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Diversity and distribution of macrofungi (mushrooms) in the Mount Cameroon Region

Egbe Enow Andrew[1]*, Tonjock Rosemary. Kinge [2], Ebai Maureen Tabi[1], Nji Thiobal[3] and Afui Mathias Mih[1]

[1]Department of Botany and Plant Physiology, Faculty of Science, University of Buea, P. O. Box 63, South West Region, Cameroon.
[2]Department of Biological Sciences, Faculty of Science, University of Bamenda, P. O. Box 39, North West Region, Cameroon.
[3]Department of Sociology and Anthropology, Faculty of Social and Management Sciences, University of Buea, P.O. Box 63, South West Region, Cameroon.

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This study was carried out to document the diversity and distribution of macrofungi in the Mount Cameroon Region. These were assessed at low and high altitudinal ranges in the four flanks of the mountain during the rainy and early dry seasons of 2010 and 2011. A total of 177 macrofungal species belonging to 83 genera and 38 families were recorded. Species richness was higher in the rainy seasons (134 species) than in the early dry seasons (89 species) and tended to decrease with altitude, with 116 and 112 species for low and high altitudes, respectively. Eighty-eight species were recorded only in the rainy seasons, 43 species in the early dry seasons only, and 46 species were common to both seasons. Sixty-five species were found only in the low altitude, 61 species only in the high altitude, and 51 species were common to both altitudes. *Auricularia auricular* was the most abundant species during the rainy seasons, while *Coltricia cinnamomea* was rare during the rainy seasons, and the most abundant during the dry seasons. Six of the 12 morpho-groups identified occurred across the sites, with the gilled fungi being the most frequent. *Cyathus striatus* was found only in Buea Town during the rainy seasons. The study established that macrofungal diversity is threatened in the Mount Cameroon Region and needs for conservation measures especially for edible and medicinal species.

Key words: Abundance, diversity index, distribution, evenness index, macrofungi, Mount Cameroon.

INTRODUCTION

Fungi are a group of heterotrophic organisms that consist of a thallus, an assemblage of vegetative cells not forming tissue in the functional sense, and therefore not having differentiated organs. They are one of the most diverse groups of organisms on earth, and constitute a significant part of terrestrial ecosystems. They form a large share of the species richness and are key-players in ecosystem processes (Keizer, 1998; Seen-Irlet et al., 2007). Mushrooms are economically important since they serve as food, medicine, biocontrol agents, chemical producers of bioactive compounds used in the pharmaceutical and many other industries (Duarte et al., 2006). It has been known that several macrofungal species, such as *Trametes versiocolor*, serve as decom-posers of organic persistent pollutants (Tran et al., 2010; Tran et al., 2013). Macrofungi are useful in the bioreme-diation of industrial waste and the accumulation of heavy metals from the environment (Demirbas 2000; Kalac et al., 2004). Lignicolous macrofungi also have secondary metabolites which expressed significant effects such as

*Corresponding author. E-mail: egbe1@yahoo.com.

antibacterial activity (Hur et al., 2004; kalyoncu et al., 2010). They can also be grown and used as a cash crop (Mandeel and Al-Laith 2007). In spite of their beneficial properties some also have harmful effects on plants.

The term macrofungi (mushrooms) or Macromycetes has been variously defined by several authors. All the definitions lay emphasis on the production of fruiting bodies that are visible to the unaided eye (Da Silva, 2005; Lodge et al., 2004; Redhead, 1997; Seen-Irlet et al., 2007). According to Da Silva (2005), mushrooms are fleshy conspicuous fungi that have provided food for millennia and are in many cases associated with potentates and royalty because of their pleasant taste and flavour. Macrofungi include well-known groups that have been described by popular terms such as 'gilled fungi', 'cup fungi', 'bracket fungi', 'puffballs', and 'truffles'. These terms reflect the morphological diversity that is encountered within the macrofungi. Ecologically, macrofungi can be classified into three groups: the saprophytes, the parasites and the symbiotic (mycorrhizal) species. Most terrestrial macrofungi are saprobes or mycorrhizal symbionts, but some are pathogens of plants or fungi. Macrofungi fruiting on woody substrata are usually either saprobes or plant pathogens (Mueller et al*.,* 2007).

Macrofungi were long considered a strange group of organisms, poorly understood and difficult to study due to their largely hidden nature and frequently sporadic and short-lived sporocarps. Hence they have largely been neglected and overlooked in national and international nature conservation actions. However, through the research our knowledge of macrofungi has significantly increased. It is now largely feasible to evaluate the present status and future for macrofungi species and how human activities such as land management procedures will affect macrofungi diversity (Seen-Irlet et al*.,* 2007).

Mushrooms are widespread in nature and they remain the earliest form of fungi known to mankind (Okhuoya et al*.,* 2010). The issue of fungal diversity, its extent and conservation, has attracted more attention in the last 10 to 15 years than in any period of history (Hawksworth, 2004). Mushrooms appear to be collected and consumed during almost the entire year, but most fungi are collected during the rainy seasons, suggesting the importance of rainfall patterns in fungal phenology (Dijk et al*.,* 2003). Such is the case in tropical Africa, where many species are found in the rainy seasons, but there are a few species that are present throughout the year (Adekunle and Ajao, 2005; Gbolagade et al., 2006).

Mushroom biodiversity in Cameroon is rich and remains poorly unexplored (Yongabi et al*.,* 2004). *Termitomyces* spp are widely distributed across the country and provide an additional source of income for the rural people from Ndop plains and Baligham in the North West Region of Cameroon, as well as in Mbouda in the Western part of the country.

People in Cameroon and in most African countries undermine the importance of mushrooms (Yongabi et al*.,* 2004). However, the slow development of mushroom cultivation practices is changing due to research that have illuminated the potentials of mushroom-forming fungi, mushroom products and their uses in different spheres of human welfare (Wasser, 2007).

Given that the forest is the major habitat for macrofungi and other living organisms, there is need for appropriate design of management schemes to safeguard remnants of the tropical rain forest, as a result of rampant deforestation in the tropics due to increasing demand for land for cultivation and illegal logging practices. Effective strategies and solutions to sustainable forest management require taking into account economic and social interests of the forest dwellers as well as understanding of processes regulating the functioning of tropical rain forests.

The ecology of organisms is crucial for utilization of resources. With continuous deforestation and environmental degradation, which are contributing to loss in global biodiversity and which in many cases are irreversible, there is a risk of loss of macrofungi diversity and subsequent loss of knowledge of their existence and uses.

Only about 6.7% of 1.5 million species of fungi estimated in the world have been described and most of these are in temperate regions. The tropical region which is undoubtedly hosting the highest mycodiversity has been inadequately sampled and the mycoflora scarcely documented (Hawksworth, 2001). This makes the situation of macrofungi in the tropical forests unclear (Hawksworth, 2004). However new species are still being identified in the tropics (Douanla-Meli et al., 2007).

Mushroom resources have been exploited in most developed economies because of their huge agro-industrial, medicinal and commercial benefits **(**Okhuoya et al, 2010), while in Cameroon, mushroom biodiversity is rich, and remains poorly explored. It is therefore crucial to document the diversity, distribution and abundance of these macrofungi in the Mount Cameroon Region. The study of mushroom diversity and distribution would document the species that are found in this region and how seasonality and altitudinal gradient influence their distribution.

