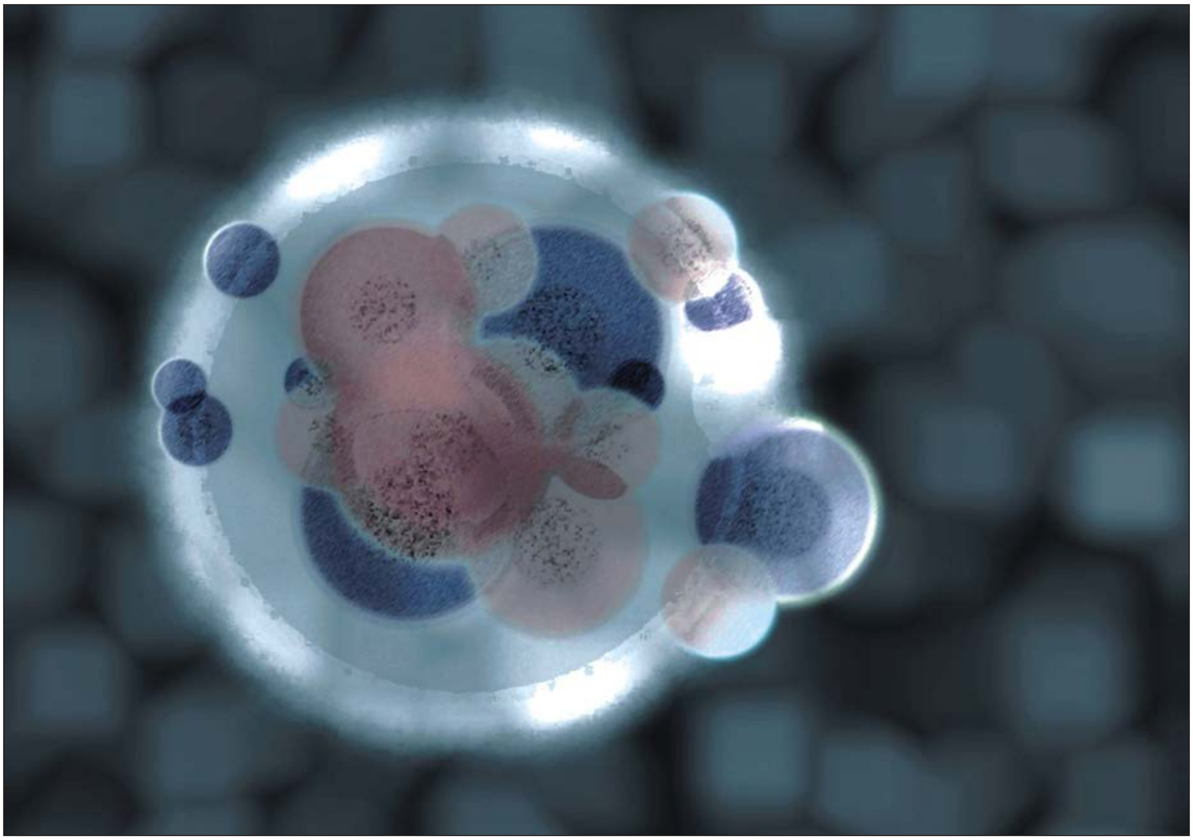

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# Diversity of Macrofungi in Oil Palm Agroforests of Edo State, Nigeria

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**Abstract:** A study of mushrooms associated with oil palm agroforests in Edo State, South-South of Nigeria was undertaken. A total of 49 fruit bodies belonging to 26 different species of mushrooms in the divisions Ascomycota and Basidiomycota, class Gasteromycetes, Discomycetes, Hymenomycetes were recorded from the study. The order Agaricales, family Tricholomataceae and genus *Marasmius* were the most abundant and commonly represented taxa. Palm Fronds (PF) supported the highest number of mushroom taxa (19%) followed by Fallen Palm Tree (FPT), Fruit Bunch (FB) and Decomposing Palm Litters (DPL) each of which supported 14% of the total species of mushrooms recorded during the study. Mushrooms irrespective of their functional role as natural decomposers were recognised by the study as pivotal to sustainable local agroforest management practices in Nigeria. Oil palm plantations surveyed during the study competes favourably with forests as sources of indigenous utility mushrooms.

