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## MACROFUNGI ABUNDANCE, DIVERSITY AND SUBSTRATE ASSOCIATION IN SHAWA COMMUNITY FOREST, BENUE STATE, NIGERIA

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**ABSTRACT:** Species assessment and diversity is an important factor in determining taxa existence in a habitat. However, habitat loss in forest ecosystem occasioned by degradation negatively affects wildlife population. Therefore, macrofungi checklist, abundance and substrate association were investigated using line transects method between November 2019 to February 2020. Three (3) 1km line transect at 250m interval apart was laid in the forest. Each line transect was walked at least 5m to 15m along and at both side in search for macrofungi species. Species were identified using field guide. Data collected were analyzed using descriptive statistics, Simpson (D) and Shannon-Wiener (H') indices. A total of 2,896 individuals were recorded in 12 taxa belonging to 10 families, 4 orders and 2 classes. *Hyphodontia sambuci* (850) was most dominant species and the least was *Phellinus gilvus* (50). The dominant families were Polyporaceae and Ganodermataceae with 2 species each, Polyporales (50%) and Agaricomycetes (75%) were dominant order and class, respectively. The indices values of  $D = 0.82$  and  $H' = 2.02$  obtained for macrofungi in the forest indicates a moderate diversity of the species. Substrate association was highest (42.11%) on dead trees/ logs and least on soil surface (15.75%) and litter cover (15.75), respectively. Eight (8) macrofungi species were found to be non-edible against 4 edible ones. Half (50.00%) of the macrofungi encountered in the forest were in abundance. The role of macrofungi in ecosystem and humanity is at large; therefore, its conservation is paramount especially in an anthropogenic altered environment.

Key words: Forest, check list, field guide, host and uses

### 1. INTRODUCTION

Fungi are essential components of almost all ecosystems, especially terrestrial environment. They contribute to the function of healthy range ecosystems through symbiotic association with plants by decomposing organic matter, contributing to nutrient cycling, and providing food for forest animal (Lori *et al.*, 2012; Lee and Robert, 2015). Fungi have existed long ago and are immensely diverse with 144,000 species named and classified which compare favorably to the rest of species discovery of new plants (Mora *et al.*, 2011); however, the vast majority (93%) of fungal

species is currently unknown to mycologist (Willis, 2018).

According to Willis (2018), eight phyla exist under the kingdom fungi to include Ascomycota, Basidiomycota, Mucoromycota, Chytridiomycota, Blastocladiomycota, Cryptomycota, Microsporida and Zoopagomycota. Based on estimates derived using plants/macrofungal species ratios, it has been suggested that there are between 53,000 and 110,000 species of macrofungi (Mueller *et al.*, 2007). The two main functional groups of macrofungi are

ectomycorrhizal fungi (2cm) with 6,000 specks and saprotrophic fungi (Johnson *et al.*, 2005).

Macrofungi are fungi that form large fructification visible without the aid of the microscope and include representatives from the Basidiomycota and Ascomycota (Roda, 2010, Servi *et al.*, 2010). Common names used to refer to these fungi include mushrooms, toadstools, cup fungi, gilled fungi, jelly fungi, coral fungi, stink fungi, bracket fungi, polypores, puffballs, earth starts, truffles, birds nest fungi and sequestrate fungi (Egbe *et al.*, 2013). Sequestrate fungi depends on animals to disperse their spores and are an important wildlife food (Flaherty *et al.*, 2010). Ecologically, macrofungi can be grouped as saprobes, parasites and symbiotic species (for example the mycorrhiza). Most terrestrial macrofungi are saprobes or mycorrhiza symbionts, but some are pathogens of plants, while those fruiting on woody substrates are usually either saprobes or plant pathogens (Mueller *et al.*, 2007; Maria and Tzenka, 2014). Macrofungi are crucial component of biodiversity essential for decomposition, carbon cycling and nutrient transport in forest ecosystems (Lin *et al.*, 2015). Some are edible and non-edible and are often used as innovative in biotechnological and ecological application. They are distinct organisms that digest their food externally by secreting enzymes into the environment and absorbing the dissolved organic matter back (Lori *et al.*, 2012).

