CHAPTER 6

RESULTS

DESCRIPTION OF SAMPLE PLOTS ON NGAMBA ISLAND

Figure 6.1 shows a map of Ngamba Island based on GPS measurements. The forested areas and those with herbaceous vegetation are indicated. Other landmarks, such as the fence dividing the chimpanzee area from the staff and visitors' area, as well as the centre points of the eight sample plots are also indicated.

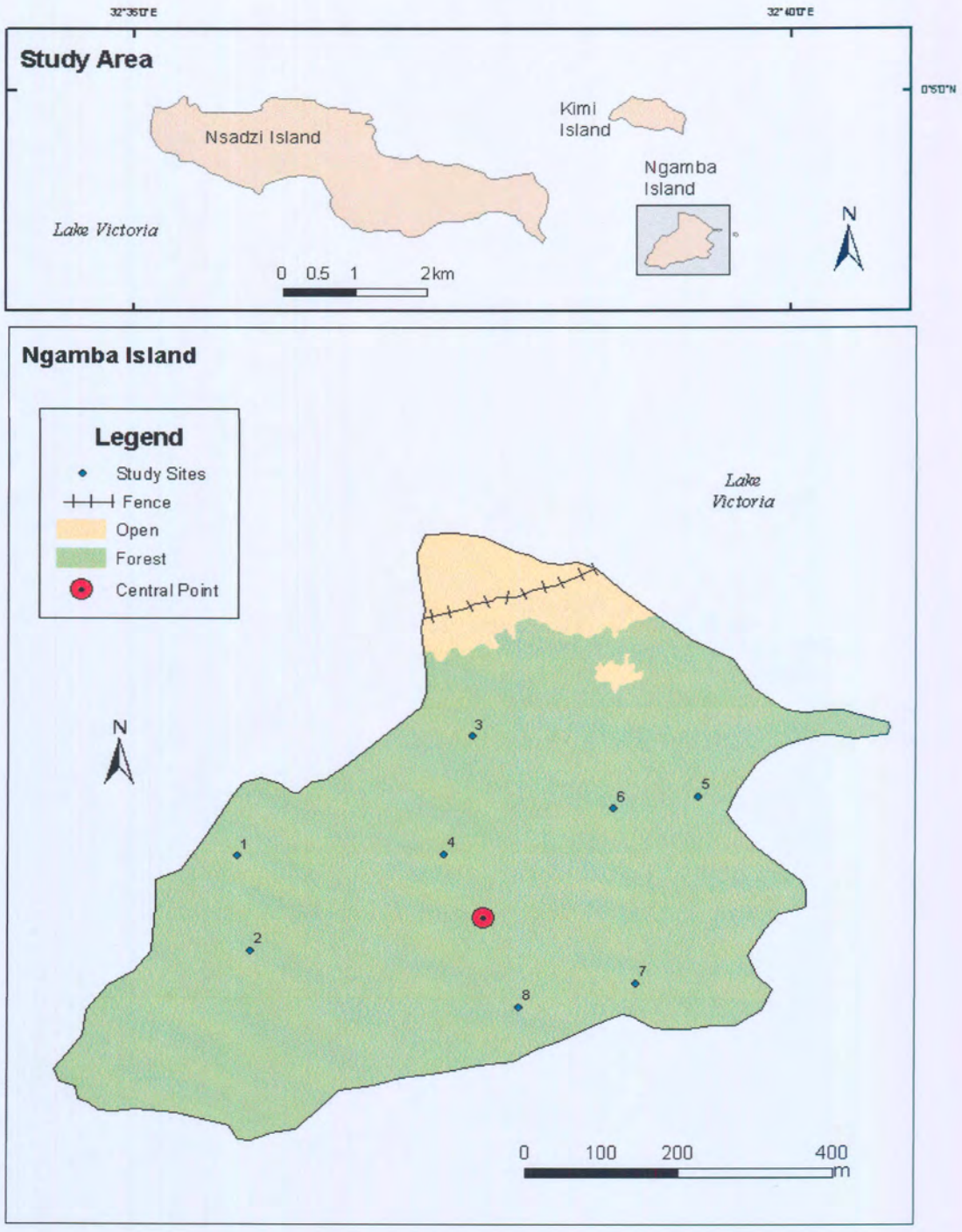

Figure 6.1: Sample plots and vegetation zones on Ngamba Island.

SAMPLE PLOTS ON NGAMBA ISLAND

Using the **highest elevation** of the island **(S 00°06 288 / E 32°39 178; 1195 ± 5 m)** as a **centre point**, four different sampling quadrats were created (Figure 6.2). In each quadrat two sample plots were randomly selected:

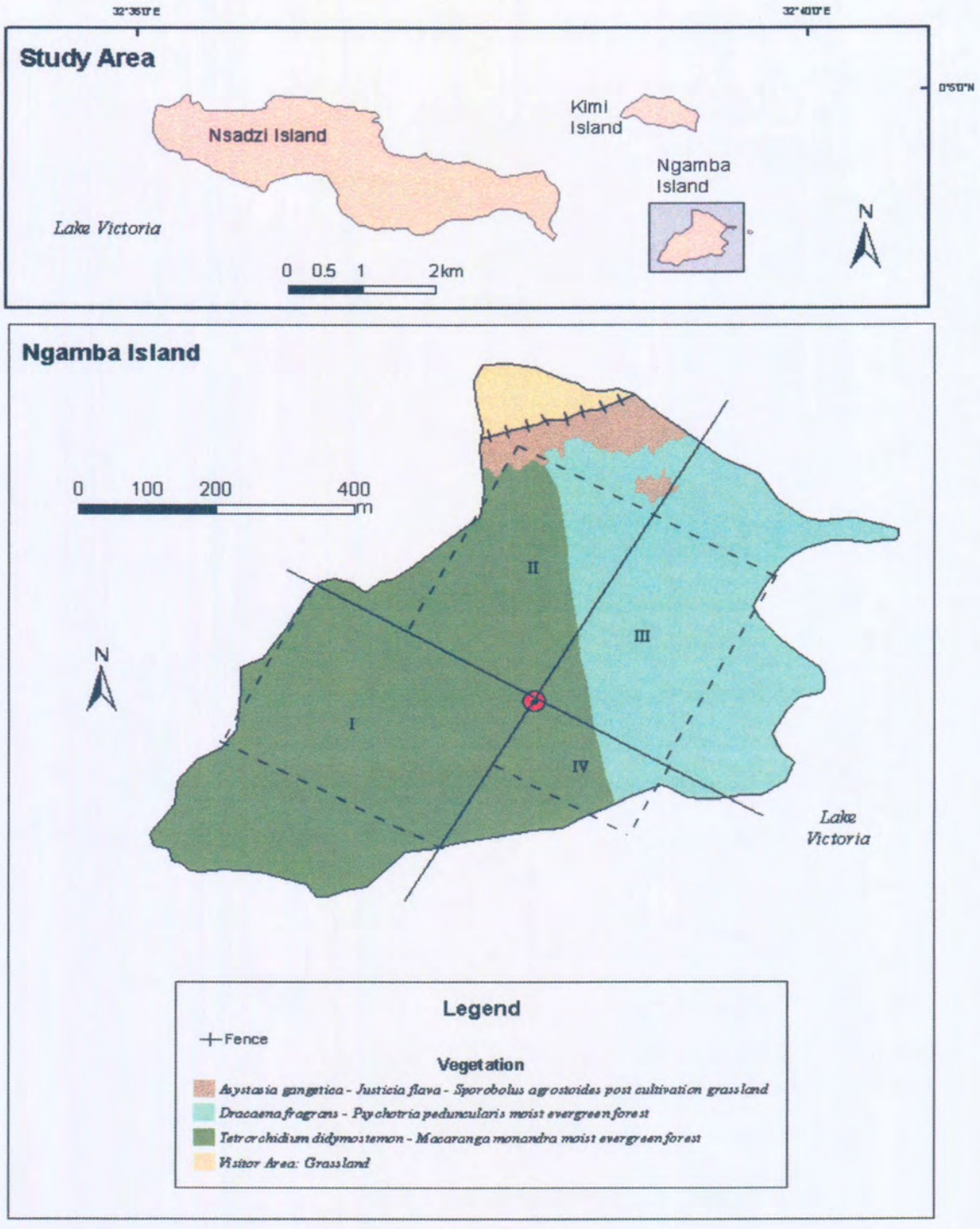

Figure 6.2: Location of the four sample quadrats on Ngamba Island.

Plot 1 - S 00°06 256 / E 32°39 005; 1 160 ± 1 m (Table 6.1)

This plot is close to the western shore of the island and has two slopes: a slight (4.6 – 9.9°) east-westwards slope and a moderate (10.0 – 27.0°) north-southwards slope (Table 6.1). The undergrowth is dense, consisting mainly of *Culcasia falcifolia* - a creeper - and *Commelina capitata*. There are not many trees of > 6.00 m in this plot. The vegetation consists mainly of *Aframomum angustifolium*. Apart from the > 6.00 m height class, trees of all other height classes are present within the five meter squares. Very few dead trees; neither standing nor fallen, are prevalent. This plot seems to receive less wind than those on the eastern side and the vegetation on this side of the island differs from that on the eastern side. There are also fewer spider webs.

Plot 2 - S 00°06 313 / E 32°39 014; 1 172 ± 2 m (Table 6.1)

This plot has a big open space in the centre with fallen dead trees covering part of the area. Almost no tracks are present. The plot has a moderate east-western slope (Table 6.1) and is close to the highest elevation on the island. The ground is covered with *Culcasia falcifolia*. On the northern side of the plot another open space is found where a number of spider webs occur. This plot contains some of the largest trees, many showing very high root buttresses.

Plot 3 - S 00°06 152 / E 32°39 169; 1 170 ± 8 m (Table 6.1)

This plot is close to the northern forest border and to the staff/visitors area. The tracks from east to west and north to south are not particularly straight in this area and could therefore be only partly used to subdivide the plot into sampling squares. There are two slopes: a slight east-western slope and a moderate south-northern slope (Table 6.1). *Albizia gumnifera* and *Aframomum angustifolium* are the most prominent woody species. In general, the vegetation is quite dense but there are also some bare patches.

Plot 4 - S 00°06 240 / E 32°39 150; 1 176 ± 5 m (Table 6.1)

This plot is situated more towards the centre of the island and in close proximity of the highest elevation. There are two slopes: one marked (27.1 – 45.0°) south-northern slope and a second, moderate east-western slope (Table 6.1). Here again, only a few spider webs are seen. The north-southwards running track is almost invisible. Two fallen trees of quite huge

dimensions are lying almost in the centre of the plot. The main tree species is *Albizia gumnifera* while fig trees are also quite prominent. The undergrowth is relatively dense.

Plot 5 - S 00°06 197 / E 32°39 328; 1 158 ± 4 m (Table 6.1)

This plot is close to the eastern shore of the island and its eastern 25 m border nearly touches the sandy beach. There is a steep (45.1 -67.5°) west-eastern slope (Table 6.1). The ground is densely covered with *Culcasia falcifolia* and *Commelina capitata*. The south-eastern square of the sample plot mainly contains *Dracaena fragrans* trees of different heights.

