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Effects of Human Impact on Miombo Woodland in Northern Malawi

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Summary: Miombo woodland is found throughout the Zambezian regional centre of endemism where most of the rural population make use of its wild plant species. This article presents the results of a study on the composition of the woody vegetation and its anthropogenous alteration in northern Malawi with particular respect to the impact caused by the collection of wild plants. The main vegetation type in this area is miombo woodland which is composed of 80 woody species. The collection of wild plants does not show an effect on the plant diversity but effects are visible in the decreasing number of tall trees.

Key words: vegetation, collection of wild plants

Les effets de l'impact humain sur les forêts claires Miombo au nord du Malawi

Résumé: Les forêts claires du type « miombo » prévalent dans le centre régional d´endémisme zambézien où la plupart de la population rurale utilise des plantes sauvages. Dans cet article les résultats des premières études botaniques dans cette région au nord de Malawi sont présentés. On a étudié et analysé la végétation en rapport avec les influences de son utilisation. La végétation principale de la région est la forêt claire du type « miombo ». Elle est composée par des 80 espèces de plantes ligneuses. Tandis qu´un effet sur la prévalence des arbres peut être observé, la composition floristique n´est pas altéré par l´utilisation des plantes sauvages.

Mots clés: végétation, utilisation, forêt claire

Anthropogene Vegetationsveränderungen der Miombo-Savannen in Nordmalawi

Zusammenfassung: Miombo Woodland ist die häufigste Vegetationsformation in der Sambesischen Florenregion, wo ein Großteil der Bevölkerung Wildpflanzen zu diversen Zwecken nutzt. In diesem Artikel werden die Ergebnisse einer in Nord-Malawi durchgeführten Untersuchung zur Zusammensetzung der Gehölzvegetation und deren anthropogenen Beeinflussungen vorgestellt. Die Hauptvegetationsformation der Region ist Miombo Woodland, das sich im Untersuchungsgebiet aus 80 Gehölzarten zusammensetzt. Die Artenzusammensetzung ist nicht durch die Nutzung der Wildpflanzen verändert, jedoch sind Einflüsse auf das Vorkommen von hohen Bäumen ersichtlich.

Schlagworte: Vegetation, Wildpflanzennutzung

1 Introduction

White (1983) describes the vegetation of Malawi as wet miombo woodland. The name miombo derived from the local name “muombo” (plural “miombo”) for some *Brachystegia* species in the Zambezian regional centre of endemism (Smith & Allen 2004). Miombo woodland is dominated by the genera *Julbernardia*, *Isoberlinia* or *Brachystegia* and differs in its species composition from region to region.

Today, 61 % of the country of Malawi is covered by farmland, 27 % by miombo woodland (Macmillan 2005). Deforestation continues at a rate of 2.8 - 3.4 %. In Malawi, 85 % of the population live in rural areas (Halle & Burgess 2006). The energy demand is covered by the use of wood fuel or charcoal in 93 % of the rural households.

Due to these facts, a general impression of a “fuel wood crisis” arose in the regions of dry tropical woodlands (Halle & Burgess 2006). However, various studies showed that this impression was not verifiable in general but a sustainable use of woody resources could be possible if the consumption does not exceed a certain quantity (Abbot & Homewood 1999, Banda et al. 2006, Dewees 1989, Foley 2001). The importance of woodland for the local population and the use of miombo species remains a subject of research and management issues (Dewees et al. 2010).

In northern Malawi, where miombo woodlands still occur, collection of wild plants is widespread and woodland is an important source for fuel wood, timbers, fruits and herbal medicines. First surveys about the most important woody species and their use in the area of Karonga and its surroundings indicate a high demand for harvesting of wild plant species (Kaunda 2007). Thus, it is of specific interest to evaluate the effects of woody plant harvesting on the species composition of miombo woodlands. As basic information on miombo woodland, vegetation is lacking for northern Malawi. Therefore, the study was aimed as a first step at inventorying and documenting miombo woodland species composition.

Karonga and its surroundings are subject of international (geological/ paleontological) research since the 1980s, which advanced considerably when hominid fossils were found near Karonga in 1991 (Schrenk et al. 1993). A museum was built at Karonga (Cultural and Museum Centre Karonga/ CMCK) and the excavation camp (Malema Camp) was turned into a research camp.

