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*Full Length Research Paper*

# Diversity of macrofungi at the University of Dar es Salaam Mlimani main campus in Tanzania

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**Macrofungi play important roles in nutrient cycling, forestry, pharmacology industry, production of cultivated fungi in the food industry, as well as their vital role in biodegradation and biodeterioration. Information about the diversity, community organization, and variations in time and space of macrofungi community belonging to the Basidiomycota and Ascomycota at the University of Dar es Salaam (UDSM) Mlimani main campus in Tanzania is totally non-existent. This study was conducted on three major habitats based on types of land use namely: natural trees, planted trees and the gardens which included cleared grounds at the UDSM. The method based on fruit body recording and analysis to provide a set of biodiversity quality indices which included fungi taxonomic field work and inventory of collections made to document the macrofungi species present. It also included quantitatively comparisons in terms of species diversity and richness across the three major habitats studied using diversity species indices. Results showed that there were 18 families, 29 genera and more than 61 species out of more than 676 fruit bodies collected. The Agaricaceae family in the Agaric morpho group were the best represented taxa (71%) with the least represented (2%) belonging to Hydnaceae of the 'tooth fungi' morpho-group. Shannon Wiener diversity species indices showed that the species composition varied among habitats with the natural tree leading (3.8882) followed by planted trees (3.1358) and the gardens recorded the least (2.8647). On the other hand, the Reyni diversity of species ordering showed a tremendous decrease of species diversity in the disturbed habitat. These results show that there is high species diversity and abundance in the 'natural trees' which are relatively protected compared to 'planted trees' and 'gardens' as well as a tremendous decrease of species diversity in the disturbed habitats. These findings suggest that disturbances and soil compaction affects the macro fungi distribution. The results thus recall for the need for conservation and further research in this area, particularly at the community and species level which is essential to monitor the effectiveness of, or the need for conservation, and also to follow the effects of natural or artificial disturbance.**

**Key words:** Ascomycota, Basidiomycota, communities, macrofungi, morpho-group.

## INTRODUCTION

Macrofungi constitutes dissimilar groups of taxa which play important roles in nutrient cycling and nutrient uptake, crucial to tree health by buffering trees from toxic minerals and nourishing them by mycorrhiza association (Gates et al., 2011). Fungi recycle lignocelluloses and mineral nutrients thus replenish them back to the ecosystem. Apart from this, their decay activities soften the woody tissues making them more habitats acquiescent to other organisms such as birds, small mammals, arthropods, nematodes as well as other fungi (Gates et al., 2011). Wood decay debris acts as a moisture sink for the maintenance of mycorrhizal fungi in

seasonally dry forests and the brown-rot residues as a major soil component (Jurgensen et al., 1986). Fungi breakdown the dead wood and fallen litter allowing the recycling of both simple and complex compounds which is vital to the ecology of the tropical forest and to any plant community. Many fungi are economically important and on the forest floor form an intimate relationship with the roots of many trees to the extent that one cannot exist without the other (Pegler, 1997). However, their variation, diversity and community organization is trivially known within the ecosystem. Fungi remain amongst the most poorly known elements with minimal mushroom diversity studies especially in many developing countries biased to edible if any (Boa, 2004; Osemwegie, 2009). The University of Dar es Salaam (UDSM) a research and teaching institution in Tanzania was chosen as the research area for this study because its macrofungi have not been investigated.

Tanzania vascular plant species and the forest communities are well documented (Clarke and Dickinson, 1995; Clarke, 2001; Rodgers et al., 1983; Wending et al., 2003). In contrast, floristic information for the macrofungi of general habitat types in the country is meager. There is no field guide to common species found in the country apart from one hundred species by Härkönen et al. (1995, 2003) who recorded randomly from different parts of the country but surprisingly without any taxa from UDSM Mlimani main campus. There is no comprehensive taxonomic treatments at the community level except for single genus studies such as Buyck et al. (2000) and Tibuhwa et al. (2008) who both worked on a genus *Cantharellus* Fr. from miombo-woodland of Tanzania. Tibuhwa et al. (2010) also studied the genus *Termitomyces* whereas Magingo et al. (2004) studied *Odumensiela* species, Mshandete and Cuff (2008) studied *Pleurotus* species recently and Tibuhwa (2011) studied the *Sarcoscypha* species.

UDSM Mlimani main campus composes of big unintentionally conserved natural trees forming huge thicket bushes left within the Dar es Salaam city in Tanzania. The area occupies 1625 acres, about 20% occupied by buildings and roads; the rest constitutes a uniquely complex ecosystem which supports a wide range of organisms. They include bird species of global conservation significance, rare mammals, reptiles, amphibians and invertebrates.

The ecosystem also supports the growth of diversified macro fungi communities in the campus which is one of the most spectacular elements of the forests and other organism but which has not yet been studied. This study therefore aimed at: 1) inventorying the compositions of macrofungi community belonging to the Basidiomycota and Ascomycota within UDSM Mlimani main campus; 2) carrying out a quantitative comparison of species diversity and richness among the three major habitats based on land use types of the studied area and 3) establishing if the habitats: natural trees, planted trees and gardens including cleared grounds affects the general distribution of mycobiota.

## MATERIALS AND METHODS

### Study area

The study was carried out at the UDSM Mlimani main campus (Figure 1) for 3 consecutive years from 2008. It is situated on the western side of the city of Dar es Salaam 6°48' South, 39°17' East (−6.8000, 39.2833), on the observation hill, 13 km from the city centre. The campus occupies 1,625 acres within Kinondoni district in the Dar es Salaam region, Tanzania. A remarkable feature of the study area is its enormous orography, geological, floristic diversity as well as different land use units which gives rise to its macrofungi diversity. Based on land use practices at the campus, three unit habitats were distinguished: i) natural trees (NT), ii) planted trees (PT) and (iii) the (GCF) representing gardens including cleared fields, playing grounds and recreation places (Figure 1).