**Key words:** Diversity, Edo State, indigenous, mushrooms, oil palm

## INTRODUCTION

Mushrooms are recorded in several published literature as the most virile primary decomposers and plant-nutrient facilitator (mycorrhizae) in many global forest ecosystems (Arora, 1986; Oei, 1991; Stamets, 2005). The growing popularity of mushrooms in the release of elements fixed in organic compounds of diverse forest and agroforest stands became the driving force behind the maintenance of ecological equilibrium (Cooke and Rayner, 1984; Arnolds, 1992; Lawton, 1994; Arunachlam, 1998; Meijer, 2001; Ferrer and Gilbert, 2003; Attignon *et al*., 2004; Wasser, 2007). Their abundance and species richness are also reported in literature to be a function of the forest ecosystem's nutrient turnover and its rate of recycling. Information on the cultivation of indigenous wild mushrooms, their long-standing traditional and cultural uses (limited to rural and farm settlements) and mycophagy (mushrooms eating habit) are growing in Nigeria (Alabi, 1991; Adewusi *et al*., 1993; Aletor, 1995; Akpaja *et al*., 2003; Osemwegie *et al*., 2006). The vitamins, minerals, proteins and other nutritional content of many edible mushrooms around the country have been evaluated and compare to those of plant vegetables, meat and beans diets (Arora, 1989; Rammeloo and Walleyne, 1993; Chang, 1998; Mshigeni, 2005). Despite growing interests in mushroom studies, little is known about mushroom diversity, ecology and biogeography in Edo State, Nigeria. The long history of consumption and ethnomycological uses of wild mushrooms in Nigeria is indirectly threatened by anthropogenic factors which include tropical rainforest deforestation, habitat destruction, population pressure, pollution, urbanization etc. (Oso, 1977; Rammeloo and Walleyne, 1993; Okhuoya, 1997; Boa, 2004; Osemwegie *et al*., 2006). The replacement of vase forest stands in Edo State and elsewhere in the world (Indonesia and Malaysia) by tree crops have also led to the gradual loss of mycota (Lelley, 1987; Attignon *et al*., 2004). The rate of decline of mushroom genetic resources due to growing agroforest industries and the degree to which these agroforests support spatial and temporal mushroom diversity have not been fully assessed. The numerous forest and agroforest stands in Nigeria remained the primary sources of wild utility (marketable, edible and medicinal) mushrooms following the dearth of mushroom cultivation industries (Akpaja *et al*., 2003; Belewu and Belewu, 2005; Osemwegie *et al*., 2006; Wasser, 2007).

Oil palm (*Elaeis guineensis* Jacq.) is one of the most economic tree crops planted in the lowland forest zone of Nigeria. Oil palm plantations have become sustainable source of spawn and substrate materials for mushroom cultivation in the country (Chang *et al*., 1993; Okhuoya, 2000; Mshigeni, 2003; Magingo *et al*., 2004; Miles and Chang, 2004). Mushrooms are implicated in agroforestry around the world (Lawton, 1994; Laitung and Chauvet,

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2005). The ecological relationship between tree crops and their respective mushroom community is not yet full understood. This study therefore aims at documenting the species of macrofungi occurring in oil palm agroforest ecosystems in Edo State, Nigeria.

## MATERIALS AND METHODS

Oil palm agroforest stands (Nigerian Institute for oil palm research, Okomu Oil Palm and Palm Royal) located around the lowland rain forest vegetation zone of Edo state (Fig. 1) were visited twice a month for 12 months (March 2002-February 2003) period across rain and dry seasons. All the plantations surveyed with the exception of Palm Royal were characterised by dwarf rows/grooves of oil palm trees which are multiclonal. Mushrooms were randomly collected along defined foot paths (50×10 m) in each of the study site. Each observed mushroom was photographed *in situ* prior to picking, picked up with the aid of a scalpel from its substrate and brought to the laboratory in special collection bags labelled with name of collector (s), collection number, location and date of collection and a few field identification tips such as colour, shape, nature of substrate/foothold, smell (if any), habit and size. The collected macrofungi were identified using coloured mushroom atlas, monographs and internet facility (Lincoff, 1981; Largent, 1986; Arora, 1991; Kirk *et al*., 2001; Lodge *et al*., 2004). Some of the mushrooms brought to the laboratory were oven dried at 60°C and remanded in a mushroom herbarium in the mushroom biology unit of the Department of Botany, University of Benin. Tiny litter agarics (fleshy mushrooms) are preserved in 2-5% formalin solution. Information relating to the collected mushrooms was gathered through personal interaction, occasionally using an interpreter, from the inhabitants around the oil palm stations visited for the study. The diversity of mushrooms were estimated using program Estimates according to Colwell 2005.