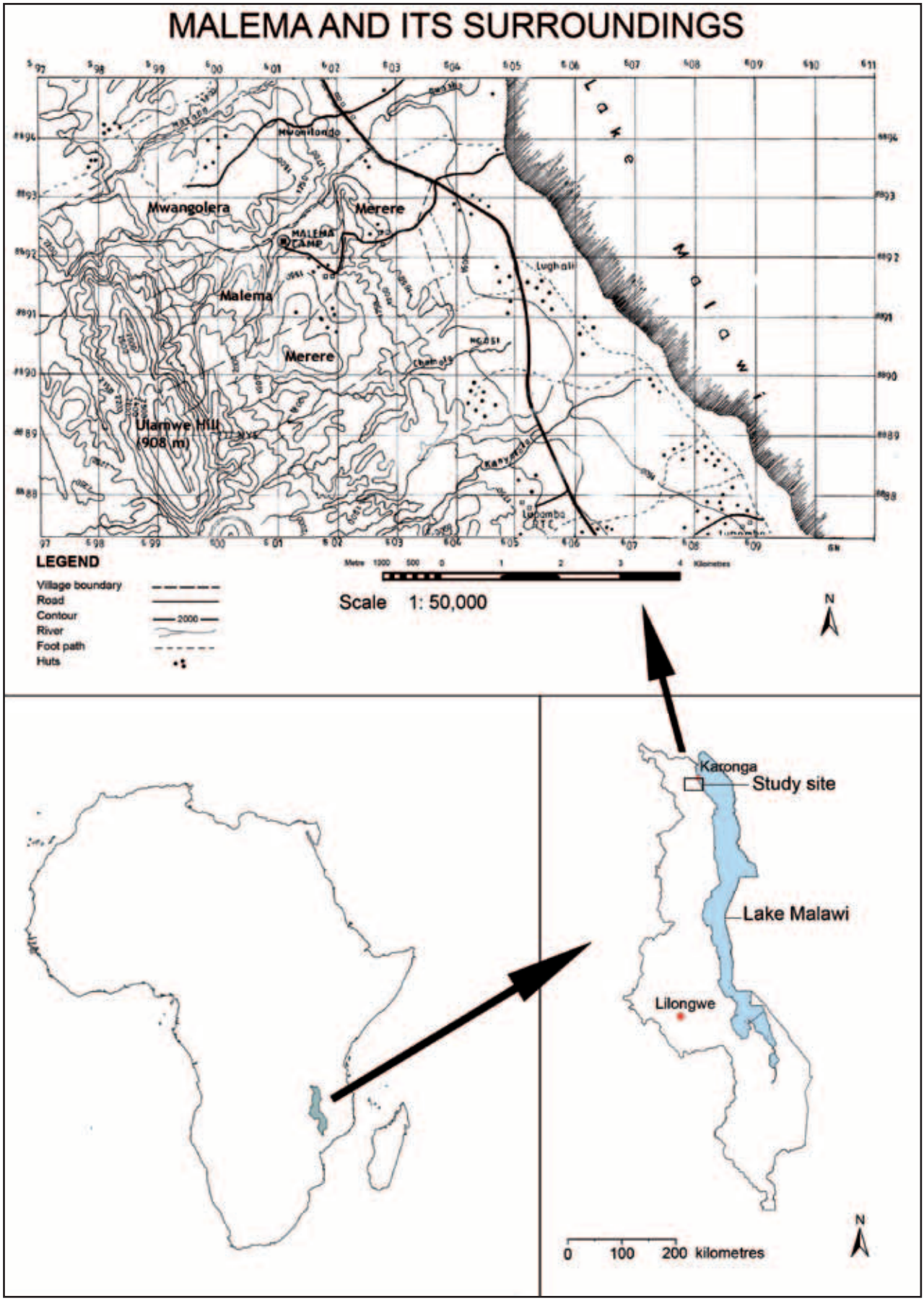

Fig. 1: The location of the study site in Malawi | La position du terrain d´étude en Malawi | Lage des Untersuchungsgebiets in Malawi

Fig. 2: Overview of the study site | Vue d´ensemble du terrain d´étude | Überblick des Untersuchungsgebiets

2 Study Site

The study site (Fig. 1 and 2) is located in the northern part of Malawi, about 10 km south of the city of Karonga (Karonga District). It has a surface area of 25 km^2 and covers parts of the territories of the villages of Malema and Merere and as parts of the protected area Ulamwe hill. Its highest peak reaches 908 m above sea level and the lake level of Lake Malawi is situated at an altitude of 500 m a.s.l.

According to Breckle (1999), the area belongs to the zonobiome of savannas, deciduous forests and grasslands. The climate is characterised by a rainy season from mid - November to April followed by a dry season (Fig. 3). According to data (1971 to 2000) from the nearby weather station "Karonga Aerodrome", the average annual precipitation was 620 mm, with lowest monthly precipitation of 0 mm (November) and highest precipitation of 540 mm (March). Mean lowest daily temperature was 17.2 °C (July), highest temperature was 32.9 °C (November).

There are different types of soil found in the region. In general, the soils of the lake basin in lower altitudes consist of calcimorphic alluvial deposits (Agnew & Stubbs 1972). Reaching towards the inner countryside, precambric basement rocks form hills and mountains mainly of granite, quartz and mica schist which provide shallow horizons of lithosol. Ulamwe hill is such a structure of basement rock. There is another plateau of mica schist towards the lake shore before the area slopes and passes over to the lakeshore plain. In between those structures a plateau of calcimorphic alluvial deposits remains. This soil has a shallow fertile horizon and therefore is entirely used as arable land.

The zonal natural vegetation of most parts of Malawi is formed by Miombo woodland (Cole 1986). White (1983) distinguishes between two types of miombo woodland: a humid and a dry one. In the study site miombo woodland dominates in the protected area on the lithosol of Ulamwe Hill. On the more profound sandy soils of the region sloping towards Lake Malawi, there is a pattern of farmland and woodlands, thickets, scrubs and parklands which form small island-like thickets between the cultivated fields.

Termite mounds are found throughout the region. The activity of termites and other organisms alter the soils and, subsequently, also the vegetation structure (Bachelier 1978). Bushfires occur frequently, even in the protected area. They are set and controlled by the residents in order to facilitate the hunting of small mammals, improve the fertility of the soil and to keep the area "tidy".

In the investigated villages, the main ethnic groups are Tumbuka and Ngonde. Most people live from agriculture or breeding of cattle and pigs. Most important crops are maize,

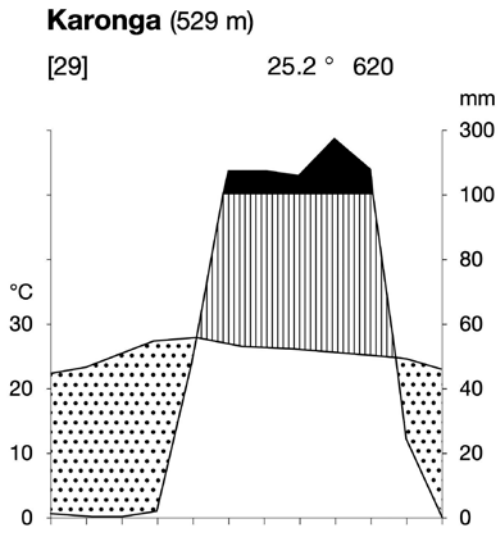

Fig. 3: Climate diagram of Karonga | Diagramme climatique de Karonga | Klimadiagramm von Karonga

cassava, cotton, borassus palm and sesame. Wild plants are collected for many purposes: as fuel, for the construction of buildings and furniture, as alimentation and spices and for medicinal application.

