Appendix B (1)

PRELIMINARY INVENTORY OF NHAMBITA COMMUNITY FOREST, GORONGOSA DISTRICT, MOZAMBIQUE[1]

[1] Draft Consultant's report prepared for ICRAF-Mozambique by Patrick Mushove, Senior Consultant, ERMAL Natural Resources Consultancy, Harare, Zimbabwe. 28 December 2003. Modified by Dr. M. Williams, 25th May 2004.

CONTENTS

ACRONYMS AND ABBREVIATIONS USED IN THE REPORT

CENACARTA	Centro Nacional de Cartografia e Teledetecção Atmosféricac
cm	Centimetre
DBH	Diameter-at-Breast Height
DRC	Democratic Republic of the Congo
GCP	Ground Control Point
GIS	Geographic Information System
GNP	Gorongosa National Park
GPS	Global Positioning System
H_t	Height
ICRAF	International Council for Research in Agroforestry
m	meter
m^2 ha^{-1}	Square meters per hectare
N	Population size
n	Sample size
NTFPs	Non Timber Forest Products
^oC	Degrees Celsius
ORAM	Organização Rural de Ajuda Mútua (Mozambican NGO)
PSP	Permanent Sample Plot
RSE	Relative Standard Error
s^2	Variance
SD	Standard Deviation
SE	Standard error
SI	Site Index
SPFFB	Serviços Provinciais de Florestas e Fauna Bravia
SPH	Stems Per Hectare
UoE	University of Edinburgh

ACKNOWLEDGEMENTS

I am deeply indebted to ICRAF for giving me this assignment. I am especially grateful to Dr. Patrick Matakala (ICRAF-Mozambique) for the guidance and logistical assistance during field work in Nhambita. The inventory team consisting of João Carlos Fernando (ICRAF), António Serra (SPFFB-Sofala), Paulo Sozinho Viage (a.k.a. Papayaman), Reginaldo Alberto, Paulino Tique Ngirazi (Nhambita community members) and Joseph Muchichwa (ERMAL P/L) was simply fantastic, especially Papayaman, the ethno botanist. Piet van Zyl (ENVIROTRADE), together with Dr. Mathew Williams (UoE) were instrumental in the preparatory work leading to the inventory and Piet continued supporting the team logistically and morally, albeit by remote control, during and after the inventory work itself. Many thanks also go to the unparalleled hospitality enjoyed from the GNP administration and catering staff. Last, but not least, I thank the local Chief of Nhambita community for collaborating with the team for the duration of the assignment.

EXECUTIVE SUMMARY

This Report presents findings from the preliminary forest inventory conducted between the 8th and 16th of December 2003 under auspices of the project *Miombo Community Land Use and Carbon Management – Nhambita Pilot Project*. The objective of the survey was to classify the woody vegetation found in Nhambita community forest and to propose a list of tree species suitable for carbon fixing through community-based reforestation initiatives.

A total of 103 woody species were identified locally and 92 of these were identified botanically. A combination of floristic associations and species dominance measured by relative basal area contribution suggested the existence of miombo woodland (three classes), *Combretum* woodland, riverine woodland and *Combretum*/Palm woodland throughout the area surveyed. A list of 25 woody species, considered suitable for carbon fixing and with other attributes that favour their use in agroforestry development, was produced.

It is concluded that Nhambita community forest is predominantly miombo vegetation dominated by *genera* such as *Brachystegia*, *Julbernardia*, *Erythrophleum*, *Burkea*, *Diplorhynchus*, and *Pterocarpus*. It is recommended that GIS-based techniques be employed to produce a vegetation map of the community area and that an intensive forestry extension programme (including participatory land use planning) be implemented in order to prepare the community members as they embark on the envisaged reforestation activities.

BACKGROUND

The Project "Miombo community land use and carbon management – Nhambita pilot project" is being implemented in partnership by the University of Edinburgh (UoE) and the World Agroforestry Centre (ICRAF). Project implementation started in August 2003, with the annual plan of activities split in quarters, the first quarter of Year 1 running from 1st August through 31st October 2003.

The project has three main objectives:

- "Develop sustainable land use practices, in participation with the Nhambita community, which have the potential to provide socio-economic benefits and protect and restore forest resources,
- Produce research outputs into the potential of sustainable land use in the miombo ecosystem to sequester and conserve carbon in order to produce regionally applicable models that may be used to quantify carbon benefits in the pilot project area and in other future projects in the region, and
- Build capacity in provincial organisations, including the Forest and Wildlife Department, so that they can use the results of the research to advise on land use activities and assess potential carbon benefits from projects in the province. This will involve the development of an independent trust fund to administer carbon sales." Project Document: pp 2 – 3.

The land use component is the main responsibility of ICRAF. This component is further divided into four sections, namely, forest management, timber utilisation, agroforestry and non-timber forest products (NTFPs). At a project implementation meeting held at Chitengo, Gorongosa National Park (GNP), between 24 and 27 November 2003, it was resolved that field activities relating to forest inventory (under the forest management section) be initiated before the end of the second quarter of Year 1 (i.e. before 31st January, 2004).

The current report is the outcome of a preliminary forest survey conducted in the Nhambita community forest between the 8th and 16th of December, 2003.

METHODOLOGICAL STRATEGY

Given the broad outline of objectives for the PSP and inventory programmes in the project document, the consultant opted for a three-phase approach to satisfy the overall objective:

i) Preliminary inventory in order to characterize the forest resource in a broad sense: the current report covers results from this phase;
ii) [Optional] More intensive inventory targeting certain species identified under phase one taking into consideration their potential for carbon production. This phase may be discarded if the present report on phase one provides a sufficiently satisfactory picture of the forest vegetation in Nhambita; and
iii) Establishment of one-hectare permanent sample plots (PSPs) at an acceptable intensity to account for variations observed from the preliminary inventory in phase one.

PRELIMINARY INVENTORY OF NHAMBITA COMMUNITY FOREST

Aim

To characterize the woody vegetation in Nhambita community area with a view to informing land-use planning for carbon production, timber utilisation and NTFPs development through community-based agroforestry schemes

Objectives

Primary Objective: to classify the woody vegetation types found in Nhambita community forest
Secondary Objective: To propose a ranked list of tree species suitable for carbon production in Nhambita community area.

MATERIALS AND METHODS

Plot Selection Protocol

It was agreed at a project implementation meeting held at Chitengo, GNP, between 24 and 27 November 2003, that the preliminary inventory should take place for a period of approximately 10 days starting from 8 December 2003. This agreement culminated in the production by Dr. Mathew Williams (UoE) of a four-page draft protocol, with inputs from Mr. Piet Van Zyl (ENVIROTRADE) and the Consultant. The draft protocol is presented in Annex 1.

The protocol was based on 15 linear transects to be traversed at right angles to various roads within the Nhambita community area road network. A maximum of four quarter-hectare plots were to be established at equal intervals along each transect, thus providing for a maximum possible of 60 plots for all 15 transects.

In order to get to the starting point of any transect the car odometer and a GPS (Garmin® GPS II Plus) were used in conjunction with navigational instructions contained in the protocol (Annex 1). Descriptive information about this point was recorded in the cluster identification form.

Sample Plot Identification and Establishment

From the transect starting point, a compass was used to determine the direction of the transect such that the transect was perpendicular to the road. Using 100 m tapes, the transect was traversed for 200 m before establishing the first plot, 450 m before the second, 700 m before the third, or 950 m before the fourth plot, as the case might be.

On arrival at the corner of the target sample plot, 50 m tapes, a compass and bright-coloured ribbons were used to mark out the 50 m by 50 m quadrat in which the tree measurements would take place. The information identifying each sample plot was recorded in the sample plot identification form. Information contained in ID forms was combined into a 16-sheet MS Excel® file. Sheets one through 15 contain information on the 15 respective transects as described in the protocol in Annex 1. The sixteenth sheet describes the five major variables assessed during the inventory.

Field Measurements

Once the sample plot was established, the inventory team proceeded to take and record measurements of all living woody specimens within the 50 m by 50 m quadrat as follows:

a) Species local name (provided by a local informant knowledgeable in ethno-botany),
b) Species botanical name (taxonomic expertise and taxonomic keys – see bibliographical references),
c) DBH (in cm) using diameter callipers or 5 m tape to measure circumference in the case of large-diameter trees: only trees with at least 5 cm of DBH were assessed for DBH,
d) Crown diameter (in m) using 5 m tape for shrubs with less than 5 cm DBH but with a height of 1.5 m or more,
e) Total tree height (in m) using a clinometer, for the upper 25% tallest trees in the plot, and
f) Digital photos of shallow soil pits and general aspects of the sample plots.

All the measurements described in a) to e) above were recorded on the field measurement forms.

Species Coding

After completing measurements in all sample plots, the checklist of all woody species encountered and assessed was elaborated and codified (Annex 2).

Data Analysis

The first step in data analysis involved data capture onto spreadsheet, after replacing the local and botanical names with numeric codes (Annex 2).

Using MS Excel® the raw data were manipulated to determine mean stocking densities (stems per hectare, or SPH) across plots, mean basal areas across plots, dominant species combinations across plots, aggregation of similar plots into woody vegetation classes and generation of approximate site index curves throughout the forest area.

RESULTS AND DISCUSSION

Sample Plot Establishment and Measurement

The inventory planning strategy developed during the morning of 8th December 2003 showed that the single inventory team available would only manage to establish and measure a maximum of two (three in exceptional cases) plots per day. A number of factors were acting against the progress of the team:

1. High temperatures in Gorongosa at this time of the year (by 8:00 hours it could be as hot as 28^{o}C), making it unhealthy to continue working after 14:00 hours,
2. Disruption of work by rains (fortunately, the team did not suffer much from this potentially adverse factor), and
3. Difficulty in traversing transects, most notoriously those transects to the left side of the Inchope-Gorongosa main road because of the rugged nature of the terrain and frequent occurrences of bamboo thickets.

In order to cover as much of the survey area as possible, the team decided to traverse all 15 primary transects stipulated in the protocol (ANNEX 1) but establishing and taking measurements in only two plots (and not four) per transect. By the last day of the survey, the following temporary sample plots had been established and measurements taken:

Table 1. Temporary sample plots established and measured in Nhambita

Transect Number	Plot			
	A	B	C	D
1	X	X		
2			X	X
3		X	X	
4			X	X
5			X	X
6	X	X		
7	X	X		
8		X	X	
9	X	X		
10	X	X		
11		X	X	
12		X	X	
13		X	X	
14	X	X		
15			X	X

Woody Species Abundance and Dominance

Of the 103 woody species encountered in all 30 sample plots measured (see ANNEX 2), 92 were identified botanically. Results of stem counts of all specimens with DBH ≥ 5 cm revealed that Plot 8C, inside the GNP, had the lowest stocking rate of 32 SPH while Plot 11B, to the left of the Inchope-Gorongosa highway, had the highest stocking rate of 1020 SPH. The histogram in Figure 1 shows the stocking rates across all 30 plots.

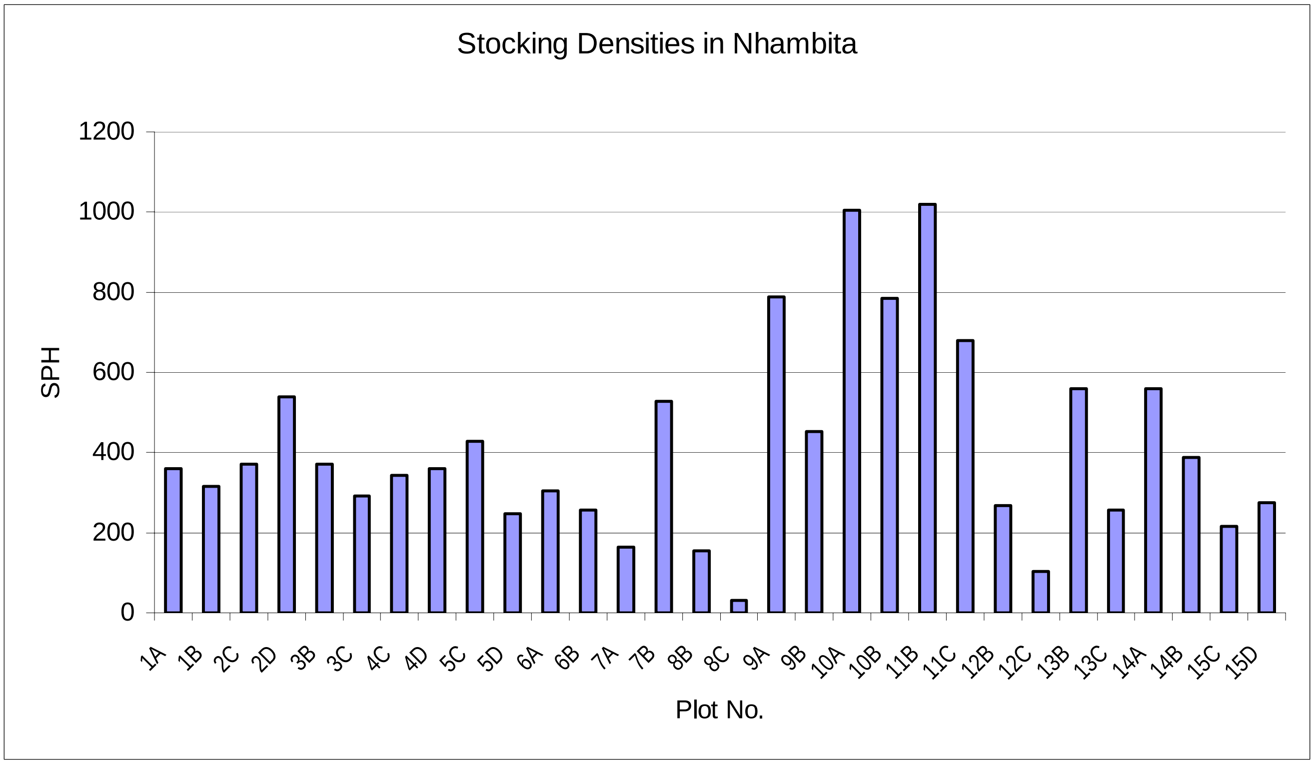

Figure 1. Stocking levels (tree stems per hectare) across 30 sample plots assessed in Nhambita community forest

By using subjective criteria combining floristic associations together with relative dominance of the respective species in those associations, a six-category woody vegetation classification was formulated (Table 2). The basic vegetation type is miombo, defined by the dominance of the three Fabaceae *genera,* namely, *Brachystegia*, *Julbernardia* and *Isoberlinia*. Following this classification scheme, Figures 2 through 7 are presented showing the stocking densities across all sample plots in the same woody vegetation group.

