina, A. muscaria*
12	Mushrooms bearing vulva are poisonous.	False	*Amanita caesarea, A. hemipha, Volvariella volvacea*	*Amanita muscaria, A. pantherina*
13	Mushrooms which cause milk or egg to coagulate are said to be poisonous	False	*Amanita caesarea, Boletus edulis*	
14	Mushrooms that produce latex on being injured are said to be poisonous	False	*Lactarius deliciosus, L. volemus, L. delica L. corrugis*	*Lactaria torminosus, L. sariflus, L. rufus*
15	Mushrooms with bitter, acrid or pungent taste are poisonous	False	*Lactarius piperetus*	
16	Poisonous mushrooms can be detoxified after boiled in water with or without salt or vinegar	False		Deadly *Amanita* sp. retains their poisonous chemical even after prolonged and repeated boiling.
17	All mushrooms loose their poison through exsiccations	False	This is true for *Gyromitra esculenta*, which when fresh cause serious intoxication but after exsiccations become completely harmless. However, this is not true for the deadly *Amanita* spp. which remains deadly even after exsiccation.	
18	Mushrooms that are consumed by flies, squirrels, cats, monkeys are edible to humans.	False	The digestive activities in these animals are quite different from human beings.	
19	Poisonous mushrooms tarnish a silver spoon, onion, and garlic pieces.	False	In case of deadly *Amanita* spp. *like A. phalloides, A. verna and A. muscaria the color of spoon, onion and garlic doesnot change in color while cooking.*	

Depending upon the places and countries, the above prejudices varies, for example *Scleroderma citrinum, S. cepa, S. aurantium and S. verrucosum* are edible in Nepal while these species are considered as poisonous in Europe and Japan (Adhikari.1996,1997,1998). *Ramaria aurea* and *R. flava* are considered edible in Nepal but the same species have been reported

poisonous in Japanese literature (Imazeki, Otani & Hongo, 1998). Irrespective of the prejudice all these species should be subject to detailed toxicological test so as to determine their viabilit as edible food stuff.

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

1.1.2.3 Mushroom Poisoning

Mushroom poisoning is caused by consumption of raw or cooked fruiting bodies (mushrooms toadstools) of a number of species of higher fungi that have been collected by nonspecialist (although specialists have also been poisoned). Most cases occur when toxic species ar confused with edible species (Ramsbottom, 1954).

Nevertheless, mushrooms are reputed to have claimed the lives of a number of historica figures, including Pope Clement VII, King Charles VI of France. One of the most celebrate casualties was the Roman Emperor Claudius Caesar. According to Dickinson & Lucas, (1979 the mushrooms, which killed him, were deliberately poisoned before being introduced into hi milk.

All humans are susceptible to mushroom toxins. The Poisonous species are ubiquitous, and geographical restrictions on types of poisoning that may occur in one location do not exist Individual specimens of poisonous mushrooms are characterized by individual variations in toxin content based on genetics, geographic mushrooms consumed, and the dose of toxin delivered. In addition, although most cases of poisoning by higher plants occur in children adults consume toxic mushrooms most often. Occasional accidental mushroom poisonings o children and pets have been reported, but adults are more likely to actively search for, and consume wild mushrooms for culinary purposes. The normally non lethal toxins more seriously affect children than are adults and are more likely to suffer very serious consequences from ingestion of relatively smaller doses. Adults who consume mushrooms are also more likely to recall what was eaten and when, and are able to describe their symptoms more accurately than children. Very old, very young, and debilitated persons of both sexes are more likely to become

seriously ill from all types of mushroom poisoning, even from those types, which are generally considered to be mild. Some mushrooms cause certain people to become violently ill, while not affecting others who consumed part of the same mushroom cap (www.gmushrooms.com).

1.1.2.3.1 Nature of Disease

Mushroom poisonings are generally acute and are manifested by a variety of symptoms and prognoses, depending on the amount and species consumed. Because the chemistry of many of the mushroom toxins (especially less deadly ones) is still unknown and positive identification of the mushrooms is often difficult or impossible, mushroom poisoning are generally categorized by their physiological effects (Svreck, 1975).

The phytochemical screening of mushrooms in modern literature has revealed that different species of mushrooms contain different chemicals (Acids and alkaloids, Amatoxin, Psilocybine, Coprin, Helvellic acid, Muscarine, Ibutenic acid), which are toxic to human health. Toxicity may be for short or long duration and prolonged activity. There are two types of intoxications caused by fungi viz one is mycetism (after the ingestion of higher fungi) and another is mycotoxicoses (after the ingestion of lower fungi) (Adhikari, 2004).

1.1.2.3.2 Treatment of mushroom poisoning

Any case of either known or suspected poisoning by fungi should be referred to a doctor or hospital for prompt medical attention. As correct treatment depends upon the species of mushroom involved, it is important, if possible, to identify the species responsible, or at least provide specimens for identification. Unfortunately, victims of mushrooms poisoning may themselves be unaware of the type involved, but all possible sources of clues, e.g., discarded remains, the original collecting site, or even regurgitated material, should be followed up (Dickinson & Lucas, 1979). The cases reached in the hospital have nearly disintegrated forms of species in the abdomen by enzymatic activity. Therefore, it is very difficult for the doctors to predict the exact species consumed. Neither the consumer can say what species they have consumed. (Adhikary, 2004)

1.1.2.4 Medicinal and Nutritional value of mushrooms

1.1.2.4.1 Medicinal value

Mushrooms are famous as the best nutraceuticals, excellent health food enriched by goo quality protein and a multitude of beneficial vitamins and minerals. Many of the poisonous an edible mushrooms are known for their antibiotic and anti-cancerous properties (Anonymou 2000). *Amanita muscaria* highly poisonous mushroom, being effectively used in China to cu neural disorders and epilepsy (Bal Krishnan & Nair 1994). Medicine from *Coriolus versicola* is a top selling anti-cancer drug in Japan (Pai *et al.* 1990). It is now common to find medicina preparations from mushrooms in various forms in the world market. For instance, 'Agarus" i an effective drug used in homeopathy for treating ailments of heart, epilepsy, mental disorder etc. The total worth of the pharmaceutical and nutraceutical products derived from mushroom is estimated to be more than $1.2 billion (Rai *et al.* 1997. Pharmaceuticals worth $ 700 millio are produced annually in Japan from the species of *Lentinus, Coriolus, Schizophyllum* an *Ganoderma*. The medicinal mushrooms that are dominant in the market are, however hardly dozen produced exclusively by China and Japan (Chang & Buswell, 1996). Japanese product containing LEM, a polysaccharide –rich extract from shiitake.

The predominant mushrooms showing promise for their antiviral activities are polypores- th so-called woody conks, thought to be the ancestors of most, if not all, gilled mushrooms A number of unique antiviral (lentinan from *Lentinus edodes*, ganoderic acid – □, lucidumo from *Ganoderma lucidum*) from mushrooms have sown efficacy in inhabiting the replication o the human immunodeficiency virus. (Suzuki, 1989; Nanba, 1992; Kim *et al.,* 1994; Collins 1997; Ghoneum, 1998; Hattori, 1997).

During the past 100 years, human progress has created an environment in which our immune systems are well catered to. Today we live in artificial environments where air is filtered and the food is processed. We frequently subject ourselves to antibiotics and a variety of interventions to improve our well-being. A slow immune response will not be able to cope with an onslaught of pathogens. Mushrooms provide a regular challenge to the immune system in a non – hostile manner (www. gmushrooms.com). Just like medicines, if mushrooms are also taken every day, we can fight against diseases like Beriberi, Scarvi, wound from burns, Leprosy, Acidity (Flamingo India, 2003).

In 'Ayurveda', the book concerning human health science in Hindu philosophy also has been found to mention about the mushrooms. The ideas given in it about the nature of investigations were not postulated in the chemical formula but rather narrated in sacred hymns. 'Madanpal Nighantu' states to have sedative properties and effective to cough, vayu and pitta in the human body (Adhikari, 1995a, 2000, 2004).

In Nepal, 19 species of wild mushrooms have been utilized by the rural people. These species still await for their chemical estimation and pharmaceuticals investigations (Adhiikari, 1988b, 1990a, 1991b, 1994, 1995a, 1996). *Ganoderma lucidum, Coriolus hirsutus,* and *Pycnoporus cinnabarinus* are generally utilized to heal cuts and wounds (Adhikari, 1988a; Bhandary, 1991). *Daldinia concentrica* is used to treat burns (Bhandary, 1991). *Cordyceps sinensis* is powdered and combined with the rhizome of *Orchis latifolia* and consumed mixed with the powder of the rice in the boiled milk. This fungus serves as special tonic and used as aphrodisiac (Adhikari, 2000)

1.1.2.4.2 Nutritional value of mushrooms

The use of food is probably as old as human civilization itself. These have been a delicacy since ancient times. The Egyptians regarded them as food for Pharaohs. The Greeks and Romans described them as "food for the Gods", and were served only on celebrations. Reference to mushrooms is found in Vedas (Chube, 1995; Adhikari, 2000, 2003). Mushrooms can be used for the food to solve the malnutrition problem (Manandhar, 2003).Nutritional analysis of mushrooms is as follows:

1. As source of proteins

Mushrooms have good nutritional value particularly as a source of protein that can enrich human diets especially in some developing countries where animal protein may not be available and are expensive. The protein content of fresh mushroom is 3.7% stated by FAO publication (1978). They have a high percentage of all essential amino acids. The protein content in mushrooms is almost equal to that of corn and milk and more than either potato or cabbage. Mushrooms are also low in cholesterol. They are still inferior in protein to such standard protein sources as meat, fish, eggs, and cheese, but their protein content is twice as high as that of most vegetables, with exception of peas and other legumes (Sohi & Sharma, 1997). *Clavaria coralloides* and *Boletus loyus* are the best protein sources but are deficient in the amino acids methionine and cysteine (Schmeda *et al.,* 1999).

2. Vitamins

Mushrooms are excellent sources of many B vitamins such as thiamine (B1), riboflavin (B2) nicotinic acid and pantothenic acid. Vegetables are reportedly poor source of vitamin B12. Thi requirement can be met with by taking as little as 3g of fresh mushrooms (Hayes & Hanc 1981). Mushrooms also contain vitamin C (Ascorbic acid) and vitamin K. Vitamins A, D and appear to be present only in very low amounts (Sohi & Sharma, 1997).

3. Minerals

Like most vegetables, mushrooms are good source of minerals and are reported to be rich i potassium, sodium and phosphorus and together with calcium and magnesium; these constitut 56-70% of the total ash content. Iron is present in appreciable amounts *Agaricus bisporus* is reported t contain considerable amounts of potassium, phosphorus, copper and iron. The highest phosphoru content is found in *Lepista nuda* in comparison to wood destroying fungi (Veter, 1994).

4. Carbohydrates

Carbohydrates constitute the main component of mushrooms. It ranges between 3 and 28 % (o a fresh weight basis) in various species. A higher value (46.6 to 81.8 %) on dry weight basis i found in different species of *Pleurotus* (Bano & Rajarathnam, 1982).

Table: 1.2 Chemical parameters and food value of wild mushrooms

S.N.	Scientific names	Protein	Phosphorus	Calcium	Iron	Carbohydrate
		%	Mg/100g	mg/100g	mg/100g	%
1	*Amanita caesarea*	28.90	690	157	7.63	52.98
2	*A. hemibapha*	28.53	636	175	8.84	53.82
3	*Cantharellus cibarius*	22.78	443	102	8.01	61.73
4	*Clavulina cinera*	19.36	334	164	30.38	-
5	*Grifola frondosa*	22.26	410	106	2.01	69.42
6	*Hericium erinaceus*	22.18	360	141	9.13	55.80
7	*Hydnum rapandum*	16.00	356	356	10.92	52.80
8	*Laccaria laccata*	20.05	234	112	-	-
9	*Laetiporus sulphureus*	13.05	403	117	11.67	70.95
10	*Meripilius giganteus*	21.67	435	129	8.91	61.03

(Source: Joshi, Adhikari, Joshi & Adhikari, 1966)

1.2 OBJECTIVES, JUSTIFICATION AND LIMITATIONS

1.2.1 Objectives

The main objective of the study was to study the mushrooms diversity in Lumle VDC, Kaski and to study Clavariales allied species collected from Lumle and surrounding forests of Kathmandu valley. The specific objectives are:

- To collect different mushrooms found growing in Lumle.
- To analyze the myco-diversity in Lumle.
- To gather Clavariales from the adjoining forests of Kathmandu valley (Dakshinkali Godavari, Matatirtha, Nagarkot, Suryavinayak).
- To study microscopic features of the collected Clavariales.

1.2.2 Justification

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). Very few study related to Nepalese mycoflora in comparison with higher plants are found. Among the study sites the west and east region need extensive exploration irrespective to central sector of Nepal (Adhikari, 2000). Lumle as maximum rainfall (5500mm) area of Nepal is a virgin place for the exploration of diversity of wild mushrooms. Therefore, present study will be helpful for the knowledge upon the mushrooms in the maximum rainfall area of Nepal.

Among the mushrooms, Clavariales are well known for their food value. In the context of Nepal, no detailed study of this order is found yet all.

1.2.3 Limitations

- The study is done as partial fulfillment of M. Sc. Degree.
- The information is based on the field investigation done in two years in Lumle study area and one year in surrounding forests of Kathmandu valley.
- Not all the collected specimens could be preserved due to their poor (Old) stage.

- All the preserved specimens could not be identified up to species level due to immatu /over matured stage of specimens as well as due to consistency of time period to work.
- Collection of mushrooms from north facing slope of Lumle couldn't be done because remoteness and harsh political condition. So, the actual comparison between the specie of two aspects couldn't be done.

However, this study will provide important features related to mushrooms diversity in Lum along with the profile of Clavariales of Lumle and Kathmandu valley.

CHAPTER - TWO

2. LITERATURE REVIEW

2.1 Historical review

J.D Hooker (1848-1854) explored east Nepal in a botanical survey. The result of his gatherings was published by Berkeley (1845 a, b, c, d). He reported 44 higher fungi in "Indian Fungi" in *Hooker's Journal of Botany.* The papers included 18 new species for Nepal viz. *Irpex zonatus, Lentinus nepalensis, L. inquinans, Lycoperdon elongatum, L. emodense, Polyporus cereus, P. elatinus, P. flavidus, P. florideus, P. nepalensis, P. pictilis, P. vivax, Radulum spongiosum, Scleroderma nitidum, Sphaeria nepalensis, Stereum endocrocinum, Trametes tephroleuca, T. versatilis* and *Xyalaria fistuca.*

Thind (1861) included three species in *"The Clavariaceae of India"* which were reported earlier by Balfour-Browne (1955).

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

Balfour - Browne (1955) studied and published the gatherings made by O. Polunin, W.R Sykes and L.H.J. Williams in 1948-50, from Jumla area, the western region of Nepal. She listed nine genera and nine species of Ascomycetes, 17 genera and 24 species of Hymenomycetes and five genera and seven species of Gasteromycetes. In the same paper some new species by herself and Corner were also added. New species were *Ramaria fuscobrunnea* Corner. and *Pleurotus nepalensis* Corner. The newly described monotypic genus *Amylaria: A. himalayensis* Corner. was also included in the same paper.

Kreisel (1964, 1967, 1969, 1976) enumerated Gasteromycetes from the collections of J. Poelt (Khumbu Himal region: east Nepal) and J.F. Dobremez (other parts of Nepal). In 1969, he enumerated 15 species, which included three new species: *Bovistella poeltii, Lycoperdon niveum* and *L. yetisodale.* In 1976 he again recorded *Bovista substerilis, B. vascelloides, Disciseda alpine, D. ochrochaleea, Lycoperdon altimontanum, L. lambinoii var. quercetorum* and *L. perlatum var. dobremezianum.*

Balfour - Browne (1968) published the fungal species collected from eastern and central Nepal by Stainton (1952-56), Norkett (1961-62), Polunin (1949) and Stainton, Sykes & Williams (1954). This paper included 12 species of Ascomycetes, 73 species of Hymenomycetes and six species of Gasteromycetes. In this paper *Clavulina alata* Corner and *Lentaria macrospora* Corner. were added as new species. A new combination viz. *Panus polychrous* (Lev.) Singer: Balfour-Browne (= *Lentinus polychrous* Lev.) was also proposed in the same paper.

Kobayashi (1865) recorded the occurrence of *Calostoma* from east Nepal.

Bhatt (1966) enumerated 118 species of fungi from different parts of Nepal .Enumerated species were Myxomycota -1, Mastigomycotina and Zygomycotina -8, Ascomycotina -27, Basidiomycotina -33, Deuteromycotina- 51.

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 (1966) reported 18 wild edible species of mushrooms sold at Kathmandu market in bamboo packages.

Singh (1968) reported 4 species of Hymenomycetes from Kathmanhdu valley.

Poelt (1969) collected 55 species of Myxomycetes from Khumbu Himal and its adjoining areas. The two species viz *Arcyria nepalensis* and *Lamproderma nigrisplendidum* were newly reported to science.

Onsberg (1973) recorded two species of Myxomycetes in which *Lycogola fuscoiviolaceunm* was added new to science.

Singh & Nisha (1974) recorded the occurrence of three species of *Exobasidium*. Among them *Exobasidium butleri* from Dhulikhel was new to Nepal.

Adhikari (1976) listed about 30 wild edible species of mushrooms collected during 'in season' as food by local herds at Manichur, Kathmandu valley.

Pandey (1976) published a list of 314 specimens of Basidiomycotina collected from central and eastern Nepal. In this paper most of the specimens were identified to generic level only. He gave the information on the distribution pattern of different taxa.

Ranjitkar & Bhatt (1976) collected *Craterellus cornucopioides* on ground from Sundarijal.

Singh & Nisha (1976 b & c) published five species of larger Ascomycetes, 68 species of Hymenomycetes and eight species of Gasteromycetes.

Singh & Adhikari (1977) described four genera and five species of fleshy fungi collected from Manichur, Kathmandu valley. Five species were new records to Nepal viz *Trichoglossum velutipes, Dacromyces palmatus, Clavaria* sp., *Clavulinopsis fusiformis* and *Clavulinopsis* sp.

Pegler (1977) reported two species of *Pleurotus* deposited in Kew Herbarium. They were *Pleurotus nepalensis* collected by Polunin, Sykes & Williams in 1952 from Chakure Lekh.

Ryavarden (1977) studied J. Poelt's collections of the wood inhabiting aphylloporaceous fungi from eastern Nepal. 50 species including a newly described species (*Phellinus poeltii*) were included along with the affinities of two tropical and subtropical and nine temperate species with Japan, Fennoscandia, Siberia and American elements.

Waraitch & Thind (1977a, b, c) reported 29 genera and 37 species of Ascomycotina from central Nepal.

Singh & Upadhyaya (1978) listed five species from Suryavinayak (Kathmandu), Jomsom and Tukuche (Central Nepal). New species were *Morchella smithiana, Amanita citrina, Asterophora lycoperdoides, Russula nigricans* and *Peridermium ephedrae.*

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

Bhandary (1980) collected 13 species of macrofungi related to seven different families, among them eight species were new to Nepal. They were *Leotia lubrica, Hygrophorus miniatus, Tricholoma terreum, Cystoderma amianthinum, Flammulina velutipes, Mycena galericulata, Pholiota aurivella* and *Phallus impudicus.*

Otani (1982 a, b) provided the critical study on *Engleromyces* and listed 15 genera and 27 species of cup fungi. Among them *Spathularia bifurcata* and *Leotia himalayaensis* were new record to country.

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

Sharma (1983a & b) while studying the type specimens at PAN Herbarium reported two species collected from central Nepal among which *Dasyscyphus thindii* was introduced as new to science.

Thind & Sharma (1983) enumerated 28 species from the critical study of Nepalese Himalayan Helotials collected by Norkett (1961-Central Zone), J.D. Stainton (1962-Central Zone) .

Adhikari (1984) reported *Asterophora parasitica* and *Russula densifolia* in Pine forest of Godavari, Kathmandu.

Bhandary (1984) prepared a checklist of edible and poisonous mushrooms along with their local names.

Hjortstam & Ryvarden (1984) published the occurrence of 60 genera and 95 species of Basidiomycetes (Aphyllophorales), from Pokhara and Annapurna region. The new species described were *Peniophora bicornis, Grammothele bambusicola, Innotus hemisetulus, Phlebia albo - fibillosa* and *Phellinus acontextus.*

Cotter & Bhandary (1985) reported the occurrence of *Cavimalum indium* (Clavicipitaceae) on *Arundinaria* sp.

Shrestha (1985) reported *Cordyceps nutans* from Lato Manang (2140m) of Manang.

Adhikari (1987) threw light on different ethnic groups associated with the collection and consumption of wild edible mushrooms in different phytogeographical belts of Nepal.

Cotter (1987) received his doctorate degree on the Pine – *Suillus* mycorrhizal research. He collected 18 samples of *Suillus,* from different phytogeographic belts and compared with West Virginian species. His thesis work included 530 species (gathered from Kathmandu valley, Daman, Muktinath, Myagdi, Langtang and Chitawan National Park).

Cotter & miller (1987) studied the ectomycorrhizal association of the Bolete genus *Suillus* in Nepal.

Adhikari (1988) reported nine species of higher fungi gathered in a botanical expedition from Langtang and adjoining areas with brief notes on their description, distribution and key to facilitate the identification of Gasteromycetes.

Adhikari (1988 a) prepared the checklist of Polypores (Wood rotting fungi) of Nepal. A check list is provided with 54 genera and about 150 species, including three species – *Inonotus hispidus, Fibuloporia vaillantii, and Heterobvasidium annosum* new to the country. The list also followed by brief notes on their distribution and economic importance.

Adhikari (1988b) reported ten species of fleshy fungi during the mycological investigation in and around the Kathmandu valley viz- *Boletus luridus, Cantharellus subcibarius, Clavaria acuta, Clavulinopsis aurantiocinnabarina, Cortinarius callisteus, Gymnopilus spectabilis, Panellus stypticus, Peziza petersii, Psathyrella hydrophilla* and *Psathyrella velutina.*

Adhikari (1988c) reported ten species of the genus *Russula* from in and around the Kathmandu valley viz- *Russula delica, R. emetica, R. fragilis, R. galochroa, R. lactea, R. ochroleuca, R. rosacea, R. sanguinea, R. sororia* and *R. subfoetens.*

Manandhar & Adhikari (1998) reported three agarics new to Nepal.

Miller & Cotter (1988) studied upon the tissue morphology and spore ultrastructure of *Calostoma junghuhnii* (Gasteromycetes).

Bills *et al.* (1989) studied taxonomy and ethnomycology of *Lactarius* Sec. Dapetes (Russulaceae) in Nepal.

Adhikari (1990a) provided a brief review on history of mycological explorations carried on by the investigators till 1990. The paper recorded about 428 genera and 1200 species.

Adhikari (1990b) reported 11 species of the genus *Russula* collected during a mycological expedition to east Nepal. Among collected species eight species were new to Nepal viz- *R. luteotacta, R. nitida, R. olivacea, R. pectinata, R. pseudodelica,* and *R. subnigricans.*

Adhikari (1991c) collected 24 species of higher fungi from the trail and vicinity from Manichaur to Gosainkunda, Central Nepal. Among them the new records for Nepal were –

Amanita caesarea, Auricularia auricula, Cantharellus cibarius, C. odoratus, Entoloma subcostatum, Ramaria aurea, Russula rubra and *Thelophora terrestris.*

Bhandary (1991) reported 25 species of edible and medicinal fungi from Dumre to Manang, Mustang and Pokhara areas. Edibility of *Coltricia perennis* and *Daldinia concentrica* and medicinal application of *Daldinia concentrica* and *Pycnoporus cinnabarinus* were not reported earlier.

Tullons *et al.* (1992) reported *Amanita neoovoidea* from Nala, Kathmandu valley.

Tullons & Bhandary (1992) reported *Amanita chepangiana* from Jugedi, Chitawan used as food by Chepangs.

Adhikari and Parajuli (1993) provided the checklist of *Amanita.*

Adhikari (1994) introduced four wild mushroom stamps (*Amanita caesarea, Cordyceps sinensis, Russula nepalensis,* and *Morchella conica)* issued by HMG Postal Service Department, Nepal.

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

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

Manandhar & Adhikari (1995a, b) studied *Lepiota* and its allied genera of Nepal.

Adhikari (1995-1996) reported ten 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 (1996a) received doctorate degree on Basidiomycotina in Nepal from UPS, Toulouse, France. The thesis deals with the mycodiversity of Basidiomycetes flora (821 species), including the list of Hymenomycetes (520) with taxonomic studies on the genera such as *Amanita, Russula, Lactarius* and *Gasteromycetes* species. It included 40 species new to Nepalese mycoflora with seven species new to science.

Adhikari (1996b) recorded nine species of Hymenomycetes from Kathmandy valley.

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

Adhikari & Manandhar (1996) provided the monographic strudy of *Lactarius* genus which deals with six species among them one species (*L. confroversus*) was new to Nepal and five spoecies 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 (4300m) and Kathmandu valley market.

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

Adhikari (1999d) reported 15 species and two varieties of the genus *Russula* from in and around the Kathmandu valley and were new to Nepal or to Indian Subcontinent. Species were – *Russula adulterina, R. alboareelata, 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.

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

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

Adhikari (2000e) reported nine genera of Ascomycotina and twenty-eight genera of Basidiomycotina from Maipokhari, East Nepal which were new to that area.

Adhikari (2001) reported 11 wild mushrooms species from Kathmandu valley .viz. *Hypomyces* sp., *Leccinum 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 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 three species viz. *Coriolus hirsutus, Microporus xanthopus* and *Pycnoporus cinnabarinus* were detailed studied.

Pandey & Budhathoki (2003) reported *Rhizinia undulata* a wild inedible mushroom from the coniferous Pinus dominat 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 two species *Amanita japonica* and *A. sychnopyramis* from central Nepal.

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

2.2 Mycodiversity in Nepal

2.2.1 General Glimpse

Nepal occupies transitional zone between the eastern and western Himalaya and covers 0.09% of the total land surface of the world (Jha, 1992). The biodiversity of the country is the reflection of its unique geographic position and altitudinal and climatic variations. These complex conditions have served this kingdom as a germ plasm center for interesting biological diversity (Adhikari, 2000). Biodiversity is the total variety of life on the earth. Biodiversity is complex beyond understanding and valuable beyond measures (Chaudhary, 1998). Several investigators and amateurs have studied the biodiversity of this region enthusiastically since the 18th century. The collection and survey on mycoflora from Nepalese Himalayan belt was at first done by J.D. Hooker (1848-54) from Eastern Nepal (Adhikari, 1990-91, 94-95).

The fungi which are described as new to science from Nepal have been named after Nepal (19 spp.), Himalaya (8 spp.), place or region (13 spp.), botanist (14 spp.), ethnic group (2 spp.), plants (17 spp.) and others (49 spp.) (Adhikari, 1993, 2000).

Table 2.1: Total Mushrooms species recorded in Nepal

Taxa	Family	Genus	Species
ASCOMYCOTINA	18	49	106
BASIDIOMYCOTINA			
Transitional group	1	4	11
Phragmo & Homobasidiomycetes	48	142	572
Gasteromycetes	10	18	87
Grand Total	77	213	776

(Source: Adhikari, 2000)

2.3 Ecology and Habitat

2.3.1 General

Mushrooms grow where sufficient moisture and favorable temperature of conditions prevail. They appear in such places where the habitats are undisturbed by man in virgin natural and afforested reserved areas. They appear in moist, open, shady places on soil, burnt ground and grassy lands. Generally the growth of thallus is controlled by different environmental and ecological factors where they retain, the moisture and nutrition necessary for growth, fructification and reproduction etc.

Different modes of mushrooms habitat can be summarized as-

- Saprophytic e.g. *Agaricus, Boletus, collybias, Coprinus* etc.
- Parasitic e.g. *Armillaria, Pleurotus, Lentinus, Polyporus, Fomes* etc.
- Mycorrhizae e.g. *Amanita, Boletus, Cantharellus, Lactarius, Russula, Scleroderma etc.*

Most authors (Krieger, 1967; Waltinjg, 1973) have described the distribution of fungi to habitat and hosts (substrate). According to Svreck (1975) –"Altitude does not influence the growth of fungi as much as it does that of green plants. Fungi in face grow in the mountains alongside the vegetation. These include some remarkable mountain species which do not exist at lower altitude or are generally rare, but thrive in certain microclimatic conditions."

Generally the growth of thallus is controlled by different environmental and ecological factors, which retains moisture and nutrition necessary for growth, fructification and reproduction etc. The soil also plays an important role for the growth of the mushroom species.

These microclimatic conditions are directly related to topography and altitude, which govern the pattern of vegetation. Vegetation is the primary influence on the growth and distribution pattern of the mycoflora. Thus the presence of a fungus in a particular area depends upon the topography, climate (rainfall and temperature) and particularly the vegetation. Temperature is the most important factor governing distribution (Bakshi, 1971).

Some species from fruit in the complete darkness of mines and caves, while few fail to form fruit due to the requirement of adequate light. The suitable condition for the occurrence of massive production of carpophores depends in the presence of humidity, nutritional substrate and mild temperature in atmosphere (Dickinson & Lucas, 1982).

Temperature is the basic factor that changes the climate although for most mushrooms species, the temperature of the substrate is more important than the air temperature. Thus sun and heat plays an important part in the fructification of the higher fungi. In temperate climates the highest production of mushrooms occur in late summer and early autumn, when the atmospheric precipitation lowers the temperature and raises the humidity level of the ground (Pacioni, 1985).

Almost all the times of the year, the mushroom species grow in different places. The mycelium of fungus exists in the soil and throughout the year, but the development and appearance of fruiting bodies is restricted to certain time and varies within each species.

Species showing a continuous production throughout the rainy season are rare (Yorou, *et al.* 2001).

2.3.2 Nepalese Contest

2.3.2.1 Vascular flora affecting mycoflora

Nepal, although occupies a small territory, has distinct phytogeopgraphical zones related to altitude and other factors. The western part is hotter and drier than the eastern and central parts. North facing slopes are wetter and cooler than south facing slopes. Thus, the vegetation varies greatly from east to west and from north to south. These varied phytogeographical elements have given Nepal a rich and economically important mycoflora. Thus, the dominant or mixed or pure forest types (*Shorea - Pinus - Quercus - Abies - Rhododendron - Betula - Juniperus*) from tropical to alpine zones with their ecological environment provide different micro-ecological conditions suitable for the origin, development and growth of diverse and specific mycotaxa such as saprophytes, parasites and mycorrhizal associates (Adhikari, 2000).

Most of the reports on mushrooms collection and study cover the west (Jumla, Darchula and Baitadi district areas), central (Pokhara, Langtang, Kathmandu valley areas) and east zones (Jiri - Junebeshi and Ilam) (Adhikari, 1991). To mention a few places like Solu (Solukhumbu), Melamchi (Helambu), Lele, Phulchowki, Shivapuri (Kathmandu), Singh Gompa (Gosaikunda), Ghorepani (Myagdi) etc. represent best site for Himalayan fungal flora. Besides, there are other favorable areas too, but information is scanty as they are virtually unexplored (Bhandary, 1984).

Till now 5636 species, 206 subspecies, 599 varieties and 60 forma have been recorded from Nepal. Thus total numbers of flowering plants are 6501 (Bista *et al.* 2001). Moreover the modification in natural habitat and vegetation (Slash and burn of trees) have provoked an alarm for the disappearance of many fungal communities. An example can be illustrated with *Lysurus* sp. (Adhikari in Singh & Nisha, 1976b) collected from Lazimpat, Kathmandu under *Duranta* hedge Due to human inhabitation and alternation of the existing ecosystem the fungus has disappeared from this place (Adhikari, 2000).