3 Methods

The aim of the study was a first assessment of the impact of harvesting of wild plants on the vegetation composition and structure. Therefore, the landscape was classified in three areas for comparison. These zones are:

• Protected area at the slopes of Ulamwe hill (Zone 1)

• Transition zone bordering on the protected area (Zone 2)

• Area near villages (Zone 3; favoured for wild plant collection)

The vegetation was analysed in 10 relevés per defined area. The relevés consist of plots sized 30 m x 30 m each. The plots were selected according to their homogeneity and apparent soil features.

Due to the common occurrence of termite-mounds, they were included in the study and analysed in 10 plots adapted to the size of the termite-mound.

The coverage of the tree and shrub layer was recorded according to Braun-Blanquet (1951). The tree layer was defined as the layer of woody species reaching above 5 m in height, the shrub layer as reaching from 1 – 5 m.

For identification, "Trees of Southern Africa (Coates-Palgrave 2002), the "Field Guide to the Trees and Shrubs of the Miombo Woodlands" (Smith & Allen 2004) and the Flora Zambesiaca (Kew Royal Botanic Gardens 2004) were used. Voucher specimens were collected from species which could not be clearly identified.. They were determined and verified by staff members of the National Herbarium and Botanic Gardens of Malawi in Zomba and later on submitted to the Herbarium Senckenbergianum Frankfurt/M. (FR). Nomenclature follows African Plant Database (http://www.ville-ge.ch/musinfo/bd/cjb/africa/recherche.php).

4 Results

In total, 80 woody species were identified in the relevés, the tree layer consisting of 32 species and the shrub layer being composed of 77 species. According to the species composition, the main vegetation type of the study site has to be classified as dry miombo woodland including elements of "rupicolous bushland and thicket" and "termite mound thicket" (White 1983).

Table 1 shows the floristic composition of the miombo woodland. Figures 4, 5 and 6 highlight the differences between protected area (Fig. 4), transition zone (Fig. 5) and the surrounding of the villages (Fig. 6). Two variants of the miombo woodland were identified. The variant represented by relevés 11 to 30 of Table 1. is differentiated by a high number of differential species showing more or less high presence (*Margaritaria discoidea*, *Rytigynia adenodonta*

Fig. 4: Miombo woodland in the protected area (Zone 1) | Miombo woodland dans la zone protégée (Zone 1) | Miombo woodland im Schutzgebiet (Zone 1)

Table 1: Floristic composition of the woody vegetation in the zones 1-3 (c = constancy)
Tableau 1: Composition floristique de la végétation ligneuse dans les zones 1-3 (c = constance)
Tabelle 1: Floristische Zusammensetzung der Gehölzvegetation in den Zonen 1-3 (c = Stetigkeit)

