

Post-Monsoon Macrofungal Diversity in Lumbini Collaborative Forest, Rupandehi District, Central Nepal

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Abstract

The study was carried out for higher fungi especially mushrooms, found in Lumbini collaborative forest, Rupandehi district, Central Nepal. Total of 31 mushroom species including both Ascomycetes (5 species) and Basidiomycetes (26 species) mushrooms were collected. Polyporales was found to be the dominant order in the study area with 16 species followed by Xylariales (5 species) and Hymenochaetales (4 species). *Terminalia alata* was found to be major host plant for harboring 10 different mushroom species (including 1 Ascomycetes and 9 Basidiomycetes species) followed by *Shorea robusta* (7 species).

Keywords: Ascomycetes, Basidiomycetes, Macrofungi, Mushroom, Substrate

Introduction

There are numerous macrofungi that generally produce fleshy or corky fruiting bodies commonly known as mushrooms and grow either above ground (epigenous) or underground (hypogenous) in nature (Pacioni, 1981) belonging to group Ascomycetes and Basidiomycetes. Ascomycetes, the Sac fungi, are the largest group of all the higher fungi having well developed, branched and septate mycelium like in Basidiomycetes. They produce sexual non motile spores i.e. ascospores (usually eight in number) endogenously enclosed within the microscopic sac like cell known as the ascus (pl. asci); the asci in most genera are arranged in a definite group within a fruiting body, the ascocarp. They are mostly terrestrial occurring as saprophytes or parasites (Alexopoulos & Mims, 1979). The cup fungi, the morels, and the truffles are among the best known examples of Ascomycetes. Basidiomycetes, the Club fungi, are thought to have evolved from an ascomycetous ancestor and are the most advanced of all the fungi (Alexopoulos & Beneke, 1962). They comprise the second biggest class of fungi which includes most of the large and conspicuous species mostly saprophytic found in fields and woods like mushroom & toadstools (collectively called agarics), jelly fungi, bracket fungi or polypores, puff-balls, coral fungi, earth-stars, bird's-nest fungi, stink-horns, etc. to micro-fungi like rusts and smuts which are

obligate plant parasites and some parasitic (Acharya & Parmar, 2016). Mushrooms generally prefer to grow under humid condition. Different terms have been given to signify their habitats. For example: species growing on grasslands are known as praticolous; on woodland- silvicolous; on wood, woody debris, trees, stumps, rotten or burnt wood- lignicolous; on dung- coprophilous; amongst moss- muscicolous; on leaf litter- humicolous and so on (Purkaryastha & Chandra, 1985).

Generally post monsoon macrofungus are mostly the members of order Polyporales and some members of Ascomycetes. In Polyporaceae some species have a toadstool form, particularly species of *Boletus*, a large and abundant genus of fleshy toadstools. However, most of Polyporaceae are wood- inhabiting fungi forming sporophores as shelves or brackets on the trunks of living trees, or on dead branches of living tree or on fallen branches or log lying on the ground or on the stump. The fruiting bodies of Polyporaceae are commonly rather leathery or corky, and only rarely fleshy (Gold, 1975).

Nepal, a well famed country for mycodiversity, with its wide range in ecological conditions from the tropical Terai to the permanent snow at the highest elevation (phytogeographic factors) have played an interesting role in the distribution of diverse mycofloral components (Adhikari, 1994-95, 2000, 2009, 2014c). Till now, 34 endemic species of

mushroom have been described from Nepal (Devkota & Aryal, 2020). So far, about 1,291 mushroom species have been recorded from Nepal ((Devkota & Aryal, 2020)). Among these about 159 species are said to be edible (Devkota & Aryal 2020) while 100 species are poisonous and 73 species have medicinal values (Adhikari, 2014). The Nepalese mycoflora are under process of exploration since the work of Lloyd (1808) and Berkely (1838) but still several parts of Nepal await their exploration, investigation, study and publication (Adhikari, 1999, 2000, 2009).