MATERIALS AND METHODS

The research was carried out in Mount Cameroon Region which is an active volcano and has an altitude of 4100 m (Figure 1). It is located between latitudes 3°57' to 4°27'N and longitudes 8°58' to 9°24'E (Suh et al*.,* 2003). The peak is at 4°7'N and 9°10'E (Tchouto, 1996). The main mass of Mount Cameroon is about 50 km long and 35 km wide. Due to the volcanic origin, the surrounding soil is rich in nutrients and provides high fertility for both natural vegetation and farmland (Egbe et al., 2012). The area has a humid tropical climate and the climatic pattern is modified by the topography from sea level to the top of the mountain. The annual rainfall on the mountain varies between 2085 and 10,000 mm. The mean annual temperature is about 25°C, and this decreases by 0.6°C per 100 m ascent (Fraser et al*.,* 1998). The climate of the Mount Cameroon Region is predominantly tropical,

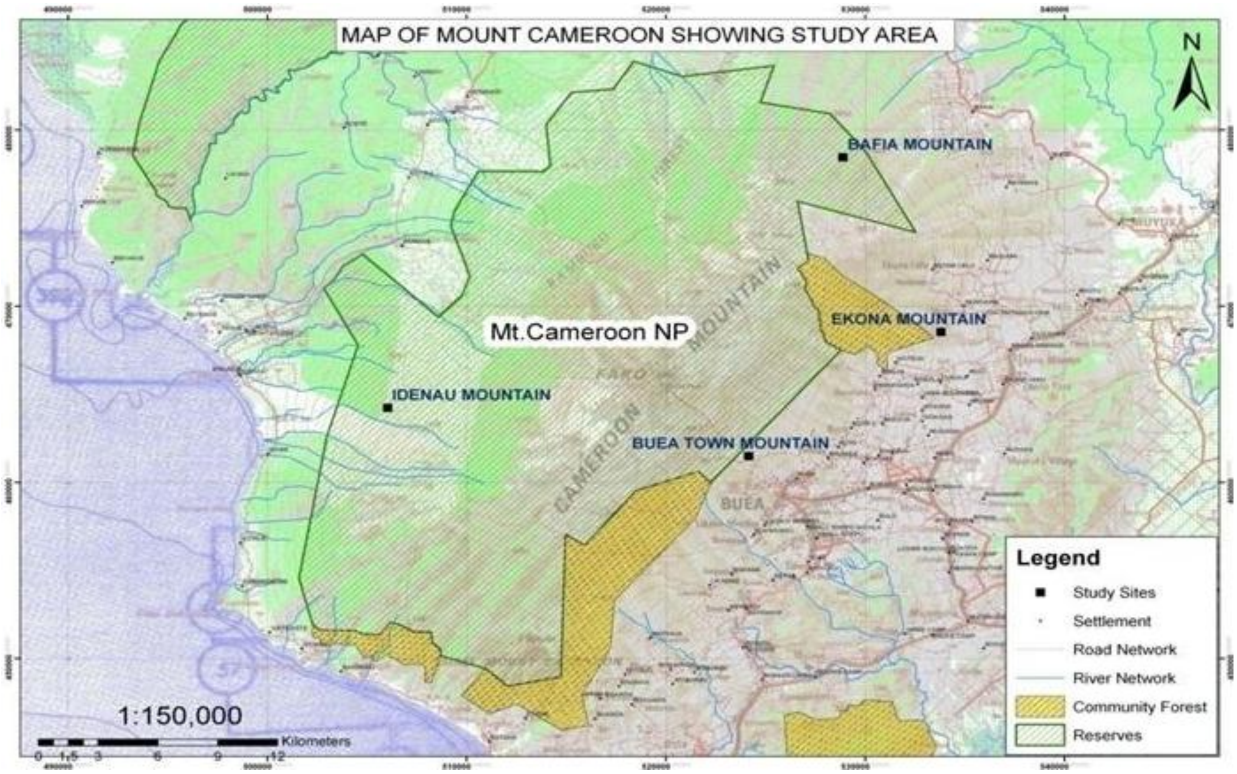


Figure 1. Study sites for diversity and distribution studies of macrofungi in the Mount Cameroon Region.

showing a definite rainy/dry season, with very high rainfall and high temperatures along the coastal belt. Rainfall and temperatures diminish and are moderated up the slopes and further inland. The indigenous inhabitants of the mountain are the Bakweri tribe and their main occupation is farming and fishing

Sampling of macrofungi

A reconnaissance survey was carried out in the Mount Cameroon Region to identify sampling sites and the following sites were chosen based on accessibility of the area (windward side, Idenau; leeward side, Ekona Lelu; midward side, Buea Town; and the hind side of the mountain, Bafia). Sampling of macrofungi was carried out in transects of 500 × 10 m and was separated by a distance 50 m along transects and 100 m between transects. The transects were established at low and high altitudes and these cut across food crop fields, bush fallow, farmers' trails, cocoa and oil palm plantations, secondary and primary forests. A total of 32 transects were thus surveyed from the 4 sites at low and high altitudinal ranges during the raining season (June to July) and early dry season (October to November) in 2010 and 2011. The location of each site is shown in Table 1.

A team of 6 people, three at each side of the central line walked along the transects and all macrofungi within the transect belt were recorded. Each macrofungi species within each transect was collected in separate specimen bags in order to avoid spore contamination among the different specimens and these were photographed in coloured and tagged. Morphological features such as size, colour, shape and texture of the sporocarp were recorded as these features might change with drying. At instances when more than one day was spent in the field, a local portable dryer (oven) was used to dry the specimens while for the closer sampling site, specimens of unidentified macrofungi were transported immediately to the laboratory using baskets and coolers. They were oven dried at 45°C for 12 to 24 h, depending on the thickness of the specimen and preserved in the refrigerator at 4°C for later identification.

Identification of specimen was based on macroscopic and microscopic features. The macroscopic features used were: the cap size, shape, colour, surface texture and surface moisture, gill colour, attachment, spacing, lamellules, the stem size, shape, surface texture and surface moisture, the presence or absence of partial and universal veils, flesh colour and texture.
Microscopic features were carried out using standard microscopic methods (Roy and De, 1996). The information of the various characters stated was used to identify each specimen by comparison with illustrations in colour field guides and also by the use of descriptions and keys (Ian et al., 2003; Jordan, 1993; Osemwegie and Okhuoya, 2009; Osemwegie et al., 2010; Roda 2010; Scott, 2006).

Using standard protocols, diversity indices such as Simpson and Shannon-Weiner diversity indices were used. The Pielous measure of species evenness was estimated and species similarity between sites was determined using the Jaccard's (Cj) and Sorenson's (Cn) coefficients (Table 2).

RESULTS

Diversity and distribution

A total of 177 species in 83 genera were collected (Appendix 1). The Subphylum Basidiomycotina had 163 species, while Ascomycotina had 14 species. There were

Table 1. Location of the sample sites used for diversity and distribution studies of macrofungi in the Mount Cameroon Region.