The chimpanzees seem to visit this area rather frequently. They seem to follow the existing track system and to diverge from there into the surrounding vegetation at different locations. They mainly pull out creepers and tear down leaves and branches, leaving them lying on the ground without eating them to a large extent. They also pull out the poles, used to mark the 5 m distances inside the plot area, quite frequently. Judging from the damage caused to the adjacent vegetation, the chimpanzees mainly follow the north-southwards running track and to a much lesser extent the west-eastwards running track, while hardly ever approaching the water in this area.

Plot 6 - S 00°06 206 / E 32°39 269; 1 167 ± 6 m (Table 6.1)

This plot is deep inside the forest under a dense vegetation cover with hardly any light penetrating. There is no visible slope (0.0 – 4.5°) present (Table 6.1). The north-western square contains a large number of *Dracaena fragrans* of which many of the taller ones have been bent over towards the ground. Smaller sidebranches spread out from the bent stems. There is a closed ground cover of *Commelina capitata*.

Plot 7 - S 00°06 338 / E 32°39 285; 1 146 ± 5 m (Table 6.1)

This plot is also close to the eastern shore and contains a number of fallen dead trees. There is a moderate north-southern slope (Table 6.1). The foremost species are *Aframomum angustifolium* and *Dracaena fragrans*, many of which are dead or bent to the ground. A large number of spiderwebs and spiders are observed. The area becomes progressively open, i.e. containing less trees, towards the shore (different to plot 5).

The chimpanzees do not seem to frequent this area as regulary as some of the other plots. However, they have broken from the track into the adjacent vegetation in many places and caused a lot of destruction, especially within the *Aframomum angustifolium* and *Dracaena fragrans* stands, many of which have been bent or broken and seem to be dying.

Plot 8 - S 00°06 355 / E 32°39 203; 1 148 ± 6 m (Table 6.1)

This plot is close to the south-eastern shore. There is a moderate north-west to south-eastern slope (Table 6.1). Towards the north-western plot area a number of whitish-grey, solid rocks occur. The vegetation is predominantly made up of *Aframomum angustifolium* while *Dracaena fragrans* is not present at all.

After the chimpanzees have visited the area a lot of destruction is visible: many *Aframomum angustifolium* have been bent and broken and seem to be dying off.

Table 6.1: *S / E-coordinates for woody vegetation on Ngamba and Nsadzi Island: Plot Number, altitude, slope and aspect of sample plots*

	S/E-coordinates	Location	Altitude [m] ± STD		Slope [°]	Category	Aspect
Plot 1	00°06 242/32°39 005	Centre	1160	1			
	00°06 256/32°39 005	South	1162	3	14.4	moderate	N
	00°06 231/32°39 007	North	1154	2	14.4	moderate	N
	00°06 238/32°39 019	East	1161	2	5.4	slight	W
	00°06 237/32°38 990	West	1158	1	5.4	slight	W
Plot2	00°06 313/32°39 014	Centre	1172	2			
	00°06 309/32°39 030	East	1179	4	12.6	moderate	W
	00°06 309/32°39 000	West	1172	5	12.6	moderate	W
Plot 3	00°06 152/32°39 169	Centre	1170	8			
	00°06 161/32°39 166	South	1172	10	23.4	moderate	N
	00°06 138/32°39 168	North	1159	4	23.4	moderate	N
	00°06 150/32°39 181	East	1172	14	5.4	slight	W
	00+06 160/32°39 155	West	1169	10	5.4	slight	W
Plot 4	00°06 240/32°39 150	Centre	1176	5			
	00°06 251/32°39 159	South	1186	9	28.8	marked	N
	00°06 224/32°39 145	North	1170	8	28.8	marked	N
	00°06 236/32°39 162	East	1180	7	10.8	moderate	W
	00°06 240/32°39 136	West	1174	6	10.8	moderate	W
Plot 5	00°06 197/32°39 328	Centre	1158	4			
	00°06 188/32°39 316	West	1173	2	52.4	steep	E
	00°06 205/32°39 333	East	1144	1	52.4	steep	E
Plot 6	00°06 206/32°39 269	Centre	1167	6		no slope	
Plot 7	00°06 338/32°39 285	Centre	1146	5			
	00°06 318/32°39 291	North	1148	7	22.7	moderate	S
	00°06 348/32°39 287	South	1136	9	22.7	moderate	S
Plot 8	00°06 355/32°39 203	Centre	1148	6			
	00°06 341/32°39 207	North	1152	17	18.7	moderate	S
	00°06 368/32°39 213	South	1142	9	18.7	moderate	S
Highest Elevation	00°06 288/32°39 178		1195	5	-	-	-
Nsadzi Plot 1	00°05 731/32°37 252	Centre	1214	32	*	marked	N
	00°05 729/32°37 252	South	1237	0	*	marked	N
	00°05 719/32°37 253	North	1212	2	*	marked	N
Nsadzi Plot 2	00°05 759/32°37 311	Centre	-	-	*	marked	N

* measurements for Nsadszi Island are too inaccurate to determine slope

Slope categories:

0.0 -	4.5° =	**no slope**
4.6 -	9.9° =	**slight slope**
10.0 -	27.0° =	**moderate slope**
27.1 -	45.0° =	**marked slope**
45.1 -	67.5° =	**steep slope**
67.6 -	100.0° =	**very steep slope**

DIMENSIONS OF SAMPLE SQUARES ON NGAMBA ISLAND

The dimensions of the respective sample areas for each height class in the eight sample plots are given in Table 6.2.

Table 6.2: *Size of sample squares for each height class in the eight sample plots on Ngamba Island*

Height class [m]	Plot 1		Plot 2	
	Size [m] of largest square	Area [m^2]	Size [m] of largest square	Area [m^2]
> 6	15 x 15	900	10 x 10	400
4 – 5	5 x 5	100	10 x 10	400
3	5 x 5	100	10 x 10	400
2	5 x 5	100	5 x 5	100
1	5 x 5	100	5 x 5	100
0.5	5 x 5	100	10 x 10	400
Standing dead	25 x 25	2500	25 x 25	2500
Fallen dead	25 x 25	2500	20 x 20	1600
Height class [m]	Plot 3		Plot 4	
	Size [m] of largest square	Area [m^2]	Size [m] of largest square	Area [m^2]
> 6	10 x 10	400	10 x 10	400
4 – 5	5 x 5	100	5 x 5	100
3	5 x 5	100	5 x 5	100
2	5 x 5	100	5 x 5	100
1	5 x 5	100	5 x 5	100
0.5	5 x 5	100	5 x 5	100
Standing dead	25 x 25	2500	25 x 25	2500
Fallen dead	25 x 25	2500	10 x 10	400
Height class [m]	Plot 5		Plot 6	
	Size [m] of largest square	Area [m^2]	Size [m] of largest square	Area [m^2]
> 6	5 x 5	100	5 x 5	100
4 – 5	10 x 10	400	5 x 5	100
3	5 x 5	100	5 x 5	100
2	10 x 10	400	5 x 5	100
1	5 x 5	100	5 x 5	100
0.5	5 x 5	100	5 x 5	100
Standing dead	25 x 25	2500	25 x 25	2500
Fallen dead	25 x 25	2500	15 x 15	900
Height class [m]	Plot 7		Plot 8	
	Size [m] of largest square	Area [m^2]	Size [m] of largest square	Area [m^2]
> 6	10 x 10	400	15 x 15	900
4 – 5	10 x 10	400	10 x 10	400
3	5 x 5	100	5 x 5	100
2	5 x 5	100	5 x 5	100
1	5 x 5	100	5 x 5	100
0.5	5 x 5	100	5 x 5	100
Standing dead	15 x 15	900	20 x 20	1600
Fallen dead	25 x 25	2500	20 x 20	1600

The majority of sample squares has the smallest possible size, i.e. 5 x 5 m (or 100 m^2 for the whole sample area per plot). This indicates a high density of trees in all height classes. In contrast, the sample squares of the two "dead tree" categories tend to be of the largest possible size, i.e. 25 x 25 m (or 2500 m^2 for the whole sample area per plot). Hence, the density of dead trees is on average much lower than that for living trees.

WOODY VEGETATION ON NGAMBA ISLAND

Density

Density of plants over all height classes and growth forms

The density of plants per hectare over all height classes and vegetation types covers quite a wide range from 3 100 plants per hectare in plot 2 to 18 050 plants per hectare in plot 7 (Figure 6.3).

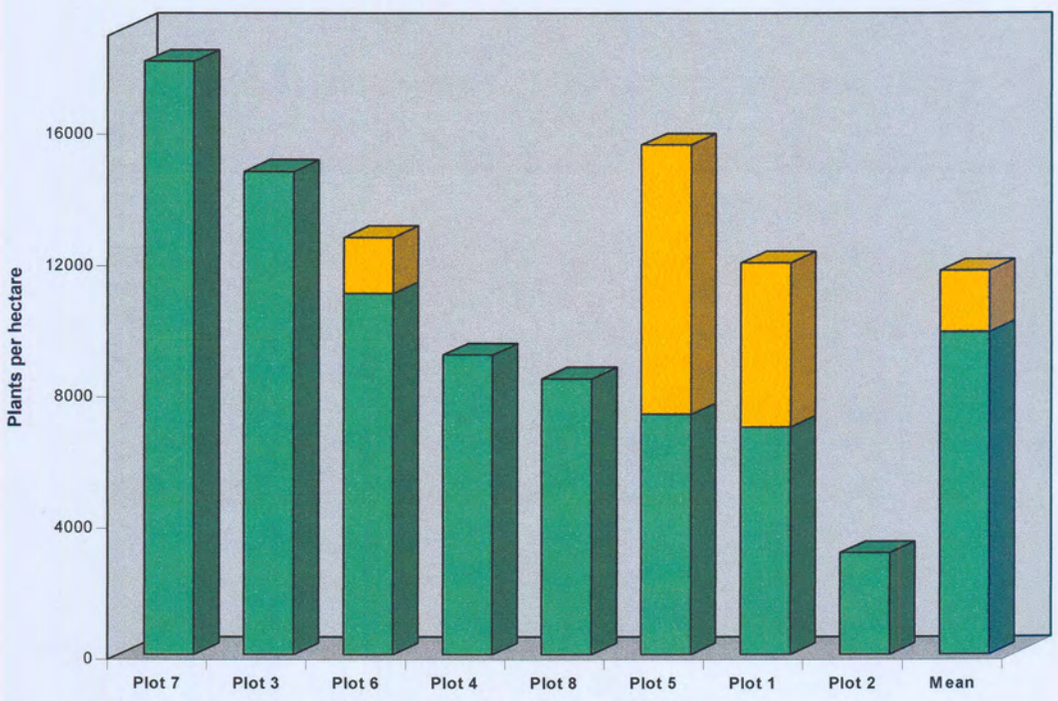

Figure 6.3: Number of plants per hectare over all height classes and vegetation types.