No. of relevé	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**c**
Area	**3**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	
Tree cover (%)	**3**	**50**	**50**	**50**	**25**	**35**	**10**	**20**	**25**	**30**	**15**	**35**	**55**	**60**	**30**	**50**	**55**	**30**	**20**	**25**	**30**	**10**	**1**	**1**	**3**	**3**	**5**	**-**	**-**	**-**	
Shrub cover (%)	**45**	**40**	**40**	**30**	**35**	**30**	**35**	**40**	**40**	**40**	**30**	**45**	**50**	**70**	**55**	**40**	**50**	**30**	**55**	**40**	**40**	**80**	**70**	**60**	**60**	**55**	**65**	**60**	**50**	**60**	
No. of species	**16**	**20**	**17**	**18**	**18**	**20**	**19**	**15**	**13**	**13**	**12**	**25**	**19**	**22**	**22**	**23**	**24**	**17**	**29**	**23**	**11**	**38**	**17**	**18**	**16**	**21**	**21**	**21**	**20**	**17**	
Exposition	**W**	**N**	**W**	**E**	**SE**	**S**	**-**	**E**	**S**	**N**	**NE**	**E**	**E**	**E**	**S**	**SE**	**SE**	**E**	**E**	**E**	**E**	**N**	**N**	**(N)**	**S**	**S**	**(N)**	**N**	**N**	**S**	
Slope	**15**	**30**	**25**	**15**	**20**	**10**	**-**	**10**	**15**	**25**	**10**	**20**	**25**	**20**	**30**	**20**	**30**	**10**	**10**	**5**	**15**	**20**	**10**	**3**	**20**	**10**	**3**	**15**	**10**	**15**	
Tree layer (> 5 m)																															
Differential species																															
Commiphora mossambicensis	.	.	1	.	.	.	.	.	.	.	+	+	1	2	+	+	1	1	+	1	2	.	.	.	.	.	.	.	.	.	**II**
Combretum apiculatum	.	.	.	.	+	.	.	.	.	.	+	+	1	2	1	+	.	1	.	+	1	.	.	.	.	.	1	.	.	.	**II**
Strychnos madagascariensis	+	.	.	.	.	.	1	.	.	.	2	+	1	.	.	.	.	3	2	2	1	.	.	.	.	.	.	.	.	.	**II**
Diplorhynchus condylocarpon	.	.	.	1	.	.	.	.	.	.	.	+	2	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Steady companions																															
Julbernardia globiflora	+	2	3	2	2	2	1	2	2	2	.	2	2	3	.	2	3	+	+	.	2	.	.	.	.	+	.	.	.	.	**IV**
Lannea discolour	.	+	1	+	.	.	.	.	1	1	1	+	.	1	1	1	.	.	.	1	1	2	.	.	1	.	.	.	.	.	**III**
Brachystegia allenii	.	2	2	3	1	3	+	1	1	2	.	.	.	.	1	+	2	.	.	.	.	.	.	.	.	.	.	.	.	.	**II**
Pseudolachnostylis maprouneifolia	.	.	.	+	.	1	2	.	.	.	2	+	.	1	1	1	.	.	.	.	.	+	.	.	.	.	+	.	.	.	**II**
Terminalia stenostachya	.	2	2	+	.	.	.	1	.	1	.	.	1	1	.	.	1	.	.	.	.	.	+	.	.	.	.	.	.	.	**II**
Other companions																															
Acacia nigrescens	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	+	.	.	1	.	+	.	.	.	.	.	.	.	.	**I**
Euphorbia matabelensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	+	.	1	+	.	.	.	.	.	**I**
Commiphora mollis	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	**I**
Sterculia africana	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Diospyros kirkii	.	.	+	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Combretum adenogonium	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Olax dissitiflora	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	**I**
Tarenna microphylla	.	.	.	.	.	.	.	.	.	.	.	2	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Coptosperma neurophyllum	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Hymenodictyon parvifolium	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Manilkara obovata	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Terminalia kaiseriana	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Canthium oligocarpum	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Acacia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Azanza garckeana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Bauhinia petersiana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	**I**
	Combretum adenogonium type										Dry miombo woodland type																				
Shrub layer (1-5 m)																															
Differential species																															
Combretum adenogonium	1	.	.	1	+	+	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	+	.	.	**II**
Terminalia kaiseriana	1	+	+	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	**II**
Xerophyta splendens	.	+	+	.	+	+	1	1	+	.	.	.	.	.	1	.	1	.	.	.	+	+	.	.	.	.	.	.	.	.	**II**
Margaritaria discoidea (Baill.) G.L.Webster var. discoidea	.	.	.	.	.	.	+	.	.	.	.	+	2	+	+	.	.	+	+	+	.	1	+	+	.	+	1	+	+	.	**III**
Rytigynia adenodonta var. *reticulata*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	1	+	+	1	.	+	+	+	1	+	+	1	**III**
Maerua parvifolia	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	+	+	.	+	+	+	+	.	+	.	+	+	**II**
Olax dissitiflora	.	.	.	.	.	.	.	.	.	.	.	+	1	1	1	+	+	.	.	.	.	.	.	+	.	.	+	.	.	.	**II**
Ormocarpum kirkii	.	.	+	.	.	.	.	.	.	.	.	1	+	+	1	.	.	.	+	+	.	+	.	.	+	+	+	.	.	+	**II**
Steady companions																															
Commiphora mossambicensis	1	1	1	+	1	2	1	1	1	+	1	1	1	1	1	1	+	1	1	2	2	1	1	1	1	1	+	1	1	1	**V**
Lannea discolour	+	+	+	+	2	2	+	1	1	1	1	1	+	1	+	1	+	1	+	+	1	+	+	1	+	+	1	1	+	1	**V**
Combretum apiculatum	+	1	1	+	+	+	+	+	+	1	1	1	1	2	+	+	2	1	+	+	1	2	+	+	+	1	+	1	+	+	**V**
Bauhinia petersiana	2	2	1	2	2	1	2	2	2	2	2	1	.	1	2	2	2	+	1	+	+	1	1	1	2	2	1	2	2	1	**V**
Diplorhynchus condylocarpon	2	1	1	1	1	1	1	.	1	2	+	1	+	1	1	1	1	+	+	.	.	2	+	2	1	1	2	1	1	1	**V**
Euphorbia matabelensis	.	1	1	+	1	1	2	2	2	+	1	2	.	.	1	.	+	2	1	1	1	1	1	1	1	1	1	+	1	1	**V**
Julbernardia globiflora	1	.	1	1	1	1	2	.	+	.	.	+	.	2	+	1	.	+	.	+	+	2	1	.	.	+	.	+	.	2	**IV**
Canthium glaucum frangula	.	2	.	+	.	+	1	+	.	.	.	+	.	+	+	+	1	.	+	+	+	1	1	+	+	+	+	+	+	+	**IV**
Terminalia stenostachya	3	1	.	+	+	+	+	1	1	.	1	+	.	+	+	.	+	.	+	.	.	1	1	.	+	+	.	2	1	+	**IV**
Strychnos madagascariensis	+	+	.	.	1	1	1	1	1	.	+	+	2	1	.	1	.	.	2	2	1	1	.	1	+	+	+	+	+	+	**IV**