Sites	Low altitude			High altitude		
	Latitude	Longitude	Elevation (m)	Latitude	Longitude	Elevation (m)
Idenau	04° 13'15.5"N	009°01'51.8"E	241	04°13'29.4"N	009°02'14.0"E	500
Bafia	04°20'53.5"N	009°18'21.7"E	404	04°19'48.0"N	009°16'57.5"E	817
EkonaLelu	04°14'37.4"N	009°18'22.4"E	560	04°13'31.7"N	009°17'08.8"E	790
Buea Town	04°10'08.6"N	009°13'15.3"E	1369	04°10'32.9"N	009°12'15.3"E	1860

Table 2. Scales used in rating of macrofungi.

Scale	Rating	Description
1	Rare	This means that the species was present in <2 transects i.e.<25%
2	Occasional	This means that the species was present in 2-3 transects i.e. >25-49%
3	Frequent	This means that the species was present in 4-5 transects i.e. 50-74%
4	Abundant	This means that the species was present in 6-8 transects i.e. 75-100%

T**able 3.** Seasonal variation in the species diversity and evenness of macrofungi in the Mount Cameroon Region.

Site	Season*					
	RS			EDS		
	Simpson	Shannon-Weiner	Pielous	Simpson	Shannon-Weiner	Pielous
Idenau	0.9247	3.2107	0.8386	0.9169	2.6840	0.8560
Bafia	0.8367	2.6489	0.6959	0.7302	2.0384	0.5688
Ekona	0.9259	3.0648	0.8148	0.9215	2.8672	0.7882
Buea Town	0.9321	3.0265	0.7861	0.9036	2.7060	0.7956

* RS =Rainy season, EDS =Early dry season

134 species in 67 genera in the raining seasons, while in the early dry seasons there were 89 species in 46 genera. Eighty-eight species were present in the rainy seasons only and 43 species were present in the early dry seasons only, while 46 species were present both in the rainy seasons and in the early dry seasons (Appendix 1). The species richness tended to decrease with altitude, with 116 and 112 species for low and high altitudes, respectively. Sixty-five species were collected in only the low altitude, 61 species in only the high altitude and 51 species were common to both altitudes (Appendix 1).

The Identified species belong to 38 families of 15 Orders. Majority of the fungi belonged to the Agaricales (87 species), followed by the Polyporales (32 species) while the Eurotiales, Nidulariales and Phallales were each represented by just a single species (Figure 2).

The species abundance of the families was also assessed. The most abundant family was the Polyporaceae with 21 species, followed by Marasmiaceae and Tricholomataceae represented by 18 and 17 species respectively (Figure 3).

The macrofungi species were distribution across the four areas for the low and high altitudes as shown in Figures 4a and 4b respectively. For the low altitude, Buea Town had the highest number of species (23) in the rainy seasons, while Idenau had the least number of species (11) in the early dry seasons. In the high altitude Idenau had the highest number of species (23) in the rainy seasons and Idenau alongside Bafia had the least (13) in the early dry seasons.

The diversity indices and species evenness of macrofungi in the wet and dry seasons are presented in Table 3. Bafia had the lowest Simpson diversity indices in the wet and early dry seasons (0.84 and 0.73 respectively) while Idenau, Ekona Lelu and Buea Town (0.94) were about the same. The indices for evenness in the raining seasons ranged from 0.69 to 0.83 while that of the dry seasons was 0.56 to 0.85.

The variation in diversity and evenness with altitude during the wet and the dry seasons is in Table 4. During the wet and early dry seasons, diversity was higher at high altitudes with a range of 0.79 to 0.92 than low altitudes which had a range of 0.50 to 0.88 for all sampling sites. The species were more even at the high

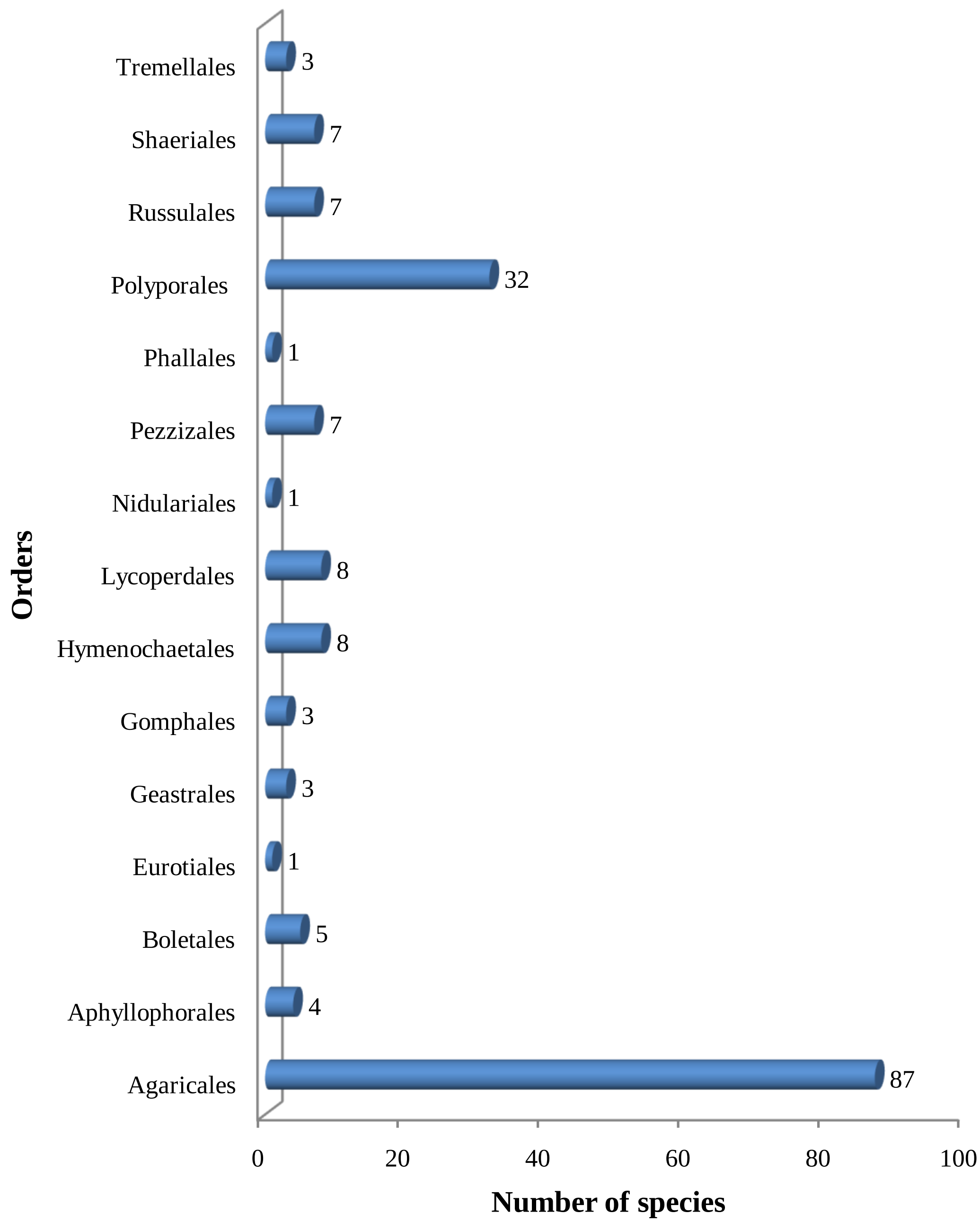


Figure 2. Orders and ampleness of macrofungi species in the Mount Cameroon Region.

altitudes than the low altitudes. The same trend was observed during the dry seasons, except for Idenau and Ekona Lelu during early dry seasons (0.83 and 0.76 respectively), where the species were more even at the low than at the high altitudes.

