PRELIMINARY OBSERVATIONS ON THE SPECIES COMPOSITION AND DISTRIBUTION OF INDIGENOUS WILD MUSHROOMS IN THE LAKE VICTORIA BASIN WETLANDS, MUSOMA, TANZANIA

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ABSTRACT

Harvesting of wild mushrooms in the Lake Victoria basin for household food and inter-household trade is widespread and mushrooms contribute strongly to household food security. In spite of the importance of mushrooms to household food security the spatial and temporal distribution and ecological conditions influencing mushroom growth and availability in the Lake Victoria basin are yet to be documented adequately to enable development of plans for their conservation. The objective of this study was to document the composition, seasonal and spatial distribution of the mushrooms of the Lake Victoria basin wetlands and their habitats. Preliminary surveys identified a total of nine species most of which are of the genus Termitomyces. Generally most of the mushrooms were associated with termite mounds thus growing on clay soils and soils associated with low organic matter. Some species grow solely on termite mounds while others can grow a distance from a termite mound but associated with underground termite nests. Majority of the mushrooms appear during the rain season and are equally available during the short and long rains. This suggests that most species will grow well throughout the year whenever moisture level in the substrate is adequate irrespective of the season. Some of the species especially the Polypores (Ganoderma sp.) grow on dead wood as well as on living trees, infecting living trees through wounds. Most of the species grow in acidic (pH 6.5) substrates with a pH range between 5 and 6.8 though one species (*Termitomyces clypeatus*) was observed to grow on slightly alkaline conditions. Generally the substrate for most species had low organic carbon ranging from 3% to slightly above 4%. More detailed study of the ecology of the most important mushrooms in the Lake Victoria basin wetlands is important as a basis for their management and domestication.

Key Words: Lake Victoria – mushrooms – ecology - food security - wetlands

INTRODUCTION

Natural products have proven to be an important source of both new pharmaceuticals and lead compounds that can be modified for improved efficacy (Olila *et al.* 2001a; Olila *et al.* 2001b; Olila *et al.* 2002a; Kivaisi & Mtui, 2004). Mushrooms in particular have been traditionally useful for food and as sources of drugs (especially antibiotics) (Russo, 2002). Mushrooms like other plant species will grow in areas where the environmental conditions support their growth. Like any other plant species mushroom growth; distribution and abundance will be influenced by the variety of micro sites available for their favorable growth (Stanley, 2002; Munishi, 2001). Mushrooms are diverse and grow in different places on different environments.

Despite their diversity, mushrooms are rarely seen next to each other and form unique associations determined by their environmental requirements (Walker, 1996; Russo, 2002). Mushrooms form a part of the ecology of many environments including forests, grasslands, and wetlands. They are dependent on the same limiting factors that influence other organisms in a given habitat (Russo, 2002). It is known that all species of mushrooms have specific requirements of moisture, and temperature before they will produce a fruit. Some mushrooms have a very restrictive set of requirements while others have very broad sets of requirements (Russo, 2002). Even under proper climatic conditions, mushrooms may not develop if the mycelium lacks the necessary food energy and associations (Aanen *et al.* 2002). Many mushrooms will not fruit for several years, but when everything is just right, they will come up in large quantities. Other mushrooms with a broader range of temperature and moisture requirements appear annually. During a year with heavier than normal rainfall, the usual mushroom crop may be depressed. However, there are mushrooms that require extremely wet conditions for normal growth. While some mushrooms do appear in other seasons, majority of mushrooms come during the rainy months with favorable temperatures.

According to Pilz *et al.* (2001), Droege & Laurel (2003), various species of mushrooms are found under certain kinds of trees and shrubs thus being habitat specific. Some mushrooms tend to occur in a variety of habitats but many are restricted in distribution. Unlike those fungi that live on logs and ultimately die when the food runs out, the mycelium of ground dwelling fungi can live for centuries in their natural habitat. Research has shown that certain mushrooms are restricted to old growth forests and others to mature forests. This underscores the importance of forest management that maintains a wide range of forest types and ages (Michelle, 2001). A variety of creatures big and small, turn to mushrooms for food, thus animals including humans as well as insects are a very important part of mushroom ecology.