### Vegetation

The NT characterised with huge bushes comprise a large part of the vegetation which are strictly protected and less disturbed. There is no outstanding human activity in the area except for researchers and practical classes for students. It is scattered within the major part lying to the periphery from the South east extending to North-east to Msewe village border, then stretching out to Changanyikeni village border in the Northern part. The vegetation in the natural trees is of thicket bushland found in patches with high diversity of shrubs and small trees. Common trees are *Albizia petersiana*, *Pteleopsis myrtifolia*, and *Dalbrgia melanoxylon* (ebony tree) while common shrubs includes: *Grewia forbesii*, *Grewia microcarpa* and *Cassia abbreviata*. The PT is dominated with exotic tree species with few remnant indigenous trees and shrubs and is commonly found within the residential areas including the student hostels, academic blocks as well as administration blocks. The dominant exotic tree species includes: *Peltophorum pterocarpum*, *Ficus benjamina*, *Delonix regia*, *Anacardium occidentale* and *Azidarachta indica* (Neem tree); while dominant indigenous trees are *Pteleopsis myrtifolia*, *Ficus capensis* and *Strychnos madagascariensis*. The huge bushes of planted trees were observed near the estate and the north western part of Mlimani primary school.

The PT is dominated by huge trees of *F. benjamina* planted purposely for its fibrous root system which help in reducing soil erosion due to the hilly topography of the campus. The third habitat constitutes the central fringe of the study area surrounding the building premises including cultivated gardens and cleared fields for playing and recreation grounds. The gardens are dominated by exotic species of shrubs. The common shrubs includes: *Bouganvillea glabra*, *Plumeria rubra*, *Lantana camara*, *Allamanda carthatica* and *Codiaeum variegatum* respectively. In areas with water leakage sometimes, small wetland vegetation type becomes commonly formed with sedges and rushes species such as *Cyperus rotundus* and *Typha capensis*; while cleared grounds and sports fields mainly composed grassland vegetation type dominated by indigenous grass species which includes: *Dichanthium annulatum*, *Cynodon dactylon* and *Sporobolus pyramydalis*. The only common exotic grass species is *Stenotaphrum dimidiatum* (Pemba grass) which is planted on the surrounding of the buildings and gardens.

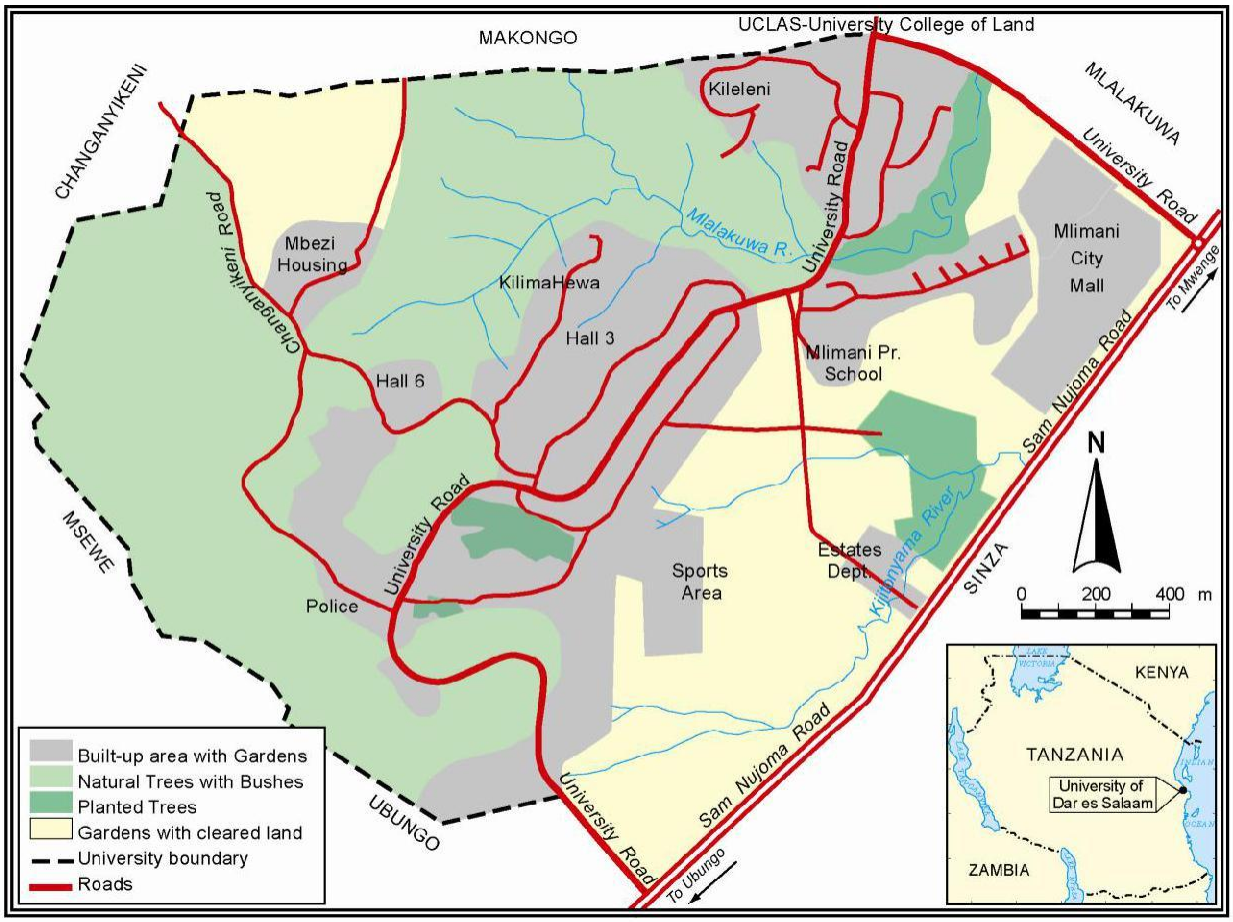


**Figure 1.** University of Dar es Salaam Mlimani main campus showing studied sites.

**Geology and climate**

The University of Dar es Salaam lies in the eastern coast of the country and is geologically underlined by coastal plain Pleistocene sediments which include beach sands and coral limestone without any extensive outcrops (Moore, 1962). The entire area has a tropical rainforest microclimate with average rainfall of 1042 mm per year and with a broad range of temperatures of 20 to 35°C. The average annual relative humidity is 77.9% with 72% in January and 82% in April. Average sunlight hours per year are 2836 h with an average of 7.8 h of sunlight per day without any frost.