Fungivorous wildlife species also benefit from the fungal food source and host plants benefits using the symbiotic fungi to absorb soil nutrients (Yager *et al.*, 2019). In spite of the numerous key functions played by macrofungi in almost all ecosystem, intense research and conservation initiative is not put in place especially in community range ecosystem where protection is partial (Pecoraro *et al.*, 2014). The relationship between macrofungi and ecosystem biotic and abiotic substrates assessment play a key role in determining species function. One of the common inspirations to carry out study on wildlife species is to document the species existence, abundance and diversity in a location (Yager *et al.*, 2019) and sometimes used to document the presence of rare,

uncommon and endangered species, but more usually to demonstrate their existence (Yager *et al.*, 2018).

The research focus on the abundance and diversity of macrofungi in respect to substrate host association. This is important since it will provide an understanding of the macrofungi relationship with biotic and abiotic components within human altered habitats. Hence, this will promote future conservation and sustainable range management in the study area.

## 2. MATERIAL AND METHODS

### 2.1 Location of the Study Area

The research was conducted in Shawa Community Forest in Gwer-East Local Government Area of Benue State, Nigeria. The area is located at the North Western part of the State and lies between latitude 7° 26' to 7° 16' North of equator and longitude 8° 35' to 8° 32' East of the Greenwich Meridian with a land mass of about 6 km<sup>2</sup>. The Local Government Area (LGA) has three (3) major districts namely; Yonov, Ngyohov and Njiriv and is boarded by Makurdi LGA to the North, Otukpo to the West, Obi and Konshisha to the South and Gwer-West to the North-West (Figure 1). The study area experiences distinct dry and wet seasons with temperature and relative humidity varying with seasons. The wet or rainy season fall between April to October while dry season is experienced from approximately November to march. Mean annual temperature is 32.5°C, mean humidity is 57% and mean annual rainfall ranges from 1000mm to 1200mm. The vegetation in the study area is composed of thick grasses (*Pennisetum purpureum*, *Oryza barthii*, *Cenchrus macrourus*), woody plants (*Azelia africana*, *Detarium microcarpum*, *Elaeis guineensis*, *Ficus sur*), herbs (*Sida acuta*, *Tridax procumbens*, *Hibiscus asper*) and shrubs species. The soil is very fertile, poorly drained with sandy loam. Dominant Wild animal species include; *Tragelaphus scriptus*, *Varanus niloticus*, *Cricetomys gambianus* and bird species (*Senegal parrot*, *Crinifer piscator*, *Ploceus cucullatus*), with river Mu passing through the forest to the North which service different needs of the fauna species especially dry the raining seasons.