No. of relevé	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**c**
Area	**3**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	
Tree cover (%)	**3**	**50**	**50**	**50**	**25**	**35**	**10**	**20**	**25**	**30**	**15**	**35**	**55**	**60**	**30**	**50**	**55**	**30**	**20**	**25**	**30**	**10**	**1**	**1**	**3**	**3**	**5**	**-**	**-**	**-**	
Shrub cover (%)	**45**	**40**	**40**	**30**	**35**	**30**	**35**	**40**	**40**	**40**	**30**	**45**	**50**	**70**	**55**	**40**	**50**	**30**	**55**	**40**	**40**	**80**	**70**	**60**	**60**	**55**	**65**	**60**	**50**	**60**	
No. of species	**16**	**20**	**17**	**18**	**18**	**20**	**19**	**15**	**13**	**13**	**12**	**25**	**19**	**22**	**22**	**23**	**24**	**17**	**29**	**23**	**11**	**38**	**17**	**18**	**16**	**21**	**21**	**21**	**20**	**17**	
Exposition	**W**	**N**	**W**	**E**	**SE**	**S**	**-**	**E**	**S**	**N**	**NE**	**E**	**E**	**E**	**S**	**SE**	**SE**	**E**	**E**	**E**	**E**	**N**	**N**	**(N)**	**S**	**S**	**(N)**	**N**	**N**	**S**	
Slope	**15**	**30**	**25**	**15**	**20**	**10**	**-**	**10**	**15**	**25**	**10**	**20**	**25**	**20**	**30**	**20**	**30**	**10**	**10**	**5**	**15**	**20**	**10**	**3**	**20**	**10**	**3**	**15**	**10**	**15**	
Pseudolachnostylis maprouneifolia	+	+	.	+	+	1	2	.	+	.	1	.	.	.	+	2	.	.	+	.	.	.	1	1	1	+	+	+	1	+	**IV**
Bridelia cathartica	+	.	+	+	+	1	.	.	.	+	.	+	+	+	.	+	+	.	.	.	.	+	.	.	.	+	1	+	1	.	**III**
Cassipourea mollis	.	+	+	+	.	1	.	.	.	.	.	1	1	.	+	1	.	+	+	.	.	+	.	+	+	+	+	+	.	+	**III**
Brachystegia allenii	+	.	.	+	.	1	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	1	1	2	1	1	2	+	2	1	**III**
Dichrostachys cinerea	+	.	+	.	.	.	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	+	+	+	+	.	.	+	.	**II**
Tarenna neurophylla	.	+	.	.	.	1	+	.	.	.	.	+	+	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	**II**
Catunaregam spinosa	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.	+	+	.	**II**
Other companions																															
Sterculia quinqueloba	.	.	.	.	.	.	.	.	1	.	.	+	+	1	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	**I**
Gardenia resiniflua	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	1	+	1	.	1	.	.	.	.	.	.	.	.	**I**
Vepris stolzii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+	.	.	.	.	+	+	.	.	**I**
Diospyros kirkii	+	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Cassia singueana	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Acacia nigrescens	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	**I**
Vitex payos	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	.	.	.	.	.	.	.	.	.	.	**I**
Crossopteryx febrifuga	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	**I**
Hymenodictyon parvifolium	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	+	.	.	+	.	.	.	.	.	.	.	.	**I**
Canthium oligocarpum	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Brachystegia microphylla	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Hymenodictyon floribundum	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.	**I**
Commiphora eminii zimmermanii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	.	.	.	+	.	.	.	.	**I**
Rourea orientalis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	**I**
Ximenia caffra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	.	**I**
Cissus cornifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	**I**
Brackenridgea zanguebarica	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Acacia sp.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Indigofera emarginella	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Schrebera trichoclada	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	**I**
Dombeya acutangula	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	**I**
Psychotria kirkii	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	**I**
Allophylus chaunostachys	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	.	.	**I**
Rhus natalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	.	.	**I**
Sterculia africana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	**I**
Rytigynia macrura	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	**I**
Sclerocarya birrea caffra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	**I**
Steganotaenia araliacea	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
Clerodendrum glabrum	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**

Additonally with + in Relevé No. 4: *Acacia gerrardii; Bridelia cathartic*a; 2: *Cussonia arborea;* 6: *Flacourtia indica*; 13: *Dichrostachys cinerea, Grewia stolzii;* 15: *Maerua triphylla*; 17: *Dalbergia nitidula, Rytigynia adenodonta* var. *reticulate*; 18: *Holarrhena pubescens;* 19: *Kirkia acuminata, Phytolacca dodecandra;* 20: *Azanza garckeana, Rytigynia monantha;* 22: *Afzelia quanzensis, Commiphora africana, Eminia antennulifera, Ficus natalensis*; 24: *Boscia mossambicensis*.

var. *reticulata*, *Maerua parvifolia*, *Olax dissitiflora*, *Ormocarpum kirkii*). This variant consists of a subtype with a well developed tree layer and one, more or less, treeless subtype. In the tree layer, additional differential species exist: *Commiphora mossambicensis*, *Combretum apiculatum*, *Strychnos madagascariensis* and *Diplorhynchus condylocarpon*. The second variant is mainly negatively differentiated, but some weak differential species exist (*Combretum adenogonium*, *Terminalia kaiseriana* and *Xerophyta splendens*). One of the relevés shown in Table 1 (No. 10) has an intermediate position between these two variants.

The vegetation on termite mounds (Table 2, Fig. 7) forms dense thickets. The species prevailing on the mounds differ from those characteristic for the other vegetation types. Five species are restricted to termite mounds: *Boscia angustifolia* var. *corymbosa*, *Cadaba kirkii*, *Grewia bicolor*, *Maerua angolensis* and *Rhynchosia caribaea*. A variant is characterised by the occurrence of *Combretum apiculatum*, *Commiphora puguensis* and *Sterculia africana* in the tree layer.

In all the three zones, the shrub cover is of almost 50 % with the highest figures in Zones 1 and 3. The tree cover decreases from Zone 1 (47 %) towards Zone 3 (3 %). In average, 20 woody species are found per plot which are mostly shrubs (average 18 species). On termite mounds, tree cover is even higher (70 %), but the average number of species is lower (9). The average number of trees and their maximum height decreases from Zone 1 towards Zone 3 (from 8 species to 1 species). The average maximum height of woody

Fig. 5: Miombo woodland in the transition zone (Zone 2) | Miombo woodland dans la zone de transition (Zone 2) | Miombo woodland im Übergangsgebiet (Zone 2)

Fig. 6: Miombo woodland in the area near the villages (Zone 3) | Miombo woodland dans la zone près des villages (Zone 3) | Miombo woodland im siedlungsnahen Gebiet (Zone 3)

Fig. 7: Vegetation of a typical termite mound | Végétation sur une termitière typique | Vegetation auf einem typischen Termitenhügel

plants is 8.2 m, with 7.4 m on termite mounds. The highest trees found in the plots reach 12 m and 13 m on the termite mounds.

The species composition is similar in the area near the villages compared to the protected area. Yet a difference can be found in the tree layer of the area favoured for harvesting of wild plants. Near the villages, trees rarely reach heights of over 5 m in contrast to the protected area where they often reach 10 m (compare Figures 4, 5 and 6).

5 Discussion

Geographically and thus floristically, Malawi represents a transition region between Eastern, Southern and Central Africa. Miombo woodland occurs throughout this region but shows differences in its floristic composition. In all variants of miombo woodland the dominating species belong to the genera *Julbernardia*, *Isoberlinia* or *Brachystegia*. Termite mounds occur all over the Sudano-Zambezian savanna belt, but local variation of their floristic composition is not yet very well studied.