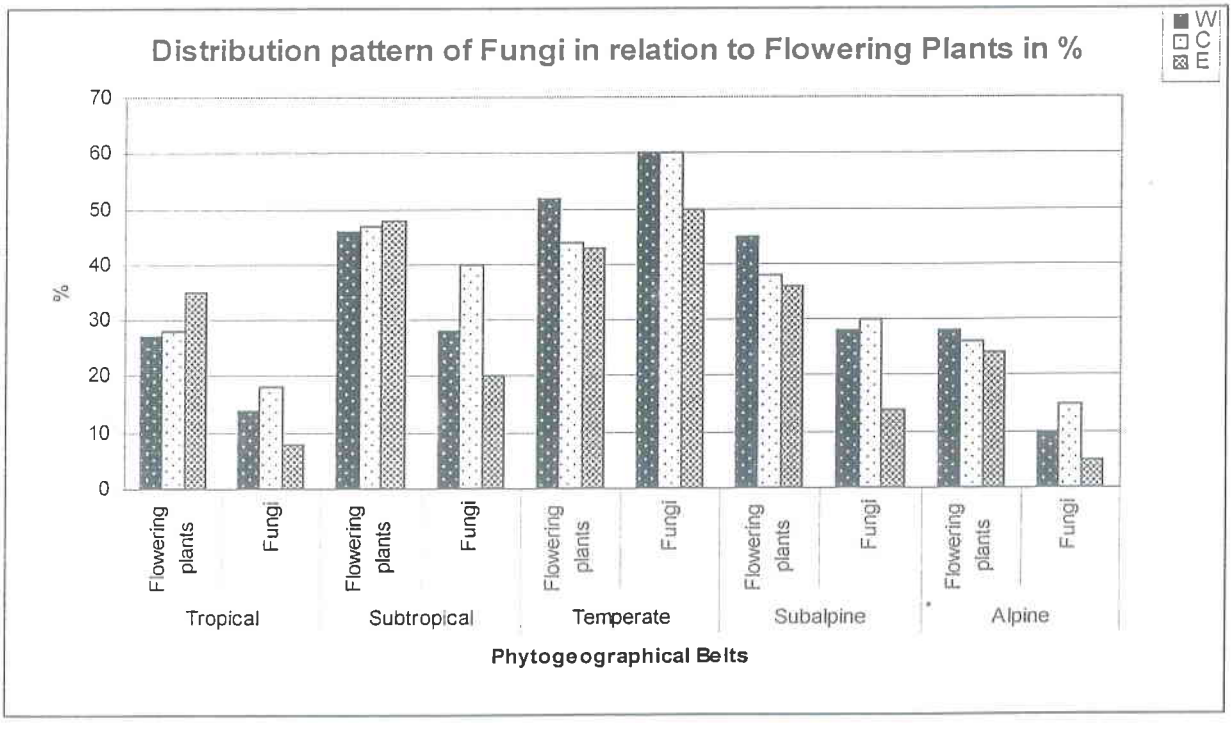


Fig 2.1: Distribution pattern of Fungi in relation to Flowering Plants (*Source: Adhikari, 2000)*

2.3.2.2 Ecological factors affecting mycoflora

Temperature has a universal influence and acts as a limiting factor for the growth and distribution of plants. The interaction of temperature with other physical environmental factors cause many other climatic changes which influence the life in one way or other (Lekhak & Lekhak, 2003). In the tropical belt, in spring and summer seasons the environment is dry and the temperate exceed 25^0C. The saprophytic and mycorrhizal fungi grow only after the shower in rainy season. In the subtropical and temperate belts the temperature between 15^0C and 25^0C favor the growth of different mycotaxa. That is to say the 'in season' for mushrooms in Nepal is between May and October. They flourish luxuriantly during July and August. However in sub alpine and alpine regions, as the temperature falls below 15^0C the population dynamics of fungi are retarded. Moreover, the fungal diversity is favored in central sector rather than east (with high temperature, humidity and precipitation) and western (with high temperature, dry environment and low precipitation) sector of the country (Adhikari, 2000).

Table: 2.2 Myco - demography in different phytogeographical belts

Total Fungi Population (TFP)		**Ascomycotina** 270		**Basidiomycotina** 720		**Impertect fungi** 326	
Phytogeographical Regions	Altitude (m)	Species Frequency (SF)					
		No. of Species	%	No. of species	%	No. of species	%
Tropical	Up to 1000	16	5.92	72	10.00	76	23.20
Subtropical	1000 – 2000	88	32.59	252	35.00	137	42.00
Temperate	2000 – 3000	151	55.92	474	65.83	114	34.94
Subalpine	3000 – 4000	40	14.81	118	16.78	3	0.90
Alpine	4000 – 5000	1	0.37	27	3.15	-	-

(Source: Adhikari, 2000)

In Nepal, it is the pre monsoon periods (April- May) with occasional shower of rain followed by sunny days affect the perforation of mycelium in the soil, appearance of fruit bodies and population dynamics. In the month of March to May the group of Ascomycotina fluctuates between 19^0C and 29^0C (difference of 10^0C) while the average minimum temperature fluctuates in between 3^0C and 20^0C (difference of 18^0C) through out the year. The maximum numbers of genera are found growing during rainy season as there is high humidity and nearly a constant tempearature (Adhikari, 2000).

The pattern of appearance and distribution of Hyphomycetes looks complex. As the temperature rises associated with frequent rainfall *Rusulla, Hygrophorus, Amaita, Canthrellus, Boletus* and *Suillus* are seen growing. Except other mushrooms, the *Amanita* and *Laccaria* are found growing from late May to October. The polypores (especially parasitic ones) are found throughout the year (Adhikari, 2000).

A very interesting myco-demography was observed in the pine forests. The litter debris of the pine trees control and regulate the temperature of soil, maintain soil moisture, texture and nutrition. The natural forests provide luxuriant growth of mycorrhizal fungi viz. *Amanita, Boletus, Lactarius, Russula, Sclerodema* and *Trichoderma.* The taxa like *Russula nigricans, R. virescens, R. delica, Lactarius piperatus, L. subpiieratus* and *Scleroderma citrinum* have been found in all the types of pine forests (Adhikari, 2000).

It is noted that very few species are reported from the high alpine belt (above 4700m). Till now no other fungi than *Bovista* (5450m), *Geastrum* (5200m), *Cythipodia corium* (Web.) Bond (48,00m), *Physarum bitectum* Lister (4700m) and *P. bogoriense* Raciblrski (4700m) are reported from the high alpine belt (Balfour - Browne, 1955; Poelt, 1965; Kreisel, 1969; Durrieu, 1980).

Long term surveys are important for understanding the structure of mushrooms assemblages and their biodiversity (Straatsma *et al.* 2003).

CHAPTER - THREE

3. STUDY AREA

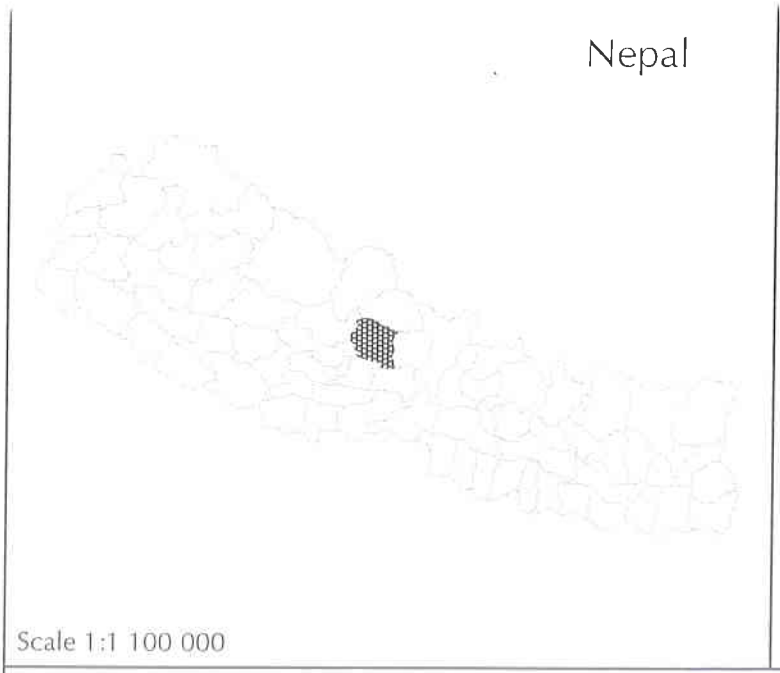
3.1 Lumle Area

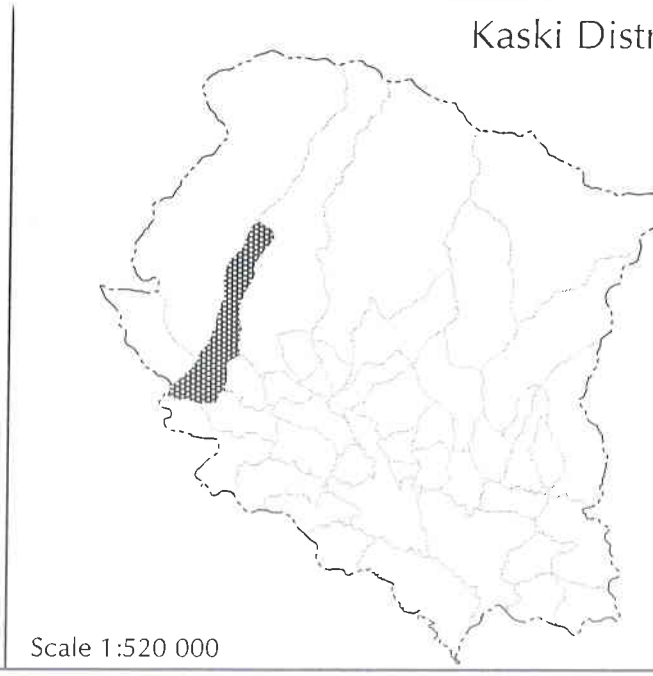
3.1.1 Physical setting

Lumle VDC in Kaski, Gandaki situates in the northwestern part between latitude 28^0 17' to 28^0 28' N and longitude 83^0 47' to 83^0 58' E. It accounts an area of 5529.72 ha (55.29 Km^2) possessing 2.74 % of the total area of the Kaski district. The Modi River acts as a boarder on its north-west with Dangsing and Ghandruk VDC. The VDC is bordered by Sallyan VDC towards south, Dhampus VDC towards northwest and Dhikurpokhari VDC towards southeast. The VDC is extending from north to south at the lap of magnificent Mt. Machhapuchre (6993 m.). The main route to Annapurna Base Camp (ABC) and Machhapuchre Base Camp (MBC) passes through this VDC. Facing towards the west and surrounded by hills, due to which the sun rises late and sets early. The total sunshine hours are comparatively less and most parts of the village remain under shade particularly in the winter. The study area consists dominantly of rugged mountain topography with elevation ranging from 1250m to 3500m. The mountain range elevates abruptly steep from the Modi River in the West to the maximum height toward the central northeast. The hilly ridge slopes are gently inclined to the southeast in Dhikurpokhari VDC. The lower and gentler slopes are covered into terraces for cultivation. The steep slopes and higher elevation are under forest cover. The topographical structure is synclinal, steep and jagged (Devkota, 2001).

3.1.2 Climate

The Lumle VDC falls broadly in the meso - thermal zone of Nepal. However, due to the high elevation of the topography and direct influence of the cold breeze from the snowy Annapurna range, the microclimate conditions normally remain humid-temperate type. Lumle is one of the heaviest rainfall recipient parts of the country. Normally, it receives rainfall amount between 5000 mm - 6000 mm annually. Most of the rainfall down pour during June to September (4 months) and normally remained above 70 rainy days. During these days, occurrence 100 mm rainfall exceeded days is counted above 20 days. Such type of heavy cloudburst storm sometimes brings nightmare to the mountain people. Temperature condition generally summer


Nepal
Scale 1:1 100 000


Kaski Distr
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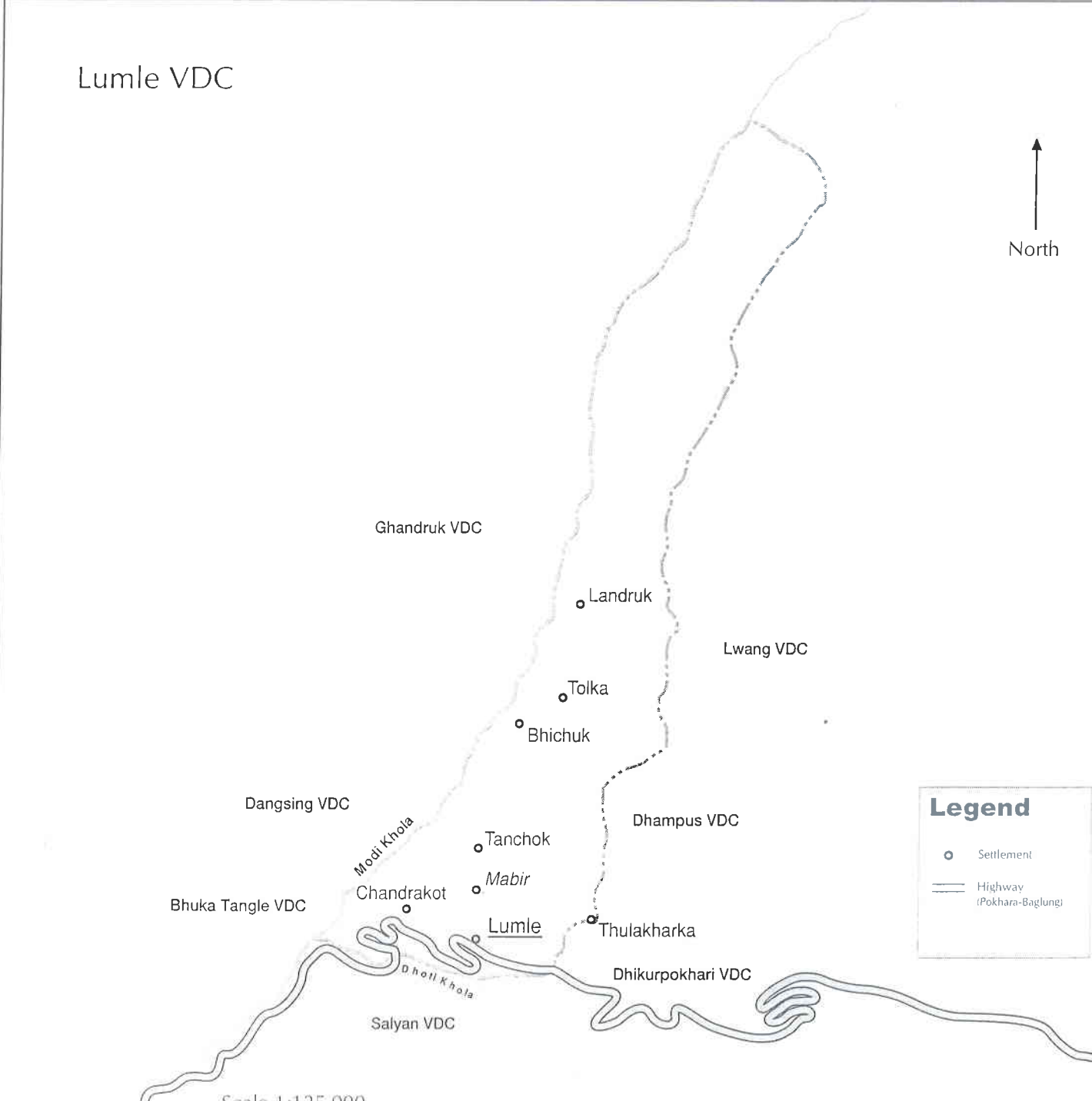

Lumle VDC
North
Ghandruk VDC
Landruk
Lwang VDC
Tolka
Bhichuk
Dangsing VDC
Modi Khola
Tanchok
Dhampus VDC
Mabir
Chandrakot
Bhuka Tangle VDC
Lumle
Thulakharka
Dhoti Khola
Dhikurpokhari VDC
Salyan VDC
Legend
Settlement
Highway
(Pokhara-Baglung)

is mild with temperature around 20^0c while winter is cold with mean temperature below 12^0C (Devkota, 2001). During winter, some upper reaches are covered with snowfall and frost fall is common to this area.

The meteorological data of the study area were taken from Lumle meteorological station at Lumle Agricultural Research Center (LARC). The meteorological data of five years (2000-2004) were analyzed.

At Lumle, highest maximum average temperature was recorded during July (20.78^0C). The average minimum temperature was recorded during January (9.51^0C). The average precipitation was highest during August (1432.07mm). Lowest precipitation was recorded in December (28.52mm).

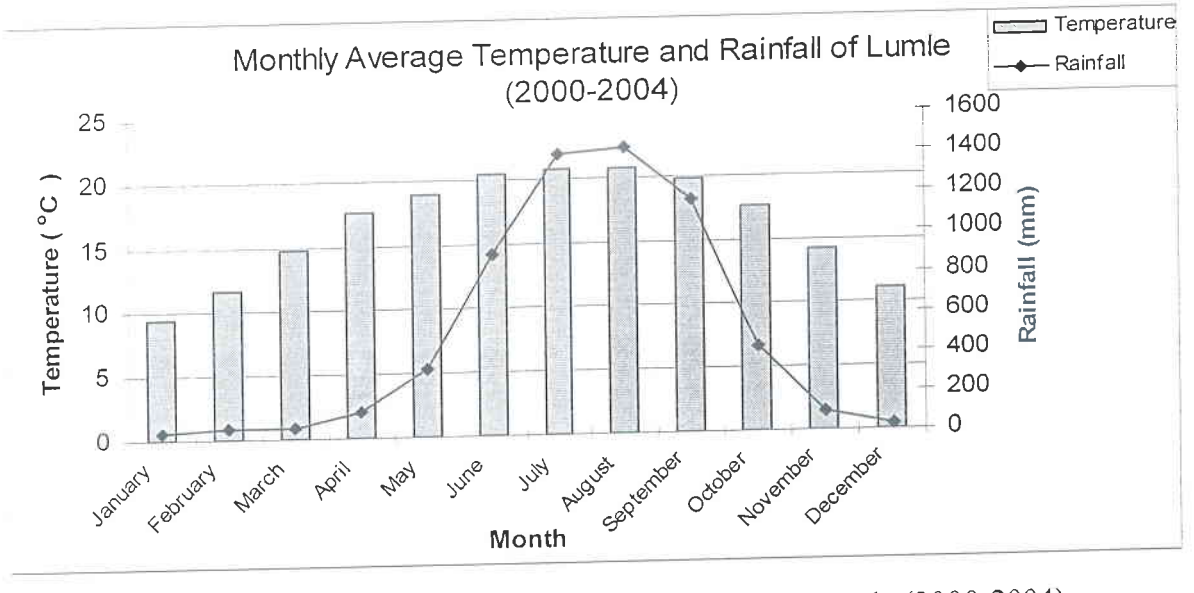


Fig. 3.1: Monthly variation in total temperature and rainfall of Lumle (2000-2004)

3.1.3 Vegetation

Lumle VDC is confined within the altitude from 1250m to 3500m. Corresponding to the climatic variation, there also occur changes in vegetation types from subtropical to temperate. The vegetation of the study area is of mixed type consisting of deciduous soft and semi hard wood, shrub and conifers. Because of topographic elevation, soil depth and climatic variation, the forest species are quite diverse from crest range to middle part of hill slopes and low land. The dominant tree species present in the study area at the high altitude above 1800m are *Schima wallichii*, *Daphniphyllum himalaense*, *Rhododendron arboreum*,

Quercus semecarpifolia, *Pinus roxburghii*, *Quercus lamellose*, and *Quercus lanuginose*. Shrubs mostly of *Daphne bholua* and *Maesia chisia* are found to enrich the vegetation in this level. Below 1800m the vegetation is enriched with *Alnus nepalensis*, *Castonopsis indica, Rhododendron arboreum, Myrica esculenta*, *Prunus cerasoides* and *Eurya acuminate* etc. and dense bushes of bamboos. The Lumle VDC is also under command area of both Lumle Agriculture Research Center (LARC) and Annapurna Conservation Area Project (ACAP).

3.2. Kathmandu area

3.2.1 Physical setting

The valley of Kathmandu, the capital city of Nepal, is located between latitudes $27^0$34' N to 27^0 48' N and longitudes 85^0 10' E to 85^0 32' E consists of three main districts, Kathmandu, Lalitpur and Bhaktapur. It is saucer – shaped valley with the valley floor lying at about 1350m. altitude surrounded by the mountains, the highest peak being Phulchowki (2715m.) which is situated on the south-east corner of the valley. Its area is approximately 650 square Km (Malla *et al.*1986)

3.2.2 Climate

Kathmandu valley is characterized by typical monsoon climate with rainy summer and dry winter. Pre-monsoon season during March to May is mostly dry and warm. This period is characterized by hazy atmosphere with dusty winds. Later part of this season brings down some precipitation with thunderstorm and is frequently associated with hailstorms. Over 80 % of the total rainfall is encountered during monsoon period starting from early June and ending by late September. Post-monsoon, starting from September to November is sunny and is mostly dry with gradual decrease in rainfall and temperature. Few spells of rain are, however, brought down during winter from January to February (Malla *et al.* 1986).

The meteorological data of the study area were taken from Meterological station at Kathmandu. The meteorological data of five years (2000-2004) were analyzed.

At Kathmandu, highest maximum average temperature was recorded during August (24.55^0C). The average minimum temperature was recorded during January (11.12^0C). The average precipitation was highest during July (1192.9mm). Lowest precipitation was recorded during December (9.3mm).

Nepal

cale 1:1 100 000

Kathmandu, Lalitpur & Bhaktapur

Scale 1:520 000

North

ale 1:260 000

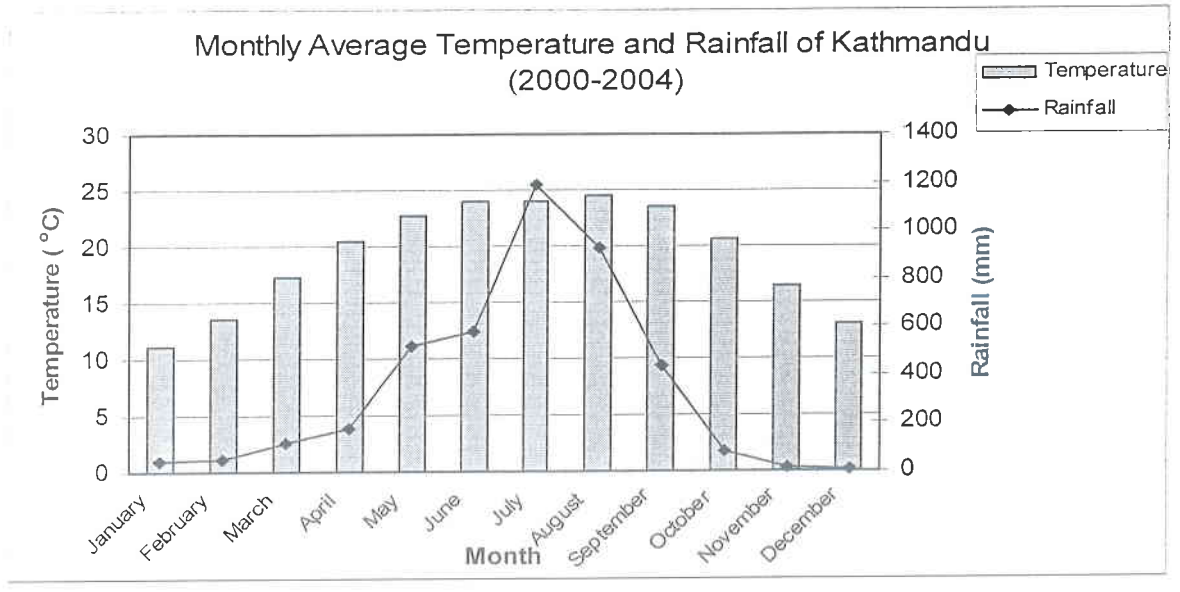


Fig. 3.2: Monthly variation in total temperature and rainfall of Kathmandu (2000-2004)

3.2.3 Vegetation

The areas (Nagarjun, Shivapuri, Manichaur, Nagarkot, Suryavinayak, Phulchoki, Lele, Dakshinkali, and Chandragiri) surrounding the valley consists of sub-tropical to temperate forests. The sub-tropical elements predominate at lower elevations, while temperare forest species dominate towards the top of the mountains surrounding the valley and its adjoining areas. The main vegetation types prevalent in the valley are *Schima –Castonopsis* on the valley floor and hill slopes, *Pinus roxburghii* on lower hill slopes and on the southern aspects, *Oak* forest at high level, *Quercus lanata* dominating upper hill slopes of Phulchoki, Shivapuri and Chandragiri and *Rhododendron* spp.on the upper reaches of valley hills (Joshi & Joshi,1999).

The evergreen broad-leaved forest is mainly composed of *Schima wallichii, Castonopsis indica* with other predominant trees like *Ilex doniana, Zizyphus incurva, Leucosceptrum sanum, Myrica esculenta, Rhododendron arboretum,* etc. Wet ravines and gullies are occupied by *Alnus nepalensis*. Prominent shrubs are *Daphney papyracea, Mahonia napaulensis, Rubus ellipticus, Phyllanthus parvifolius, Viburnum coriaceuk, Eurya acuminate,* etc (Malla *et al.*1986).

CHAPTER - FOUR

4. MATERIALS AND METHODS

4.1. Materials and Equipments

Following materials and equipments are necessary for the collection of mushrooms (Adhikari, 1991; Brundrett, et *al.*, 1996).

Equipments

- Camera with macro (Close - up) lens.
- Collecting basket or bag
- Fungus dryer
- Hand lens (10-20 x magnification)
- Compass, GPS
- Pocket knife or trowel for unearthing entire specimens.
- Storage containers with lids

Stationaries

- Brush for cleaning specimens
- Envelopes for storing dried specimens
- Grey colour board as background for photographs
- Maps, pens/pencils
- Reference books (field – guide type)
- Ruler for measuring mushrooms
- Small and large paper bags to keep collections from the same location.
- Small notebook for recording data
- Standardized data sheet for detailed notes
- Wax paper roles, bags
- White/ black paper for spore prints

Others

- First aids

Chemicals

- FeSo4 crystals
- KOH 10 %,
- Melzers solution

4.2. Collection of Mushrooms

The fieldwork was conducted four times (August- October -2003, and June-July -2004) in Lumle area and only one time (July, August -2004) in vicinity (Dakshinkali, Godavari, Matatirtha, Nagarkot and Suryavinayak) of Kathmandu valley. Clavariales and allied species were collected from vicinity of Kathmandu; other mushrooms species were collected from Lumle. While conducting field trips in Lumle, a professional mushroom hunter and some other friends were accompanied. Moving in a dense forest in rainy season with the risk of wild animals was challenging task

In case of Kathmandu sites, collecting Clavariales and allied genera was easy task but giving concentration only in one genus, the collection was not so handful as was in Lumle. While conducting field trip in Dakshinkali and Nagarkot, local mushroom hunter accompanied for the collection. Rests of the places were visited with amateur friends.

The mushrooms were photographed in their natural habitat before they were collected. The broken, rotten and insect eaten species were discarded. The basidiocarps were picked up by digging them out carefully with the help of sharp knife. Attempts were made to collect all the developmental stages of the basidiocarps to have idea of all morphological characters. Keeping in mind 'Few good specimens are better than several ones' (Adhikari,1991), more specimens were not collected in the same day rather the collections were usually made till 2-3 o'clock and rest of the time was utilized in processing of collected specimens.

Two types of field observation format were prepared [Annex-1(i) & (ii)] to record information about all the morphological and chemical characters including surrounding ecology of

specimens. Specific collection numbers were given for each species. These formats were filled up in the mean time of collection except in some cases of obtaining spore print.

Either each specimens of same species or different species collected from same locality or different localities were cleaned with the help of brush. They were placed in separate wax paper bags to prevent mixture of spores. Bamboos baskets and paper bags were used for the collection of specimens in the field.

The indigenous knowledge and beliefs towards the wild mushrooms were taken with the help of questionnaire (Annex-2).

Spore Print: For taking spore prints, stipe of the fruit body was cut and the cap was set on a piece of white paper (For white spored fungi, black paper was used or half white and half black paper for any mushrooms) turning the gills downwards. A drop of water was mounted on the cap in order to minimize drying out of tissues. The material was then placed on a container and incubated for some time (2 - 24 hours) depending on the nature of the fruit body. Finally, cap was removed carefully and the characteristics of the spore prints were noted.

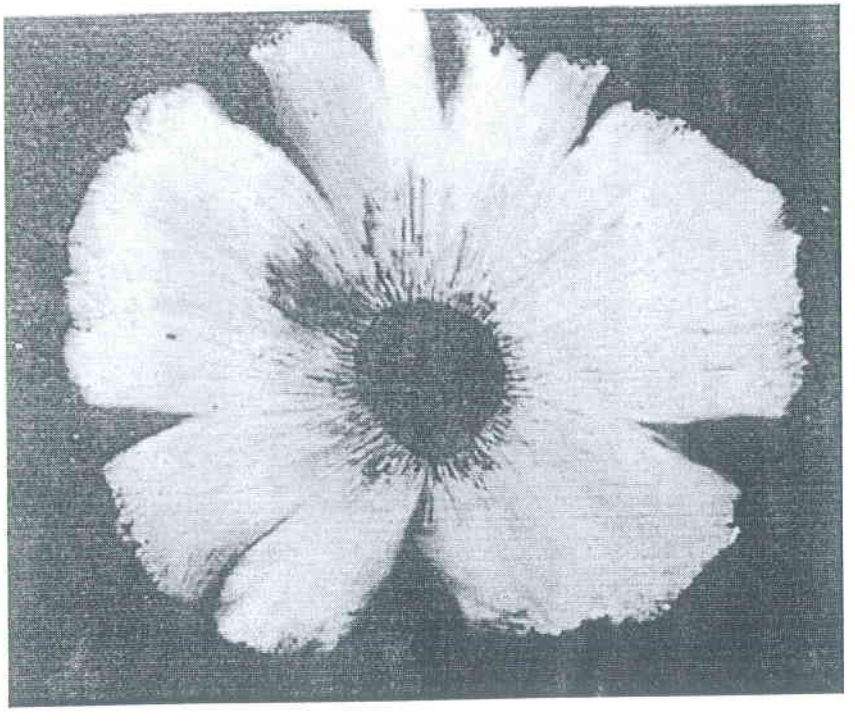


Plate: Spore Print of *Lepiota* sp.

4.3 Preservation of mushrooms

The specimens were preserved in dry condition and in liquid.

4.3.1 Dry Preservation:

The specimens gathered were dried immediately in order to prevent from rotting. Sun drying was suitable for drying mushrooms. However, due to poor weather conditions and collections were made in rainy season, all the specimens could not be dried only in sunlight. Wire trays with mushrooms specimens were placed over the hearth in near about 40^0C to dry mushrooms. After well drying, the specimens were packed in paper bags with some Naphthalene bulbs and shield in auto lock plastic bags to prevent from decay and insect. Preserved specimens were thoroughly checked and were sun dried in the intervals of 1-2 months.

Plate: Sun drying specimens

Plate: Well preserved specimens

4.3.2 Liquid preservation

The fleshy specimens for museum were preserved in a mixture of distilled water, alcohol and formalin or distilled water and formalin with 70:25:5 or 95:5 concentrations followed by Ainsworth (1971).