**Sampling and data collection**

Macrofungi were expediently collected along five laid transects in each established three land use types of the UDSM Mlimani main campus, each measuring 15 × 20 m marked with fixed ribbons on pegs and on site trees. The plots were approximately 10 m apart and 5 m away from the main road. Surveys in the plots were done three times every year (two rain seasons, March to May, September to November and one dry season July to August) for all three consecutive years. Sampling methods complies with that of Tibuhwa et al. (2010) and consists of collecting the basidiomata randomly throughout each specified habitat recording each collection point using the „global positioning system" (GARMIN 12 XL, USA). The macrofungi nomenclature is based on Kirk and Ansell (1992) as well as the web site of CABI bioscience databases (http://www.speciesfungorum.org/Names/Names.asp). Scientific names are those recognized by the „index fungorum". Each observed mushroom was photographed *in situ*, prior to picking from its substrate (Figure 2). Picking was done with the aid of the Scalpel and in a special case long pseudorrhiza such as that of *Termitomyces*, with a hoe and bush knife for hard wood inhabiting mushrooms.

Picked mushrooms were then packed into collecting plastic bags which were correctly labeled with collection number, collecting date, name of the collector as well as few field identification tips such as sporocarp shape, colour, smell, colour changing on bruising, and tentative name before it was brought to the department of Molecular Biology and Biotechnology laboratory at the UDSM for further identification.

The collected macro fungi were identified using colored field guide books, monographs (Arora, 1986; Härkönen et al., 1995, 2003; Kirk et al., 2001; Lodge et al., 2004) and internet facility. Some of the mushrooms after freshly observation were oven dried at 50°C for 8 h and deposited at the UDSM mycological herbarium. In order to facilitate the understanding for non-mycologist readers, taxa were also grouped in seven traditional morpho-groups according to the fruit bodies they produce (Table 1) as asserted by Michael and Stevens (2008). The morpho- groups were: 1) Agarics/fleshy (fleshy mushrooms with flat, radiating bladelike


**Figure 2.** Some *in situ* photo of macrofungi fruitbodies inventoried in this study: (a) *Aulicuralia polytricha*, (b) *Agaricus* species, (c) *Pycnoporus sanguineus*, (d) *Volvariella volvacea*, (e) *Funalia polyzona*, (f) *Chlorophyllum molybdites*, (g) *Termitomyces aurantiacus*, (h) *Ganoderma tsugae* and (i) *Mycena* species.

projections (gills) under the cap; usually with a stipe) attached to the cap); 2) bolets (fleshy mushrooms with tubes rather than gills, the tube layer usually easily separable from the cap; stipe mostly central); 3) jelly fungi (fruiting bodies gelatinous in texture, convoluted, sometimes cupulate, spatulate, to ear-shaped, occasionally erect and branched mimicking coral fungi); 4) puff balls and earth stars (spherical to pear-shaped fruiting body, some with splitting outer layer into star-like rays; occasionally stalked); 5) polypore fungi (leathery conks or brackets, typically perennial, occasionally annual and fleshy; fertile layer poroid, less commonly gill-like, labryinthoid or tooth-like, not readily separable from the rest of the fruiting body); 6) shelf fungi and bracket (fungi that make shelves or brackets to produce spores above the ground; they are woody, leathery or fleshy polypores having no or with only a short lateral stem); and 7) teeth fungi (fruiting bodies variously shaped; all with a fertile, lower surface composed of tooth-like projections).

The species that could not be identified were placed under the aforementioned groups with a reference number. The nomenclature and approximation was based on the fruiting bodies observed features thus missed the taxa that do not form conspicuous sporocarps which often requires molecular tools which were not covered in this study.

**Statistical analysis**

Statistical analyses which include determining the Shannon Wiener species diversity index among the habitats of the studied sites were carried out according to Magurran (1988) using PISCES for species diversity and richness version 2. 65, while the Sørensen similarity Index and Reyni diversity of species ordering were both done according to Sørensen (1948) using PISCES Community analysis Package Version 1.50 all under license of PISCES Conservation Ltd (2001), (IRC House, Pennington, Lymington SO41 8GN UK).

## RESULTS

### Macrofungi richness and diversity

In the studied area, more than 676 macrofungi individuals were collected (Table 1). The species diversity index differed among the three habitats (Table 2) with the „natural trees" recording the highest diversity and

**Table 1.** Mushroom observed during the study, their distribution in the three land use types and frequency of encounter.

