

COMPARISON OF THE WOODY STRUCTURE IN A REGRESSIVE ZAMBEZIAN SUCCESSION : DRY EVERGREEN FOREST-OPEN FOREST - WOODED SAVANNA (LUISWISHI, SHABA, ZAIRE)*

Comparaison de la structure ligneuse dans une série régressive de la région zambézienne : forêt dense sèche - forêt claire - savane boisée (Luiswishi, Shaba, Zaïre)*

F. MALAISSE**

RESUME

Comparaison de la structure ligneuse dans une série régressive de la région zambézienne : forêt dense sèche - forêt claire - savane boisée (Luiswishi, Shaba, Zaïre). Trois formations végétales (forêt dense sèche, forêt claire et savane boisée) d'une série régressive de la région zambézienne sont comparées sur la base de la composition floristique des strates ligneuses (présence et densité) et de leur surface terrière. Sur un ensemble de 120 essences, les trois formations végétales ne possèdent que 5 % de plantes en commun; par contre chacune d'elles est pourvue d'un noyau d'espèces endémiques, soit respectivement 38, 28 et 12 pour la forêt dense sèche, la forêt claire et la savane boisée. La surface terrière apparaît comme un outil précieux et précis dans la quantification des distinctions relatives au peuplement ligneux des trois formations végétales envisagées. Un système global de distinction est proposé, à savoir :

Formation végétale	Surface terrière (en m ² .ha ⁻¹)
Savane herbeuse	< 1
Savane arbustive et arborée	1 à 5
Savane boisée	5 à 15
Forêt claire	15 à 25
Forêt claire "muhuluteuse"	25 à 30
Forêt dense sèche	30 à 40

* Note 50 of the "Contribution to the study of the open forest ecosystem (Miombo)".

** Laboratoire de Botanique et d'Ecologie, Université de Lubumbashi, B.P. 3429, Lubumbashi, Zaïre.

ABSTRACT

Three vegetation types (dry evergreen forest, open forest and wooded savanna) of a Zambezian regressive succession are compared on the basis of tree and shrub composition (presence and density) as well as basal area. Of a total of 120 species, only 5 % occurred in all 3 vegetation types. In contrast, each type had a core of endemic species; 38, 28 and 12 for the dry evergreen forest, the open forest and the wooded savanna respectively. Basal area appears to be a useful parameter for distinguishing between the three vegetation types. A general system for characterising them is as follows :

Basal area ($m^2 \cdot ha^{-1}$)

Herbaceous savanna	< 1
Shrub and tree savanna	1 to 5
Wooded savanna	5 to 15
Open forest	15 to 25
"Muhuluteous" open forest	25 to 30
Dry evergreen forest	30 to 40

INTRODUCTION

Over a period of about 80 years ($\pm$ 1870-1950) biogeographers develop a series of names and systems for classifying plant-dominated landscapes in tropical regions, including Africa; for example, the studies by GRISEBACH (1872), DRUDE (1887), RUBEL & BROCKMANN-JEROSH (1912), SCHIMPER & VON FABER (1935), BURTT DAVY (1938). In 1956 the technical meeting of the CCTA/CSA of Yangambi regularized the situation. The proposals resulting from this have been more or less faithfully followed by WALTER (1962, 1968), ELLENBERG & MUELLER-DOMBOIS (1974), TROCHAIN (1980). This phytogeographical terminology increased in importance with the development of the concept of the ecosystem and an emphasis on ecosystem dynamics. The ecological study of biomes came to correspond to the recognition and description of vegetation formations.

The distinction between savanna, shrubby savanna, tree savanna, woodland, open forest and dense dry evergreen forest is purely physiognomic and the cross-section provides an extremely useful graphic representation. But it is difficult to quantify these differences, and few satisfactory suggestions have been made up to now. Elsewhere, however, I have proposed (MALAISSE, 1973) that the degree of the woody plant cover be used to distinguish between open forest and woodland, with (in Upper Shaba) a value of 60 % cover forming the dividing line. The respective dominance of semi-heliophile or heliophile ecological groups in

the grass layer depends on whether the woody plant cover is greater or lesser than 60 %.

In this study the problem is re-examined using the forest inventory technique, based on densities and, in particular, on basal area of the constituent species. The technique is well known by forest-rangers but ecologists are only beginning to use it.

STUDY AREA AND METHODS

The Luiswishi plots are situated 28 km N.E. of Lubumbashi (11° 29' 05" S and 27° 36' 10" E) at an altitude of 1208 m. Here, on the same pedological parent material, sandstone of the Kaponda serie (SYS & SCHMITZ, 1959), three different vegetation types have developed, these being dry evergreen forest, open forest and wooded savanna (MALAISSE, 1973).

The dry evergreen forest belongs to the *Entandrophragma*-*Diospyretum* *hoyleanae*, and is generally considered to be the climax forest on the laterite soils surrounding Lubumbashi. The Luiswishi open forest is dominated by *Marquesia macroura*, and forms the first stage of climax alteration. In some places it shows dense dry forest physiognomy whilst in parts of the dry evergreen forest the vegetation is in the process of evolving towards a climax under an older *Marquesia* dominant tree layer. The grass layer of the savanna is dominated by *Loudetia simplex*. Locally, mainly around high termitaria, there are woodland patches which (from a point of view of the woody layer) are similar to the woodland features of the *Marquesia* open forest. It is probable, therefore, that the vegetation at Luiswishi represents three stages of a regressive succession : dry evergreen forest - open forest - wooded savanna.

The present study compares the woody vegetation of the three types, based on normal upland vegetation, and ignoring the high termitaria. The woody inventory was made on 5 hectares in open forest and in the wooded savanna, and on 1 hectare in the dry evergreen forest (0.8 ha in full space, and 2 ha at 1/10th). Detailed analysis gives precise measures of the floristic composition, species' density, presence, basal area and ecological characteristics. It also allows for recognition of the main ecological groups. Particular interest in the concept of basal area for recognizing zonal vegetation types in Upper Shaba is underlined and a system of classification is proposed.

The woody inventory includes all stems with a diameter equal to or greater than 5 cm at 1.3 m in height. Stems with a diameter less than

5 cm were counted and identified on ten 100 sq. m. chosen at random in dry evergreen forest and on the entire plot for the other two vegetation types. Circumference measurements were facilitated by the absence of alliform buttresses. Only a few old specimens of *Parinari excelsa* show small buttresses at their bases but these do not reach 1.3 m height. On the other hand *Marquesia macroura* and *Afroseralisia cerasifera* show, from a certain age, grooves which may easily reach up to 5 metres or more in height. The reduction of the outer circumferences to theoretical inner circumferences calculated on the basis of the real basal area was established on a series of planimetre measurements of the surface gaps. This allowed us to establish correction coefficients which are listed in Table I.

Radius (mm)	Correction coefficient	Radius (mm)	Correction coefficient	Radius (mm)	Correction coefficient
1 - 125	1.000	213 - 237	0.950	338 - 375	0.890
126 - 142	0.990	238 - 262	0.935	376 - 450	0.880
143 - 162	0.980	263 - 287	0.920	451 - 550	0.870
163 - 187	0.970	288 - 312	0.910	551 - 650	0.860
188 - 212	0.960	313 - 337	0.900	651 - 750	0.850

Tab. I : Correction coefficients for the calculation of the true basal area from the theoretical basal area for *Marquesia macroura*.

RESULTS

Floristic structure

The general data from the woody plant inventories are presented for dry evergreen forest (Appendix I), for open forest (Appendix II) and for wooded savanna (Appendix III and IV). Comparison of these 3 inventories shows that species richness diminishes with the passage from the most densely wooded environment to the most open (Fig. 1). 120 different woody species were found in these 3 vegetation types, only 6 of which were common to all 3 types (Appendix V). Dry evergreen forest was the most distinctive group with 38 endemic species (Tab. II), followed by the open forest (28 species) and wooded savanna (12 trees and shrubs).

In the dry evergreen forest the 4 leading plant families, Rubiaceae, Apocynaceae, Fabaceae and Annonaceae, on average represented 59 % of all species, and 26.8 % of all individuals above 1.3 m height and 5 cm dbh.

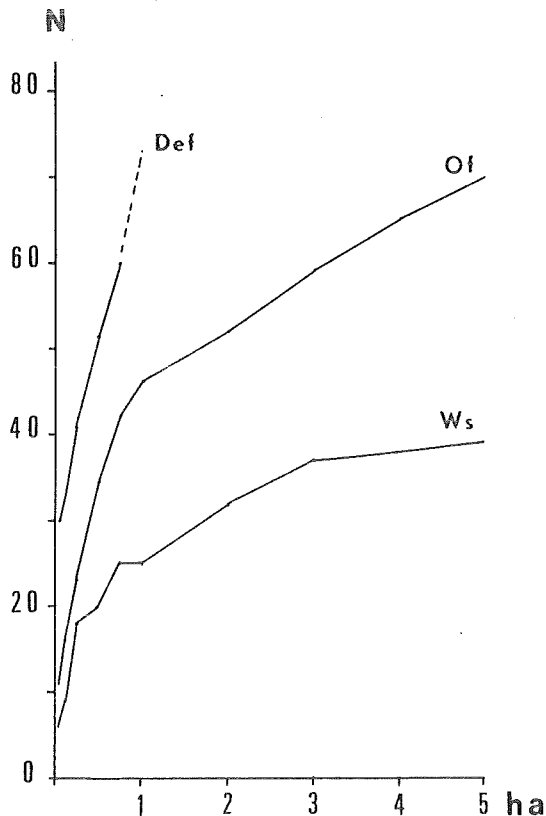


Fig. 1 : Comparison of species richness (N) according to the area sampled (Def : dry evergreen forest, Of : open forest, Ws : wooded savanna; continuous line : full inventory, broken line : 1/10th inventory).