Key:

- Number of plants per hectare without *Commelina capitata*
- Number of *Commelina capitata* per hectare

Even though *Commelina capitata* (COMCAP) is not a woody species but a herb (Lind & Tallantire 1962, Langdale-Brown *et al.* 1964, Lind & Morrison 1974, Blundell 1982, Katende *et al.* 1999), it has been sampled and included under the former since it is very prevalent in three (plot 1, plot 5 & plot 6) of the eight sample plots and is one of the selected food species by Ngamba Island chimpanzees (Marshall, 2000). It increases the number of plants per hectare from 6 922 to 11 922 in plot 1, from 7 300 to 15 500 in plot 5 and from 11 000 to 12 700 in plot 6 (Figure 6.3). For all further calculations *Commelina capitata* is not considered, unless mentioned otherwise.

The mean density of the woody vegetation for the entire Ngamba Island is 9 820 individuals per hectare (Figure 6.3 & 6.4). The lowest densities are found in quadrat I, with 3 100 (plot 2) and 6 922 (plot 1) plants per hectare, respectively (Figure 6.3). Thus, the mean density is 5 011 plants per hectare for the whole of quadrat I, which is far below the mean for the whole island. The difference between the densities of the two plots is 3 822 plants per hectare.

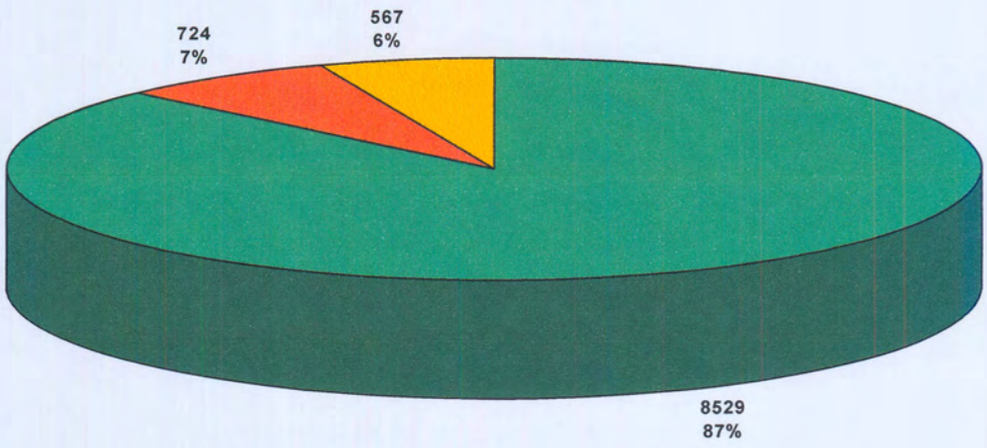

Figure 6.4: Percentage contribution of growth forms to overall density.

Key:

- Tree
- Sparse shrub
- Shrub

Although quadrat I thus has a low density of woody plants per hectare throughout, this density varies widely between areas. With 5 000 plants per hectare plot 1 has the second highest density of *Commelina capitata* (Figure 6.3).

Quadrat II has a mean density of 11 912.5 plants per hectare, with 14 700 (plot 3) and 9 125 (plot 4) plants per hectare, respectively. The difference between the two sample plots is 5 575 plants per hectare and thus varies quite markedly. The two sample plots have the second (plot 3) and fourth (plot 4) highest density of plants and their mean density lies well above the mean for Ngamba Island (Figure 6.3). There is no *Commelina capitata* in this quadrat.

Quadrat III has a mean density of 9 150 plants per hectare which compares well with the mean for the whole island, with 7 300 (plot 5) and 11 000 (plot 7) plants per hectare, respectively. The difference between plots is 3 700 plants per hectare and is thus the most homogenous of all the quadrats. Both plots in this quadrat contain *Commelina capitata* and with 8 200 plants per hectare in plot 5 also the highest number of this species per hectare (Figure 6.3).

Quadrat IV has the highest mean density with 13 218 plants per hectare and thus higher than the mean for the whole island. With 18 050 plants per hectare plot 7 has the highest density of all plots, while plot 8 with 8 386 plants per hectare has the fourth lowest density. The difference between the density in the two plots is 9 664 plants per hectare indicating the highest variation In density of plants per hectare in this quadrat (Figure 6.3).

Density of the different vegetation types

Figure 6.4 compares the mean density of the different growth forms on Ngamba Island. Trees are by far the most prominent growth form with 87% (8 529 plants per hectare), while "sparse shrubs" (individuals with two to four stems) follow with 7% (724 plants per hectare) and then "shrubs" (individuals with five or more stems) which only constitute 6% (567 plants per hectare) of the woody vegetation. This pattern varies slightly between the individual sample plots, although the general trend stays the same (Figure 6.4).

In two of the plots (plot 4 and plot 5) the order of "sparse shrubs" and "shrubs" is reversed and with 12.06% respectively 8.22% also markedly above the mean for "shrubs" per hectare

(Figure 6.5). In both of these plots the percentage of trees is slightly lower than the mean percentage per hectare (Figure 6.4 & 6.5).

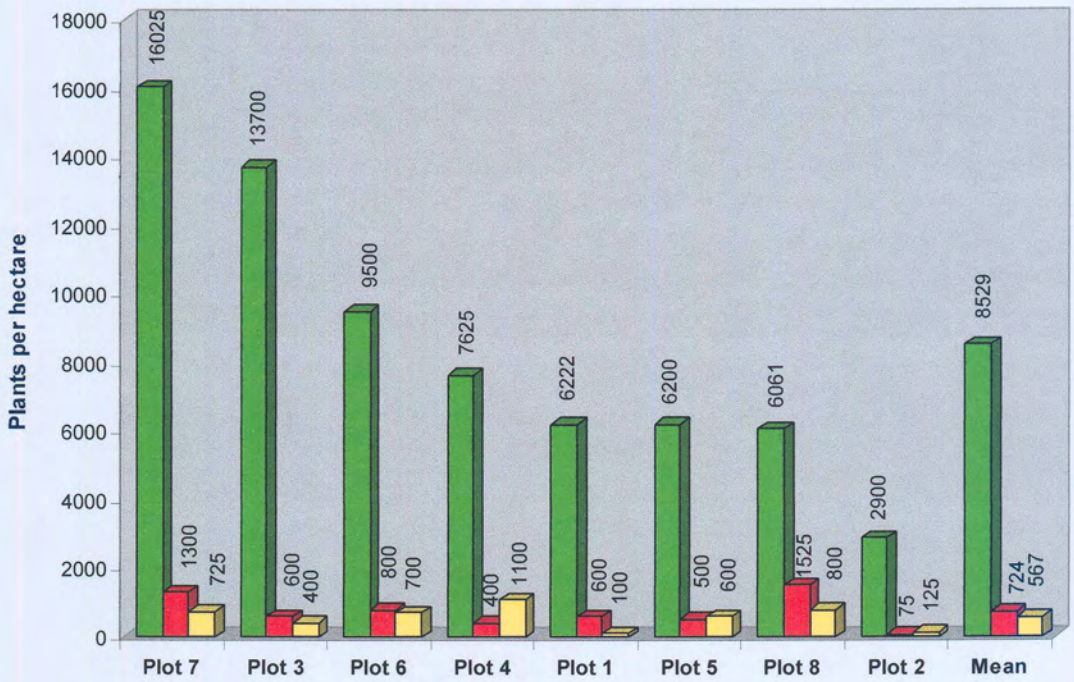

Figure 6.5: Plants per hectare according to growth form.

Key:

- Tree
- Sparse shrub
- Shrub

In plot 8 the shrub component is with 27.72% much higher than in the other sample plots.The percentage of shrubs is about 1.7 times higher than the mean percentage per hectare and the percentage of sparse shrubs about 2.5 times (Figure 6.4 & 6.5).

In contrast to that plot 2 shows a high prevalence of trees (93.55%), while sparse shrubs are hardly present and are with only 2.42% more than three times below the mean percentage per hectare. Similarly, even though shrubs are with 4.03% more prevalent than the former, they are still 1.74% below the mean percentage per hectare for the whole island (Figure 6.4 & 6.5).

Number of plant species

The mean number of different plant species (species richness) per sample plot is 11.63 (Figure 6.6). Plot 5 has the highest number of different species, namely 17, followed by plot 3 with 14 (Figure 6.6). The lowest number of different species occurs in plot 8 with 9, while the remaining five plots all have between ten and eleven different species (Figure 6.6).

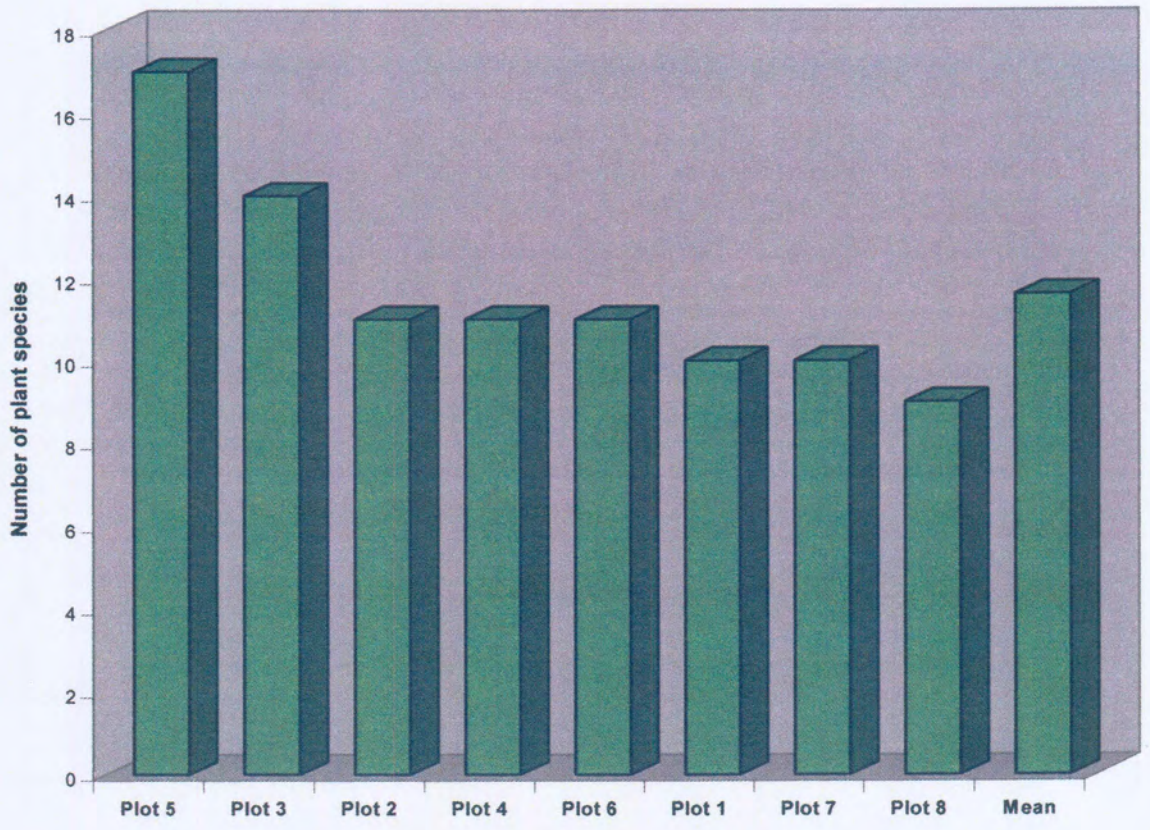

Figure 6.6: Species richness in each of the sample plots.