| Morphogroups | Family | Genus | Habitat types | | | Frequency |
|---|---|---|---|---|---|---|
| | | | NT | PT | GCF | |
| *Agarics/fleshy* | Lyophyllaceae | *Termitomyces microcarpus* (Berk. & Broome) R. Heim | + | + | + | 5 |
| " | " | *T. aurantiacus* (R. Heim) R. Heim | − | − | + | 3 |
| " | " | *T. clypeatus* R. Heim | + | + | + | 2 |
| " | " | *T. umkowaan* (Cooke & Massee) D.A. Reid | + | − | − | 1 |
| " | " | *T. tylerianus* Otieno | − | − | + | 3 |
| " | Tricholomataceae | *Lepista sordida* (Schum.: Fr.) Singer | + | − | − | 2 |
| " | " | *Tricholoma spectabilis* Peerally & Sutra | + | + | − | 3 |
| " | Agaricaceae | *Agaricus campestris* L.:Fr. | + | + | + | 8 |
| " | " | *A. bisporus* (J.E. Lange) Imbach | + | + | − | 7 |
| " | " | *A. xanthodermus* Genev. | + | − | + | 5 |
| " | " | *A. augustus* Fr. | + | + | − | 4 |
| " | " | *A. sylvaticus* J. Otto | + | − | − | 3 |
| " | " | *A. birnbaumii* Corda | + | − | + | 6 |
| " | " | *A. placomyces* mult. | + | + | + | 3 |
| " | " | *A. bitorquis* (Quél.) Sacc. | + | + | + | 3 |
| " | " | *A. volvatulus* Heinem. & Gooss | + | + | + | 2 |
| " | " | *Agaricus* sp.1 | + | + | − | 3 |
| " | " | *Agaricus* sp.2 | + | − | − | 4 |
| " | " | *Agaricus*sp.3 | + | + | + | 12 |
| " | " | *Macrolepiota procera* (Scop.) Singer | + | + | − | 5 |
| " | " | *Leucocoprinus fragilissimus* (Berk. & M.A. Curtis) Pat | + | + | − | 5 |
| " | " | *Coprinus disseminatus* (Pers.) Gray | + | − | − | 3 |
| " | " | *C. comatus* (O.F. Müll.) Pers | + | − | − | 3 |
| " | " | *Chlorophyllum molybdites* (G. Mey.) Massee | + | + | + | 15 |
| " | " | *C. rhacodes* (Vittad.) Vellinga | + | − | + | 4 |
| " | Mycenaceae | *Mycena pura* (Pers.) P. Kumm. | + | − | − | 3 |
| " | " | *M. inclinata* (Fr.) Quél. | + | + | − | 2 |
| " | " | *Favolaschia calocera* R. Heim | + | − | − | 2 |
| " | Marasmiaceae | *Marasmius bekolacongoli* Beeli | + | + | − | 3 |
| " | " | *Marasmius delectans* Morgan | + | + | + | 2 |
| " | " | *Marasmius*sp.1 | + | − | − | 3 |

**Table 1.** Contd.

| | | | | | | |
|---|---|---|---|---|---|---|
| " | " | *Marasmius rotula* (Scop.) Fr. | + | + | + | 2 |
| " | " | *Marasmius haematocephalus* (Mont.) Fr. | + | − | − | 1 |
| " | " | *Marasmius* sp.2 | + | + | − | 4 |
| " | Pleurotaceae | *Pleurotus sajor-caju* (Fr.) | + | + | − | 3 |
| " | " | *P. eryngii* (DC.) Quél. | + | − | − | 2 |
| " | " | *P. tuber-regium* (Rumph. ex Fr.) Singer | + | − | − | 4 |
| " | Pluteaceae | *Volvariella volvacea* (Bull.) Singer | − | − | + | 3 |
| *Shelf and Bracket* | Fomitopsidaceae | *Laetiporus sulphureus* (Bull.) Murrill | + | − | − | 3 |
| " | Hymenochaetaceae | *Phellinus gilvus* (Schwein.) Pat. | + | − | − | 2 |
| " | Sclerodermataceae | *Scleroderma aurantium* (L.) Pers | + | − | − | 2 |
| *Jelly fungi* | Auriculariaceae | *Auricularia delicata* (Mont.) Henn. | − | − | − | 4 |
| " | " | *A. polytricha* (Mont.) Sacc. | + | − | − | 3 |
| " | Tremellaceae | *Tremella fuciformis* Berk | + | − | − | 2 |
| *Polypore Fungi* | Polyporaceae | *Trametes elegans* (Spreng.) Fr. | + | − | − | 2 |
| " | " | *Earliella scabrosa* (Pers.) Gilb. & Ryvarden | + | − | − | 2 |
| " | " | *Funalia polyzona* (Pers.) Niemelä | + | − | − | 3 |
| " | " | *Polyporus moluccensis* (Mont.) Ryvarden, | + | − | + | 6 |
| " | " | *Polyporus tenuiculus* (P. Beauv.) Fr | + | − | − | 3 |
| " | " | *Microporus affinis* (Blume & T. Nees) Kuntze | + | − | − | 1 |
| " | " | *Pycnoporus sanguineus* (L.) Murrill | + | − | − | 6 |
| " | Schizophyllaceae | *Schizophyllum commune* Fr. | + | + | − | 9 |
| " | Ganodermataceae | *Ganoderma boninense* Pat. | + | − | − | 3 |
| " | " | *Ganoderma tsugae* Murrill | + | − | − | 2 |
| *Bolete* | Boletaceae | *Boletus satanas* Lenz | + | − | − | 1 |
| " | " | *B. pallidissimus* Watling | + | − | − | 2 |
| " | " | *B. rubripes* Thiers | + | − | − | 1 |
| *Puff balls & Earth star* | Geastraceae | G*eastrum saccatum* sensu auct. brit. | + | − | − | 4 |
| " | " | *G. triplex* Jungh. | + | + | + | 3 |
| *Teeth Fungi* | Hydnaceae | *Hydnum repandum* L. | + | − | − | 3 |
| " | | *Hydnum* sp. | + | − | − | 5 |

'+': Present; '−': Absent; NT: Natural Trees; PT: Planted Trees; GCF: Garden, cleared ground and fields.

abundance (Figure 3b). The collected mushrooms represent more than 61 species in 29 genera, in 18 families (Table 1). Most species belonged to Agarics and polypore morpho-groups (Figure 3a).