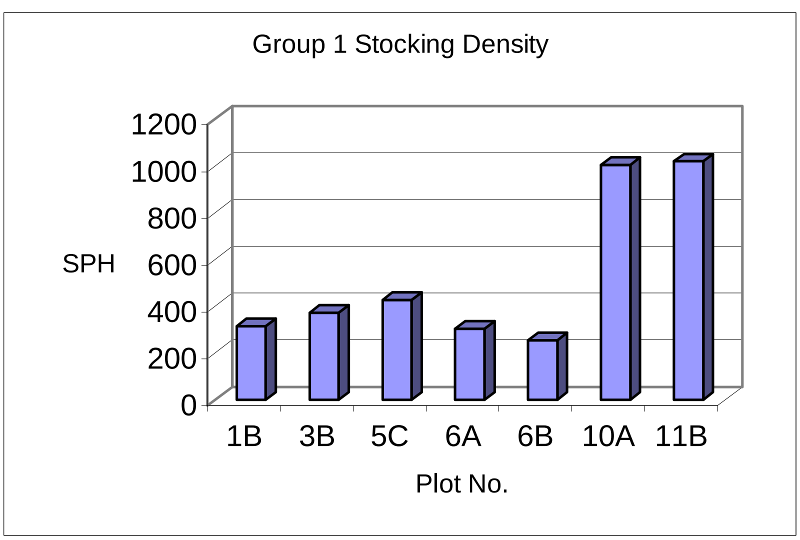

Figure 2. Stocking rates in Group 1 (mean = 528; SD = ± 335)

Table 2. Woody vegetation classes (groups) found in Nhambita community forest

Sample Plots in Group	Woody Vegetation Group					
	1. Miombo dominated by *Brachystegia* and *Julbernardia*	2. Miombo as in Group 1 but with abundance of *Diplorhynchus*	3. Miombo with significant dominance from *Pterocarpus rotundifolius*, *Burkea africana*, and *Erythrophleum africanum*	4. *Combretum* Woodland	5. Riverine Woodland	6. *Combretum*/ Palm Woodland
1A					X	
1B	X					
2C			X			
2D			X			
3B	X					
3C				X		
4C		X				
4D		X				
5C	X					
5D			X			
6A	X					
6B	X					
7A			X			
7B		X				
8B				X		
8C					X	
9A						X
9B						X
10A	X					
10B		X				
11B	X					
11C			X			
12B		X				
12C					X	
13B				X		
13C				X		
14A					X	
14B					X	
15C		X				
15D			X			

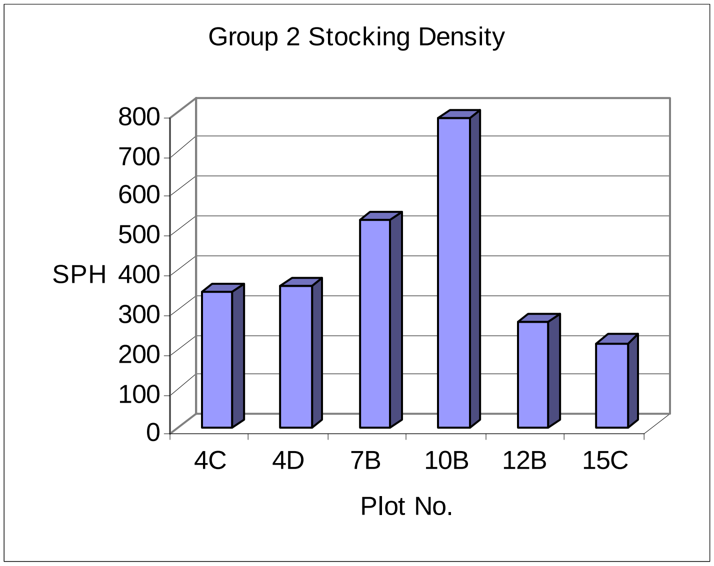

Figure 3. Stocking rates in Group 2 (mean = 417; SD = ± 209)

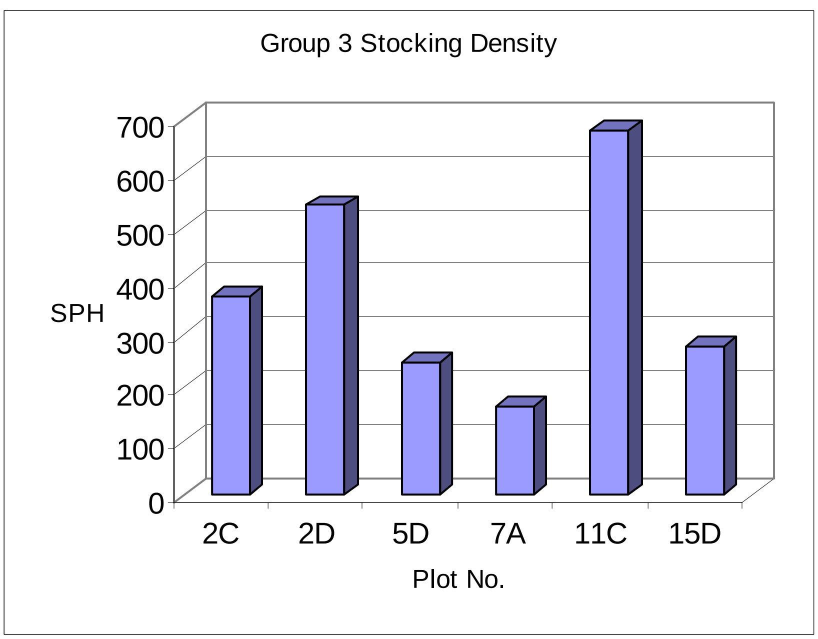

Figure 4. Stocking rates in Group 3 (mean = 380; SD = ± 195)

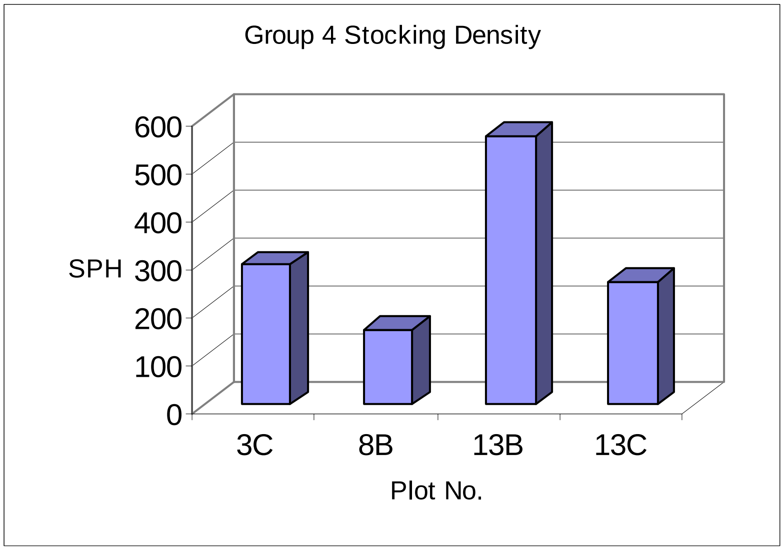

Figure 5. Stocking rates in Group 4 (mean = 316; SD = ± 172)

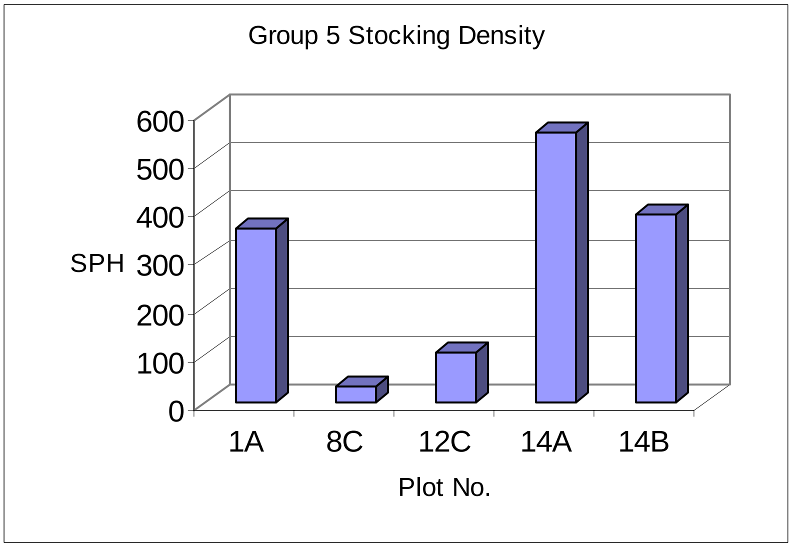

Figure 6. Stocking rates in Group 5 (mean = 289; SD = ± 217)

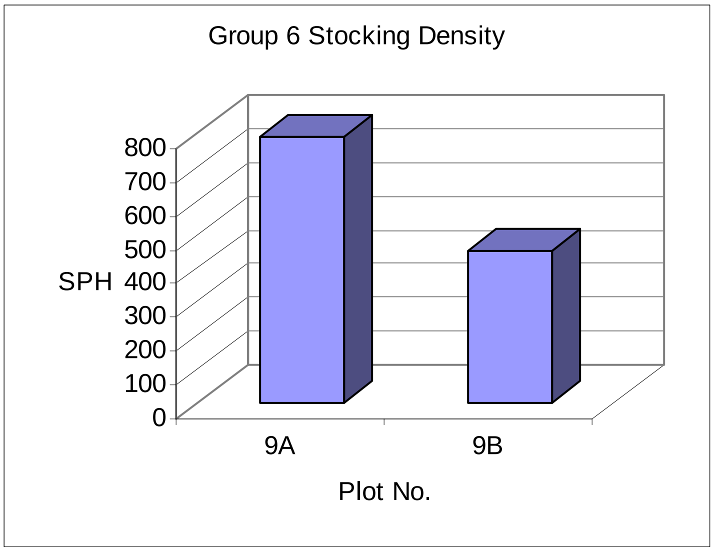

Figure 7. Stocking rates in Group 6 (mean = 620; SD = ± 237)

Stocking rates are generally high for those plots located in old agricultural fields (more than 20 year-fallow) with little disturbance from wild fires. Most such plots were located in predominantly miombo woodland to the left side of the Inchope-Gorongosa highway. These included 10A, 10B, 11B, 11C and 2D, all in miombo woodland. The other two plots with particularly high stocking rates were 13B and 14A, located, respectively in *Combretum* woodland and riverine woodland. Both plots are located alongside the main Park Access Track but far deeper into the direction of the park and therefore far away from possible influence of settlers from across the highway.

The plots with low stocking densities are located close to the road junction between the Park Access Track and the Inchope-Gorongosa highway. The low stocking rates in this area are attributed mostly to periodic incursions by settlers from across the highway, who are used to harvesting construction timber from that area. The other plots with low stocking densities are located close to heavily settled sites (with agricultural activities, charcoal production and even commercial timber logging) to the left side of the Inchope-Gorongosa highway.

Stem counts alone do not give a complete picture of vegetation composition and species dominance across vegetation types. This is the reason why the relative dominance of individual species or groups of species is an important measure determining the vegetation types. In forestry, basal area (i.e. the surface area in m^2 ha^{-1} that is covered by wood) is used as an appropriate measure of dominance under the assumption that only dominant species are more likely to withstand competition for nutrients, moisture and light in order for them to attain large diameters, and hence higher dominance. The basal area of one stem is obtained by calculating the area of an equivalent circle whose diameter equals the DBH of that stem. Figure 8 presents the basal areas of all trees measured across all sample plots. Tables 3 through 8 and Figures 9 through 14 present the relative dominance rates of the main species across sample plots and vegetation types.