The floristic composition of miombo woodland in the study site is more related to the Tanzanian types of miombo (Backéus et al. 2006, Boaler 1966, Burtt 1942) than to the Zambian miombo woodland (Chidumayo 1987, Trapnell 1959). This can be explained by the local geomorphology and soils (see below). In addition, the East African Rift escarpment separates the north Malawian woodland from the south western (Zambian) woodlands. The fact that our study area in the map of White (1983) is assigned to the wet miombo woodland while we stated dry miombo woodland is not really contradictory but might be a matter of scale.

Apart from anthropogenic influences which comprise most of the frequent bushfires, soil conditions are of importance for the structure and species composition of the vegetation. Miombo woodland species in general prefer shallow soils rich in minerals, a condition which exists more or less equally in our study area. Bushfires however, occur most frequently in Zone 2 which might explain the lower cover of the shrub layer observed in this zone. In the study site a variant including *Combretum adenogonium* is found. *C. adenogonium*, which White (1983) characterises as belonging to the general type of the undifferentiated miombo woodland, was observed in our case only in a particular subtype. This might be explained by the observations of Boaler (1966), who considered *C. adenogonium* as a typical species of disturbed habitats. This is not contradictory to our findings where *C. adenogonium* mainly occurs on soils with high moisture content, because higher moisture means higher productivity and thus a higher degree of disturbance by grazing animals.

Some relevés on termite mounds show a remarkable tree layer in combination with a higher number of species. As in general only dead termite mounds are colonised by plant species, this indicates that the mounds were abandoned by the termites a long time ago. Three of the five species restricted to termite mounds belong to the family Capparaceae. These species prefer base-saturated soils as found on termite mounds (Fanshawe 1986). The species are characteristic for these specific soil conditions and apparently those species, if found in other relevés, could indicate the former occurrence of a termite mound already eroded or another type of soil with similar conditions as provided by the activity of termites. These results underline the importance of termites and termite mounds for the vegetation composition and plant diversity of the region.

The diversity of the miombo woodland in the study area shows no clear differences in regard to the use of wild

Table 2: Floristic composition of the woody vegetation on termite mounds (c = constancy)
Tableau 2: Composition floristique de la végétation ligneuse sur les termitières (c = constance)
Tabelle 2: Floristische Zusammensetzung der Gehölzvegetation auf Termitenhügeln (c = Stetigkeit)

No. of relevé	31	32	33	34	35	36	37	38	39	40	c
Tree cover (%)	**0**	**90**	**3**	**40**	**30**	**20**	**75**	**25**	**50**	**0**	
Shrub cover (%)	**60**	**20**	**90**	**50**	**90**	**90**	**50**	**80**	**80**	**90**	
No. of species	**6**	**12**	**11**	**14**	**13**	**13**	**6**	**8**	**4**	**7**	
Area	**3**	**1**	**3**	**1**	**1**	**1**	**1**	**3**	**1**	**3**	
Tree layer (>5 m)											
Differential species											
Combretum apiculatum	.	3	1	1	2	+	.	.	.	.	III
Commiphora eminii zimmermannii	.	+	.	1	.	+	.	.	.	.	II
Sterculia africana	.	.	.	3	.	2	.	.	.	.	I
Companions											
Bauhinia petersiana	.	3	.	.	.	.	.	2	.	.	I
Commiphora mollis	.	.	.	.	1	.	4	.	.	.	I
Tarenna neurophylla	.	2	.	.	.	.	.	.	.	.	I
Julbernardia globiflora	.	1	.	.	.	.	.	.	.	.	I
Lannea discolor	.	+	.	.	.	.	.	.	.	.	I
Maerua angolensis	.	.	.	.	1	.	.	.	.	.	I
Afzelia quanzensis	.	.	.	.	.	.	.	.	3	.	I
Shrub layer (1-5 m)											
Differential species											
Vepris stolzii	1	1	+	1	1	.	.	.	.	.	III
Canthium glaucum frangula	1	2	1	.	1	.	.	.	.	.	II
Ormocarpum kirkii	+	+	.	1	1	.	.	.	.	.	II
Azanza garckeana	+	.	.	+	2	+	.	.	.	.	II
Asparagus setaceus	.	.	+	1	1	+	.	.	.	.	II
Acacia nilotica	.	.	2	2	.	2	.	.	.	.	II
Steady companions											
Gardenia resiniflua	3	1	1	3	3	3	2	2	3	+	V
Grewia stolzii	1	1	+	2	1	1	2	1	.	+	V
Other companions											
Margaritaria discoidea	.	.	.	+	2	.	.	1	1	.	II
Boscia angustifolia var. *corymbosa*	.	.	+	.	.	.	.	+	.	+	II
Grewia bicolor	.	.	.	.	.	2	1	2	.	.	II
Allophylus chaunostachys	.	.	.	.	.	1	.	1	.	2	II
Tannea neurophylla	.	1	1	.	.	.	.	.	.	.	I
Commiphora africana	.	.	1	2	.	.	.	.	.	.	I
Commiphora mossambicensis	.	.	+	.	.	+	.	.	.	.	I
Rhynchosia caribaea	.	.	.	.	1	.	1	.	.	.	I
Boscia mossambicensis	.	.	.	.	.	+	1	.	.	.	I
Cadaba kirkii	.	.	.	.	.	.	.	+	.	+	I
Cassipourea mollis	.	+	.	.	.	.	.	.	.	.	I
Rourera orientalis	.	.	.	1	.	.	.	.	.	.	I
Julbernardia globiflora	.	.	.	+	.	.	.	.	.	.	I
Hymenodictyon parvifolium	.	.	.	.	1	.	.	.	.	.	I
Diplorhynchus condylocarpon	.	.	.	.	.	1	.	.	.	.	I
Combretum apiculatum	.	.	.	.	.	.	.	.	2	.	I
Dombeya angulata	.	.	.	.	.	.	.	.	.	+	I
Phytolacca dodecandra	.	.	.	.	.	.	.	.	.	+	I

plants. However, the tree layer is strongly affected by human activities such as bushfires and browsing. Many woody species are adapted to bushfires and damage caused by browsing animals by the ability to produce new coppice shoots. This can be observed throughout the study area. Many plants can survive after felling by this adaptation as well. Thus, the diversity is currently not influenced by harvesting of wild plants. It is more influenced by the predominating soils and the occurrence of bushfires. In contrast the physiognomic aspect of the vegetation is altered and an influence can be perceived.