## RESULTS

The mushroom taxa recorded during the study were enumerated in Table 1. A total of 26 species of

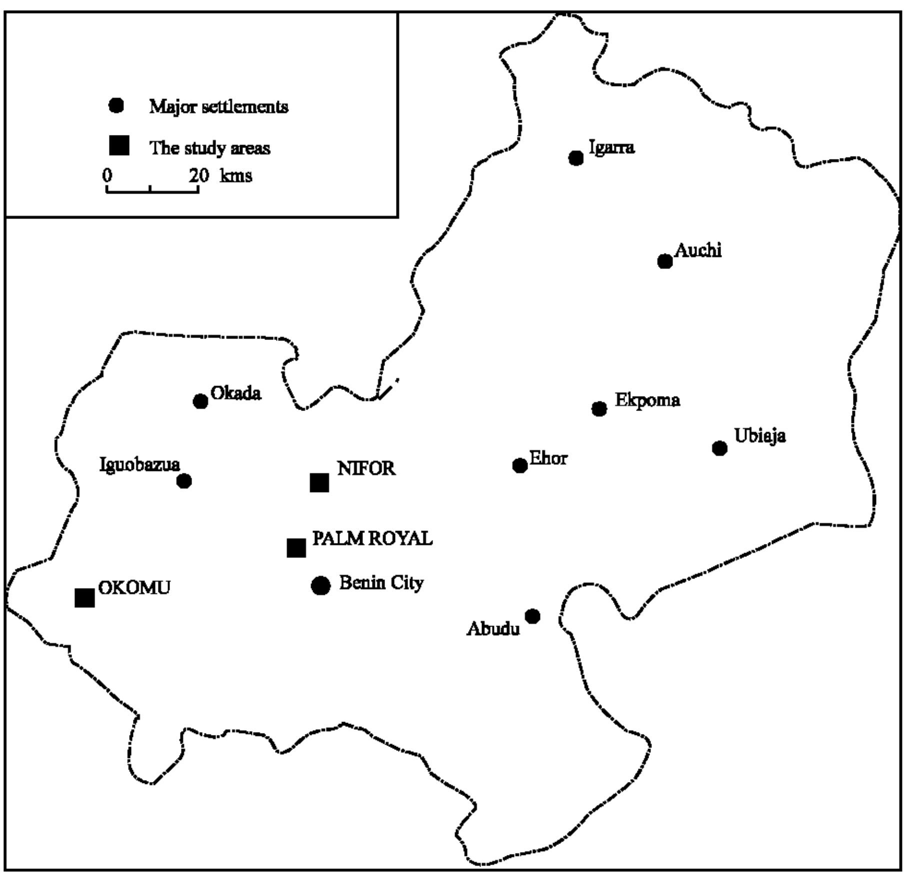


Fig. 1: Distribution of the various oil palm agroforests in Edo State surveyed for the study

Table 1: Checklist of mushrooms observed during the study, the substrate(s) on which they grow, their distribution and fruit body phenology