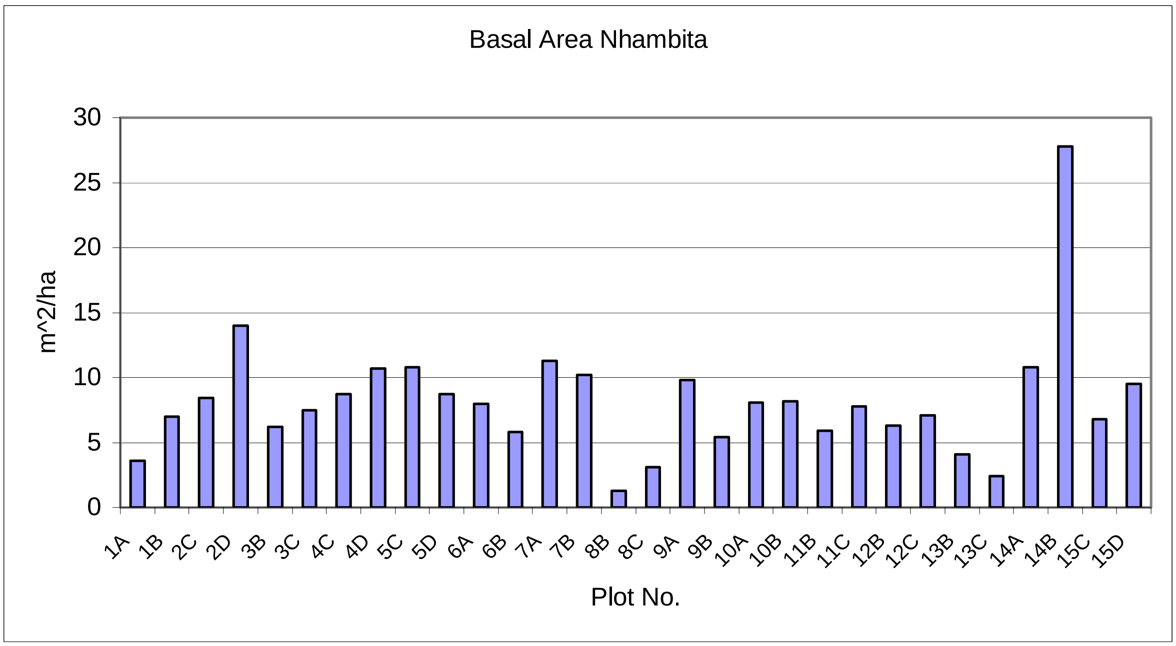

Figure 8. Basal areas across all 30 sample plots

Table 3. Group 1 (miombo dominated by *Brachystegia* and *Julbernardia*): Basal area (m^2 ha^{-1}) contribution by dominant species across sample plots

Species Code*	Sample Plots						
	1B	3B	5C	6A	6B	10A	11B
2	0.63	-	1.47	-	-	-	0.28
14	1.51	0.55	2.56	0.31	0.72	0.48	-
27	2.18	-	2.39	1.31	1.64	2.07	2.64
35	0.95	1.69	2.12	-	-	1.33	0.15
36	-	1.12	-	1.76	-	0.51	0.20
37	-	1.10	-	2.43	0.93	1.93	1.19
42	-	-	-	0.24	0.98	-	-
% of total basal area	75.3	71.9	79.1	75.6	73.6	78.0	75.6

* 2 *Albizia lebbeck* 14 *Diplorhynchus condylocarpon* 27 *Brachystegia boehmii*
35 *Brachystegia spiciformis* 36 *Pterocarpus angolensis* 37 *Julbernardia globiflora*
42 *Erythrophleum africanum*

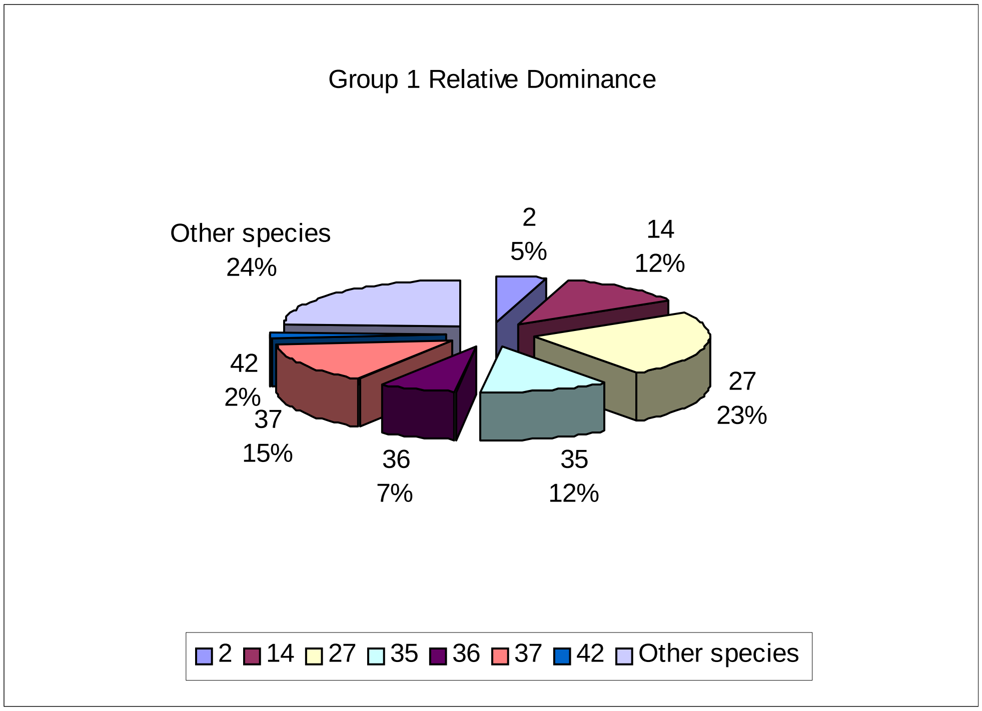

Figure 9. Species relative dominance in Group 1 (miombo)

Table 4. Group 2 (miombo floristically dominated by *Diplorhynchus condylocarpon*): Basal area (m^2 ha^{-1}) contribution by dominant species across sample plots

Species Code*	Sample Plots					
	4C	4D	7B	10B	12B	15C
3	-	-	-	0.51	-	-
4	-	0.65	0.14	0.35	-	-
5	0.69	-	4.02	0.19	-	-
6	0.87	-	0.71	0.31	-	-
8	0.61	-	-	-	-	-
9	-	-	0.37	0.38	-	-
14	1.51	0.77	1.93	0.58	1.12	1.02
26	-	-	-	0.15	0.59	-
27	2.19	6.53	0.92	4.47	-	-
35	-	-	-	-	1.07	1.03
38	-	-	-	-	0.43	-
39	0.55	-	-	-	0.38	-
40	-	-	-	-	0.65	-
42	0.39	0.41	-	-	0.24	2.95
53	-	1.63	-	-	-	0.28

84	-	-	0.78	0.21	0.22	0.64
% of total basal area	78.3	93.4	86.9	87.2	74.6	87.0

*3 *Dalbergia melanoxylon* 4 *Sclerocarya birrea* 5 *Acacia nigrescens*
6 *Pterocarpus rotundifolius* 8 *Pericopsis angolensis* 9 *Bauhinia petersiana/B. Galpinii*
26 *Piliostigma thonningii* 38 *Strychnos innocua* 39 *Zanha africana*
40 *Premna senensis* 53 *Burkea africana* 84 *Combretum apiculatum*

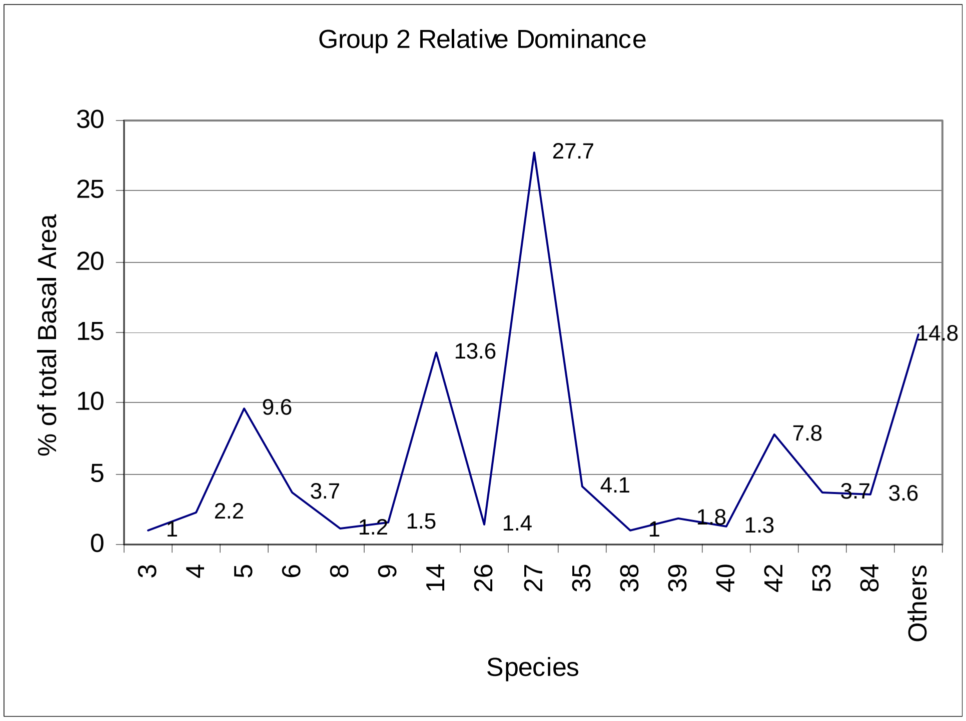

Figure 10. Species relative dominance in Group 2 (miombo)

Table 5. Group 3 (miombo with abundance of *Pterocarpus rotundifolius*, *Burkea africana*, *Erythrophleum africanum*): Basal area ($m^2\ ha^{-1}$) contribution by dominant species across sample plots

Species Code*	Sample Plots					
	2C	2D	5D	7A	11C	15D
2	-	-	-	-	0.41	-
4	0.40	-	-	-	0.70	0.95
5	0.98	1.59	-	2.68	-	-
6	1.34	8.21	0.31	0.68	0.95	-
14	1.11	2.16	0.42	-	-	0.78
17	-	-	-	2.33	-	-
23	0.76	-	-	-	-	-
27	-	-	6.91	4.10	1.28	-
32	1.07	-	-	-	-	-
35	-	-	0.30	-	0.57	3.32
37	-	-	-	-	0.89	-

42	-	-	0.53	-	0.31	1.62
44	0.41	-	-	0.30	-	-
52	-	-	-	-	0.13	0.91
53	-	-	-	-	0.98	-
79	0.80	-	-	-	-	-
84	-	1.64	-	-	-	-
% of total basal area	81.8	97.1	97.3	89.3	79.7	79.8

*17 *Combretum molle* 23 *Millettia stuhlmannii* 32 *Crossopteryx febrifuga*
44 *Terminalia stenostachya* 52 *Amblygonocarpus andongensis* 79 *Sterculia africana*

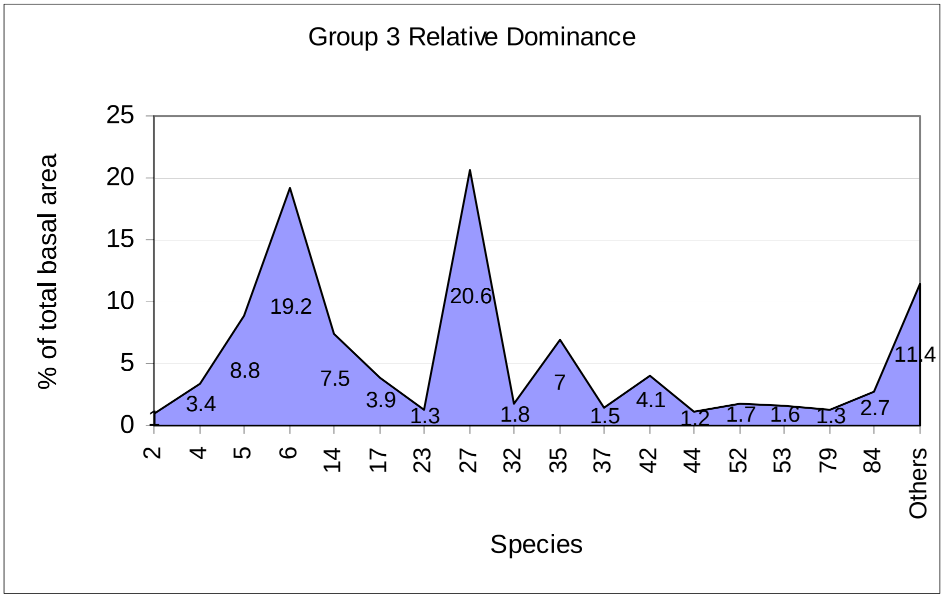

Figure 11. Species relative dominance in Group 3 (miombo)

Table 6. Group 4 (*Combretum* woodland): Basal area (m^2 ha^{-1}) contribution by dominant species across sample plots

Species Code*	Sample Plots			
	3C	8B	13B	13C
5	-	-	0.14	0.85
6	0.87	-	1.48	-
10	0.47	-	-	-
16	0.60	-	0.14	-
68	2.31	-	-	-
75	0.59	-	-	-
80	-	-	-	0.65
84	0.75	1.12	1.97	0.69
% of total basal area	74.5	86.1	91.0	91.2