These study results are in concordance with those of other authors stating that the collection of wild plants does not necessarily result in a degradation of the vegetation (Abbot & Homewood 1999, Banda et al. 2006, Dewees 1989, Foley 2001). However, succession in miombo woodland is not fully understood (Trapnell 1959) and a long-term impact cannot be out ruled. Banda et al. (2006), though on a larger scale, provide results similar to this study and even show that a strict protection can result in a decrease of species. It would be important would be to quantify harvesting intensities and the valuation of woodlands in economical terms (Dewees et al. 2010) for developing possibilities of a sustainable management, including the provision of an income and poverty reduction for the local populace.

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Appendix

A I: List of woody plants species and their local names (in alphabetical order of the scientific names).
Liste des espèces ligneuses et leurs noms locaux (en ordre alphabétique des noms scientifiques).
Liste der Gehölzarten und ihrer Lokalnamen (in alphabetischer Reihenfolge der wissenschaftlichen Namen).

Accepted scientific name (African Plant Data Base)	Plant family	Local name (Chitumbuka/ Chinkhonde)	Synonyms
Acacia gerrardii Benth.	Fabaceae		
Acacia nigrescens Oliv.	Fabaceae	Mkuntu	
Acacia nilotica (L.) Willd. ex Del.	Fabaceae	Chibiriri	
Afzelia quanzensis Welw.	Fabaceae	Kamilang´onga	
Allophylus chaunostachys Gilg	Sapindaceae	Nyatatu	
Asparagus setaceus (Kunth) Jessop	Asparagaceae	Mkhorankhanga	
Azanza garckeana (F. Hoffm.) Exell & Hillc.	Malvaceae	Mtowo	
Bauhinia petersiana Bolle	Fabaceae	Mpapa	
Boscia angustifolia A.Rich. var. *corymbosa* (Gilg) DeWolf	Capparaceae	Luvwi	
Boscia mossambicensis Klotzsch	Capparaceae	Luvwi	
Brachystegia allenii Hutch. & Burtt Davy	Fabaceae	Nguti	
Brachystegia microphylla Harms	Fabaceae	Msalasala	*Brachystegia tamarindoides* ssp. *microphylla* (Harms) Chikuni
Brackenridgea zanguebarica Oliv.	Ochnaceae		
Bridelia cathartica G.Bertol.	Euphorbiaceae	Mguzabango	
Cadaba kirkii Oliv.	Capparaceae	Mbozga	
Canthium glaucum ssp. frangula (S.Moore) Bridson	Rubiaceae	Kamyong´onyo	
Canthium oligocarpum Hiern	Rubiaceae		
Cassia singueana Delile (accepted in FTA)	Fabaceae	Kamemena	*Senna singueana* (Delile) Lock
Cassipourea mollis (R.E.Fr.) Alston	Rhizophoraceae	Kafulankhwale	
Catunaregam spinosa (Thunb.) Tirveng.	Rubiaceae	Mvunganjati	*Catunaregam obovata* (Hochst.) A.E. Gonç.
Cissus cornifolia (Baker) Planch.	Vitaceae	Mlewe ("male")	
Clerodendrum glabrum E. Mey.	Verbenaceae	Kawingawazimu	
Combretum adenogonium Steud. ex A.Rich.	Combretaceae	Kansewe	*Combretum fragrans* F. Hoffm.
Combretum apiculatum Sond.	Combretaceae	Mlama	
Commiphora africana (A. Rich.) Engl.	Burseraceae	Nyatatu	
Commiphora eminii subsp. zimmermannii (Engl.) J.B.Gillett	Burseraceae	Chitonto ("green")	*Commiphora puguensis* Engl.
*Commiphora mollis (*Oliv.) Engl.	Burseraceae	Chitonto	
Commiphora mossambicensis (Oliv.) Engl.	Burseraceae	Chitonto	
Crossopteryx febrifuga (Afzel. ex G.Don) Benth.	Rubiaceae	Chiwaja chikhowo	
Cussonia arborea Hochst. ex A.Rich.	Araliaceae	Chimpombwe	
Dalbergia nitidula Baker	Fabaceae	Luwewa	
Dichrostachys cinerea (L.) Wight & Arn.	Fabaceae	Mphangala	
Diospyros kirkii Hiern	Ebenaceae	Chigulya	
Diplorhynchus condylocarpon (Müll. Arg.) Pichon	Apocynaceae	Mnthalembe	
Dombeya acutangula Cav.	Sterculiaceae		*Dombeya cincinnata* K. Schum.
Eminia antennulifera (Baker) Taub.	Fabaceae		
Euphorbia matabelensis Pax	Euphorbiaceae	Wulimbo	
Ficus natalensis Hochst.	Moraceae	Mvumu	
Flacourtia indica (Burm.f.) Merr.	Flacourtiaceae	Ndawi	
Gardenia resiniflua Hiern	Rubiaceae	Nyatatu	
Grewia bicolor Juss.	Tiliaceae	Lusako	
Grewia stolzii Ulbr.	Tiliaceae		
Holarrhena pubescens (Buch.-Ham.) Wall. ex G.Don	Apocynaceae	Njenje	
Hymenodictyon floribundum (Hochst. & Steud.) Robbr.	Rubiaceae	Chitechitechi	