| S. No. | Taxon | Habitat type NIFOR | PR | OKO | Substrate type | Fruit body phenology |
|---|---|---|---|---|---|---|
| | **ASCOMYCOTINA** | | | | | |
| | ***DISCOMYCETES | | | | | |
| | **PEZIZALES | | | | | |
| | *SARCOSCYPHACEAE | | | | | |
| 1 | *Cookeina sulcipes* (Berk.) Kuntze. | + | - | + | PF, FPT | Jul-Nov. |
| | **BASIDIOMYCOTINA** | | | | | |
| | ***HYMENOMYCETES | | | | | |
| | **AGARICALES (AGARIC FUNGI) | | | | | |
| | *BOLBITACEAE | | | | | |
| 2 | *Agrocybe* sp. | + | - | - | FPT, S | Sept |
| | *COPRINACEAE | | | | | |
| 3 | *Coprinus acuminatus* (Romagn.) P.D.Orton | + | - | + | FB, PTS | Jun-Aug. |
| 4 | *Coprinus disseminatus* (Pers.) Gray | + | + | + | FB, PTS | Jul- Sept. |
| 5 | *Coprinus plicatilis* (Curtis) Fr. | + | - | + | FB, PF | Jun-Sept. |
| | *PLEUROTACEAE | | | | | |
| 6 | *Pleurotus squarrosulus* (Fr.) Kummer | + | + | + | FPT,WD | AYR |
| 7 | *Pleurotus tuberregium* (Fr.) Singer | + | + | - | S, WD | Jul-Sept. |
| | *PLUTACEAE | | | | | |
| 8 | *Volvariella volvacea* (Bull.) Singer | + | + | + | FB, PTS, DPL, FPT | Jul-Nov. |
| | *TRICHOLOMATACEAE | | | | | |
| 9 | *Marasmius androsaceus* (L.) Fr. | + | + | + | DPL, PF, FB | Mar-Aug. |
| 10 | *M. delectans* Morgan | + | - | + | DPL, PF | Sept |
| 11 | *M. foetidus* (Sowerby) Fr. | + | + | + | DPL, PF, FB | Jun-Sept. |
| 12 | *M. siccus* (Schw.) Fr. | + | - | - | PF | |
| 13 | *M. rotula* (Scop.) Fr. | + | + | + | DPL, PF, FB | Jun-Jul. |
| 14 | *Marasmiellus albocorticis* (Secr.) Sing. | + | + | - | RPF, PF, | Jun-Sept. |
| 15 | *Mycena adonis* (Bull.) Gray | + | + | + | DPL, PF | Apr-Jul. |
| 16 | *M.* species | + | - | + | FB, DPL | Jun |
| 17 | *Pleurocybella porrigeus* (Pers.) Sing. | - | - | + | FPT, PTS | Aug-Sept. |
| 18 | *Tricholoma* sp. | - | + | - | S | Jul |
| | **APHYLLOPHORALES (POLYPORE FUNGI) | | | | | |
| | *AURICULARIACEAE | | | | | |
| 19 | *Auricularia auricula* Judae (Bull.) Pat. | + | - | - | RPF | AYR |
| | *HYMENOCHAETACEAE | | | | | |
| 20 | *Coltricia perennis* (L) Murr | + | - | - | RPF, PTS, FPT | Aug-Nov. |
| | *POLYPORACEAE | | | | | |
| 21 | *Ganoderma lucidum* (Leyss.) P.Karst. | - | + | - | WD, PTS | AYR |
| | *SCHIZOPHYLLACEAE | | | | | |
| 22 | *Schizophyllum commune* Fr. | + | + | + | RPF, FPT | AYR |
| | **PHALLALES | | | | | |
| | *PHALLACEAE | | | | | |
| 23 | *Phallus hadriani* Vent. | + | - | - | DPL | Sept |
| | **TREMELLALES | | | | | |
| | *TREMELLACEAE | | | | | |
| 24 | *Tremella fuciformis* Berk. | - | - | + | RPF | Aug-Sept. |
| | ***GASTEROMYCETES | | | | | |
| | **LYCOPERDALES (STOMACH FUNGI) | | | | | |
| | *GEASTRACEAE | | | | | |
| 25 | *Geastrum saccatum* Speg. | - | + | - | S, DPL | Nov. |
| | *LYCOPERDACEAE | | | | | |
| 26 | *Calvatia cyathiformis* (Bosc.) Morg. | + | - | + | S | Dec-May |

+: Present, -: Absent. NIFOR: Nigeria institute for oil palm research, PR: Palm royal, OKO: Okomu oil palm, Substrate: AYR: All year round, DPL: Decomposing palm litters, FPT: Fallen palm trees, FB: Fruit bunch, PF: Palm fronds, PTS: Palm tree stumps, RPF: Rachis of palm fronds, S: Soil, WD: Wood debris

mushrooms that amounted to 49 sporocarps were identified and named. The Nigerian Institute for Oil Palm Research recorded the highest number of species (21) followed by Okomu Oil Palm (15) and Palm Royal (13) respectively (Table 2). These mushrooms are distributed into two sub-divisions (Ascomycotina and

Table 2: Number of species recorded for each study location and number of unshared taxa amongst study locations

| Habitat type | No. of unshared | No. of taxa |
|---|---|---|
| NIFOR | 5 | 21 |
| PR | 3 | 13 |
| OKO | 2 | 15 |

NIFOR: Nigerian institute for oil palm research, PR: Palm royal, OKO: Okomo oil palm