Mushrooms grow on lands under the jurisdiction of many organizations whose management decisions greatly affect mushroom conservation. Humans, being a part of mushroom ecology will influence mushroom diversity in various ways (David Suzuki Foundation, 2002). Conservation of mushrooms in lands under human management will therefore be based on best available information at hand and policy modifications regarding conservation of mushroom. Biodiversity information can be made adequately when scientific research provides updated data on the resource and the role of mushrooms to the society and their conservation needs.

Tanzania has a rich diversity of edible mushrooms, many of which have potential medicinal value. Many tribes in the country include mushrooms in their diets but also use mushrooms in special diets to promote recovery of mothers after delivery and to cure certain ailments in humans and animals (Kivaisi & Mtui, 2004). Harvesting of wild mushrooms in the Lake Victoria basin for household food and inter-household trade is widespread and mushrooms contribute strongly to household food security. In spite of the importance of mushrooms to household food security the spatial and temporal distribution and ecological conditions influencing mushroom growth and availability in the Lake Victoria basin are yet to be documented adequately to enable development of plans for their conservation. This situation calls for action to clarify and document the dynamics of mushroom populations in the Lake Victoria basin wetlands as a step towards their conservation and proper utilization. The major objective of the present study was to document at least preliminarily the composition, seasonal and spatial

distribution of the mushrooms of the lake Victoria basin wetlands and their habitats.

MATERIALS AND METHODS

Study Site

Musoma district is located in the northern part of Tanzania on the eastern shore of Lake Victoria. The district is bordered by Tarime district to the north, Bunda district to the south and Lake Victoria to the west. The study villages were Buhemba, Magunga, Mirwa and Bisumwa in Butiama Ward and Songora village in Buruma Ward.

Data collection and analysis

Data on the ecology and seasonal distribution of mushroom combined participatory discussions and field observations on growth and availability of mushrooms. Participatory Rural Appraisal (PRA) surveys and discussions with the local people aimed at getting information on mushroom occurrences and seasonal availability. Through discussions and transect walks the local people identified areas where mushrooms are normally collected or have been collected. Field observations were conducted in farmlands, bush lands and other specific locations such as termite mounds and information on the habitats of different mushroom species collected as observed in their natural environment. At each point where a mushroom was collected/observed substrate/soil samples were collected for laboratory analysis of pH and organic carbon to determine substrate requirements of the different mushroom species observed. pH was determined in distilled water and percentage of organic matter was measured by the Walkley-Black method (Nelson & Sommers, 1996).

RESULTS AND DISCUSSION

Table 1 shows the habitats and seasonal distribution of some mushroom species observed in the Lake Victoria basin wetlands. Generally most of the mushrooms were associated with termite mounds thus growing on clay soils and soils associated with low organic matter. Some species grow solely on termite mounds while others can grow a distance from a termite mound but associated with underground termite nests. Majority of the mushrooms appear during the rain season and are equally available during the short and long rains. This suggests that most of the species will grow well under adequate moisture and some are would appear throughout the year whenever moisture levels in the substrate is adequate irrespective of the season. Some of the species especially the polypores (*Ganoderma* sp.) grow on dead wood as well as on living trees, infecting living trees through wounds.

Table 1 Habitats and seasonal distribution of mushroom in Buhemba Ward, Musoma District Northern Tanzania