4.4 Post field studies

The specimens were brought to the laboratory for the microscopic studies and identification. A very fine section passing through the epicutis to hymenial surface (spore bearing layer) was taken with the help of razor blade. The section of dried materials was then mounted in water with a drop of 10% KOH or NaOH solution (this solution revives the section to its original size for the measurement). Then the section was covered with microscopic cover slip and gently tapped with a blunt of a pencil and observed under 15 x10 and 15 x 40 powers for further studies. The specimens were studied at Central Department of Botany, T.U., Kirtipur and National Herbarium and Plant Laboratories, Godavary. The specimens that were collected and preserved as herbarium were identified with the help of standard literatures (Adhikari, 2000; Bakshi, 1971; Corner, 1950, 1973; Dickinson & Lucas, 1979; Fries, 1938; Imazeki, Otani & Hongo, 1988; Kibby, 1979; Kumar *et al.* 1990; Pacioni, 1985; Philips, 1981; Purukayastha & Chandra, 1985; Rinaldi & Tyndalo, 1972; Svreck, 1975; Teng, 1988; and Thind, 1961). They were also compared with the specimens at National Herbarium (KATH) and Tribhuvan University Central herbarium (TUCH) and some of them were identified by consulting other relevant literatures of respective sites. Nomenclature follows Adhikari (2000). The voucher specimens were deposited in TUCH and KATH.

4.5 Statistical Analysis

4.5.1 Indexes of Similarity (IS)

It is the simplest method to compare samples only in terms of species presence or absence. It gives the degree of similarity between any two stand which depends on the quantitative phytosociological characters of species common to both stands. It was calculated by Sorensen's Indexes of Similarity (1948), which has formula-

$$IS = \frac{2C}{A + B} \times 100$$

Where, IS = Indexes of Similarity

A = the total no. of species in one zone

B = the total no. of species in the other zone

C = the number of species which occur in both zones

4.5.2 Ordination

Ordination is a collective term for multivariate technique which adapt a multi-dimensional swarm of data points in such a way that when it is projected into a two dimensional space any intrinsic pattern the data may possess becomes apparent upon visual inspection (Pielou, 1984). Basically, ordination serves to summarize community data (such as species abundance data) by producing a low-dimensional ordination space in which species and samples most similar to one another will be close together, and species and samples most dissimilar from one another will appear farther apart (Leps & Smilauer, 2003). Since variation in a population is related to one or several environmental parameters and in turn these are reflected in the abundance of indicator species, the resultant ordination can efficiently summarize a large body of information (Kershaw, 1977).

Ordination techniques

There are several different ordination techniques, all of which differ slightly, in the mathematical approach used to calculate species and samples similarity/dissimilarity. According to Palmer, (2005) most commonly used ordination techniques are Detrended Corresponding Analysis (DCA), Principal Component Analysis (PCA) and Cannonical Corresponding Analysis (CCA). In this analysis, first I have applied Detrended correspondence analysis (DCA; Hill & Gauch, 1980) to estimate the compositional gradient length in SD-units (Hill & Gauch, 1973, Leps & Smilauer 2003). DCA is the most accessible and widely applied ordination method in vegetation science (Van der maarel *et al.* 1985, Okland & Eilertsen 1996, Ejrnes 2000, Exner *et al.* 2002, Leps & Smilauer, 2003). DCA was performed by selecting method of detrending by segment. I have found shorter gradient length (SD = 2.29) so linear model is a appropriate method. PCA was applied to know the crude relationship between species. I have also used CCA to show the relationship between elevation and species. To check the variation of species composition described by elevation, Monte Carlo Permutation Test was performed (ter Braak, 1986).

CHAPTER - FIVE

5. FINDINGS

5.1 Enumeration of mushroom species collected from study areas

The local names, place of representative collection, ethnic value and distribution of the species are provided alphabetically.

1. *Amanita cokeri* (Gilb. & Kühn.) Gilb. ex Pilat

On moist ground, in *Rhododendron arboreum* - *Schima wallichii* forest, Mulabari, Lumle, 1830m, 14. 6. 2004 (2061.02.32), Devkota, S., no.00120, TUCH & KATH. (Pl.n. 1)

Previous records were from Nagarkot (1600m); Lele (1600m) and Suryavinayak (1531m) (Adhikari, 1996b; Adhikari *et. al.* 1998).

Poisonous.

Distribution – N. America, Japan and Nepal.

2. *Anthracobia macrocystis* (Cke.) Boud.

On soil, Saujung, Lumle, 1651m, 13.6.2004 (2061.2.31). Devkota, S., no. 00107, TUCH & KATH. (Pl. n. 2)

Previously reported on soil in *Pinus roxburghii* forest, Balaju (Waraitch & Thind, 1977a).

Not edible.

Distribution – Europe, America. and Nepal

3. *Aphelaria tuberosa* (Grev.) Corner

On soil under *Pinus roxburghii*, Dakshinkali, 1340m, 13.08.2004 (2061.4.29). Devkota, S., no. 00146, TUCH & KATH. (Pl. n. 3)

Not edible.

New to Nepal.

4. *Ascobolus magnificus* Dodge

On Buffalo dung, Jharamta, Lumle, 1635m, 17.8.2003 (2060.4.32). Devkota, S., no. 0092, TUCH & KATH. (Pl.n. 4)

New to Nepal.

Not edible.

Distribution – China, Nepal.

5. ***Auricularia auricula - judae*** **(Bull. : Fr.) Wettst.** - Kane chyau, Musakane chyau, Narvyang shyamo, Chipley chyau, Nalele, Naladi, Kukhura ko sir chyau.

Growing on dead stumps of *Alnus nepalensis*. Jhakrey, Lumle, 1645m, 14.6.2004 (2061.02.32). Devkota, S., no.00111, TUCH & KATH. (Pl.n. 5)

It was previously reported from Manichaur (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). Common species.

Edible but not known to local people.

Distribution - Europe, Japan, China, N. America, Australia, India, and Nepal.

6. ***Auriscalpium vulgare*** **S.F. gray**

On *Pinus* cone, Saujung, Lume, 1651m, 13.6.2004 (2061.2.31). Devkota, S., no. 00109, TUCH & KATH. (Pl.n. 6)

Previous reports were made from Nagarjoon (Pandey, 1976), Nagarjoon and Syabru (Cotter, 1987).

Edibility – Unknown

Distribution – Europe, N. America, Japan and Nepal.

7. ***Cantharellus cibarius*** **(Fr. : Fr.) Fr.** – Ura shyamo, Kukhura ko phul chyau, Besare chyau.

On soil, in *Pinus roxburghii* forest, Saujung, Lumle, 1651m, 13.6.2004 (2061.02.31). Devkota, S., no. 00110, TUCH & KATH.

Previously reported from Bajrayogini (Manichaur) (Adhikari, 1976); Manang (Bhandary, 1991); Sundarijal and Kathmandu market (Adhikari & Adhikari, 1997; Adhikari *et al.*1996b).

Edible.

Distribution – Worldwide.

8. ***Chlorociboria aeruginosa*** **(Fr.) Seaver ex Ram** ***et al.*** [= *Chlorosplenium aerugineum* (Berk.) Sacc.]

On stump of *Quercus semecarpifolia*, Thulakharka, Lumle, 2108m, 15.8.2003 (2060.04.30). Devkota, S., no. 0078, TUCH & KATH.

This species was previously reported from Dakshinkali (1800m), Kathmandu, Symbhuanjyanj (2300m), Daman (Thind *et al.,* 1983) and Nagarkot (Adhikari, 1999)

Not edible.

Distribution - Europe, Japan and Nepal.

9. ***Clavaria acuta*** **Sch. : Fr.**

On soil of *Rhododendron arboreum,* Bhirmuni, Lumle, 1925m. 29.6.2004 (2061.03.15). Devkota, S., no. 00131. On soil, of *Pinus roxburghii* forest Dakshinkali, 1340m, 13.08.2004 (2061.4.29).Devkota, S. no.00141, TUCH & KATH.

Previously, recorded on soil in *Castonopsis* forest, Godavari (Adhikari, 1988b); in mixed forest, Suryavinayak (1540m) and Sundarijal (1780m) (Adhikari, 1996b; Adhikari *et al.,* 1996).

Edibility- unknown

Distribution – India, Japan, S. Australia (Victoria), Europe, U.S.A. and Nepal.

10. ***Clavaria fumosa*** **Fr.**

On soil, under *Alnus nepalensis* forest, near Godavari Kunda, Godavari, 1515m, 21.08.2004 (2061.5.5). Devkota, S., no. 00165, TUCH & KATH. (Pl. n. 7)

New to Nepal.

Edibility - Unknown

Distribution – China, Nepal

11. ***Clavaria rosea*** **Fr.**

On soil, under the shade of *Daphniphyllum himalense*, Thulakharka, Lumle, 2108m, 15.8.2003 (2060.04.30). Devkota S., no.0077, TUCH & KATH. (Pl. n. 8)

Previous records were from Dakshinkali (Adhikari, 1996a; Adhikari *et al.,* 1996). Rare species.

Not edible.

Distribution – Distribution: India, West Pakistan, China, Japan, Bonin Isl., Ceylon, Java, Australia, S. Africa, Europe, N. America, Nepal and generally common in temperate regions.

12. ***Clavaria vermicularis*** **Swartz: Fr.** - Chwali chyau, Chwali shyamo.

On open ground, Jharamta, Lumle, 1635m, 2.10.2003 (2060.06.15). Devkota, S., no. 0096. On open ground, Matatirtha, Kathmandu, 1520m, 25.08.2004 (2061.05.09).Devkota, S., no. 00170, TUCH & KATH. (Pl. n. 9)

Previously reported from Manichaur (Adhikari, 1976, 1991c); Godavari (1991) and Suryavinayak (Singh & Nisha, 1976c; Adhikari *et al.,* 1996). Common.

Edible

Distribution – India, West Pakistan, China, Japan, Java, Australia, S. Africa, Europe, and Nepal

13. *Clavulinopsis fusiformis* (Sow. : Fr.) Corner. - Chwali shyamo, Puju shyamo, Keshari chyau

On soil, under the shade of *Daphne* sp., Thulakharka, Lumle, 2048m, 15.8.2003 (2060.04.30). Devkota, S., no. 0086, On open ground, Suryavinayak, 1531m, 14.08.04 (2061.4.30). Devkota, S., no. 00153. On soil under *Pinus roxburghii,* Nagarkot, 1600m, 21.08.2004 (2061.5.5). Devkota, S., no. 00156, On soil under *Alnus nepalensis,* Matatirtha, 1520m, 25.08.2004 (2061.5.9). Devkota, S., no. 00169, TUCH & KATH. (Pl. n. 10)

Previous records were from Nabuchur (Adhikari, 1976, Singh & Adhikari, 1977) and Maipokhari (Adhikari, 2000e).

Edibility: Edible

Distribution- Europe, U.S.S.R., China, N. America, Japan, India and Nepal.

14. *Coprinus comatus* (Müll: Fr.) Pers. - Gobre chyau, Koper shyamo, Mang shyamo, Chyapu shyamo, Chyapi shyamo.

On soil of open ground, Thulakharka, Lumle, 2185m, 15.6.2003 (2060.03.01). Devkota, S., no. 0029, TUCH & KATH. (Pl. n. 11)

Previously reported from Chima gaun (Balfour- Browne, 1998), Godavari (Singh & Nisha, 1976c), Khumal (Pandey, 1976), Manichaur, Godavari and Phulchowki (Adhikari, 1976, 1987) pastureland, Phulchowki (1780m) and from Maipokhari (Adhikari, 2000e).

Common species.

Edible in young stage but not known to local people.

Distribution- Worldwide.

15. *Coprinus disseminatus* (Pers. : Fr.) Gray - Gobrey chyau

On stump of *Alnus nepalensis*, Majkhola, Lumle, 1643m, 12.8.2003 (2060.04.27). Devkota, S., no. 0059, TUCH & KATH.

Previously reported from Arun Valley (Balfour- Browne, 1968); Phulchowki (Singh & Nisha, 1976c) and growing on rotten wood, Pokhara (900m) (Adhikari *et.al,* 1996). Common species.

Not edible.

Distribution – Worldwide.

16. ***Coriolus hirsutus* (Fr.) Quel.** – Kathey chyau

On stump of *Alnus nepalensis*, Chandrakot, Lumle, 1660m, 14.6.2003 (2060.02.31). Devkota, S., no. 003, TUCH & KATH.

Previously reported on *Juniperus* sp., Thodung, Khumbu, Chialsa Gompa, and Likhu Khola (Ryv. 1979); Milke Danda (Dhankuta Dist.) (Balfour-Browne, 1968); Kakani (Kathmandu Dist.) (Pandey, 1976); on rotten poplar log, Jadabagar, Baitadi, (Adhikari, 1988) and on rotten log, Pokhara (900m) in tropical to temperate belts (Adhikari, 1996b)

Not edible.

Distribution - Worldwide

17. ***Daldinia concentrica* (Bull. : Fr.) Ces. & De Not.** – Dalley chyau

On log of *Alnus nepalensis,* Jhakrey, Lumle 1645m, 10.8.2003 (2060.04.25). Devkota, S., no. 0054, TUCH & KATH. (Pl. n. 12)

Previously it is reported on log Kathmandu valley (1580m) (Adhikari, 1997); Pokhara (900m) (Adhikari *et al.,* 1996); on dead *Dalbergia sissoo,* Hetauda, Tamagadhi and Siraha (Adhikari) and Maipokhari (Adhikari, 2000e). Common species.

Medicinal

Distribution - Worldwide.

18. ***Exobasidium butleri* P. & H. Sydow** -Pani Pokey Chyau

On both sides of green leaves of *Rhododendron arboreum.* Mulabari, Lumle, 1830m, 4.7.2004 (2061.03.20). Devkota, S., no. 00138, TUCH & KATH. (Pl. n. 13)

It was reported previously from, Dhulikhel, Daman (Singh & Nisha, 1974, 1976b) Godavari (Adhikari, 1996b) and Maipokhari (Adhikari, 2000e).

Edible.

Distribution – India and Nepal.

19. ***Ganoderma lucidum* (Fr.) Karst.** – Dadu chyau (Nep.), Dhi shyamo (Tam.), Kanchatak.

On *Quercus semecarpifolia* trunk Thulakharka, Lumle, 2190m, 16.6.2003 (2060.03.02). Devkota, S., no. 0045, TUCH & KATH.

Previously reported from, Kenja Likhu khola (Ryv, 1979); on rotten trunk, Bakhri Kharka (north of Pokhara) (Balfour-Browne, 1968); on tree trunk, Lele (Kathmandu valley) (Singh & Nisha, 1976c) and on trunk of *Rhododendron arboreum* and *Quercus,* Manichaur (Adhikari, 1988); on stump, between Seti Khola Bagar and Agra gaun (Bajhang Dist.) (1700m) (Adhikari, 1988); in root crevices of stump, Phulchowki (1800m); on tree stump (Thapa, 1990); Suryavinayak (1540m) (Adhikari *et al.,* 1996) and very common in *Dalbergia sissoo* and *Acatia catechu* plantations of Terai belts (Hetauda, Chitawan, Bara, Parsa, Rautahat, Siraha, Saptari, Dhanusha, Mahottari, Udayapur, Rajbiraj etc. (Between 70 and 500m). Found infecting mango plantations have been recorded. Wide spread in tropical to temperate belts (Adhikari, 1996a; Parajuli *et al.,* 1999ab).

Recently used as edible species. It is known to be of medicinal mushrooms widely used for many diseases (Adhikari, 2005)

Distribution- Worldwide

20. *Grifola frondosa* (Dicks. : Fr.) S.F. Gray- Sulsing marmo, Nagroom, chyapki, Nangrey chyau

On *Quercus semecarpifolia* trunk. Thulakharka, Lumle, 2105m, 15.8.2003 (2060.04.30). Devkota, S., no. 0079, TUCH & KATH. (Pl. n. 14)

Previously reported from, Pokhara market (Bhandary, 1980) on *Quercus glauca* tree, Manichaur (Kutung Sang) (Adhikari, 1988) and sold in the market, Sundarijal (1780m) Kathmandu.

Edible and highly preferred by Local people.

Distribution – In temperate Oak forests. N. America, Australia, Japan, Europe and Nepal.

21. *Guepinia spathularia* (Schw.) Fr.

On stump of *Alnus nepalensis.* Piya Ko Dada, Lumle, 1647m, 17.8.2003 (2060.04.32). Devkota S., no. 0091, TUCH & KATH.

Previously reported in *Schima- Castonopsis* forest, Pokhara (980m) (Adhikari *et al.,* 1996).

Not edible.

Distribution - Europe, N. America, Japan, India and Nepal.

22. *Hericium erinaceus* (Bull. : Fr.) Pers. – Thokre chyau, Thakre chyau.

On Stump of *Alnus nepalensis.* Malaurii, Lumle, 1603m, 31.10.2003 (2060.7.14). Devkota, S., no. 00106, TUCH & KATH. (Pl. n. 15)

Previously reported on *Quercus,* Sauwala Khola and Chima gaun (Balfour-Browne, 1968); on *Quercus semecarpifolia.* Phulchowki (Singh & Nisha, 1976, 1987, 1996a; Adhikari & Adhikari, 1997; Adhikari *et al.,* 1996).

Edibility of this mushroom was not known among the local people before this survey, but during collection period, author (Devkota, S.) ate it showing to local, then after they also used to eat it.

Distribution – Worldwide.

23. *Hygrocybe coccinea* (Schaeff. : Fr.) Kummer

On soil in moist shady place in *Quercus* forest. Doka Dada, Lumle, 2187m, 15.8.2003 (2060.04.30). Devkota S., no. 0075, TUCH & KATH. (Pl. n. 16)

Previous report was from Phulchowki (Singh & Nisha, 1976c).

Inedible.

Distribution – Europe, Japan, China, N. America, India and Nepal.

24. *Hypoxylon multiforme* (Fr.) Fr.

On log of *Engelhardia spicata*, Lumle Agriculture Research Center (LARC), 1725m, 14.6.2004 (2061.3.1). Devkota, S., no. 00123, TUCH & KATH.

Previously reported on branch, Taplejung, Mewakhola, on log, Ankhu Khola, Ganesh Himal (Balfour – Browne, 1968).

Not edible.

Distribution – Europe and Nepal.

25. *Laccaria laccata* (Scop. : Fr.) Cooke – Budhi Chyau, Jhari Chyau, Kukhure Chyau,

On soil in moist place. Syaniswara, Lumle, 1775m, 14.8.2003 (2060.04.29). Devkota, S., no. 0061, TUCH & KATH.

Previously reported from Arun valley (Balfour-Browne, 1968); Bajrabarahi, Nagarjoon (Pandey, 1976); Godavari (Singh & Nishsa, 1966c); growing in moist shady place in *Pinus* forest, Kakani (1760m); Tokha (1680m); Bajrayogini (1600m); Lele (1600m); Nagarkot

(1680m); in mixed forest, Sundarijal (1700m); Suryavinayak(1540); Matatirtha (1620m) and Pokhara (980m) (Adhikari *et al.* 1996). Common species.

Edible. Sold in the Kathmandu market in large quantity (Adhikari, 2000).

Distribution- Worldwide.

26. *Lactarius piperatus* (Fr.) S.F. Gray – Dudhey chyau

On soil in *Rhododendron* forest. Gairi Khoria, Lumle, 1773m, 4.7.2004 (2061.03.20). Devkota S., no. 00136, TUCH & KATH. (Pl. n. 17)

Previously reported from Kathmandu valley (Singh, 1996); Daman (Pandey, 1976); growing on soil in *Pinus roxburghii* forest, Tokha (1520m); Nagarkot (1600m) (Adhikari, 1996a; Adhikari *et al.,* 1996a); Suryavinayak (1540m); Lele (1380m) Phulchowki (1700m) (Adhikari, 1996a) and Lamjung (Adhikari & Adhikari, 2003) Common species.

Edible. This species is eaten though not preferred by Tamang casts dwelling near by the *Pinus roxburghii* forests (Adhikari, 2000).

Distribution- China, Europe, U.S.S.R., N. America, Japan and Nepal.

27. *Lactarius volemus* (Fr.) Fr. – Dudhey chyau

On soil in the shade of *Rhododendron arboreum.* Mulabari, Lumle, 1836m, 14.8.2003 (2060.04.29). Devkota, S. no. 0069, TUCH & KATH. (Pl. n. 18)

Previously reported from Manichaur (Adhikari, 1976); Nagarjoon , Kathmandu valley (Pandey,1976); on soil in *Pinus roxburghii* forest, Nagarkot (1620m); Lele (1380m); Bajrayogini (1600m); Dakshinkali (1340m); in mixed forest, Matatirtha (1520m); Suryavinayak (1560m) and Phulchowki (1750m) (Adhikari, 1996a; Adhikari *et al.*, 1996) and Maipokhari (Adhikari, 2000e).Common species.

Edible and local people often eat it in row condition.

Distribution- China, Europe, N. America, Japan and Nepal.

28. *Lentaria mucida* (Fr.) Corner

On stump of *Quercus semecarpifolia,* Mabir, Deurali, Lumle, 2052m, 5.7.2004 (2061.3.21). Devkota, S., no. 00139SD, TUCH & KATH. (Pl. n. 20)

New to Nepal.

Inedible

Distribution – Japan and Nepal.

29. *Lycoperdon pyriforme* Schaeff. : Pers. - Phusphuse chyau, Nagala phum shyamo.

On moist ground, under the shade of *Alnus nepalensis*. Gairi Khoria, Lumle, 1748m, 14.6.2004 (2061.02.32). Devkota, S., no .00112, TUCH & KATH. (Pl. n. 19)

Previously reported on rotten dead wood in moist shady places, Sulighadh (West Nepal) (Balfour –Browne, 1968); Thodung, Lamjura and Junebeshi (Kreisel, 1969); Phulchowki and Sundarijal (Singh & Nisha, 1976c) and Kakani (Pandey, 1976); Kaligad, Surmasarowa Lekh, Dhuli, Simen, Langtang valley (Kreisel, 1976); between Syabru besi and Lama hotel (2380m); Langtang National Park (Adhikari, 1996b); Kakani (1780m) and Pokhara (980m) (Adhikari, 1996); Kakani (1780m) and Pokhara (980m) (Adhikari *et al.*, 1996). Common species.

Edible. Medicinally used to cure wounds.

Kreisel (1996) treats the new species *L. emodense* Berk. described by Berkeley (1854, reprint 1969) gathered from East Nepal, as synonum of *L .pyriforme.*

Distribution- Europe, Sino-Japan, Central and South-East Asia, North America, Australia, Africa, Tasmania, New Zealand and Nepal.

30. *Oudemansiella radicata* (Rehl. : Fr.) Singer – Kag khuttey chyau, Tang shyamo.

On soil of *Alnus nepalensis*, Gobaney, Lumle, 1657m, 14.6.2003 (2060.02.31). Devkota, S., no. 0011, TUCH & KATH.

Previously reports were made from, Manichaur, Godavari, Lele, Matatirtha, Sundarijal, Kakani, Nagarkot, Suryavinayak (1520m); Lele (1600m); Kakani (1780m) (Adhikari, 1976 and pers. Obs.), Nagarjoon, Chautara, Pathibhanjyang and Ghorepani (Cotter, 1987) and Maipokhari (Adhikari, 2000e). Common species.

Edible. Roasted on fire or cooked with many things as vegetable (Adhikari, 2000).

Distribution- Worldwide

31. *Pholiota squarrosa* (Müll. : Fr.) Kummer - Chiple chyau

On stump of *Quercus semecarpifolia*. Thulakharka, Lumle, 2021m, 15.8.2003 (2060.04.30). Devkota S., no.0071, TUCH & KATH.

Previously reported from Chimagoan (Balfour - Browne, 1968) and market (Bhandary, 1984).

Edible

Distribution – Europe, Japan, China, N. America, India and Nepal.

32. *Pycnoporus cinnabarinus* (Jacq. : Fr.) Karst. - Rato kathey Chyau, Raktey Chyau

On bark of stump of *Alnus nepalensis.* Jhakrey, Lumle, 1645m, 10.8.2003 (2060.04.25). Devkota, S. no. 0056, TUCH & KATH. (Pl. n. 21)

It is reported previously on dead wood, place not mentioned (Berkeley, 1984); Khand Bari (Pandey, 1976); on *Betula* sp., Chheti gaon, Darchula Dist. (Adhikari *et al.,* 1996); Pokhara (900m) (Adhikari ,1996) and Lamjung (Adhikari & Adhikari, 2003). Medicinally used to cure cuts and burns.

Distribution – Worldwide.

33.. *Ramaria botrytis* (Pers. : Fr.) Ricken – Thokre Chyau, Kawali Chyau.

On ground on the base of *Aurandaria* sp. Dakshinkali, Lalitpur, 1340m, 13.08.2004 (2061.4.29). Devkota S., no.00148, TUCH & KATH (Pl. n. 22)

Previously reported in Rigmo (Balfour–Browne, 1968); Kakani (Pandey, 1976), Pisang (Bhandary, 1991) and Kathmandu market (Adhikari, 1996a; Adhikari & Adhikari, 1997; Adhikari *et al.,* 1996).

Edible

Distribution- Europe, N. and S. America, Australia, Japan, India and Nepal.

34*Ramaria flaccida* (Fr. : Fr.) Ricken - Kauli chyau

On moist ground, under the shade of *Rhodendron arboreum.* Gairi Khoria, Lumle, 1775m, 14.6.2004 (2061.02.32). Devkota, S., no. 00116, TUCH & KATH. (Pl. n. 23)

Previously reported in pine wood, on soil, Taglung (Balfour- Browne, 1968).

Edible. Local people used to cook it like noodles.

Distribution – Europe, China, N. America, Japan and Nepal.

35. *Russula aurora* Krombh.- Sindure Chyau [=*R. rosea* Pers., *R. rosacea* (Pers.) Gray]

On moist ground, under the shade of *Schima wallichii.* Gairi Khoria, Lumle, 1775m, 14.6.2004 (2061.02.32). Devkota, S., no. 00117, TUCH & KATH. (Pl. n. 24)

It was reported previously in *Pinus roxburghii* forest, Royal Botanical Garden, Godavary (1515m) (Adhikari, 1988c); Bajrayogini (1680m); Phulchowki (1980m) and Lele (1600m) (Adhikari, 2000).

Edible but not known to local people.

Distribution – China, Europe, India, Japan, N. America and Nepal.

36.Russula chloroides **(Krombh.) Bres.**

On moist ground, under the shade of *Schima wallichii.* Gairi Khoria, Lumle, 1775m, 14.6.2004 (2061.02.32). Devkota, S., no. 00118, TUCH & KATH. (Pl. n. 25)

Previously, reported from moist place of *Shorea robusta* forest, Vrindavan Herbal Farm, Hetauda, Narayani zone (560m) and Royal Botanical Garden, Godavari (1515m) and Dakshinkali (1500m) (Adhikari,2000)

Edible

Distribution – Europe, Japan, North America and Nepal.

37. ***Schizophyllum commune*** **Fr. : Fr**. – Mizu chyau, Kathe bagale chyau.

On the logs, stumps and sticks of *Alnus nepalensis.* Jhakrey, Lumle, 1645m, 10.8.2003 (2060.04.25). Devkota, S., no. 0055, TUCH & KATH. (Pl. n. 26)

Previously it is reported in growing on decayed wood, Ranipauwa, Kaligandaki (Balfour-Browne, 1968), Bagarchhap (Bhandary, 1991) and Pokhara (Adhikari, 1996a; Adhikari *et al.,* 1996). Common species in Tropical to Temperate belts.

Edible used by Magar and Newar ethnic casts (Adhikari, 2000).

Medicinal

Distribution – Worldwide.

38. ***Trametes versicolor*** **(L. : Fr.) Llyod** [= *Coriolus versicolor* (Fr.) Pilat; *Polyporus versicolor* L. : Fr., *Polystictus versicolor* (Fr.) Cooke; *Polyporus pictilis* Berk] - Kathey chyau, Mudhey chyau

On dead trunk of *Alnus nepalensis.* Gobaney, Lumle, 1657m, 7.10.2003 (2060.06.20). Devkota, S., no. 00104, TUCH & KATH.

Previously reported on wood, Nangki (Berkeley, 1854); Hatier (Arun valley),Sanghu and Mewa Khola (Balfour-Browne,1968); Jiri, Chialsa, Thodung, Junbesi and Khumbu (Ryu.,1979);on dead birch, place not mentioned (Berkeley,1854);on tree stump, Dhulikhel (Singh and Nisha,1976c); Ranipauwa and Lete (Kaligandaki), Bakhri Kharka (Pokhara) (Balfour-Browne,1968); on stump, Manichur (2160m) (Adhikari,1988a); on dead tree stump, Hurikot, Jumla Dist. (Balfour-Browne,1955); on stump, Shree Bhabar Lekha, Bajhang Dist. (2400m) (Adhikari,1988a) Lamjung (Adhikari & Adhikari, 2003) In tropical to temperate belts (Adhikari, 1966a).

Not edible.

Distribution- Worldwide.

39. *Trichoglossum farlowi* (Cooke) Durand

On soil. Thulakharka, Lumle, 2048m, 15.8.2003 (2060.4.30). Devkota, S., no.0087, TUCH & KATH. (Pl. n. 27)

Previous reports were made from Gokarna, Kathmandu (Otani, 1982) Chandanbari (2800m) and Dhunche (Thind *et al.,* 1983).

Not edible.

Distribution – Japan, China and Nepal.

40. *Xylaria filliformis* (Alb. et Schw.) Fr.

On decaying leaves of *Daphniphyllum himalense,* Mulabari, Lumle, 1825m, 14.6.2004 (2061.02.32). Devkota, S., no. 00119, TUCH & KATH. (Pl. n. 28)

New to Nepal.

Edibility- Unknown

Distribution- China and Nepal

41. *Xylaria nigrescens* (Sacc.) Lloyd

On log of *Quercus semecarpifolia,* Thulakharka, Lumle, 2101m, 15.8.2003 (2060.4.30). Devkota, S., no. 0081, TUCH & KATH. (Pl. n. 29)

New to Nepal.

Edibility - Unknown

Distribution- China and Nepal.

42. *Xylaria plebeja* Ces.

On log of *Quercus lamellose,* Thulakharka, Lumle, 2035m, 15.8.2003 (2060.4.30). Devkota, S., no. 0090, TUCH & KATH. (Pl. n. 30)

New to Nepal.

Edibility – Unknown

Distribution – China and Nepal.

43. *Xylaria polymorpha* (Pers. : Fr.) Grev. [=*Sphaeria polymorpha* Pers. : Fr.]

On log of *Quercus semecarpifolia.* Thulakharka, Lumle, 2040m, 15.8.2003 (2060.04.30). Devkota, S., no.0089, TUCH & KATH.

Previous reports were made from East Nepal, Helok- Baroya, khimty (Imazeki *et al,* 1966); on tree trunk, Arun Valley (Balfour –Browne, 1968) and from Ilam (1200m) (Adhikari, 1988)

Not edible.

Distribution – Europe, Japan, China, India, Nepal, America and Australia.