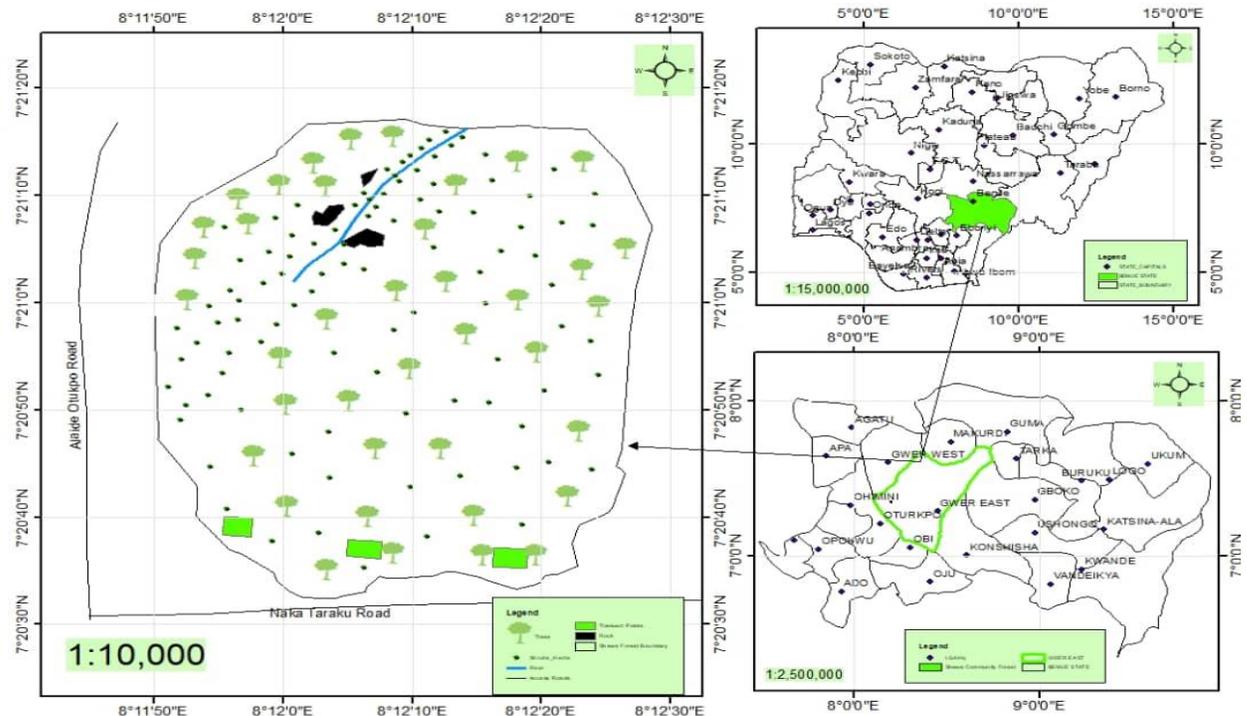


Fig. 1: Map of Benue State showing the study area

Source: earthexplorer.usgs.gov, 2020

## 2.2 Data Collection and Macrofungi Identification

A reconnaissance survey was carried out to identify features of the study area and adopt appropriate method for the research. The coordinate of the forest area was taken at its four edges with a global positioning system. The systematic line transects sampling technique (Avery and Burkhardt 2002; Derr *et al.* (2003) was adopted. Three (3) line transect of 1 km length and 250m apart was laid between November 2019 to February 2020.

Macrofungi species were identified and recorded at approximately 40 m interval along each transect, one surveyor walked at least 5m to 15m along and at both side in search for macrofungi species. The species were identified using fungi field guide by Peters and Shelley (2010).

## 2.3. Statistical Analysis

### 2.3.1 Species check list, macrofungi abundance and diversity

- i. A checklist of macrofungi species was compiled in Microsoft excel showing common species names and as well as their frequencies of each species of macrofungi and their occurrences.

Macrofungi and substrate host were identified and recorded.

- ii. Macrofungi diversity was determined using Simpson (D) and Shannon-Wiener diversity index ( $H'$ ), Evenness ( $E_H$ ) and Margalef Index ( $MI$ ). This is illustrated below.

$$\lambda = \sum \frac{n_i(n_i-1)}{N(N-1)} \quad (1)$$

$$H' = - \sum_{i=1}^s p_i \ln p_i \quad (2)$$

$$E = \frac{H'}{\ln S} \quad (3)$$

$$MI = \frac{S-1}{\ln N} \quad (4)$$

Where  $S$  = the total number of species;  $p_i$  = the proportion of individuals in the  $i$ th species;  $\ln$  = the natural logarithm, and  $N$  = the number of individuals

## 3. RESULT AND DISCUSSION

### 3.1 Check list, Occurrence, Abundance Substrate host of Macrofungi

The result of check list, substrate host and abundance of macrofungi species in the study area is present in

Table 1. The result shows a check list of 12 different macrofungi species in the study area. A total of 2,896 individuals were identified belonging to 10 families, 4 orders and 2 classes. This indicate a moderate diversity of macrofungi species encounter as against Yager *et al* (2019) in Pandam wildlife park who reported 15 (5,308), this probably could be as a result of difference in ecological sites, though most of the species were recorded in both sites. However, the macrofungi species encountered constitute a significant part of terrestrial ecosystem forming a large share of species richness and key players of ecosystem processing (Seen-Irlet *et al.*, 2007). The result of occurrence, abundance and substrates host revealed that *Hyphodontia sambuci* (850) was most dominant species and the least was *Phellinus gilvus* with 6 species (50%) occurrence. Based on index of species abundance stated (Table 1), six macrofungi species each were both uncommon and common, respectively. Brown *et al* (2006); Douanla-meli (2007) reported the effect of habitat degradation and forest fragmentation as threats to macrofungi abundance. Macrofungi were recorded on different substrates which varied from