*10 *Azanza garckeana* 16 *Sterculia appendiculata* 75 *Faidherbia albida*
80 *Combretum hereroense*

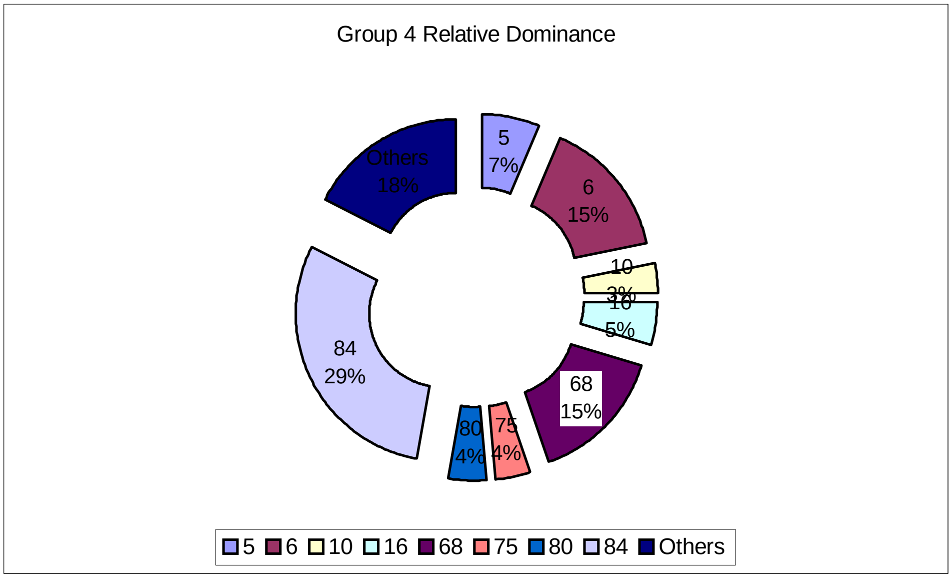

Figure 12. Species relative dominance in Group 4 (*Combretum* woodland)

Table 7. Group 5 (Riverine Woodland): Basal area ($m^2 ha^{-1}$) contribution by dominant species across sample plots

Species Code*	Sample Plots				
	1A	8C	12C	14A	14B
1	0.24	-	-	-	-
2	0.29	-	-	-	-
3	0.48	-	-	-	-
4	0.41	-	-	-	1.88
5	-	0.51	0.95	-	2.88
6	0.11	-	0.45	-	-
10	0.20	-	-	-	-
14	-	-	1.21	-	0.15
17	0.16	-	-	-	-
23	0.21	-	-	-	0.37
30	-	-	0.78	-	2.46
41	-	0.59	-	0.88	0.44
49	-	-	6.85	-	-
68	-	1.68	-	0.90	-
71	-	-	-	3.36	2.36
72	-	-	-	0.69	0.31
75	0.60	-	-	0.47	0.24
77	-	-	-	0.71	0.23
79	-	-	-	1.79	-
83	-	-	-	-	14.72
% of total basal area	75.0	89.7	87.5	81.5	93.7

*1 *Lannea schimperi* 30 *Xeroderris stuhlmannii* 41 *Philenoptera violacea*
49 *Khaya anthoteca* 71 *Cleistochlamys kirkii* 72 *Scolopia stolzii*
77 *Lecaniodiscus fraxinifolius* 83 *Adansonia digitata*

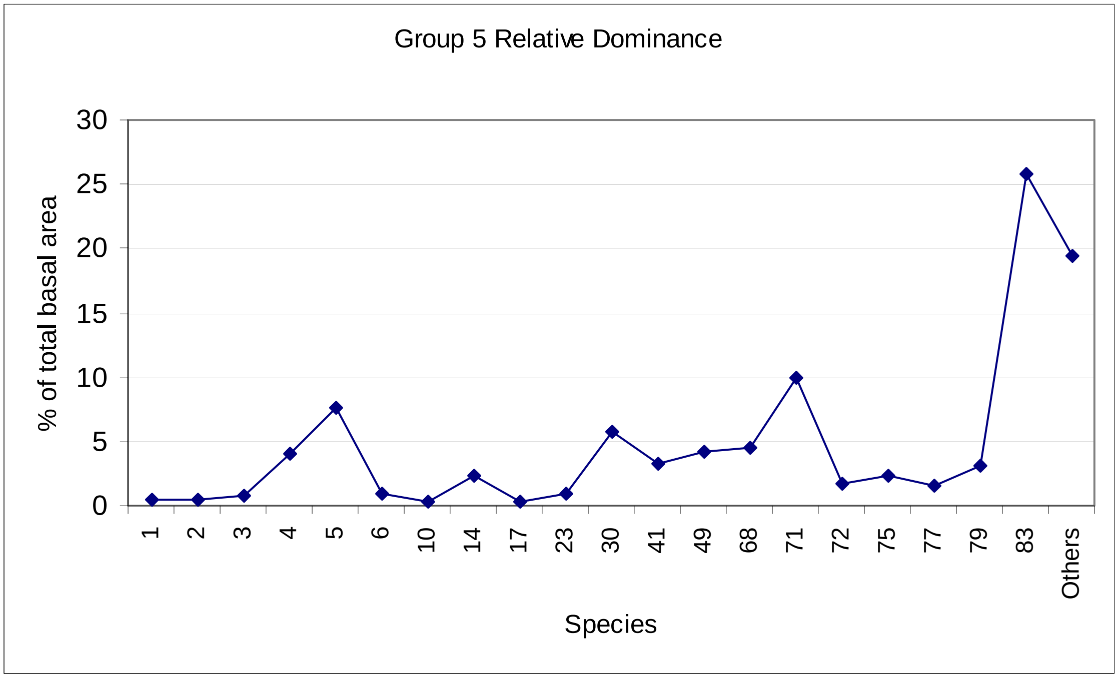

Figure 13. Species relative dominance in Group 5 (Riverine woodland)

Table 8. Group 6 (*Combretum*/Palm Woodland): Basal area (m^2 ha^{-1}) contribution by dominant species across sample plots

Species Code*	Sample Plots	
	9A	9B
4	0.79	0.24
26	0.93	0.12
41	2.14	1.64
81	-	0.94
84	2.85	1.45
88	0.45	0.10
89	1.42	0.83
98	1.07	-
% of total basal area	98.5	98.5

*88 *Kigelia africana* 89 *Hyphaene coriacea* 98 "muchambu" (chiSena)

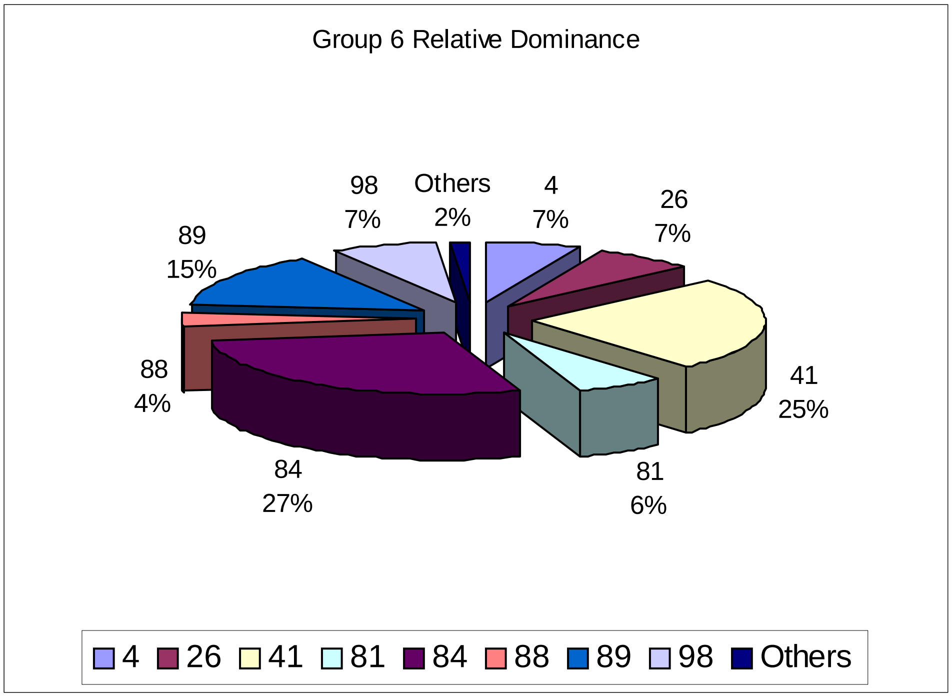

Figure 14. Species relative dominance in Group 6 (*Combretum*/Palm woodland)

In order to validate dominance by certain species in specific vegetation types, a measure of dominance in the shrub layer was calculated in terms of relative crown cover per unit area by dominant shrub layer species. This was computed as the area of crown projections on the ground, adjusted to m^2 ha^{-1}. Figures 15 through 19 present the relative dominance of shrub species across vegetation types. Group 6 did not have shrubs but heavy herbaceous cover.

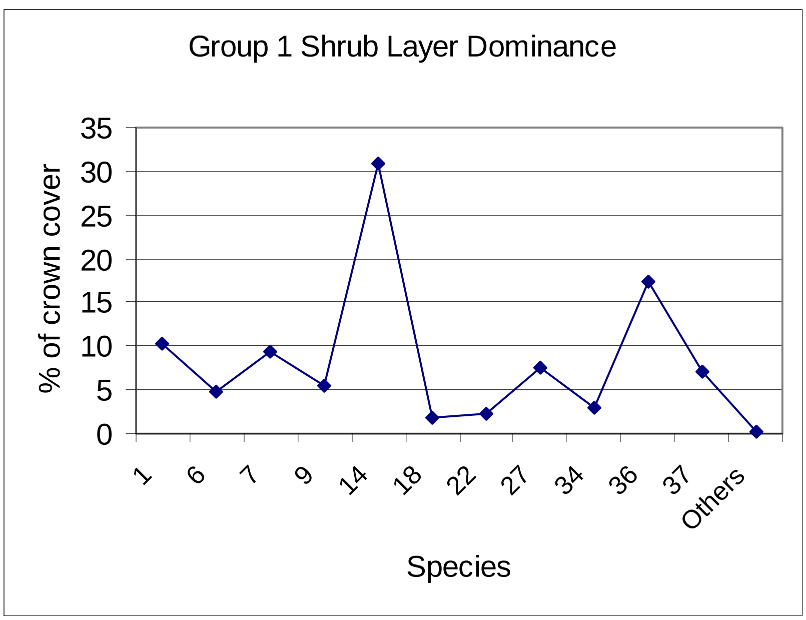

Figure 15. Relative dominance in the shrub layer, Group 1 (miombo)

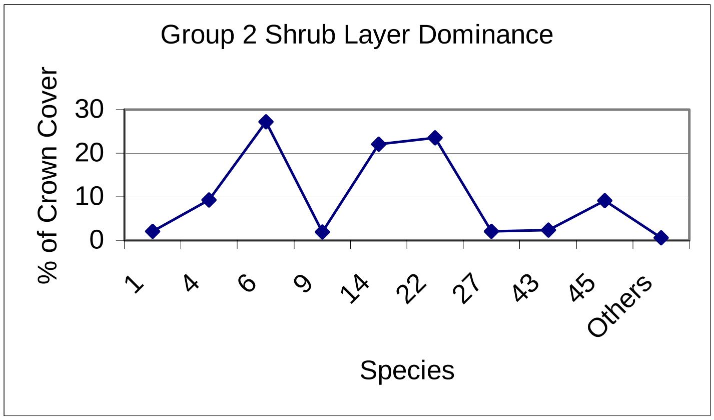

Figure 16. Relative dominance in the shrub layer, Group 2 (miombo)

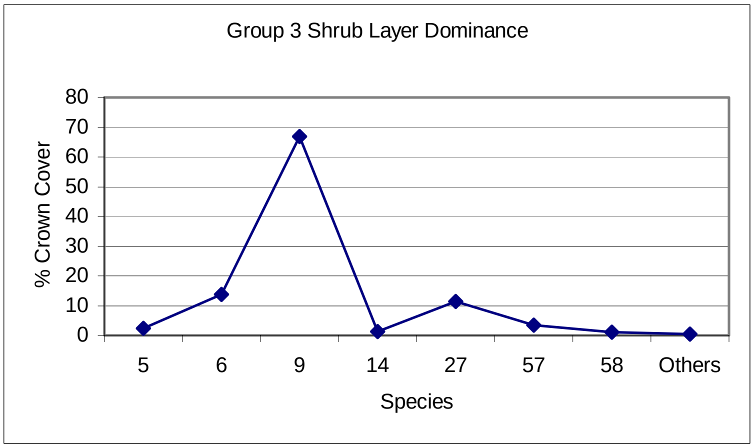

Figure 17. Relative dominance in the shrub layer, Group 3 (miombo)