5.2 Detailed studies of Clavariales

5.2.1 Identification key to the collected Clavariales

Key to the families of Clavariales

Basidiocarps usually fleshy to tough, growing on rotten log to soil, erect, cylindric, clavate or branched, round or flattened, the upper portion of the basidiocarp fertile, covered by the hymenium on all sides, basidiospores hyaline to subhyaline .....Clavariaceae

Basidiocarps occurring on humus; medium to very large; radially branched, generally colored, coral red to yellowish brown; fleshy-fibrous, softly-leathery, tough; basidiospores pale yellow, ochraceous, ellipsoid, smooth.....Ramariaceae

Key to the Genera of Clavariales

A. Fruit body simple or branched, spores hyaline to subhyaline, fertile portion needle like.....1

1a. Growing on rotten log with green algae, simple or branched.....*Lentaria*

1b. Growing on soil.....2

2a. Fructification tough.....3

3a. Fructification simple or sparsely branched, tough, rough, dirty white, brighter at the tip, on drying turning brown, spores hyaline.....*Aphelaria*

2b. Fructification fleshy.....4

4a. Fruit body simple, white to red, fleshy, with or without trunk, trunk with grooved or without grooved, spores hyaline, ...*Clavaria*

4b. Fruit body simple, caespitose clusters, orange color, with cylindrical trunk, trunk without grooved, fleshy and somewhat brittle, yellow- orange, pink or red; spores subhyaline.....*Clavulinopsis*

B. Fruit body medium to very large, radially branched, colored, ...5

5a. Fruit body radially branched, massive to small spores yellow to brown coloured, mycelium thick walled.....*Ramaria*

Key to the Species of Clavariales

A. Basidiocarps simple, or at times forked or slightly branched, single or divided into groups, growing on logs or soil.....1

1a .Growing on rotting logs.....2

2a. Fruit body small, 0.5-1.0 cm x 0.5-1.0 mm, thick simple or branched, white, slimy, spore globular, 2.5 x 2.5 µm .....*Lentaria mucida*

1b. Growing on humus or as a saprophyte in moss.....3

3a. Fruit body white and tough 4

4a. Fructification small, 2.1-5 x 0.6-1.2 cm, gregarious, trunk 1.5 - 3.2 cm x 0.8-2 mm, brighter at the tip, 1-3 dichotomous, spores elongated-ellipsoid, 14.4-2.0 x 4.8-6.4 µm .....*Aphelaria tuberosa*

3b. Fruit body white and fleshy.....(5)

5a. Fructification small, upto 5cm tall, erect, simple, trunk 1-1.5cm long, spores oval, 7.5-10 x 2.5-5 µm.....*Clavaria acuta*

5b. Fructification 2-14cm tall, gregarious, with 3-8 clubs, erect, hollow, apex concolorous, spores ellipsoid, subglobose to globose, 2.5-6.5 x 2.5-4 µm .....*Clavaria vermicularis*

3c. Fruit body toffee colored to yellow.....6

6a. Fruit body 6-12cm tall, clusters up to 5-9 cm broad, toffee coloured, trunk with grooved apices concolorous; spores broadly ellipsoid, 6-7 x 2.5-6.0 µm .....*Clavaria fumosa*

6b. Fruit body 2-8.5 cm tall, clusters up to 3-5 cm broad, yellow, the tips often discolored, trunk without grooved; spores obovate, 5-7.5 x 6-12 µm .....*Clavulinopsis fusiformis*

B. Basidiocarps tough, radially branched, coral red to yellowish brown, growing on soil.....6

6a. Fruit body 7-15 x 6-20 cm , much branched cauliflower like, coral red at the apex, spores oblong- elliptic, 14-16 x 4.5-5.5 µm .....*Ramaria botrytis*

6b. Fruit body 5-12 x 4.0 cm, gregarious, medium sized, flaccid, yellowish – brown, dirty brown, spores ellipsoid, 6-8.5 x 2.5-5 µm .....*Ramaria flaccida*

***Aphelaria tuberosa* (Grev.) Corner**

Corner (1950), *A monograph of Clavaria and allied genera*, p.192; Thind (1961), *The Clavariaceae of India*, 36; Parmasto (1965) *Keys to the Clavariaceae of U.S.S.R,* 157.

Fructification 2.1-5 x 0.6-1.2 cm, gregarious, scattered, erect, small sized, radial to flattened, trunk present, sparsely branched, sometimes simple, tough, rough, dirty white, becoming brighter at the tip. On drying turning brown; trunk 1.5-3.2 cm x 0.8-2mm; cylindrical; branches lax, sparse, 1-3 dichotomous, unequal, mostly in one plane, lower branches flattened and broadly palmately divided, ultimate branchlets long, radial upto 1.7cm long; apices acute on exposure or brushing; smell and taste inparticular.

Hymenium spread all over except the sterile apices and the lower sterile part of the trunk, thickening with numerous embedded spores, upto 315µm long.

Basidiospores 14.4-20.0 x 4.8-6.4µm, hyaline, elongated – ellipsoid, subfusoid or subsigmoid, subacute, papillate, attenuating to the papilla, papilla prominent and 1-16µm long, smooth, aguttate.

Hyphae monomitic, 3-4µm wide, hyaline, thin walled to slightly thick walled, branched, uninflated, septate, septa at long intervals, clamped.

Specimens examined: On soil under *Pinus roxburghii*, Dakshinkali, 1340m, 13.08.2004 (2061.4.29). Devkota, S., no. 00146, TUCH & KATH.

No any previous records were made from Nepal so, it is new species to Nepal.

Aphelaria pusio (B.) Corner differs from the present species in having spores 9-15 x 4-7 µm and with oblong fruit body.

Distribution - India, China, Japan, Sweden, Finland, United Kingdom. America, Brazil and Nepal.

Clavaria acuta Fr.

Corner (1950), *A monograph of Clavaria and allied genera*, p.222; Thind & Anand (1956), *Journal of Indian Botanical Society,* 35: 105d; Thind (1961), *The Clavariaceae of India*, 141; Parmasto (1965) *Keys to the Clavariaceae of U.S.S.R,* 72; Corner (1973), *The Clavariales of the US and Canada,* 50.

Fructification up to 5 cm. tall, solitary, scattered, erect, slender, small sized, radial, trunk present, simple, clavate, fleshy, brittle, smooth, glabrous, head 0.2-3 cm. long and 0.5-1 mm wide, white, elongated, bent or allantoid, cylindrical, usually slightly broader at the top, apex acute in young fruit bodies, becoming obtuse or blunt in mature ones; trunk 1-2.5 cm. long and 0.5-1 mm. wide, distinctly demarcated, white, narrow, smooth but with very fine narrow hyphae loosened out from its surface and appearing as a fine irregular pubescence which is more pronounced at the base; numerous rhizomorphic mycelial threads given out from the base of the fructifications; flesh white; smell and taste inparticular.

Hymenium spread all over the head, trunk sterile, not thickening, up to 55μm thick.

Badidia 35-42.5 x 5-7.5μm, hyaline, clavate with along tapered base, provided with a wide loop- like clamp at the base; sterigmata 2-4, long, straight, 2.5-7.5μm long.

Basidiospores 7.5-10 x 2.5-5μm, hyaline, oval, papillate, smooth, aguttate, filled with dense granular contents.

Hyphae monomitic, 5-25μm wide, hyphal cells up to 375μm long, hyaline, thin walled, branched, inflated, septate, septa at long intervals, clamps absent.

Specimens examined: On soil of *Rhododendron arboreum,* Bhirmuni, Lumle, 1925m. 29.6.2004 (2061.03.15). Devkota, S., no. 00131. On soil of *Pinus roxburghii* forest Dakshinkali, 1340m, 13.08.2004 (2061.4.29).Devkota, S. no.00141, TUCH & KATH.
Previously, recorded on soil in *Castonopsis* forest, Godavari (Adhikari, 1988b); in mixed forest, Suryavinayak (1540m) and Sundarijal (1780m) (Adhikari, 1996b; Adhikari *et al.,* 1996).
Edibility unknown

Clavaria acuta differs fundamentally from *C. vermicularis* Fr. having the loop-like clamp at the base of the basidium and in the broad multiguttulate.

Distribution – India, Japan, S. Australia (Victoria), Europe, U.S.A. and Nepal.

***Clavaria fumosa* Fr.**

Fries (1821), *Systema mycologicum,* 1:483; Bresadola (1927-1933), *Icnographia mycologia,* 1101; Corner (1950), *A monograph of Clavaria and allied genera,* p.235; Thind & Anand (1956), *Journal of Indian Botanical Society,* 35: 92-102; Thind (1961), *The Clavariaceae of India,* 146; Imazeki & Hongo (1965), *Fungi of Japan* 2 113,f.211; Coker(1973), *The Clavariales of the US and Canada,* 50.

Fructifications up to 6-12 cm tall and up to 5-9cm broad, solitary, densely caespitose, erect, large-sized, radical, without a trunk, simple, fleshy, brittle, smooth, glabrous, light milk, toffee-coloured, base whitish, a large number of clubs arise from a common base, indivisual clubs up to 2-2.5 mm wide; club long, cylindrical, tapering at the top and unbranched, longitudinally grooved, ligulate and hollow; apices concolorous and blunt; flesh pale concolorous, not changing on brushing; tase and smell inparticular.

Hymenium spread all over except the whitish base, compound, up to 52µm broad.

Basidia 5.5-7.5µm broad, clavate; sterigma 3-4, small, stout, slightly incurved, 1.5-5µm long.

Basidiospores 6-7 x 2.5-6.0µm, hyaline, broadly ellipsoid, some slightly allantoid papillate, smooth, aguttate, filled with granular contents.

Hyphae monomitic, 5-15.5µm wide, hyphal cells small, 5-75µm long, hyaline, thin walled inflated, clamps absent, septate, septa at short intervals, also secondarily septate, Hyphae are short celled and closely apposed so as to give the appearance of a pseudoparenchyma. The individual hyphae nature is, however easily revealed by separating them with dissecting needles because the hyphae are very easily separated from one another.

Specimens examined: On soil, under *Alnus nepalensis* forest, near Godavari Kunda, Godavari, 1515m, 21.08.2004 (2061.5.5). Devkota, S., no. 00165, TUCH & KATH. It has no previous record from the country so found to be new record to Nepal.

This species closely related to *Clavaria vermiculata* which however has shorter spores than *Clavaria fumosa.*

Distribution: India (Mussoorie), Europe (Common), N. America (Common), Siberia, Java, Nepal.

***Clavulinopsis fusiformis* (Sow. : Fr.) Corner.**

Corner (1950), *A monograph of Clavaria and allied genera*, p.367; Thind (1961) *The Clavariaceae of India*, 173; Imazeki & Hongo (1965), *Fungi of Japan* 2 113, f.211; Corner (1973), *The Clavariales of the US and Canada,* 50; Parmasto (1965), *Keys to the Clavariaceae of U.S.S.R,* 72. Philips (1981), *Mushrooms and other fungi of Great Britain and Europe,* p. 258.

Fructification 2-8.5cm tall, caespitose clusters up to 3-.5cm, broad, individual clubs up to 0.3 cm broad solitary, caespitose, erect, medium sized, radial, trunk present, simple, fleshy, smooth, glabrous, orange at the top, fading to yellow lower down, and finally white in the region of trunk; trunk cylindrical, not grooved, one- third of the length of the clubs, clearly demarcated by its white color; young clubs cylindrical, mature clubs becoming grooved and often flattened, a single groove running along the middle of the club, mature clubs slightly hollow within; apices acute, concolorous; flesh paler concolorous; taste and smell imparticular.

Hymenium spread all over except the trunk. Thickening, up to 75µm.

Basidia 5-12.5µm broad, clavate with along tapered base, often becoming thick walled and persisting in the hymenium, subhyaline, filled with large globules; sterigmata two, large, stout and straight, 5–12.5µm long.

Basidiospores 5–7.5 x 6–12µm, subhyaline, obovate, papillate, smooth, aguttate, papilla 1–2µm long.

Hyphae monomitic, narrow uninflated hyphae. 2.5–5µm broad and with cells up to 75µm long, broader inflated hyphae 7-16µm long, broader inflated hyphae 7–16µm broad and with cells 25-52µm long, hyaline, thin walled, parallel, sparsely branched, inflated, septate, septa at short intervals, clamps absent.

Specimens examined: On soil, under the shade of *Daphne* sp., Thulakharka, Lumle, 2048m, 15.8.2003 (2060.04.30). Devkota, S., no. 0086, On open ground, Suryavinayak, 1531m, 14.08.04 (2061.4.30). Devkota, S., no. 00153. On soil under *Pinus roxburghii,* Nagarkot, 1600m, 21.08.2004 (2061.5.5). Devkota, S., no. 00156, On soil under *Alnus nepalensis,* Matatirtha, 1520m, 25.08.2004 (2061.05.09). Devkota, S., no. 00169, TUCH & KATH.

Previous records were from Nabuchur (Adhikari, 1976; Singh & Adhikari, 1977).

Clavulinopsis fusiformis is closely allied to *C. amoena* (Zoll. et Mor.) Corner which, however, has less developed apiculus to the spores.

Distribution- Europe, U.S.S.R., China, N. America, Japan, India and Nepal.

***Clavaria rosea* Fr.**

Corner (1950), *A monograph of Clavaria and allied genera*, p.248; Parmasto (1965), *Keys to the Clavariaceae of U.S.S.R,* 6.; Philips (1981), *Mushrooms and other fungi of Great Britain and Europe,* p. 257.

Plants simple, solitary or in groups of 6-10 high, fragile, bright rose –pink; taste and smell none. Clubs slender, cylindrical or compressed, equal or tapering upwards, smooth, solid, 2-5mm, thick, apex blunt or pointed. Stem distinct, paler sometimes yellowish. Flesh whitish deep rose beneath the hymenium.

Internal structure septate, irregularly hyphae, 5-10µm in diameter, semi-parenchymatous in transverse section.

Basidia conspicuous, 45-55 x 7.5-12.5µm, granular, sterigmata four, erect.

Spores copious, smooth, hyaline, ovoid, or broadly elliptical, 7.5-5 x 2.5-5µm.

Specimens examined: On soil, under the shade of *Daphniphyllum himalense*, Thulakharka, Lumle, 2108m, 15.8.2003 (2060.04.30). Devkota S., no.0077, TUCH & KATH. Previous records were from Dakshinkali (Adhikari, 1996a; Adhikari *et al.,* 1996). Rare species.
Not edible.

This species closely resembles with *Clavaria helveola,* for colour.

Distribution – Distribution: India, West Pakistan, China, Japan, Bonin Isl., Ceylon, Java, Australia, S. Africa, Europe, N. America and Nepal.

***Clavaria vermicularis* Fr.**

Corner (1950), *A monograph of Clavaria and allied genera*, p.251; Imazeki & Hongo (1965), *Fungi of Japan* 2 114f.212; Parmasto (1965), *Keys to the Clavariaceae of U.S.S.R,* 72. Imazeki, Otani & Hongo (1988), *Coloured Illustration of fungi of Japan,* p.407; Philips (1981), *Mushrooms and other fungi of Great Britain and Europe,* p. 257.

Fructification up 2- 14 cm. tall, gregarious , mostly caespitose, with 3-8 clubs , individual clubs up to 5mm wide, solitary, erect, medium sized, radial or cylindric, trunk present, simple, fleshy, very brittle, smooth, glabrous, white, becoming pale yellow and flattened when old, turning ochraceous on drying; head 2-10 cm. x 1-7 mm, white, cylindric, often becoming flattened and longitudinally grooved along the middle when mature, some are twisted and flexous, tapering upward, hollow, apex concolorous, acute in young and obtuse in mature clubs. Hyphae of the stem often loosened out so as to give a hairy appearance as observed under low power of the microscope, flesh concolorous, unchanging; taste and smell particular.

Hymenium spread all over except the sterile trunk, not thickening, up to 45µm broad; subhymenium hyphae slender, very fine, interwoven, not inflating, 2.5-5µm wide.

Basidia 25-45 x 5-7.5µm, clavato-elongate, without clamps, multiguttulate; sterigmata 4, long, straight to slightly incurved, 5-7.5µm long.

Basidiospores 2.5-6.5 x 2.5-4µm, hyaline, broadly ellipsoid, subglobose to globose, papillate.

Hyphae monomitic, 2-25µm wide, hyphal cells mostly short, longitudinal, closely packed so as to give a pseudoparenchymatous appearance, 25–75µm long, inflated, thin walled, hyaline, septate, without clamps, secondary septa more or less constricted at the primary septa.

Specimens examined: On open ground, Jharamta, Lumle, 1635m, 2.10.2003 (2060.06.15). Devkota, S., no. 0096. On open ground, Matatirtha, Kathmandu, 1520m, 25.08.2004 (2061.05.09.).Devkota, S., no. 00170, TUCH & KATH.
Previously reported from Manichaur (Adhikari, 1976, 1991c); Godavari (1991) and Suryavinayak (Singh & Nisha, 1976c; Adhikari *et al.,* 1996). Common.

Clavaria vermicularis resembles fundamentally with *C. acuta* Fr. except the absence of the loop-like clamp at the base of the basidium and in the broad multiguttulate.

Distribution – India, West Pakistan, China, Japan, Java, Australia, S. Africa, Europe and Nepal.

***Lentaria mucida* (Fr.) Corner**

- Thind (1961) *The Clavariaceae of India*, 96.

Fruiting body 0.5-1.0 cm tall, 0.5-1.0 mm thick, gregarious, erect, strand, straight or with a basal bend, apex fertile, glabrous, oval in cross-section, in age or on drying tawny-brown; sterile lower portion scarcely distinct from fertile area, usually pallid to white, solid, cream-colored, algae associated with the base.

Spores 2.5 x 2.5 µm, globular, thin-walled, smooth, spore print not seen.

Hyphae monomitic, narrow 2.5µm broad and with cells up to 72.5µm long, hyaline, thin walled, parallel.

Specimens examined: On stump of *Quercus semecarpifolia,* Mabir, Deurali, Lumle, 2052m, 5.7.2004 (2061.3.21). Devkota, S., no. 00139SD, TUCH & KATH.

Edibility- Unknown, too small to have any culinary value.

Lentaria byssiseda Corner, a closely related species differs from this species having densely branched fruiting body with long, ellipsoid spores, 10-18 x 1.8-3µm.

Distribution – Japan, Nepal

***Ramaria botrytis* (Fr.) Ricken**

Corner (1950), *A monograph of Clavaria and allied genera*, p.560; Parmasto (1965), *Keys to the Clavariaceae of U.S.S.R.* p. 129; Corner (1970), *Supplement to a monograph of Clavaria and allied genera.* p.265; Svreck (1975), *The Himalayan Book of Mushrooms and Fungi*, 291.

Fruit body 7-15 cm high, 6-20cm wide, numerous thick, much branched, crowded, cauliflower like, coral–red or bricki red at the apex, ochreous when nature light after drying.

Stout stem 3-4 x 1.5-6 cm, broad, narrow at the base, pale yellow. Outer cortex up to 35µm, light pale, branched, septate hyphae. Inner cortex up to 750µm, (in dry specimens) loosely arranged hyphae, 18-28.5µm, smooth, thin walled, septate, hyaline. Hymenial layer in tips, upto 25µm broad, bright yellow, profusely branched hyphae. Cystidia up to 425µm (in dry specimens), loosely arranged 28.5 x 2µm septate, undulate, smooth walled, hyaline hyphae, Basidia 20-23 x 2-4µm club sterigmata, 6-8 x 2µm, thick walled, hyaline. Basidiospores 14-16 x 4.5-5.5µm, ochraceous, oblong –elliptic, longitudinally striate.

Taste fruity, flesh firm brittle, white, become grey, and smell sweet.

Specimens examined: On ground, on the base of *Drepanostachym* sp. Dakshinkali, Kathmandu, 1340m, 13.08.2004 (2061.4.29). Devkota S., no.00148, TUCH & KATH

Previously reported in Rigmo (Balfour–Browne, 1968); Kakani (Pandey, 1976), Pisang (Bhandary, 1991) and Kathmandu market (Adhikari, 1996a; Adhikari & Adhikari, 1997; Adhikari *et al.*, 1996). Edible

Distribution- Europe, N. and S. America, Australia, Japan, India and Nepal.

***Ramaria flaccida* (Fr.) Ricken**

Corner (1950), *A monograph of Clavaria and allied genera*, p.567; Thind & Anand (1956), *Journal of Indian Botanical Society,* 35: 93.

Fructifications up to 4cm broad, 5-12cm tall, humicolous, gregarious, medium sized, rarely large sized, radial, slender, flaccid, trunk absent, profusely branched, fleshy, smooth, glabrous, yellowish–brown, dirty brown; apices concolorous, acute, fertile, flesh lighter coloured; taste and smell inparticular. Numerous rhizomorphic mycelial threads given out from the base of the fructifications.

Hymenium spread all over except the lighter coloured base, compound, with numerous embedded spores in clusters of four, 70-105µm thick.

Basidia 4–7.5µm broad, clavate; sterigmata 4, slightly incurved, 2–6 µm long.
Basidiospores 6–8.5 x 2.5-5µm, small, ochraceous to brown, ellipsoid, papillate, profusely echinulate, wall dark, aguttate.
Hyphae monomitic, 5-7.5µm broad, hyaline, branched, thin walled, septate, septa at long intervals, not inflated, considerably swollen into sac–like structures at places near the ends or at the septa, clamped, clamps prominent.

Specimens examined: On moist ground, under the shade of *Rhododendron arboreum.* Gairi Khoria, Lumle, 1775m, 14.6.2004 (2061.02.32). Devkota, S., no. 00116, TUCH & KATH.

Previously reported in pine wood, on soil, Taglung (Balfour- Browne, 1968).
Edible. Local people used to cook it like noodles.
This species so close with *Ramaria pussila* (Pk.) Corner is that only flesh is unchanging in *R. flaccida.*
Distribution – Europe, China, N. America, Japan and Nepal.

CHAPTER - SIX

6. RESULT AND DISCUSSION

6.1 Result

6.1.1 Floristic Distribution of mushrooms

Altogether 76 wild mushrooms specimens belonging to 36 families and 49 genera were collected from different locations of Lumle VDC. Of the collected specimens, all the specimens were identified upto generic level and 40 were identified up to species level [Annex 3 (i)]

In the present study it was found that *Alnus nepalensis* (Uttis) bears a maximum number of mushroom species (17 spp.), followed by *Quercus semecarpifolia* (Kharsu) (9 spp.), *Garuga pinnata* (Dabdabey) (2 spp.) and *Quercus lamellose* (Phalant), *Engelhardia spicata* (Mauwa), *Castonopsis indica* (Katush), *Rhododendron arboreum* (Lali Gurans), *Alangium salvifolium* (Aamphi), *Brassaiopsis* sp. (Chuletro), Ganauney. tree and on cone of *Pinus roxburghii* in each. According to their growth 16 species were collected from soil, 3 species from leaf (*Xylaria filliformis* on dorsal surface of *Daphniphyllum himalense* (Rakchan) leaf, *Exobasidium butleri* on both sides of *Rhododendron arboreum* (Lali Gurans) leaf, *Marasmius* sp. on leaf of Orchid), and 1 species *Ascobolus magnificus* on buffalo dung were recorded.

The largest families were Polyporaceae and Xylariaceae as they included 7 species in each. They were followed by families, Russulaceae 6 species, Clavariaceae and Cortinariaceae 5 species in each.

Russula was the largest genus that consists of 6 species, which is followed by genera, *Pholiota* (5 spp.), *Xylaria* (4 spp.), *Clavaria* (3 spp.), 13 genera with 2 spp. and remaining 32 genera were the smallest; consist of only one species each.

Clavariales allied nine species were collected from Lumle and vicinities of Kathmandu valley. Among them six species such as – *Clavaria acuta, C. rosea, C. vermicularis, Clavulinopsis fusiformis, Lentaria mucida* and *Ramaria flaccida* were collected from Lumle. Similarly *Clavaria fumosa* from Godavari, *Ramaria botrytis* and *Aphelaria tuberosa* from Dakshinkali were collected [Annex 3 (ii)]

Out of identified specimens *Ascobolus magnificus, Lentaria mucida, Xylaria filliformis, X. nigrescens and X. plebeja* from Lumle area; *Clavaria fumosa* near Godavary Kunda, Godavary and *Aphelaria tuberosa* from Pinus forest of Dakshinkali have no previous records from the country and found to be new records to Nepal

Three species *Aphelaria tuberosa, Clavaria fumosa* and *Lentaria mucida* of Clavariaceae are recorded as new to Nepal.

Three genus *Meruliapsis* from Lumle and *Aphelaria* species from Dakshinkali are recorded as new genera to Nepal

During collection 16 species (*Anthracobia macrocystis*, *Auricularia auricula-judae, Coprinus disseminatus, Coriolus hirsutus, Coriolus* sp., *Fomes* sp. *Guepinia spathularia, Laccaria laccata,* 3 *Pholiota* sp., 2 *Polyporus* sp., *Pycnoporus cinnabarinus, Schizophyllum commune* and *Trametes versicolar*) were found at all (Six) altitudinal levels. In five, four, three and two levels two species in each were found respectively. 52 species were found at definite altitude only (Annex- 4).