**Effect of land use on macrofungi species diversity**

The distribution of mushroom species in the three land use habitats showed the NT leading with a total of 51.0% followed by PT with 25% and the GCF recorded the least with 24.0% (Figure 4a). Percentages of taxa in common for all three

**Table 2.** Shannon Wiener species diversity indeces and Sørensen similarity indeces for three habitats.

| Habitat type | Shannon index | Simpsons index | Number of species |
|---|---|---|---|
| Gardens | 2.8647 | 18.561 | 22 |
| Natural trees | 3.8882 | 70.000 | 54 |
| Planted trees | 3.1358 | 41.353 | 26 |
| | **Sørensen similarity index** | | |
| Natural trees vs. gardens | 0.3896 | | |
| Natural trees vs. planted trees | 0.561 | | |
| Planted trees vs. gardens | 0.5366 | | |

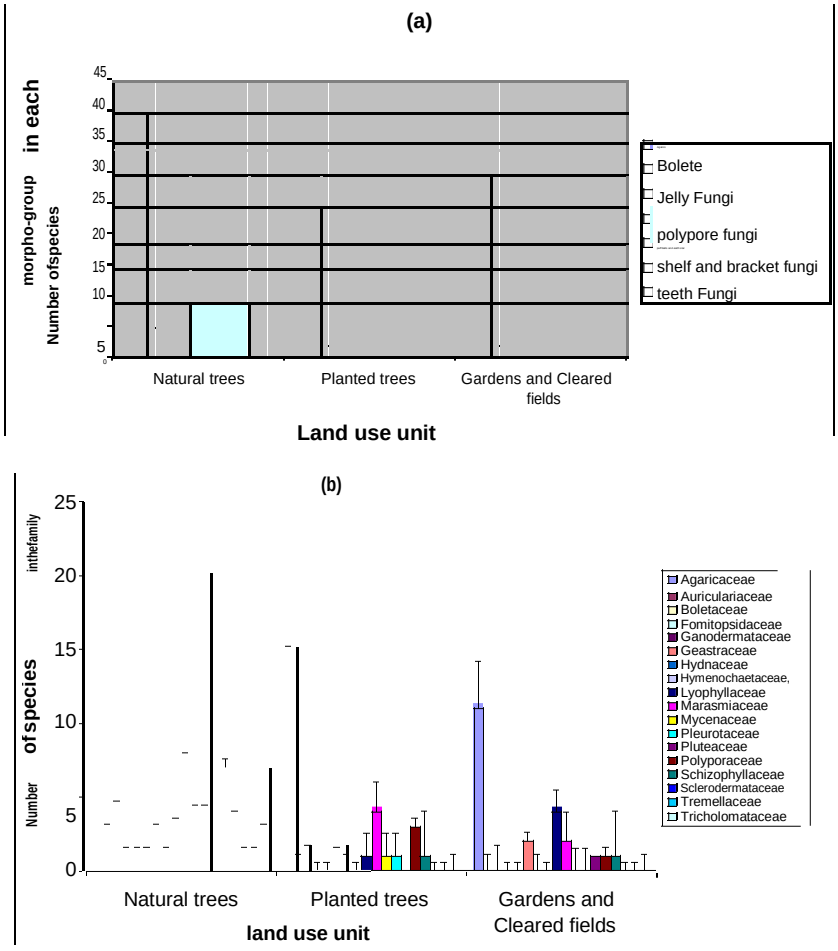


**Figure 3.** Distribution of mushroom species in the three land uses based on: (a) Number of species in the traditional morpho-groups and (b) number of species in the family.

habitats were 22.2%. This number of common species was relatively small and the numerical distribution of exclusive species was lower in planted trees than in the natural trees and gardens. For the established morpho-groups the more noteworthy results were: *fleshy/agaric*: The total number of agarics was high (71.0%) in all the habitats (Figure 4b), the NT with high abundance followed by GCF (Figure 3a). This fact was