Key: Number of plant species

Braun-Blanquet classification

Using the Braun-Blanquet classification of the vegetation cover (see Chapter 5 – Analysis of data), the single woody species have been categorised as either *differential*, *indifferent* or *companion* species and the eight sample plots have then been combined according to their differential species (Table 6.3).

Table 6.3: *Braun-Blanquet classification of Ngamba Island woody vegetation and combination of plots according to their differential species*

	Community 1					Community 2		
Plot	3	4	8	2	1	6	7	5
Species	Braun-Blanquet Classification							
Differential species								
Tetrorchidium didymostemon	4	+	3	2A				
Galinera saxifraga	3	2A	1					
Ouratea hiernii		5		2A	1	+		
Macaranga monandra	2A	2B			2A			
Alchornea cordifolia			3	+	1			
Dracaena fragrans	1					2B	4	2A
Psychotria peduncularis						+	+	1
Commelina capitata					1	+		+
Peddiea fischeri						1	1	
Indifferent species								
Albizia gumnifera	2A	2B	2A	+	2A	+	2A	+
Guarea cedrata	3	1	2B	5	2B	5	2B	2A
Oxyanthus speciosus	2B		3	2B	5	4	+	2B
Aframomum angustifolium	2B		3		2A	2B	2B	+
Palisota mannii	+		1		+		2B	2A
Companion species								
Pachystela brevipes	1			+				5
Beilschmedia ugandensis		+						1
Dictyandra arborescens					2A			
Clitandra cymulosa				3				
Oxyanthus subpunctatus				1				
Ficus species 1				+				
Nephrolepis biserrata				+				
Canarium schweinfurthii	2A							
Unidentified species 1	2A							
Clitandra species 1	1							
Entandrophragma utile	+							
Ficus ovata		2A						
Coffea canephora		1						
Antiaris toxicara		+						
Trichilia species 1		+						
Eugenia capensis								2B
Rinorea brachipetala								1
Canthium species 1								+
Milettia dura								+
Psychotria mahonii								+
Psychotria species 1								+
Trilepsium madagascariense								+
Clerodendrum formicarum						1		
Palisota schweinfurthii						1		
Oxyanthus speciosus var. stenocarpus							2A	
Ficus species 2							+	
Ficus wildemanniana			1					

Two major plant communities could be established for the whole island (Table 6.3 & Figure 6.7). The first community has *Macaranga monandra*, *Alchornea cordifolia*, *Tetrorchidium didymostemon* and *Galinera saxifraga*, as differential species and contains five of the eight sample plots, namely plot 1, plot 2, plot 3, plot 4 and plot 8 (Figure 6.7). The second community has *Dracaena fragrans*, *Psychotria peduncularis*, *Commelina capitata* and *Peddiea fischeri* as differential species and contains the remaining three sample plots, namely plot 5, plot 6 and plot 7 (Table 6.3 & Figure 6.7). The following two communities can therefore be formed:

Community 1: ***Tetrorchidium didymostemon – Macaranga monandra moist evergreen forest***

Community 2: ***Dracaena fragrans – Psychotria peduncularis moist evergreen forest***

Figure 6.2 & 6.7 show the distribution of these plant communities throughout the island. Community 1 occupies, with 25.76 hectare, the larger central and western part of the island, while community 2 occupies, with 16.64 hectare, the remaining smaller and eastern part of the forest-covered island area; community 3 represents the grassland community and covers altogether an area of 1.89 hectare (Figure 6.2 & 6.7).

From observations during the study period it seems that the chimpanzees favour community 2, since they visit (and destroy the vegetation of) the eastern area of Ngamba Island much more frequently

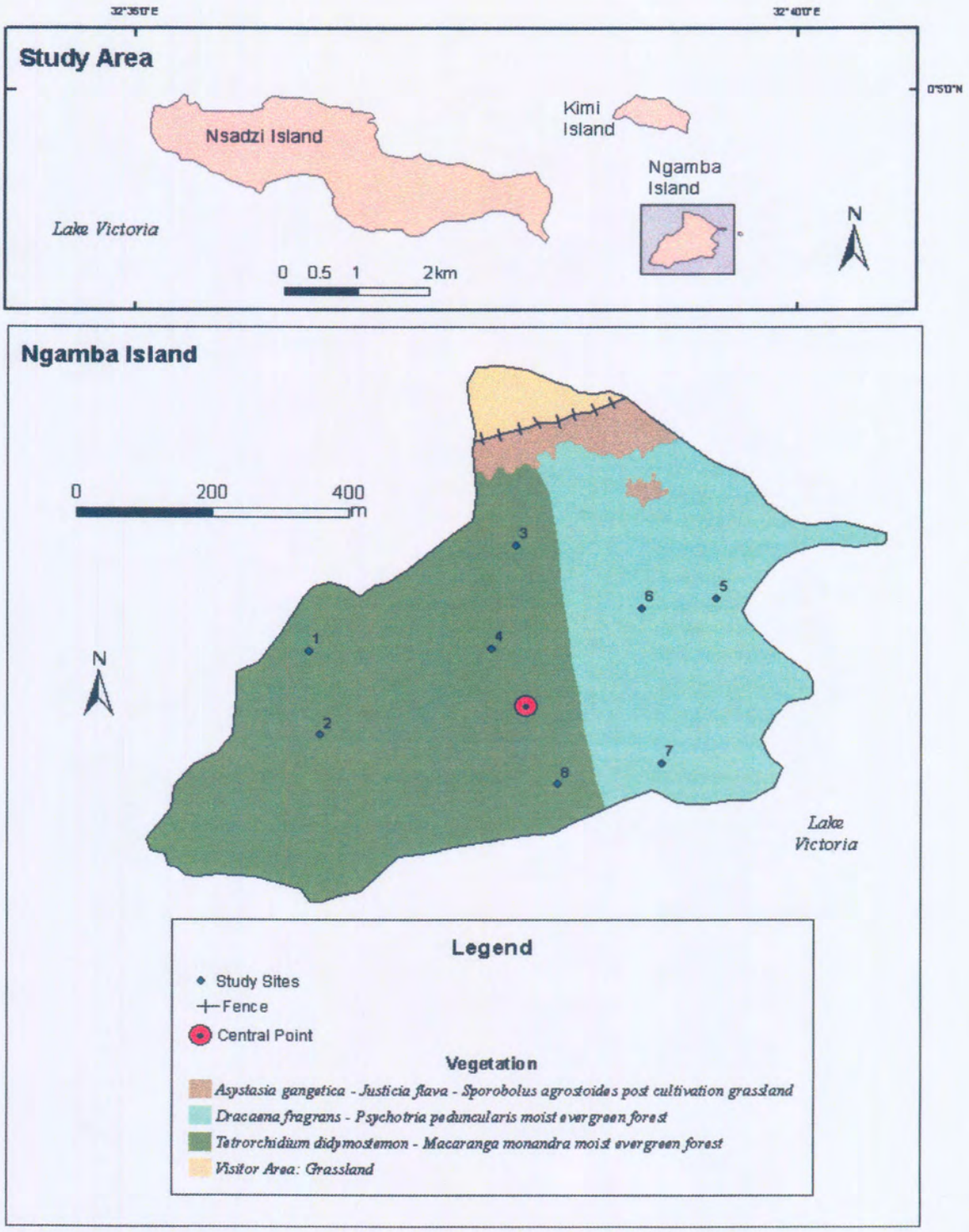

Figure 6.7: Braun-Blanquet classification of Ngamba Island Vegetation.

Density of plants per species and per hectare

Figures 6.8 – 6.11 indicate the mean density of woody species for the whole island. Since there are large differences in plant density, the species have been arranged in four different groups, namely (1) species with > 500 plants per hectare, (2) species with > 100 - 500 plants per hectare, (3) species with > 20 - 100 plants per hectare and (4) species with 1 - 20 plants per hectare (Figures 6.8 – 6.11).

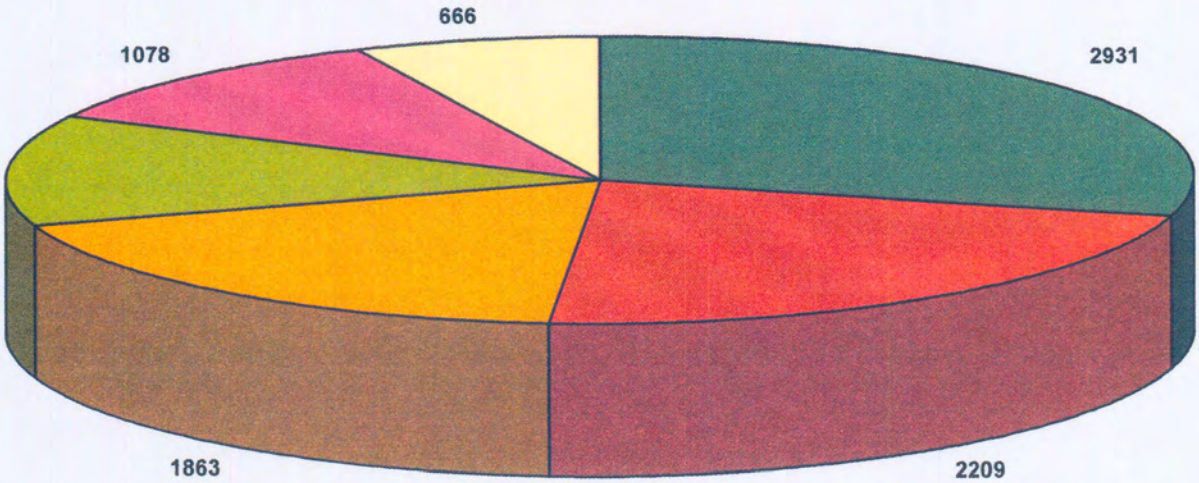

Figure 6.8: Mean density (plants per hectare) for species with > 500 plants per hectare.