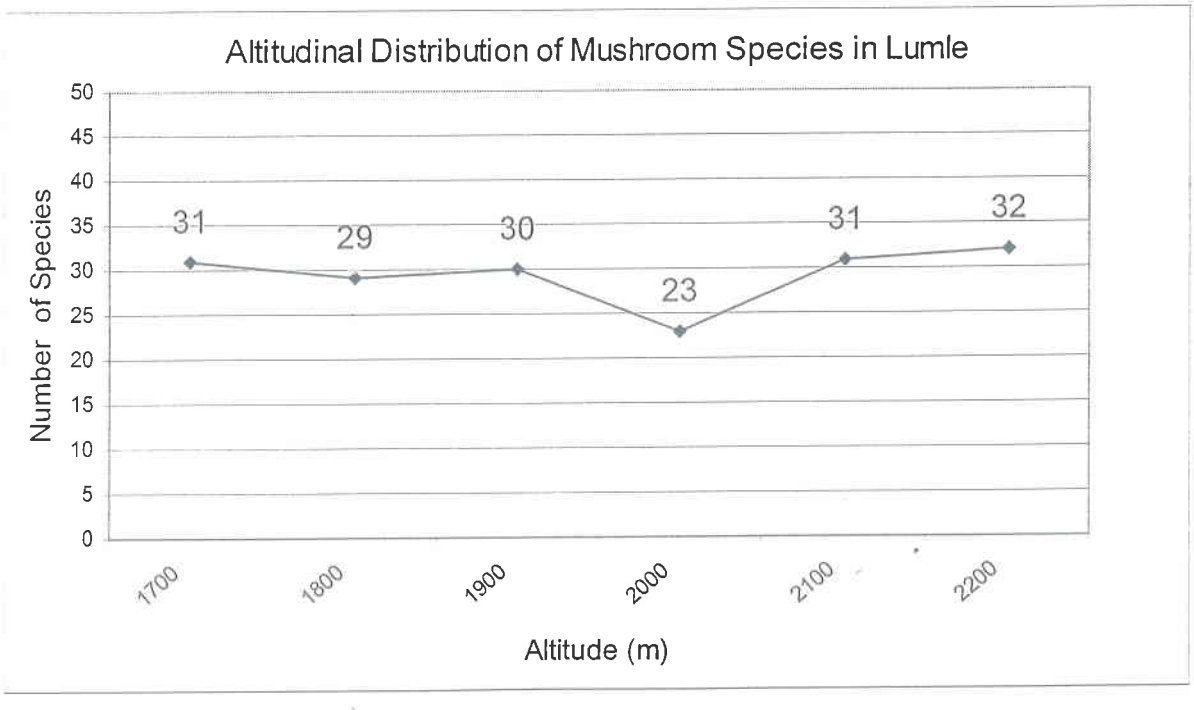


Fig.6.1: Altitudinal distribution of mushroom species in Lumle

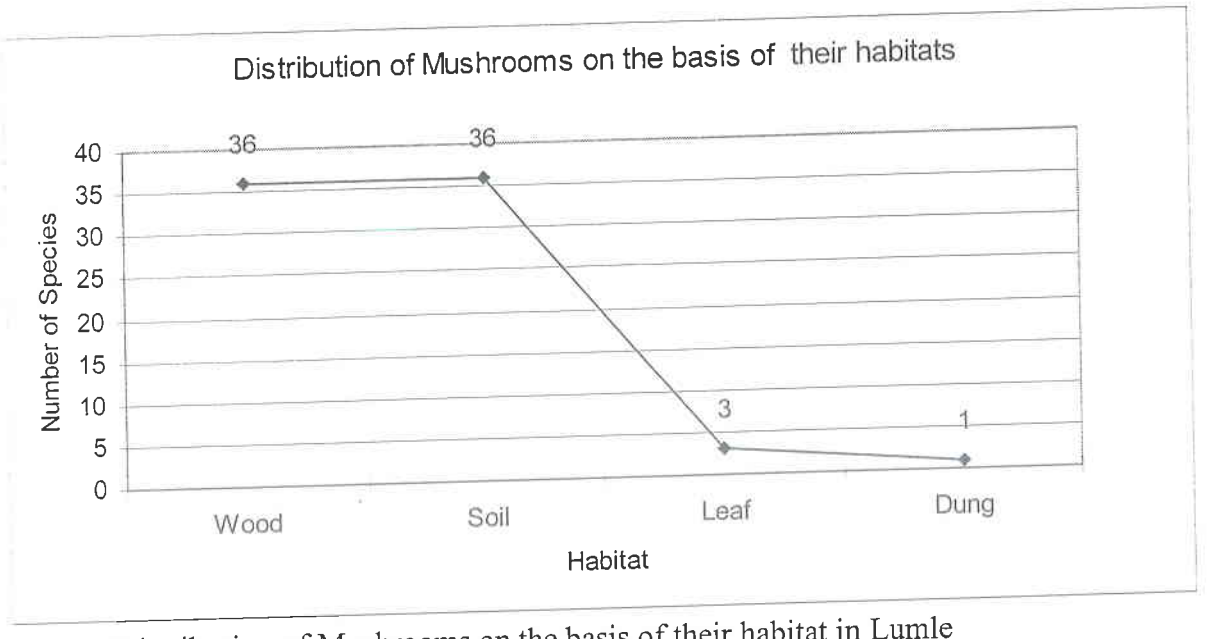


Fig.6.2: Distribution of Mushrooms on the basis of their habitat in Lumle

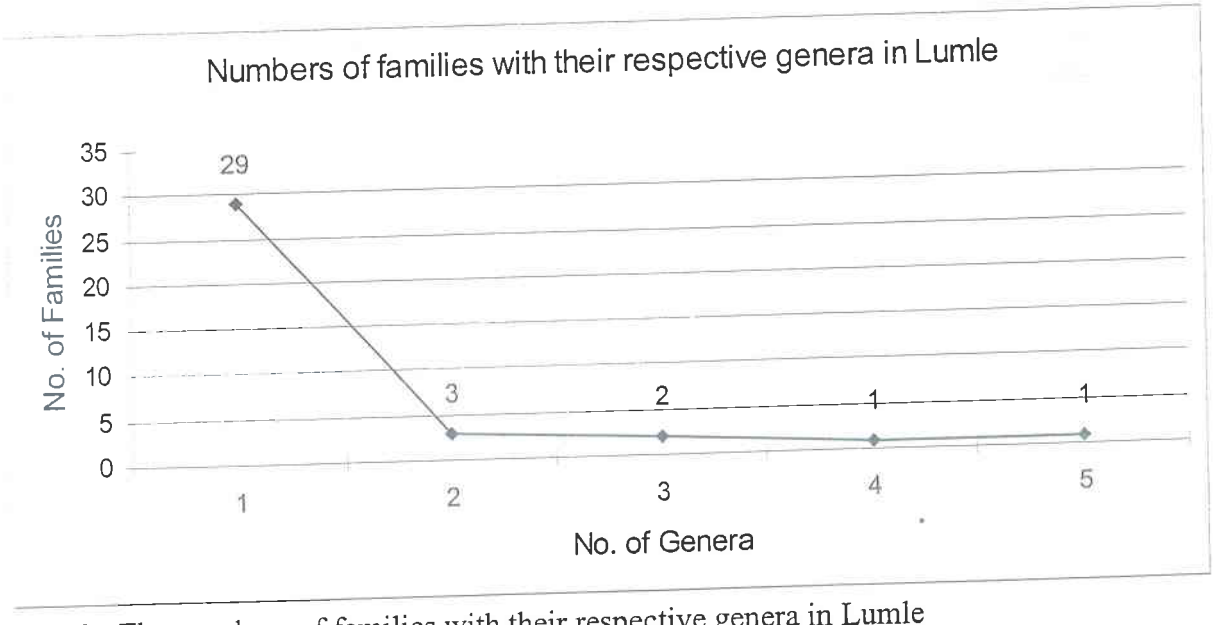


Fig.6.3: The numbers of families with their respective genera in Lumle

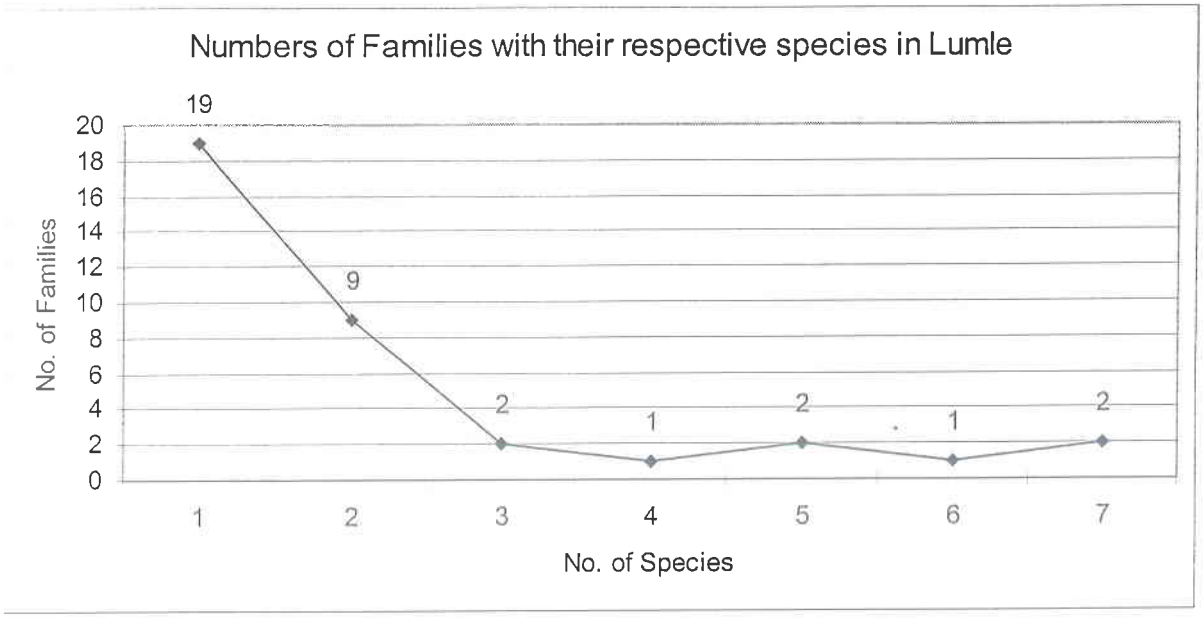


Fig. 6.4: The numbers of families with their respective species in Lumle

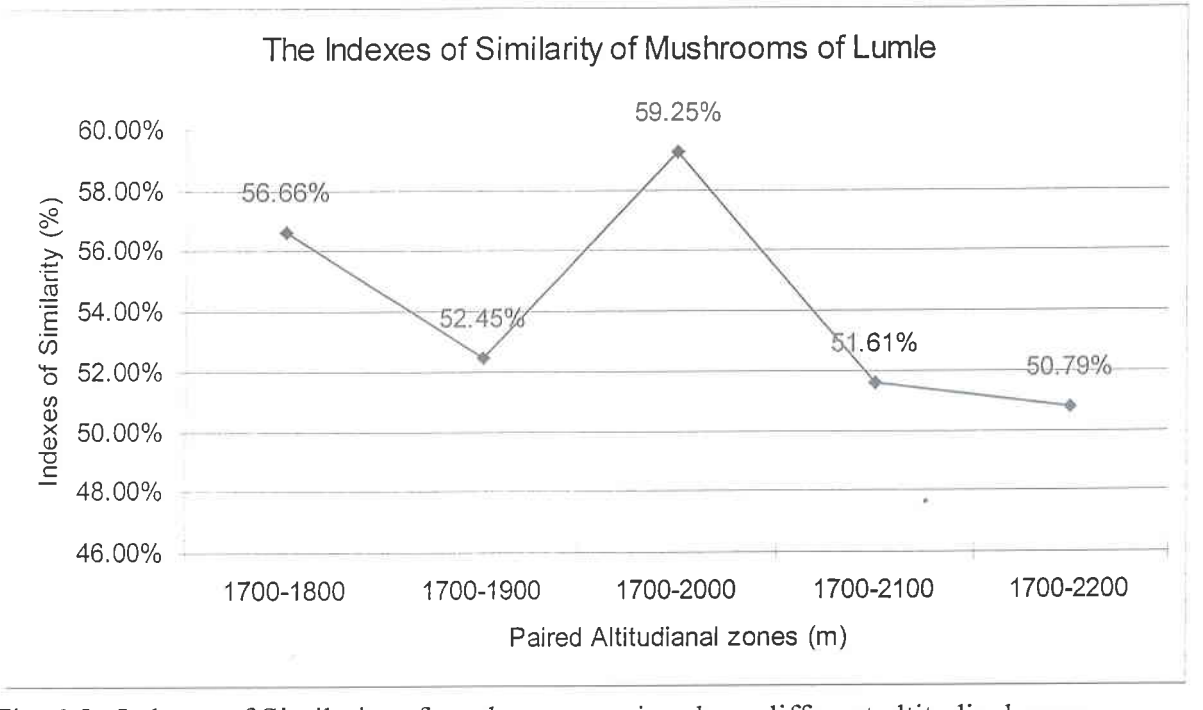


Fig. 6.5: Indexes of Similarity of mushroom species along different altitudinal zones.

6.1.2 Species composition and elevation gradient

All together 76 mushroom species were found from 1700-2200m a.s.l. The Detrended Correspondence Analysis (DCA) shows that there is a gradient on species distribution from lower to higher elevation. In total data set length of gradient was found 2.29 in SD unit. In Fig.6.6 seven points from 1-6 represent altitudinal gradients from 1700-2200m respectively. Lower altitudinal bands are distributed along the positive end of the DCA axis 1 where as higher altitudinal bands are distributed on the negative end of the DCA axis 1.

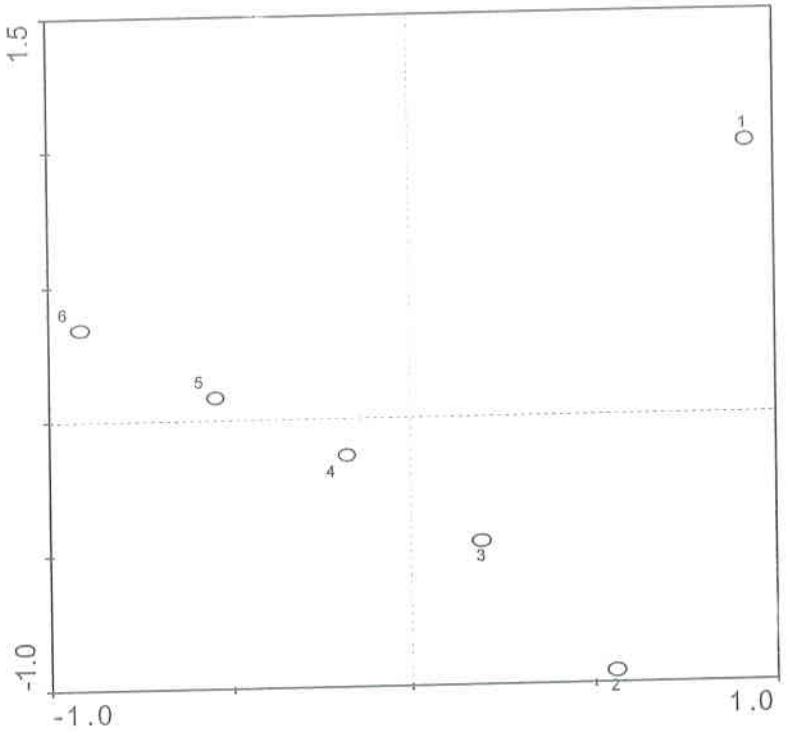


Fig. 6.6: DCA diagram showing the gradient of the altitude *(where, 1=1700m, 2=1800m, 3=1800m, 4=1900m, 5=2000m, 6=2100m, 7=2200m elevation bands)*

The first three DCA axes explained approximately 70% of the variance (Table. 6.1). First axis explained more than 46% of the variation of the entire data set, and second axis explained 20% of the variation. The amount of variation explained by third axis is very low. The sum of all eigenvalues is the total inertia 1.54 for data set. Thus percentage of inertia 'extracted' by the first two axes is = 42.85%.

Table: 6.1 Summary of DCA result

Axes	1	2	3	Total inertia
Eigenvalues	0.46	0.20	0.04	1.54
Lengths of gradient	2.29	1.98	1.94	
Cumulative percentage variance of species data	30.0	42.7	45.3	
Sum of all eigenvalues				1.54

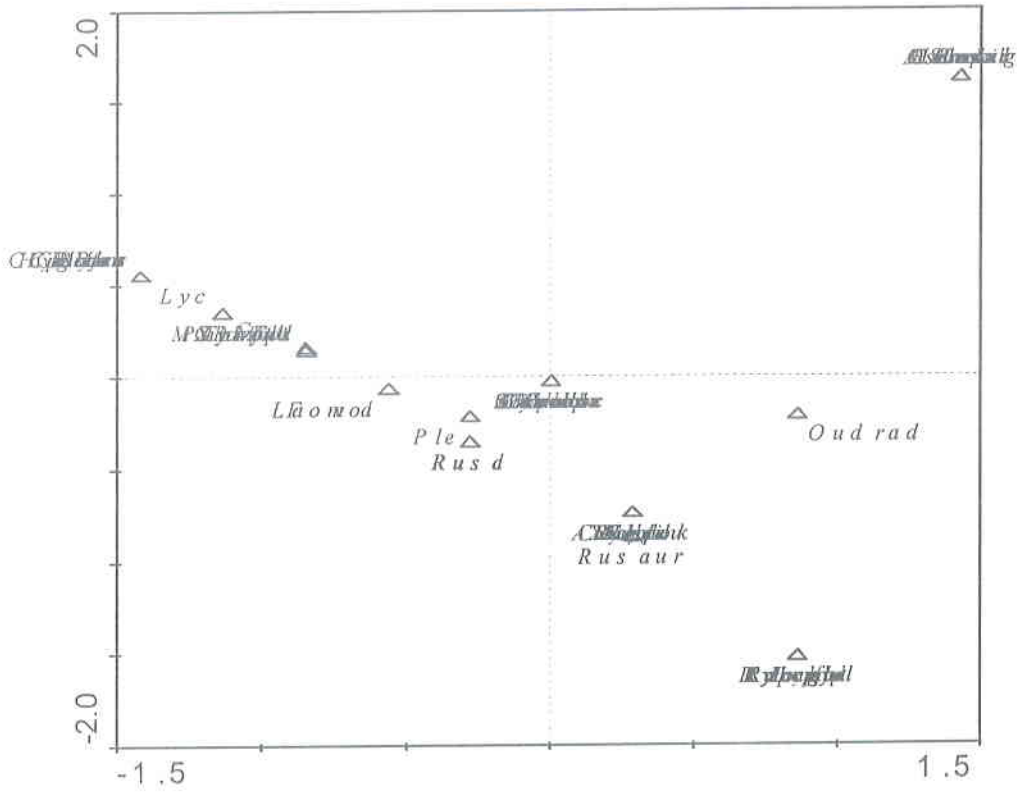


Fig. 6.7: DCA diagram (horizontal line represents axis – 1 and vertical line represents axis- 2) where species are represented by symbols (triangles)

The species are distributed from -1.5 to along +1.5 SD unit (Fig. 6.7). It shows that the dispersion of species is not uniform with respect to the coordinate origin. *Pleurotus* sp., *Russula* sp. and *Lycoperdon* sp. are similar as they occupied –ve end of the axis. Similarly, and *Russula aurora* groups may favour similar ecological requirements as they observed in +ve end of the axis of DCA diagram.

CCA Bi-plot diagram (Fig. 6.8) displayed the relationship between species and altitude. The altitude is found statistically significant to describe the variation of species distribution. Species found at the +ve end of CCA axis 1 are *Oudemansiella radicata* and *Russula aurora* group show negative correlation with altitude. Where as species *Lycoperdon* sp., *Pleurotus* sp., *Russula* d and others clumped groups are found at the –ve end of CCA axis 1 show positive correlation with altitude. The overlapping clumps indicate species are collected from same sample point (elevation) so these species are not dispersed.

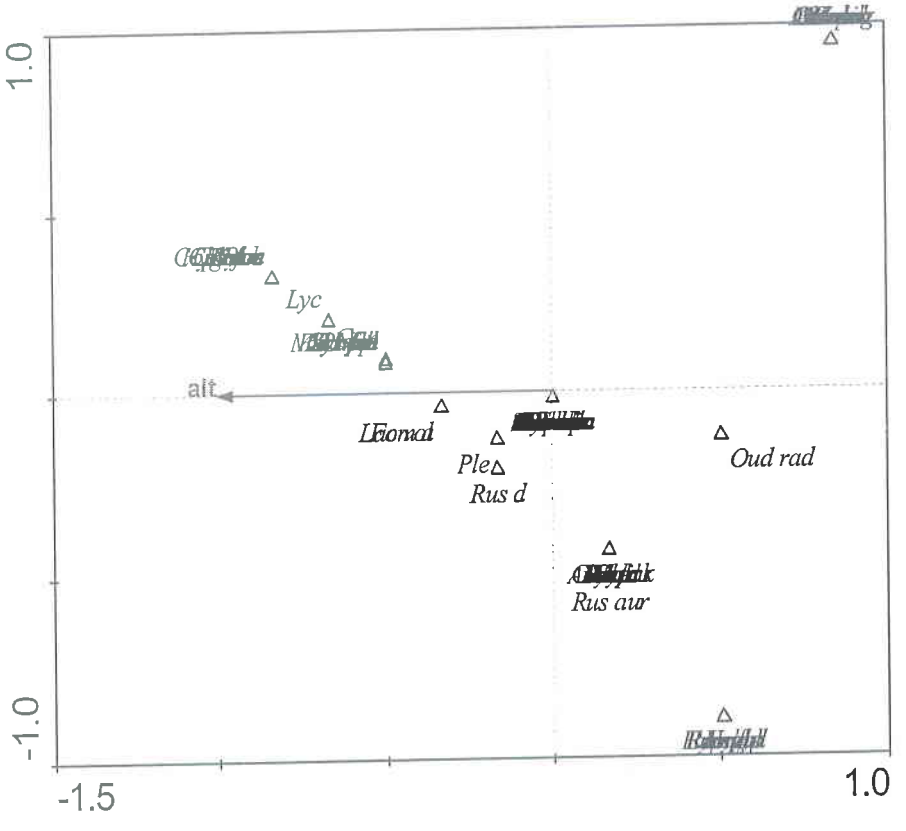


Fig. 6.8: CCA Bi- Plot diagram (alt = altitude)

Table: 6.2 Summary of the Monte Carlo Permutation test

Test of significance of all canonical axes	
Trace	0.416
F-ratio	1.480
P-value	0.002

PCA diagram shows relationship among different species (Fig. 6.9).Each species indicated by each arrow points in the direction of steepest increase of value for the corresponding species. The angles between arrows indicate correlations (or covariance) between the species. Species such as *Clavaria acuta, Amanita cokeri, Xylaria filliformis, Thelophora* sp. *Hypoxylon* sp. *Guepinea spathularia, Marasmius* sp. *Russula aurora, Pholiota c, Pleurotus* sp., *Coriolus hirsutus, Schizophyllum commune, Pycnoporus cinnabarinus, Coprinus disseminatus, Polyporus a, Polyporus b,* etc. are indicated by short arrow. While species such as *Oudimansiella radicata, Stropharia b, Auriscalpium vulgare, Cantharellus cibarius, Hexagonia* sp., *Ganoderma lucidum, Lepiota* sp. *Hericium erinaceus, Clavaria vermicularis, Daldinia concentrica Tulostoma* sp. *Fomes* sp., *Lactarius volemus, Lycoperdon* sp., *Coprinus comatus, Russula d* etc. are indicated by long arrow from the coordination point. The distance between two arrows indicated the approximated correlation of one species with the others.

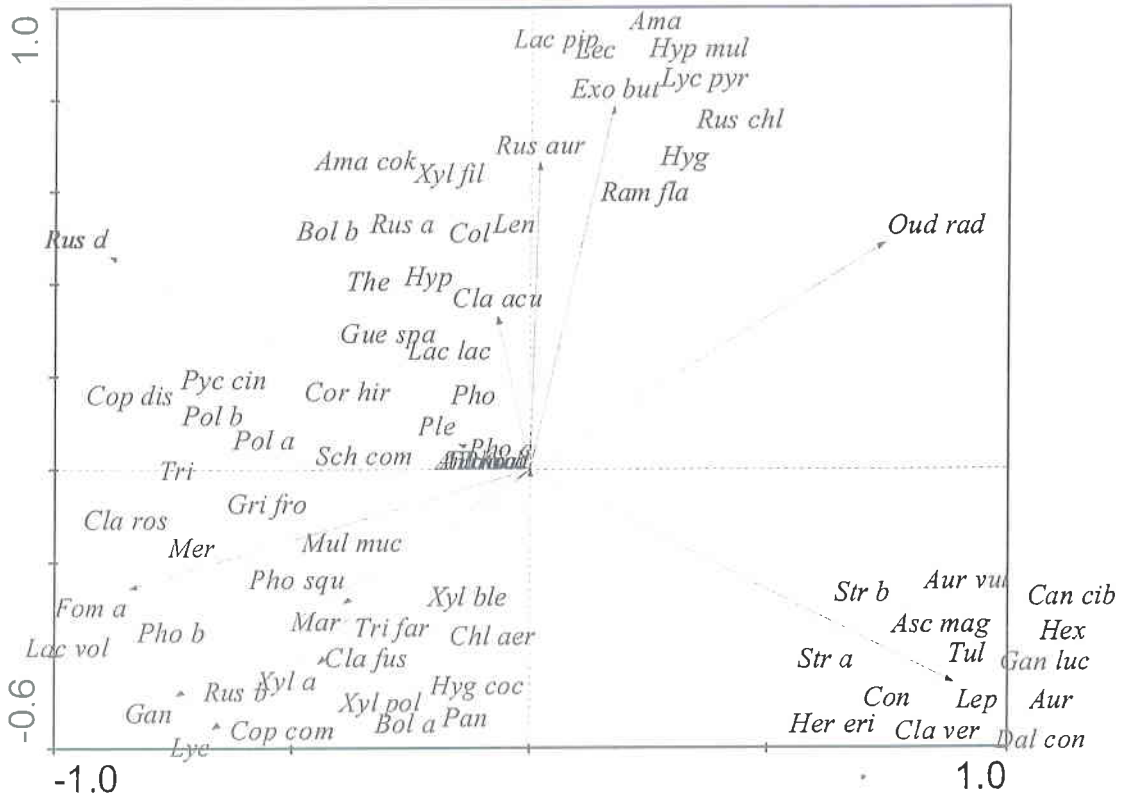


Fig. 6.9: PCA diagram. (Each species is represented by arrow and the first three letters are abbreviation of genus and species.

6.1.3 Uses of wild mushrooms

Six species of wild mushrooms with their medicinal value have been collected from Lumle area. They were-

- *Coriolus hirsutus* Paste is used to cure wounds.
- *Daldinia concentrica* Paste of mature body is used to cure burns.
- *Grifola frondosa* Used as vegetable to get relief from backache.
- *Lycoperdon pyriforme* Powder is used to clot blood and to cure wounds.
- *Pycnoporus cinnabarinus* Paste with mustard oil is used to cure wounds.
- *Schizophyllum commune* Paste is used to cure wounds.

Local people of Lumle area used *Grifola frondosa, Laccaria laccata, Oudimansiella radicata, Lactarius volemus, Pholiota squarrosa, Exobasidium butleri, Ramaria flaccida, Lepiota* sp. and *Lentinus* sp., as their food value. Of these *Grifola frondosa* and *Lepiota* sp. are considered by local people to be vulnerable and endangered:. Tamang community of Dakshinkali highly preferred *Ramaria botrytis* for their food value.

Local people of Lumle area do not use any species of mushrooms for their religious value. Similarly people from vicinities of Kathmandu do not use any Clavariales allied species for their religious value.

One interesting use of Polypores, especially of *Trametes versicolor, Coriolus hirsutus Ganoderma* sp. and *Fomes* sp. are used to lock the crevices of the wooden pot (Thekaa). They are cut into small pieces, inserted into crevices and left for one whole night in water. Mushrooms after soaking in water completely, blocked the crevices. This was more common among the hoteliers of Australian Camp, Lumle.

It was observed that people of Lumle were unknown about the edibility of *Hericium erinaceus.* During the field study, the knowledge about edibility of this mushroom was demonstrated between local people, then after they have started to eat it.

Similarly, most of the local people were unknown about *Exobasidium butleri* found on the leaves of *Rhododendron arboreum.* They used to think it as insect nest or gall of leaf. Only few numbers of people who are engaged in tourist line knew about it. They knew from foreign tourists, they used to squeeze it during shinny days as alternate to water to made throat wet. They called it as "Pani Pokey Chyau". This local name is first local name ever known to Nepalese mycoflora.

Poisonous mushrooms collected from Lumle area was *Amanita cokeri.* It was observed that if a fly settles on the gills of this mushroom, which will die within few minutes. Local people even hesitate to touch this mushroom due to its extra looking appearance with deadly warts on the pileus.

6.1.4 Ethnic concepts

The favorable season for mushrooms collection is rainy season. Some 'Tithis' such as 'Purnima', 'Aausi', and 'Domasey' are the best 'Tithis', in which local mushroom hunters prefered to go for hunting.

Regarding the collection, people of Lumle believed that, especially *Lepiota* sp. after picking from the ground a central black part of pileus should keep in the hole made by its stipe, so that in next season same collector could collect mushroom. This is a gentle thought for mushroom conservation that leaving some pileus portion over there means leaving spores for further life. Similarly, they believed that if a person hits a mushroom with leg, he/she will have lame children. By this way people of the very region had superstitions about mushroom conservation.

Local people of Lumle area thought that, the youngsters and elders both eat edible mushrooms upto Shrawan and after this month only elderly people eat and youngsters are not allowed to consume. According to their beliefs eating mushrooms after Shrawan by youths may cause some sort of unwanted events in the home.

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

- Mushroom species having annulus nearby the cap are poisonous.
- Mushrooms species with more curved pileus with annulus are also poisonous.
- Mushrooms species whose flesh changes to black color after touching are said to be edible but if changes to white that is poisonous.
- Mushrooms found on the fodder plants are generally edible.
- Mushrooms which peeled off easily are edible.

Proverb like "if the Brahmines have eaten the mushrooms, they could know the actual taste of mushrooms" was also prevails in every study areas. But nowadays Brahmines are also started to eat mushrooms due to their taste and knowledge about mushrooms. The reasons behind this proverb found almost same in every study areas while asking to local people. They thought that it was due to that Brahmines are of higher cast and they are forbidden to eat mushrooms and fermented products like alcohol.

One different type of belief was found in Lumle area about this proverb. According to them there was a history- Once upon a time farmers were busy in planting rice and almost all the hours they spend in fields. There was an elderly sick person lying in the bed. In the morning when all the family members were just moving to the field, they found that he was died. Having no time to cremate his dead body, they cover that body with mat. After completing their farming, while they were gathered to cremate him, at that time they found that mushrooms were growing on the mat. After that event Brahmin have discarded mushrooms as food.

6.1.5 Poisoning

Local people of Lumle area used *Parish poryphylla* (Satuwa), *Xanthoxylum armatum* (Aakhen Timur), *Allium sativum* (Lasun) used to minimize possible poisoning along with vinegar. One different type of method to minimize severe mushroom poisoning came from Dakshinkali Tamang community. According to them if the case is severe, patient should be given white stools of black dog to eat. This method though reflects impractical they have heard it from their ancestors. This type of belief did not found in any other study areas.

6.2. DISCUSSION

6.2.1 Distribution

6.2.1.1 General

The present study has attempted to study two perspectives of wild mushroom. First major objective was to collect, identify and enumerate the mushrooms of Lumle VDC; second objective was to have detail study about the Clavariales allied species collected from Lumle and adjoining forests of Kathmandu valley i.e. Nagarkot, Suryavinayak, Godavari, Dakshinkali and Matatirtha. The common methods of collection, preservation and microscopic study were used for the identification of specimens.

The Lumle area was visited four times while Kathmandu areas were visited only one time. The field visit was accompanied with the local professional collectors. Although, the results of this study cannot predict the total no. of mushrooms species in Lumle area, and Clavariales in surrounding of Kathmandu valley, it will help in visualization of the distribution pattern of the wild mycoflora. Long time surveys are important for understanding the structure of mushroom assemblage and their diversity. For e.g. Fisher *et al.* (2003) collected some rare and other remarkable mushrooms (Basidiomycetes) from the Prignitz region, NW Brandejnjburg, Germany. The observations were mostly made in the last ten years. Straatsma *et al.* (2003) studied assemblage structure, species richness, abundance and distribution of fungal fruit bodies in a Seven years plot – based survey near Vienna.

Lumle as maximum rainfall area of Nepal having cool and humid environment, found to be favorable location for the growth of wild mushrooms. The total collected specimens of mushrooms were 76; among them all were identified upto generic level belonging to 36 families and only 40 specimens were identified upto species level. Identification of all the collected specimens up to species level is time consuming as well as vigorous job. Similar types of identification problems were faced by a renowned mycologists Natour *et al.* [1992 (1993)]. They collected 270 wild mushroom specimens from 15 different localities in Jordan. Among them only 56 mushroom species were identified; one of which *Boletus* sp. was the first mushroom species recorded in the world.

Among the collected Clavariales *Clavaria rosea* is rare species (Adhikari, 2000). Previously this species was reported on soil, Dakshinkali by Adhikari, (1996a); and Adhikari *et al.*, (1996). *Ramaria botrytis* which was collected from Dakshinkali is highly demanded mushroom for market value. *Ramaria flaccida* which was collected from Lumle is also edible and prepared in kitchen like that of noodles.

Many mushrooms prefer to grow specifically near certain angiospermic or gymnospermic plants. Most of the species, especially the mycorrhizal ones were found appearing on the same places and even on the same spots year after year. It is probably because their dormant rhizomorphs are activated on the advent of rains (Corner, 1935).

Mushrooms differ in their temperature and humidity requirements and hence appear in the early or late rainy season, as it is clear from the growing period of different mushrooms. The total growing period of different species also depends upon their fulfillment of temperature and humidity requirements. It was observed that some species of mushrooms appear early in the lower altitude and later in the higher altitude. Temperature seems to be the deciding factor in this case. Similar type of observation also made by Kumar *et al.* (1990) for Indian Amanitaceae.

6.2.1.2 Multivariate analysis

The present study, suggests that the variation of species composition along the altitudinal gradient is a homogenous type which is indicated by shorter gradient length SD = 2.29 (Table. 4.1). This may indicates that, species occurring in lower elevation may also observed in higher elevation (ter Braak and Šmilauer 1998) and that the mushroom species may do not have narrow ecological niche. The shorter gradient length might be due to the captures of small altitudinal range1700-2200m. Larger gradient may exists if one captures larger elevation range. It is well-established fact that species numbers increase as a function of area (Gleason, 1922; Rahbek 1997; Rosenzweig, 1997).Though it has a shorter gradient length the altitude statistically explain the significant part of species distribution. The adiabatic laps rate is 0.53° C /100m elevation in Nepal Himalayas (Bhattarai, 2003). So abundance of mushroom species with the increase of elevation might be due to decrease of temperature. In the tropical and subtropical belts the temperature between 15° C and 25° C favors the growth of different

mycotaxa. However, in subalpine and alpine regions, the mean annual temperature falls below 15° C the population dynamics of fungi are retarded (Adhikari, 2000). The climatic factors which vary with elevation are temperature, potential evapotranspiration, length of growing season, humidity, air pressure, nutrient availability, ultraviolet radiation (UV) and rainfall (Funnell & Parish, 2001), which all have an influence on the distribution of species along the ecological gradient (Körner, 1999).

Cloud formation is a decisive factor for the vegetation of Nepal (Beug & Miehe, 1999). The cloud zones are a source of moisture, which creates microhabitats and favours high species richness (Vetaas, 1993; Rahbek, 1995). The cloud forest is rich in diversity (Falkenberg & Voltonilini, 1994). As the study area has maximm rainfall (5000-6000mm annualy) area of Nepal, and usually remains with the cloud bands, the mushrooms species richness with increasing altitude is expected until cloud zone.

The collection of higher numbers of mushroom species in the altitude 1600-1700 might be also due to higher frequency of collection. This range is rich in humicolous soil and consists of different types of forest such as *Pinus roxburghii, Alnus nepalensis* etc. This finding has been well supported by the works of Brooks (1965), and Adhikari, (2000). The numbers of species found in certain area is influenced by topographic factors. Lower numbers of species (only 23) were collected from 1800-1900m. This might be associated to steep cliff formation and having lesser numbers of trees in the study area. Broad - leaved evergreen forest support the distribution of mycoflora from field above 2000m, study area. This implies that the abundance of the species is continuously increasing (Fig. 6.8). Similar types of results were obtained by Van der maarel *et al.* (1985), Moore *et al.* (1989), Adhikari (2000) and Arnolds (2001).

Oudemansiella radicata which occupies upper +ve end of PCA axis 1(Fig.6.8) with long arrow from the coordination point is drastically different in their distribution pattern with the species *Ganoderma* sp., *Lycoperdon* sp, *Coprinus comatus, Lactarius volumes, Clavaria rosea, Xylaria a* of -ve end of axis 1. Agnew (1961) when he studied the variation of floristic composition of communities dominated by *Juncus effuses* in North Wales also found species with similar ecological niche at one end and different ecological niche at the other end.

Similarly, the indexes of similarity of mushroom species along different altitudinal levels ranges 50.79 – 59.25 %. This analytical result suggests that these different altitudinal levels have got more than 54.152% similar mushroom species. This is because of different altitudinal levels that have got more or less similar climate (rainfall, temperature) and vegetation. Therefore, occurrence of similar species of mushrooms at different altitudinal levels is justified.

6.2.3 Uses

Among the collected medicinal mushrooms except *Schizophyllum commune* all were previously reported from other mycologists with their medicinal values (Adhikari, 1988b, 1990a, 1991b, 1994, 1995a, 1996 & 2000; Bhandary, 1991). So, this mushroom is considered as new medicinal mushroom to Nepal.

Among the collected species from both areas 23 species have their culinary value. Of them edibility of *Auricularia auricula -judae, Clavaria acuta, C. fusiformis, C. vermicularis, Coprinus comatus, Lactarius piperatus, Lycoperdon pyriforme, Russula aurora, Russula chloroides and Schizophyllum commune* were not known to local people but they are mentioned as edible species by Adhikari, (2000).

No religious mushrooms neither from Lumle nor from Kathmandu areas were recorded. It may be due to that Lumle area is dominantly settled by Brahmins and other mycophagous casts are less in numbers. No any Clavariales allied species are yet reported from country as religious mushrooms. The religious values of *Schizophyllum commune* is reported by Adhikari (2000) among the Tamang and Newar community around Kathmandu valley.

Specific uses of *Trametes versicolor, Ganoderma lucidum, and Coriolus hirsutus* for the ignition of cigarettes was found from Lumle area. Similar information was reported by Bhandary, (1984) and Adhikari, (2000).

6.2.4 Ethnic concept

Proverb like "if the Brahmines have eaten the mushrooms, they could know the actual taste of mushrooms" was also prevails in every study areas. Their thought towards this concept was same as Adhikari, (2000) that is Brahmines are of higher cast and they are forbidden to eat mushrooms and fermented products like alcohol.

The favorable season for mushrooms collection is rainy season. Some 'Tithis' such as 'Purnima', 'Aausi', and 'Domasey' are the best 'Tithis', in which local mushroom hunters prefer to go for hunting. It may be due to that during these days the moisture content in the atmosphere raises creating favorable condition for mushroom growth (Adhikari, 2000).