The Sorenson's similarity matrices between the sites for the two seasons are represented in Table 5. The similarity indices of the macrofungi in both the raining and early dry seasons were very low with ranges 0.13 to 0.32 and 0.12 to 0.31 respectively. A generally weak similarity was observed between the sites, but in both seasons, Bafia and Ekona Lelu were more similar in their species composition (Table 5).

Frequency of occurrence of species within the altitudinal ranges and seasons

During the wet seasons 79.10% of the 134 species were rare, occurring in just one out of 8 transects surveyed (Figure 5). A similar trend was observed during the early dry seasons sampling, with 83.62% of the species being

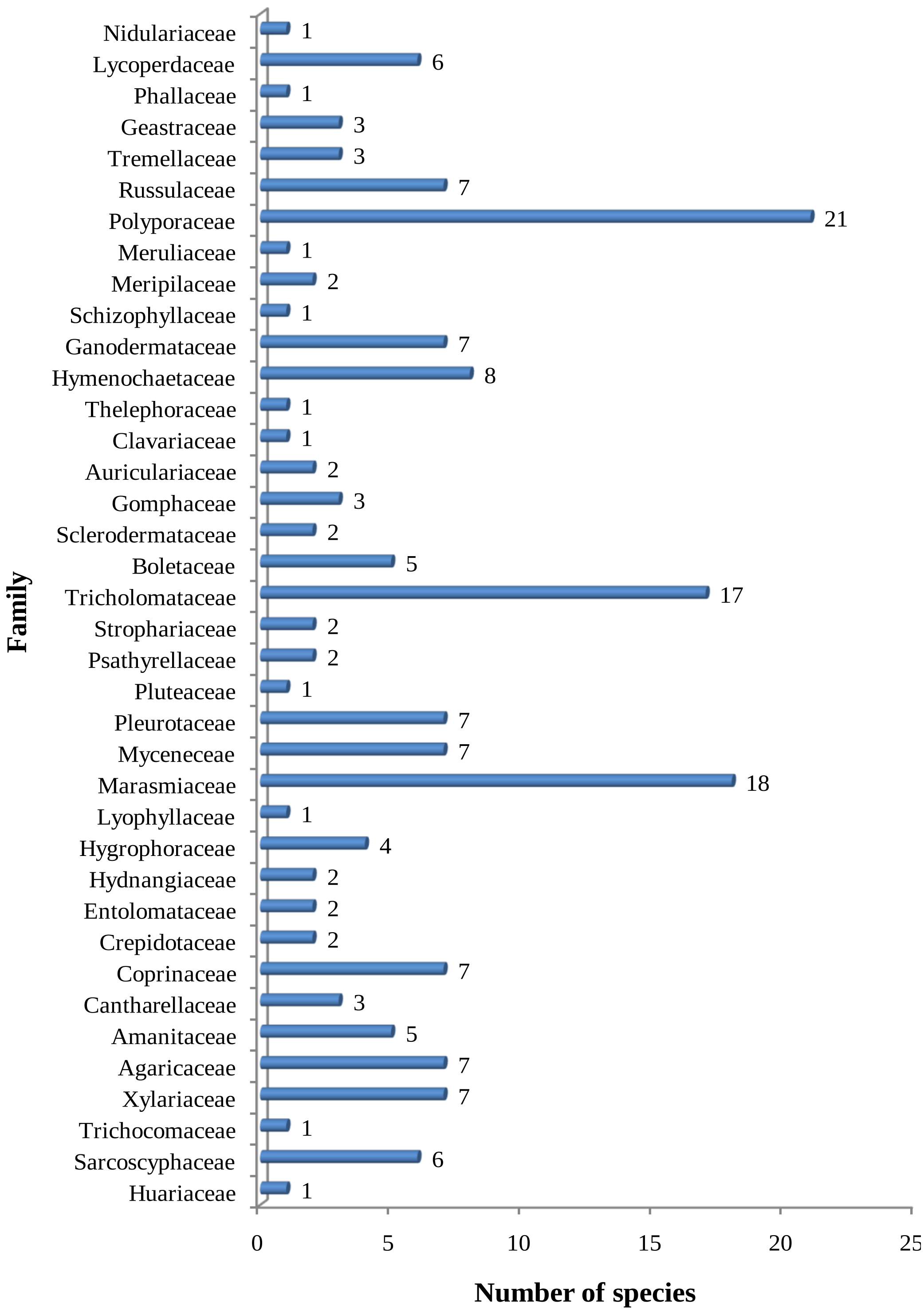
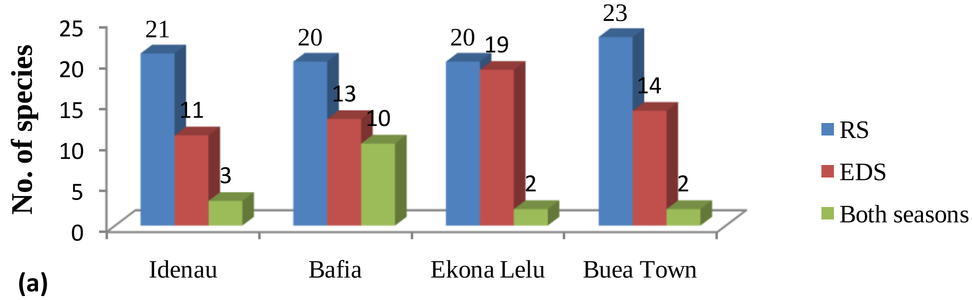


Figure 3. Families and ampleness of macrofungi species in the Mount Cameroon Region.

rare (Figure 6). In each seasons, only one species could be classed as abundant – *Auricularia auricular* for the wet seasons and *Coltricia cinnamomea* for the early dry seasons, occurring in at least 16 of the 32 transects surveyed.

Morphological groups of mushrooms recorded in the mount Cameroon Region

The macrofungi recorded were placed in twelve morpho-groups (Table 6). Most of the mushrooms were the gilled



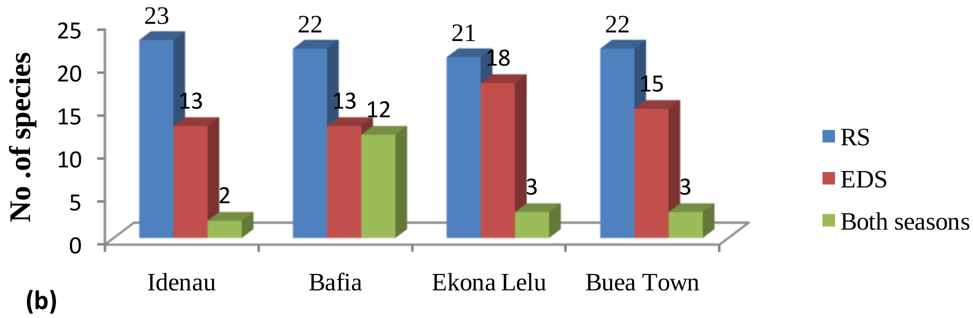


Figure 4. Seasonal occurrence of macrofungi species (a) in the low altitude in the Mount Cameroon Region. (b) at high altitude in the Mount Cameroon Region. * RS = Rainy season, EDS = Early dry season.