Intense mycological exploration and investigation, though, is carried out more in Central Nepal as compared to eastern and western regions of Nepal (Adhikari, 1999, 2000; Adhikari & Bhattarai, 2014), present study was carried out to document the higher fungi of both Ascomycetes and Basidiomycetes species from Lumbini collaborative forest, Rupandehi district (Central Nepal) which was still unexplored.

Materials and Methods

Study area

Lumbini collaborative forest (Terai sal forest) lie in Kanchan rural municipality-5, Fayarlayan, Rupandehi district. Rupandehi district is a part of the Terai region of Central Nepal and covers a total area of 130,522 ha in which 6,512 ha. lies in Terai and 18,593 ha. in Churiya region (Department of Forest Research and Survey [DFRS], 2015). It has about 73% land is agricultural land, urban areas, and roads, 23% forest, and the remaining 4% water resources (District Development Committee [DDC], 2007). Present research was carried out in one compartment (along east-west highway) of Lumbini collaborative forest, Fayarlayan, Rupandehi district. The forest is spreading over 1,321 ha where 204 ha. lies in steep churia range and remaining area in plane Terai region of Nepal. The forest is divided into eight compartments for scientific forest management. The forest is mainly dominated by Sal (*Shorea robusta*) with its associated species like Saj (*Terminalia*