In the study areas it was found that generally mature people with sound knowledge on edible mushrooms go for the collection. It is quite different from Akpaja *et al.* (2003). In ethnomycological study among Igbo people of Nigeria they found that, mushroom hunting are status and gender related issues, being generally regarded as work for women and children.

6.2.4 Poisoning

No any serious mushroom poisoning was reported from Lumle area till now. Local people generally used to add some vinegar while cooking mushrooms to minimize mushroom poisoning. Addition of Vinegar is a worldwide method to minimize mushroom poisoning. Many mycologist such as Ramsbottom, (1954); Rinaldi and Tyndalo (1972); Purukayastha and Chandra (1985); Bhandary, (1984); Chube, (1995); and Adhikari, (2000) mentioned about the uses of vinegar.

CHAPTER - SEVEN

CONCLUSION

The present study focused on the mushrooms diversity of Lumle VDC, Kaski and study of Clavariales allied species collected from Lumle as well as vicinity (Nagarkot, Suryavinayak, Godavari, Matatirtha and Dakshinkali) of Kathmandu valley. The present study has been able to make the following conclusions.

Among 76 species collected from Lumle in the elevation of 1600-2200m, 16 species were found at all (Six) altitudinal zones and 52 species were only found at definite altitude. *Alnus nepalensis* (Uttis) bears a maximum number of mushroom species (17 spp.), followed by *Quercus semecarpifolia* (Kharsu) (9 spp.). 16 species were from soil, 3 species from leaf and single species on buffalo dung were recorded. The largest families were Polyporaceae and Xylariaceae as they included 7 species in each.

The analytical result of indexes of similarity suggests that different altitudinal levels have got more than 54.152% similar mushroom species.

This study reflects that, there is a gradient of species distribution along the altitude, with low spatial turnover; which may indicate homogenous distribution of mushrooms flora. Good numbers of mushroom species in a narrow ecological range with the homogenous distribution suggests that, the Lumle area could be hot spot to establish mycofloral reservoir.

Ascobolus magnificus, Lentaria mucida, Xylaria filliformis, X. nigrescens and X. plebeja from Lumle; *Clavaria fumosa* from Godavary and *Aphelaria tuberosa* from Dakshinkali have no previous record from Nepal so found to be new records to Nepal. Two genera *Meruliapsis* from Lumle and *Aphelaria* from Dakshinkali were recorded as new genera to Nepal. Rare mushrooms like *Auriscalpium vulgare* and *Clavaria rosea* were collected from Lumle.

Six medicinal mushrooms and 23 edible mushrooms were collected from both study areas, and among them *Schizophyllum commune* was recorded as new medicinal mushroom to Nepal.

Detailed studies of 9 Clavariales allied species were made. Among them 7 were from Clavariaceae and 2 from Ramariaceae.

Local people's beliefs towards mushrooms, classical ideas to distinguished edible and poisonous ones, their methods to minimize poisoning were also documented and found interesting.

REFERENCES

Adhikari, K.S. and Adhikari, M.K. 1996-1997. Collection and consumption of wild edible mushrooms sold in Kathmandu valley, Nepal. *The Geographer's Point.* 1-2: 1-9.

Adhikari, M.K. 1976. Chyau ek charcha (= Mushrooms: a discussion). *Gorkhapatra.* (Kathmandu) 76: 6 (in Nepali) (2033.8.10).

Adhikari, M.K 1981-82. Chyau: Ayurvediya vishleshan ek vivechana (Mushrooms: An Ayurvedic concepts). *Jour. Nep. Pharm. Asso.* **9**. 17-21 (In Nepali).

Adhikari, M.K. 1984. Note on *Asterophora parasitica* (Fr.) Sing. and *Russula densifolia* (Secr.) Gillet from Nepal. *Jour. Nat. Hist. Mus.* **8 (1-4)**: 123-126.

Adhikari, M.K.1987. Nepalma chyauko upabhoga ra upabhokta: prarambhik sarbhekshan ek chhoto janakari (= Consumers and consumption of mushrooms in Nepal: a preliminary survey). *Naya Aawaj.* **6 (16)**: 3-4 (in Nepali).

Adhikari, M.K. 1988a. Polypores (wood rotting fungi) of Nepal. *Banko Janakari* **2 (1)** : 9-20.

Adhikari, M.K. 1988b. New records of fleshy fungi from Kathmandu valley. *Cryptogams of the Himalayas.* Vol. 1: *The Kathmandu valley.* Eds. by M. Watanabe and S.B Malla. National Science Museum, Tsukuba, Japan. 133-139.

Adhikari, M.K 1988c. The genus *Russula* from the Kathmandu valley. *Ibid.* pp. 141-146.

Adhikari, M.K 1988d. Some higher fungi from Langtang and its adjoining area. *Proceeding of the papers National Conference on Science and Technology* organized by RONAST, Kathmandu: BSNS Ia: 1, 237-241.

Adhikari, M.K. 1990a. History of mycological explorations in Nepal. *Cryptog. Mycol.* **11(2)** : 111-128.

Adhikari, M.K. 1990b The genus *Russula* from Nepal (II). *Cryptograms of the Himalayas.* Vol. 2. *Central and Eastern Nepal.* Eds. by M. Watanabe and S.B Malla. National Science Museum, Tsukuba, Japan. 101-112.

Adhikari, M.K. 1991a. Hunting wild mushrooms in Nepal. Presented at the training on the study, collection and preservation on Natural History of Nepal. Organized by Natural History Museum, Goethe Institute and King Mahendra Trust for Nature Conservation. p.12.

Adhikari, M.K. 1991b. Nepalka Jangali Chyauharu: Chhoto Jankari (= Wild Mushrooms of Nepal: Brief Introduction). *Kalpavriksha.* **1(4)**: 4-5. bb.-Idem. 2. *Ibid.* **1(5)**: 6-8. bc-Idem 3. *Ibid.* **1(6)** : 6-7. bd – Idem. 4. *Ibid.* **1(7)** : 5-7.

Adhikari, M.K. 1991c. Notes on some higher fungi from Nepal. *Jour. Nat. Hist. Mus.* **12 (1-4)**: 9-18.

Adhikari, M.K. 1991d. Research trends on Nepalese mycoflora. *Jour. Inst. Agric. Ani. Sc.* **12** : 17-27.

Adhikari, M.K. 1994. First wild mushroom series stamps. *Philatelic news*, Nepal. **2 (1)** : 5-6.

Adhikari, M.K. 1994-95. Mycodiversity in Nepal: a glimpse. *Bull. Nat. Hist. Soc. Nep.* 3-**4 (1-4)** : 4-6.

Adhikari, M.K.1995a. Toxic and medicinal mushrooms from Nepal. *Network* APINMAP/ SCAMAP, Nepal. **1 (1)** : 1-2.

Adhikari, M.K. 1995b. New records of fleshy fungi from the Kathmandu valley.2 *Green World.* **6 (1)** : 37-38.

Adhikari, M.K. 1996a. Biodiversite des Basidiomycetes au Nepal. Etdue systematique et biogeographique. Specialite Ecologie-Mycoloique. 1996. These du Doctorat de l'Universite present devant l'Universite Paul Sabatier, Toulouse, France. No. d'ordre 2309, p. 205.

Adhikari, M.K.1996b. New records of fleshy fungi from the Kathmandu valley.3 *Nat. Hist. Soc. Bull.* **5-6 (1-4)** : 13-15.

Adhikari, M.K. 1998. New records of some Teliomycetes from Nepal. *Nat. hist. Soc.nep. Bull.* **8(1-4)** : 2-8

Adhikari, M.K. 1999a. Wild relatives of some arable mushrooms found in Nepal. *In Proceedings on National Conference on Wild relatives of Cultivated plants in Nepal.* June 2-4. 1999. Organized by Green Energy Mission / Nepal, Kathmandu, Nepal. Pp. 149-156.

Adhikari, M.K. 1999b. Status of wild potential mushrooms in Nepal. In abstracts of Third *National Conference on Science and Technology.* Organized by RONAST, Kathmandu: BSNS Abs: BSC069: 104.

Adhikari, M.K.1999c. Gasteromycetes from Nepal. *Nepal's Nature Paradise.* Eds. by T.C. Majupuria and R. Kumar. M. Devi, Gwalior, India. Pp. 642-654.

Adhikari, M.K. 1999d Global affinity of Nepalese mucoflora. *Scientific World.* **1(1)** L105-112.

Adhikari, M.K. 1999e. The Genus *Russula* (Basidiomycota, Agaricales) from Nepal (3). *Nat. Hist. Bull. Ibaraki.* Uni. **4**: 3-13.

Adhikari, M.K. 1999f. Diversity of Fungal resources in Nepal and its sustainable utilization or socio-economic growth in context to patenting intellectual property rights. *Bull. Nat. Hist. Soc. Nep.* **9 (1-4)** : 5-13.

Adhikari, M.K. 2000a. *Mushrooms of Nepal.* P.U. Printers, Kathmandu, Nepal.

Adhikari, M.K. 2000b. A preliminary study on the mycodiversity of Maipokhari, east Nepal. *Bull. National Science Museum*, Tokyo, Ser. B**26 (2)** : 67-74.

Adhikari, M.K. 2001. New record of fleshy fungi from Kathmandu Valley, Nepal- 4. *Green World.* **7(1)** : 3-7.

Adhikari, M.K. 2004a. Mushroom poisoning and its state in Nepal. In: *Plant Resources Bulletin* No. 25. Department of Plant Resources Kathmandu, Nepal. pp. 56-58.

Adhikari, M.K. 2004b. Nepalma Jangali Chyauharuko Sankalan ra Byapaar. (Wild Mushrooms Trade in Nepal). *Prakrit.* **2 (3)** :27-31. (In Nepali).

Adhikari, M.K. 2004c. Flora – trainiana. In *Proceedings of the 2nd Training Workshop on the flora writing.* 8-9 July, 2003, Organized by HMG/MoFSC, DPR, Nepal Flora Implementation Project, Thapathali, Kathmandu, Nepal. Pp. 13-28.

Adhikari, M.K. 2005. Daadu Chyau (*Ganoderma lucidum*). *Prakrit* (In press)

Adhikari, M.K. and Adhikari, K.S. 1999. Wild edible mushrooms. *The Rising Nepal.*, XXXIV (94): Friday supplement (March 19).

Adhikari, M.K., Adhikari, K.S., Joshi, A.R., Bhandary, R.C., Gyawali, M.B. and Pradhan, B. 1996. Studies on food value and mycotoxic wild mushrooms of Nepal submitted to APINMAP / SCAPMAP/ UNESCO Committee of Nepal, Ministry of Education, Nepal. p. 92.

Adhikari, M.K., Bhattarai, N.K. and Shah, K.B. 1992. Yarsagumba: eke anautho dhusi (= *Cordyceps sinensis* : an interesting fungi). *Kalpavriksha*, **2**: 5-9.

Adhikari, M.K. and Durrieu, G. 1996. Ethnoimycologie nepalaise *Bull. Soc. Myc.* France. 112: 31-41.

Ainsworth, G.C 1973. *The Fungi: An Advanced Treatise*; IV (B).pp 1-7. Academic press.

Alexopoulos, C.J. and Mims, C. W. 1993. *Introductory mycology* (third edition) WEL New Delhi, India.

Annonymous. 2000. Mushrooms may stop Cancer cells multiplying. *THE HINDU,* India's National Newspaper. Sep. 28, 2000.

Arnolds, E. 2001. Hope for the Chanterelle. *Coolia.* **44 (1):** 48-56.

Bakshi, B.K. 1971. *Indian Polyporaceae.* ICAR , New Delhi.

Balfour-Browne, F.L. 1955. Some Himalayan fungi. *Bull. Brist. Mus. (Nat. Hist.)* Ser. Bot. 1: 189-218.

Balfour-Browne, F.L. 1968. Fungi of recent Nepal expedition. *Ibid.* **4**: 99-141.

Balkkrishna, B. & Nair, M. C. 1994. Medicinal Mushrooms. In Nair, M.C, Gokulapalan. C., and Luludas- Eds: *Advances in Mushroom Biotechnology.* Scientific publishers, Jodhpur, India.

Bano, Z. and Rajarathnam, S. 1982. Mushrooms. *Mushroom J.* **115**: 243-245

Barbour, M.G.; Burk, J.H.; Pitts, W.D.; Gilliam, F.S. and Schwartz, M. W. 1999. *Terestrial Plant Ecology.* Addison Wesley Longman, Inc. Pp. 257-267.

Bauhin, G. 1623. *Pinax Theatri Botanici.* Basel, Ludovicus.

Berkeley, M.J. 1954a. Decades XLI- XLII. Indian fungi. *Hooker's Jour. Bot.* Kew. Gard. Misc. Jour. **6**: 129-143. b- Decades XLIV – XLVI. Indian fungi. *Ibid.* **6**: 161-174. c- Decades XLVII-XLVII. Indian fungi. *Ibid.* **6**: 204-212. d- Decades XLIX – L. Indian fungi. *Ibid.* **6**: 225-235. (Reprint 1969, Decades of fungi 1-62. Amsterdam, Asher Co. 280).

Bessey, E.A. 1950. *Morphology and Taxonomy of Fungi.* The Blakiston Co. Philadelphia.

Bessey, E.A. 1978. *Morphology and Taxonomy of Fungi.* V.P.H. Pvt.Limited. India.

Beug, H.J. & Miehe, G. (1999) Vegetation history and human impact in the eastern central Himalaya (Langtang and Helambu, Nepal). *Dissertationes Botanicae Band 318.* Gebrüder Borntraeger, Berlin, Stuttgart, Germany.

Bhandary, H.R. 1980. Notes on some macrofungi on Nepal. *Jour. Nat. Hist. Mus.* 4: 23-32.

Bhandary, H.R. 1984. Mushrooms. 33. In T.C. Majupuria (Eds.), *Nepal Nature's* Paradise, Bangkok. White Lotus Comp. Ltd. Pp.235-246.

Adhikari, M.K. and Manandhar, V. 1993a. Khetiyogya kehi jangali aushdhopayogi chyauharu: Chhoto jankari (= some arable wild medicinal mushrooms: a brief introduction). *Kalpavriksha*. **2 (23)** : 10-12 (in Nepali).

Adhikari, M.K. and Manandhar, V. 1996a. The genus *Lactarius* in Nepal. *Advances in Botany.* **21**: 387-395, India.

Adhikari, M.K. and Manandhar, V. 1998. New record of *Clavatia gigantea* from Kathmandu valley, Nepal. *Nat. Hist. Soc. Nep. Bull.* **8 (1-4)** : 10.

Adhikari, M.K. and Manandhar, V. 2004a. Some fungi collected from Nepal. In: *plant Resources Bulletin* No. 25, Department of Plant Resources Kathmandu, Nepal. pp. 5-10.

Adhikari, M.K and Manandhar, V. 2004b. Populus trees and their diseases in Nepal. In: *Plant Resources Bulletin* No. 25, Department of Plant Resources Kathmandu, Nepal.

Adhikari, M.K. and Parajuli, P. 1993. The genus *Amaita* au Nepal. *Banko Janakari.* **4 (2)** : 130-134.

Adhikari, M.K. and Parajuli, P. 1996. Mycorrhizal fungal diversity in the pine forests of Kathmandu valley, Nepal: an ecological approach. *Environment and Biodiversity: In the Context of South Asia.* ECOS, Kathmandu, Nepal. Pp. 182-197.

Adhikari, M.K. and Parajuli. P.and Durrieu, G. 1994. Le genere *Amaita* au Nepal. *Bull. Soc. Myc. France.***110 (1):** 29-33.

Adhikari. M.K. and Pokhrel, N. 1999. Nepalka khoya chyauharu: eke sarbhkshan. *Kalpavriksha.* **9** (96-97): 13-18. (=Morels of Nepal: a survey)

Adhikari, M.K. and Shrestha, T. 1990-92. A report on the natural occurrence of *Claviceps purpurea* on a hither-unknown host *Helictotrichon virescens* in Nepal. *J. Nep. Pharm. Asso.* **17**: 7-11.

Adhikari, M.K., Shrotriya, J.N and Durrieu, G. 2003. Soma: The Rigvedic drink of immortality. *Banko Janakari.***13 (2)** :54-62.

Adhikari, S. and Adhikari, M.K. 2003. Some higher fungi from Lamjung Nepal. *Botanical orientalis.* **3**:133-134.

Agnew, A.D.Q. 1961. The ecology of *Juncus effuseus* L. in North Wales. *J. Ecol.* **49**: 83-102.

Ainsworth, G.C.1971. *Ainsworth & Bisby's Dictionary of Fungi.* CMI, Kew Surrey, England.

Bhandary, H.R. 1985. Nepalka Chyauharu: ek Charcha (= Mushrooms of Nepal a discussion). *Bull. Nat. Hist. Mus.* **1**: 17-19 (In Nepali).

Bhandary, H.R. 1991. Some edible and medicinal fungi from Dumre to Manang, Mustang and Pokhara. *Jour. Nat. Hist. Mus.* **12** : (1-4): 47-60.

Bhatt, D.D. 1966. Preliminary list of plant diseases recorded in Kathmandu valley. *J.Nat. His. Mus.*, **2** : 13-20.

Bhattarai, K.R. and Vetaas, O.L. (2003). Variation in plant species richness of different lifeform along a subtropical gradient in the Himalayas, east Nepal. *Global Ecology and Biogeography.* **12**: 327-340.

Bills, G.F. and Cotter, H.V.T. 1989. Taxonomy and ethnomycology of *Lactarius* Sec. Dapetes (Russulaceae) in Nepal. *Memoirs of New York Botanical Garden.* **49** : 192-197.

Bista, M.S., Adhikari, M.K. and Rajbhandary, K.R. 2001. *Flowering Plants of Nepal (Phanerogams).* His Majesty's Government of Nepal, Ministry of Forest and Soil Conservation, Department of Plant Resources, Kathmandu, Nepal.

Brooks, W.H. 1969. Some quantitative aspects of the present shrub community in Ginkgo state park, Washington. *ND RTHWEST SCI.* **43 (4)** : 185-190.

Brundrett, M., Bougher, N., Dell, B., Grover, T. and Malajczuk, N. 1996. Working with mycorrhizas in forestry and agriculture.ACIAR. *Monograph* . 32 .Pp374.

Chang, S.T. and Buswell, J.A. 1966. Mushroom nutriceuticals. *World J. Microbial Biotechnology.* **12**: 473-476.

Chaube, H.S. 1995. Nutritional and Medicinal Values of Mushrooms. *Mushroom production Technologies*. University of Agriculture and Technology, India. Pp.1-6

Chaudhary, R.P. 1998. *Biodiversity in Nepal: Status and Conservation.* Craftsman Press, Bangkok.

Clark, C. 2005. *An introduction to Ordination.* http://www.okstate.edu/artsci/botany/ordinate/

Collins, R.A. 1997. "Polysaccharopeptide from *Coriolus versicolor* has potential for use against human immunodeficiency virus type 1 infection. *Life Sciences* **60 (25)**: PL383-7.

Corner, E.J.H 1970. Supplement to a monograph of *Clavaria* and allied genera. *Nova Hedwigia.* **33** Verlag von. J Cramer

Cooke, M.C. 1888. Some exotic fungi. *Grevillea.* **16**: 121.

Cotter, H. V. T. and Miller, O. K. 1987. Ectomycorrhizal association of the Bolete genus *Suillius* in Nepal. Proceeding Seventh North American conference in mycorrhizae, Ganeaville, Fl. U.S. A. p. 5.

Cotter, H.V.T. 1987. The systematics and ecology of boletes with special reference to the genus *Suillus* and its ectomycorrhizal relationship in Nepal. Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in Partial fulfillment of the requirement for the degree of Ph.D. in Botany, Blacksburge, Virginia, U.S.A. p. 175.

Cotter, V.T. and Bhandary, H. R. 1985. *Cavimalum indicum* (Clavicipitaceae) on *Arundinarium* in Nepal. *Jour. Nat. Hist. Mus.* **9** : 115-120.

Das, A.K. 2001. A note on wild edible mushrooms of East Siang District of Arunanchal Pradesh. *Ethnobotany*.**13** : 126-128.

Das, N. Mahapatra, S.C. and Chattopadhya, R.N. 2002. Wild edible mushrooms: Non-wood forest products for livelihood generation. *Indian forester*. **128 (4)** : 445-455.

Dekesel, A. and Vanholen. B. 2000. A forest full of mushrooms on the outskirts of Brussels. *Levende Natuur*. **101 (6)** : 207-208.

Devkota, R.P. 2001. *Agroforestry practices in Lumle VDC, Kaski district*. Dissertation submitted to Department of Geography, Prithivi Narayan Campus, T.U., Pokhara.

Dickinson, C. and Lucas, J. 1979. *Encyclopedia of Mushrooms*. Orchid Publication, London.

Dobremez, J.F. 1971.*Carte Ecologique du Nepal,*Annapurna / Dhaulagiri. Doc. Carte Veg. Alpes, IX.

Ejrnes, R. 2000. Can we trust gradient extracted by Detrended Corresponding Analysis? *J. Veg. Sci.* **11**: 565-572.

Exner, A., Willner, W. And Grabherr, G. 2002. *Picea abies* and *Abies alba* forests of the Alps: Numeriocal classification and ordination. *Folia Geobot.* **37**:383-402.

Falkenberg, D. B. & Voltonilini, J.C. (1994) The Montane Cloud Forest in Southern Brazil. *Tropical Montane Cloud Forests.* (ed. By Hamilton, L.S., James, O.J.& Scatena, F.N.) New York: Springer-Verlag.

F.A.O. 1978. *F.A.O. Production Year Book.* Vol. 32.

Fisher, W. and Hagen, D. 2003. Contributions to the knowledge of the mycotic flora of the Prignitz region, NW Brandenburg, Germany. *Verhandulungen des Botanischen Vereins Von Berlin Und Brandenburg* **136** : 269-320.

Fisher, W. and Hagen, D. 2003. Verhandulungen des Botanischen Vereins von Berlin and Brandenburg (136):. Contributions to the knowledge of the mycotic flora of the Prignitic region, NW Brandenburg, Germany. Pp.269-320

Fries, E.M. 1838. *Epicrisis Systematis mycologici.* Upasala.

Funnell, D. & Parish, R. (2001) *Mountain environments and communities.* Routledge physical environment series. London and New York.

Ghoneum, M. 1998. "Anti –HIV activity in vitro of MGN-3, an activated arabinoxylane from rice bran.*Biochemical and Biophysical Research Communications.* 243: 25-29.

Gleason, H.A. (1922) On the relation of species and area. *Ecology,* **6**, 66-74.

Goos, R.D. 1962. The occurrence of *Sphaerostilbe repens* in Central American soils. *Am.J.Bot.* **49** : 19-23.

Gwynne- Vaughan, H.C.I. and Barnes, B. 1937. *The Structure and Development of the Fungi.* Cambridge University Press, Cambridge.

Hara, H. and Williams, L.H.J. 1979. *An enumeratuin of the flowering plants of Nepal.* 2. Trustees British Museum (Nat. Hist.) London. p. 220.

Hattori, M. 1997. "Inhabitory effects of components from *Ganoderma lucidum* on the growth of human immunodeficiency virus (HIV) and the Protease Activity"In: *Proceedings of the 1st International Symposium on Ganoderma lucidum* in Japan. Nov. 17-18th, Tokyo. Pp. 128-135.

Hawker, L.E. 1996. *Fungi.* Hutchinson & Co. Ltd. London.

Hawksworth, D.L. 1974. *Mycologist's Handbook.* Commonwealth Mycological Institute, Kew Surrey, England.

Hill, M.O & Gauch, H.G. JR. 1980. Detrended correspondence analysis: An improved ordination technique. *Vegetation* **42** : 47-58.

Hjortstam, K. and Ryvarden, L. 1984. Some new and noteworthy Basidiomycetes (Aphyllophorales) from Nepal. *Mycotaxon.* **20** : 133-151.

Hooker, J.D. 1854. *Himalayan Journals.* 1-2. J. Murray, London.

Horie, Y. and S. Udagawa, 1974. *Anixiella* and *Gelasinospora* from Himalayan soils. *Trans. Mycol. Soc. Japan.,* **15** : 195-206.

Imazeki, R., Kobayashi, Y. and Aoshima, K. 1966. Fungi. *The flora of eastern Himalaya.* Ed. H. Hara. University of Tokyo, Japan. Pp. 611-626.

Imazeki, R., Otani, Y. and Hongo, T. 1988 *Coloured Illustration of Fungi of Japan.* YAMA-KEI Publishers Co. Ltd. Tokyo, Japan.

Jha, P.K. 1992. *Environment and Man in Nepal.* Know Nepal Series 5. Craftman Press, Bangkok, Thailand.

Joshi, A.R., Adhikari, M.K., Joshi, K. and Adhikari, K.1996. A study of food value and toxin of wild mushrooms of Kathmandu and Pokhara Valley. *A newsletter of APINMAP / SCAMAP.* Nepal. Pp. 47-56.

Joshi, A.R., Shrestha, S.L. and Joshi, K. 2003. *Environmental Management and Sustainable Development at the Crossroad.* Ankush, Kathmandu, Nepal. p.208

Joshi, K. and Joshi A.R. 1999. Ethnobotanical study of some mushrooms of two valleys (Kathmandu and Pokhara) of Nepal. *Ethnobotany* .**11**: 47-56.

Kershaw, K.A. 1977. *Quantitative and Dynamic Plant Ecology.* The English Language Book Society and Edward, Arnold Publishers Ltd., London. pp 191-230.

Kharel, S. 1999. New record of *Lentinellus ursinus* (Fr. : Fr.) Kuhner. In abstracts of Third *National Conference of Science and Technology.* Organized by RONAST, Kathmandu, *Abs.* : BSC003: 64.

Kibby, G. 1979. *Mushrooms and Toadstools.* Oxford University Press, London.

Kim, B.K., Kim H.W. and Choi, E.C.1994. "Anti-HIV effects of *Ganoderma lucidum"* In:Ganoderma: Systematics, Phytopathology and Pharmacology: *Proceedings of ContributedSymposium 59 A, B. 5th International Mycological Congress.* Vancouver, Canada.

Kobayashi, Y. 1965. Himalayan *Calostoma* and *Isaria. Jap. Jour. Bot.* **40** : 228-229.

Korner, C.(1999) *Alpine Plant Life.* Springer Verlag, Berlin.

Kreiger, H. 1967. *The Mushroom Handbook.* Dover, New York.

Kreisel, H. 1964. Vorlaufige obersicht der Gattung *Bovista*. *Feddes Report*. **69**: 191-211.

Kreisel, H. 1967. Taxonomisch-Pflane-zengeographische Monographie der Gattung *Bovista*. *Nova. Hedwigia*. 25: 62.

Kreisel, H. 1969. Gasteromyzeten aus Nepal. II. *Feddes Reportorium*. **87 (1-2)** : 83-107.

Kreisel, H. 1969. Gasteromyzeten aus Nepal. *Khumbu Himal*. **6 (1)** : 25-35.

Krieger, L.C. 1997. *The Mushroom Handbook*. Dover, New York.

Kumar, A., Bhatt. R.P. and Lakhanpal, T.N. (1990) *The Amanitaceae of India*. Bishen Singh Mahendra Pal Singh, 23-A. Deharadun, India.

Kuo, M., 2004. Clubs and corals. http://www.mushroomexpert.com/clubscorals.html

Kuyper and Thomas. W. 2002. Ethnomycology in Africa. *Coolia*. **45 (4)** : 191-197.

Lekhak. H.D. and Lekhak. B. 2003. *Natural Resource Conservation and Sustainable Development in Nepal*. Kshitiz Publication. Kathmandu. Nepal.

Leps. J. and Smilauer. P. 2003. *Multivariate analysis of Ecological data using Canoco*. Cambridge University Press. Great Britain.

Linnaeus. C. 1753. *Species Plantarum* **2**: *561-1200*. Holmiae.

Maharjan. P. and Budhathoki. U. 2003. Some polypores of Raniban, Pumdibhumdi VDC of Kaski District. *Botanica Orientalis*. **3**: 116-117.

Malla. S.B., Rajbhandary. S.B., Shrestha. T.B., Adhikari. P.M., Adhikari. S.R, and Shakya. P.R.1986. *Flora of Kathmandu Valley*. HMG / MoFSC, Department of Medicinal Plant. Thapathali. Kathmandu.

Manandhar. K.L. 2003. Mushroom Cultivation Technology for Women's Income. *Proceedings of International Conference on Women. Science &Technology for Poverty Alleviation*. Organized by Women in Science and Technology (WIST). Kathmandu. Nepal. Pp. 165-168.

Manandhar. V. and Adhikari. M.K. 1988. Three agarics new to Nepal. *Proceedings of National Conference of Science and Technology*. Organized by RONAST. Kathmandu, Nepal. BSNS 28: 31.

Manandhar. V. and Adhikari. M.K. 1995a. *Lepiota* and its allied genera in Nepal. *Proceedings of Second National Botanical Conference*. Organized by Nepal Botanical Society. Kathmandu. Nepal. Pp. 79-86.

Manandhar, V. and Adhikari, M.K. 1995b. *Lepiota* and its allied genera from Nepal 2. *Nat. Hist. Soc. Bull.* **3-4**: 2-3.

Manjula, B. 1983. A revised list of agaricoid and boletoid Basidiomycetes from India and Nepal. *Proc. Indian Acad. Sci.* (Pl. Sci.) **92**: 81-213.

Micheli, P.A. 1729. *Nova Plantarum Genera Juxta Tournefortii Methodum Disposita.* Firenze. p. 234.

Miller, O.K. 1984. *Mushrooms of North America.* E.P. Duttom Publishing Company Inc. NewYork.

Miller, O.K and Cotter, H.V.T. 1988. Observation of tissue morphology and spore ultrastructure of *Calostoma junghuhnii* (Gasteromycetes). *Can. J. Bot.*, **66** : 2470-2473.

Moore, D., Siu W.C., Hatit U., M. and Sanchez, C. 1998. In the midst of death, we are in life: Further advances in the study of higher fungi. *Botanical Journal of Scotland.* **50(2)** : 121-135.

Moore, D.R.J. & Keddy, P.A. (1989) The relationship between species richness and standing crop in wetlands: the importance of scale. *Vegetatio.* **79**. 99-106.

Nanba, H. 1992. "Immunostimulant activity in- vivo and anti- HIV activity in – vitro of 3 branched β-1-6 glucans extracted from Maittake mushroom *(Grifola frondosa). Proceedings of the VIII International Conference on AIDS and the III STD World Congress.*

Natour, R.M., Salhab, A.S., El-moumani, A.R. and Saba, E.F. 1992(1993). Wild mushrooms in Jordan. *Dirasat Ser B Pure Appl Sci.* **19(2)**: 47-60.

Okland, R.H. & Eilertsen, O. 1996. Dynamics of understory vegetation in an old growth boreal coniferous forest. 1988-1993. *J. Veg. Sci.* **7**: 747-767.

Onsburg, P. 1973. *Lycogala fuscoviolaceum* sp. Nov. and *Diderma niveum* from Nepal. *Bot. Tidskr.* **76**: 159-162.

Otani, Y. 1982a. Cup fungi collected in Nepal. 1. *Reports on the Cryptogamic study in Nepal.* Ed. Y. Otani, National Science Museum, Tokyo. pp. 75-91.

Otani, Y. 1982b. *Engleromyces* goetzii P. Henn. Collected in Nepal. *Ibid.* 93-96.

Pacioni, G. 1985. *The Mcdonald's encyclopedia of mushrooms and toadstools.* Mcdonald & Co. Ltd., London.

Pai, S.H., Jong, S.C. and Low, D.W. 1990. Uses of Mushroom. *Bio-industry,* Vol. V.