Table 4. Diversity indices and species evenness of macrofungi around Mount Cameroon at different altitudes and seasons.

Site	Season*	Diversity index				Pielous evenness	
		Simpson		Shannon Weiner			
		Low altitude	High altitude	Low altitude	High altitude	Low altitude	High altitude
Idenau	RS	0.8396	0.9042	2.4812	2.7477	0.7708	0.8536
	EDS	0.8662	0.7948	2.2160	1.7953	0.8397	0.7797
Bafia	RS	0.7933	0.8391	2.2449	2.4091	0.6890	0.7230
	EDS	0.5092	0.8573	1.2523	2.3681	0.4253	0.7661
EkonaLelu	RS	0.8475	0.9217	2.3250	2.7950	0.7522	0.8795
	EDS	0.7992	0.8769	1.9928	2.4080	0.6768	0.7790
Buea Town	RS	0.8892	0.8630	2.4953	2.3418	0.7958	0.7188
	EDS	0.8151	0.8652	1.9681	2.3594	0.7673	0.8013

* RS =Rainy season, EDS =Early dry season

fungi, which had 99 species, followed by the polypores with 39 species, while the bird's nest fungi and the stinkhorns were represented in the whole collection by a single species each. Fifty percent (50%) of the morpho-groups were ubiquitous, occurring in all the four sites surveyed, while 25% were found in three sites, 16.7% in two sites and 8.3% in one site. The distribution is shown in Table 6 and the morpho-groups are illustrated in Figure 7.

DISCUSSION

Species diversity was higher in the rainy seasons compared to the early dry seasons, as there is adequate moisture available during the rainy seasons, as moisture is one of the major factors influencing the fruiting of macrofungi. This corresponds with the findings of Dijk et al. (2003), in the Southern part of Cameroon, Apetorgbor

Table 5. Sorenson's similarity matrices for the rainy and early dry seasons.

Season	Idenau	Bafia	EkonaLelu	Buea Town
Raining season				
Idenau	1			
Bafia	0.286	1		
EkonaLelu	0.159	0.318	1	
Buea Town	0.130	0.174	0.180	1
Early dry season				
Idenau	1			
Bafia	0.237	1		
EkonaLelu	0.167	0.306	1	
Buea Town	0.115	0.188	0.212	1

Table 6. Distribution of morpho-groups of macrofungi in the Mount Cameroon Region.

S/N	Morphotype	Total no. of spp present in all the collection	No. of species				Total no. of sites present
			Idenau	Bafia	EkonaLelu	Buea Town	
1	Gilled	99	21	34	35	36	4
2	Boletes	3	2	0	1	0	2
3	Chanterelles	3	2	2	1	0	3
4	Club fungi	5	2	0	0	4	2
5	Polypores	39	23	15	16	17	4
6	Jelly fungi	5	2	3	4	1	4
7	Puffballs	7	2	3	2	1	4
8	Earthstars	3	0	1	2	2	3
9	Bird's nest fungi	1	0	0	0	1	1
10	Stinkhorn	1	1	1	0	1	3
11	Cup fungi	6	1	5	3	3	4
12	Flask fungi	5	4	3	2	3	4

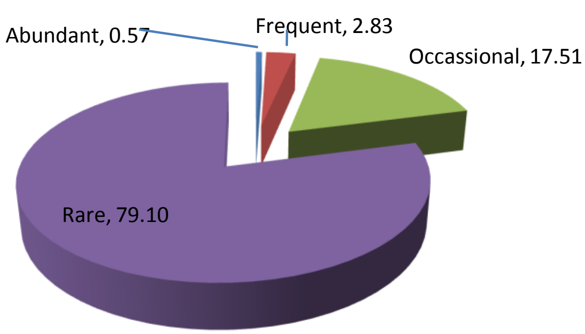


Figure 5. Frequency of occurrence of macrofungi species in the rainy season.

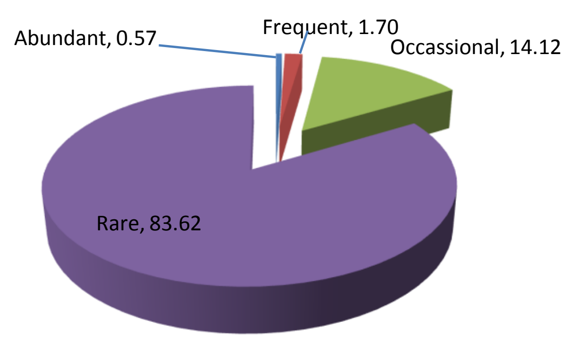


Figure 6. Frequency of occurrence of macrofungi species in the early dry season.

et al. (2005) in Southern Ghana, Brown et al. (2006) and Swapna et al. (2008) who worked on the diversity of macrofungi in semi-evergreen and moist deciduous forest of Shimoga District-Ksrnataka, India. Some species were present in both rainy seasons and early dry seasons, whereas others were present only in either of the periods. This could be due to differences in the time lag between the onset of favourable fruiting conditions and fruit body