dead tree/logs, live trees, soil and litter cover (Fig. 2). This agrees with the findings of Osarenkhoe *et al.*, 2014; Nagaraju *et al* 2014; Apollos *et al* 2017. The substrate specificity general trend showed that macrofungi prefers certain specific substrates. Dead trees/logs (42.11%) supported more macrofungi hosting in the study area. The high occurrence on dead trees/logs in the forest habitat favoured macrofungi species. This was observed on the high decomposition rate of forest decay and standing logs in the forest. This is similar to the findings of Nagaraju *et al* 2014 and Apollos *et al* 2017 in Kogi State, Nigeria and India. Brown *et al* (2006) also stated that occurrence of macrofungi on different substrates occurs due to environmental conditions and habitat. The association of macrofungi more on dead decay/logs encourages nutrients recycling in a given ecosystem and promotes forage growth for animal foraging. Among the macrofungi species identified, eight are non-edible while the four are edible. Pictorial view of the macrofungi species is given in Appendix 1 to 12 indicating those that are edible and non-edible species.

Table 1: Check list, Occurrence, abundance and substrate host of macrofungi in the study area

S/N	Fungi species	Transect			Substrate	Uses	Occurrence %	Index of Abundance
		1	2	3				
1	<i>Phellinus gilvus</i>	-	-	+	Live tree ( <i>Acacia sayal</i> )	Non-edible	50 (1.73)	U
2	<i>Ganoderma applanatum</i>	-	+	-	Live tree ( <i>Acacia sayal</i> )	Non-edible	83 (2.87)	U
3	<i>Hygrophorus eburneus</i>	+	+	-	Soil/litter dead tree ( <i>Linea acida</i> )	Edible	650 (22.44)	C
4	<i>Hyphodontia sambuci</i>	+	+	+	Dead tree ( <i>Linea acida</i> )	Non-edible	850 (29.35)	C
5	<i>Lentinus tigrinus</i>	+	-	+	Soil/litter	Edible	125 (4.32)	C
6	<i>Ganoderma lucidum</i>	-	+	+	Dead tree ( <i>Sarcocephalus latifolius</i> )	Non-edible	86 (2.97)	U
7	<i>Parasola auricoma</i>	-	-	+	Live tree ( <i>Daterium microcarpum</i> )	Non-edible	62 (2.14)	U
8	<i>Trametes elegans</i>	-	-	+	Dead tree ( <i>Acacia sayal</i> )	Non-edible	52 (1.79)	U
9	<i>Auricularia auricular</i>	+	-	+	Live tree/dead log ( <i>Allophylus niloticus</i> )	Edible	420 (14.50)	C
10	<i>Pleurotus pilmonarius</i>	-	+	-	Soil / litter/dead tree	Edible	205 (7.08)	C
11	<i>Fomitopsis spp</i>	-	-	+	Live tree/dead log ( <i>Mytragyna inermis</i> )	Non-edible	63 (2.18)	U
12	<i>Irpex lacteus</i>	-	+	+	Dead tree ( <i>Linea acida</i> )	Non-edible	250 (8.63)	C
							2,896 (100)	