Palmer, M.W. 2005. *Ordination method an overview.* http://www.okstate.edu/artsci/botany/ordinate/

Pandey, B.D. 1976. Survey, collection, preservation and identification of the mushrooms in Nepal. *Nep. Jour. Agri.* **6-11**: 115-129.

Pandey, N. and Budhathoki, U. 2003. New record of fleshy fungi from Kathmandu Valley. *Botanica Orientalis* **3**: 111.

Pandhy, S.N., Dash, S.K. and Mohapatra, R. 2001. The Vedic Soma plant, how much ethnobotanical ? An introspective review. *Ethnobotany.***13** : 45-59.

Pegler, D. N. 1977. *Pleurotus* (Agaricales) in India, Nepal and Pakistan. *Kew Bull.* **31 (3)**: 501-510.

Philips, R. 1981. *Mushrooms and other Fungi of Great Britain and Europe.* Pan Book Ltd. London.

Pielou, E. C. 1984. *The Interpretation of Ecological Data: A Primer on Classification and Ordination.* Wiley, New York.

Poelt, J. 1965. Myxomycetes aus Nepal. *Khumbu HImal.* **1**: 59-70.

Ptaller, W., Gstraunthaler, G., Prast, H., Rupp, L., Rubedi, C., Michelitsch, S., and Moser, M. 1991. Effects of the fungal toxin Orellanine on renal epithelium. *Nephrotoxicity.* Marcel Dekker Inc. New York. Pp. 63-69.

Purukayastha, R.P. and Chandra, A. 1985. *Manual of Indian Edible Mushrooms.* Jagendra Book Agency, New Delhi, India.

Rahbek , C. (1995) The elevational gradient of species richness, a uniform pattern?. *Ecography*, **18**: 200-205.

Rahbek , C. (1997) The relationship among area, elevation and regional species richness in neotropical birds. *American Naturalists*, **149**: 875-902.

Rai, S.D., Dhar, B.L. and Verma. 1997. Advances of Mushroom Biology and Production. In: *Proceedings of National Conference on Mushrooms.* NCMRT. Solan.

Rajbhandary, S. (1999). Mushrooms of Nepal: A brief Introduction. *Botanica Orientalis.* **1**: 72-75.

Ramsbottom, J. 1954. *Mushrooms & Toadstools.* Collins 14 ST James's Place London.

Ranjitkar, H.D. and Bhatt, D.D. 1976. A note on *Craterellus cornucopioides. Ind. Phytopath.* **29**: 305-306.

Rea, C. 1922. *British Basisiomycetae. Biblio. Mycol.* 15 J Cramer.

Rinaldi, A. and Tyndalo, V. 1972. *The Complete Book of Mushrooms.* Crescent Book, New York.

Rosenzweig, M.L. (1997) *Species diversity in space and time*. 2nd edn, Cambridge University Press, Cambridge.

Ryvarden, L. 1977. Some wood inhabiting Aphyllophoraceous fungi from Nepal. *Khumbu Himal.* **6**: 379-386.

Sacherer, J. 1979. The high altitude Ethnobotany of the Rolwaling Sherpas: a contribution of Nepalese studies. *Jour. Res. Cen. Nep. Stud.* CNAS **6 (2):** 46-64

Schaefer, Th. 2000. Microscopic analysis of hallucinogenic mushroom powders- *Psilocybe* sp. *Archiv fuer Kriminologie.* **205(1-2)**: 30-36.

Schmeda, H., Guillermo, Razmilic, I., Margarita, I., Gutierrez and Loyola, J. 1999. Proximate composition and biological activity of food plants gathered by Chilean Amerindians. *Economic Botany.* **53(2)**: 177-187.

Sharma, M. P. 1983a. A new *Dasyscyphus* species from India. *Fungi of Indian Subcontinent: a collection of papers. Biblio. Mycol.* **91**: 115-121.

Sharma, M. P. 1983b. Helotiales type specimens in the PAN Herbarium. *Ibid.* **91**: 139-150.

Sharma, O.P.1998. *Textbook of Fungi.* Tata McGraw Hill. New Delhi, India.

Shrestha, K. 1985. *Cordyceps nutans* Pat. From Lato Manang. *Jour. Nat. Hist. Mus.* **9**: 111-114.

Simon and Schuster, 1981.*Guide to Mushrooms.* Simon and Schuster Inc. New London, Toronto, Sydney, Tokyo.

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

Singh, S.C. 1966. Mushrooms. *Deorali.* **4**: 15-31.

Singh, S.C. 1968. Some parasitic fungi collected from Kathmandu valley (Nepal). *Ind. Phytopath.* **21**: 23-30.

Singh, S.C. and Adhikari, M.K. 1977. Some fleshy fungi from Kathmandu (Nepal). *Jour. Nat. Hist. Mus.* **1(1):** 49-57.

Singh, S.C. and Nisha 1974. *Exbasidium butleri* in Nepal. *Ind. Phytopath.* 27: 387-389.

Singh, S.C. and Nisha 1976b. A contribution to the parasitic mycoflora of Nepal. *Ibid.* **6**: 11-14.

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

Singh, S.C. and Upadhyaya, B.N. 1978. Notes on some fungi to Nepal. *Ibid.* **2**: 51-53.

Smith, G.M. 1955. *Cryptogamic Botany.* Vol. I. (2nd Ed.) McGraw- Hill Book Company, New York.

Snell, W.H and Dick, E.A. 1971. *A Glossory of Mycology.* XXXI Harvard University Press, Cambridge. Pp. 181.

Sohi, H, S. and Sharma, S.R. 1997. Mushroom Cultivation Technology: An overview. *Recent Researches in Ecology, Environment and Pollution.* Vol. XI: 473-491.

Sorensen, T. 1948. A method of establishing groups of equel amplitude in plant sociology on similarity species content. *Det Kong Danske Videndk Selsk. Biol. Skr (Copenhegen)* 5: 1-34

Stevenson, G.B. 1970. *The Biology of Fungi, Bacteria and Viruses.* (2nd edn.) Edward Amold, London.

Straatsma, G. and Greilhuber, I. 2003. Assemblage structure, species richness, abundance and distribution of fungal fruit bodies in a Seven year Plot – based survey near Voenna. *Mycological Research.* **107(5):** 632-640.

Suzuki, H., Okubo, A., Yamazaki, S., Suzuki, K., Mitsuya, H. and Toda, S. 1989. "Inhibition of the infectivity and cytopathic effect of human immunodeficiency virus by water soluble lignin extract of the culture medium of *Lentinus edodes* mycelium (LEM)." *Biochemical and Biophysical Research Communications.* Vol. 160, no.1.

Svreck, M. 1975. *A colour guide to Familiar Mushrooms.* Octopus Book Company.

ter Braak, C.J.F. 1986. Canonical correspondence analysis: a new eigenvector technique for multivariate direct gradient analysis. *Ecology* **67**:1167-79.

ter Braak, C.J.F. and Smilauer, P. 1988. *CANOCO Reference Manual and User's Guide to Canoco for Windows, Software for Cannonical Community Ordination (version 4).* Center for Biometry, Wageningen.

Thapa, F. 1990. Die back threatening *Dalbergia sissoo. Farm. Forest. News.* FRED Project, WINROCK Int. USA **3 (4)**: 8.

Thind, K.S. and Sharma, M.P. 1983. The Nepal Helotiales. Fungi of Indian subcontinent: a collection of papers. *Biblio. Mycol.* **91**: 265-279.

Tullons, R.E. and Bhandary, H.R. 1992. *Amanita chepangiana;* a new species from Nepal. *Mycotaxon*. XLLIII: 25-31.

Tullons, R.E., Hongo, T. and Bhandary, H.R. 1992. *Amanita neoovoidea-* Taxonomy an distribution. *Mycotaxon*. XLLV (1): 235-242.

Udagawa, S. and Horie, Y. 1982. Two new species of terrestrial Ascomycetes from eastern Nepal. *in Y. Otani, ed. Reports on the Cryptogams of the Himalayas: Central and eastern Nepal. National Science Museum, Tokyo.* **2**: 73-84

Van der Marrel, E. 1977. *Biodiversity: from babel to biosphere management*. Oplus Press, Uppsala.

Vetaas, O.R. (1993) Spatial and temporal vegetation changes along a moisture gradient in northern Sudan. *Biotropica,* **25**, 166-175.

Vetter, J.1988. Toxins of *Amanita phalloides. Toxicon*. **36**(1): 13-24.

Voss *et al.,* 1983. *International Code of Botanical Nomenclature*. Bohn, Scheltema and Holkema, Dr. W. Jenek Publisher. The Hauge.

Walting, R. 1973. *Identification of larger fungi.* Hulton group Key, Hulton, Educ. Pub. Ltd. Bucks.

Waraitch, K.S. and Thind, K.S. 1977a. Fungi of Nepal (Pezizales). *Jour Nat. Hist. Mus.* **1**: 21-34.

Waraitch, K.S. and Thind, K.S. 1977b. Pyrenomycetous fungi from Nepal. *Ibid.* **1**: 203-206.

Waraitch, K.S. and Thind, K.S. 1977c. Idem. 2. *Ibid.* **1**: 207-214.

Webster, J. 1980. *Introduction to Fungi.* (2nd Edn.) Cambridge University Press, Cambridge.

Whittaker, R.H. and Margulis, L.L. 1978. *Biosystems* **10**: 3-18.

Annex- 1(i): Format of the macroscopic field observation sheet for pileus bearing mushrooms

MUSHROOMS OF LUMLE

(Macroscopic or Field observation – 1)

Col. No..... **Date**..... **Altitude**..... **Locality**.....

Habitat:

Substrate: Soil, leaves, humus, tree, stump, wood, branch.....

Condition: moist, dry, open, dark, forest.....

Fruit Body: Fleshy, tough, corky, woody, leathery, membranous, cartilaginous, auricular, clavaroid, spathulate, round, convoluted and others.....

Pileus: Present, Absent.

Size: .....cm, ...mm

Colour:.....

Shape: Ovoid, hemispherical, conical, convex, campanulate, umbonate, umbillicate, Infundibuliform, turbinate, didiminate, resupinate, applanate and others.....

Surface: dry, viscid, sticky, smooth, powdery, granular, scaly, cracked, glabrous, hairy, wrinkled, and others.....

Margin: straight, incurved, entire, torn, wavy, striate (finely, strongly, terbecular), extending beyond hymenial layer and others.....

Pellicle: thin, thick, semiseparable, not separable, separable, color under the pellicle.

Stipe: Present or absent.

Size: .....cm, ...mm

Colour: .....& colour changes.

Shape: straight, curved, cylindrical, swollen below, tapering above/below, with or without rhizoidal strands & others.....

Surface: smooth, scaly, powdery, hairy, dotted, lined, netted, pitted & others.

Nature: cartilaginous, ridged, twisted, solid, stuffed, hollow, compressed, brittle.

Annulus: Skirt, pendent, sheathing, cobwebby, superior, inferior, smooth, straight, single, double, entire, lobed, color.

Volva: Present or absent.

Size: .....cm, ...mm

Colour: .....

Nature: entire, divided, scaly, circumsessile, friable, lobed.

Annex- 1(ii): Format of the macroscopic field observation sheet for Clavaroid and Gasteroid allied species

MUSHROOMS OF LUMLE

(Macroscopic or Field observation – 2)

Col. No.....Date..... Altitude..... Locality.....

Habitat:

Substrate: Soil, leaves, humus, tree, stump, wood, branch.....

Condition: moist, dry, open, dark, forest.....

Fruit Body: Fleshy, tough, corky, woody, leathery, membranous, cartilaginous, auricular, clavaroid, spathulate, round, convoluted & others.....

Clavaroid fruit body:

Size: .....cm, ...mm

Color:..... And color changes .....

Nature: simple, branched, glabrous, fragile, fleshy, firm, rigid, single, caespitose, gregarious, straight, curved.

Stem: short, long, thick, thin, fleshy, brittle, firm, rigid, slender, solid, hollow, curved, straight, flattened, compressed.

Branches: irregular, regular, dichotomous, simple, coralloid, compressed, cylindrical, size, color, smooth.

Tips: size..... color....., acute, obtuse, fragile, tough.

Gasteroid (within the peridium) or round or puff ball allies:

Exoperidium size: .....cm, ...mm.

Color: .....color changes .....

Nature: sessile, stalked, smooth, warted, scaly, round, star like rays, outer layer falling into flakes, hygroscopic or not.

Flesh: color ..... Color changes ....., thickness .....

Endoperidium (glebe):

Number of chambers (single to many.....), powdery, cell like with peridioles, (number of peridioles) with or without separating layer.

Pore: color ..... Number ..... Nature ..... Size.....

Smell of fruit body: fruit, rotten, fish, anise, radish, corn, garlic .....

Chemical Reactions:

$FeSo_4$

KOH (10%): .....

Remarks:.....

.....

.....

Hymenial surface:

Colour: .....

Nature: lamellate, poried, smooth, spiny. corolloid, within peridium.

Lamellae colour: .....and colour change.....

Attachment: Free, adnexed, sinuate, adnate, decurrent or mixed.

Length: uniform, interspaced with shorter ones, forked, bifurcate (Below or above), equal, unequal.

Margin: entire, serrate, dentate, torn.

Poried surface:

Color :.....and colour changes.....

Size: pore size:.....mm

Shape: round, angular, hexagonal, elongate, rectangular, not definite or mixed.

Nature: papillate, tubular, single layered, stratified

Attachment: free, adnate, decurrent

Thickness: ... .mm .....cm

Spore Print: .....Colour

Other Characteristics:

Flesh (Pileus & Stipe): thickness, softness, colour..... and colour changes.....after brushing.

Taste (Gills & Stipe): mild, acrid, pleasant, bitter, ...

Smell of fruit body: fruity, rotten fish, anise, radish, corn, garlic, ...

Latex: color ....., amount ....., taste .....

Chemical reactions:

$FeSo_4$ Color change on flesh of cap ..... gill ..... And stipe.....with crystals.

KOH (10%): color changes ..... In the hymenial surfaces.

Remarks:.....

.....

.....

Annex-2: Format of the questionnaire

Date:

Name:

Address:

Age: **Sex:** **Cast:** **0ccupation:**

1. Do you go daily / occasionally for collection?
2. Which type of forest you prefer to go for collection?
3. Which season is favorable for collection?
4. Do you know some Tithis (तिथी) in which mushrooms are found enough?
5. What are the plant species and their condition on which mushrooms generally grow?
6. How do you collect mushrooms?
7. How do you store mushrooms?
8. How do you identify poisonous or edible mushrooms?
9. How can we minimize the poisonous nature of mushrooms so that they can be suitable to eat?
10. What are the best edible mushrooms and generally collected?
11. Do you know any mushrooms having religious / medicinal values?
12. Do you know some more values?
13. Have you ever sold mushrooms?
14. Which species the buyer usually prefer?
15. Have you seen any type of mushrooms, which were existed in the past time but now are rare or extinct?
16. Have you marked any type of mushrooms eaten by animals like monkeys or others?
17. Have you ever eaten poisonous mushrooms unknowingly? If yes, then what did you feel? After, how did you do at that time?
18. Do you face the problems during mushrooms collection?
19. Do you think that, the mushrooms diversity should be conserved?
20. It is a saying that, "If the Brahmins have eaten the mushrooms, they could have known the actual taste of mushrooms." What do you think about this? In your opinion why this type of belief arose?
21. Lastly, do you know the local names of mushrooms in Lumle area?

Thank You

Annex-3 (i) List of mushrooms collected from Lumle

S.N.	Col.No.	Col.Date	Locality	Altitude(m.)	Scientific Name	Local Name	Family
1	001SD	14.6.2003 (2060.2.31)	Jhyani Bas	1640	*Tulostoma* sp.	-	Tulostomataceae
2	003SD	14.6.2003 (2060.2.31)	Chandrakot	1660	*Coriolus hirsutus*	Kathey Chyau	Polyporaceae
3	0011SD	14.6.2003 (2060.2.31)	Gobaney	1657	*Oudimansiella radicata*		Dermolomataceae
4	0012SD	14.6.2003 (2060.2.31)	Gobaney	1657	*Polyporus* sp.	Kathey Chyau	Coriolaceae
5	0029SD	15.6.2003 (2060.3.1)	Thulakharka	2185	*Coprinus comatus*	Gobarey Chyau	Coprinaceae
6	0045SD	16.6.2003 (2060.3.2)	Thulakharka	2190	*Ganoderma lucidum*	Mudhey Chyau	Ganodermataceae
7	0051SD	10.8.2003 (2060.4.25)	Deutako Than	1652	*Polyporus* sp.		Coriolaceae
8	0052SD	10.8.2003 (2060.4.25)	Deutako Than	1652	*Pholiota* sp.		Cortinariaceae
9	0053SD	10.8.2003 (2060.4.25)	Deutako Than	1652	*Conocybe* sp.		Bolbitinaceae
10	0054SD	10.8.2003 (2060.4.25)	Jhakrey	1645	*Daldinia concentrica*	Dalley Chyau	Xylariaceae
11	0055SD	10.8.2003 (2060.4.25)	Jhakrey	1645	*Schizophyllum commune*	Mujurey Chyau	Schizophyllaceae
12	0056SD	10.8.2003 (2060.4.25)	Jhakrey	1645	*Pycnoporus cinnabarinus*	Raktey Chyau	Polyporaceae
13	0059SD	12.8.2003 (2060.4.27)	Majkhola	1643	*Coprinus dissemanatus*	Gobrey Chyau	Coprinaceae
14	0060SD	14.8.2003 (2060.4.29)	Syaniswara	1775	*Hygrophorus* sp.		Hygrophoraceae
15	0061SD	14.8.2003 (2060.4.29)	Syaniswara	1775	*Laccaria laccata*	Jhari Chyau	Tricholomataceae
16	0064SD	14.8.2003 (2060.4.29)	Mulabari	1836	*Coltricia* sp.		Hymenochaetaceae
17	0068SD	14.8.2003 (2060.4.29)	Mulabari	1836	*Russula* sp.	Chatey Chyau	Russulaceae
18	0069SD	14.8.2003 (2060.4.29)	Mulabari	1836	*Lactarius volemus*	Dudhe Chyau	Lactariaceae
19	0070SD	14.8.2003 (2060.4.29)	Mulabari	1836	*Fomes* sp.	Mudhey Chyau	Polyporaceae
20	0071SD	15.8.2003 (2060.4.30)	Thulakharka	2021	*Pholiota squarrosoides.*	Chipley Chyau	Cortinariaceae
21	0072SD	15.8.2003 (2060.4.30)	Parseulii	2170	*Lycoperdon* sp.	Phusphusey Chyau	Lycoperdaceae
22	0073SD	15.8.2003 (2060.4.30)	Doka Dada	2187	*Panellus* sp.		Tricholomataceae
23	0074SD	15.8.2003 (2060.4.30)	Doka Dada	2187	*Hygrophorus coccineus.*		Hygrophoraceae
24	0075SD	15.8.2003 (2060.4.30)	Doka Dada	2187	*Boletus* sp.		Boletaceae
25	0076SD	15.8.2003 (2060.4.30)	Thulakharka	2155	*Meruliapsis* sp.		Stereaceae
26	0077SD	15.8.2003 (2060.4.30)	Thulakharka	2108	*Clavaria rosea*		Clavariaceae
27	0078SD	15.8.2003 (2060.4.30)	Thulakharka	2108	*Chlorociboria aeruginosa*		Pezizaceae
28	0079SD	15.8.2003 (2060.4.30)	Thulakharka	2105	*Grifola frondosa*	Nangrey Chyau	Grifolaceae
29	0080SD	15.8.2003 (2060.4.30)	Thulakharka	2105	*Russula* sp.	Chatey Chyau	Russulaceae
30	0081SD	15.8.2003 (2060.4.30)	Thulakharka	2101	*Xylaria nigrescens**		Xylariaceae

31	0083SD	15.8.2003 (2060.4.30)	Thulakharka	2075	*Tricholoma* sp.		Tricholomataceae
32	0084SD	15.8.2003 (2060.4.30)	Thulakharka	2058	*Pholiota* sp.	Chipley Chyau	Cortinariaceae
33	0086SD	15.8.2003 (2060.4.30)	Thulakharka	2048	*Clavulinopsis fusiformis (=Clavaria fusiformis)*		Clavariaceae
34	0087SD	15.8.2003 (2060.4.30)	Thulakharka	2048	*Trichoglossum farlowi*		Geoglossaceae
35	0089SD	15.8.2003 (2060.4.30)	Thulakharka	2040	*Xylaria polymorpha*		Xylariaceae
36	0090SD	15.8.2003 (2060.4.30)	Thulakharka	2035	*Xylaria plebeja**		Xylariaceae
37	0091SD	17.8.2003 (2060.4.32)	Piya ko Dada	1647	*Guepinia spathularia*	Mudhey Chyau	Tremellaceae
38	0092SD	17.8.2003 (2060.4.32)	Jharamta	1635	*Ascobolus magnificus**	Gobrey Chyau	Pezizaceae
39	0094SD	1.10.2003 (2060.6.14)	Jharamta	1635	*Coriolus* sp.	Kathey Chyau	Polyporaceae
40	0095SD	1.10.2003 (2060.6.14)	Jharamta	1635	*Stropharia* sp.		Stroipharíaceae
41	0096SD	2.10.2003 (2060.6.15)	Jharamta	1635	*Clavaria vermicularis*		Clavariaceae
42	0098SD	2.10.2003 (2060.6.15)	Jharamta	1635	*Stropharia* sp.		Strophariaceae
43	00100SD	7.10.2003 (2060.6.20)	Gobaney	1657	*Pholiota* sp.	Jhari Chyau	Cortinariaceae
44	00101SD	7.10.2003 (2060.6.20)	Gobaney	1657	*Fomes* sp.		Polyporaceae
45	00102SD	7.10.2003 (2060.6.20)	Gobaney	1657	*Pholiota* sp.	Patpatey Chyau	Cortinariaceae
46	00103SD	7.10.2003 (2060.6.20)	Gobaney	1657	*Hexagonia* sp.		Polyporaceae
47	00104SD	7.10.2003 (2060.6.20)	Gobaney	1657	*Trametes versicolar*	Kathey Chyau	Polyporaceae
48	00105SD	8.10.2003 (2060.6.21)	Bhir Muni	1892	*Thelophora* sp.		Thelophoraceae
49	00106SD	31.10.2003 (2060.7.14)	Malaurii	1603	*Hericium erinaceus*		Hericiaceae
50	00107SD	13.6.2004 (2061.2.31)	Saujung	1651	*Anthracobia macrocystis*		Pezizaceae
51	00109SD	13.6.2004 (2061.2.31)	Saujung	1651	*Auriscalpium vulgare*		Auriscalpiaceae
52	00110SD	13.6.2004 (2061.2.31)	Saujung	1651	*Canthrellus cibarius*	Besarey Chyau	Cantharellaceae
53	00111SD	14.6.2004 (2061.2.32)	Jhakrey	1645	*Auricularia auricula-judae*	Thalthaley Chyau	Auriculariaceae
54	00112SD	14.6.2004 (2061.2.32)	Gairi Khoria	1748	*Lycoperdon pyriforme*	Phusphusey Chyau, Syal chyau	Lycoperdaceae
55	00113SD	14.6.2004 (2061.2.32)	Gairi Khoria	1748	*Russula* sp.	Chatey Chyau	Russulaceae
56	00114SD	14.6.2004 (2061.2.32)	Gairi Khoria	1768	*Leccinum* sp.	Thopley Chyau	Boletaceae
57	00115SD	14.6.2004 (2061.2.32)	Gairi Khoria	1771	*Russula* sp.	Chatey Chyau	Russulaceae
58	00116SD	14.6.2004 (2061.2.32)	Gairi Khoria	1775	*Ramaria flaccida*	Kauli Chyau	Ramariaceae
59	00117SD	14.6.2004 (2061.2.32)	Gairi Khoria	1775	*Russula aurora(=R. rosea, R. rosacea)*	Chatey Chyau	Russulaceae
60	00118SD	14.6.2004 (2061.2.32)	Gairi Khoria	1775	*Russula chloroides*	Chatey Chyau	Russulaceae
61	00119SD	14.6.2004 (2061.2.32)	Mulabari	1825	*Xylaria filliformis**		Xylariaceae
62	00120SD	14.6.2004 (2061.2.32)	Mulabari	1830	*Amanita cokeri*		Amanitaceae

63	00121SD	14.6.2004 (2061.2.32)	Mulabari	1830	*Boletus* sp.		Boletaceae
64	00122SD	14.6.2004 (2061.2.32)	Mulabari	1833	*Lentinus* sp.	Mirghi Chyau	Pleurotaceae
65	00123SD	14.6.2004 (2061.2.32)	LARC	1725	*Hypoxylon multiforme*		Xylariaceae
66	00124SD	15.6.2004 (2061.3.1)	Chitrey	1635	*Auricularia* sp.	Thalthaley Chyau	Auriculariacea
67	00126SD	21.6.2004 (2061.3.7)	Gaira	1641	*Lepiota* sp.	Gobrey Chyau	Agaricaceae
68	00128SD	29.6.2004 (2061.3.15)	Bhir Muni	1902	*Ganoderma* sp.	Mudhey Chyau	Ganodermatac
69	00129SD	29.6.2004 (2061.3.15)	Bhir Muni	1908	*Pleurotus* sp.		Pleurotaceae
70	00130SD	29.6.2004 (2061.3.15)	Bhir Muni	1915	*Hypoxylon* sp.		Xylariaceae
71	00131SD	29.6.2004 (2061.3.15)	Bhir Muni	1925	*Clavaria acuta*		Clavariaceae
72	00136SD	4.7.2004 (2061.3.20)	Gairi Khoria	1773	*Lactarius piperatus*		Lactariaceae
73	00137SD	4.7.2004 (2061.3.20)	Gairi Khoria	1778	*Amanita sp.*		Amanitaceae
74	00138SD	4.7.2004 (2061.3.20)	Gairi Khoria	1705	*Exobasidium butleri*	Pani Pokey Chyau	Exobasidaceae
75	00139SD	5.7.2004 (2061.3.21)	Mabir, Deurali	2052	*Lentaria mucida* *		Clavariaceae
76	00140SD	5.7.2004 (2061.3.21)	Mabir, Deurali	2058	*Marasmius* sp.		Tricholomatace

**Marks indicate new report to Nepal (5)*

Annex- 3(ii) List of Clavariales collected from Kathmandu valley

S.N	Col.No.	Col.Date	Locality	Altitude (m.)	Scientific name	Local Name	Family
1	00141SD	13.08.2004 (2061.4.29)	Dakshinkali	1340	*Clavaria acuta*		Clavariaceae
2	00146SD	13.08.2004 (2061.4.29)	Dakshinkali	1340	*Aphelaria tuberosa**		Clavariaceae
3	00148SD	13.08.2004 (2061.4.29)	Dakshinkali	1340	*Ramaria botrytis*	Kawali chyau	Ramariaceae
4	00153SD	14.08.04 (2061.4.30)	Suryavinayak	1531	*Clavulinopsis fusiformis (=Clavaria fusiformis)*		Clavariaceae
5	00156SD	21.08.2004 (2061.5.5)	Nagarkot	1600	*Clavulinopsis fusiformis (=Clavaria fusiformis)*		Clavariaceae
6	00165SD	21.08.2004 (2061.5.5)	Godavari	1515	*Clavaria fumosa**		Clavariaceae
7	00169SD	25.08.2004 (2061.5.9)	Matatirtha	1520	*Clavulinopsis fusiformis (=Clavaria fusiformis)*		Clavariaceae
8	00170SD	25.08.2004 (2061.5.9)	Matatirtha	1520	*Clavaria Vermicularis*		Clavariaceae

**Marks indicate new report to Nepal (2)*

Annex- 4: Distribution patterns of mushrooms at different altitudes

S.N	Species	Altitude (m)					
		1700	1800	1900	2000	2100	2200
1	*Tul*	1	0	0	0	0	0
2	*Cor hir*	1	1	1	1	1	1
3	*Oud rad*	1	1	1	0	0	0
4	*Pol a*	1	1	1	1	1	1
5	*Cop com*	0	0	0	0	0	1
6	*Gan luc*	1	0	0	0	0	0
7	*Pol b*	1	1	1	1	1	1
8	*Pho*	1	1	1	1	1	1
9	*Con*	1	0	0	0	0	0
10	*Dal con*	1	0	0	0	0	0
11	*Sch com*	1	1	1	1	1	1
12	*Pyc cin*	1	1	1	1	1	1
13	*Cop dis*	1	1	1	1	1	1
14	*Hyg*	0	1	0	0	0	0
15	*Lac lac*	1	1	1	1	1	1
16	*Col*	0	0	1	0	0	0
17	*Rus a*	0	0	1	0	0	0
18	*Lac vol*	0	0	1	1	1	1
19	*Fom a*	0	0	1	1	1	1
20	*Pho squ*	0	0	0	0	1	0
21	*Lyc*	0	0	0	0	1	1
22	*Pan*	0	0	0	0	0	1
23	*Hyg coc*	0	0	0	0	0	1
24	*Bol a*	0	0	0	0	0	1
25	*Mer*	0	0	0	0	0	1
26	*Cla ros*	0	0	0	0	0	1
27	*Chl aer*	0	0	0	0	0	1
28	*Gri fro*	0	0	0	0	0	1
29	*Rus b*	0	0	0	0	0	1
30	*Xyl nig*	0	0	0	0	0	1
31	*Tri*	0	0	0	0	1	0
32	*Pho b*	0	0	0	0	1	0
33	*Cla fus*	0	0	0	0	1	0
34	*Tri far*	0	0	0	0	1	0
35	*Xyl pol*	0	0	0	0	1	0
36	*Xyl ple*	0	0	0	0	1	0
37	*Gue spa*	1	1	1	1	1	1
38	*Asc mag*	1	0	0	0	0	0
39	*Cor*	1	1	1	1	1	1
40	*Str a*	1	0	0	0	0	0
41	*Cla ver*	1	0	0	0	0	0
42	*Str b*	1	0	0	0	0	0
43	*Pho c*	1	1	1	1	1	1

44	*Fom b*	1	1	1	1	1	1
45	*Pho d*	1	1	1	1	1	1
46	*Hex*	1	0	0	0	0	0
47	*Tra ver*	1	1	1	1	1	1
48	*The*	0	0	1	0	0	0
49	*Her eri*	1	0	0	0	0	0
50	*Ant mac*	1	1	1	1	1	1
51	*Aur vul*	1	0	0	0	0	0
52	*Can cib*	1	0	0	0	0	0
53	*Aur aur*	1	1	1	1	1	1
54	*Lyc pyr*	0	1	0	0	0	0
55	*Rus c*	0	1	1	1	1	1
56	*Lec*	0	1	0	0	0	0
57	*Rus d*	0	1	1	1	1	1
58	*Ram fla*	0	1	0	0	0	0
59	*Rus aur*	0	1	0	1	0	0
60	*Rus chl*	0	1	0	0	0	0
61	*Xyl fil*	0	0	1	0	0	0
62	*Ama cok*	0	0	1	0	0	0
63	*Bol b*	0	0	1	0	0	0
64	*Len*	0	0	1	0	0	0
65	*Hyp mul*	0	1	0	0	0	0
66	*Aur*	1	0	0	0	0	0
67	*Lep*	1	0	0	0	0	0
68	*Gan*	0	0	0	1	1	1
69	*Ple*	0	0	0	1	0	0
70	*Hyp*	0	0	1	0	0	0
71	*Cla acu*	0	0	1	0	0	0
72	*Lac pip*	0	1	0	0	0	0
73	*Ama*	0	1	0	0	0	0
74	*Exo but*	0	1	0	0	0	0
75	*Mul muc*	0	0	0	0	1	0
76	*Mar*	0	0	0	0	1	0

