



## Macrofungal biodiversity in the western ghat foot hill semi-urban city of Manipal and forest terrains of Koodlu Theertha falls, Karnataka

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### Abstract

Fungi plays an important role for a sustainable ecology. This study was carried out to document the niche macrofungal diversity and distribution in the western ghat foot hill semi-urban city of Manipal and the forest region near Koodlu Theertha Falls, Udupi Dist., Karnataka. Generic diversity was observed among 30 sporocarp forage sampling during the period August - September 2015. Out of these, maximum ten genera were assignable to family Polyporaceae, three genera to Clavariaceae, two genera to Ganodermataceae, Marasiaceae respectively and one genus to Cantharellaceae. Rest of the families were denoted by single genus only. Out of 30 mushrooms 10 were identified upto species level by Morphing Mushroom Identifier (MMI) and MycoKey version 4.1 innovative identification tool. The ecological preference revealed that maximum was saprophyte, living on dead substrates or decaying wood debris, few were found associated with roots of higher angiospermic trees while only one were found parasitic. The Simpson diversity and Shannon biodiversity index were calculated and documented for both Manipal (0.95 and 2.204) and Koodlu Theeratha falls (0.85 and 1.874). Species richness was higher in the post monsoon seasons than in the early dry seasons and tended to decrease with increasing altitude. The present study is first of its kind to document the macro fungal biodiversity in the pristine forest area near Koodlu Theertha falls and the growing semi-urban city of Manipal.

**Key words** – ecology – species abundance – mushrooms – diversity

### Introduction

Mushrooms maybe the most unique form of life and have a class of their own, they are neither vegetable nor animal, they contain no chlorophyll and are heterotrophs in their environment (Enow et al. 2013, Tapwal et al. 2013, Dwivedi et al. 2012).

The mushroom that are visible is just the largest part of an organism most of which lies in the soil, embedded in leaf litter, humus, decaying wood, and similar habitats. Many are essential to the growth and survival of trees (Enow et al. 2013, Tapwal et al. 2013).

Even though the mushroom has been extensively studied in different parts of the world, India has yet to offer and explore the diversity of fungi (Karun & Sridhar 2014, Bhagwat et al. 2005). This project is the first of its kind and its main aim is to document the niche of diversity and

distribution of macrofungi in the Western ghats foothill semi urban city of Manipal and the forest terrain of Koodlu Theertha falls, Udupi district, Karnataka.

## Materials & Methods

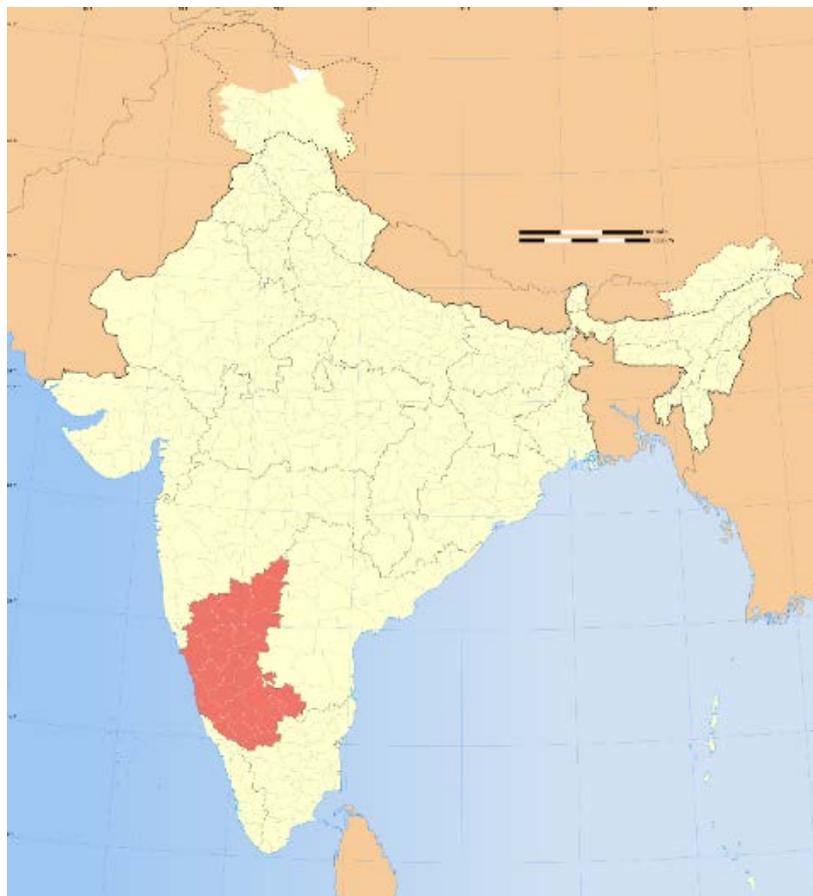
### Geographical location of the ecological survey