In the open forest, on the other hand, the 5 leading plant families, Caesalpiniaceae, Fabaceae, Euphorbiaceae, Rubiaceae and Combretaceae, represented 43.1 % of all species, and 41.8 % of all individuals above 1.3 m height and 5 cm dbh. In wooded savanna the 4 leading plant families, Euphorbiaceae, Combretaceae, Fabaceae and Rubiaceae, on average represented 45.9 % of all species, and 53.2 % of all individuals above 1.3 m height and 5 cm dbh.

Density and presence

Table III shows the total number of stems observed at the Luiswishi site. The number of trees diminishes along the gradient from the

Type of repartition			Number of species
Dry evergreen forest	Open forest	Savanna	
+++	.	.	38
++	+	.	13
+	++	.	4
+++	++	+	2
+	++	+	3
+	+	++	1
.	+++	.	28
.	++	+	10
.	+	++	9
.	.	+++	12
			120

Tab. II : Types of repartition in a regressive succession (Shaban-Zambia domain).

most wooded environment to the most open. In the Luiswishi dry evergreen forest the total number individuals per ha is 67,850. This value does not take in account 40,000 one or two-year seedlings. In open forest the total number of individuals per ha is 5,125, in wooded savanna about 2,000.

The comparison of stem numbers per hectare (Tab. III) contained in the 3 vegetation types is eloquent. If all stems over 1.3 metres in height are taken into consideration, we obtain values of 17,343, 836 and 326 stems respectively per hectare for dry evergreen forest, open forest and wooded savanna : i.e. a ratio of 53, 2.6 and 1. The differences change when the slenderest stems are no longer taken into consideration. Hence for stems whose diameter is equal or superior to 5 cm, the ratio is 7, 2.7 and 1; and for trees exceeding 20 cm diameter 7.7, 4.8 and 1.

Appendixes VI to XI present the values of species density and presence for dry evergreen forest, open forest and wooded savanna respectively. A core of some ten species dominates each vegetation type.

Total basal area

Values for total basal area are given in Table III. Basal area diminishes with the passage from the most densely wooded environment (33.7)

		<1.3 m height										>1.3 m height											
Diameter (cm)		0.1- 4.9	5.0- 9.9	10.0- 14.9	15.0- 19.9	20.0- 24.9	25.0- 29.9	30.0- 34.9	35.0- 39.9	40.0- 44.9	45.0- 49.9	50.0- 54.9	55.0- 59.9	60.0- 64.9	65.0- 69.9								
Dry evergreen forest	50505	15880	896	215	121	74	46	31	24	20	12	7	7	2	2								
Open forest	4555	266	207	143	76	39	33	20	21	11	7	5	4	1.2	1.2								
Savanna - stem	)	116	115	42	23	12	8	3	2	2	2	0.2	0.4	0	0.2								
- stockshoot	) 1711	?	91	42	11	4	0.6	0.4	0.4	0.2	-	-	-	-	-								
Dry evergreen forest	2	70.0- 74.9	75.0- 79.9	80.0- 84.9	85.0- 89.9	90.0- 94.9	95.0- 99.9	100.0- 104.9	105.0- 109.9	110.0- 114.9	Total	Total ≥ 5.0	Total ≥10.0	Total	Basal area								
Open forest	0	1.0	0.4	0.2	0.2	-	-	-	-	-	836	570	363	144	19.257								
Savanna - stem	-	-	-	-	-	-	-	-	-	-	326	210	95	30	3.253								
-stockshoot	-	-	-	-	-	-	-	-	-	-	130	130	39	6	+1.476								

Tab. III : Evolution of the number of stems per hectare according to thickness classes in a regressive series of the Zambezan Region (diameter classes at 1.3 m height in cm).

to the most open (3.3).

We have tried to show the evolving trend of the woody savanna which undergoes intense burning each year in June or July. In fact, just before the fire passage the grass layer mass is composed of about 0.24 t.ha^{-1} biomass and 2.86 t.ha^{-1} necromass. We made an inventory of all stocks emitting shoots whose diameter at 1.3 metres height is less than 5 cm. We noted the species as well as the diameter of the base of the stock (Appendix IV). An examination of the results allows several facts to be deduced :

- Typical open forest species are absent from this inventory, or disappear progressively,
- Certain savanna species resist burning easily, a notable example being *Securidaca longepedunculata*.

Floristic and phytomass structure

The floristic and phytomass structure of a stand can simultaneously be expressed by the species-dominance curve (BRUNIG & KLINGE, 1976), which represents the contribution of each species to the stand basal area. The species are plotted in order of their contribution in percent of the stand total. The species-dominance curves of the plots in the 3 vegetation types at Luiswishi are shown in figure 2. The curve for open forest shows the flattest trend suggesting that competitive exclusion is weak and that random distribution of ecological niche prevails. This means that distribution is instead largely governed by chance.

Familial importance value (F.I.V.)

A familial importance value (FIV) was developed and values for each family were calculated as follows (MORI et al., 1983) :

$$\text{FIV} = \frac{\text{no of species in family}}{\text{total no species}} (\text{relative diversity}) + \frac{\text{no of trees in family}}{\text{total no of trees}}$$

$$(\text{relative density}) + \frac{\text{basal area of family}}{\text{total basal area}} (\text{relative dominance}) \times 100$$

For the Caesalpiniaceae of the dry evergreen forest we calculated :

$$\text{FIV} = \frac{4}{62} + \frac{261}{1463} + \frac{130151.25 \text{ cm}^2}{336785.77 \text{ cm}^2} = 62.9$$

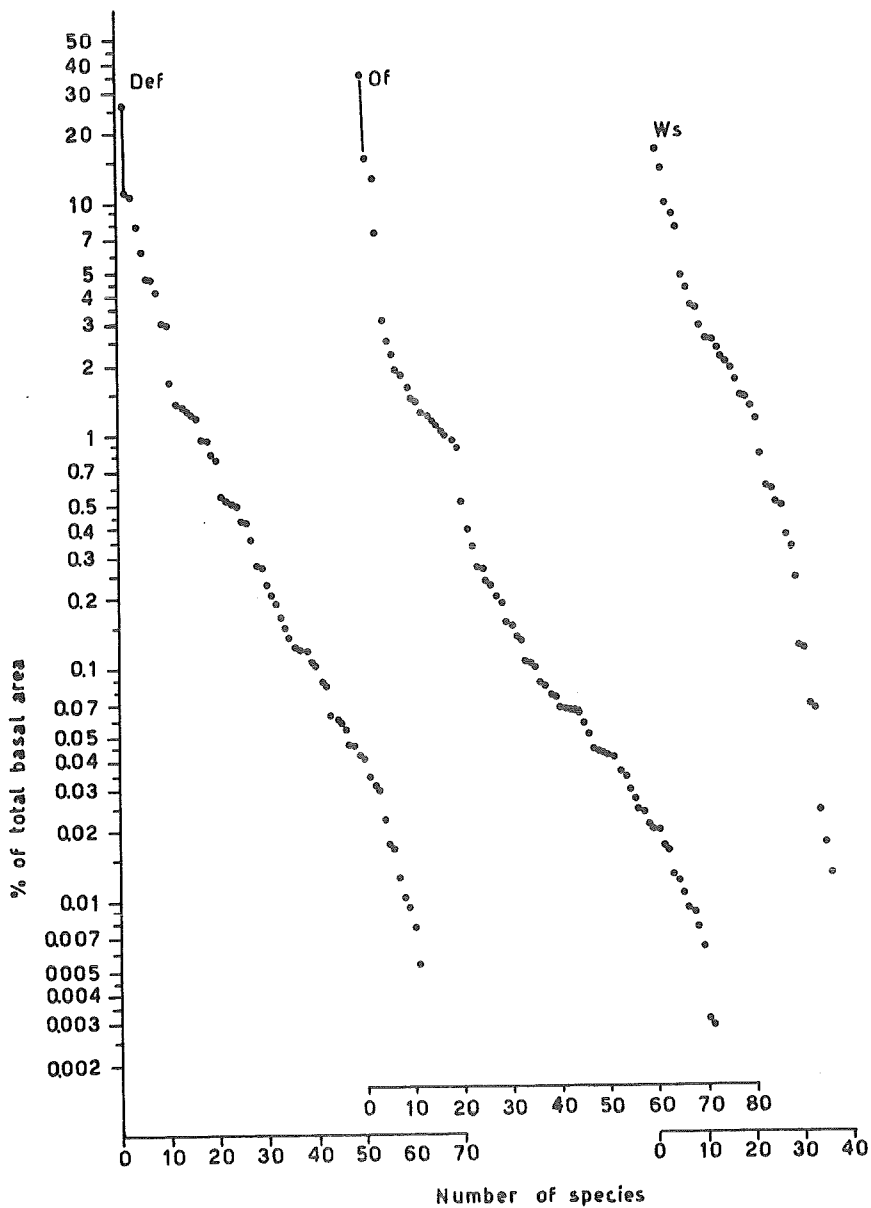


Fig. 2 : Dominance-diversity curves for the Luiswishi plots (Def : dry evergreen forest, Of : open forest, Ws : wooded savanna; data for open forest and wooded savanna on 5 ha, for dry evergreen forest on 1 ha).

The values for the 10 most important families in our study area are listed in table IV for dry evergreen forest, table V for open forest and table VI for wooded savanna.

Family	FIV	Number of species	Number of individuals	Basal area (cm ²)
1. Caesalpinieae	62.9	4	261	130,151.3
2. Rubiaceae	39.2	7	325	8,999.5
3. Combretaceae	17.3	5	100	7,905.0
4. Apocynaceae	15.3	4	100	6,743.3
5. Chrysobalanaceae	14.7	1	75	26,867.6
6. Dipterocarpaceae	14.6	1	29	37,167.4
7. Myrtaceae	13.4	1	81	21,002.9
8. Loganiaceae	12.8	3	67	11,298.1
9. Anacardiaceae	11.6	2	90	7,819.2
10. Ebenaceae	11.0	1	119	4,345.6
11. Remaining families	87.2	33	186	64,485.9
Totals	300.0	62	1463	336,785.8

Tab. IV : Familial importance values for the 10 ecologically most important plant families of a zambeian dry evergreen forest.