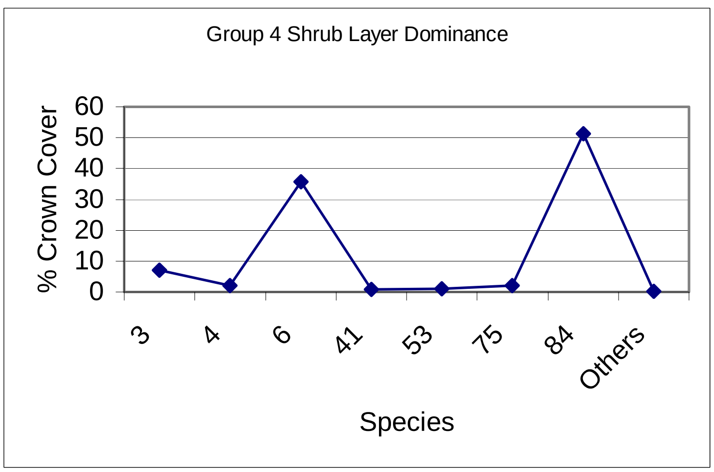

Figure 18. Relative dominance in the shrub layer, Group 4 (*Combretum* woodland)

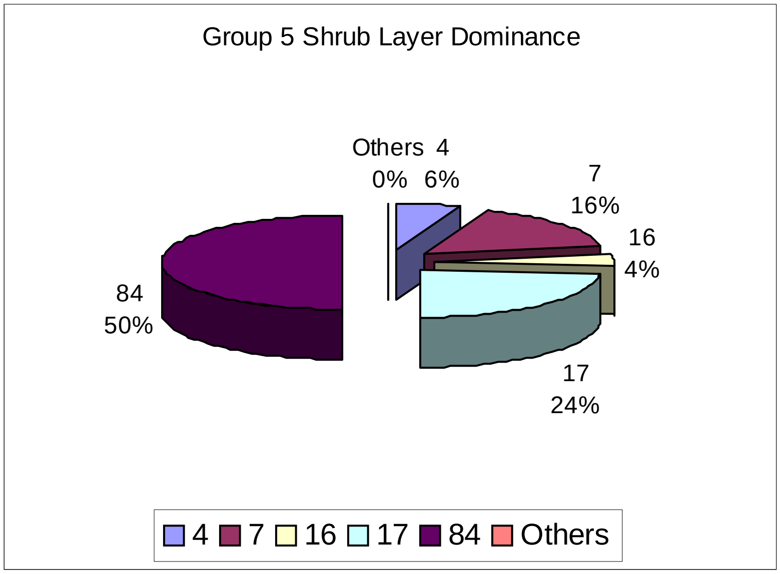

Figure 19. Relative dominance in the shrub layer, Group 5 (Riverine woodland)

In Group 1 (miombo), tree layer, *Brachystegia boehmii*, *B. spiciformis* and *Julbernardia globiflora* together accounted for 50% of the basal area, thus confirming the typical miombo nature of that vegetation. Still in Group 1, *Diplorhynchus condylocarpon* alone accounted for 14% of the total basal area. The absence of *Isoberlinia* is to be expected because that *genus* is only found in wet miombo mostly in Zambia and the DRC. Still in the tree layer, Group 2, *Julbernardia* was replaced by *Diplorhynchus condylocarpon* to bring the total basal area contribution by the three species to about 45%. This substitution of *Julbernardia* by *Diplorhynchus* was more evident in the less xeric sites. In a coarse classification scheme, therefore, Groups 1 and 2 can be conveniently combined into one miombo vegetation class. When considering the shrub layer, in Group 1 *Diplorhynchus condylocarpon* contributed 30% of the crown cover, *Pterocarpus angolensis* 17% and *Brachystegia boehmii* 7%. In Group 2, shrub layer, *Pterocarpus rotundifolius* contributed 28%, *Diplorhynchus condylocarpon* 22% and *Rhus* spp. 24%. From the foregoing, there is a general tendency for *Diplorhynchus condylocarpon* to register a dominant presence in Group 1 and 2 vegetation in both the tree and shrub layers. *Julbernardia globiflora* still retains some presence in the shrub layer of Group 1 and *Pterocarpus angolensis* and *P. rotundifolius* become important in the shrub layers of Group 1 and 2, respectively.

In the tree layer of Group 3 (miombo woodland) *Brachystegia boehmii* contributes 20.6% of the basal area, *P. rotundifolius* 19.2%, *Acacia nigrescens* 8.8% and *Diplorhynchus condylocarpon* 7.5%, making a total of 56.1%. This type of miombo is more common on soils that have hydromorphic properties and therefore not best suited for supporting *B. spiciformis* or *J. globiflora*, both of which prefer well-drained soils, even with loose stones. In the shrub layer of Group 3 *Bauhinia* species (66.8%), *P. rotundifolius* (13.7%) and *B. boehmii* (11.4%) dominate.

In the *Combretum* woodland *Combretum apiculatum* (29%), *Commiphora mossambicensis* (15%) and *P. rotundifolius* (15%) dominate the tree layer while *C. apiculatum* (51.3%) and *P. rotundifolius* (35.7%) dominate the shrub layer. In addition, *C. apiculatum* (50%) and *Combretum molle* (24%) dominate the shrub layer of the riverine woodland. The tree layer of riverine woodland is dominated by *Adansonia digitata* (25.8%), *Cleistochlamys kirkii* (10%), *A. nigrescens* (7.6%) and *Xeroderris stuhlmannii* (5.7%).

The *Combretum*/Palm woodland tree layer is dominated by *C. apiculatum* (27%), *Philenoptera violacea*, formerly *Lonchocarpus capassa* (25%) and *Hyphaene coriacea* (15%). As indicated earlier on, the Group 6 vegetation did not have any significant shrub layer, instead it had abundant herbaceous cover.

In an attempt to validate the subjective vegetation classification proposed above, statistical analyses were carried out with respect to the mean basal area stocking in Nhambita community forest (Table 9):

Table 9. Basal area statistics for Nhambita community forest

Stratum	Statistic					
	N (No. of 0.25 ha plots)	*n* (No. of sample plots)	y_{mean} (mean basal area in m^2 ha^{-1})	SE (Standard Error in m^2 ha^{-1})	RSE (Relative Standard Error, %)	95% confidence interval
Nhambita productive forest (10000 ha)	40000	30	8.2	0.852	10.4	(6.4, 9.9)
Group 1 (miombo)	140	7	7.4	0.653	8.8	(6.0, 8.7)
Group 2 (miombo)	120	6	8.5	0.703	8.3	(7.0, 9.9)
Group 3 (miombo)	120	6	9.9	0.925	9.3	(8.0, 11.8)
Group 4 (*Combretum* woodland)	80	4	3.8	1.319	34.7	(1.1, 6.5)
Group 5 (Riverine woodland)	100	5	10.5	4.43	42.2	(1.3, 19.6)
Group 6 (*Combretum*/ Palm woodland)	40	2	---	---	---	---

The statistics in Table 9 suggest that the sampling intensity applied during the survey was adequate with respect to the three miombo vegetation classes, where the RSE was within about 10%. For the *Combretum* woodland, the riverine woodland and the *Combretum*/Palm woodland, more sampling would be required in order to reduce the error to more acceptable levels. In any case these three vegetation classes are not widespread, if at all, within the Nhambita community forest. Rather, they are found mainly in the GNP and, therefore, would normally fall out of the management jurisdiction of the Nhambita community.

Further statistical tests were carried out focusing only on the three miombo classes. *F*-tests showed that the samples taken from Group 1, Group 2 and Group 3 came from populations having the same variance (Table 10):

Table 10. *F*-tests for variances among miombo basal areas

Comparison	Statistic		
	F (calculated)	Degrees of freedom	*F* (Table)
Group 1 vs Group 2	1.16	(5, 6)	4.39
Group 1 vs Group 3	2.01	(5, 6)	4.39
Group 2 vs Group 3	1.73	(5, 5)	5.05

After carrying out a two-tailed *t*-test at 5% level of significance, it was concluded that the miombo populations from Group 1, Group 2 and Group 3 were significantly different with respect to their mean basal area (Table 11):

Table 11. *t*-tests for comparison of mean basal areas in miombo strata

Comparison	Statistic			
	Pooled variance (s^2)	Computed value of *t*	Degrees of freedom	Value of *t* (Table)
Group 1 vs Group 2	0.418	3.06	11	2.20
Group 1 vs Group 3	0.621	5.71	11	2.20
Group 2 vs Group 3	0.675	2.95	10	2.23

Site Index Curves

In deriving site indices, the most important relationship is that between tree growth in height over time, more specifically the time it takes for a particular species to attain the maximum possible height constrained by the site conditions. A high site index indicates optimum growing conditions, even under competition from other plants. Soil nutrients, soil structure and depth are key determinants of site class. For this reason, forest vegetation types are often used as surrogate measures of soil characteristics, in the absence of detailed soil analyses of the sites in question. With reference to the preliminary survey of Nhambita community forest, this work was carried out before the detailed soil studies were carried out. All the same, digital photos of shallow soil pits were taken at all 30 sample plots surveyed. The importance of this stepwise process in resources inventory lies in the fact that the detailed soil analyses will no longer take place from scratch and will in fact help validate the indirect soil classification achieved through vegetation classification.

Similarly, DBH is used as a proxy for time, when there exists no information on the height growth curves of particular species. A site index is normally expressed as the mean total height (in meters) attained by the dominant tree species in a stand, at a reference age (i.e. time). Thus $H_{t(50)} = 15$ refers to a Site Index (SI) of 15 meters height at the age of 50 years. If the mean DBH attained by the same dominant species at the age of 50 years is 35 cm, then the same SI can be represented as: $H_{DBH(35)} = 15$. Figures 20 through 25 present site index scatter graphs for the six vegetation groups.