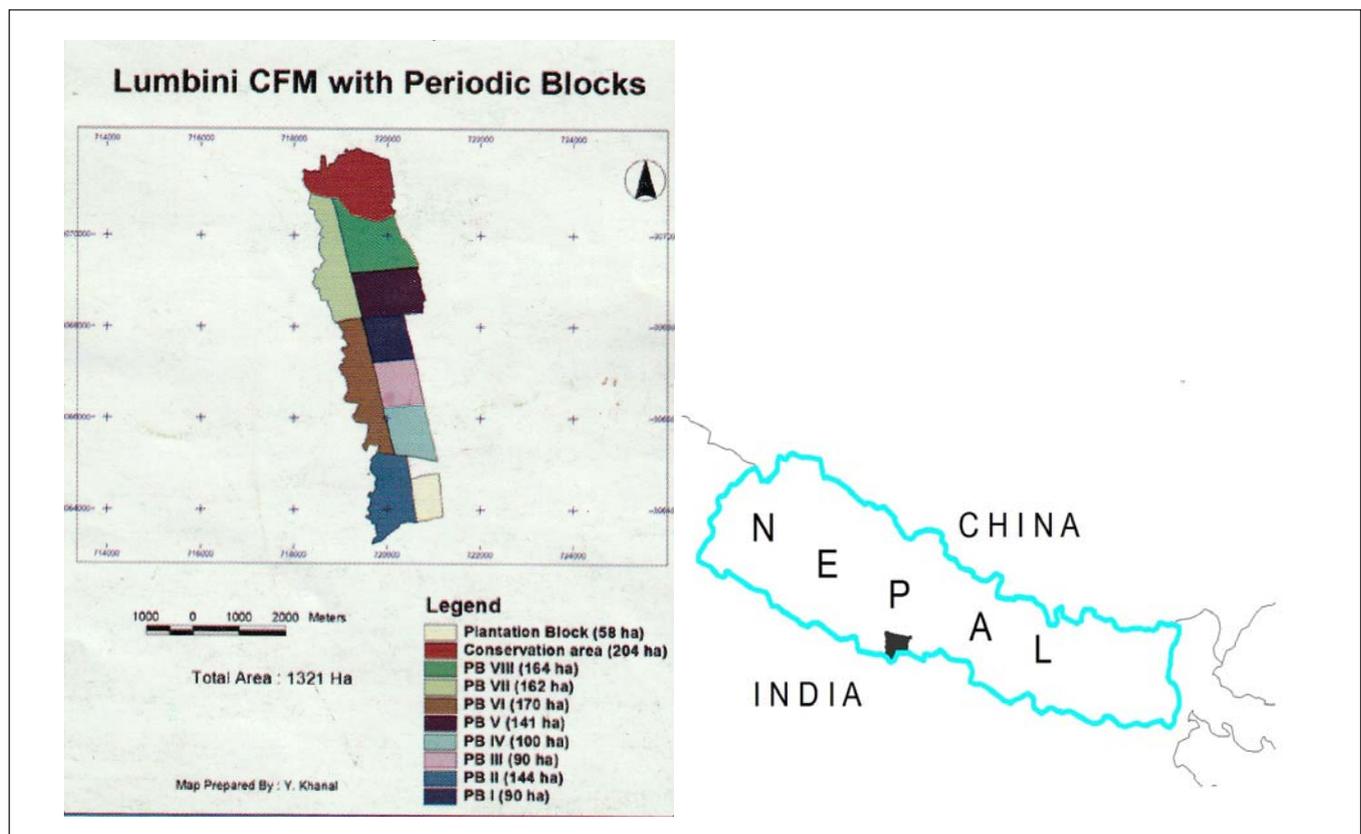


Figure 1: Map of the study area

alata), Banjhi (*Anogeissus latifolia*), *Adina cordifolia*, etc. The climate of the area is typically tropical dominated by the southeast monsoon. A hot climate generally prevails throughout the year except in the short winter.

Collection and identification

The study area was surveyed in October 2019. One compartment (along east-west highway) of Lumbini collaborative forest was extensively explored for Ascomycetes and Basidiomycetes mushroom from October 10 to 11, 2019. Altogether 31 species of fungal species including both Ascomycetes (5 species) and Basidiomycetes fungi (26 species) were collected from nature in the study area. The species collected were well air dried in the shade and packed in paper envelopes with proper tag/collection numbers. The species found in soil were collected carefully by digging with the help of a digger. Other specimens which were found to grow on fallen or rotten branches/wooden logs, branches or trunks of dying or dead plants; or trunks of living plants were collected along with their host plant by cutting with the help of saw. During collection, at least one fruiting body (sporocarp) i.e. ascocarp or basidiocarp was left for their spore dispersal.

Photographs of all the mushroom specimens were taken in their natural habitat prior to collection. Date of collection, altitude, the nature of habitat/substrate, surrounding plant community especially trees, any distinctive odor, any change in color on cutting or bruising when fresh, color of latex (if present), whether growing solitary or in groups was recorded. Most of the host plants or substrates were identified in the field and for unidentified ones like piece or branch of wood or fallen leaf litter, etc. their sample were collected for identification in the herbarium. The paper envelopes with the collected fungi were brought to National Herbarium and Plant Laboratories (KATH), Godawari for identification and making herbarium specimens. Identified mushroom specimens are housed in National Herbarium and Plant Laboratories, Godawari, Lalitpur. The identification was done following key identifying taxonomical characters of relevant literatures (Teng, 1939; Walting, 1973; Alexopoulos

& Mims, 1979; Dickson & Lucas, 1979; Pacioni, 1981; Dennis, 1981; Svrček, 1983; Miller, 1984; Purkayastha & Chandra, 1985; Adhikari, 2014). It was also identified by tallying photographs of the relevant literatures and cross checking the collected specimens to that of identified herbarium specimens deposited at the herbarium. Some species were also identified seeking the help of expert of Mycology. The nomenclature of all the identified fungal species follows Adhikari (2012, 2014).