Family	FIV	Number of species	Number of individuals	Basal area (cm ²)
1. Dipterocarpaceae	60.8	3	499	74,151.5
2. Caesalpinieae	60.0	8	421	64,810.5
3. Fabaceae	32.2	8	399	12,690.6
4. Apocynaceae	31.4	1	619	14,563.3
5. Euphorbiaceae	20.7	7	206	6,762.1
6. Combretaceae	13.1	4	141	4,691.8
7. Rubiaceae	11.2	6	67	740.1
8. Loganiaceae	9.4	3	110	2,355.8
9. Chrysobalanaceae	6.5	1	65	4,910.1
10. Annonaceae	6.4	4	13	728.3
11. Remaining families	48.4	28	219	6,166.9
Totals	300.0	72	2759	192,571.1

Tab. V : Familial importance values for the 10 ecologically most important plant families of an open forest.

Family	FIV	Number of species	Number of individuals	Basal area (cm ²)
1. Combretaceae	57.6	4	192	8,373.9
2. Fabaceae	48.3	4	189	5,440.3
3. Euphorbiaceae	31.0	5	85	2,671.3
4. Chrysobalanaceae	26.4	2	48	5,116.9
5. Apocynaceae	24.4	1	110	3,132.5
6. Caesalpinaceae	16.7	3	33	1,623.5
7. Myrtaceae	15.2	1	76	1,360.9
8. Rubiaceae	14.2	4	19	416.3
9. Verbenaceae	14.2	2	56	849.7
10. Mimosaceae	10.4	2	14	1,133.8
11. Remaining families	41.6	9	90	2,413.7
Totals	300.0	37	912	32,532.8

Tab. VI : Familial importance values for the 10 ecologically most important plant families of a wooded savanna.

A comparison of tables IV to VI shows few differences and a considerable similarity in the rankings of each family in each of the 3 vegetation types. This is mainly a reflection of the frequency of species replacements within a genus according to vegetation types (*Combretum*, *Strychnos* for instance) and, to a lesser degree, of the existence of ecophyletic series such as in the genus *Syzygium* and *Parinari*.

DISCUSSION

The vegetation of Luiswishi probably represents three stages of a regressive succession. This is a rare occurrence which seems to be exceptional, if not absent, in other savanna dominated region (WALKER, 1981). For instance, succession never progresses beyond a dry thicket physiognomy in Southern African arid savanna (HUNTLEY, 1982). Consequently a comparison of the three vegetation types found at Luiswishi was of particular interest, in that marked differences could be distinguished.

It should be noted that the total number of trees (including woody lianes), in other studies published to date, appears to vary very widely in tropical forests as a result of differences in vegetation type, site, spatial distribution pattern and stage of development. Lastly another source of variation consists in the height of the trees and the

Plant Community (Species dominant)	Location (Country)	Number trees.ha ⁻¹ ≥10 cm DBH	Number trees.ha ⁻¹ ≥20 cm DBH	References
Tall amazon caatinga (<i>Mi- cranda sprucei</i>)	San Carlos (Venezuela)	992	269	KLINGE & HERRERA, 1983
Lowland rain forest	(Ecuador)	883	474	GRUBB et al., 1963
Lowland rain forest (<i>Shorea ferruginea</i> and <i>S. quadriner- vis</i>)	Gunung Mulu (Sarawak)	778	327	PROCTOR et al., 1983
Lowland rain forest (<i>Calo- phyllum teije- mannii</i>)	Gunung Mulu (Sarawak)	708	269	PROCTOR et al., 1983
Tropical rain forest	Kha Chong (Thailand)	706	-	OGAWA et al., 1965
Lowland rain forest	(Brazil)	678	-	GRUBB et al., 1963
Lowland rain forest (<i>Hopea nutana</i>)	Gunung Mulu (Sarawak)	644	219	PROCTOR et al., 1983
Wallaba forest (<i>Eperua falca- ta</i>)	(British Gui- ana)	617	-	RICHARDS, 1952
Alluvial rain forest (<i>Ehesa paniculata</i>)	Gunung Mulu (Sarawak)	615	197	PROCTOR et al., 1983
Equatorial rain forest	(Brazil)	594	-	CAIN et al., 1956
Submontane rain forest (<i>Anacardium excelsum</i>)	Darien (Panama)	592	192	GOLLEY et al., 1975
Open forest (<i>Shorea obtu- sa</i> and <i>Pentac- me suavis</i>)	Ping Kong (Thailand)	581	-	OGAWA et al., 1965
Lowland rain forest	(Ecuador)	581	290	GRUBB et al., 1963
Dry evergreen forest (<i>Entan- drophragma de- levoyi</i>)	Luiswishi	567	231	Present study
Lowland rain forest (<i>Dipte- rocarpus hispi- dus</i> and <i>Camp- nosperma zeyla- nica</i>)	Kottawa (Sri Lanka)	552*	-	PEMADASA & GUNATILLEKE, 1981

Monsoon forest (<i>Lagerstroemia calyculata</i> and <i>Dipterocarpus obtusifolius</i>)	Ping Kong (Thailand)	544	-	OGAWA et al., 1965
Montane rain forest	(Ecuador)	495	301	GRUBB et al., 1963
Tropical rain forest (<i>Cava- nillesia plantanifolia</i>)	Santa Fe (Panama)	480	168	GOLLEY et al., 1975
Lowland rain forest	(British Gui- ana)	452	248	GRUBB et al., 1963
Lowland rain forest	(Brazil)	442	205	GRUBB et al., 1963
Lowland rain forest	(Nigeria)	441	209	RICHARDS, 1939
Lowland rain forest	(Nigeria)	420	237	GRUBB et al., 1963
Lowland rain forest	(Tobago)	398	258	GRUBB et al., 1963
Lowland rain forest	(Dominica)	365	247	GRUBB et al., 1963
Open forest (<i>Marquesia ma- croua</i>)	Luiswishi (Zaire)	363	144	Present study
Riparian fo- rest	(Nigeria)	360	241	RICHARDS, 1939
Mangrove fo- rest	Darien (Panama)	348	112	GOLLEY et al., 1975
Riparian fo- rest	(British Gui- ana)	310	-	RICHARDS, 1952
Tropical dry forest (<i>Lica- nia arborea</i>)	Guanacaste (Costa Rica)	260	111	HUBBEL, 1979
Riparian fo- rest (<i>Prioria copaifera</i>)	Chucunaque (Panama)	252	144	GOLLEY et al., 1975

Tab. VII : Representative tree densities of tropical forest. * 30 cm circumference or 9.55 diameter at breast height.

minimal dbh value taken into consideration. This last variability of size restriction is easily apparent, for instance, in the woody plant stem basal area values summarized by RUTHERFORD (1982) concerning *Burkea africana* communities.

As far as the total number of trees is concerned, values of the Zambezian dry evergreen forest ($67,850 \text{ stems.ha}^{-1}$) are slightly below those published for rain forests. For the Amazonian rain forest for instance AUBREVILLE (1961) recorded 73,000 trees and 6,000 palms ha^{-1} whilst KLINGE & RODRIGUES (1971, 1973) give a density value of all trees and palms above 20 cm height of $93,780 \text{ individuals ha}^{-1}$. Both figures do not include lianes, vascular epiphytes, etc ... (BRUNIG & KLINGE, 1976). When only those stems whose diameter at 1.3 m height is equal or superior to 10 or 20 cms are considered, the set of values recorded for different tropical vegetations also shows great amplitude (Tab. VII). Certain tendencies may nonetheless be singled out : hence riparian forests show lower values than tropical rain forests. Values noted for the dry evergreen forest at Luiswishi correspond to those noted elsewhere for tropical vegetation types (i.e. average values of tropical rain forests, but also montane rain forests, monsoon forests, and even an open forest in Thailand).

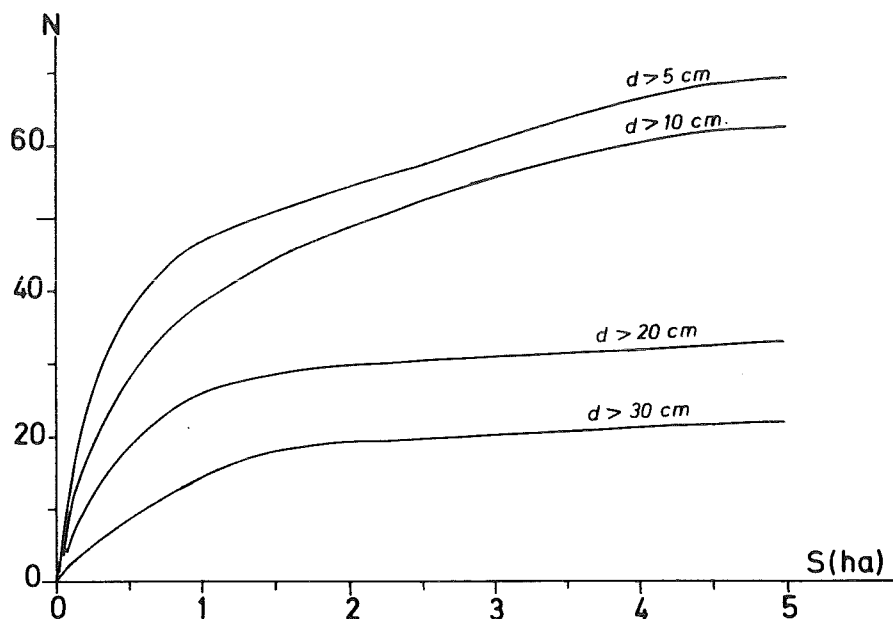


Fig. 3 : Species number as a function of diameter class and size of study plots in the Upper-Shaban open forest.