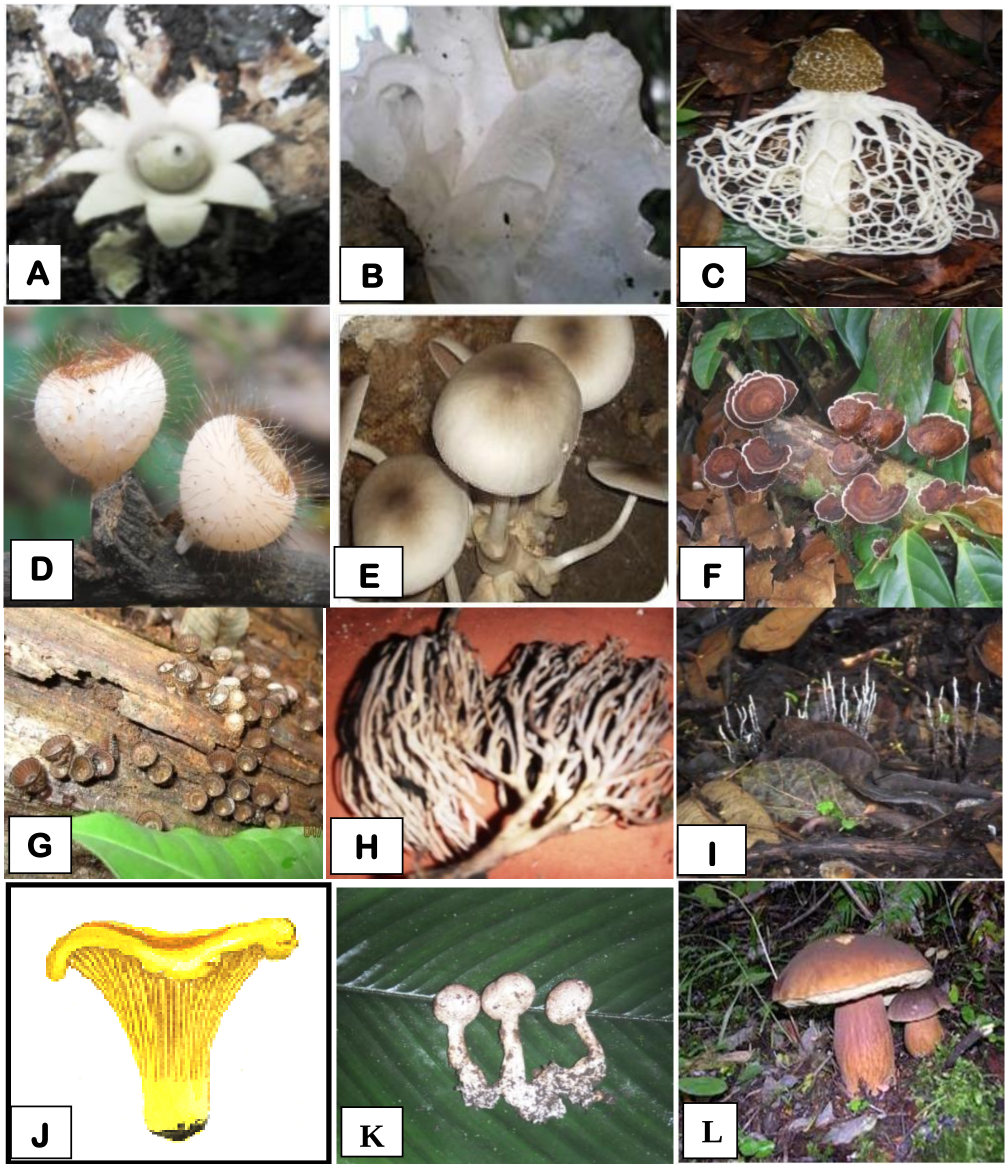


Figure 7. Representative morpho-groups of macrofungi found in the Mount Cameroon Region. ***Geastrum saccatum*** (Earthstar), **B)** ***Tremella fuciformis*** (Jelly fungi), **C)** ***Dictyophora indusiata*** (Stinkhorn), **D)** ***Cookeina tricholoma*** (Cup fungi), **E)** ***Volvariella volvaceae*** (Gilled fungi), **F)** ***Coltricia cinnamomea*** (Polypore), **G)** ***Cyathus striatus*** (Bird's nest fungi), **H)** ***Ramaria pallida*** (Club fungi), **I)** ***Xylaria* sp** (Flask fungi), **J)** ***Cantherellus* sp** (Chanterelle). K) ***Lycoperdon* sp.** (Puffballs) **L)** ***Boletus* sp. (Boletes).**

production between the different species of macrofungi studied. This collaborates with the findings of Tibuhwa (2011), who studied substrate specificity and phenology of macrofungi community in Tanzania. It could also be due to succession of macrofungi in this region. Succession involving changes in community composition often are related to changes in the quality of the substratum. For instance Heilmann-Clausen (2001) observed that trunks of large fallen trees host a cadre of fungi that fruit early during log decomposition and others that fruit only later. Generally small sized species are delicate and fragile with small wiry stipes and frequently marcescent from litter-inhabiting genera such as *Coprinus, Marasmius* and *Mycena,* and they fruited out first with early rains. These species appeared and disappeared very quickly while the large sized fruit bodies fruited after a continued period of rains of more than two weeks. This might be due to their small fruit bodies and their nature of forming fruit bodies at relatively shallow depth thus fluctuation in moisture has more effect on them than other groups of macrofungi. Similar results were also found by Gates et al. (2011), who noted that most macrofungi require a period of vegetative growth before fruiting during which the mycelia accumulate before being triggered to fruit.

Most of the fleshy and gilled macrofungi were recorded in the rainy seasons as this period is favourable for their production, since there is adequate moisture, favourable temperature, relative humidity and sunshine, which also aids the macrofungi in the decomposition of dead organic matter. While the early dry season collection was predominated by the polypores since there is decrease in rainfall and relative humidity, increase in temperature and sunshine, most of the fleshy macrofungi cannot withstand these conditions. It might also be probable that these species are not readily eaten by insects and other animals, thus the increase in their abundance. This might also be due to their perceptible tough and large sized fruit bodies, and also their unique adaptations of surviving for several years producing a new layer of spore producing surfaces thus elevate above the ground ensuring a continuous supply of food material.

Volvariella volvacea among other species did not show any seasonal variation but occurred in all the collection periods. Similar results were also recorded by Dijk et al. (2003). Species of *Termitomyces* were found only in the early dry seasons, which are in confirmation with the findings of Dijk et al. (2003) who reported that *Termitomyces* spp peaks early in the long rainy season in the region of South Cameroon.

The high species diversity at high altitude was due to low temperature, high relative humidity and soil moisture which in turn affected the type of vegetation found on the mountain slope (Payton, 1993). This could also be due to the anthropogenic influence in the low altitude, where most of the forest has been destroyed. Although there were more genera and species in the high altitude, the abundance of the species was higher in the low altitude. This is probably due to the higher number of fallen dead leaves and woods of cocoa trees, coffee trees and other agricultural crops in the lower altitude. There was high abundance of species of *Mycena* and *Marasmius,* which are typically found as wood and leaf litter saprotrophs (Alexopoulos et al., 1996), and species of *Xylaria*, which are wood–decomposing saprotrophs and weak parasites.

Apart from *A. auricular, Xylaria carpophila, Lenzites betulina, Ganoderma applanatum, Flavolus brasiliensis, C. cinnamomea, Scutellinia stecullata, Cookeina sulcipes and cookeina tricholoma,* the rest of the species were either occasional or rare. The reason for the rareness of most of these species could be due to the environmental degradation as a result of deforestation. Also it could be that the environmental factors do not favour their growth, which could include the presence of their mycorrhizal plant counterparts.

Macrofungi diversity was higher in the high altitudes in both the rainy seasons and early dry seasons. The higher diversity in the high altitude was probably because of the less anthropogenic effect in the high altitude as compared to the mass forest destruction in the low altitude, for the establishment of oil palm and rubber plantations, cocoa farms, food crop fields etc.

The Subphylum Basidiomycotina, class Hymenomycetes, order Agaricales, and the genus *Marasmius* were the most represented taxa recorded during the study. This agrees well with the works of Osemwegie and Okhuoya (2009) in their study of diversity of macrofungi in oil palm agroforests of Edo State, Nigeria.

Conclusion

There is increasing interest in the mapping of macrofungal flora of many areas to obtain the distribution records similar to those already existing for flowering plants. However, unlike plants the identification of macrofungi relies on the collection of fruiting bodies, which in turn is largely dependent upon the availability of moisture in most cases.

The list of macrofungi in this study provides the baseline information needed for the assessment of changes in biological diversity in Mount Cameroon Region. It is an important first step towards producing a checklist of macrofungi in Mount Cameroon Region.

The importance of mushrooms not only in the ecosystem dynamics but also in human diet and health increases the need for the conservation of this non-timber forest product resource. Conservation can also be achieved through cultivation, creation of national parks and forest reserve areas, and the reduction of illegal logging of timber. It is therefore necessary to include macrofungi biodiversity conservation in forest management policies in Cameroon.

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Appendix 1. Macrofungi collected in the Mount Cameroon Region at different altitudinal ranges and seasons.