**Source:** Field survey 2020

**Key:** U= Uncommon and C= Common

+ = Present

- = Absent

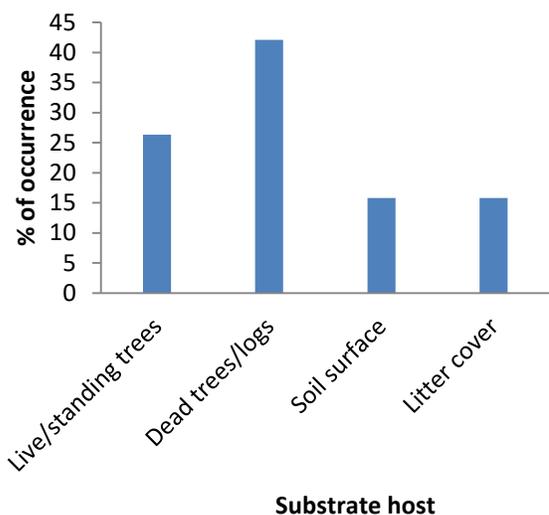


Figure 2: Percentage Representation of Macrofungi on Substrates host

### 3.2 Macrofungi family, order, class and diversity

The result of Macrofungi family, order, class and diversity in the study area is shown in Figure 3 to 4 and Table 2 to 3. The results indicate dominance in Polyporaceae (16.67%) and Ganodermataceae (16.67%) families, while the remaining eight families with 1 species (8.33%). The order Polyporales was dominant with 6 species (50%) and the least was Auriculariales with 1 species (8.3%). The class Agaricomycetes was dominant with 9 species (75%) and class basidiomycetes with 3 species (25%). Researchers like Tadosa *et al*, (2011) in the province of Aurora, De Leon *et al*, (2013) in Central Luzon and Rajput *et al* (2015) in Philippines and Gujarate state of India reported more taxa for both family and orders. The Simpson (D) and diversity index (H) for Macrofungi in the study area as given in Table 3 was found to be D= 0.82 and H<sup>2</sup>= 2.02, which indicates a moderate diversity of the species encountered. The diversity indices of any taxa vary with location and habitat specificity. This implies that habitat structure plays significant role in dictating species diversity. The

forest habitat in the study area has been altered through logging, farmland encouragement, hunting and burning. This may partly be responsible for the moderate diversity indices of the values obtained which lies within the general limit of (H = 1.3 - 3.5).

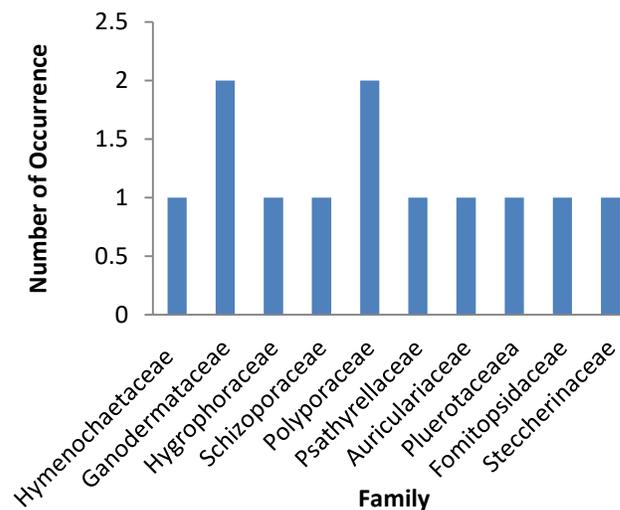


Figure 3: Family Representative of Macrofungi in the Study Area

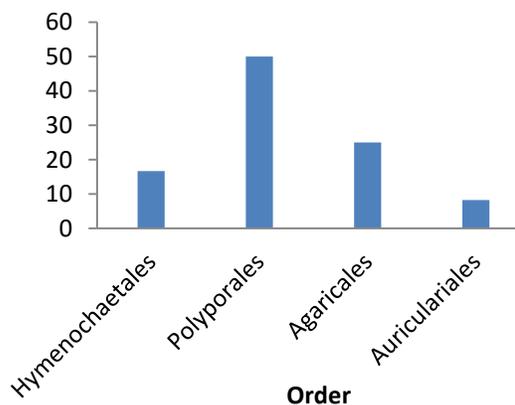


Figure 4: Percentage occurrence of Macrofungi Order in the study Area

Table 2: Classification of Macrofungi Species in the study area

Family	Species (macrofungi)	Class	Species/order
Hymenochaetaeae	<i>Phellinus gilvus</i>	Agaricomycetes	Hymenochaetales
Ganodermataceae	<i>Ganoderma applanatum</i>	Agaricomycetes	Polyporales
Hygrophoraceae	<i>Hygrophorus eburneus</i>	Agaricomycetes	Agaricales
Schizoporaceae	<i>Hyphodontia sambuci</i>	Basidiomycetes	Hymenochaetales
Polyporaceae	<i>Lentinus tigrinus</i>	Basidiomycetes	Polyporales
Ganodermataceae	<i>Ganoderma lucidum</i>	Agaricomycetes	Polyporales
Psathyrellaceae	<i>Parasola auricoma</i>	Agaricomycetes	Agaricales
Polyporaceae	<i>Trametes elegans</i>	Basidiomycetes	Polyporales
Auriculariaceae	<i>Auricularia auricula</i>	Agaricomycetes	Auriculariales
Pluerotaceae	<i>Pleurotus pulmonarius</i>	Agaricomycetes	Agaricales
Fomitopsidaceae	<i>Fomitopsis species</i>	Agaricomycetes	Polyporales
Steccherinaceae	<i>Irpex lacteus</i>	Agaricomycetes	Polyporales