Values for a *Marquesia macroura* dominated open forest are lower than those of lowland rain forests and come closer to the tropical dry forest of Costa Rica. However, observations on stem density are still too rare in open forests for general conclusions to be drawn. However, the increase in species richness in terms of area inventoried shows parallel progressions, for the various size categories, to those noted for tropical rain forests (Fig. 3), for example in the Central Amazonian rain forest (BRUNIG & KLINGE, 1976).

As far as the total basal area is concerned the results obtained for the various vegetation types at Luiswishi, together with other observations made in Southern Shaba (MALAISSE, 1978), allow the establishment of a general system for characterising them, viz. :

Vegetation types	Basal area ($\text{m}^2.\text{ha}^{-1}$)
Herbaceous savanna	< 1
Shrub and tree savanna	1 to 5
Wooded savanna	5 to 15
Open forest	15 to 25
"Muhuluteous" open forest	25 to 30
Dry evergreen forest	30 to 40

As far as the open forests of the Zambezian region are concerned, Southern Shaba values are greater than those noted elsewhere; this may mainly be explained by the higher average annual rainfall (Fig. 4). This tendency towards high values is again confirmed when the Shaban values are compared to results noted for other open forests outside the Zambezian region (Tab. VIII).

Finally it should be noted that a core of 8 families dominates the general pattern of the flora within this regressive zambezian succession; they are, in decreasing order of importance : Caesalpiniaceae, Combretaceae, Apocynaceae, Fabaceae, Dipterocarpaceae, Rubiaceae, Chrysobalanaceae and Euphorbiaceae.

Differences with other regions are obvious. For the Hylaea, only Caesalpiniaceae and Chrysobalanaceae remain important, whereas Sapotaceae, Lecythidaceae, Lauraceae, Moraceae, Vochysiaceae, Burseraceae, Arecaceae, Violaceae and Bombacaceae, among others take over (TAKEUSHI, 1962; GRUBB *et al.*, 1963; KLINGE, 1973; PRANCE *et al.*, 1976; MORI *et al.*, 1983). For South-East Asian rain forests differences with the Zambezian vegetation still exist, but are not as outstanding; the main families being

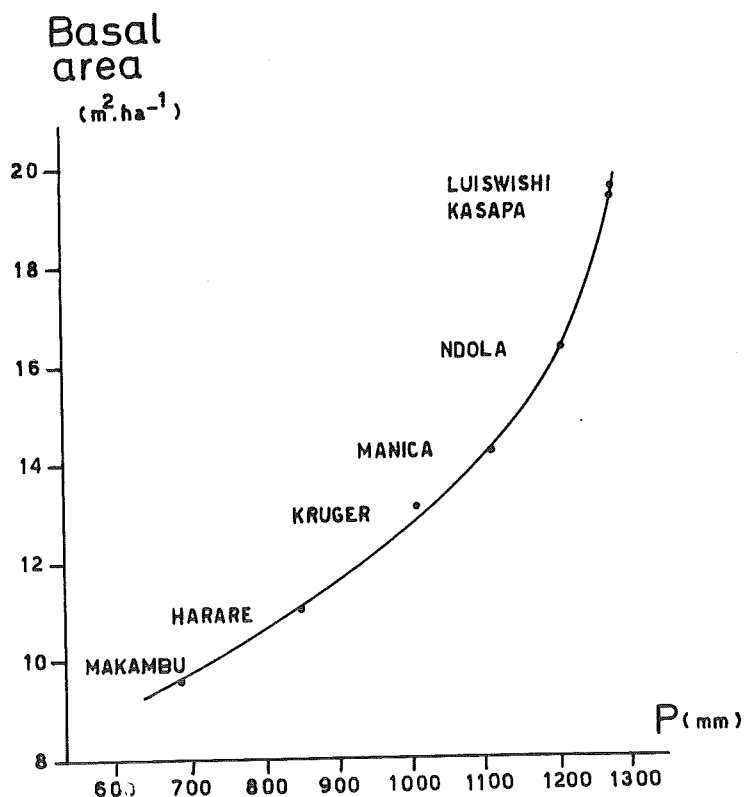


Fig. 4 : Basal area of Zambebian open forests as a function of mean annual rainfall.

Dipterocarpaceae, Euphorbiaceae, Myrtaceae, Sapotaceae, Ebenaceae, Anacardiaceae, Myristicaceae, Erythroxylaceae, Sterculiaceae and Lauraceae (PROCTOR et al., 1983; PEMADASA & GUNATILLEKE, 1981; JAYASURIYA & PEMADASA, 1983).

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Plant community (species dominant)	Locality (country)	Size restrictions	Basal area (m ² .ha ⁻¹)	References
Lowland rain forest (<i>Shorea ferruginea</i> and <i>S. quadrinervia</i>)	Gunung Mulu (Sarawak)	≥ 1 m height	61.6	PROCTOR et al., 1983
Riparian forest (<i>Prioria copaifera</i>)	Chucunaque (Panama)	-	59.64	GOLLEY et al., 1975
Lowland rain forest (<i>Calophyllum teijsmanii</i>)	Gunung Mulu (Sarawak)	≥ 1 m height	50.9	PROCTOR et al., 1983
Montane forest (<i>Syzygium staudtii</i> and <i>Balthasaria schliebenii</i>)	Kamiranzovu (Rwanda)	> 1.3 m height	46.69	BOUXIN, 1977
Tropical rain forest (<i>Cavanillesia plantani- folia</i>)	Santa Fe (Panama)	-	45.28	GOLLEY et al., 1975
Lowland rain forest (<i>Hopea nutans</i>)	Gunung Mulu (Sarawak)	≥ 1 m height	42.1	PROCTOR et al., 1983
Tropical rain forest	Khao-Chong (Thailand)	> 4.5 cm diameter	38.3	OGAWA et al., 1965
Montane forest (<i>Syzygium staudtii</i> and <i>Memecylon bequaertii</i>)	Kamiranzovu (Rwanda)	> 1.3 m height	37.71	BOUXIN, 1977
Alluvial rain forest (<i>Bhesa paniculata</i>)	Gunung Mulu (Sarawak)	≥ 1 m height	36.3	PROCTOR et al., 1983
Monsoon forest (<i>Lagerstroemia calyculata</i> and <i>Dipterocarpus obtusifolius</i>)	Ping Kong (Thailand)	> 4.5 cm diameter at breast height	36.2	OGAWA et al., 1965
Dry evergreen forest (<i>Entandrophragma delavayi</i>)	Luiswishi (Zaire)	≥ 5 cm diameter at breast height	33.68	Present study
Submontane rain forest (<i>Anacardium excelsum</i>)	Darien (Panama)	-	33.08	GOLLEY et al., 1975
Lowland wet forest (<i>Myrtaceae</i>)	Una (Brazil)	≥ 10 cm diameter at breast height	31.15	MORI et al., 1983
Evergreen subequatorial forest (<i>Dacryodes klaineana</i> and <i>Diospyros sanza-minika</i>)	Yapo (Ivory Coast)	> 40 cm circumference at breast height	31 ± 2.3	BERNHARDT-REVERSAT et al., 1978
Evergreen subequatorial forest (<i>Dacryodes klaineana</i> and <i>Turraeanthus africana</i>)	Banco (Ivory Coast)	> 40 cm circumference at breast height	30 ± 2.6	BERNHARDT-REVERSAT et al., 1978
Tall amazon caatinga (<i>Micranda sprucei</i>)	San Carlos (Venezuela)	> 10 cm diameter at breast height	29.4	VEILLON IN KLINGE & HERRERA, 1983

Tab. VIII : Woody plant stem basal area for tropical vegetation types. (To be continued).

Lowland wet forest (<i>Lecythidaceae</i>)	Manaus (Brazil)	-	29.39	PRANCE et al., 1976
Semi-deciduous secondary forest (<i>Celtis</i> sp.)	Lamto (Ivory Coast)	> 5 cm diameter at breast height	25-30	DEVINEAU, 1982
Dry evergreen forest (<i>Anogeissus leiocarpus</i>)	Ouango-Fitini (Ivory Coast)	> 5 cm diameter at breast height	25-30	DEVINEAU, 1982
Dry evergreen forest (<i>Afraegle paniculata</i>)	Ouango-Fitini (Ivory Coast)	> 5 cm diameter at breast height	25-30	DEVINEAU, 1982
Open forest (<i>Marquesia macroura</i>)	Luiswishi (Zaire)	≥ 5 cm diameter at breast height	19.26	Present study
Open forest (<i>Julbernardia paniculata</i>)	Kasapa (Zaire)	> 1.3 m height	19.15	MALAISSÉ, 1978
Open forest (<i>Shorea obtusa</i> and <i>Pentacme suavevis</i>)	Ping Kong (Thailand)	> 4.5 cm diameter at breast height	17.36	UGAWA et al., 1965
Open forest (<i>Brachystegia longifolia</i>)	Ndola (Zambia)	> 5 cm diameter at breast height	16.1	ENDEAN, 1967 (quoted in RUTHERFORD, 1982)
Open forest (<i>Uapaca togoensis</i>)	Ferkessédougou (Ivory Coast)	≥ 5 cm diameter at breast height	14.78	COULIBALY, 1977 (quoted in MONNIER, 1981)
Open forest (<i>Amblygonocarpus andongensis</i>)	Manica (Mozambique)	> 15 cm diameter	13.95	GUERREIRO, 1966
Open forest (<i>Colonnospermum mopane</i>)	Kruger (South Africa)	-	13	VAN DER SCHIJF, 1957
Bana woodland (<i>Rhodognaphalopsis discolor</i> and <i>Remijia morilloi</i>)	San Carlos (Venezuela)	≥ 10 cm diameter at breast height	13.0	VEILLON IN KLINGE & HERRERA, 1983
Open forest (<i>Brachystegia spiciformis</i> and <i>Julbernardia globiflora</i>)	Zimbabwe (Rhodesia)	-	10.8	STRANG, 1974
Open forest (<i>Uapaca togoensis</i>)	Ferkessédougou (Ivory Coast)	> 5 cm diameter at breast height	10.0	MONNIER, 1981
Wooded savanna (<i>Isobertia doka</i> and <i>Burkea africana</i>)	Mole (Ghana)	> 1 m height	9.92	LAWSON et al., 1968
Open forest (<i>Baikiaea plurijuga</i> and <i>Pterocarpus angolensis</i>)	Makambu (Namibia)	> 5 cm diameter at breast height	9.44	GELDENHUYS, 1977
Wooded savanna (<i>Crossopteryx febrifuga</i>)	Mole (Ghana)	> 1 m height	9.43	LAWSON et al., 1968