S/N	Species	Low altitude								High altitude								Total number across sites
		Idenau		Bafia		EkonaLelu		Buea Town		Idenau		Bafia		EkonaLelu		Buea Town		
		RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	
1	*Agaricus arvensis*	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	9
2	*Agaricus campestris*	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
3	*Agaricus impudicus*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
4	*Agaricus trisulphuratus*	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	1
5	*Amanita battarrae*	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3
6	*Amanita cygnea*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
7	*Amanita malleata*	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	9
8	*Amanita similis*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
9	*Amanita* sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
10	*Amauroderma* sp	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
11	*Amauroderma subrugosum*	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6
12	*Auricularia auricular*	20	5	0	0	11	0	15	15	7	0	21	56	0	71	74	0	305
13	*Auricularia polytricha*	0	0	22	26	0	0	0	0	0	0	12	19	25	0	0	0	104
14	*Bjerkandera fumosa*	0	0	0	0	0	0	0	63	0	0	0	0	9	0	0	0	72
15	*Boletus calopus*	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
16	*Boletus* sp	0	0	0	0	0	7	0	0	0	0	0	7	0	0	0	0	14
17	*Boletus venenatus*	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
18	*Bondarzewiames enterica*	0	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
19	*Bovista* sp	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	16
20	*Calvatiaexci puliformis*	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	14
21	*Calvatia pyriformis*	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
22	*Calvatia* sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
23	*Campanella junghuhnii*	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	40
24	*Cantharellu scibarius*	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	7
25	*Cantharellus luteopunctatus*	0	0	0	0	11	1	0	0	0	0	70	0	0	9	0	0	91
26	*Cantharellus* sp	15	0	0	0	0	0	0	0	0	12	16	0	0	0	0	0	43
27	*Chlorophullum molybdites*	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	5
28	*Clavaria multifida*	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
29	*Clitocy begibba*	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	5	12
30	*Clitocy berevoulosa*	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0	22
31	*Clitocybe* sp	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	11
32	*Clitocybe squamulosa*	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	7
33	*Collybia butyraceae*	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	15
34	*Collybia cookei*	0	0	0	0	0	0	61	0	0	0	0	0	0	0	0	0	61

S/N	Species	Low altitude								High altitude								Total number across sites
		Idenau		Bafia		EkonaLelu		Buea Town		Idenau		Bafia		EkonaLelu		Buea Town		
		RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	
35	*Collybia dryophila*	0	0	40	0	45	0	0	0	0	0	67	0	0	0	0	0	152
36	*Collybia maculata*	14	0	0	0	3	0	0	0	0	0	0	0	0	0	150	0	167
37	*Coltricia cinnamomea*	0	52	0	20	0	35	0	0	21	0	25	37	0	13	0	16	219
38	*Coltricia perennis*	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4
39	*Cookeina sulcipes*	0	0	51	15	0	10	0	0	0	0	55	88	19	0	13	0	251
40	*Cookeina tricholoma*	0	0	26	31	0	7	0	0	0	0	11	1	0	4	0	0	80
41	*Coprinus comatus*	0	0	0	0	0	120	0	0	105	0	0	0	0	0	0	3	228
42	*Coprinus disseminates*	112	82	175	0	0	0	0	0	0	0	0	22	0	0	0	0	391
43	*Coprinus friesii*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97	0	97
44	*Coprinus galopus*	0	0	0	0	0	0	0	7	0	0	0	0	84	0	0	0	91
45	*Coprinus micaceus*	0	9	17	1	0	0	0	0	18	66	0	0	0	0	0	0	111
46	*Coprinus plicatilis*	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	7
47	*Coprinus* sp	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	11
48	*Crepidotus mollis*	0	0	0	0	0	0	43	0	0	0	0	0	0	0	0	0	43
49	*Crepidotussub sphaerosporus*	0	0	0	0	0	0	97	0	0	0	0	0	0	0	0	0	97
50	*Cyathus striatus*	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	8
51	*Daedaleopsis confragosa*	0	0	0	0	0	0	0	0	0	14	0	54	0	5	0	0	73
52	*Daldinia concentrica*	0	0	35	0	0	0	102	0	0	0	0	0	25	0	13	0	175
53	*Dictyophora indusiata*	11	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0	15
54	*Echinocheatea* sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	77
55	*Entoloma* sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
56	*Flammulina velutipes*	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0	31
57	*Flavolus brasiliensis*	27	0	0	0	45	0	0	13	0	0	26	77	61	114	0	30	393
58	*Ganoderma applanatum*	0	0	0	0	0	16	0	4	11	0	0	0	0	1	1	0	33
59	*Ganoderma lucidum*	0	0	0	8	0	0	5	0	0	0	0	0	0	0	0	0	13
60	*Ganoderma ryvardensis*	5	0	0	0	0	0	30	15	5	0	0	0	9	0	0	1	65
61	*Ganoderma zonatum*	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	9
62	*Ganoderma* sp	0	0	21	0	2	0	0	0	0	0	0	0	0	0	0	0	23
63	*Geastrum mirabile*	0	0	0	0	0	0	0	0	0	0	33	0	0	0	13	0	46
64	*Geastrum saccatum*	0	0	0	0	25	0	0	0	0	0	0	0	35	0	5	0	65
65	*Geastrum triplex*	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	16
66	*Gerronem abeninensis*	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	50
67	*Guepinia spathularia*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	133	0	133
68	*Haploporus odorus*	0	0	0	0	0	0	0	60	0	0	0	0	0	0	0	0	60
69	*Hygrocybe* sp	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	7	12
70	*Hygrophorus* sp	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	10

S/N	Species	Low altitude								High altitude								Total number across sites
		Idenau		Bafia		EkonaLelu		Buea Town		Idenau		Bafia		EkonaLelu		Buea Town		
		RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	
71	*Hypholoma marginatum*	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	13
72	*Inonotus radiates*	0	0	8	0	0	0	0	0	0	20	11	0	35	0	0	0	74
73	*Laccaria amethystina*	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	88
74	*Laccaria laccata*	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55
75	*Lactarius intermedius*	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	45	50
76	*Lentinus sajor-caju*	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
77	*Lentinus* sp	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
78	*Lentinus tigrinus*	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
79	*Lenzites acuta*	0	0	0	0	0	0	0	0	0	0	0	29	0	0	0	0	29
80	*Lenzites betulina*	0	0	16	0	43	0	0	0	6	2	0	0	16	0	0	0	83
81	*Lenzites* sp	0	51	0	0	0	89	0	0	0	0	0	0	0	0	0	0	140
82	*Lenzites warnieri*	0	0	0	8	0	0	0	0	0	0	0	0	0	25	0	0	33
83	*Lepiota cristata*	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	5	35
84	*Lepista* sp	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
85	*Lycoperdon pyriforme*	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	5
86	*Lyophyllum* sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
87	*Macrolepiota rhacodes*	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4
88	*Marasmiellus chamaecyparidis*	0	0	0	4	21	0	0	0	0	0	150	0	0	0	0	0	175
89	*Marasmiellus ramealis*	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
90	*Marasmiellus vaillantii*	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	16
91	*Marasmius candidus*	0	0	0	0	37	0	0	0	0	0	0	0	11	0	0	0	48
92	*Marasmius cohaerens*	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	28
93	*Marasmius graminum*	0	0	0	0	22	0	0	0	0	0	0	0	0	28	0	0	50
94	*Marasmius maximus*	0	0	0	0	0	0	17	0	0	0	0	0	35	11	0	10	73
95	*Marasmius ohshimae*	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	6
96	*Marasmius oreades*	0	0	0	0	103	0	0	0	0	0	0	60	0	0	0	0	163
97	*Marasmius pulcherripes*	0	0	85	00	115	0	0	0	0	0	35	0	0	0	0	0	235
98	*Marasmius pura*	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25
99	*Marasmius purpureostriatus*	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	12
100	*Marasmius rotula*	0	0	87	0	0	0	0	0	0	0	0	0	0	0	0	0	87
101	*Marasmius scorodonius*	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
102	*Marasmius siccus*	0	0	44	0	0	0	0	0	31	0	18	0	0	0	0	0	93
103	*Marasmius undatus*	0	0	0	0	0	1	5	0	0	0	0	0	0	0	0	0	6
104	*Micromphale* sp	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	20
105	*Microporus affinis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	25
106	*Mycena galopus*	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1