The area focus on this project is the Western Ghats foot hill of the urban city premises of Manipal and the terrains region of the forest of Koodlu Theertha falls in Udupi district in Karnataka (Figs 1–4). Manipal is located in 13.3470 North latitude 74.7880 East longitude. It has an average elevation of 73m (240ft) extending from Arabian Sea to the west and Western Ghats to the east. The average annual temperature is 26.70C. The rainfall here averages 4866mm. Koodlu Theertha falls is located 13024° 47° North latitude 7507°15° East longitude amidst jungles of Western Ghats in Udupi district, 42km from Udupi near Hebri town. It is recognized as the first waterfall of river Sita and one of the divisions of Seetha falls. The study period for the mushroom survey were carried out from the month of August to September 2018.

Mushroom samples are collected on the way (the trekking trails) towards the falls. There are 7 collection sites and are marked on the map.

### Isolates and morphology

All macro fungi were identified by its morphological characteristic and habitat that were visible to the naked eye (>1mm). Survey can be performed just after the rainy season. Major drawback was that only small proportions of macro fungi were visible on a single visit. The geographic coordinates of each study sites were integrated using an online GPS coordinator Latlong.net to generate a study map for spatial distribution of sampling locations at the two sites, Manipal and Koodlu Theertha falls, Udupi district.



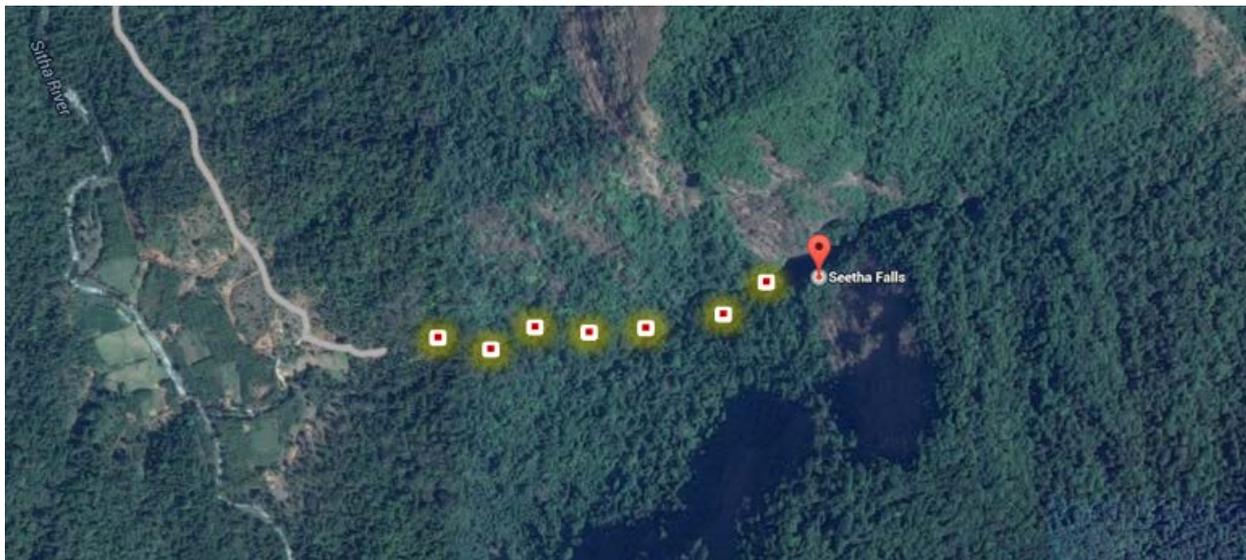
**Fig. 1** – India map showing Karnataka state (Red highlight)



**Fig. 2** – Udupi District in Karnataka (Red highlight)



**Fig. 3** – Site A – Manipal. Mushroom samples were collected from 9 different sites in and around university campus. The collection sites are marked in the map.