Tab. VIII : Woody plant stem basal area for tropical vegetation types. (To be continued)

Wooded savanna (<i>Terminalia avicennioides</i>)	Mole (Ghana)	> 1 m height	9.32	LAWSON et al., 1968
Wooded savanna (<i>Acacia nigrescens</i>)	Kruger (South Africa)	-	9.0	VAN DER SCHIJF, 1957
Wooded savanna (<i>Burkea africana</i>)	Hosdene (South Africa)	> 0.5 cm diameter at 20 cm height	8.5	RUTHERFORD & KELLY, 1978
Wooded savanna (<i>Butyrospermum parkii</i> and <i>Lophira lanceolata</i>)	Olokemeji (Nigeria)	> 2 m height	7.67	HOPKINS, 1962
Guinean wooded savanna (<i>Crossopteryx febrifuga</i> and <i>Cussonia barteri</i>)	Lamto (Ivory Coast)	-	5.8	CESAR & MENAUT, 1974
Wooded savanna (<i>Burkea africana</i> and <i>Ochna pulchra</i>)	Nysvley (South Africa)	≥ 1 cm diameter at 20 cm height	6.26	RUTHERFORD, 1982
Wooded savanna (<i>Detarium microcarpum</i>)	Mole (Ghana)	> 1 m height	4.91	LAWSON et al., 1968
Wooded savanna (<i>Combretum mechowianum</i>)	Luiswishi (Zaire)	≥ 5 cm diameter at breast height	3.25	Present study

Tab. VIII : Woody plant stem basal area for tropical vegetation types.

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Appendix I : Luiswishi dry evergreen forest. Full inventory of 0.8 ha (high termitaria excluded) + 1/10th inventory over 2 ha. Diameter at 1.3 m height $\geq$ 5 cm.

	Diameter classes of 5 cm (lower limit included)																			
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Total	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
1. <i>Marquesia macrocra</i>	29	8	3	4	3	2	-	2	2	-	-	1	-	1	-	-	-	-	-	2
2. <i>Entandrophragma delevoiyi</i>	6	-	-	1	1	-	-	-	1	-	2	-	-	-	-	-	-	-	-	1
3. <i>Afroseralisia cerasifera</i>	7	4	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	1
4. <i>Brachystegia spic. var. schmitzii</i>	208	58	32	34	25	14	17	9	6	6	3	3	-	-	1	-	-	-	-	-
5. <i>Parinari excelsa</i>	75	26	11	12	11	7	2	1	2	-	-	2	1	-	-	-	-	-	-	-
6. <i>Brachystegia taxifolia</i>	47	4	6	5	9	8	5	4	2	2	1	-	1	-	-	-	-	-	-	-
7. <i>Anthocleista zambesiaca</i>	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8. <i>Albizia adianthifolia</i>	12	2	1	-	2	1	1	1	3	-	1	-	-	-	-	-	-	-	-	-
9. <i>Syzygium guineense</i> subsp. <i>afromont.</i>	81	29	16	17	7	5	3	1	1	2	-	-	-	-	-	-	-	-	-	-
10. <i>Strychnos angolensis</i>	37	26	6	1	2	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-
11. <i>Brachystegia spic. var. latifoliolata</i>	5	-	-	1	2	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
12. <i>Faurea saligna</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13. <i>Julbernardia paniculata</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14. <i>Apodytes dimidiata</i>	29	5	10	4	3	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-
15. <i>Lannea antiscorbutica</i>	9	3	3	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
16. <i>Raphiostylis beninensis</i>	8	5	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17. <i>Strychnos lucens</i>	27	20	-	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18. <i>Garcinia smeathmannii</i>	5	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19. <i>Combretum gossweileri</i>	58	41	12	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20. <i>Garcinia huillensis</i>	14	6	4	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21. <i>Combretum</i> sp.	5	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22. <i>Tabernaemontana angolensis</i>	47	27	10	9	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23. <i>Brachystegia</i> sp.	3	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

24. <i>Cleistunthus milleri</i>	1	-	-	-	1
25. <i>Albizia antunesiana</i>	1	-	-	-	1
26. <i>Aidia micrantha</i> var. <i>msonju</i>	268	205	56	7	
27. <i>Sorindeia katangensis</i>	81	67	11	3	
28. <i>Combretum acutifolium</i>	25	21	3	1	
29. <i>Ochna afzelii</i>	24	15	8	1	
30. <i>Artabotrys monteiroae</i>	8	6	1	1	
31. <i>Uvaria angolensis</i> subsp. <i>angolensis</i>	7	6	-	1	
32. <i>Ochna puberula</i>	6	5	-	1	
33. <i>Cassine buchananii</i>	2	-	-	2	
34. <i>Manilkara obovata</i>	2	1	-	1	
35. <i>Mussaenda arcuata</i>	2	1	-	1	
36. <i>Anisophyllea boehmii</i>	1	-	-	1	
37. <i>Vitex</i> sp.	1	-	-	1	
38. <i>Diospyros hoyleana</i>	119	116	3		
39. <i>Rothmannia whitfieldii</i>	35	34	1		
40. <i>Dichtyophleba lucida</i>	21	19	2		
41. <i>Landolphia eminiana</i>	19	17	2		
42. <i>Canthium gueinzei</i>	17	16	1		
43. <i>Landolphia buchananii</i>	13	12	1		
44. <i>Combretum</i> sp.	10	7	3		
45. <i>Garcinia</i> sp.	4	3	1		
46. <i>Baphia bequaertii</i>	2	1	1		
47. <i>Bequaertiaodendron magalis-</i> <i>montanum</i>	1	-	1		
48. <i>Sapium schmitzii</i>	1	-	1		
49. <i>Rawsonia lucida</i>	13	13			
50. <i>Craterosiphon schmitzii</i>	11	11			
51. <i>Ritchiaea quarrei</i>	7	7			
52. ?	7	7			
53. ?	7	7			
54. <i>Melodorum gracile</i>	4	4			
55. <i>Ficus</i> sp. 1	3	3			
56. <i>Ficus</i> sp. 2	3	3			

57.	<i>Allophylus</i> sp.	3	3
58.	<i>Cissus petiolata</i>	3	3
59.	?	3	3
60.	<i>Opilia celtidifolia</i>	2	2
61.	?	2	2
62.	<i>Combretum celastroides</i>	2	2
63.	<i>Bridelia duvigneaudii</i>	1	1
64.	<i>Psorospermum tenuifolium</i>	1	1
65.	<i>Harungana madagascariensis</i>	1	1
66.	<i>Garcinia</i> sp.	1	1
67.	?	1	1
Total		1463	896

		Diameter classes (cm)																		
		5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80		85	90
Total		9.9	14.9	19.9	24.9	29.9	34.9	39.9	44.9	49.9	54.9	59.9	64.9	69.9	74.9	79.9	84.9	89.9	94.9	99.9
1.	<i>Marquesia macroura</i>	337	51	44	40	30	26	42	35	23	14	11	3	4	0	5	2	2	1	1
2.	<i>Brachystegia spiciformis</i> var. <i>latifoliolata</i>	137	2	7	20	21	32	13	14	8	5	4	5	2	2					
3.	<i>Brachystegia spiciformis</i> var. <i>schmitzii</i>	18	4	4	1	-	1	2	2	1	1	-	1	1						
4.	<i>Julbernardia globiflora</i>	198	12	11	27	31	29	25	37	15	4	5	2							
5.	<i>Brachystegia taxifolia</i>	20	1	3	4	5	-	3	1	-	-	2	1							
6.	<i>Pericopsis angolensis</i>	29	12	4	2	5	3	1	1	-	-	-	1							
7.	<i>Monotes katangensis</i>	78	24	19	16	8	4	5	-	1	1	-	-							
8.	<i>Parinari curatellifolia</i>	65	15	16	10	7	9	5	2	-	1	1	-							
9.	<i>Swartzia madagascariensis</i>	9	5	1	-	1	1	-	-	-	-	-	-							
10.	<i>Baphia bequaertii</i>	298	170	105	16	6	-	-	-	1										
11.	<i>Monotes africanus</i>	84	28	26	17	7	3	2	-	1										
12.	<i>Anisophyllea boehmii</i>	43	14	11	9	-	4	1	3	1										
13.	<i>Erythrophloeum africanum</i>	41	13	2	6	3	11	1	3	2										
14.	<i>Pterocarpus chrysorrhoea</i>	23	4	1	3	2	6	1	4	2										
15.	<i>Pseudolachnostylis mabrouneifolia</i>	49	18	18	6	4	2	-	1											
16.	<i>Uapaca nitida</i>	47	13	12	11	5	4	1	1											
17.	<i>Pterocarpus angolensis</i>	35	12	8	4	3	4	3	1											
18.	<i>Brachystegia boehmii</i>	4	-	1	-	-	2	-	1											
19.	<i>Annona senegalensis</i>	3	2	-	-	-	-	-	1											
20.	<i>Diploclathrus condylocarpon</i> subsp. <i>mosambicensis</i>	619	297	167	109	25	14	7												
21.	<i>Combretum mechowianum</i> subsp. <i>gazanense</i>	70	24	16	17	9	3	1												
22.	<i>Uapaca kirkiana</i>	70	28	20	13	7	1	1												
23.	<i>Combretum molle</i>	65	22	19	14	8	1	1												
24.	<i>Syzygium guineense</i> subsp. <i>afromontanum</i>	5	-	1	2	1	-	1												
25.	<i>Lonchocarpus katangensis</i>	2	-	1	-	-	-	1												
26.	<i>Brachystegia microphylla</i>	1	-	-	-	-	-	1												
27.	<i>Albizia antunesiana</i>	1	-	-	-	-	-	-												
28.	<i>Ocotea lemaireana</i>	35	22	10	1	-	2													
29.	<i>Vitex fischeri</i>	1	-	-	-	-	1													
30.	<i>Strychnos innocens</i>	87	39	30	14	4														

Appendix III : Luiswishi wooded savanna. Full inventory of 5 ha (high termitaria excluded). Diameter at 1.3 m height > 5 cm.