Key:

- *Aframomum angustifolium*
- *Dracaena fragrans*
- *Commelina capitata*
- *Albizia gumnifera*
- *Guarea cedrata*
- *Oxyanthus speciosus*

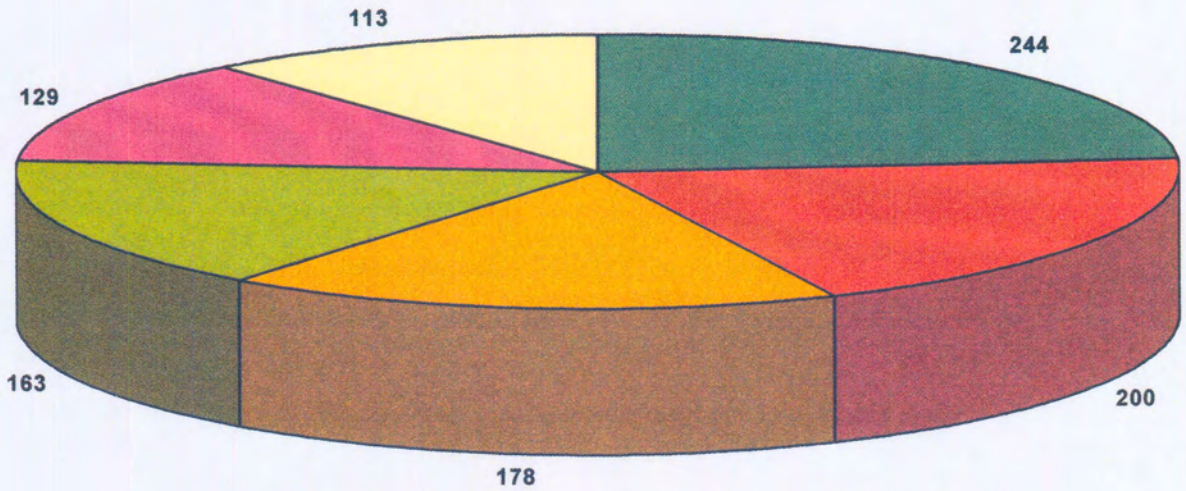

Figure 6.9: Mean density (plants per hectare) for species with > 100 - 500 plants per hectare.

Key:

- *Ouratea hiernii*
- *Palisota mannii*
- *Galinera saxifraga*
- *Pachystela brevipes*
- *Tetrorchidium didymostemon*
- *Dictyandra arborescens*

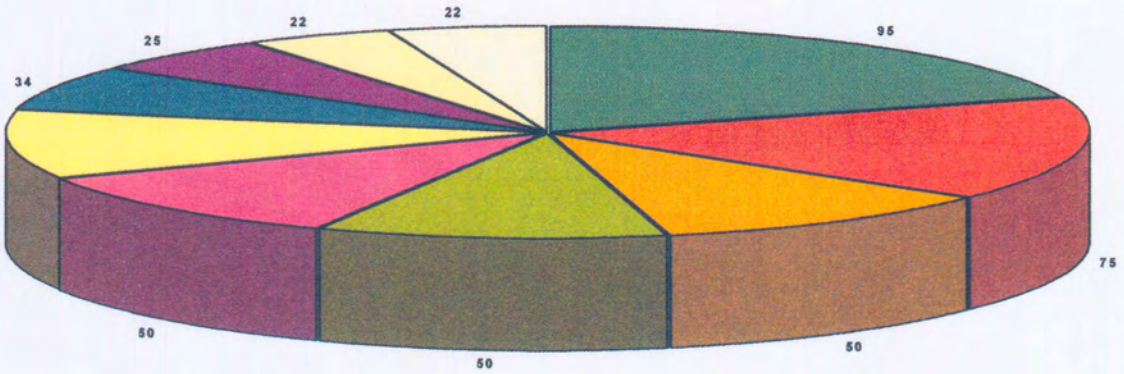

Figure 6.10: Mean density (plants per hectare) for species with > 20 - 100 plants per hectare.

Key:

- *Alchornea cordifolia*
- *Ficus ovata*
- *Macaranga monandra*
- *Coffea canephora*
- *Eugenia capensis*
- *Palisota schweinfurthii*
- *Psychotria peduncularis*
- *Canthium species 1*
- *Beilschmedia ugandensis*
- *Peddiea fischeri*

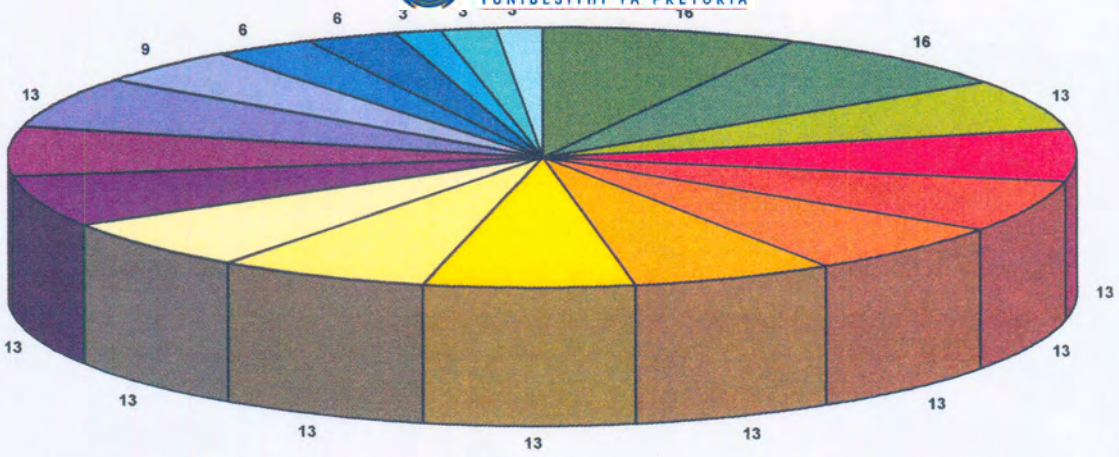

Figure 6.11: Mean density (plants per hectare) for species with 1 - 20 plants per hectare.

- *Ficus species 1*
- *Nephrolepis biserrata*
- *Oxyanthus subpunctatus*
- *Canarium schweinfurthii*
- *Clitandra species 1*
- *Entandrophragma utile*
- *Antiaris toxicara*
- *Trilepsium species 1*
- *Millettia dura*
- *Psychotria species 1*
- *Clerodendrum formicarum*
- *Ficus species 2*
- *Oxyanthus speciosus var. stenocarpus*
- *Rinorea brachypetala*
- *"Unidentified species"*
- *Ficus wildemanniana*
- *Clitandra cymulosa*
- *Psychotria mahonii*
- *Trilepsium madagascariense*

There are only six different species in the first group, namely *Aframomum angustifolium*, *Dracaena fragrans*, *Commelina capitata*, *Albizia* gumnifera, *Guarea cedrata* and *Oxyanthus speciosus* (Figure 6.8). Only three of those species, namely *Albizia gumnifera* (1 238 plants per hectare), *Guarea cedrata* (1 078 plants per hectare) and *Oxyanthus speciosus* (666 plants per hectare) are "real" tree species. All three of those species have been classified as *'indifferent species'* in the Braun-Blanquet classification (Table 6.3). They are prevalent to different degrees in all eight sample plots (*Oxyanthus speciosus* only in seven) and hence seem to be distributed ubiquitously throughout the whole island (Table 6.3). They also constitute known food species for the Ngamba Island chimpanzees (Table 6.4).

Table 6.4: *Number of plants per hectare of known Ngamba Island chimpanzees' plant food species*

Species	Plot								Mean
	1	2	3	4	5	6	7	8	
Aframomum angustifolium	2 700		5 700	425	100	3 700	5 200	6 100	2 991
Dracaena fragrans			200		2 300	4 100	11 075		2 209
Commelina capitata	5 000				8 200	1 700			1 863
Albizia gumnifera	133	5 825	2 300		50	100	50	1 022	1 185
Guarea cedrata	344	225	3 350	1 150	1 075	1 700	650	133	1 078
Oxyanthus speciosus	2 333		75	575	1 250	600	300	297	679
Pachystela brevipes			300	100	900				163
Tetrorchidium didymostemon		100	800	100				33	129
Ficus species		125		600			100	50	109
Dictyandra arborescens	900								113
Canthium species 1					100				13
*Culcasia falcifolia**	+	+			+				+
Total	11 410	6 750	12 725	2 475	13 975	11 900	17 375	7 635	10 531

- In this study only the presence (+) or absence of the creeper *Culcasia falcifolia* in a sample plot has been determined.

Aframomum angustifolium (2 931 plants per hectare) has the highest mean density of all plants (Figure 6.8). This underlines the role it plays as a food source for the Ngamba Island chimpanzees (Table 6.10). The same is true for the next two most prominent plants, namely *Dracaena fragrans* (2 209 plants per hectare) and *Commelina capitata* (1 863 plants per hectare) (Table 6.4). Furthermore, all six plant species with the highest mean density per hectare are known potential food species for the Ngamba Island chimpanzees (Marshal 2000).

Six plant species are also represented in the second group, namely *Ouratea hiernii* (244 plants per hectare), *Palisota mannii* (200 plants per hectare), *Galinera saxifraga* (178 plants per hectare), *Pachystela brevipes* (163 plants per hectare), *Tetrorchidium didymostemon* (129 plants per hectare) and *Dictyandra arborescens* (113 plants per hectare) (Figure 6.9). Of those, three are known to be potential food species for Ngamba Island chimpanzees, namely *Pachystela brevipes*, *Tetrorchidium didymostemon* and *Dictyandra arborescens* (Table 6.4) (Marshall 2000). One of these species - namely *Tetrorchidium didymostemon* - has been classified as a *'differential species'* according to the Braun-Blanquet classification (Table 6.3). The other two, *Pachystela brevipes* and *Dictyandra arborescens*, have been classified as *'companion species'* and have a very localized distribution throughout the island, only appearing in three or one sample plot respectively (Table 6.3). Altogether, 75% (9 out of 12) of the known food species of Ngamba Island chimpanzees are represented in the two high density categories of woody plant species (Figure 6.8 & 6.9 & Table 6.4).

Ten species are prevalent in the third group (Figure 6.10). The most prominent species here is *Alchornea cordifolia* with 95 plants per hectare, followed by *Ficus ovata* with 75 plants per hectare (Figure 6.10). Four species are still prominent in this category with 50 plants per hectare, namely *Macaranga monandra*, *Coffea canephora*, *Eugenia capensis* and *Palisota schweinfurthii* (Figure 6.10). The remaining four species, namely *Psychotria peduncularis*, *Canthium sp.1*, *Beilschmedia ugandensis* and *Peddiea fischeri*, all have less than 40 plants per hectare (Figure 6.10). Only *Ficus ovata* and *Canthium sp.1* are known food species of the Ngamba Island chimpanzees (Figure 10 & Table 6.4) (Marshall 2000).