S/N	Species	Low altitude								High altitude								Total number across sites
		Idenau		Bafia		EkonaLelu		Buea Town		Idenau		Bafia		EkonaLelu		Buea Town		
		RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	
107	*Mycena haematopus*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
108	*Mycena pura*	0	0	0	0	8	0	1	0	0	0	0	0	0	0	0	0	99
109	*Mycena rhenana*	35	0	0	0	0	0	0	0	0	93	0	0	0	0	0	0	128
110	*Mycena stipata*	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	6	14
111	*Mycena tenerrima*	0	0	0	0	0	1	0	0	0	0	251	0	0	0	0	0	252
112	*Nigroporus vinosus*	0	0	0	0	0	0	0	7	0	0	0	1	0	0	0	30	38
113	*Nothopanus hygrophanus*	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	150
114	*Oudemansiella canarii*	0	0	0	13	0	0	0	0	0	0	0	0	15	0	0	10	38
115	*Oudemansiella radicata*	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
116	*Oudemansiella* sp	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
117	*Oxyporus corticola*	0	30	0	0	0	4	0	0	0	0	0	0	0	0	0	0	34
118	*Panellus stipiticus*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	12
119	*Panus fulvus*	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	7
120	*Panus* sp	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	6
121	*Penicilliopsis* sp	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	12
122	*Perenniporia ochroleuca*	0	104	0	0	0	0	0	132	0	0	0	0	0	0	0	25	261
123	*Pezziza badida*	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	5
124	*Pezziza* sp	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	5
125	*Phellinus gilvus*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	35
126	*Phellinus igniarius*	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	0	23
127	*Phellinus noxius*	7	0	0	0	5	5	0	0	7	1	0	0	**0**	0	0	0	25
128	*Phellinus* sp	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	40
129	*Phellinus xeranticus*	0	3	0	0	0	0	0	0	9	0	0	51	0	0	0	0	63
130	*Phillipsia domingensis*	0	0	0	4	0	0	10	0	0	0	0	0	0	0	0	0	14
131	*Pholiota highlandensis*	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	10
132	*Phylloporu stenuipes*	9	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	9
133	*Plectania nannfeldtii*	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4
134	*Pleurotus flabellatus*	0	0	0	0	0	0	0	0	17	0	0	0	0	13	0	0	30
135	*Pleurotus luteoalbus*	0	0	0	0	0	0	0	11	0	0	45	0	33	55	0	0	144
136	*Pleurotus pulmonarius*	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	13
137	*Pleurotus squarrosulus*	0	0	0	0	0	0	0	0	11	0	0	10	0	10	0	0	31
138	*Pleurotus tuberregium*	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4
139	*Polyporus tenuiculus*	0	0	0	0	0	0	0	48	0	0	0	0	0	0	0	0	48
140	*Psathyrella* sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	35
141	*Psathyrella spadiceogrisea*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4

S/N	Species	Low altitude								High altitude								Total number across sites
		Idenau		Bafia		EkonaLelu		Buea Town		Idenau		Bafia		EkonaLelu		Buea Town		
		RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	
142	*Pycnoporellus fulgens*	0	0	0	0	0	0	0	0	0	61	0	0	0	0	0	0	61
143	*Ramaria fennica*	0	0	0	0	0	0	44	0	0	0	0	0	0	0	0	0	44
144	*Ramaria ochraceovirens*	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
145	*Ramaria pallida*	13	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	19
146	*Rigidoporus lineatus*	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	18
147	*Rigidoporus microporus*	13	25	6	0	2	0	0	0	0	0	0	0	0	0	0	0	46
148	*Russula acriannulata*	0	0	0	0	0	0	0	0	**0**	0	0	0	1	0	0	0	1
149	*Russula anthracina*	0	0	2	9	0	0	0	0	0	0	0	0	0	1	0	0	33
150	*Russula cosobrina*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
151	*Russula earlei*	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
152	*Russula emetica*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
153	*Russula gracillima*	0	0	0	0	0	0	0	2	0	0	0	0	0	**0**	0	0	2
154	*Russula luteotacta*	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
155	*Schizophyllum commune*	0	0	75	0	0	0	0	0	0	0	0	0	0	0	0	0	75
156	*Scleroderma* sp	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
157	*Scutellinia stecullata*	0	0	0	794	0	0	0	0	0	22	0	303	0	0	0	30	1149
158	*Termitomyces medius*	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	10
159	*Termitomyces* sp	0	0	0	0	0	0	0	0	0	0	0	9	**0**	0	0	0	9
160	*Trametes cervina*	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	10
161	*Trametes elegans*	7	0	0	20	0	6	0	0	19	0	0	0	0	0	0	0	52
162	*Trametes pubescens*	0	0	0	0	0	0	0	35	0	0	0	0	0	0	0	0	35
163	*Trametes* sp	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
164	*Trametes versicolor*	0	0	5	0	0	2	0	0	40	0	0	17	0	0	50	12	126
165	*Tremella fuciformis*	0	0	4	0	0	0	0	0	0	0	0	0	9	0	0	0	13
166	*Tremella mesenterica*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
167	*Tremella* sp	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
168	*Tricholoma* sp	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
169	*Tricholoma ustale*	22	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	22
170	*Vascellum pratense*	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	5
171	*Volvariella volvaceae*	0	0	0	0	0	0	0	0	19	0	52	3	0	0	0	0	74
172	*Xeromphalina tenuipes*	0	45	0	0	0	0	0	0	0	0	0	0	0		0	0	45
173	*Xylaria carpophila*	253	0	579	186	250	0	0	0	0	0	500	0	0	60	250	95	2173
174	*Xylaria hypoxylon*	22	0	0	0	0	0	0	0	0	0	0	272	0	0	0	0	294
175	*Xylaria polymorpha*	0	19	21	0	0	0	16	0	0	0	11	0	0	0	0	0	67
176	*Xylaria* sp	0	3	0	0	0	0	0	0	0	0	0	0	0	0	22	0	25
177	*Xylaria tuberoides*	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2

S/N	Species	Idenau		Bafia		EkonaLelu		Buea Town		Idenau		Bafia		EkonaLelu		Buea Town		Idenau
		RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	RS	EDS	
Total		723	452	1387	1167	794	361	703	401	454	296	1496	1137	497	481	953	335	11,637

*RS = Rainy season, EDS = Early dry season.