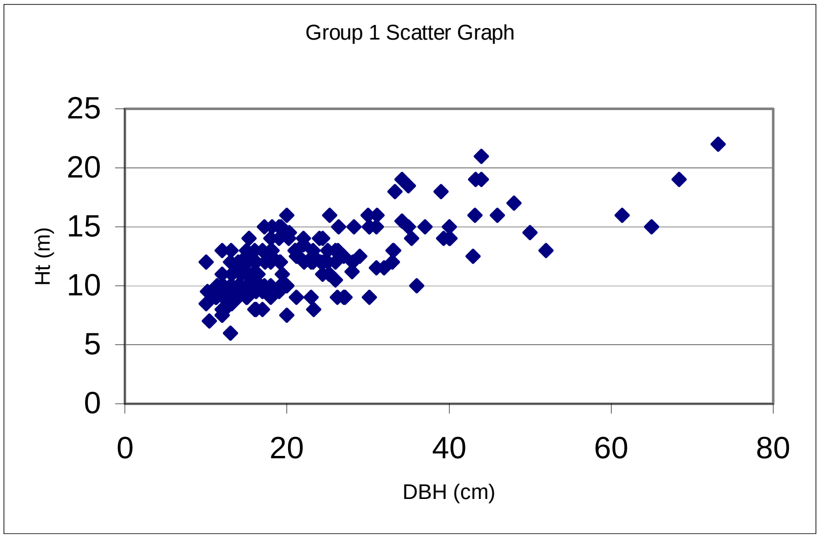

Figure 20. Ht/DBH scatter graph for Group 1 vegetation

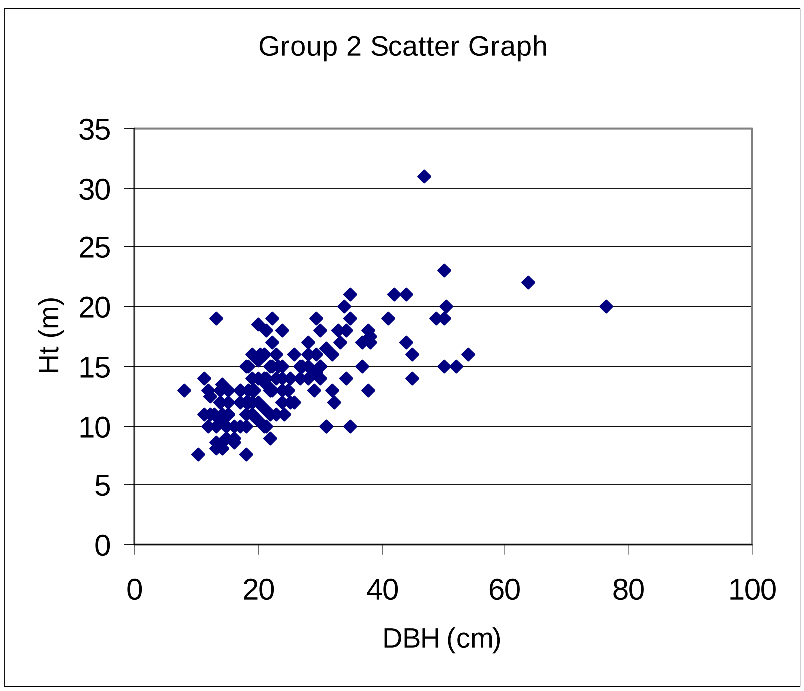

Figure 21. Ht/DBH scatter graph for Group 2 vegetation

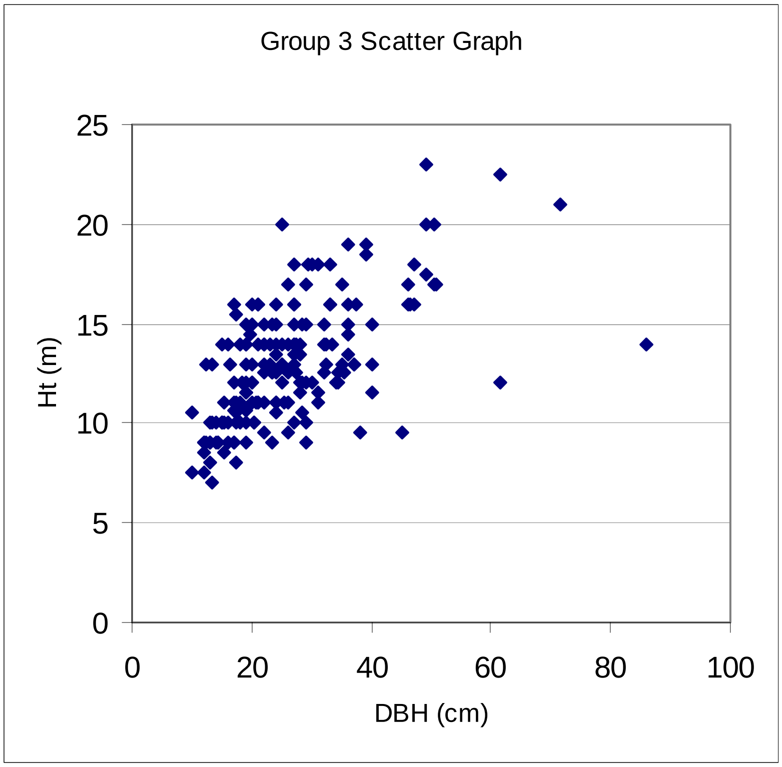

Figure 22. Ht/DBH scatter graph for Group 3 vegetation

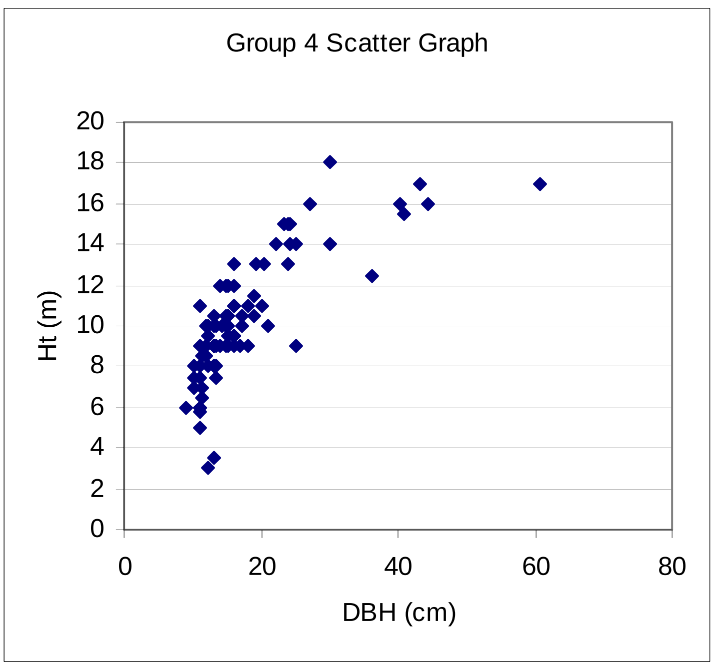

Figure 23. Ht/DBH scatter graph for Group 4 vegetation

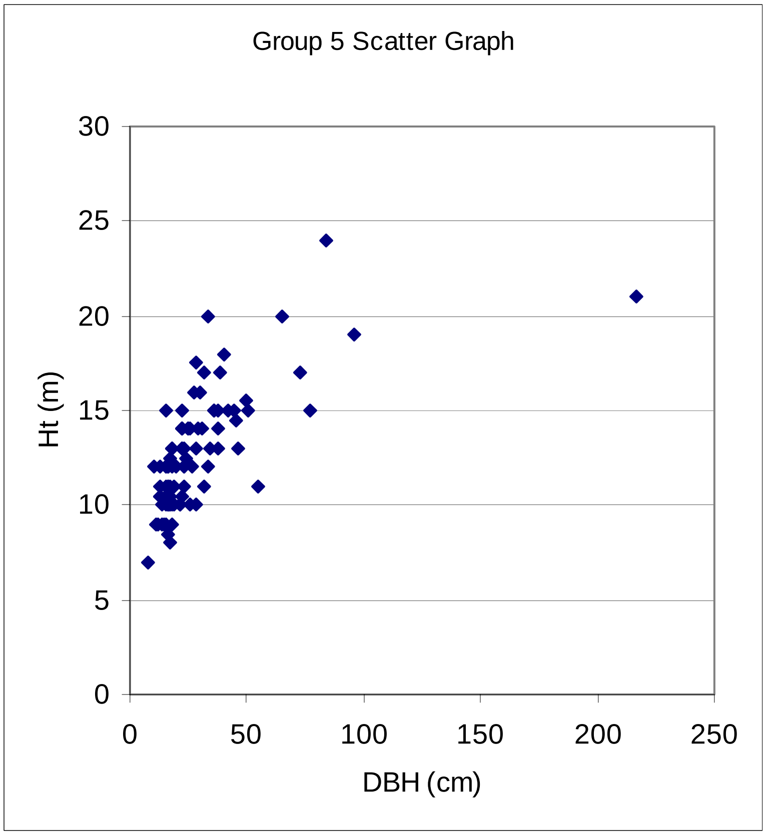

Figure 24. Ht/DBH scatter graph for Group 5 vegetation

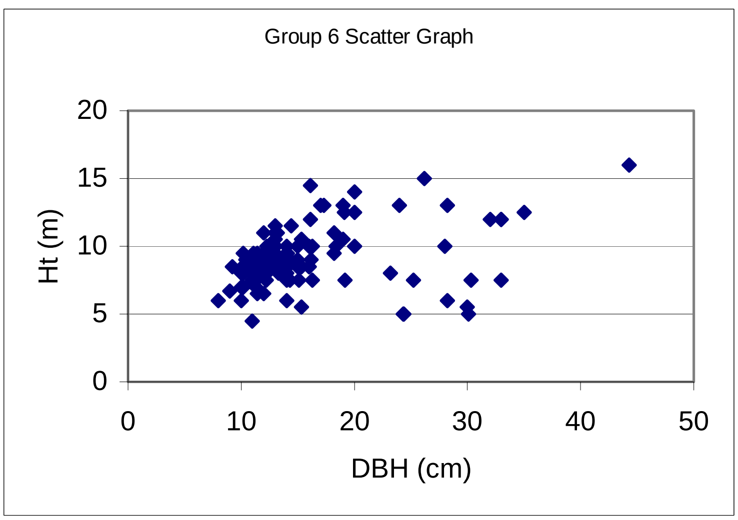

Figure 25. Ht/DBH scatter graph for Group 6 vegetation

Table 12 and Figure 26 present the site index regression functions derived for all six vegetation types, taking 30 cm as the reference DBH.

Table 12. Regression functions for all six vegetation types

Group	Function	*n*	*n/N* (%)	*r*	SI (m) = $H_{DBH(30)}$
1	Ht = -2 + 4.6Ln(DBH)	174	18.8	0.7	13.6
2	Ht = -3.99 + 5.72Ln(DBH)	148	23.7	0.66	15.5
3	Ht = -2.86 + 4.96Ln(DBH)	178	31.2	0.64	14.0
4	Ht = -8.19 + 6.63Ln(DBH)	83	26.3	0.84	14.3
5	Ht = -0.9 + 4.32Ln(DBH)	95	26.3	0.74	13.8
6	Ht = 3.6 + 2.07Ln(DBH)	121	39.0	0.33	10.6

The optimum sample size for purposes of calculating site indices is not easy to determine. In the case where an inventory is conducted to estimate timber volumes, it may be better to use the minimum harvestable DBH of the commercial species of interest. For the Nhambita survey, a subjective sampling intensity of "the upper quartile" (i.e. the tallest upper 25% trees in the plot) had been targeted. As is evident from Table 12, the actual sample ranged from 18.8% (Group 1) to 39% (Group 6), with the overall mean target having been exceeded by 2.5%. In diverse ecosystems such as miombo it is not easy to maintain strict control of such subjective concepts as "upper quartile" if efficiency in taking measurements is not to be compromised. In any case, a less biased sample will be achieved by selecting the tallest trees from the long and narrow transect rather than from the 50 m X 50 m quadrats.

Both Table12 and Figure show that Site 2 offers the best growth conditions. Site 6 is the least favourable, but with some explanation. It will be noted from that site's scatter graph (Figure 25) there are a number of open-grown trees denoted by points of high DBH values but low Height values. This is common on sites of low diversity characterised by high stocking densities in the lower diameter classes only. As competition sets in, only few individuals remain by virtue of their higher adaptability to the habitat. They then continue to survive under minimum competition for light, hence the open growth, characterised by high leaf area indices and large diameters. For Site 6, one should actually refer mostly to the seasonal marshes so common in GNP.

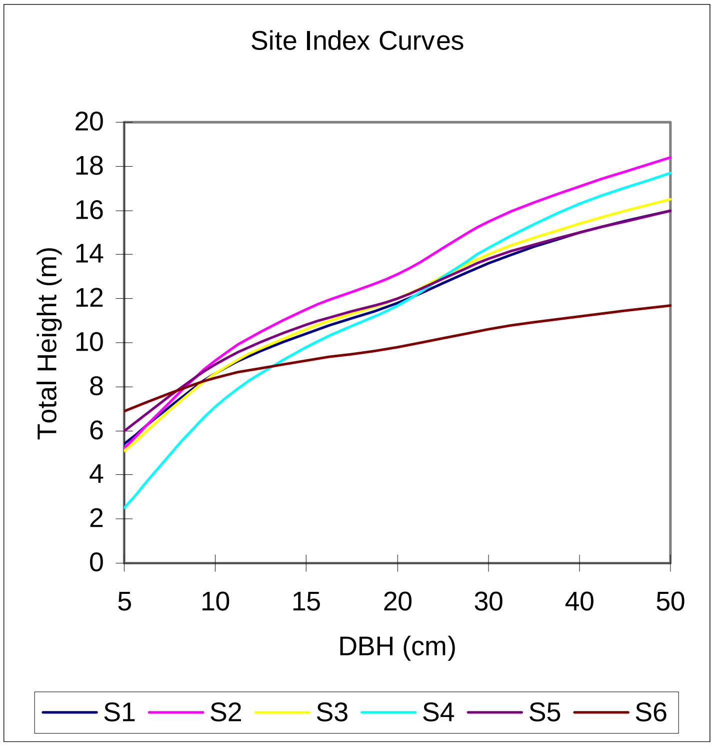

Figure 26. Site index curves for all six sites represented by the 6 vegetation types
NB: S2>S4>S3>S5>S1>S6

IMPLICATIONS FOR CARBON PRODUCTION

Bearing in mind that the overall objective of the current survey aimed at determining which tree species occur naturally in Nhambita area and which could be incorporated into the carbon production initiatives under the project, an attempt was made to compile a list of candidate species, not only suitable for carbon production but also serving other multiple purposes (Table 13). The first 19 species listed in Table 13 refer to species which were actually identified, measured and recorded in one or more of the 30 sample plots inventoried. The last six species in the same table were either sighted but not within the sample plots (*Schinziophyton rautanenii*, *Tamarindus indica*, *Cordyla africana, Trichilia emetica*) or are species that may need to be "introduced" given their potential for carbon fixing and other purposes (*Parinari curatelifolia*, *Kirkia acuminata*).

In embarking on reforestation in the project area, it has to be remembered that fire constitutes part and parcel of miombo ecology. In reforestation, however, fire has to be kept out completely until the plants escape the suffrutex height (typically 1.5 m) for moderate fires. The implication of this is that fire protection activities should be more intensive during the first three or so seasons for the moderately fast growing species. This brings in the observation in favour of tree species that can propagate vegetatively from truncheons: such species have the advantage of jump-starting their establishment into saplings, beyond the suffrutex stage, thus completely doing away with the seedling stage in the nursery. Since the reforestation will be community-based, there will be need for concerted effort in local level capacity building on basic Silviculture, mass mobilisation to strengthen the local village institutions as well as instilling a sense of discipline and responsibility through participatory land use planning.