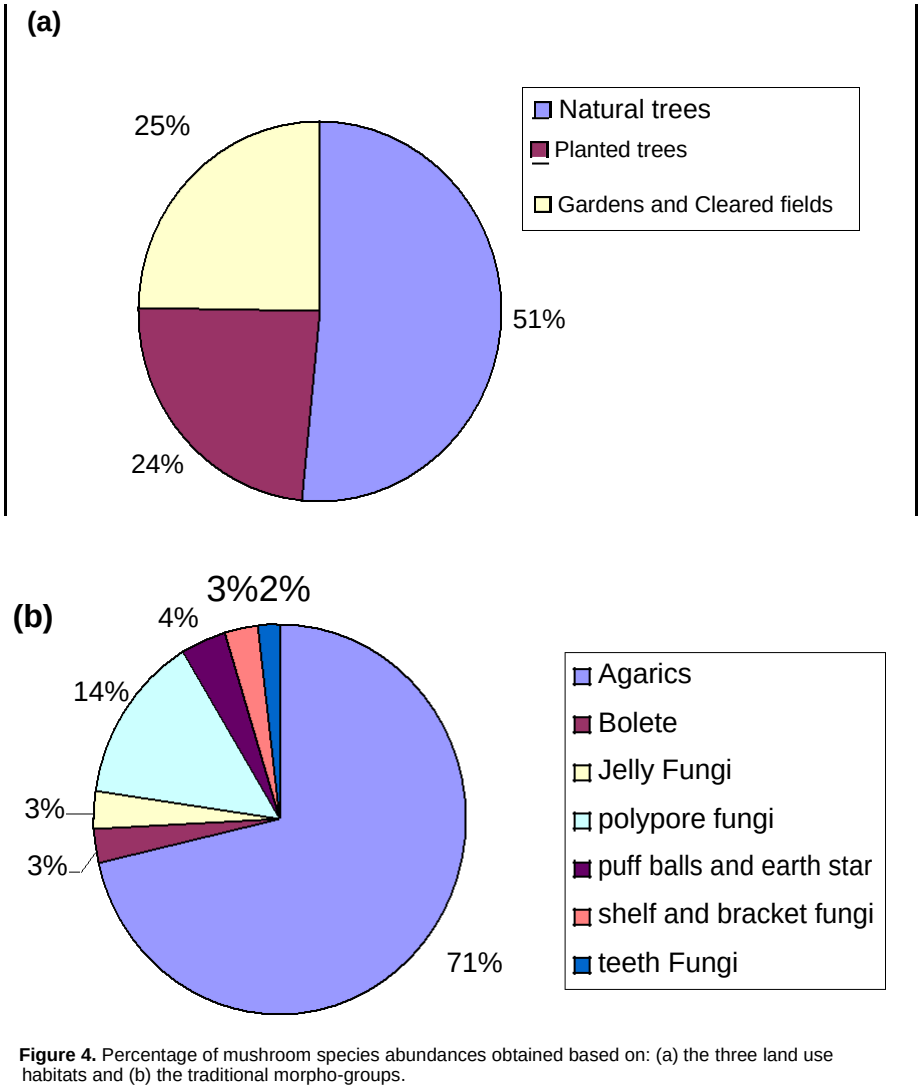


**Figure 4.** Percentage of mushroom species abundances obtained based on: (a) the three land use habitats and (b) the traditional morpho-groups.

significant in the case of the family Agaricaceae, since its representation was also high in NT followed by PT and GCF (Figure 3b). The species richness of the family Lyophyllaceae (*Termitomyces* species) and Pluteaceae (*Volvacea* sp.) on contrary were greater in the GCF (Figure 3b). The „*polypore fungi'* followed the agarics by far with only 14% and „bolete" with only 4%. With an exception of *puffballs* and *Earth* star which recorded the least 2%, the rest (*teeth fungi*, *jelly fungi*, *shelf* and *bracket fungi*) had 3% each (Figure 4b).

***Boletes*:** The bolete richness was only limited to natural trees and only three species were encountered (Table 1). The gasteroid fungus of the Puff balls and earth star morphogroup were higher in the gardens and cleared fields than in the natural and planted trees (Figure 3b). While the distribution of Jelly fungi were limited to natural trees, that of polypores were distributed in all the habitats (Table 1). The puff balls and earth star together with teeth fungi morpho-groups, both had their distribution limited to two habitats, NT and PT with none recorded from the GCF (Table 1). To the reasons not known to this study, there were no cup, club and coral traditional fungi morpho-groups encountered in the study area. Other major ectomycorhiza fungi such as Cantharellales, Russulales and Lactarialles had no representation in the campus probably due to their host specificity principally forming mycorhizal association with tree species of the miombo-woodlands which are not well represented in the campus vegetation. The diversity of species ordering computed using Pisces Community analysis Package Version 1.50 across the three habitats revealed a tremendous decrease of diversity in the „gardens" followed by „planted trees" but relatively stable in the

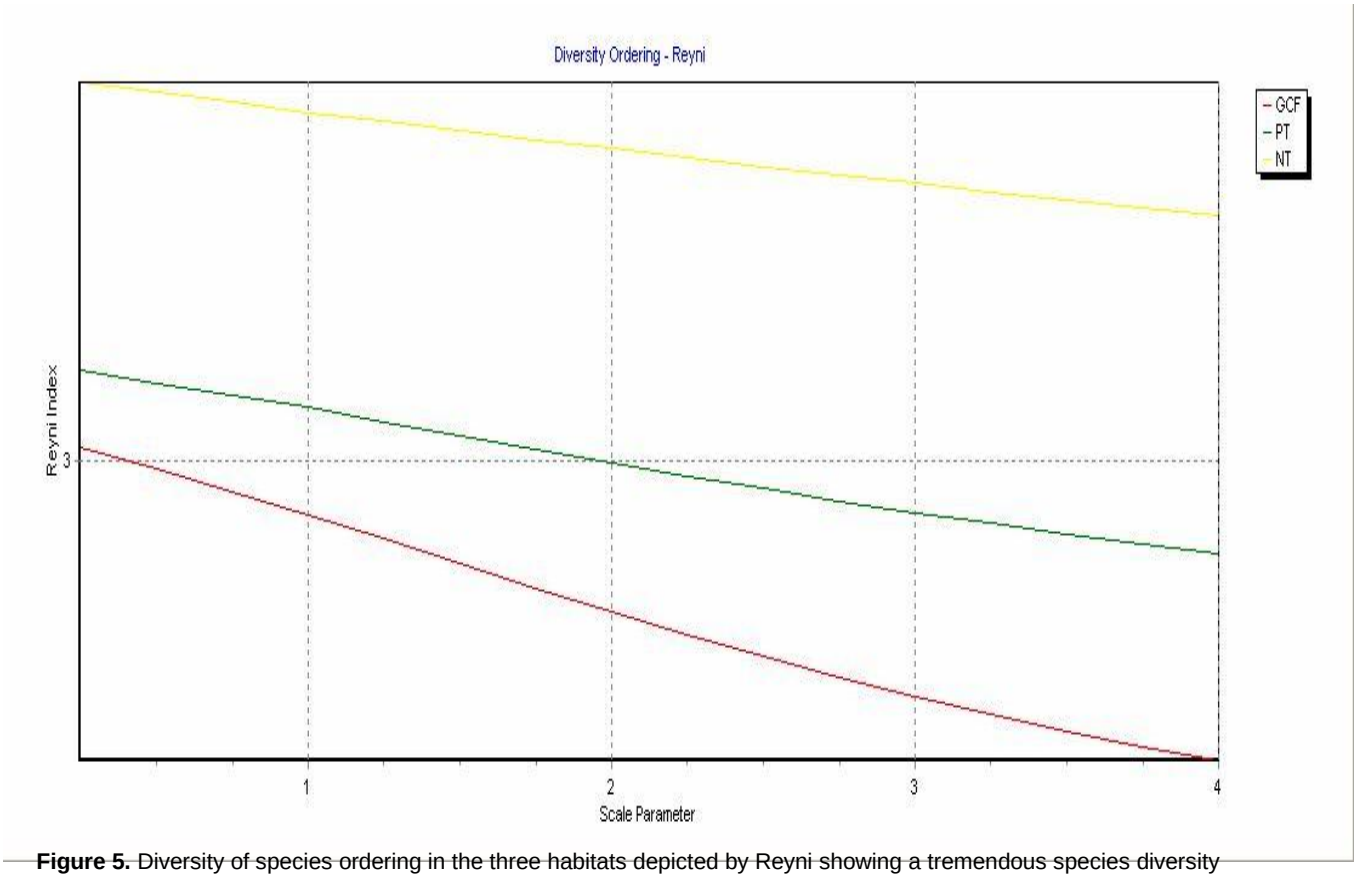


**Figure 5.** Diversity of species ordering in the three habitats depicted by Reyni showing a tremendous species diversity decrease in „gardens" and cleared fields followed by „planted" tree habitats.