The largest number of species (19) is found in the fourth group (Figure 6.11). The main representatives here are *Ficus sp.1* and *Nephrolepis biserrata* (both with 16 plants per hectare), while 11 species have a mean density of 13 species per hectare each (Figure 6.11). Those are *Oxyanthus subpunctatus*, *Canarium schweinfurthii*, *Clitandra sp.1*,

Entandrophragma utile, *Antiaris toxicara*, *Trichilia sp.1*, *Millettia dura*, *Psychotria sp.1*, *Clerodendrum formicarum*, *Ficus sp.2* and *Oxyanthus speciosus var. stenocarpus* (Figure 6.11). The remaining six species all have mean densities below 10 plants per hectare (Figure 6.11). The three remaining *Ficus spp.* are part of this last density group (Figure 6.11). All four *Ficus spp.*, namely *Ficus ovata*, *Ficus wildemanniana*, *Ficus sp.1* and *Ficus sp.2*, are collectively called *Ficus spp.* when referring to them as food species for the Ngamba island chimpanzees (Table 6.4).

Density according to height classes and growth form

Trees in all eight sample plots have representatives in each of the six investigated height classes (Table 6.5 - 6.8). Sparse shrub and shrubs are absent in the > 6.0 m height class.

Table 6.5: *Density (plants per hectare) of woody vegetation according to height class and growth form in quadrat I*

Height class	Quadrat I / Plot 1				Quadrat I / Plot 2				Mean Total
	Total	Tree	Sparse shrub	Shrub	Total	Tree	Sparse shrub	Shrub	
> 6 m	122	122			250	250			186
4 – 5 m	1 100	800	300		250	250			675
3 m	1 300	1 200	100		325	325			813
2 m	2 000	1 900	100		600	600			1 300
1 m	1 600	1 600			1 000	1 000			1 300
0.5 m	800	600	100	100	675	475	75	125	737
Total	6 922	6 222	600	100	3 100	2 900	75	125	5 011

Table 6.6: *Density (plants per hectare) of woody vegetation according to height class and growth form in quadrat II*

Height class	Quadrat II / Plot 3				Quadrat II / Plot 4				Mean Total
	Total	Tree	Sparse shrub	Shrub	Total	Tree	Sparse shrub	Shrub	
> 6 m	200	200			125	125			163
4 – 5 m	2 100	2 100			1 200	1 200			1 650
3 m	2 600	2 400	200		2 200	2 100	100		2 400
2 m	3 200	3 000	100	100	2 900	1 700	100	1 100	3 050
1 m	3 800	3 700	100		1 300	1 100	200		2 550
0.5 m	2 800	2 300	200	300	1 400	1 400			2 100
Total	14 700	13 700	600	400	9 125	7 625	400	1 100	11 913

Table 6.7: *Density (plants per hectare) of woody vegetation according to height class and growth form in quadrat III*

Height class	Quadrat III / Plot 5				Quadrat III / Plot 6				Mean Total
	Total	Tree	Sparse shrub	Shrub	Total	Tree	Sparse shrub	Shrub	
> 6 m	700	700			500	500			600
4 – 5 m	275	275			1 000	900	100		638
3 m	700	700			1 800	1 400	200	200	1 250
2 m	925	825	100		1 400	1 100	300		1 162
1 m	1 800	1 400	200	200	3 400	3 100	200	100	2 600
0.5 m	2 900	2 300	200	400	2 900	2 500		400	2 900
Total	7 300	6 200	500	600	11 000	9 500	800	700	9 150

Table 6.8: *Density (plants per hectare) of woody vegetation according to height class and growth form in quadrat IV*

Height class	Quadrat IV / Plot 7				Quadrat IV / Plot 8				Mean Total
	Total	Tree	Sparse shrub	Shrub	Total	Tree	Sparse shrub	Shrub	
> 6 m	425	425			111	111			268
4 – 5 m	425	300		125	375	350	25		400
3 m	600	200	300	100	1 800	800	500	500	1 200
2 m	2 800	2 400	400		3 100	2 100	900	100	2 950
1 m	3 600	3 200	400		1 900	1700	100	100	2 750
0.5 m	10 200	9 500	200	500	1 100	1000		100	5 650
Total	18 050	16 025	1 300	725	8 386	6 061	1 525	800	13 218

Quadrat I

Quadrat I has the lowest incidence of shrubs of all quadrats. Furthermore, these shrubs only occur in the lowest height class of 0.50 m and they are made up solely of *Palisota mannii* (PALMAN) in plot 1 and of *Nephrolepis biserrata* (NEPBIS) in plot 2, respectively (Table 6.5 & Figure 6.12 & 6.13).

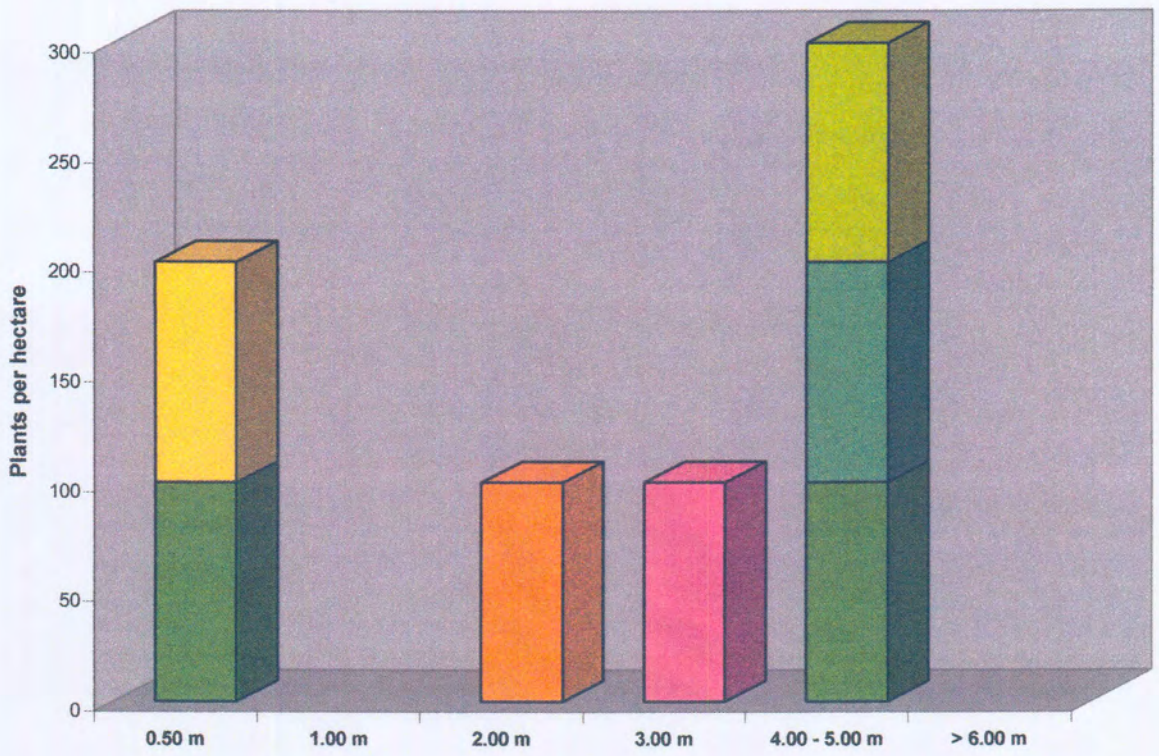

Figure 6.12: Density (plants per hectare) of sparse shrub (full colour) and shrub (chequered colour) according to height class and species in plot 1.

Key:

- *Palisota mannii*
- *Ouratea hiernii*
- *Aframomum angustifolium*
- *Macaranga monandra*
- *Dictyandra arborescens*
- *Oxyanthus speciosus*

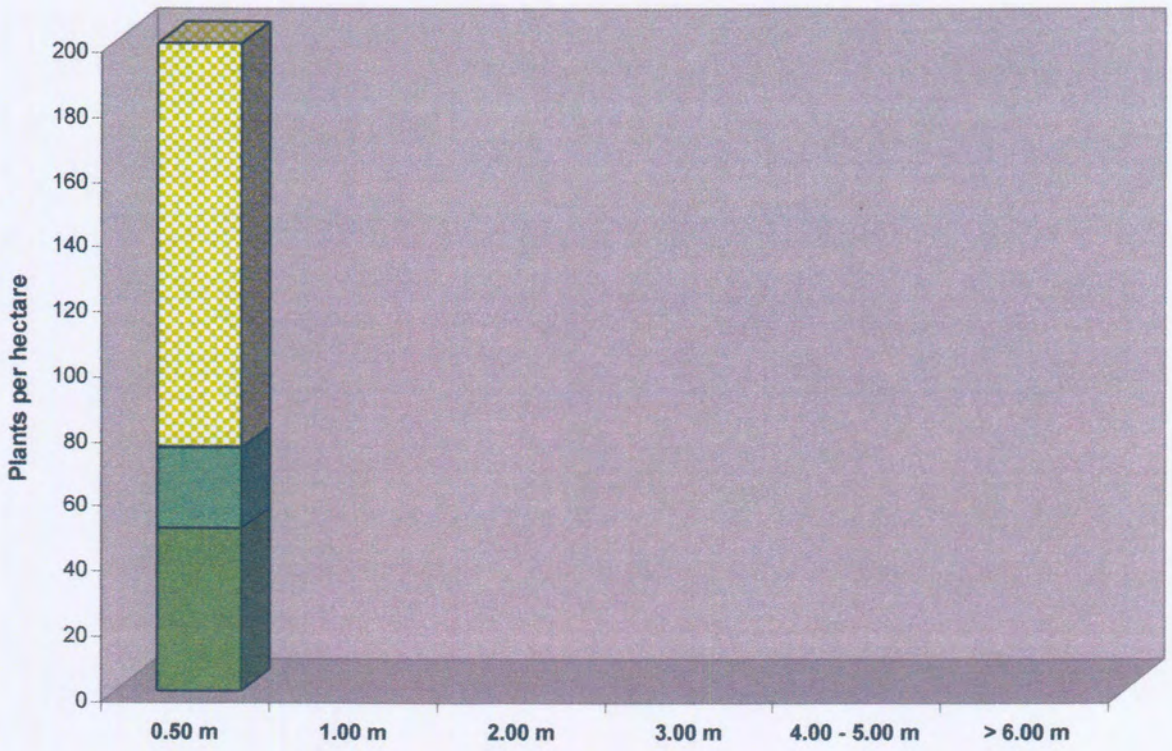

Figure 6.13: Density (plants per hectare) of sparse shrub (full colour) and shrub (chequered colour) according to height class and species in plot 2.

Key:

Nephrolepis biserrata
Oxyanthus speciosus
Ouratea hiernii

The sparse shrubs form of *Ouratea hiernii* appears in three height classes (2.0 m, 3.0 m & 4.0 – 5.0 m) in plot 1 and in one height class (0.5 m) in plot 2, which has no sparse shrubs in any other height class. While *Oxyanthus speciosus* appears in both plots, plot 1 additionally contains sparse shrubs of *Aframomum angustifolium*, *Macaranga monandra* and *Dictyandra arborescens* (Table 6.5 & Figure 6.12 & 6.13).