Mushroom Species	Habitat and Season
Termitomyces microcarpa (Bwishohere,Nyakisasi in Zanaki)	Under a tree shed, near termite mound, high moisture and moderate organic matter from leaf litter. Common at the end of the rain season and beginning of the dry season. Also appears during the short rains September/ October.
Termitomyces euhrrhizus (Nyakiswa - Zanaki)	Common in cultivated fields on or very close to anthills (termite mounds) and associated with underground termite nests. Common during the long and short rains
Termitomyces clypeatus (Nyarusasi - Zanaki)	Grows on or near anthills (termite mounds) in small groups in connection with underground termite nests. Common during both the short and long rain seasons.
Termitomyces aurantiacus (Nyakitwi in Zanaki)	In fields cleared for cultivation on clay soils. Also occurs on spots of clay soil in a generally sandy soil in the vicinity of a termite mound. It is a species that appears early during the rain season (both short and long rains).
Puffballs (Nyaribu – Kizanaki, Nyafumbi – Kuria	Observed in cultivated fields especially in areas that have been left fallow for sometime. Also in natural grasslands where disturbance is minimal. Not very widespread and appears when the moisture level are adequate. Not common in very wet habitats or seasons
Polypores (Amoba ga nyiti – Zanaki, Gita and Kabwa; Ritumbe rya Nyamuko – Kuria; Guok komu – Jaluo)	Wide range of habitats on living tree trunks, rotting tree trunks and fallen branches. Wide range of seasons though may be most prominent during periods of high moisture in the substrate
Stropharia semiglobata (Nyabuturi – Zanaki)	Observed on cow dung in grazing lands (grassland). Seems widespread in grazing lands associated with cow manure. Grows well with adequate moisture during both the short and long rain seasons
Hypholoma subviride	Base of a tree in the woodlands. Available all seasons whenever there is adequate moisture
Coprinus disseminatus (Bwishohere in Zanaki)	Grows during the first rains between November to January on a wide variety of substrates in cassava and maize fields and grasslands
Cantherellus cibarius	This species grows widely during the rain season. It is a dense forest species growing on tree stumps of different species

Description of the Habitats of Some Mushrooms

Termitomyces microcarpa (Bwishohere, Nyakisasi in Zanaki)

Grows in clumps widespread with availability of sufficient moisture. Found growing on clay soils where there is accumulation of organic matter especially in areas under tree or any other shed that preserves moisture adequately as well as on termite mounds. Grows during the first rains between November to January on a wide variety of substrates in cassava and maize fields. It also grows widely in grasslands especially on and around stumps on rotting maize straws and decaying trees and tree stumps. It is also common at the end of the rain season and beginning of the dry season in most areas.

Termitomyces euhrrhizus (Nyakiswa)
This is a common species during the rain season. Grows very rapidly when the soil moisture is adequate thus appears soon in the beginning of the rain seasons. Responds very quickly to soil moisture and one to two days heavy rain is sufficient for the species to start growing. This species is restricted on termite mounds compared to *Termitomyces clypeatus* which can grow a distance from a termite mound through underground mycelia.

Termitomyces clypeatus (Nyarusasi). Found scattered on cultivated fields especially associated with underground termite nests. Grows in small groups. It has been described to be a common species in tropical Africa (Härkönen *et al.* 2003).

Termitomyces aurantiacus (Nyakitwi)
This is one of the first species to appear at the beginning of the rain season in most areas. Observed mostly in areas that were cleared for cultivation or cultivated fields on clay soils. Also occurs on spots of clay soil in a generally sandy soil in the vicinity of termite mounds. The species is said to occur in many parts of Tanzania (Härkönen *et al.* 2003).

The Polypores (Amoba ga nyiti – Zanaki, Gita and Kabwa; Ritumbe rya Nyamuko – Kuria; Guok komu – Jaluo). Most common genus – Ganoderma

Ganoderma sp. *(cf. lucidium & applanatum)*
The Polypores seem to grow on a wide range of habitats on living tree trunks, rotting tree trunks and fallen branches. The most common genus is *Ganoderma*. This species was observed occurring in solitary or small groups on tree stumps, rotting logs and also on living trees especially on injured parts of the tree. It can be found on a wide range of tree species. The species is an important decay fungi on dead trees but can easily infect living trees through wounds. It has been said to have perennial robust fruit bodies infecting a wide range of broadleaved trees both planted and indigenous in Tanzania as a pathogenic white rot fungi (Härkönen *et al.* 2003).

Stropharia semiglobata (Nyabuturi – Zanaki)
The species seems to be widespread in grazing lands associated with cow manure. Grows well with adequate moisture during both the short and long rain seasons. It was observed on cow dung in grazing lands (grassland). It seems to be not a very common in the Lake Victoria basin compared to the genus Termitomyces, which is the most common with several species.