„natural trees" (Figure 5).

## DISCUSSION

More than 61 species were recorded in the three habitats natural trees, planted trees and gardens including cleared fields. The reason for the high diversity might be due to the relatively strict protection provided to natural trees habitat at the campus which attributes to dynamics of macro-micro climate thus providing diversified micro habitat which support species diversity. The Shannon Wiener diversity indices varied substantially across the three habitats (Table 2). This result shows clear evidence that land use practices affects the distribution of mycobiota. High Shannon diversity index (3.8882) obtained in „natural trees" habitat validated high abundance and species richness in the natural trees compared to planted trees with diversity index of 3.1358 while the least Shannon diversity index was found in the „gardens" and cleared fields (2.8647). The results also showed that disturbances affect mycobiota distribution and which consequently lead to loss of diversity as it was depicted in Reyni diversity of species ordering (Figure 5) which shows a tremendous decrease of species diversity in the „gardens habitats". The „natural trees" has high species richness compared to „planted trees" and least to „garden" (Figures 3 and 4). The highest record in the natural trees with minimal human disturbances shows that disturbed habitat and soil compaction affects macrofungi distribution and diversity. Natural trees at the campus are highly protected while Gardens including cleared grounds are the mostly disturbed and compacted by the relatively high population density of about 20,000 people. The macrofungi community differed across the three habitats in traditional morpho-groups of the fruit bodies they produce and species diversity (Figures 3 and 4).

The Agaricaceae and Polypore fungi had high representation in the studied area (Figure 4b). This could be attributed to the fact that most of these species are saprotrophic, capable of biodegrading many recalcitrant organic-based substrates (Lynch and Thorn, 2006) present in some of the land use systems like „natural" and „planted" trees. The agarics traditional morpho-group of the family Agaricaceae, genus Agaricus were the most represented taxa across the three habitats (Figure 3). This agrees with the observation of O"Dell et al. (2004), Lamrood and Vaidaya (2006) and Osemwegie et al. (2006). Among the factor that would be associated with

the high abundance of these taxa is their good biological efficiency to utilize the available substrates. The high abundance of the Agaricaceae members observed in this study also agrees well with the finding by Vellinga (2004) who noted their wide distribution worldwide with many representatives in tropical and temperate region. In Table 2 the „planted" trees and „natural" tree had high Sørensen similarity index (0.561) probably due to the wood based substrate prominently found in both habitats. Wood-based substrates have been shown elsewhere to be a major determinant of mushroom diversity in woodland vegetations (forest and agro-forests) in both temperate and tropical regions (Osemwegie et al., 2010). The high abundance of mushrooms in decaying woody debris may also be related to their high moisture retention (Edmonds, 1991; Graham et al., 1994). Compared to other morpho-forms, polypore were found capable to survive and overcome environmental changes including desiccation unlike other forms which produce simple short lived fruit bodies. They were able to survive for several years producing a new layer of spore producing surfaces, thus elevate above the ground vouching a continuous supply of food material as it was also noted by Pegler (1997).

The natural trees habitat harbored all the perennial species which included members of the family: Polyporaceae (*Trametes elegans* (Spreng.) Fr., *Earliella scabrosa* (Pers.) Gilb. and Ryvarden, *Funalia polyzona* (Pers.) Niemelä); family Ganodermataceae, Schizophyllaceae (*Schizophyllum commune* Fr.) and Hymenochaetaceae (*Phellinus gilvus* (Schwein.) Pat.).

## Conclusion

Based on the data on hand from this study, it shows that there is high species diversity and abundance in the „natural" trees which are relatively protected compared to „planted trees" and gardens. This fact supports the finding from the analyses of Reyni diversity ordering in this study which depicts a tremendous decrease of species diversity in the disturbed habitat. These findings suggest that disturbances and soil compaction affects the macro fungi distribution hence the need for conservation in order to prevent biodiversity loss. While the results from this study will provide a baseline mycological database for further research in this area, further research on macrofungi biodiversity particularly at the community and species level which is essential to monitor the effectiveness of, or the need for conservation, and also to follow the effects of natural or artificial disturbance is needed.

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## REFERENCES

Arora D (1986). Mushrooms demystified: A comprehensive guide to the fleshy fungi. Berkeley: Ten Speed Press, p. 959.

Boa ER (2004). Wild edible Fungi: A Global perspective view of Their Use and Importance to People. FAO Publishing Management Services, Rome.

Buyck B, Eyssartier G, Kivaisi A (2000). Addition to the inventory of the genus *Cantharellus* (Basidiomycotina, Cantharellaceae) in Tanzania. Nova Hedwigia, 71: 491 –502.

Clarke GP (2001). The lindi local centre of endemism in southeastern Tanzania. SGP, 71: 1063-1072.

Clarke GP, Dickinson A (1995). Status Reports for 11 Coastal Forests in Coast Region, Tanzania. Frontier-Tanzania. Technical Report No. 17. London and Dar es Salaam: The Society for Environmental Exploitation/The University of Dar es Salaam.

Edmonds RL (1991). Organic matter decomposition in western United States. In Management and productivity of western montane forest soils. Edited by A.E. Harvey and L.F. Neuenshcwander. USDA For. Serv. Gen. Tech. Rep., INT-123, pp. 118-128.