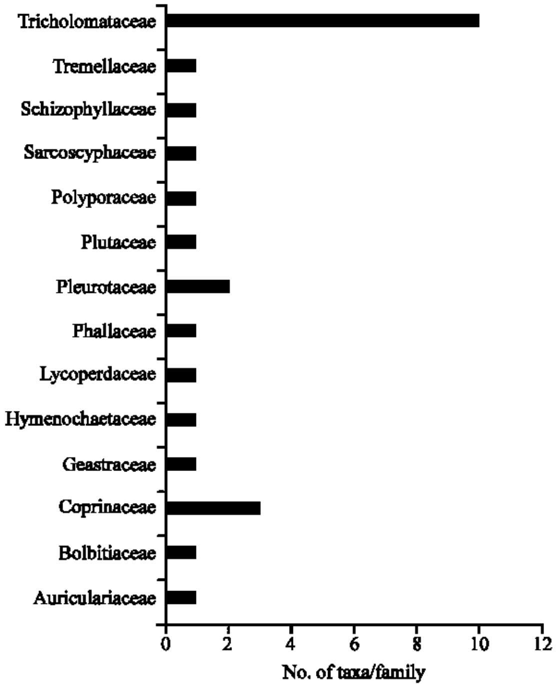


Fig. 2: The number of species in the mushroom families represented in the study

Basidiomycotina), three classes (Discomycetes, Gasteromycetes and Hymenomycetes), six orders (Agaricales, Aphyllophorales, Lycoperdales, Tremellales, Pezizales, Phallales) and fourteen familes which include Auriculariaceae, Bolbitaceae, Coprinaceae, Geastraceae, Hymenochaetaceae, Lycoperdaceae, Pleurotatceae, Phallaceae, Plutaceae, Polyporaceae, Sarcoscyphaceae, Schizophllaceae, Tremellaceae, Tricholomataceae respectively (Table 1, Fig. 2). The family Tricholomataceae recorded the highest number of species (10) and genera (5). *Auricularia auricula* Judae, *Pleurotus squarrosulus* (Fr.) Kummer, *Ganoderma lucidum* (Leyss.) Karst and *Schizophyllum commune* Fr were perennial, each producing fruit bodies (sporocarps) that survived throughout the duration of study. They also occurred in all the plantations surveyed. *Coprinus disseminatus* (Pers.) S.F.G, *Volvariella volvacea* (Bull.) Singer, *Marasmius delectans* Morg., *Marasmius foetidus* (Sowerby) Fr. and *Mycena adonis* (Bull.) Gray were observed in all the plantations mapped for the study even though they were ephemeral (short-lived fruit bodies) (Table 1). Eight mushrooms constituting about 32% of the total were observed to be edible while only 5 were medicinal. *Ganoderma lucidum* (Leyss.) Karst was medicinal but not confirmed as food (personal communication with the locals).

Table 3: Observed and estimated values of mushroom species richness (±SD) during the period of study

| | Sampled plots | | |
|---|---|---|---|
| Biodiversity index | PR | OKO | NIFOR |
| Sob (Mao Tau) | 16.00 (1.9) | 21.67 (1.92) | 25.00 (2.0) |
| ICE | 96.93 (35.25) | 41.68 (5.7) | 35.05 (0.0) |
| Chao 1 | 137.49 (61.76) | 28.77 (5.46) | 32.14 (5.9) |
| Chao 2 | 96.93 (41.23) | 28.77 (5.46) | 32.14 (5.9) |

Richness estimators are Mean±SD calculated from 100 randomizations of species-samples matrix using the program Estimates (Colwell, 2006)

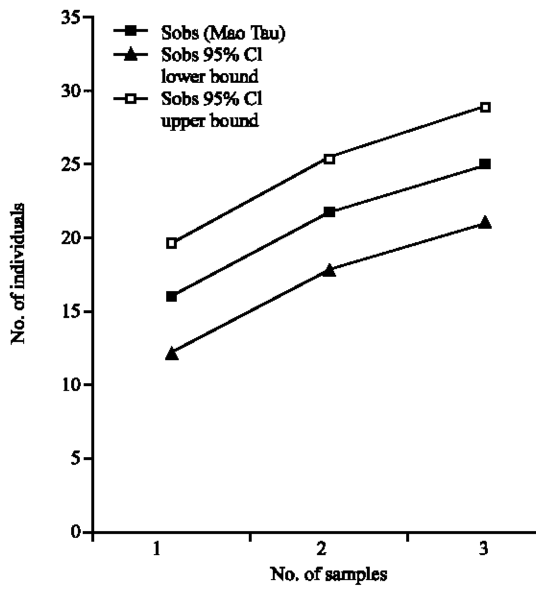


Fig. 3: Species-abundance accumulation curve for 100 randomised samples from the study using Estimates

The Nigeria Institute for Oil Palm Plantations (NIFOR) recorded about 42.86% of the total mushrooms observed during the study while Palm royal recorded the least (26.53%). The use of species richness estimator S according to Colwell (2006) showed that NIFOR had the highest number of observed species (Mao Tau) with a value of 25±2.0 in 100 randomized samples and 95% confidence interval (Table 3). Furthermore, the values of incidence-based coverage estimate (ICE), Chao 1 and Choa 2 per plantation increases with reduction in the number of observed species of mushrooms with Chao estimates recording a much larger error values than the ICE. The sample accumulation curve showed no asymptote (Fig. 3). Each of the study location registered few unshared species with NIFOR recording the highest number of unshared taxa which include *Agrocybe* sp., *Auricularia auricular* Judae, *Coltricia perennis*, *M. siccus* (Schw.) Fr. and *Phallus hadriani* Vent. compared to Okomu oil palm with only *Tremella fuciformis* Berk. and *Pleurocybella porrigens* (Pers.)