Enumeration of species

1. ***Daedaleopsis* sp.** [Polyporales: Polyporaceae] Log of *Terminalia alata* Roth, Lumbini collaborative forest, 165 m, 11 October 2019, collection no. 201933, collector- Rajendra Acharya & Bipin Khanal
2. ***Daedaleopsis* sp.** [Polyporales: Polyporaceae] Log of *Terminalia alata* Roth, Lumbini collaborative forest, 165 m, 11 October 2019, collection no. 201927, collector- Rajendra Acharya & Bipin Khanal
3. ***Daedaleopsis conchiformis*** Imazeki [Polyporales: Polyporaceae] Fallen branch of *Shorea robusta* Gaertn., Lumbini collaborative forest, 165m, 11 October 2019, collection no. 201931, collector- Rajendra Acharya & Bipin Khanal
4. ***Daedaleopsis confragosa*** (Bolt.: Fr.) Schr. var. *confragosa* [Polyporales: Polyporaceae] Log of *Anogeissus latifolia* (Roxb. ex DC.) Wall. ex Bedd., Lumbini collaborative forest, 165 m, 11 October 2019, collection no. 201926, collector- Rajendra Acharya & Bipin Khanal
5. ***Daldinia concentrica*** (Bolt.: Fr.) Ces. & De Not [Xylariales: Xylariaceae] Rotten log of unknown tree, Lumbini collaborative forest, 160 m, 10 October 2019, collection no. 20198, collector- Rajendra Acharya & Bipin Khanal
6. ***Ganoderma lucidum*** (Curt.: Fr.) Karst. [Polyporales: Ganodermataceae] On soil at the base of rotten wood, Lumbini collaborative forest, 165m, 11 Oct. 2019, collection no. 201922, collector- Rajendra Acharya & Bipin Khanal

7. **Hexagonia sp.** [Polyporales: Polyporaceae]
Wood of unknown tree, Lumbini collaborative forest, 160 m, 11 Oct. 2019, collection no. 201923, collector- Rajendra Acharya & Bipin Khanal
8. **Inonotus sp.** [Hymenochaetales: Hymenochaetaceae]
Stump of unknown tree, Lumbini collaborative forest, 165 m, 10 October 2019, collection no. 201915, collector- Rajendra Acharya & Bipin Khanal
9. **Lenzites betulina** (L.) Fr. [Polyporales: Polyporaceae]
Log of *Lagerstroemia parviflora* Roxb., Lumbini collaborative forest, 165 m, 11 October 2019, collection no. 201938, collector- Rajendra Acharya & Bipin Khanal
10. **Laetiporus sp.** [Polyporales: Polyporaceae]
Fallen branch of *Shorea robusta* Gaertn., Lumbini collaborative forest, 165 m, 11 October 2019, collection no. 201929, collector- Rajendra Acharya Bipin Khanal
11. **Microporus xanthopus** Fr. Kuntz [Polyporales: Polyporaceae]
Stump of *Melia azedarach* L., Lumbini collaborative forest, 160 m, 11 October 2019, collection no. 201924, collector- Rajendra Acharya & Bipin Khanal
12. **Phellinus gilvus** (Schw.) Pat. [Hymenochaetales: Hymenochaetaceae]
Log of *Shorea robusta* Gaertn., Lumbini collaborative forest, 165 m, 10 October 2019, collection no. 201910, collector- Rajendra Acharya & Bipin Khanal
13. **Phellinus igniarius** (L.) Fr. Quèl. [Hymenochaetales: Hymenochaetaceae]
Rotten log of *Shorea robusta* Gaertn., Lumbini collaborative forest, 160 m, 11 October 2019, collection no. 201937, collector- Rajendra Acharya & Bipin Khanal
14. **Pleurotus sp.** [Agaricales: Pleurotaceae]
On moist soil, Lumbini collaborative forest, 160 m, 11 October 2019, collection no. 201925, collector- Rajendra Acharya & Bipin Khanal
15. **Polyporus sp.** [Polyporales: Polyporaceae]
Log of *Shorea robusta* Gaertn., Lumbini collaborative forest, 165 m, 11 October 2019, collection no. 201921, collector- Rajendra Acharya & Bipin Khanal
16. **Polyporus sp.** [Polyporales: Polyporaceae]
Log of *Shorea robusta*, Lumbini collaborative forest, 160 m, 11 October 2019, collection no. 201930, collector- Rajendra Acharya & Bipin Khanal
17. **Polystictus sp.** [Hymenochaetales: Hymenochaetaceae]
Rotten log of unknown tree, Lumbini collaborative forest, 165 m, 10 October 2019, collection no. 20194, collector- Rajendra Acharya & Bipin Khanal
18. **Pycnoporus cinnabarinus** (Jacq.: Fr.) Karst. [Polyporales: Polyporaceae]
Log of *Terminalia alata* Roth, Lumbini collaborative forest, 165 m, 11 Oct. 2019, collection no. 201919, collector- Rajendra Acharya & Bipin Khanal
19. **Schizophyllum commune** (Fr.) Fr. [Agaricales: Schizophyllaceae]
Log of *Terminalia alata* Roth, Lumbini collaborative forest, 165 m, 10 October 2019, collection no. 201912, collector- Rajendra Acharya & Bipin Khanal
20. **Stereum sp.** [Russulales: Stereaceae]
Log of *Lagerstroemia parviflora* Roxb., Lumbini collaborative forest, 165 m, 11 October 2019, collection no. 201920, collector- Rajendra Acharya & Bipin Khanal
21. **Stereum hirsutum** (Willd.: Fr.) Gray [Russulales: Stereaceae]
Log of *Adina cordifolia* (Roxb.) Hook. f., Lumbini collaborative forest, 160 m, 11 October 2019, collection no. 201922, collector- Rajendra Acharya & Bipin Khanal
22. **Thelephora sp.** [Thelephorales: Thelephoraceae]
Log of unknown tree, Lumbini collaborative forest, 160 m, 10 October 2019, collection no. 20193, collector- Rajendra Acharya & Bipin Khanal
23. **Trametes versicolor** (L.: Fr.) Pilat [Polyporales: Polyporaceae]
Log of *Terminalia alata* Roth, Lumbini collaborative forest, 165 m, 11 October 2019, collection no. 201921, collector- Rajendra Acharya & Bipin Khanal