Gates GM, Mohammed C, Wardlaw T, Ratkowsky DA, Davidson NJ (2011). The ecology and diversity of wood-inhabiting macrofungi in a native Eucalyptus obliqua forest of southern Tasmania, Australia. Fungal Ecol., 4: 56-67.

Graham RT, Harvey AE, Jurgensen MF, Jain TB, Tonn JR, Page-Dumroese DS (1994). Managing coarse woody debris in forests of the Rocky Mountains. USDA For. Serv. Res. Pap. INT-RP-477.

Härkönen M, Niemelä T, Mwasumbi L (1995). Edible Mushrooms of Tanzania. Karstenia, p. 92.

Härkönen M, Niemelä T, Mwasumbi L (2003). Tanzanian Mushrooms: Edible, Harmful and Other Fungi. Norrlinia, p. 200.

Jurgensen MF, Larsen MJ, Mroz GD, Harvey AE (1986). Timber harvesting, soil organic matter and site productivity. In Productivity of northern forests following biomass harvesting. Edited by Smith TC, Wayne MC, Tritton LM . US DA For. Serv. Gen. Tech. Rep. NE-115. pp. 43-52.

Kirk PM, Ansell AM (1992). Authors of fungal names. A list of authors of scientific names of fungi with recommended standard forms of their names, including abbreviations. Index of Fungi Supplement. CAB International, Kew, Great Britain, p. 95.

Kirk PM, Cannon PF, David JC, Stalfers JA (2001). Ainsworth and Bisby"s Dictionary of the Fungi. 9th Edn., CABI Publishing.Electronic version: htpp://www.speciesfungorum.org/AuthorsoffungalNames.htm Wallingford, UK.

Lamrood PY, Vaidya GJ (2006). Fungal genera of the Pune City. Pune Alive, 3: 29-35.

Lodge JD, Ammirati FJ, O"Dell ET, Mueller MJ (2004). Collecting and Describing Macrofungi. In Biodiversity of Fungi: Inventory and Monitoring Methods, Mueller, MG, Bills FG, and Foster SM (Eds.). Elsevier Academic Press, San Diego, CA., pp. 128-158.

Lynch MDJ, Thorn RG (2006). Diversity of basidiomycetes in Michigan agricultural soils. Appl. Environ. Microbiol., 72: 7050-7056.

Magingo FS, Oriyo N, Kivaisi AK, Danell E (2004). Cultivation of Oudemensiella Tanzanica nom.prov. on agric solid wastes in Tanzanaia Mycologia, 96: 197 – 204.

Magurran AE (1988). Ecological Diversity and its Measurement, Coastal Forest Research Programme Tanzania. The society for Environmental Exploration and The University of Dar es Salaam. Chapman & Hall, London.

Michael W, Stevens F (2008). The Fungi of California on a Myko Web Page. Available from http://www.mykoweb.com/CAF/skey.html.

(cited on 5th March 2008).
Moore WR (1962). Geology of Quarter Degree Sheet 168, Bagamoyo and a compilation of map of Tanganyika coastal sediments north of Dar es Slaam. Records of the Geological Survey of Tanganyika, 10: 1-6.
Mshandete AM, Cuff J (2008). Proximate and nutrient composition of three types of indigenous edible wild mushrooms grown in Tanzania and their utilization prospects AJFAND, 7: 1-16.
O"Dell TE, Lodge DJ, Mueller MG (2004). Approaches to Sampling Macrofungi. In Biodiversity of Fungi: Inventory and Monitoring Methods, Mueller, G.M., F.G. Bills FG,and S.M. Foster SM (Eds.). Elsevier Academic Press, San Diego. CA., pp. 163-168,
Osemwegie OO, Eriyaremu EG, Abdulmalik A (2006). A survey of macrofungi in Edo/Delta region of Nigeria, their morphology and uses. Glob. J. Pure Appl. Sci., 12: 149-157.
Osemwegie OO, Okhuoya JA (2009). Diversity of macrofungi in oilpalm agroforest of edo Edo state Nigeria. J. Biol. Sci., 9: 584-593.
Osemwegie OO, Okhuoya JA, Oghenekaro AO, Evueh GA (2010). Macrofungi Community in Rubber Plantations and a Forest of Edo State, Nigeria. J. App. Sci., 10: 391-398
Pegler DN (1997). The Larger Fungi of Borneo, Natural History Publications, Kota kinabalu.
Rodgers A, Hall JB, Mwasumbi LB, Griffiths CI, Vollesen K (1983). The Conservation Values and Status of Kimboza Forest Reserve, Tanzania. Technical Report No. 22. University of Dar es Salaam.
Sørense TA (1948) "A Method of Establishing Groups of Equal Amplitude in Plant Sociology Based on Similarity of Species Content, and its Application to Analysis of the Vegetation on Danish Commons", Biologiske Skrifter Det Kongelige Danske Videnskabernes Selskab, 5: 134.
Tibuhwa DD (2011). Morphology and taxonomy of *Sarcoscypha ololosokwaniensis* sp. nov.: A new Ascomycota species from Serengeti National Park-Tanzania. J. Yeast Fungal Res., 2(1): 1 – 6.
Tibuhwa DD, Buyck B, Kivaisi AK, Tibell L (2008). *Cantharellus fistulosus* sp. nov. from Tanzania. Cryptogamie Mycol., 29: 129 – 135.
Tibuhwa DD, Kivaisi AK, Magingo FFS (2010). Utility of the macro-micromorphological characteristics used in classifying the species of *Termitomyces* Tanz. J. Sci., 36: 31- 46.
Vellinga EC (2004). Ecology and Distribution of Lepiotaceous Fungi (Agaricaceae) – A Review. Nova Hedwigia, 78: 273-299.
Wending H, Pohjonen V, Johansson S, Nashanda S, Katigula MIL, Luukkanen O (2003). Species diversity, forest structure and specie composition in Tanzania tropical forests. Forest Ecol. Manag., 173: 11-24.