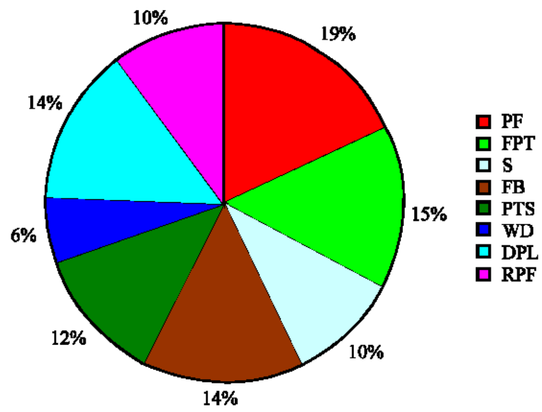


Fig. 4: Distribution of mushrooms on diverse substrates encountered during the study

Sing. (Table 2). *Pleurotus tuberregium* (Fr.) Sing. and *Tricholoma* species were observed to grow only on non-oil palm substrates such as wood debris and soil while all other mushrooms colonised different parts of the oil palm plant as substrate (Table 1). *Agrocybe* sp., *Geastrum saccatum* Speg. and *Tricholoma* sp. were observed to produce fruit bodies that were ephemeral and survived for not more than 2 weeks. *Phallus hadriani* Vent registered the shortest phenology of 2 days while the fruit bodies of *Marasmius delectans* and *Mycena* species remained visible for less than a week. Palm Fronds (PF) were the most colonised substrates supporting 18.37% of the 49 sporocarps encountered followed by Fallen Palm Trees (FPT), Fruit Bunch (FB) and decomposing palm litters which supported 14.19% each. Decomposing palm litters was the least colonised substrate with 6.15% mushrooms (Fig. 4). None of the recorded mushrooms with the exception of *Auricularia auricular*, *Calvatia cyathiformis*, *Marasmius siccus*, *Phallus hadriani*, *Tremella fuciformis* and *Tricholoma* sp. were observed to colonise and grow on only a particular type of substrate (substrate-specific) throughout the study period (Table 1).

## DISCUSSION

A total of 26 different species (Table 1) of wild mushrooms (non-lichenized) were recorded during a 12 months (one year) study. The species richness (types of species) recorded during the study was comparable to that reported in the works of Hyde *et al.* (1997) and Treu (1998). There was however a slight variation in the checklist of species observed form each of the studies. The reason for the differences in species assemblage can be attributed to variations in the ecosystems that were studied which may differ in climate (macro- and micro-), physiognomy, synecology, litterfall dynamics and composition, succession and geography. In addition, the differences in the composition of biota, level of competitiveness amongst biota and level of human disturbances may have also resulted in differences in species assemblage recorded during this study. The mushroom composition and number of species recorded during the study may be a function of the area surveyed coupled with the duration and time of foray (Arnolds, 1992; Lodge and Cantrell, 1995; Cifuentes and Villarruel-Ordaz, 2006; Osemwegie, 2006). Mushrooms recorded can not be separated into introduced (immigrant) species and indigent (resident) species due to lack of baseline data coupled with poor knowledge of biogeography and dynamics of dispersed mushroom spores in Nigeria (Cooke and Rayner, 1984; Stevens, 1997; O'Dell *et al.*, 2004; Laitung and Chuavet, 2005).

The total number of mushroom species (26) recorded in this study was lower compared with those recorded in previous regional biodiversity studies of non-agroforests in Nigeria (Oso, 1977; Nicholson, 1989; Alabi, 1991; Kayode, 2006; Osemwegie *et al.*, 2006). This may be attributed to the heterogeneous tree composition characterizing the forests studied. Earlier studies on the documentation of indigenous wild mushroom resources, their respective uses and fungal ecology in agroforests in Nigeria are dearth (Christensen, 1989). Biodiversity studies of macrofungi carried out in Nigeria and other parts of Africa include Zoberi (1973), Oso (1977), Nicholson (1989), Alabi (1991), Harkonen (1992), Adewusi *et al.* (1993), Masuka and Ryvarden (1993), Rammeloo and Walleyne (1993), Harkonen *et al.* (1994), Ishikuemhen (1996), Akpaja *et al.* (2003), Dijk *et al.* (2003), Magingo *et al.* (2004), Yongabi *et al.* (2004), Mshigeni (2005), Osagualekhor and Okhuoya (2005), Kayode (2006) and Osemwegie *et al.* (2006). Wild mushrooms were also lumped together with green flora of Edo State in some publications by Idu *et al.* (2006, 2008) and Idu and Osemwegie (2007) in other studies.