collaborative forest, 160 m, 10 October 2019, collection no. 201912, collector- Rajendra Acharya & Bipin Khanal

24. *Trametes lactinea* (Berk.) Pat. [Polyporales: Polyporaceae]

Log of *Terminalia alata* Roth, Lumbini collaborative forest, 165 m, 11 October 2019, collection no. 201938, collector- Rajendra Acharya & Bipin Khanal

25. *Trametes* sp. [Polyporales: Polyporaceae]

Log of *Shorea robusta* Gaertn., Lumbini collaborative forest, 165 m, 10 October 2019, collection no. 20195, collector- Rajendra Acharya & Bipin Khanal

26. *Tremella fusiformis* Berk. [Tremellales: Tremellaceae]

Log of *Terminalia alata* Roth, Lumbini collaborative forest, 165 m, 10 October 2019, collection no. 201914, collector- Rajendra Acharya & Bipin Khanal

27. *Trichaptum byssogenum* (Jung.) Ryv. [Polyporales: Polyporaceae]

Log of *Terminalia alata* Roth, Lumbini Collaborative forest, 165 m, 10 October 2019, collection no. 20197, collector- Rajendra Acharya & Bipin Khanal

28. *Xylaria filiformis* (Alb. et Schw.: Fr.) Fr. [Xylariales: Xylariaceae]

Leaf litter of *Terminalia alata* Roth, Lumbini collaborative forest, 160 m, 11 October 2019, collection no. 201932, collector- Rajendra Acharya & Bipin Khanal

29. *Xylaria furcata* Fr. [Xylariales: Xylariaceae]

Rotten log of *Terminalia alata* Roth, Lumbini collaborative forest, 165 m, 10 October 2019, collection no. 201917, collector- Rajendra Acharya & Bipin Khanal

30. *Xylaria nigripes* (KI.) Sacc. [Xylariales: Xylariaceae]

Rotten log of *Shorea robusta* Gaertn., Lumbini collaborative forest, 160 m, 10 October 2019, collection no. 20199, collector- Rajendra Acharya & Bipin Khanal

31. *Xylaria polymorpha* (Pers.: Fr.) Grev. [Xylariales: Xylariaceae]

On soil at the base of rotten wood, Lumbini

collaborative forest, 165 m, 10 October 2019, collection no. 201913, collector- Rajendra Acharya & Bipin Khanal

Results and Discussion

Altogether 31 species of fungi including Ascomycetes (5 species) and Basidiomycetes fungi (26 species) were collected from the study area. Out of total 31 identified fungal species, Ascomycetes species were from single order belonging to single family and two genera whereas Basidiomycetes species were from six orders belonging to 8 families and 18 genera.