Source: Field survey: 2020

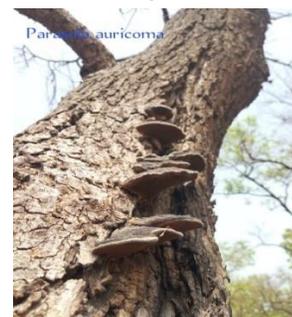
Table 3: Diversity Indices of Macrofungi in the study area

Diversity indices	Parameters
Taxa_S	12
Individuals	2896
Dominance_D	0.1751
Simpson_1-D	0.8249
Shannon_H	2.024
Evenness_e^H/S	0.6306
Margalef	1.38

From the findings of this study, the following conclusions are made:

1. The Shawa community forest harbor significantly moderate diversity of macrofungi, although most of the species encountered were non-edible, however were vital in decomposition process of the forest debris.
2. The macrofungi showed high association with dead tress/logs, this indicate high nutrient recycling process in the forest ecosystem.
3. Proper conservation and management strategies of the community forest is advocated.

#### 4. CONCLUSION

1. *Fomitopsis spp* (NE)2. *Hyphodontia sambuci* (NE)3. *Phellinus gilvus* (NE)4. *Ganoderma applanatum* (NE)5. *Ganoderma lucidum* (NE)6. *Parasola auricoma* (NE)

7. *Hygrophorus eburneus* (E)8. *Lentinus tigrinus* (E)9. *Trametes elegans* (NE)10. *Auricularia auricular* (E)11. *Pleurotus pulmonarius* (E)12. *Irpex lacteus* (NE)

**Note:** E = Edible and NE = Non-edible

## REFERENCES

- Apollosa, W.P., Victoria, I.J. and Hannatu, D.M. (2017). Agaricomycota (Mushroom) occurrence distribution and species abundance in Kogi State, Central Nigeria. *International Journal of Sciences: Basic and Applied Research*, 2017, 35 (3):12-29.
- Avery, T.E. and Burkhurt, H.E. (2002). Forest measurements. McGraw-Hill Pub. New York: 2002, 34pp
- Brown, N., Bhagwat, S. and Watkinson, S. (2006). Macrofungal diversity in fragmented and disturbed forests of the Western Ghats of India. *Journal of Applied Ecology*, 2006, (43): 11-17.
- De Leon, A.M., Luangsa-ard, J.J.D., Karunarathna, S.C., Hyde, K.D., Reyes, R.G. and Dela-Cruz, T.E.E. (2013). Species listing, distribution, and molecular identification of macrofungi in six Aeta tribal communities in Central Luzon, Philippines. *Mycosphere*, 2013, 4(3):478–494.
- Derr, C., Helliwell, R., Ruchty, A., Hoover, L., Geiser, L., Lebo, D. and Davis, J. (2003). Survey Protocols for Survey & Manage Category A & C Lichens in the Northwest Forest Plan Area, Version 2.1. U.S. Department of Interior, Bureau of Land Management, Oregon/Washington and U.S. Department of Agriculture, Forest Service, Region 6. pp86. Accessed online at <http://www.blm.gov/or/plans/surveyandmanage/sp.htm>.
- Douanla-Meli, C. (2007). Fungi of Cameroon: ecological diversity with emphasis on the taxonomy of non-gilled Hymenomycetes from the Mbalmayo Forest Reserves. *Bibliotheca Mycologica*, 2007, pp410.
- Egbe, E.A., Tonjock, R.K., Ebai, M.T., Nji, T. and Afui, M.M. (2013). Diversity and distribution of macrofungi (mushrooms) in the Mount Cameroon Region. *Journal of Ecology and the Natural Environment* 2013, 5(10):318-334.
- Flaherty, E.A., Ben-David, M. and Smith, W.P. (2010). Diet and food availability: Implications for foraging and dispersal of Prince of Wales northern flying squirrels across managed landscapes. *Journal of Mammalogy*, 2010, 91(1): 79–91.
- Johnson, D., Ijdo, M., Genney, D.R., Anderson, I.C. and Alexander, I.J. (2005). How do plants regulate the function, community structure, and diversity of mycorrhizal fungi?. *Journal of Experimental Botany*, 2005, (56)1751–1760.
- Lee, T.D., Robbert, L.S., (2015). The soil fungi: occurrence, phylogeny and ecology soil microbiology, Ecology and Biochemistry, 2015, pp78 – 108.
- Lin, W.R., Wang, P.H., Chen, M.C., Kuo, Y.L., Chiang, P.N. and Wang, M.K. (2015). The impacts of thinning on the fruiting of saprophytic fungi in *Cryptomeria japonica* plantations in central Taiwan. *Forest Ecology and Management*, 2015, (336):183–193.