*Auricularia auricularia*, *Pleurocybella porrigens*, *Pleurotus squarrosulus*, *Pleurotus tuberregium*, *Schizophyllum commune* and *Volvariella volvacea* recorded by the study were hitherto eaten as food or used to complement many bland diets of the people of Edo State (personal communications). In addition, the above mentioned species of mushrooms with the exception of *Volvariella volvacea* produced fruit bodies with extensive phenology and were non-substrate specific but rather colonize a wide range of wood substrates. This suggests a positive relationship between phenology (longevity) of indigenous mushroom, their ethnobotanical uses and edibility by humans. Earlier studies have however failed to relate mushroom edibility to either substrate selectivity or fruit body longevity (Zoberi, 1973; Ogundana, 1975; Aletor, 1995; Akpaja, 2003; Dijk *et al*., 2003; Boa, 2004; O'Dell *et al*., 2004; Osemwegie *et al*., 2006). *Tricholoma* sp. was although confirmed by the people around Okomu oil palm plantations to be previously eaten by their ancestors but rarely eaten in recent times. This may be attributed to its sudden scarcity as observed by this study. *Ganoderma lucidum* was however not eaten directly as food but milled and brewed in hot to warm water and drunk as tea or nerve tonic, immune-modulator, sexual potentiator, hyperlipidaemia and hypercholesterolaemia (Chang, 2000; Chang and Mshigeni, 2001; Osemwegie *et al*., 2006). Mushrooms such as *Coprinus* spp. and *Marasmius* spp. were not edible nor of ethnomycological value (personal communication) and occurred mostly on litters (Ogundana, 1975; Fanelli *et al*., 2000; Boa, 2004).

In Nigeria, mushroom production and their ethnomycological uses are still far from becoming commercial ventures when compared with some developed nations of America, Europe and Asia (Ogundana, 1975; Labarère and Menini, 2000; Mshigeni, 2003; Boa, 2004; Magingo *et al*., 2004). The practice of hunting mushrooms in the wild for food, medicine and business in both forests and agroforests in Edo State by the people may have long-term effects on mycotaxa population leading to selective and/or general loss of mushroom genomes and extinction (Rotheroe, 1998; Ferrer and Gilbert, 2003; Boa, 2004). There is therefore a possibility that some ethnomycological knowledge and some indigenous mushroom taxa were already lost.

The rich cellulose, lignin, other polysaccharides and mineral content (Stevens, 1997; Kittikhun *et al*., 2002; Ferrer and Gilbert, 2003; Attignon *et al*., 2004) of oil palms qualify them as good alternative sources of substrate and spawn materials for mushroom cultivation (Oei, 1991; Chang *et al*., 1993; Isikhuemhen and Okhuoya, 1996; Okhuoya, 2000; Magingo *et al*., 2004). The nature of agroforest management practice i.e., non-removal of palm trees fallen by heavy wind activity and pruned palm frond from plantations; dumping of processed fruit bunches and oil palm fruit wastes back into the plantations could have also facilitated the presence of diverse mushroom taxa and other non-wood products.

The phylum Basidiomycotina, class Hymenomycetes, order Agaricales, family Tricholomataceae and genus *Marasmius* were the most represented taxa recorded during the study (Fig. 2, Table 2). This agrees with the works of Rammeloo and Walleyne (1993), Hyde *et al*. (1997), Treu (1998), Isikhuemhen (2000), O'Dell *et al*. (2004), Lamrood and Vaidya (2006) and Osemwegie *et al*. (2006). The appearance of members of each of these taxonomic hierarchies may be spurred by a number of interacting factors. These factors include the nature and nutrient composition of available substrates, enzyme spectrum and enzyme dynamics, biological efficiency (ability to utilize a substrate) and climatic variations. Ecological relationship between mushrooms, flora and fauna, their competitive status, decomposition dynamics, tree diversity and canopy spread and human disturbances may also have collectively structured the mushroom composition and the distribution of taxa in any ecosystem. This could have equally accounted for the lack of distinctive biogeographic barriers. It is not however fully understood if any one of these interacting factors could be the singular cause of increased representation of a particular taxonomic hierarchy or taxon.