**Fig. 4** – Site B – Koodlu Theertha Falls.

The mushroom sporocarp specimens were collected fresh with great care without any damage and soil debris was removed using a soft brush. Wood inhabiting macro fungi were collected along with the substratum. The habitat and morphological characteristics of the macro fungi were noted, and photographs were taken during the collection and labelled with the collection number. The specimen was preserved in a wide mouth 30 ml McCartney bottle with 1% formalin in 1% normal saline. All the sample were deposited at the culture collection Mycology Laboratory, Department of Microbiology, Kasturba Medical College, Manipal, Karnataka.

For identification tools utilized were mushroomexpert.com and the pocket guide to Mushroom (Jean 2005). The Diversity of the two sites were calculated using the Simpson's and Shannon's diversity index (Pushpa & Puroshothama 2012).

## Results

During the survey of different parts of Manipal and the forest near Koodlu Theertha falls, 29 mushrooms were collected. These mushrooms belong to different genus and representative members are depicted in Fig. 5.

The mushrooms collected were identified up to the genus and species level (Table 1). Identification of the mushrooms were done using an online software Morphing Mushroom Identifier (MMI) using a MycoKey version 4.1 which allows users to identify mushrooms by selecting shape, size, texture, color, margins of the cap, shape of stipe, bulb, volva, and attachment of the gills to the stipe and according to the description, the software will provide a list of names in which details of the mushroom can be further investigated.