The distribution of macro-fungal species is low in autumn season and so the exploration of Ascomycetes and Basidiomycetes fungi during autumn resulted in relatively fewer collections. The collected species of Ascomycetes fungi were the member of order: Xylariales with its corresponding family Xylariaceae (see in enumeration of mushroom species). In contrast, most of the collected Basidiomycetes fungi were the members of order Polyporales. Polyporales, the dominant order, in the study area with 15 species was followed by Hymenochaetales (4 species), Agaricales, Russulales (2 species each) (Figure 2). Similarly, Polyporaceae was found to be the dominant family represented by 15 species. It was followed by Hymenochaetaceae (4 species) and followed by Stereaceae (2 species each) and rest of the families was represented by only single Basidiomycetes species (Figure 3).

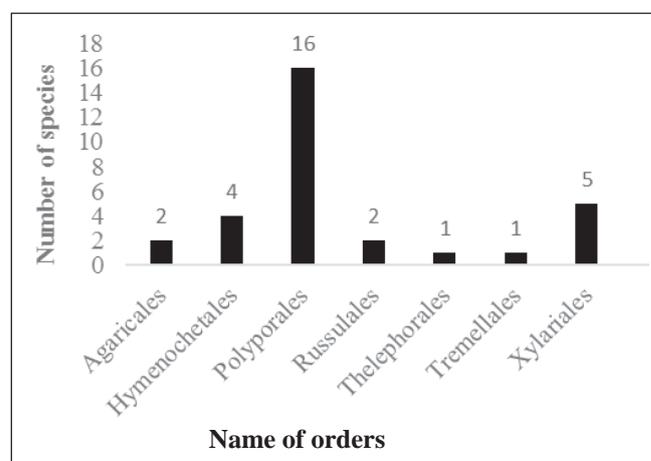


Figure 2: Orders representing number of species in the study area

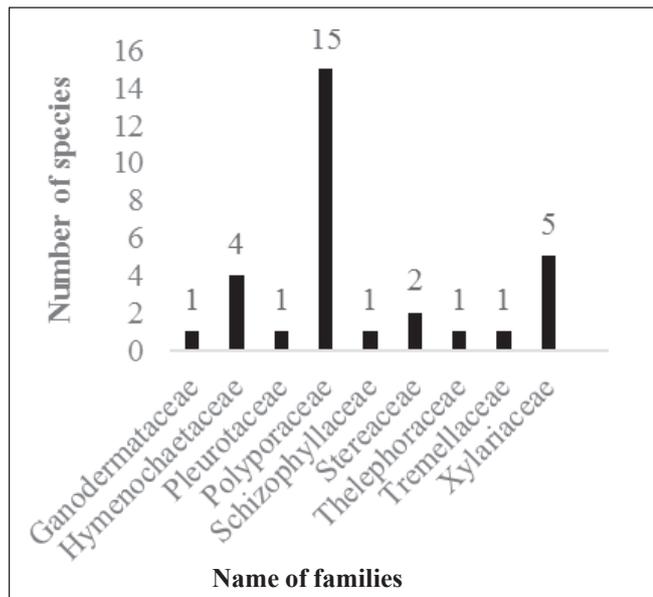


Figure 3: Families representing number of species in the study area

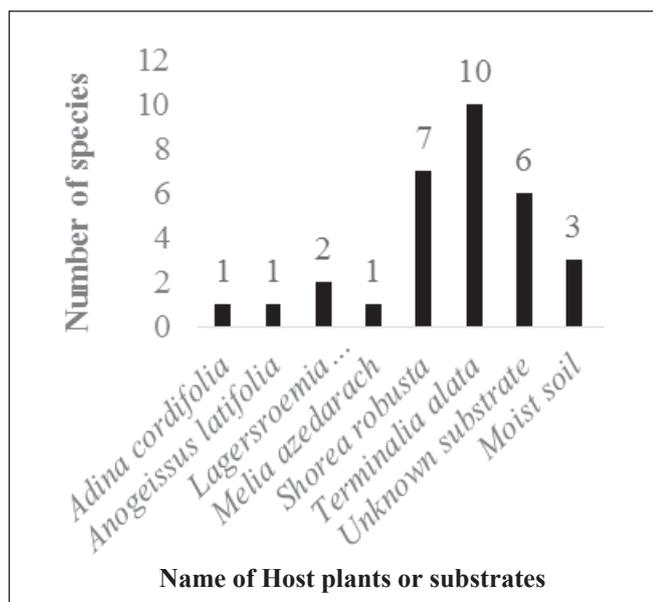


Figure 4: Host plants or substrates harboring number of fungal species in the study area

Polypores were the most common and were found to grow on dead woods, fallen logs, stumps, rotten branches and dead part of trunk and branches of living tree. Out of 31 fungal species, Ascomycetes species like *Daldinia concentrica* (Figure 5), *Xylaria nigripes* and Basidiomycetes species like *Daedaleopsis confragosa* (Figure 9), *Schizophyllum commune* (Figure 6), *Microporus xanthopus*, *Trametes versicolor* (Figure 7), *Pycnoporus*

cinnabarinus (Figure 4) were found to be very common in the study area. Species of *Pycnoporus cinnabarinus*, *Ganoderma lucidum* and *Trametes hirsuta* reported in the present study area was also reported by Aryal & Budhathoki (2013) at Sankarnagar community forest, Rupandehi district (Central Nepal). *Pycnoporus cinnabarinus*, *Microporus xanthopus* and *Daldinia concentrica* reported in preset study area was also reported by Pokhrel (2017) at Amrite community forest, Kapilvastu district (Central Nepal).