The most widely distributed tree species in plot 1 is *Oxyanthus speciosus* with representatives in all six height classes (Figure 6.14). While *Aframomum angustifolium* is the most prominent species in the three lowest height classes, *Oxyanthus speciosus* is the species with the highest prevalence in the three tallest height classes (Figure 6.14). The number of plants per hectare increases about threefold from the 0.5 m height class, over the 1.0 m height class to the 2.0 m height class (from 600 plants per hectare to 1 900 plants per hectare) (Table 6.5 & Figure 6.14). It decreases again stepwise about 15-fold towards the > 6.0 m height class (from 1 900 plants per hectare to 122 plants per hectare) (Table 6.5 & Figure 6.14). This plot contains seven different tree species with the highest number of species, namely five, in the 4.0 – 5.0 m height class, followed by four different species in the > 6.0 m height class (Table 6.5 & Figure 6.14).

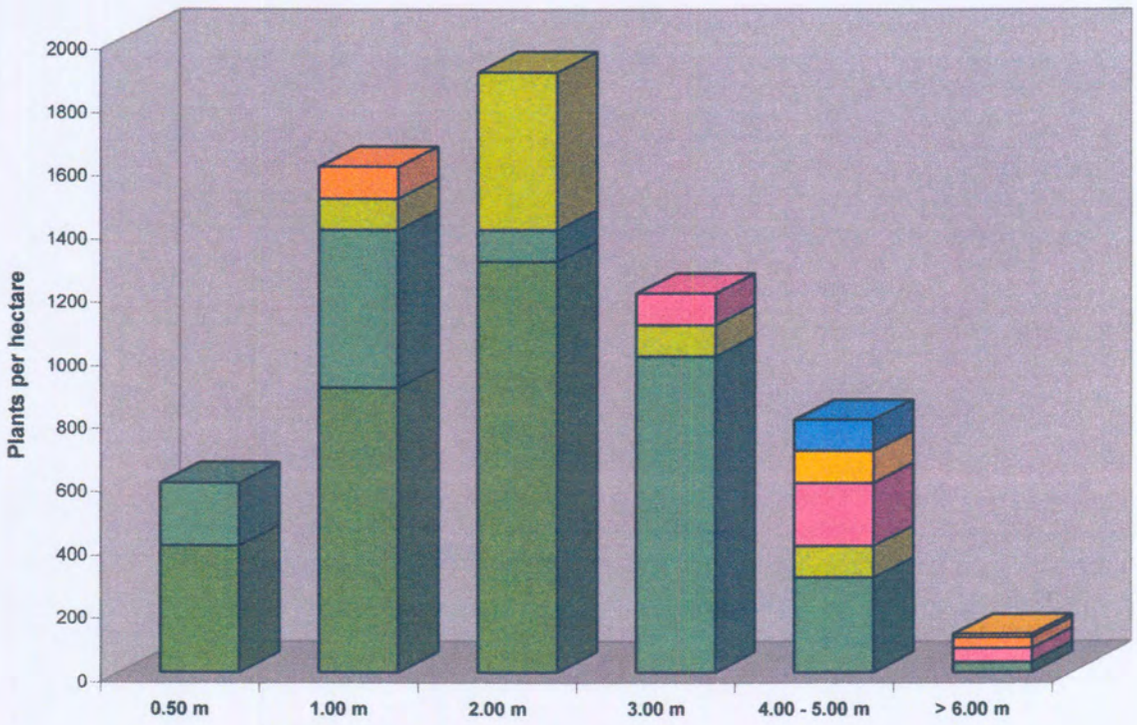

Figure 6.14: Density of trees (plants per hectare) according to height class and species in plot 1.

Key:

- *Macaranga monandra*
- *Alchornea cordifolia*
- *Albizia gumnifera*
- *Guarea cedrata*
- *Dictyandra arborescens*
- *Oxyanthus speciosus*
- *Aframomum angustifolium*

The most widely distributed species in this plot with representatives in all six height classes of the tree category as well as in two of the sparse shrub classes is *Oxyanthus speciosus* with 2 333 plants per hectare (Figure 6.12 – 6.14); while *Aframomum angustifolium* is with 2 600 plants per hectare the most prominent species (Figure 6.12- 6.14).

Altogether ten different tree species are present in plot 2, with the 1.0 m height class showing the highest density per hectare (1 000 plants) (Figure 6.15). The second highest, but 40% lower density of trees is in the 2.0 m height class with 600 plants per hectare. The three tallest height classes all have about half of this plant density per hectare, while the 0.5 m height class lies in between (475 plants per hectare) (Table 6.5 & Figure 6.15). The highest number of different species, namely five, occurs in the 0.5 m height class. The number of species decreases towards the taller height classes with four different species each in the next four height classes and three different species each in the two tallest height classes (Table 6.5 & Figure 6.15).

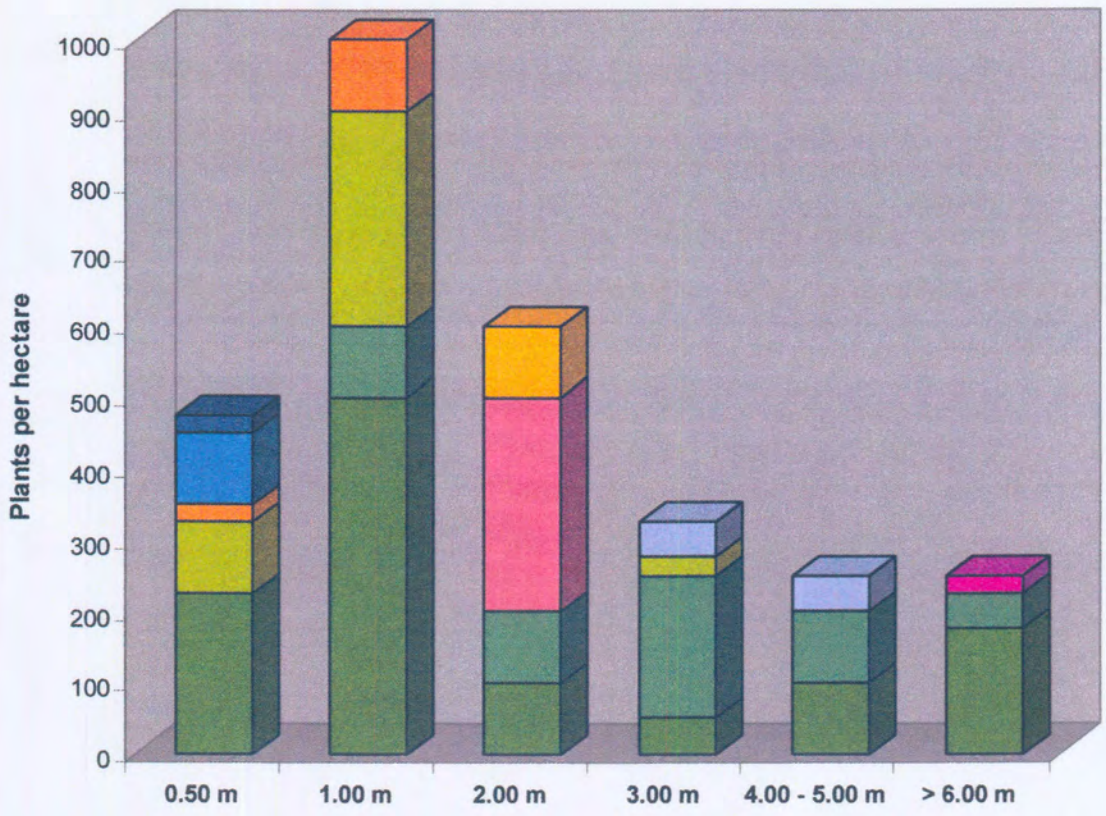

Figure 6.16: Density of trees (plants per hectare) according to height class and species in plot 2.

Key:

- *Clitandra cymulosa*
- *Alchornea cordifolia*
- *Tetrorchidium didymostemon*
- *Pachystela brevipes*
- *Oxyanthus subpunctatus*
- *Ficus species 1*
- *Ouratea hiernii*
- *Albizia gumnifera*
- *Oxyanthus speciosus*
- *Guarea cedrata*

Although *Guarea cedrata* does not contribute to any of the shrub growth forms, it is the most wide spread species with representatives in all six height classes, followed by *Oxyanthus speciosus* with representatives in all but the 0.5 m height class (Figure 6.12, 6.13 & 6.15).

Figure 6.16 summarises the mean number of plants per hectare over all species present, including dead plants, for quadrat I. Species that occur in both sample plots are indicated in a lighter green. Overall, 15 different species occur in quadrat 1 (Figure 6.16). The most prominent species of which is *Oxyanthus speciosus* with a mean of 1 454 plants per hectare. This species is also prevalent in both sample plots and is quite evenly distributed throughout this quadrat. The second most prominent species is *Aframomum angustifolium* with 1 350 plants per hectare. Since this species is only present in plot 1 its distribution throughout quadrat I is patchier. *Guarea cedrata*, as the third most prominent species with 747 plants per hectare, is again prevalent in both sample plots and thus also more evenly distributed in this quadrat. Although *Dictyandra arborescens* is found only in plot 1 it is still the fifth most prominent species with 450 plants per hectare. *Albizia gumnifera* and *Ouratea hiernii* are again prevalent in both sample plots and contribute a mean of 279 and 225 plants per hectare, respectively. The remaining nine species have mean densities of 100 or below plants per hectare and of those only *Alchornea cordifolia* is present in both sample plots. The "Standing dead" (XXXXXX) and "Fallen dead" (YYYYYY) plants account for two and 23 plants per hectare respectively (Figure 6.16).

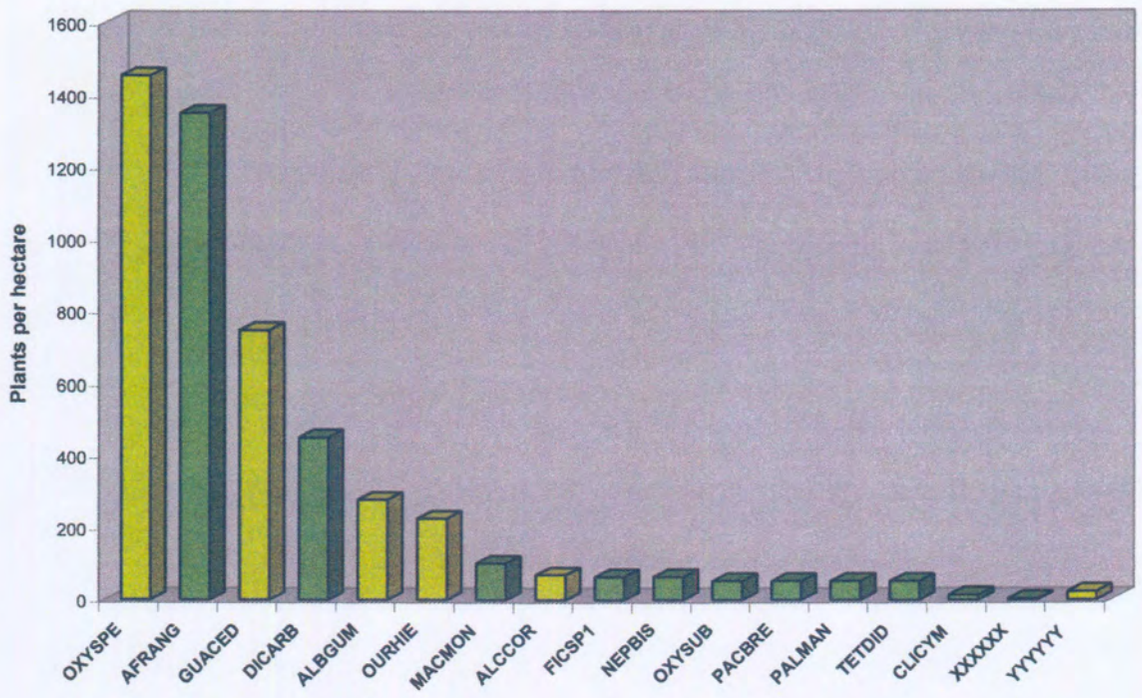

Figure 6.16: Mean density (plants per hectare) per species in quadrat I.