Hypholoma subviride

The species is a common wood rotting fungi and was observed growing on the base of a tree in the woodlands. It grows in clusters on decaying trees and is a close associate of *Armillaria mellea* and a common species in Tanzania (Härkönen *et al.* 2003). It seems to be available all seasons whenever there is adequate moisture. It thought to be poisonous by the local people and thus has no local name. Härkönen *et al.* (2003) observed that poisonous mushrooms normally do not have local names because they are not edible and thus of low interest to the local communities. The species has been observed to have a bitter taste and its close relative *Hypholoma fasciculare* has caused poisonings of gastrointestinal type in Europe.

Cantherellus cibarius
This species grows widely during the rain season. It is a dense forest species growing on tree stumps of different species. It is possibly not species specific. It can be observed both during the short rains and the long rains even at relatively low moisture content but favorable temperatures.
Coprinus disseminatus (Bwishohere in Zanaki)

Grows during the first rains between November to January on a wide variety of substrates in cassava and maize fields. It also grows widely in grasslands especially on and around stumps on rotting maize straws and decaying trees and tree stumps. The species is characteristically whitish small, and looks like iron nails.

Substrate characteristics for some mushroom species

Table 2 shows the substrate condition under which different mushroom species are found. The substrate pH for most of the species was more acidic to slightly acidic with two species (Termitomyces clypeatus and Puffballs) found on substrate that is slightly alkaline. Generally the substrate for most species had low organic carbon ranging from 3% to slightly above 4%.

Table 2 Substrate conditions under which different mushrooms were collected in Musoma District Tanzania

No	Mushroom Species	Site	pH	OC (%)
1	***Termitomyces microcarpa***	Magunga village	6.93	3.0
		Milwa village	6.74	3.1
		Bisumwa village	6.80	3.2
		Isamiro (Buhemba)	7.10	3.2
		Milwa village	6.45	3.0
		Average	**6.80**	**3.1**
2	*Termitomyces euhrrhizus*	Isamiro (Buhemba)	5.42	3.1
		Isamiro (Buhemba)	5.94	3.2
		Milwa village	5.70	3.1
		Milwa Village	5.79	3.3
		Magunga village	5.65	3.2
		Magunga village	5.49	3.1
		Average	**5.67**	**3.2**
3	*Termitomyces clypeatus*	Milwa village	7.62	3.1
		Milwa Village	7.07	3.2
		Isamiro (Buhemba)	7.82	3.1
		Isamiro (Buhemba)	7.13	3.5
		Magunga village	6.94	3.1
		Magunga Village	6.64	3.3
		Average	**7.20**	**3.2**
4	*Termitomyces aurantiacus*	Milwa village	6.35	3.2
		Magunga village	6.65	3.1
		Magunga Village	6.57	3.5
		Bisumwa village	6.35	3.7
		Bisumwa Village	6.09	3.8
		Isamiro (Buhemba)	6.41	3.1
		Average	**6.40**	**3.4**
5	**Puffballs**	Milwa village	7.20	4.2
6	*Ganoderma lucidium*	Musoma town	6.98	4.4
		Milwa village	7.02	4.9
		Bisumwa village	6.56	3.9
		Average	**6.85**	**4.4**
7	*Stropharia semiglobata*	Magunga Village	6.34	3.2

No	Mushroom Species	Site	pH	OC (%)
		Bisumwa Village	6.54	4.6
		Milwa Village	6.14	3.6
		Average	**6.34**	**3.8**
8	*Hypholoma subviride*	Magunga village	6.23	3.6
		Milwa village	6.12	3.8
		Milwa village	6.55	3.7
		Average	**6.30**	**3.7**
9	*Coprinus disseminatus*	Magunga village	6.40	4.3
10	*Cantherellus cibarius*	Milwa village	6.83	4.1
		Magunga Village	6.44	4.3
		Average	**6.64**	**4.2**

CONCLUSIONS

There is apparently an appreciable diversity of mushrooms in the Lake Victoria Basin the ecology of which is not well understood. Preliminary it seems most of the species grow well on acidic substrates. The availability of most of the mushrooms is controlled by moisture availability and this suggests that most of the mushroom species would grow throughout the year with minimum moisture requirements. More detailed study of the ecology of the most important mushrooms in the Lake Victoria basin wetlands is important as a basis for their management and domestication.

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