Terminalia alata was found to be major host plant for harboring 10 different mushroom species (including one Ascomycetes and remaining nine Basidiomycetes species) which is followed by *Shorea robusta* (7 species), *Lagerstroemia parviflora* (2 species) and least by *Adina cordifolia*, *Buchanania latifolia* and *Melia azedarach* with one species only (Figure 4). All the host plants or substrates of the fungal species were identified except six since it was almost old tree stump and log with rotten bark. On the other hand, one species of Ascomycetes fungi belonging to the order Xylariales (Xylariaceae family) and two species of Basidiomycetes fungi belonging to the order Agaricales and Polyporales (Pleurotaceae and Ganodermataceae families respectively) were found to be grown on moist soil (see in enumeration of mushroom species).

Conclusion

A total of 31 fungal species from Ascomycetes (5 species) and Basidiomycetes fungi (26 species) were collected from Lumbini collaborative forest, Rupandehi district, Central Nepal. The identified Ascomycetes species were from single orders belonging to single family and two genera whereas Basidiomycetes species were from six orders belonging to 8 families and 18 genera. In overall, Polyporales and Polyporaceae were the dominant order and family respectively. *Terminalia alata* was found to be the major host plant for 10 different mushroom species (including 1 Ascomycetes and remaining 9 Basidiomycetes species). Beside post monsoon period further mycological exploration

should be carried out in monsoon rainy season in all compartment to document the other macrofungal species for determining actual mycodiversity of that forest.

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Figure 4: *Pycnoporus cinnabarinus* (Jacq.: Fr.) Karst.



Figure 5: *Daldinia concentrica* (Bolt.: Fr.) Ces. & De Not



Figure 6: *Schizophyllum commune* (Fr.) Fr.



Figure 7: *Trametes versicolor* (L.: Fr.) Pilat



Figure 8: *Hexagonia* sp.



Figure 9: *Daedaleopsis confragosa* (Bolt.: Fr.) Schr. var. *confragosa*