	Total	Diameter classes (cm)														60.0	65.0
		5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	59.9	64.9	69.9		
1. <i>Anisophyllea boehmii</i>	9	3	2	1	2	-	-	-	-	-	-	-	-	-	-	1	
2. <i>Parinari curatellifolia</i>	42	15	3	4	2	6	5	1	2	3	-	-	-	-	-	1	
3. <i>Azelia guanzensis</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
4. <i>Oldfielda dactylophylla</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
5. <i>Albizia antunesiana</i>	12	3	2	2	1	1	1	1	-	1	-	-	-	-	-		
6. <i>Swartzia madagascariensis</i>	11	5	2	1	-	1	1	-	-	1	-	-	-	-	-		
7. <i>Maranthes floribunda</i>	6	1	1	3	-	-	-	-	-	-	-	-	-	-	-		
8. <i>Combretum mechowianum</i>	118	48	25	20	14	3	3	2	3	-	-	-	-	-	-		
9. <i>Combretum molle</i>	66	29	13	9	6	5	2	-	2	-	-	-	-	-	-		
10. <i>Erytrophleum africanum</i>	31	18	6	3	-	2	-	1	1	1	-	-	-	-	-		
11. <i>Uapaca kirkiana</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
12. <i>Diplorhynchus condylocarpon</i>	110	55	28	13	7	5	1	1	-	-	-	-	-	-	-		
13. <i>Pericopsis angolensis</i>	69	38	12	3	9	3	2	2	-	-	-	-	-	-	-		
14. <i>Pterocarpus angolensis</i>	19	10	5	1	-	2	1	-	-	-	-	-	-	-	-		
15. <i>Baphia bequaertii</i>	90	61	18	9	1	1	-	-	-	-	-	-	-	-	-		
16. <i>Syzygium guineense</i> subsp. <i>macrocarpum</i>	76	54	14	6	1	1	-	-	-	-	-	-	-	-	-		
17. <i>Vitex madiensis</i>	38	23	12	2	-	-	-	-	-	-	-	-	-	-	-		

Appendix IV : Luaiwishi wooded savanna. Full inventory of 5 ha (high termitaria excluded). Diameter at soil level of stocks provided with shoots.

	Total	Diameter classes (cm)							
		5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0
1. <i>Baphia bequaertii</i>	31	17	8	4	-	-	-	1	1
2. <i>Pericopsis angolensis</i>	92	43	34	9	3	2	1		
3. <i>Parinari curatellifolia</i>	7	3	2	1	-	-	1		
4. <i>Combretum mechowianum</i>	164	86	56	14	7	1			
5. <i>Securidaca longepedunculata</i>	179	136	34	8	1				
6. <i>Maprounea africana</i>	36	23	9	3	1				
7. <i>Syzygium guineense</i> subsp. <i>macrocarpum</i>	19	13	4	-	2				
8. <i>Combretum molle</i>	18	8	5	4	1				
9. <i>Vitex madiensis</i>	13	8	4	-	1				
10. <i>Psorospermum febrifugum</i>	8	6	1	-	1				
11. <i>Afzelia quanzensis</i>	1	-	-	-	-				
12. <i>Vitex mombassae</i>	38	25	12	1	1				
13. <i>Diplorhynchus condylocarpon</i>	25	19	4	2	2				
14. <i>Erythrophleum africanum</i>	12	8	2	2					
15. <i>Swartzia madagascariensis</i>	3	1	1	1					
16. <i>Crossopteryx febrifuga</i>	19	15	4						
17. <i>Hymenocardia acida</i>	10	9	1						
18. <i>Pseudolachnostylis maprouneifolia</i>	4	2	2						
19. <i>Pterocarpus angolensis</i>	3	-	3						
20. <i>Albizia antunesiana</i>	3	2	1						
21. <i>Annona senegalensis</i>	1	-	1						
22. <i>Ochna schweinfurthiana</i>	1	-	1						
23. <i>Protea madiensis</i>	1	-	1						
24. <i>Terminalia mollis</i>	2	2							
25. <i>Anisophylla boehmii</i>	1	1							
26. <i>Lannea stuhlmannii</i>	1	1							
27. <i>Vangueriopsis lanciflora</i>	1	1							
Total	745	429	190	45	18	3	2	1	1

Appendix V : Evolution of the composition and the basal area ($\text{m}^2.\text{ha}^{-1}$)
in a regressive series of the Zambebian Region.

	Dry evergreen forest	Open forest	Savanna
1. <i>Parinari excelsa</i>	2.6868	0	0
2. <i>Aidia micrantha</i> var. <i>msonju</i>	1.5744	0	0
3. <i>Afroseralisia cerasifera</i>	1.5663	0	0
4. <i>Entandrophragma deleveyi</i>	1.3978	0	0
5. <i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	1.0166	0	0
6. <i>Anthocleista schweinfurthii</i>	0.5836	0	0
7. <i>Tabernaemontana angolensis</i>	0.4438	0	0
8. <i>Combretum gossweileri</i>	0.4159	0	0
9. <i>Faurea saligna</i>	0.4029	0	0
10. <i>Strychnos angolensis</i>	0.2859	0	0
11. <i>Strychnos lucens</i>	0.2603	0	0
12. <i>Combretum</i> sp. 1	0.1706	0	0
13. <i>Raphiostylis beninensis</i>	0.1662	0	0
14. <i>Julbernardia paniculata</i>	0.1470	0	0
15. <i>Rothmannia whitfieldii</i>	0.1229	0	0
16. <i>Dichtyophleba lucida</i>	0.0882	0	0
17. <i>Landolphia eminiiana</i>	0.0783	0	0
18. <i>Canthium gueinzei</i>	0.0710	0	0
19. <i>Landolphia buchananii</i>	0.0640	0	0
20. <i>Combretum</i> sp. 2	0.0555	0	0
21. <i>Rawsonia lucida</i>	0.0452	0	0
22. <i>Craterosiphon schmitzii</i>	0.0409	0	0
23. <i>Uvaria angolensis</i> var. <i>angolensis</i>	0.0394	0	0
24. <i>Manilkara obovata</i>	0.0362	0	0
25. (Annonaceae)	0.0337	0	0
26. <i>Ritchiaea quarrei</i>	0.0211	0	0
27. <i>Monanthotaxis schweinfurthii</i> var. <i>schweinfurthii</i>	0.0204	0	0
28. <i>Mussaenda arcuata</i>	0.0198	0	0
29. <i>Artabotrys monteiroae</i>	0.0179	0	0
30. <i>Bequaertiodendron magalismsontanum</i>	0.0167	0	0
31. <i>Cissus petiolata</i>	0.0134	0	0
32. <i>Ficus</i> sp. 1	0.0105	0	0
33. <i>Sapium schmitzii</i>	0.0099	0	0
34. <i>Allophylus abyssinicus</i>	0.0079	0	0
35. <i>Tricalysia myrtifolia</i>	0.0053	0	0
36. <i>Memecylon flavoiresens</i>	0.0043	0	0
37. <i>Combretum</i> sp. 3	0.0034	0	0
38. <i>Garcinia volkensii</i>	0.0026	0	0
39. <i>Brachystegia spiciformis</i> var. <i>schmitzii</i>	8.9823	0.3079	0
40. <i>Brachystegia taxifolia</i>	3.5682	0.2351	0
41. <i>Syzygium guineense</i> subsp. <i>afromontanum</i>	2.1003	0.0260	0
42. <i>Sorindeia katangensis</i>	0.4621	0.0066	0
43. <i>Diospyros hoyleana</i>	0.4346	0.0070	0
44. <i>Ochna afzelii</i>	0.1735	0.0025	0
45. <i>Garcinia huillensis</i>	0.1815	0.0215	0
46. <i>Combretum acutifolium</i>	0.1450	0.0079	0
47. <i>Tricalysia nyassae</i>	0.0910	0.0033	0
48. <i>Ochna puberula</i>	0.0510	0.0081	0
49. <i>Ficus rhodesiaca</i>	0.0114	0.0021	0
50. <i>Psorospermum tenuifolium</i>	0.0059	0.0012	0
51. <i>Harungana madagascariensis</i>	0.0032	0.0020	0