- 0 = *Absent*, 1 = *Present*

Annex- 5: Edible mushrooms of Nepal

S.N.	Scientific Name	S.N.	Scientific Name
1	*Agaricus bisporus* (Lange) Imbach.	45	*Entoloma subcostatus* Atkinson
2	*A. bitorquis* (Quel.) Sacc.	46	*Exobasidium butleri** P. & H. Sydow
3	*A. campestris* L. : Fr.	47	*Favolus canadensis* Klotzsch.
4	*A. silvicola* (Vitt.) Peck.	48	*Fistulina hepatica* (Schaeff.) Fr.
5	*A. subrufescens* (Peck.) Hobson & Stuntz	49	*Flammulina velutipes* (Curt. : Fr.) Karst.
6	*Aleuria aurantia* (Fr.) Fuck.	50	*Gomphus clavatus* (Pers. : Fr.) S. F. Gray
7	*Amanita caesarea* (Scop. : Fr.) Pers.	51	*G. floccosus* (Schw.) Singer
8	*A. hemibapha* (Berk. & Br.) Sacc.	52	*Grifola frondosa** (Dick. & Fr.) S. F. Gray
9	*A. rubescens* (Pers. :) S. F. Gray	53	*Helvella crispa* (Scop. : Fr.) Fr.
10	*Armillaria mellea* (Vahl. : Fr.) Kummer.	54	*H. elastica* Bull. : Fr.
11	*A. tabescens* (Scop. : Fr.) Em.	55	*Hericium clathroides* (Pall. : Fr.) Pers.
12	*Astraeus hygrometricus* (Pers. : Pers.) Morgan	56	*H. erinaceus* *(Bull. : Fr.) Pers.
13	*Auricularia auricula-judae** (Bull. : Fr.) Wettst	57	*H. flagellum* (Scop) Pers.
14	*A. delicata* (Fr.) Henn. Apud Bres.	58	*Hydnellum concresecns* (Pers.) Banker
15	*A. mesenterica* (Dicks. : Fr.) Pers.	59	*H. velutinum* (Bohm. : Fr.) Karst.
16	*A. polytricha* (Mont.) Sacc.	60	*Hydnum imbricatus* L. : Fr.
17	*Boletus edulis* Bull. : Fr.	61	*H. repandum* L. : Fr.
18	*Bondarzewia berkeleyi* (Fr.) Bond & Singh.	62	*Hygrocybe conica* (Scop. : Fr.) Kummer
19	*B. montana* (Quel.) Singer	63	*H. nigrescens* (Quel.) Kuhn.
20	*Bovista plumbea* Pers.	64	*H. miniata* (Fr. : Fr.) Kummer
21	*Bjerkandera adusta* (Fr.) Karst.	65	*Hygrophorus eburneus* (Bull. : Fr.) Fr.
22	*Calvatia gigantea* (Batsh. Ex Pers.) Lloyd	66	*Laccaria amethystina* (Huds.) Cooke
23	*Cantharellus cibarius** (Fr. : Fr.) Fr.	67	*L. laccata** (Scop. : Fr.) Cooke
24	*C. leucocomus* Bigelow	68	*Lactarius controversus* (Pers. : Fr.) Fr.
25	*C. odoratus* (Scw. : Fr.) Fr.	69	*L. deliciosus* (L. : Fr.) S. F. Gray
26	*C. subalbidus* Smith & Morse	70	*L. deceptivus* P.K.
27	*C. subcibarius* Corner	71	*L. indigo* (Schew.) Fr.
28	*C. tubiformis* Fr.	72	*L. lignyotus* Fr.
29	*Clitocybe diatreta* (Fr. : Fr.) Kummer	73	*L. piperatus* *(Fr.) S. F. Gray
30	*C. gibba* (Pers. : Fr.) Kummer	74	*L. subdulcis* (Fr.) S.F. Gray
31	*Cordyceps sinensis* (Berk.) Sacc.	75	*L. subpiperatus* Hongo
32	*Craterellus cornucopioides* (L. : Fr.) Pers.	76	*L. volemus** (Fr.) Fr.
33	*C. cornucopioides* var. *Mediosporus*	77	*L. thakalorum* Bills & Cotter
34	*Clavaria acuta** Sch. :Fr.	78	*Laetiporus sulphureus* (Fr.) Murr.
35	*C. vermicularis** Swartz : Fr.	79	*Lentaria macrospora* Corner
36	*Clavulinopsis fusiformis** (Sow. : Fr.) Corner	80	*Lentinellus ursinus* (Fr.) Kuhner
37	*Clavulina cinerea* (Bull. :Fr.) Schroet.	81	*Lentinus badius* (Berk.) Ber.
38	*C. cristata* (Fr.) Schroet.	82	*L. conchatus* (Bull. : Fr.) Schr.
39	*Collybia butyracea* (Bull. : Fr.) Kummer	83	*L. polychrous* Lev.
40	*Conocybe lactea* (Lange) Metrod	84	*L. sajor-caju* (Rumph. : Fr.) Fr.
41	*C. tenera* (Schaeff. Ex Fr.) Fayod	85	*L. strigosus* (Schw.) Fr.
42	*Coprinus comatus** (Mull. : Fr.) Pers.	86	*L. tigrinus* (Bull. : Fr.) Fr.
43	*Craterellus cornucopioides* (L. : Fr.) Pers	87	*L. tuber-regium* (Fr. : Fr.) Fr.
44	*Dacrymyces palmatus* (Schw.) Burt.	88	*L. velutinus* Fr.
		89	*Lentinula edodes* (Berk.) Pegler
		90	*Lycoperdon perlatum* Pers. : Pers.
		91	*L. pyriforme* *Schaeff. Ex Pers.

92 *Macrolepiota procera* (Scop. : Fr.) Singer
93 *Marasmius oreades* (Bolt. : Fr.) Fr.
94 *Meripilus giganteus* (Fr.) Karst.
95 *Microporus affinis* (Blume & Nees)Kuntze
96 *M. xathopus* (Fr.) Kuntze
97 *M. venicipes* (Berk.) Kunt.
98 *Morchella angusticeps* Peck.
99 *M. conica* Pers.
100 *M. deliciosa* Fr.
101 *M. elata* Fr.
102 *M. esculenta* L. : Fr.
103 *M. smithiana* Cooke
104 *M. vulgaris* (Pers.) Boud.
105 *Oudimansiella radicata** (Rehl. : Fr.) Singer
106 *Omphalina* sp.
107 *Peziza repanda* Pers.
108 *P. vesiculosa* Bull.
109 *Pholiota aurivella* (Batsch. : Fr.) Kummer
110 *P. gummosa* (Lasch. : Fr.) Singer
111 *P. nameko* (Ito) Ito & Imai
112 *P. squarrosa** (Mull. : Fr.) Kummer
113 *Phyllopporus rhodoxanthus* (Schw.) Bres.
114 *Pleurotus circinatus* Fr.
115 *P. cornucopiae* (Paul.) Rolland
116 *P. dryinus* (Pers. : Fr.) Kummer
117 *P. nepalensis* Corner
118 *P. ostreatus* (Jacq. : Fr.) Kummer
119 *P. ostreatus* var. *magnificus* Peck.
120 *Pluteus cervinus* (Sch. : Fr.) Kummer
121 *Polyporellus brumalis* (Fr.) Karst.
122 *Polyporus arcularius Fr.*
123 *P. arcularius* Fr. var. *arcularius* Pilat
124 *P. arcularius* Fr. var. *strigosus* Bourd. &Galz.
125 *P. badius* (S. F. Gray) Schw.
126 *P. durus* (Timm.) Kreisel
127 *P. nepalensis* Berk.
128 *P. squamosus* Michel. : Fr.
129 *P. varies* Fr.
130 *Psathyrella piluliformis* (Bull. : Fr.) Orton
131 *Ramaria aurea* (Sch.) Quel.
132 *R. botrytis* *(Pers. : Fr.) Ricken
133 *R. botrytoides* (Peck.) Corner
134 *R. flaccida* *(Fr. : Fr.) Ricken
135 *R. flava* (Sch. : Fr.) Quel.
136 *R. formosa* (pers. : Fr.) Quel.
137 *Rhizopogon luteolus* Fr. & Nordholm
138 *R. roseolus* (Corda) Fr.
139 *Russula adusta* (Pers. : Fr.) Fr.
140 *R. aurora** Krombh.
141 *R. chloroides** (Krombh.) Bres.
142 *R. chloroides* (Krombh.) Bres. var.*godavariensis* Adhikari
143 *R. claroflava* Grove
144 *R. cyanoxantha* (Sch.) Fr.
145 *R. delica* Fr.
146 *R. delica* Fr. var. *dobremezii* Adhikari
147 *R. densifolia* (Secr.) Gill.
148 *R. galochroa* (Fr.) Fr.
149 *R. heterophylla* (Fr. : Fr.) Fr.
150 *R. kathmanduensis* Adhikari
151 *R. lactea* (Pers. : Fr.) Fr.
152 *R. nigricans* (Bull.) Fr.
153 *R. ochroleuca* (Hall.) Pers.
154 *R. puellaris* Fr.
155 *R. sanguinaria* (Schum.) Rausch.
156 *R. undulata* Vel.
157 *R. velenovskyi* Melz. & Zvara
158 *R. vesca* Fr.
159 *R. virescens* (Sch.) Fr.
160 *Sarcodon asparatus* (Berk.) Ito
161 *S. laevigatus* (Swartz) Karst.
162 *Schizophyllum commune** Fr. : Fr.
163 *Scleroderma cepa* Pers. : Pers.
164 *S. citrinum* Pers. : Pers.
165 *S. polyrhizum* J. F. Gmel. : Pers.
166 *S. verrucosum* (Bull.) Pers.
167 *Termitomyces eurhizus* (Berk.) Heim.
168 *Tremella mesenterica Retz. : Fr.*
169 *Tricholoma terreum* (Schaeff. : Fr.) Kummer
170 *Vascellum pratense* (Pers. : Pers.) Kreisel
171 *Volvariella volvacea* (Bull. : Fr.) Singer

(Source: Bhandary, 1999; Adhikari, 2000)
** - Mushrooms found in study areas*

Annex- 6: Toxic mushrooms of Nepal

S.N.	Scientific Name	S.N	Scientific Name
1	*Agaricus subrufescens* (Peck.) Hobson & Stuntz	34	*Lentinellus* sp.
2	*Amanita citrina* (Schaeff. : Fr.) S. F. Gray	35	*Lepiota castanea* Quel
3	*A. cokeri* (Gilb. & Kuhn.) Gilb. Ex Pilat*	36	*L. cristata* (Alb. & Schw.) Fr.
4	*A. muscaria* (L. : Fr.) Hook	37	*L. erminea* (Fr. : Fr.) Gill.
5	*A. pantherina* (DC. : Fr.) Kromb.	38	*L. felina* (Pers. :Fr.) Karst.
6	*A. phalloides* (Veill. : Fr.) Link.	39	*L. friesii* (Lasch.) Fr.
7	*A. porphyria* (Alb. & Schw. : Fr.) Mlady	40	*Marasmius crinis-equi* Müll. Ex Kalch.
8	*A. pseudoporphyria* Hongo	41	*M. oreades* (Bolt. : Fr.) Fr.
9	*A. rubrovolvata* Imai	42	*Mycena galericulata* (Scop. :Fr.) S.F. Gray
10	*A. virosa* (Lam.) Bert.	43	*Mycena* sp.
11	*A. vittadinii* (Moretti) Vitt.	44	*Macrolepiota procera* (Scop. : Fr.) Singer
12	*Bolbitius* sp.	45	*Naematoloma* sp.
13	*B. vitellinus* (Pers. : Fr.) Fr.	46	*Nyctalis agaricoides* (Fr. : Fr.) Bon
14	*Boletus luridus* Schaeffer : Fr.	47	*N. parasitica* (Bull. : Fr.) Fr.
15	*Cavimalum indicum* Doi	48	*Omphalina* sp.
16	*Conocybe brunneola* (Kuhn.) ex Kuhn. & Watl.	49	*Panellus stypticus (Bull. : Fr.) Karsten*
17	*Cortinarius callisteus* (Fr. : Fr.) Fr.	50	*Panus* sp.
18	*Cortinarius* sp.	51	*Psathyrella lacrymabunda* (Bull. : Fr.) Moser
19	*Crepidotus mollis* (Fr.) Stoude	52	*P. piluliformis* (Bull. : Fr.) Orton
20	*Coprinus bulbillosus* Pat.	53	*Paneolus papilionaceus* (Bull. : Fr.) Quel.
21	*C. disseminatus* (Pers. : Fr.) Gray*	54	*P. retrugis* (Fr.) Gillet
22	*Clitocybe diatreta* (Fr. : Fr.) Kummer	55	*P. rickenii* Hora
23	*Gymnopilus spectabilis* (Fr. :Fr.) Smith	56	*Pholiota aurivella* (Batsch. : Fr.) Kummer
24	*Hebeloma* sp.	57	*P. gummosa* (Lasch. : Fr.) Singer
25	*Hygrocybe conica* (Scop. : Fr.) Kummer	58	*Psilocybe coprophila* (Bull. : Fr.) Kummer
26	*H. miniata* (Fr. : Fr.)Kummer	59	*Ramaria flava* (Schaeff. : Fr.) Quel.
27	*H. pseudoconica* Lange	60	*R. formosa* (Pers. : Fr.) Quel.
28	*H. conia* (Scop. : Fr.) Kummer	61	*Suillus bovinus* (Fr.) Kurtz.
29	*Hygrophorus camarophyllus* (Alb. & Schw. : Fr.)Fr.	62	*S. granulatus* (L. : Fr.) Rous.
		63	*S. placidus* (Bonord.) Singer
30	*Hypholoma fasciculare* (Huds. : Fr.) Kummer	64	*S. sibiricus* (Singer) Singer
31	*H. udum* (Pers. : Fr.) Kuhn	65	*Suillus* sp.
32	*Inocybe rimosa* (Bull. : Fr.) Kummer	66	*S. viscidus* (L.) Rous.
33	*Inocybe* sp.		

(*Source*: *Adhikari, 2000*)

* - *Mushrooms found in study areas*

Annex: 7 Medicinal mushrooms of Nepal

S.N.	Scientific Name	S.N.	Scientific Name
1	*Cordyceps sinensis* (Berk.) Sacc.	11	*Lycoperdon perlatum* Pers. : Pers
2	*Coriolus hirsutus* (Fr.) Quel.*	12	*Lycoperdon pyriforme* Schaeff. : Pers.*
3	*Daldinia concentrica* (Bull. : Fr.) Ces. & De Not.*	13	*Meripilus giganteus* (Fr.)Karst.
4	*Fistulina hepatica* (Schaeff.) Fr.	14	*Polyporellus brumalis* (Pers. : Fr.) Karst
5	*Fibuloporia vailantii* (Fr.) Bond & Singer	15	*P. melanopus* (Schw. : Fr.) Fr.
6	*Ganoderma applanatum* (Pers.) Pat.	16	*Pycnoporus cinnabarinus* (Jacq. : Fr.)Karst.*
7	*G. lucidum* (Fr.) Karst.*	17	*Scleroderma* sp.
8	*Grifola frondosa* (Dick. & Fr.) S. F. Gray*	18	*Schizophyllum commune* Fr. : Fr.**
9	*Inonotus hispidus* (Fr.) Karst.	19	*Trametes versicolor* (L. Fr.) Llyod*
10	*Laetiporus sulphureus* (Fr.) Murr		

Sources: (Adhiikari, 1988b, 1990a, 1991b, 1994, 1995a, 1996, 2000; Bhandary, 1991)

*- * Mushrooms found in study areas*

*-** New to Nepal*

Annex-8: Glossary

Achlorophyllous	-	lacking chlorophyll
Acute	-	sharp at the end, pointed, tapering to a fine point
Adnate	-	gills attached squarely, by the entire gill width, to the
Adnexed	-	gills narrowly attached to the stem
Allantoid	-	sausage–shaped, somewhat curved with rounded ends
Amphigenous	-	growing on either the upper or lower surface, or growing around an object.
Annulus	-	the ring on the stem of some mushrooms
Apothecium	-	an open ascocarp
Appressed	-	pressed closely down on the surface, flattened
Ascospores	-	a meiospore borne in an ascus
Ascus	-	a sac like cell generally containing a definite number of ascospores formed by free cell formation usually after Karyogamy and meiosis: characteristic of the class Ascomycetes
Azonate	-	without zones, furrows or concentric markings
Basidiocarp	-	a fruiting body that bears basidia
Basidiocarp	-	the fruiting body, sporophore, which bears basidia
Basidium	-	structure bearing on its surface a definite number of basidiospores (typically four) that are usually formed following Karyogamy and meiosis.
Bifurcate	-	forked into two
Caespitose	-	growing in tufts or clumps, the stem usually more or les united at the base
Campanulate	-	bell – shaped
Cap	-	the pileus, or the structure that bears the hymenium
Capitate	-	having a small knob at the end
Cartilaginous	-	of the texture of cartilage; cartilaginous stems break clean, with a snap, when bent sharply
Ciliate	-	fringed with hairs
Clamp connection	-	a bridge-like hyphal connection characteristic of the secondary mycelium of many Basidiomycetes
Clavate	-	club- shaped
Cleistothecium	-	a completely close ascocarp
Concave	-	round, depressed like a bowl
Concolorous	-	of the same color
Confluent	-	running into one another, joined
Context	-	the inner sterile hyphae of the cap or pileus
Convex	-	regularly rounded or regularly bulging
Coriaceous	-	leathery in texture
Crustaceous	-	having a crust, crust like
Cuticle	-	(of cap) a very thin covering tissue
Cuticle	-	(of cap) a very thin covering tissue

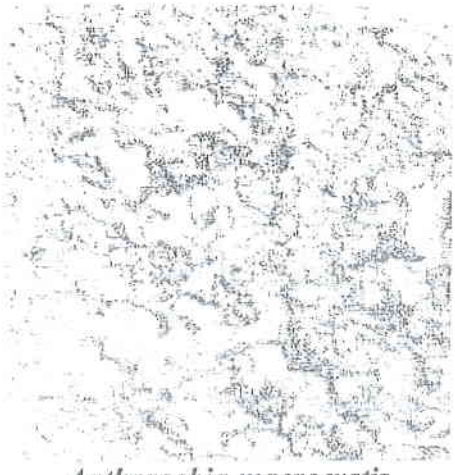
Cystidia	-	sterile structures of various shape and form, located between the basidia in the hymenium and usually projecting beyond them
Cystidium	-	a sterile element occurring in the hymenium of certain Basidiomycetes: Cystidia are generally larger than other hymenial elements and protrude beyond them
Depressed	-	(of center of the cap) slightly sunken
Deteriorate	-	to break down, disintegrate
Echinulate	-	covered with finely pointed spines
Effused	-	spread out over the substratum without regular form
Effused-reflexed	-	spread out over the substratum and turned back (reflexed) at the margin to form a pileus
Epigeaen	-	above the ground
Fibril	-	a small thin, thread like fiber
Fibrillose –hairy	-	covered by or compressed of minute fibers which are thin or thread- like, arranged more or less parallel to one another
Fibrous	-	(of stem) composed of tough, string- like tissue
Filliform	-	thread-like, long and slender
Flaccid	-	without firmness, soft, limber, flabby
Flesh	-	inner sterile substance of pileus or stipe exclusive of the gills, spines, tubes, etc., i.e. context
Fleshy	-	(of stem and cap) or rather soft consistency, tending disintegrate or decay fairly rapidly, as opposed to leathery, corky, woody, membranous, etc.
Free	-	(of gills) not attached to the stem
Gelatinous	-	jelly like, applied to basidiocarps that have the consistency of jelly when wet, often drying down to a thin membrane and becoming jelly like again when remoistened
Gills	-	plate or knife blade-like structures on the underside of the cap, often radiating from a point, covered by the hymenium of Basidia; also called lamellae; characteristic of the Agaricaceae
Glabrous	-	with neither hairs or scales; smooth
Gregarious	-	growing close to each other but not tufted
Hirsute	-	covered with stiff hairs that are rather long
Hyaline	-	colorless
Hymenium	-	the layer of Basidia, i.e. the basidiospore-bearing layer, may contain Cystidia, paraphyses, etc.: in the polypores it lines the insides of tubes, in the mushrooms it lines the outsides of the gills, it covers the spines of the Hydnaceae, etc.
Hypha	-	one of the elongated cells or filaments of the vegetative phase or in the fruit body
Hypogean	-	growing below the ground
Hypothecium	-	a thin layer of interwoven hyphae immediately below the hymenium of an apothecium
Imbricate	-	overlapping one another, like the shingles on a roof
Inferior	-	(of the annulus) attached to the mid- or lower portion of the stem; on the under surface

Infundibuliform	-	shaped like a funnel
Involute	-	(of margin of the cap) rolled inward
Lamella	-	a leaf- like plate or knife blade-like plate of tissue on the under surface of the cap; a gill
Lamellate	-	composed of lamellae or gills
Lateral	-	(of stem) attached to one side of the cap (or pileus)
Lobate	-	divided into lobes or having large, rounded divisions
Membranous	-	very thin
Micron	-	one one–thousandth of a millimeter
Monomitic	-	term used to describe a basidiocarp composed of only generative hyphae; single thread or hyphae
Mycelium	-	mass of hyphae constituting the body of a fungus
Mycelium	-	the whole mass of hyphae forming the vegetative or somatic portion of a fungus, it is a collective term
Mycophagy	-	the eating of mushrooms
Ochraceous	-	cinnamon-buff to brownish-yellow
Orbicular	-	(of the cap) circular or round in outline
Papilla	-	a small nipple–shaped elevation
Papillose	-	having one or more papillae
Paraphysis	-	sterile, basally attached structure in a hymenium
Partial veil	-	a fungus membrane extending from the stem to the margin of the cap and inclosing the gills; when it ruptures it usually leaves the ring on the stem
Pellicle	-	the thin cuticle-like covering of the cap in some species
Pendent	-	hanging down from an apical point of attachment
Perennial	-	lasting for more than one year; in Fomes showing more than one layer of tubes, on layer for each year
Peridium	-	an outer enveloping coat or layer of a basidiocarps
Pileate	-	having a cap or pileus
Pileus	-	the cap- like portion of a mushroom, with or without a stem, if it is not resupinate, i.e. the bracket of polypores, it bears the hymenium on its lower surface (Pilei is plural)
Plane	-	(of the cap) having a flat or even surface, it concerns configuration
Pubescent	-	covered with short, soft, or downy hairs
Pyriform	-	pear- shaped
Radicating	-	a long root- like extension of the stem
Reniform	-	shaped like a kidney
Resupinate	-	(of basidiocarp) spread out flat against the substratum, only one exposed surface, with neither cap nor stem
Reticulate	-	covered with a network of interlacing lines, ridges, or veins
Reviving	-	(of basidiocarps) resuming the normal fresh natural shape and functions in moist weather or when rewetted, after having dried, shriveled and become dormant in dry weather
Rhizomorph	-	a strand or cord of compacted mycelium, visible to the naked eye
Ring	-	same as annulus

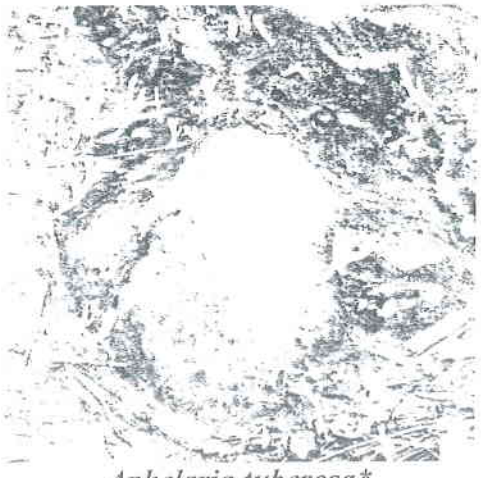
Scales	-	(of the surface of the cap) a torn part of the cuticle, it may be membranous, fibrillose, hairy, floccose, hard, erect, etc.
Sclerotium	-	a small, hard, compact, resistant tuber- like vegetative body containing stored food
Serrate	-	margin with teeth like a saw blade
Sessile	-	without a stem, the basidiocarp is not resupinate and is attached to the sub-stratum usually by one of its slides; a bracket- or shelf-basidiocarp
Seta	-	a sterile, brown, sharp-pointed structure in the hymenium or context of certain species; Setae- is plural
Sinuous	-	crooked, curved or windy; of pores–with curved walls
Spathulate	-	shaped like a spoon or spatula, oblong with a narrowing base
Spinulose	-	covered with small spines
		stem, not easily detached.
Sterigma	-	the tiny spine- like projection of the basidium or Epibasidium upon which the basidiospore is produced
Stipe	-	stem
Stipitate	-	possessing a stem or stipe
Subcylindrical	-	almost of the same diameter throughout its length
Substratum	-	the substance upon or in which a fungus grows
Subulate	-	awl-shaped
Superimposed	-	overlapping
Tawny	-	dull yellowish–brown, about the color of a lion
Teeth	-	the spine- like or tooth–like structure in the Hydnaceae, covered by the hymenium
Terrestrial	-	growing on the ground
Trama	-	the sterile inner portion or hyphae, of the gills, or tubes; when composed of interwoven fibers of a uniform diameter, it is termed floccose; when the hyphae are frequently enlarged so as to give, in section, the appearance of rounded cells, it is termed vesiculose
Tube	-	the cylindrical hollow that bears the hymenium lining the inside the Polyporaceae
Turbinate	-	shaped like a top, like an inverted cone
Universal veil	-	a fungus membrane enclosing the entire mushroom when young; when it ruptures it may leave a basal cup– like part, called the volva
Volva	-	the remnant of the universal veil at the base of the stem, usually as a cup or sheath, or broken into fragments.
Zonate	-	marked with concentric bands

PLATES

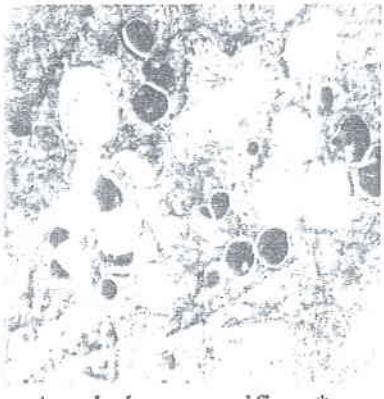
Amanita cokeri



Anthracobia macrocystis



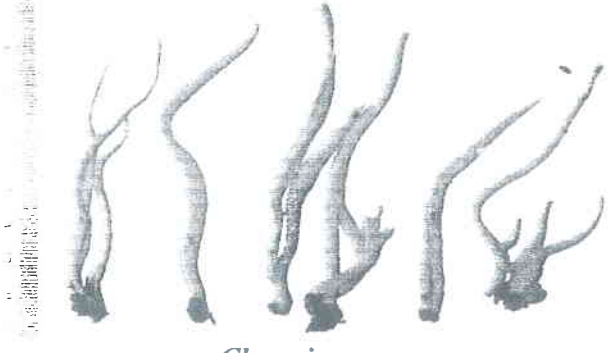
*Aphelaria tuberosa**



*Ascobolus magnificus**

Auricularia auriculara- judae

Auriscalpium vulgare



*Clavaria fumosa**

Clavaria rosea

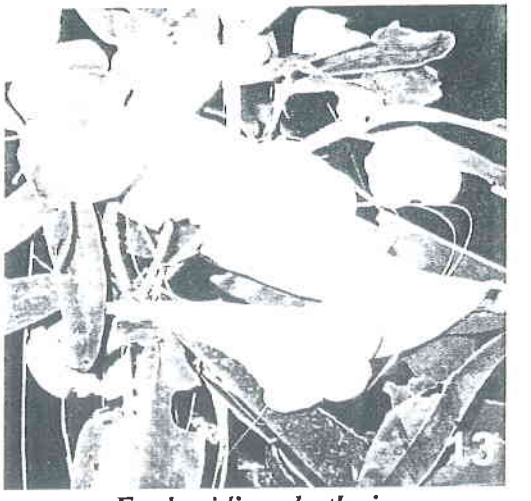
Clavaria vermicularis

Clavulinopsis fusiformis

* = *New to Nepal*

Coprinus comatus

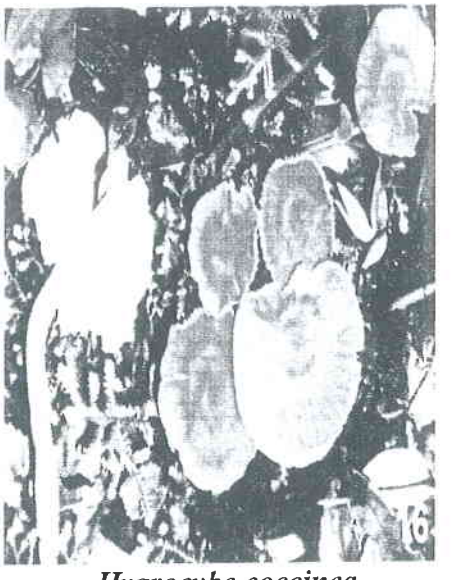
Daldinia concentrica



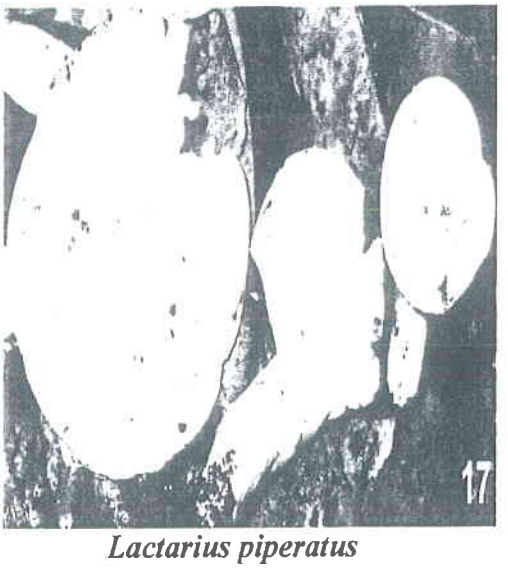
Exobasidium butleri

Grifola frondosa

Hericium erinaceus



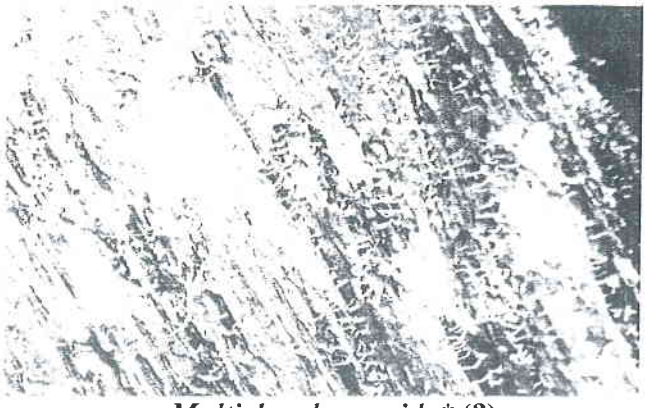
Hygrocybe coccinea



Lactarius piperatus

Lactarius volemus

Lycoperdon pyriforme



Multiclavula mucida (?)*

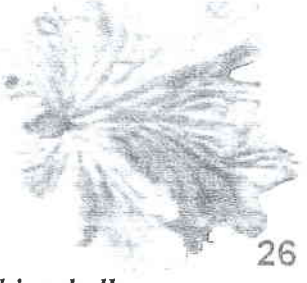
Pycnoporus cinnabarinus

Ramaria botrytis

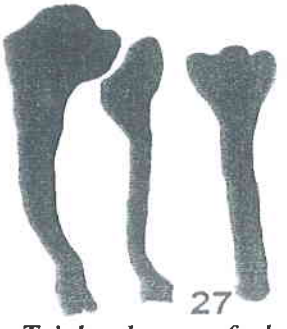
Ramaria flaccida

Russula aurora

Russula chloroides



Schizophyllum commune



Trichoglossum farlowi

*Xylaria filliformis**

*Xylaria nigrescens**

*Xylaria plebeja**

** = New to Nepal*