- Lori, M.C., Christopher, R.L. and Carol, M.S. (2012). Introduction to fungi. The plant Health Instructor Doi: 1094/PH1-1.
- Maria, L. and Tzenka, R. (2014). Fungal diversity in Chivira Protected Area, Mt. Sredna Gora, Bulgaria. *International Journal of Biological Science*, 2014, (11): 1–17.
- Mora, C., Tittensor, D.P., Adl, S., Simpson, A.G.B. and Worm, B. (2011). How many species are there on earth and in the ocean? *PLoS Biology*, 2011, (9) e1001127
- Mueller, G.M., Schmit, J.P., Leacock, P.R., Buyck, B., Cifuentes, D.J., Kurt, H., Teresa, I., Karl-Henrik, L.D., Jean, L., Tom, W.M., David, M., Mario, R., Scott, A.R., Leif, R., James, M.T., Roy, W. and Qiuxin, W. (2007). Global diversity and distribution of macrofungi. *Biodiversity and Conservation*, 2007, (16): 37-48.
- Nagaraju, D., Kumar, S.G., Kunwar, I.K. and Manoharachary, C. (2014). Fungi occurring on diversified habitats around some sanctuaries and water-bodies of Telangana and Andhra Pradesh, India. *Journal of Experimental Biology*, 2014, 2(5):24-28.
- Osarenkhoe, O.O., Okhuoya, A.J. and Dania, A.T. (2014). Ethnomycological conspectus of West African mushrooms: An awareness document. *Advances in Microbiology*, 2014, (4): 39–54.
- Pecoraro, L., Angelini, P., Arcangeli, A., Bistocchi, G., Gargano, M.L., Rosa, A., Lunghini, D., Polemis, E., Rubini A, Saitta S, Venanzoni R. and Zervakis,. *Plant Biosystems*, 2014, (148):367-76.
- Peters, R. and Shelley, E. (2010). The book of fungi; A life-size guide to six hundred species from around the world. Pp5-345
- Rajput, K.S., Koyani, R.D., Patel, H.P., Vasava, A.M., Patel, R.S., Patel, A.D. and Singh, A.P. (2015). Preliminary checklist of fungi of Gujarat State, India. *Current Research in Environmental and Applied Mycology*, 2015, 5(4):285–306.
- Roda, F.A. (2010). Survey of Macrofungi (including Truffles) in Qatar KBM. *Journal of Biology*, 2010, (1):26-29.
- Seen-Irlet, B., Heilmann-Clausen, J., Genney, D. and Dahlberg, A. (2007). Guidance for the conservation of mushrooms in Europe. Convention on the conservation of European wildlife and natural habitats 27th meeting, Strasbourg, pp1-34.
- Servi, H., Akata, I. and Cetin, B. (2010). Macrofungal diversity of Bolu Abant Nature Park (Turkey). *African Journal of Biotechnology*, 2010, (9):3622–3628.
- Tadosa, E.R., Agbayani, E.S. and Agustin, N.T. (2011). Preliminary Study on the Macrofungi of Bazal Baubo Watershed, Aurora Province, Central Luzon, Philippines. *Asian Journal of Biodiversity*, 2011, (2):149–171
- Willis, K.J. (ed). (2018). State of the World fungi, 2018 Report. Royal Botanic Garden, Kew. pp1-93.
- Yager, G.O., Alarape, A.A. and Onuwa, O.A. (2018). Preliminary assessment of fauna species diversity in Ipinu Igede community range forest in Oju Local Government of Benue State, Nigeria. *Asia Journal of Biology*, 2018, 5(4):1-11
- Yager, G.O., Mbakuuv, B. and Ityavyar, J.A. (2019). Preliminary Survey of Abundance and Ecological distribution of Macrofungi of Pandam Wildlife Park, Nigeria. Proceedings of 3<sup>rd</sup> Wildlife Society of Nigeria Conference, held on 16-19 September at Ibadan pp412-421.