Approved scientific name	Plant family	Local name	Synonyms
Hymenodictyon parvifolium Oliv.	Rubiaceae		
Indigofera emarginella Steud. ex A.Rich.	Fabaceae	Mwafongo	
Julbernardia globiflora (Benth.) Troupin	Fabaceae	Kamphoni	
Kigelia africana (Lam.) Benth.	Bignoniaceae	Mfungwe	
Kirkia acuminata Oliv.	Simaroubaceae	Mzumbazumba	
Lannea discolor (Sond.) Engl.	Anacardiaceae	Kaumbweumbwe	
Maerua angolensis DC.	Capparaceae		
Maerua parvifolia Pax	Capparaceae	Luvwi	
Maerua triphylla A.Rich.	Capparaceae		*Maerua cafra* (DC.) Pax
Manilkara obovata (Sabine & G.Don) J.H.Hemsl.	Sapotaceae		
Margaritaria discoidea (Baill.) G.L. Webster	Euphorbiaceae		
Olax dissitiflora Oliv.	Olacaceae	Foka	
Ormocarpum kirkii S.Moore	Fabaceae	Mbankho	
Phytolacca dodecandra L'Hér.	Phytolaccaceae		
Pseudolachnostylis maprouneifolia Pax	Euphorbiaceae	Msolo	
Psychotria kirkii Hiern	Rubiaceae		
Rhus natalensis Bernh. ex C.Krauss	Anacardiaceae	Nyatatu	
Rhynchosia caribaea (Jacq.) DC.	Fabaceae		
Rourea orientalis Baill.	Connaraceae	Mwawani	*Byrsocarpus orientalis* (Baill.) Bak.
Rytigynia adenodonta var. *reticulata* (Robyns) Verdc.	Rubiaceae	Mpokuso	
Rytigynia bugoyensis (K.Krause) Verdc.	Rubiaceae		
Rytigynia macrura Verdc.	Rubiaceae		
Rytigynia monantha (K.Schum.) Robyns	Rubiaceae	Mpokuso	
Rytigynia reticulata Robyns	Rubiaceae	Mpokuso	*Rytigynia adenodonta* var. *reticulata* (Robyns) Verdc.
Schrebera trichoclada Welw.	Anacardiaceae	Mpioka	
Sclerocarya birrea subsp. *caffra* (Sond.) Kokwaro	Anacardiaceae	Msere	*Sclerocarya caffra* Sond.
Steganotaenia araliacea Hochst.	Apiaceae	Mnyongoloko	
Sterculia africana (Lour.) Fiori	Sterculiaceae	Muyamba	
Sterculia quinqueloba (Garcke) K.Schum.	Sterculiaceae	Mosha	
Strychnos madagascariensis Poir.	Loganiaceae	Kamira walumba	
Tarenna neurophylla (S.Moore) Bremek.	Rubiaceae		*Coptosperma neurophyllum* (S. Moore) Degreef
Terminalia kaiseriana F.Hoffm.	Combretaceae	Mpululu	
Terminalia stenostachya Engl. & Diels	Combretaceae	Mpokwa	
Vepris stolzii l.Verd.	Rutaceae	Foka	
Vitex payos (Lour.) Merr.	Lamiaceae	Mfuru	
Xerophyta splendens (Rendle) N.L.Menezes	Velloziaceae	Chisuche	
Ximenia caffra Sond.	Olacaceae	Mlewe (edible)	

A II: **List of the plant families and the associated species. | Liste des familles des plantes et des espèces correspondantes. | Liste der Pflanzenfamilien und ihnen zugehöriger Spezies**

Anacardiaceae
Lannea discolor
Rhus natalensis
Schrebera trichoclada
Sclerocarya birrea caffra

Apiaceae
Steganotaenia araliacea

Apocynaceae
Diplorhynchus condylocarpon
Holarrhena pubescens

Araliaceae
Cussonia arborea

Asparagaceae
Asparagus setaceus

Bignoniaceae
Kigelia africana

Burseraceae
Commiphora africana
Commiphora mollis
Commiphora mossambicensis
Commiphora puguensis

Capparaceae
Boscia angustifolia
Boscia mossambicensis
Cadaba kirkii
Maerua angolensis
Maerua cafra
Maerua parvifolia

Combretaceae
Combretum apiculatum
Combretum adenogonium
Terminalia kaiseriana
Terminalia stenostachya

Connaraceae
Byrsocarpus orientalis

Ebenaceae
Diospyros kirkii

Euphorbiaceae
Bridelia cathartica
Euphorbia matabelensis
Margaritaria discoidea
Pseudolachnostylis maprouneifolia

Fabaceae - Caesalpinioideae
Bauhinia petersiana
Brachystegia allenii
Brachystegia tamarindoides ssp. *microphylla*
Julbernardia globiflora
Senna singueana

Fabaceae - Mimosoideae
Acacia gerrardii
Acacia nigrescens
Acacia nilotica
Afzelia quanzensis
Dichrostachys cinerea

Fabaceae - Papilionoideae
Eminia antennulifera
Indigofera emarginella
Ormocarpum kirkii
Rhynchosia caribaea
Dalbergia nitidula

Flacourtiaceae
Flacourtia indica

Lamiaceae
Vitex payos

Loganiaceae
Strychnos madagascariensis

Malvaceae
Azanza garckeana

Moraceae
Ficus natalensis

Ochnaceae
Brackenridgea zanguebarica

Olacaceae
Olax dissitiflora
Ximenia caffra

Phytolaccaceae
Phytolacca dodecandra

Rhizophoraceae
Cassipourea mollis

Rubiaceae
Canthium glaucum frangula
Canthium oligocarpum
Catunaregam obovata
Coptosperma neurophyllum
Crossopteryx febrifuga
Gardenia resiniflua
Hymenodictyon floribundum
Hymenodictyon parvifolium
Psychotria kirkii
Rytigynia adenodonta var. *reticulata*
Rytigynia bugoyensis
Rytigynia macrura
Rytigynia monantha

Rutaceae
Vepris stolzii

Sapindaceae
Allophylus chaunostachys

Sapotaceae
Manilkara obovata

Simaroubaceae
Kirkia acuminata

Sterculiaceae
Dombeya cincinnata
Sterculia africana
Sterculia quinqueloba

Tiliaceae
Grewia bicolor
Grewia stolzii

Velloziaceae
Xerophyta splendens

Verbenaceae
Clerodendrum glabrum

Vitaceae
Cissus cornifolia