52. <i>Marquesia macroura</i>	3.7167	6.6316	0
53. <i>Canthium venosum</i>	0.0156	0.0369	0
54. <i>Vitex</i> sp. 1	0.0279	0.0296	0
55. <i>Bridelia duvigneaudii</i>	0.0021	0.0039	0
56. <i>Albizia adianthifolia</i>	1.0394	0.0129	0.0022
57. <i>Lannea discolor</i>	0.3198	0.0166	0.0116
58. <i>Brachystegia spiciformis</i> var. <i>latifolio-</i> lata	0.3176	2.4631	0.0006
59. <i>Baphia bequaertii</i>	0.0141	0.6022	0.1519
60. <i>Anisophyllea boehmii</i>	0.0291	0.1830	0.0946
61. <i>Albizia antunesiana</i>	0.0408	0.0152	0.1112
62. <i>Julbernardia globiflora</i>	0	3.0213	0
63. <i>Monotes katangensis</i>	0	0.4315	0
64. <i>Monotes africanus</i>	0	0.3521	0
65. <i>Pterocarpus tinctorius</i> var. <i>chrysothrix</i>	0	0.2805	0
66. <i>Uapaca nitida</i>	0	0.2186	0
67. <i>Strychnos innocua</i>	0	0.2110	0
68. <i>Ochthocosmus lemaireanus</i>	0	0.0760	0
69. <i>Brachystegia boehmii</i>	0	0.0515	0
70. <i>Craterosiphon quarrei</i>	0	0.0458	0
71. <i>Salacia rhodesiaca</i>	0	0.0431	0
72. <i>Uvariastrum hexaloboides</i>	0	0.0201	0
73. <i>Strychnos cocculoides</i>	0	0.0199	0
74. <i>Brachystegia microphylla</i>	0	0.0192	0
75. <i>Hexalobus monopetalus</i>	0	0.0163	0
76. (Rubiaceae) (M 12453)	0	0.0132	0
77. <i>Lonchocarpus nelsii</i> subsp. <i>katangensis</i>	0	0.0127	0
78. <i>Xylopia odoratissima</i>	0	0.0109	0
79. <i>Uapaca pilosa</i>	0	0.0086	0
80. <i>Dalbergia boehmii</i>	0	0.0083	0
81. <i>Rothmannia engleriana</i>	0	0.0058	0
82. <i>Strychnos pungens</i>	0	0.0047	0
83. <i>Boscia corymbosa</i>	0	0.0045	0
84. <i>Ficus dekdekena</i>	0	0.0040	0
85. <i>Uapaca sansibarica</i>	0	0.0039	0
86. <i>Ficus</i> sp. 2	0	0.0032	0
87. <i>Schrebera trichoclada</i>	0	0.0017	0
88. <i>Sericanthe andongensis</i>	0	0.0015	0
89. <i>Haplocoelum foliolosum</i>	0	0.0006	0
90. <i>Diplorhynchus condylocarpum</i>	0	1.4563	0.3133
91. <i>Parinari curatellifolia</i>	0	0.4910	0.4467
92. <i>Erythrophleum africanum</i>	0	0.3724	0.1141
93. <i>Uapaca kirkiana</i>	0	0.2319	0.0257
94. <i>Pseudolachnostylis maprouneifolia</i>	0	0.1697	0.0688
95. <i>Pterocarpus angolensis</i>	0	0.0988	0.0628
96. <i>Ochna schweinfurthiana</i>	0	0.0527	0.0159
97. <i>Annona senegalensis</i>	0	0.0256	0.0021
98. <i>Diospyros mwerocensis</i>	0	0.0168	0.0078
99. <i>Canthium crassum</i>	0	0.0134	0.0008
100. <i>Combretum mechowianum</i> subsp. <i>gazense</i>	0	0.2721	0.5378
101. <i>Combretum molle</i>	0	0.1887	0.2859
102. <i>Pericopsis angolensis</i>	0	0.1999	0.2539
103. <i>Syzygium guineense</i> subsp. <i>macrocarpum</i>	0	0.0303	0.1361
104. <i>Hymenocardia acida</i>	0	0.0397	0.0831
105. <i>Swartzia madagascariensis</i>	0	0.0661	0.0755
106. <i>Vitex madiensis</i> subsp. <i>milanjiensis</i>	0	0.0052	0.0661
107. <i>Afzelia quanzensis</i>	0	0.0098	0.0477
108. <i>Combretum zeyheri</i>	0	0.0006	0.0100
109. <i>Securidaca longepedunculata</i>	0	0	0.0825

110. <i>Maranthes floribunda</i>	0	0	0.0550
111. <i>Oldfieldia dactylophylla</i>	0	0	0.0471
112. <i>Maprounea africana</i>	0	0	0.0423
113. <i>Crossopteryx febrifuga</i>	0	0	0.0365
114. <i>Psorospermum febrifugum</i>	0	0	0.0193
115. <i>Vitex mombassae</i>	0	0	0.0188
116. <i>Strychnos spinosa</i>	0	0	0.0161
117. <i>Gardenia jovis-tonantis</i>	0	0	0.0039
118. <i>Terminalia mollis</i>	0	0	0.0038
119. <i>Protea bequaerti</i>	0	0	0.0016
120. <i>Vangueriopsis lanciflora</i>	0	0	0.0004

Appendix VI : Density, in number of individuals per hectare, of the most frequent species of the Luiswishi dry evergreen forest (DHB>10 cm).

1. <i>Brachystegia spiciformis</i> var. <i>schmitzii</i>	150
2. <i>Aidia micrantha</i> var. <i>msonju</i>	63
3. <i>Syzygium guineense</i> subsp. <i>afromontanum</i>	52
4. <i>Parinari excelsa</i>	49
5. <i>Brachystegia taxifolia</i>	43
6. <i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	24
7. <i>Tabernaemontana angolensis</i>	20
8. <i>Marquesia macroura</i>	19
9. <i>Combretum gossweileri</i>	17
10. <i>Sorindeia katangensis</i>	14
11. <i>Strychnos angolensis</i>	11
12. <i>Albizzia adianthifolia</i>	10
13. <i>Ochna afzelii</i>	9
14. <i>Garcinia huillensis</i>	8
15. <i>Strychnos lucens</i>	7
16. <i>Entandrophragma delevoyi</i>	6
17. <i>Lannea antiscorbutica</i>	6

Appendix VII : Presence, on 100 one are squares, of the most frequent woody species in the Luiswishi dry evergreen forest (diameter greater than 5 cm at 1.3 m height).

1. <i>Aidia micrantha</i> var. <i>msonju</i>	85
2. <i>Brachystegia spiciformis</i> var. <i>schmitzii</i>	78
3. <i>Diospyros hoyleana</i>	58
4. <i>Syzygium guineense</i> subsp. <i>afromontanum</i>	45
5. <i>Sorindeia katangensis</i>	41
6. <i>Parinari excelsa</i>	34
7. <i>Brachystegia taxifolia</i>	30
8. <i>Rothmannia whitfieldii</i>	29
9. <i>Combretum gossweileri</i>	27
10. <i>Strychnos angolensis</i>	25
11. <i>Tabernaemontana angolensis</i>	24
12. <i>Marquesia macroura</i>	22
13. <i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	21
14. <i>Ochna afzelii</i>	20
15. <i>Combretum acutifolium</i>	16
16. <i>Canthium gueinzei</i>	15
17. <i>Strychnos lucens</i>	14
18. <i>Garcinia buchananii</i>	14
19. <i>Dichtyophleba lucida</i>	13
20. <i>Landolphia eminiana</i>	13
21. <i>Albizzia adianthifolia</i>	12
22. ?	12
23. <i>Landolphia buchananii</i>	10
24. <i>Lannea antiscorbutica</i>	9
25. <i>Craterosiphon schmitzii</i>	8
26. <i>Ochna puberula</i>	7
27. <i>Rawsonia lucida</i>	7
28. ?	7
29. <i>Artabotrys monteiroae</i>	6
30. <i>Combretum</i> sp. 1	6
31. <i>Ritchiea quarrei</i>	6
32. <i>Afroseralisia cerasifera</i>	6
33. <i>Rhaphiostylis beninensis</i>	5
34. <i>Uvaria angolensis</i> subsp. <i>angolensis</i>	5
35. <i>Combretum</i> sp. 2	5
36. <i>Entandrophragma deleveyi</i>	4
37. <i>Mussaenda arcuata</i>	4

Appendix VIII : Density, in individuals per hectare, of the most abundant woody species in the Luiswishi open forest (inventory of 5 hectares, diameter greater than 10 cm at 1.3 m height).

1. <i>Marquesia macroura</i>	58
2. <i>Diplorhynchus condylocarpon</i> subsp. <i>mossambicensis</i>	54
3. <i>Julbernardia globiflora</i>	37
4. <i>Brachystegia spiciformis</i> var. <i>latifoliolata</i>	27
5. <i>Baphia bequaertii</i>	26
6. <i>Monotes katangensis</i>	11
7. <i>Parinari curatellifolia</i>	10
8. <i>Combretum mechowianum</i> subsp. <i>gazense</i>	9
9. <i>Monotes africanus</i>	9
10. <i>Strychnos innocua</i>	9
11. <i>Combretum molle</i>	9
12. <i>Uapaca kirkiana</i>	8
13. <i>Pseudolachnosylis maprouneifolia</i>	5
14. <i>Uapaca nitida</i>	5
15. <i>Brachystegia taxifolia</i>	4
16. <i>Pterocarpus chrysothrix</i>	3
17. <i>Pericopsis angolensis</i>	3
18. <i>Ochna schweinfurthiana</i>	3
19. <i>Ochthocosmus lemaireanus</i>	3

Appendix IX : Presence (in percentage), for 80 squares of 6.25 ares, of the most frequent woody species in the Luiswishi open forest (diameter greater than 5 cm at 1.3 m height).

1. <i>Baphia bequaertii</i>	95.0
2. <i>Diplorhynchus condylocarpon</i> subsp. <i>mossambicensis</i>	94.7
3. <i>Julbernardia globiflora</i>	87.5
4. <i>Marquesia macroura</i>	76.2
5. <i>Brachystegia spiciformis</i> var. <i>latifoliolata</i>	70.0
6. <i>Strychnos innocua</i>	52.5
7. <i>Monotes katangensis</i>	47.5
8. <i>Parinari curatellifolia</i>	45.0
9. <i>Monotes africanus</i>	45.0
10. <i>Combretum molle</i>	42.5
11. <i>Pseudolachnostylis maprouneifolia</i>	38.7
12. <i>Uapaca kirkiana</i>	37.5
13. <i>Combretum mechowianum</i> subsp. <i>gazense</i>	35.0
14. <i>Uapaca nitida</i>	32.5
15. <i>Ochna schweinfurthiana</i>	31.2
16. <i>Ochthocosmus lemaireanus</i>	26.2
17. <i>Anisophyllea boehmii</i>	25.0
18. <i>Pericopsis angolensis</i>	21.2
19. <i>Pterocarpus angolensis</i>	20.0
20. <i>Strychnos cocculoides</i>	20.0
21. <i>Salacia rhodesiaca</i>	18.7

Appendix X : Density, in individuals per hectare, of the most abundant woody species in the Luiswishi wooded savanna (inventory of 5 hectares, diameter greater than 10 cm at 1.3 m height).