*Coprinus disseminatus*, *Volvariella volvaceae*, *Marasmius androsaceus*, *M. foetidus* and *Mycena adonis* were observed in all the plantations surveyed during the study. This may be connected to agroforest floor litters couple with the nature of their rich composites. The nature of agroforest management practices may have been responsible for their heavy presence. This also explains the high incidence of the genera *Coprinus* and *Marasmius* species and family Tricholomataceae (Fig. 1) (Cifuentes and Villarruel-Ordaz, 2006; Osono, 2007).

Oil Palm Fronds (PF) supported the highest number of mushroom species (19%) while Fallen Palm Tree (FPT), Fruit Bunches (FB) and Decomposing Palm Litters (DPL) supported 14% each of the total species of mushrooms (Fig. 3). This may be connected to the level of fixed organic based matter and elemental nutrient in each of the substrates that accessible by macrofungi. Stevens (1997), Kittikhun *et al*. (2000), Stamets (2005) and Osono (2007) explained that the degree of fixed organic base accessed by each mushroom colonizing a particular substrate differs and determines the pattern of fungal succession in any ecosystem. This could have accounted for the differing phenology and overlapping rather than exclusive substrate propensity that was recorded in the study (Straatsma *et al*., 2001). *Calvatia cyathiformis*, *Marasmius siccus*, *Phallus hadriani*, *Tremella fuciformis*, *Tricholoma* sp. were substrate-specific. This may be attributed to their inability to fully utilize (access) available lignocellulosic base or nutrients fixated in substrates for fruit body formation. In other words, accessible nutrients required by these mushroom for fruit body formation are limited in distribution and supply. This has therefore narrowed their phenology (Table 1) and may be the best explanation for their rarity (Cooke and Rayner, 1984; Wasser, 2007).

There was high incidence of mushroom Fruit bodies recorded in the wet season (May-September). *Auricularia auricula* Judae, *Pleurotus squarrosulus*, *Ganoderma lucidum* and *Schizophyllum commune* produced fruit bodies that were observed across both the wet and dry seasons (Cooke and Rayner, 1984; Cifuentes and Villarruel-Ordaz, 2006; Lamrood and Vaidya, 2006; Osemwegie *et al*., 2006; Osono, 2007). Perennial mushrooms (occurring across season) exhibited great innate tolerance to a wide fluctuation in climate. Their perennial habit may be connected to their overlapping substrate propensity and intraspecific sociability (appearing in groups).

The Nigeria Institute for Oil Palm Research (NIFOR) and Okomu Oil palm (OKO) plantations recorded higher species diversity amounting to 42.86 and 26.5%, respectively when compared with Palm Royal (PR) which recorded the least number of (13) species amounting to 26.53% (Table 2). The species-abundance accumulation curve showed no asymptote (Fig. 3) which suggests that the sampled sites had many mycota that is still cryptic. Species diversity is therefore a function of sampling efforts measured in hours (one hour of survey per sampling plot), seasons and land area surveyed within the study period (Straatsma *et al*., 2001; Straatsma and Krisai-Greilhuber, 2003).

The use of ICE and Chao values as estimate of species richness was to remove bias caused by low sample size which could have accounted for the larger error values recorded for Chao 1 and Chao 2 estimators. The high record of species in both NIFOR and OKO may be attributed to the ecological structure of these plantations each of which was characterised by short, broad and closed canopy grooves that enhance the right climate necessary for mushroom to sprout. The steady harvesting activities of oil palm fruits in these plantations increase the volume of lignocellulosic substrates available thereby increasing the incidence of unshared species recorded for NIFOR (Table 2).

Boa (2004) reported that studies on mushroom diversity in many developing countries such as Nigeria were scattered, often times limited to regions, tribes or forests; far between and biased against non-edible, mycorrhizae and hypogenous (underground) types. This challenged and inspired us to embark on this study which was the first attempt made at studying oil palm agroforest mycobiota (micofungi, macrofungi and mycorrhizae) in Nigeria. We have also seen the need for a long-term diversity study plan on wild mushrooms of Nigeria. The people of Nigeria and Edo State still collect edible fungi from the wild to fill their bland diets (Ogundana, 1975; Chang, 1980; Chang, 2000). The rate of mycophagy is yet to be fully evaluated. This study therefore aims at providing a good baseline reference for further ecological, ethnomycological and diversity study of mushrooms in Edo State. In addition, it also contributes to the global knowledge and distribution of mycota in both agroforests and forests of Africa which were hitherto poorly reported (Meijer, 2001; Mshigeni, 2003; Boa, 2004; Mueller *et al*., 2006; Wasser, 2007).


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