Table 13. Candidate species for agroforestry-related reforestation initiatives in Nhambita community forest

Species	Attributes
1. Sclerocarya birrea	One of the most highly valued multipurpose fruit trees. Problem: sexes separate in different trees
2. Acacia nigrescens	Grows well under the natural conditions in Gorongosa
3. Pterocarpus rotundifolius	Potentially good carbon fixer given its relative abundance in the Gorongosa area
4. Annona senegalensis	Good fruit tree; medicinal properties
5. Erythrina sp.	*E. abyssinica* grows easily from truncheons and from seed, but it is frost-tender
6. Pseudolachnostylis maprouneifolia	Good honey tree; fire resistant; trees respond well to cultivation if protected during the early establishment phases
7. Vangueria infausta	Good fruit tree/shrub
8. Khaya anthoteca	The perfect carbon investment especially in riverine fringe forest
9. Strychnos sp.	*S. cocculoides* and *S. madagascariensis* produce edible fruit and the seed germinates easily; trees fast growing; success stories in Zambia
10. Amblygonocarpus andongensis	Real carbon fixer; grows to be a huge tree; occurs naturally in the Gorongosa area and so worth trying
11. Ficus sp.	*F. sur* will grow easily from truncheons, and so should *F. sycomorus*, whose figs have an acclaimed flavour
12. Commiphora mossambicensis	Fast growing; likely to propagate well from truncheons
13. Faidherbia albida	The famous agroforestry African species
14. Albizia sp.	*A. amara* is a fast growing multipurpose species (and N-fixing??)
15. Adansonia digitata	Fruit, leaves, edible; the symbolic giant of low altitudes, hot woodland; seed germinates fairly easily
16. Ziziphus sp.	Many successful introductions of *Z. mauritiana* in southern Africa for the prized fruit; *Z. mucronata* and *Z. abyssinica* valued for their medicinal properties
17. Kigelia africana	Huge carbon fixer growing up to 25 m in height; Fruit has medicinal properties and trees are easily cultivated
18. Peltophorum africanum	Potentially high carbon fixer; Bark has medicinal properties; Seed germinates well, young plants transplant easily and are fast growing
19. Ximenia caffra	Edible fruit which can be made into tart jelly; seed produces multipurpose oil; leaves used for medicinal purposes; Shrubs good candidates as live fence around homesteads and/or family gardens
**20. Parinari curatelifolia*	Prized fruit tree, fast growing (check trials in Zambia); Is Gorongosa altitude too low for the species?
**21. Schinziophyton rautanenii*	Huge carbon fixer, often occurring in pure stands (in the Kalahari sands); Seed contains edible kernel and provides edible oil; Good success recorded in Zambia trials
**22. Tamarindus indica*	Evergreen important multipurpose fruit tree
**23 Cordyla africana*	Well adapted to low altitudes in hot areas; Good fruit tree and a real carbon fixer
**24 Kirkia acuminata*	Grows well at medium to low altitudes, and on rocky ridges and outcrops; Propagates well from truncheons; fast growing, drought-resistant
**25. Trichilia emetica*	Fast growing evergreen species; good candidate for reforestation in riverine fringe forest; medicinal properties; seed produces oil with medicinal properties (balsam)

CONCLUSIONS AND FUTURE WORK

Conclusion 1. Nhambita community forest consists of mainly miombo vegetation dominated by species such as *Brachystegia boehmii, B. spiciformis, Julbernardia globiflora, Diplorhynchus condylocarpon, Erythrophleum africanum* and *Burkea africana*. Miombo shrub layer is dominated by *Bauhinia sp., D. condylocarpon, Pterocarpus rotundifolius, B. boehmii* and, occasionally, *Pterocarpus angolensis*.

Recommendation 1. In the event of a proposition to undertake commercial timber logging (only in the productive forest to the left side of the Inchope-Gorongosa highway), it is recommended first to confirm existence of merchantable logs with the SPFFB-Sofala because a forest concession is currently operating in the area. It is further recommended that participatory land use planning involving the farmers, charcoal producers and other stakeholders should precede any serious commercial commitments.

Conclusion 2. The other three vegetation types surveyed, namely, *Combretum* woodland, riverine woodland and *Combretum*/Palm woodland, do not appear to be of high importance for purposes of forest management planning in Nhambita community in the short-term. Given its fragile and vulnerable nature, however, the riverine forest deserves closer attention in terms of conservation efforts such as strict observance of the protection of strips flanking waterways etc. Both the *Combretum* and *Combretum/*Palm woodland categories are more relevant to the GNP vegetation and, presumably, adequate attention is being paid to them through the Gorongosa-Marromeu transect studies under auspices of the Millennium Assessment currently underway in southern Africa.

Recommendation 2. It is recommended that forest extension covering the area of conservation and timber utilisation be intensified especially in the area to the left of the Inchope-Gorongosa highway, which is currently facing an influx of new settlers, combined with deforestation for agriculture and charcoal production, not to mention the on-going timber concession.

Conclusion 3. There currently exists no vegetation map at an appropriate scale to cover Nhambita community forest. Both the 1:250000 land cover and land use map (IGNF-CENACARTA, 1999) and the 1:50000 topographic maps did not have the southernmost sheets on which are located Plots 8, 9, 13 and 14.

Recommendation 3. It is recommended that a satellite image of the area be acquired and that use be made of the coordinates contained in the descriptive boundary of Nhambita community area as determined by the Surveyor General's office (Geografia e Cadastro) during the demarcation of that community area (in collaboration with ORAM), to digitise the boundary of the area. As a next step, the vegetation data obtained from this preliminary inventory plots can be used as ground control points (GCPs) in interpreting the vegetation of the area as a whole. This task would suit the UoE partner best, seeing their responsibility over the GIS component, also indispensable for the decision regarding future location of PSPs.

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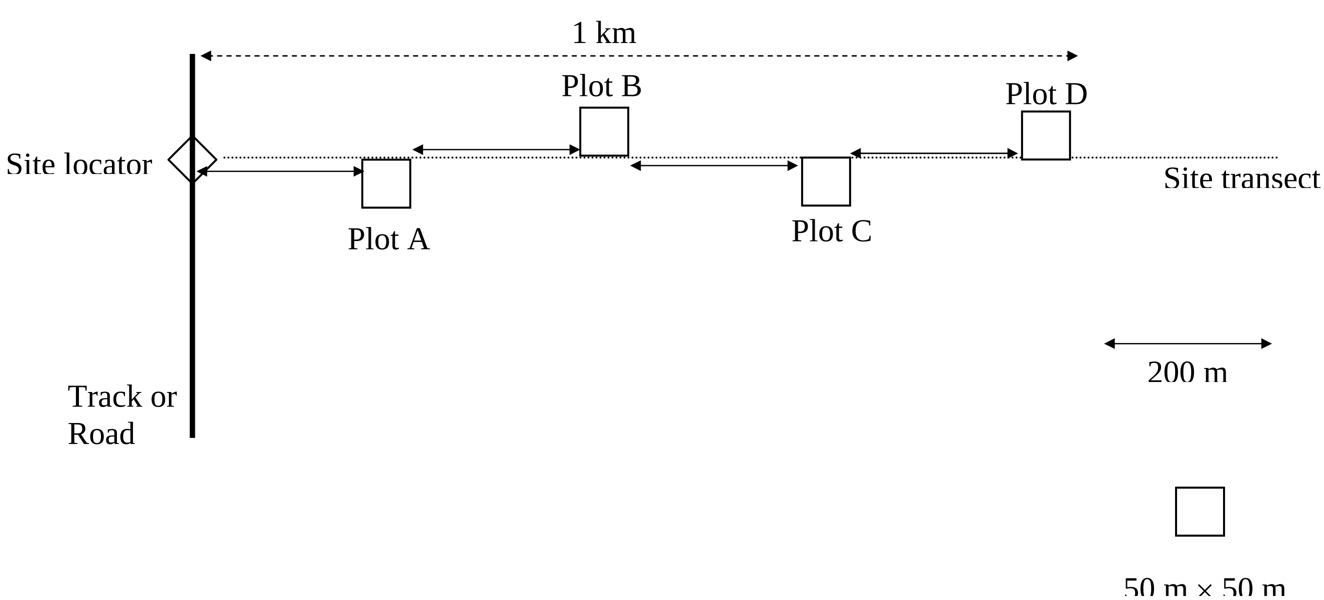
ANNEXES

ANNEX 1: Prepared by Dr. M. Williams.

0.25 ha plot selection protocol

Introduction

There are 15 cluster sites distributed at 5 km intervals along the ~75 km of the road and track network we surveyed within the Nhambita Community. At each cluster site, there are 4 plots located along a 1 km long transect perpendicular to the road. The plots are located on alternating sides of the transect - the first on the right, the second on the left etc. Each plot is 0.25 ha, 50 m × 50 m, and each is 200 m from its neighbour. The first plot, plot A, is 200 m from the track/road.



Plot identification

The plots are identified A-D, and cluster sites are identified 1-15 (there are five reserve site numbered 16-20). Complete specification of a plot identity is achieved by combining the site and plot identifier – e.g. Cluster site 3, plot C can be identified as Plot 3-C.

Site Locator

Each cluster site locator will be specified in a manner thus:

"Road: TR. From location 1, travel south 1.2 km. Transect on the L."

To decode this specification, look up the road code (TR= tarmac road running N-S through the park) and the location code (Location 1 = Northern boundary of the community on the tarmac road, S 18º 50.25, E 34º 6.165). From this point, follow the specified road the specified distance, and then sample the specified side of the road.

It is important that the site locator on the track or road can be relocated easily. Thus, some adjustment to the nominal site locator, as identified in this document, is allowable. For instance, the site locator can be moved +/-100 m along the road or track so that is can be anchored by a landmark such as a tree, rock, signpost etc. Once the actual site locator has been decided upon, make a record of the landmark and record the GPS lat/long and altitude.

Location of the site transect

Note the bearing of the road at the site locator, using a compass. Then the bearing of the site transect is perpendicular to this, i.e. at 90°, on a specified side of the road/track. Make a record of the transect bearing. Use the GPS to assist in setting out the site transect, marking out the plot locations along the way.

Potential problems

We are interested in the presence of mashambas, so make a note if any plot is located in a mashamba. However, we want to maximise our survey of biomass on unmanaged lands. So, relocate any plot nominally located on a mashamba. Move the plot to the other side of the transect line, or 100-200 m if required, to unmanaged land (i.e., forest or abandoned mashamba). Maintain the same distance from the road/track as with the nominal plot location. If the site locator is completely unsuitable, then use one of the reserve site locations (16-20) in order.

Take a game guide with you to provide advice on mines and protection from wildlife. If the nominal transect is in an area where mine are a risk, abandon the transect and use one of the reserve site locators instead.

Equipment required

GPS, compass, measuring taps, trowel, digital camera

Table 1. Locations for cluster sites, relative to given locations, and using the named road network (see relevant tables for road and location codes). R=right, L=left).

Site Number	Road	Location

1	TR	From location 1, travel south 1.2 km. Transect on the L
2	TR	From location 1, travel south 6.2 km. Transect on the R
3	TR	From location 1, travel south 11.2 km. Transect on the L
4	TR	From location 1, travel south 16.2 km. Transect on the R
5	PAT	From location 2, travel SE 1.1 Km. Transect on L
6	PAT	From location 2, travel SE 6.1 Km. Transect on R
7	PAT	From location 2, travel SE 11.1 Km. Transect on L
8	PAT	From location 2, travel SE 16.1 Km. Transect on R
9	PAT	From location 2, travel SE 21.1 Km. Transect on L
10	WT	From location 7, travel 1.5 km S. Transect on R
11	WT	From location 7, travel 6.5 km S. Transect on L
12	CRT	From location 8, travel 3.7 km W. Transect on R
13	SST	From location 9, travel 1.6 km S. Transect on L
14	SST	From location 9, travel 6.6 km S. Transect on R
15	CET	From location 10, travel 1.5 km NE. Transect on L
16	*CET*	*From location 10, travel 0.4 km NE. Transect on R*
17	*TR*	*From location 1, travel south 7.8 km. Transect on the L*
18	*TR*	*From location 1, travel south 11.4 km. Transect on the R*
19	*PAT*	*From location 2, travel SE 8.0 Km. Transect on L*
20	*WT*	*From location 7, travel 4.2 km S. Transect on R*

Table 2. Road codes for the track/road network in the Nhambita community, as surveyed in November 2003.