Simpson's Diversity Index is a measure of diversity =  $1 - D$

$$\frac{D + \sum n(n - 1)}{N(N - 1)}$$

n = the total number of organisms of a particular species

N = the total number of organisms of all species

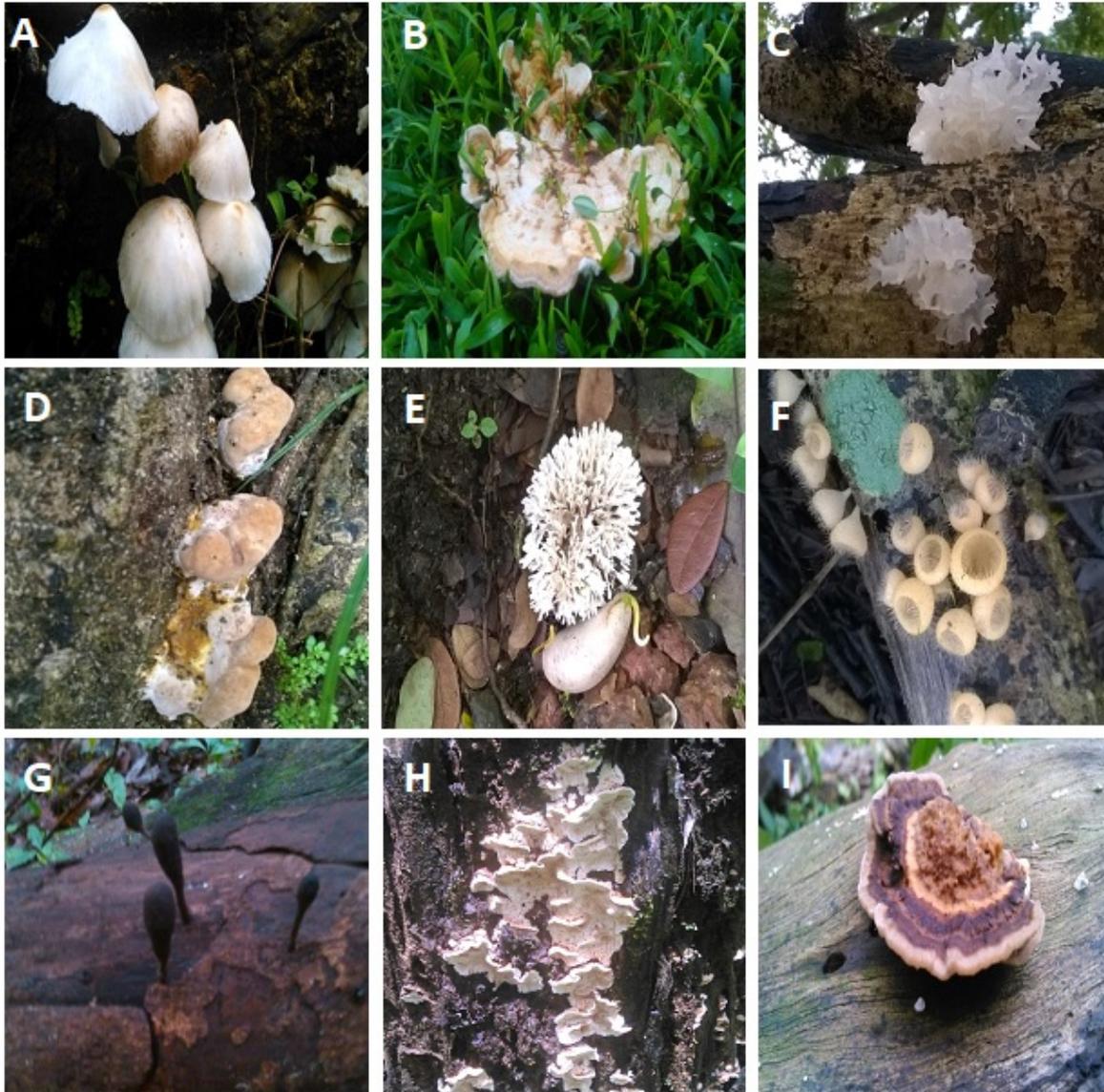
D = Simpson's index

Shannon's Diversity Index is a measure of species diversity in a community;

$$H = \sum (n/N) \log_e(n/N)$$

H = is the diversity index,  
n = the total number of organisms of a particular species  
N = the total number of organisms of all species

The value of D ranges between 0 and 1. With this index, 0 represents infinite diversity and 1, no diversity. That is, the bigger the value of D, the lower the diversity. The Simpson diversity and Shannon biodiversity index for Manipal (0.95 and 2.204) and Koodlu Theertha falls (0.85 and 1.874).



**Fig. 5** – Habitat and morphological characters: A Coprinus. B Gilled polypore. C Clavaria. D Puffballs. E Coral F. Scutellinia. G Xylaria. H Stereum. I Ganoderma. This picture is copyright of Prakash Peralam Yegneswaran.

### Discussion

The result calculation shows that the first location Manipal has Simpson's Diversity index (D value) almost equal to 1 and Shannon's Diversity index more than 1, resulting in an uncertain biodiversity i.e. the different species that grows during this monsoon season may not grow in the coming year. The second location Koodlu Theertha falls is more diverse than the first location measuring D value upto 0.85, this may be due to less human development in the forest (Jha &

Bawa 2006). The present study is first of its kind to document the macro fungal biodiversity in the pristine forest area near Koodlu Theertha falls and the growing semi-urban city of Manipal. Generic diversity was observed among 30 sporocarp. Morphing Mushroom Identifier (MMI) and the pocket guide of mushroom (Jean 2005), were the most useful identification tools. Species richness was higher in the post monsoon seasons than in the early dry seasons and tended to decrease with increasing altitude (Pushpa & Puroshothama 2012).

**Table 1** List of some of the identified mushrooms genus and their species.

Order	Family	Genus	Species (no.)
Agaricales	Maramiaceae	Maramius	<i>Maramius sullivantii</i> (1)
	Psythyoellaceae	Coprinellus	<i>Coprinellus disseminatus</i> (1)
	Tricholomataceae	Mycena	<i>Mycena galericulate</i> (1)
Cantharellales	Clavulinaceae	Clavulina	<i>Clavulina cristata</i> (1)
	Cantharellaceae	Cantharellus	<i>Cantharellus cibarius</i> (1)
Gleophyllales	Gleophyllaceae	Gleophyllum	<i>Gleophyllum sepiarium</i> (6)
Hymenochaetales	Hymenochaetaceae	Hymenochaete	<i>Hymenochaete tabacina</i> (1)
Phallales	Ramariaceae	Ramaria	<i>Ramaria stricta</i> (2)
Polyporales	Ganodermataceae	Ganoderma	<i>Ganoderma tsugae</i> (1)
	Polyporaceae	Lenzites	<i>Lenzites betulina</i> (2)
Xylariales	Xylariaceae	Xylaria	<i>Xylaria cubensis</i> (1)

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