1. <i>Combretum mechowianum</i>	14
2. <i>Diplorhynchus condylocarpum</i>	11
3. <i>Combretum molle</i>	7
4. <i>Pericopsis angolensis</i>	6
5. <i>Baphia bequaertii</i>	6
6. <i>Parinari curatellifolia</i>	5
7. <i>Maprounea africana</i>	5
8. <i>Syzygium guineense</i> subsp. <i>macrocarpum</i>	4
9. <i>Securidaca longepedunculata</i>	3
10. <i>Vitex madiensis</i>	3
11. <i>Hymenocardia acida</i>	3
12. <i>Erythrophleum africanum</i>	3
13. <i>Pseudolachnostylis maprouneifolia</i>	2
14. <i>Albizzia antunesiana</i>	2
15. <i>Pterocarpus angolensis</i>	2

Appendix XI : Presence (in percentage), for 80 squares of 6.25 ares, of the most frequent woody species in the Luiswishi wooded savanna (diameter greater than 5 cm at 1.3 m height). The second column gives values taking in account the stocks. These produce shoots which are lesser than 5 cm in diameter and which are burned each year.

1. <i>Combretum mechowianum</i>	63.5	91.2
2. <i>Pericopsis angolensis</i>	35.0	60.0
3. <i>Syzygium guineense</i> subsp. <i>macrocarpum</i>	33.7	40.0
4. <i>Baphia bequaertii</i>	33.7	37.5
5. <i>Combretum molle</i>	31.2	41.2
6. <i>Vitex madiensis</i> subsp. <i>milanjiensis</i>	30.0	36.2
7. <i>Hymenocardia acida</i>	30.0	33.7
8. <i>Securidaca longipedunculata</i>	27.5	51.2
9. <i>Diplorhynchus condylocarpon</i> subsp. <i>mossambicensis</i>	27.5	36.2
10. <i>Parinari curatellifolia</i>	27.5	27.5
11. <i>Erythrophleum africanum</i>	26.2	31.2
12. <i>Psorospermum febrifugum</i>	25.0	30.0
13. <i>Vitex mombassae</i>	16.2	16.2
14. <i>Pterocarpus angolensis</i>	13.7	15.0
15. <i>Albizzia antunesiana</i>	11.2	15.0
16. <i>Pseudolachnostylis maprouneifolia</i>	10.0	13.7
17. <i>Crossopteryx febrifuga</i>	10.0	13.7
18. <i>Swartzia madagascariensis</i>	8.7	11.2
19. <i>Strychnos spinosa</i>	7.5	7.5

Appendix XII : Listing, in decreasing size of the basal area, of the woody species of the Luiswishi dry evergreen forest.

	Basal area (m ² .ha ⁻¹)	% of the total basal area
1. <i>Brachystegia spiciformis</i> var. <i>schmitzii</i>	8.983	26.7
2. <i>Marquesia macroura</i>	3.717	11.0
3. <i>Brachystegia taxifolia</i>	3.568	10.6
4. <i>Parinari excelsa</i>	2.687	8.0
5. <i>Syzygium guineense</i> subsp. <i>afromontanum</i>	2.100	6.2
6. <i>Aidia micrantha</i> var. <i>msonju</i>	1.574	4.7
7. <i>Afrosersalisia cerasifera</i>	1.566	4.7
8. <i>Entandrophragma delevoiyi</i>	1.398	4.2
9. <i>Albizzia adianthifolia</i>	1.039	3.1
10. <i>Apodytes dimidiata</i> subsp. <i>dimidiata</i>	1.017	3.0
11. <i>Anthocleista schweinfurthii</i>	0.584	1.7
12. <i>Sorindeia katangensis</i>	0.462	1.4
13. <i>Tabernaemontana angolensis</i>	0.444	1.3
14. <i>Diospyros hoyleana</i>	0.435	1.3
15. <i>Combretum gossweileri</i>	0.416	1.2
16. <i>Faurea saligna</i>	0.403	1.2
17. <i>Lannea artiscorbutica</i>	0.320	1.0
18. <i>Brachystegia spiciformis</i> var. <i>latifoliolata</i>	0.318	0.9
19. <i>Strychnos angolensis</i>	0.286	0.9
20. <i>Strychnos lucens</i>	0.260	0.8
21. <i>Garcinia huillensis</i>	0.182	0.5
22. <i>Ochna afzelii</i>	0.173	0.5
23. <i>Combretum</i> sp. 1	0.171	0.5
24. <i>Rhaphylostylis beninensis</i>	0.166	0.5
25. <i>Julbernardia paniculata</i>	0.147	0.4
26. <i>Combretum acutifolium</i>	0.145	0.4
27. <i>Rothmannia whitfieldii</i>	0.123	0.4
28. <i>Tricalysia nyassae</i>	0.091	0.3
29. <i>Dichtyophleba lucida</i>	0.088	0.3
30. <i>Landolphia eminiiana</i>	0.078	0.2
31. <i>Canthium gueinzii</i>	0.071	0.2
32. <i>Landolphia buchananii</i>	0.064	0.2
33. <i>Combretum</i> sp. 2	0.056	0.2
34. <i>Ochna puberula</i>	0.051	0.2
35. <i>Rawsonia lucida</i>	0.045	0.1
36. <i>Craterosiphon schmitzii</i>	0.041	0.1

Appendix XIII : Listing, in decreasing size of the basal area, of the woody species of the Luiswishi open forest.

1. <i>Marquesia macroura</i>	34.4
2. <i>Julbernardia globiflora</i>	15.7
3. <i>Brachystegia spiciformis</i> var. <i>latifoliolata</i>	12.8
4. <i>Diplorhynchus condylocarpon</i>	7.6
5. <i>Baphia bequaertii</i>	3.1
6. <i>Parinari curatellifolia</i>	2.6
7. <i>Monotes katangensis</i>	2.2
8. <i>Erythrophleum africanum</i>	1.9
9. <i>Monotes africanum</i>	1.8
10. <i>Brachystegia spiciformis</i> var. <i>schmitzii</i>	1.6
11. <i>Pterocarpus chrysothrix</i>	1.5
12. <i>Combretum mechowianum</i>	1.4
13. <i>Brachystegia taxifolia</i>	1.2
14. <i>Uapaca kirkiana</i>	1.2
15. <i>Uapaca nitida</i>	1.1
16. <i>Strychnos innocua</i>	1.1
17. <i>Pericopsis angolensis</i>	1.0
18. <i>Combretum molle</i>	1.0
19. <i>Pseudolachnostylis maprouneifolia</i>	0.9
20. <i>Pterocarpus angolensis</i>	0.5
21. <i>Ochthocosmus lemaireanus</i>	0.4
22. <i>Swartzia madagascariensis</i>	0.3
23. <i>Ochna scheinfurthiana</i>	0.3
24. <i>Brachystegia boehmii</i>	0.3
25. <i>Craterosiphon quarrei</i>	0.2
26. <i>Salacia rhodesiaca</i>	0.2
27. <i>Hymenocardia acida</i>	0.2
28. <i>Canthium venosum</i>	0.2
29. <i>Syzygium guineense</i> subsp. <i>macrocarpum</i>	0.2
30. <i>Vitex fisheri</i>	0.2
31. <i>Syzygium guineense</i> subsp. <i>afromontanum</i>	0.1
32. <i>Annona senegalensis</i>	0.1
33. <i>Uvariastrum hexaloboides</i>	0.1
34. <i>Strychnos cocculoides</i>	0.1
35. <i>Brachystegia microphylla</i>	0.1
36. <i>Diospyros mweroensis</i>	0.1
37. <i>Hexalobus monopetalus</i>	0.1

Appendix XIV : Listing, in decreasing size of the basal area, of the
woody species of the Luiswishi wooded savanna.

1. <i>Combretum mechowianum</i>	16.5
2. <i>Parinari mobola</i>	13.7
3. <i>Diploerhynchus condylocarpon</i>	9.7
4. <i>Combretum molle</i>	8.8
5. <i>Pericopsis angolensis</i>	7.8
6. <i>Baphia bequaertii</i>	4.7
7. <i>Syzygium guineense</i> subsp. <i>macrocarpum</i>	4.2
8. <i>Erythrophleum africanum</i>	3.5
9. <i>Albizzia antunesiana</i>	3.4
10. <i>Anisophyllea boehmii</i>	2.9
11. <i>Hymenocardia acida</i>	2.6
12. <i>Securidaca longepedunculata</i> var. <i>parvifolia</i>	2.5
13. <i>Swartzia madagascariensis</i>	2.3
14. <i>Pseudolachnostylis maprouneifolia</i>	2.1
15. <i>Vitex madiensis</i>	2.0
16. <i>Pterocarpus angolensis</i>	1.9
17. <i>Maranthes floribunda</i>	1.7
18. <i>Azelia quanzensis</i>	1.5
19. <i>Oldfieldia dactylophylla</i>	1.4
20. <i>Maprounea africana</i>	1.3
21. <i>Crossopteryx febrifuga</i>	1.1
22. <i>Uapaca kirkiana</i>	0.8
23. <i>Psorospermum febrifugum</i>	0.6
24. <i>Vitex mombassae</i>	0.6
25. <i>Strychnos spinosa</i>	0.5
26. <i>Ochna scheinfurthiana</i>	0.5
27. <i>Lanea discolor</i>	0.4
28. <i>Combretum zeyheri</i>	0.3
29. <i>Diospyros mweroensis</i>	0.2
30. <i>Gardenia jovis-tonantis</i>	0.1
31. <i>Terminalia mollis</i>	0.1
32. <i>Albizzia adianthifolia</i>	0.1