ID	**Name**	**Runs between**	**Length (km)**
TR	Tarmac Road	Gorongosa and Inchope	20.1
PAT	Park Access Track	Tarmac Road and Chitengo	24.6
WT	Western Track	Pungoe River and Tarmac Road	7.8
CRT	Cross track	Links Tarmac Road with Western Track	7.1
SST	South scoutcamp track	Runs south from PAT to a scout camp on the Pungoe	6.7
BMT	Boa Maria Track	Runs south from PAT to Boa Maria ridge	3.4
CET	Central Track	Runs NE from PAT into the Park	3.2
NCT	Nhambita Community Track	Runs south from PAT to Papayaman's hut	2.2

Table 3. Location codes to identify fixed points with the Nhambita Community area (NB: Chitengo is outside the community)

ID	Location	Lat (S)	minute	Long (E)	minutes
1	Northern boundary of community on TR	18	50.250	34	6.165
2	PAT/TR junction	18	56.051	34	8.001
3	PAT/BMT junction - Park Gate	19	0.017	34	12.033

4	Southern boundary of community on TR (Pungoe Bridge)	18	59.528	34	5.255
5	Chitengo	?		?	
6	Eastern boundary of park on PAT - poorly defined	?		?	
7	Junction of WT with TR	18	52.237	34	5.988
8	Junction of CRT with TR	18	55.579	34	7.798
9	Junction of PAT with SST	19	0.387	34	13.524
10	Junction of PAT with CET	18	57.405	34	10.212

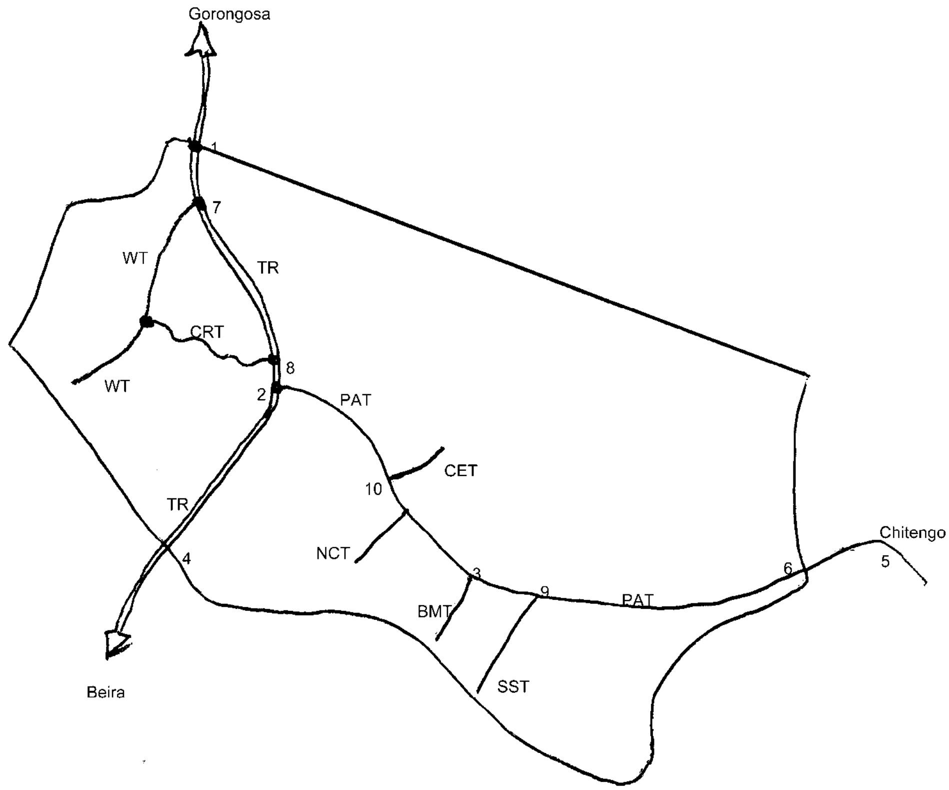


Figure 1. Map showing boundaries of Nhambita community and the surveyed road/track network. Each road/track is identified by a combination of 2 or 3 letters (see Table 2). Ten locations are also identified by a number 1-10 (see Table 3).

ANNEX 2.

NHAMBITA PILOT PROJECT – PRELIMINARY INVENTORY

CHECKLIST OF WOODY SPECIES FOUND IN SURVEY AREA

Species Code	Species Local Name	Botanical Name	Family
001	MUMBUMBU	*Lannea schimperi* (Hochst. Ex A. Rich.) Engl.	Anacardiaceae
002	TANGA TANGA	*Albizia lebbeck* (L.) Benth.	Fabaceae; Mimosoideae
003	XIMANDA	*Dalbergia melanoxylon* Guill. & Perr.	Fabaceae; Papilionoideae
004	MARULA	*Sclerocarya birrea* (a. Rich.) Hochst.	Anacardiaceae
005	MUGÓE; NGUNGO	*Acacia nigrescens* Oliv.	Fabaceae; Mimosoideae
006	MIÓMBA	*Pterocarpus rotundifolius* (Sond.) Druce	Fabaceae; Papilionoideae
007	MILORO; MULEMBE	*Annona senegalensis* Pers.	Annonaceae
008	XOUANGA	*Pericopsis angolensis* (Baker) Meeuwen	Fabaceae; Papilionoideae
009	MUNHANDO	*Bauhinia petersiana* Bolle *Bauhinia galpinii* N.E.Br.	Fabaceae; Caesalpinioideae
010	MUTOHUE; MUTOGUE	*Azanza garckeana* (F. Hoffm.) Exell & Hillc.	Malvaceae
011	MUCOMBACORE	*Excoecaria bussei* (Pax) Pax	Euphorbiaceae
012	CHIMANDA	*Dalbergia boehmii* Taub.	Fabaceae; Papilionoideae
013	MUNDANGAMUNHO	*****	
014	NHAM'TOMOLE	*Diplorhynchus condylocarpon* (Műell.Arg.) Pichon	Apocynaceae
015	MUANGA	*Pterocarpus lucens* Guill. & Perr.	Fabaceae; Papilionoideae
016	BICANCULA	*Sterculia appendiculata* K.Schum.	*Sterculiaceae*
017	FITHIDONDO	*Combretum molle* R.Br. ex G.Don	Combretaceae
018	M'TENGUENE	*Ximenia caffra* Sond.	Olacaceae
019	NHANTSANGU; M'TSHANGA	*Combretum* sp.	Combretaceae
020	THITHI	*Erythrina* sp.	Fabaceae; Papilionoideae
021	RURONDE	*****	

022	**CHINAMAZIZE**	*Rhus* sp.	Anacardiaceae

Species Code	**Species Local Name**	**Botanical Name**	**Family**
023	**PANGA PANGA**	*Millettia stuhlmannii* Taub.	Fabaceae; Papilionoideae
024	**MUCHANFU**	*Rhus chirindensis(?)* Baker f.	Anacardiaceae
025	**MUCHENDJE**	*Cussonia spicata* Thunb.	Araliaceae
026	**MUSSEQUECE**	*Piliostigma thonningii* (Schumach.) Milne-Redh.	Fabaceae; Caesalpinioideae
027	**M'FUTI**	*Brachystegia boehmii* Taub.	Fabaceae; Caesalpinioideae
028	**XITHETHE; M'TONGOLO**	*Monotes engleri* Gilg	Dipterocarpaceae
029	**MUCUVU**	*Vitex doniana* Sweet	Lamiaceae; Labiatae
030	**MULONDE NJENJEMA**	*Xeroderris stuhlmannii* (Taub.) Mendonça & E.P.Sousa	Fabaceae; Papilionoideae
031	**MUMUDENDO**	*****	
032	**MUCOMBÊGO**	*Crossopteryx febrifuga* (Afzel. Ex G.Don) Benth.	Rubiaceae
033	**MUNDOTO; MUSONZOUA**	*Pseudolachnostylis maprouneifolia* Pax	Euphorbiaceae
034	**MUNOMORO**	*Gardenia ternifolia* Schumach. & Thonn.	Rubiaceae
035	**MESSASSA**	*Brachystegia spiciformis* Benth.	Fabaceae; Caesalpinioideae
036	**MBILA**	*Pterocarpus angolensis* DC	Fabaceae; Caesalpinioideae
037	**MUHIMBE**	*Julbernardia globiflora* (Benth.) Troupin	Fabaceae; Caesalpinioideae
038	**MUTEME**	*Strychnos innocua* Delile	Strychnaceae
039	**CHICUMBITE**	*Zanha africana* (Radlk.) Exell	Sapindaceae
040	**NHACANUCANUNGA**	*Premna senensis* Klotzsch	Lamiaceae; Labiatae
041	**MPAKHASI**	*Philenoptera violacea* (Klotze) Schrire (formerly *Loncocarpus capassa*)	Fabaceae; Papilionoideae
042	**MUCARATE**	*Erythrophleum africanum* (Benth.) Harms	Fabaceae; Caesalpinioideae
043	**CHERECHETI**	*Sterculia quinqueloba* (Garcke) K.Schum.	Sterculiaceae
044	**MUCODONE**	*Terminalia stenostachya* Engl. & Diels	Combretaceae

045	**CANTASSARO**	*Ozoroa* sp.	Anacardiaceae
046	**MUNZIRO**	*Vangueria infausta* Burch.	Rubiaceae

Species Code	**Species Local Name**	**Botanical Name**	**Family**
047	**MUSSUNGANHEMBA**	*Pteleopsis myrtifolia* (M.A.Lawson) Engl. & Diels	Combretaceae
048	**MUFUMA**	*Diospyros mespiliformis* Hochst. ex A.DC.	Ebenaceae
049	**UMBAUA**	*Khaya anthoteca* (welw.) C.DC	Meliaceae
050	**CUMBANZÓO**	*Holarrhena pubescens* (Buch.-Ham.) Wall ex G.Don	Apocynaceae
051	**CHIBARAMADONA**	*Brackenridgea zanguebarica* Oliv.	Ochnaceae
052	**MUNJONJOTA**	*Amblygonocarpus andongensis* (Welw. ex Oliv.) Exell & Torre	Fabaceae; Mimosoideae
053	**MESSIMBE MUSSIMBE**	*Burkea africana* Hook	Fabaceae; Caesalpinioideae
054	**TADZA**	*Grewia monticola* Sond.	Tiliaceae
055	**MUCODOMUE**	*Terminalia brachystemma* Welw.	Combretaceae
056	**MUSSUSSU**	*Terminalia sericea* Burch. ex DC.	Combretaceae
057	**MUPANGARA NHANGASSADZE**	*Dichrostachys cinerea* (L.) Wight & Arn.	Fabaceae; Mimosoideae
058	**POTANZOE**	*Stereospermum kunthianum* Cham.	Bignoniaceae
059	**MUSSENGUE**	*Cussonia arborea* Hochst. ex A.Rich.	Araliaceae
060	**CHIGULAMADEMO**	*Berchemia discolor* (Klotzsch) Hemsl.	Rhamnaceae
061	**MUTUNDURU**	*Strychnos madagascariensis* Poir.	Strychnaceae
062	**NHANCAMBA**	*****	
063	**BUEMBACOR**	*Senna petersiana* (Bolle) Lock	Fabaceae; Caesalpinioideae
064	**MURARA**	*****	
065	**CUACUACHO**	*Ehretia amoena* Klotzsch	Boraginaceae
066	**MUNDANGARAMUNHU**	*Antidesma venosum* E.Mey ex Tul.	Euphorbiaceae
067	**PHEWA; FEBA; P'FEUA**	*Markhamia obtusifolia* (Baker) Sprague	Bignoniaceae
068	**DZVOTOTO**	*Commiphora mossambicensis* (Oliv.) Engl.	Burseraceae
069	**GUOE; M'GUOE**	*Acacia polyacantha* Willd.	Fabaceae; Mimosoideae
070	**MUSHAMVU**	*Ficus sycomorus* L.	Moraceae

Species Code	Species Local Name	Botanical Name	Family
071	MUNHONGOLO	*Cleistochlamys kirkii* (Benth.) Oliv.	Annonaceae
072	COMACAMBA	*Scolopia stolzii* Gilg ex Sleumer	Flacourtiaceae
073	NHAPONDA MUCHENGA	*Voacanga thouarsii* Roem. & Schult.	Apocynaceae
074	MUCUIRAMHONDORO	****	
075	MUSSADZE	*Faidherbia albida* (Delile.) A.Chev.	Fabaceae; Mimosoideae
076	MUTHUPA	*Strychnos potatorum* L.f.	Strychnaceae
077	MUTARARA	*Lecaniodiscus fraxinifolius* Baker	Sapindaceae
078	MUNHENZA	*Boscia salicifolia* Oliv.	Capparaceae
079	MUNJALE; GOSA	*Sterculia africana* (Louri.) Fiori	Sterculiaceae
080	MUNANGARE; MUCHENALORE	*Combretum hereroense* Schinz	Combretaceae
081	MUCHECHENI	*Ziziphus mucronata* Willd.	Rhamnaceae
082	MUSSORORA	*Albizia amara* (Roxb.) Boivin	Fabaceae; Mimosoideae
083	MULAMBA	*Adansonia digitata* L.	Bombacaceae
084	M'FITHI	*Combretum apiculatum* Sond.	Combretaceae
085	MUTUMBOTUMBO	*Flacourtia indica* (Burm.f.) Merr.	Flacourtiaceae
086	MUDOGODOGO	*Ximenia americana* L.	Olacaceae
087	SURUZA/TSURUDZO	*Heteropyxis dehniae* Suess.	Heteropyxidaceae
088	MEVUNGUTE	*Kigelia africana* (Lam.) Benth.	Bignoniaceae
089	MUCHEU	*Hyphaene coriacea* Gaertn.	Arecaceae
090	MUZEZE	*Peltophorum africanum* Sond.	Fabaceae; Caesalpinioideae

Species Code	**Species Local Name**	**Botanical Name**	**Family**
091	**MUTUNGURICUA**	*****	
092	**NHACAFUPA**	*****	
093	**NHACASSADZI**	*Acacia nilotica* (L.) Willd. ex Delile	Fabaceae; Mimosoideae
094	**MUPUPO/MPUMPU**	*Securidaca longipedunculata* Fresen.	Polygalaceae
095	**MUCUNO/MUCUNA**	*Vitex* sp.	
096	**MULUMANHAMA**	*Acacia* sp.	
097	**MUCHINGE**	*Monodora stenopetala* Oliv.	Annonaceae
098	**MUCHAMBU**	*****	
099	**PAU FERRO**	*Swartzia madagascariensis* (Desv.)	Fabaceae; Papilionoideae
100	**NHAMUKABARI**	*Markhamia zanzibarica* (Bjer ex DC) K.Schum.	Bignoniaceae
101	**MUGARAMANJIVA**	*****	
102	**MUSSUNGAROSSA SANGKALA**	*Millettia mossambicensis* J.B.Gillett	Fabaceae; Papilionoideae
103	**MUCHINGUENA**	*****	