Key:			
	OXYSPE	=	*Oxyanthus speciosus*
	AFRANG	=	*Aframomum angustifolium*
	GUACED	=	*Guarea cedrata*
	DICARB	=	*Dictyandra arborescens*
	ALBGUM	=	*Albizia gumnifera*
	OURHIE	=	*Ouratea hiernii*
	MACMON	=	*Macaranga monandra*
	ALCCOR	=	*Alchornea cordifolia*
	FICSP1	=	*Ficus species 1*
	NEPBIS	=	*Nephrolepis biserrata*
	OXYSUB	=	*Oxyanthus subpunctatus*
	PACBRE	=	*Pachystela brevipes*
	PALMAN	=	*Palisota mannii*
	TETDID	=	*Tetrorchidium didymostemon*
	CLICYM	=	*Clitandra cymulosa*
	XXXXXX	=	Standing dead trees
	YYYYYY	=	Fallen dead trees
		=	Plant species present in both sample plots
		=	Plant species only present in one sample plot

Quadrat II

Quadrat II has shrubs only in two different height classes and each of the height classes is made up of only one species, namely *Palisota mannii* (PALMAN) in the 0.5 m height class of plot 3 (300 plants per hectare); and in the 2.0 m height class of plot 3 and plot 4 *Galinera saxifraga*, (GALSAX) (100 plants per hectare) and *Ouratea hiernii* (1 100 plants per hectare) (Figure 6.17 & 6.18). The mean number of shrubs per hectare for this quadrat is 750 and hence lies about 1.3 times above the mean density for this growth form for all sample plots (Table 6.5 – 6.8 & Figure 6.5). Nearly 75% of this number is contributed by the high density of *Ouratea hiernii* in plot 4 (Figure 6.18).

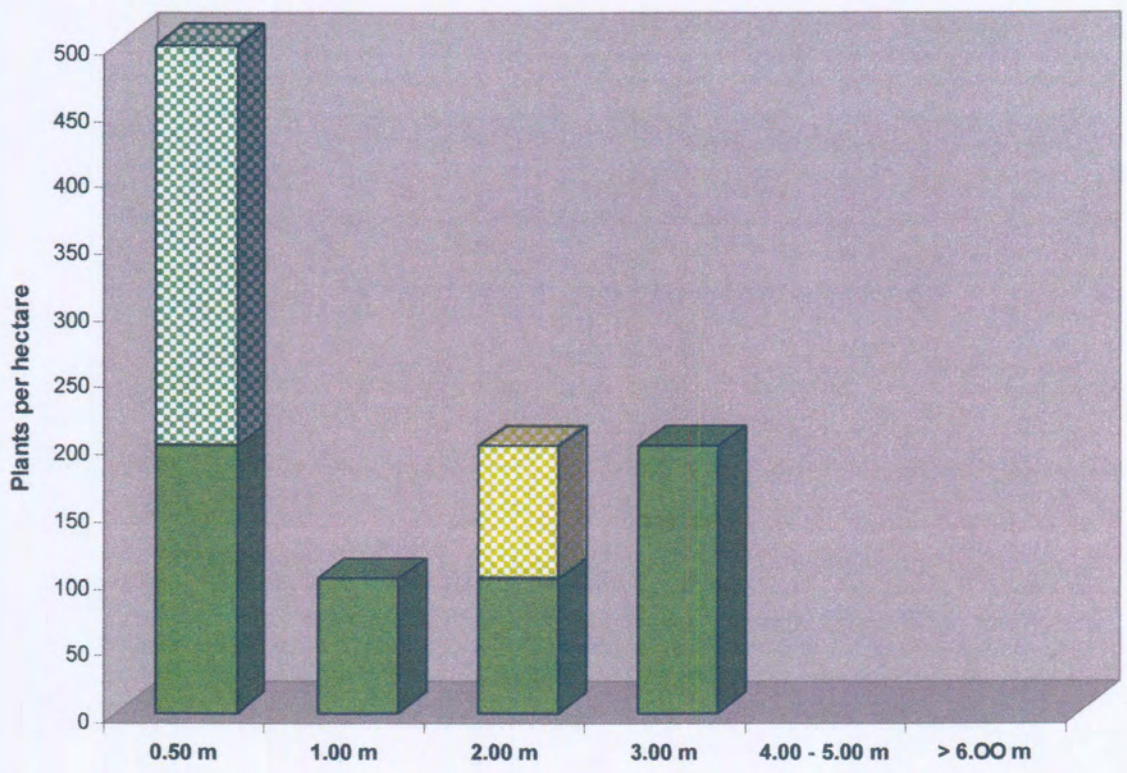

Figure 6.17: Density (plants per hectare) of sparse shrub (full colour) and shrub (chequered colour) according to height class and species in plot 3.

Key:

Galinera saxifraga
Palisota mannii
Aframomum angustifolium

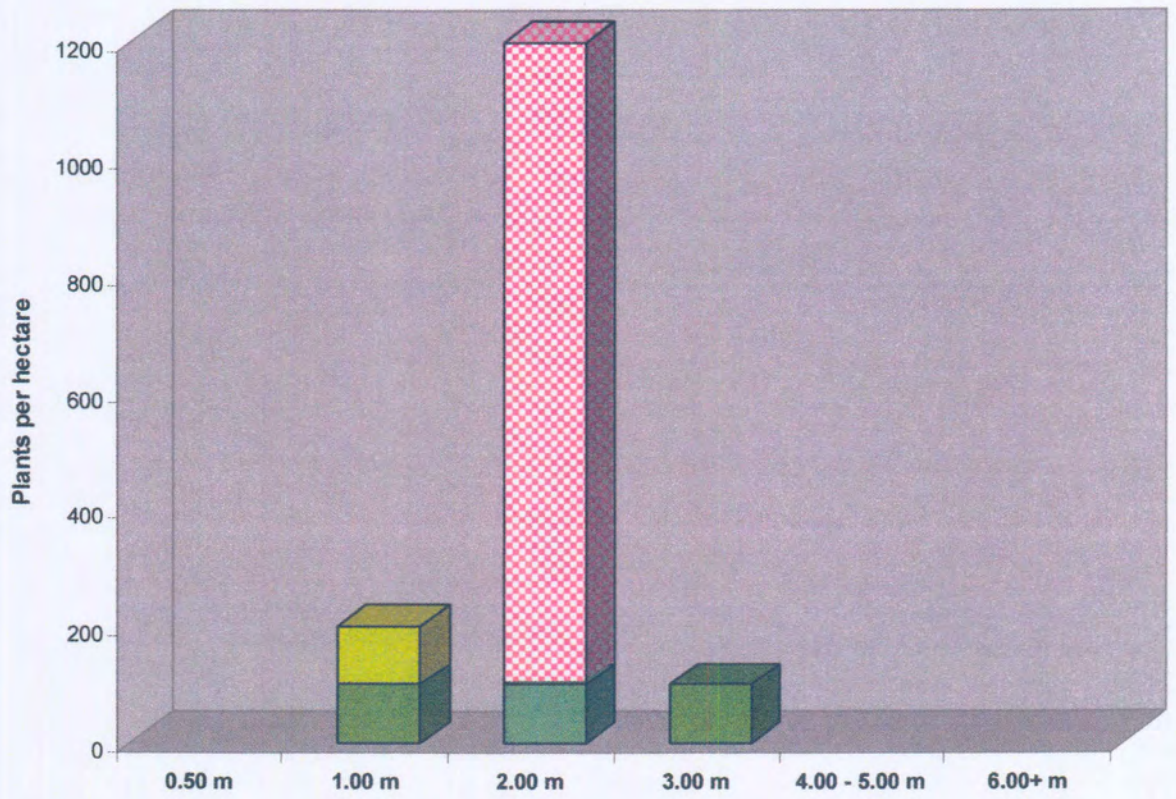

Figure 6.18: Density (plants per hectare) of sparse shrub (full colour) and shrub (chequered colour) according to height class and species in plot 4.

Ouratea hiernii
Albizia gumnifera
Antiaris toxicara
Coffea canephora

Sparse shrubs are distributed over the first four height classes in this quadrat (Table 6.6). In plot 3 all these height classes contain only representatives of *Aframomum angustifolium*, namely 200 plants per hectare in the 0.5 m and the 3.0 m height class, respectively, and in the 1.0 m and 2.0 m height classes 100 plants per hectare each (Table 6.6 & Figure 6.17). In plot 4 this growth form has no representatives in the 0.5 m height class (Table 6.6). *Albizia gumnifera* and *Coffea canephora* (COFCAN) are represented in the 1.0 m height class (Figure 6.18), while *Antiaris toxicara* and *Coffea canephora* (100 plants per hectare each) are represented in the 2.0 m and 3.0 m height class, respectively (Figure 6.18).

With 13 700 plants per hectare plot 3 contains the second highest density of trees of all eight sample plots (Table 6.5 – 6.8). *Aframomum angustifolium* (5 100 plants per hectare) is the most prominent tree in this plot, followed by *Guarea cedrata* (3 500 plants per hectare) and *Albizia gumnifera* (2 300 plants per hectare) (Figure 6.19). It also has the second highest number of different tree species, namely 13, of all eight sample plots (Figure 6.14, 6.15, 6.19, 6.20, 6.24, 6.25, 6.29 & 6.30). Like in plot 2 the highest density of plants per hectare is in the 1.00 m height class (3 700 plants per hectare) with a steady decline over the next three taller height classes (to 2 100 plants per hectare in the 4.0 – 5.0 m height class), followed by a more than tenfold decline to the > 6.0 m height class (from 2 100 to 200 plants per hectare) (Table 6.6 & Figure 6.19). The lowest number of different tree species is in the 0.5 m height class, namely three, followed by the > 6.0 m height class with four different tree species, while all other height classes have either six or seven different tree species (Figure 6.19).

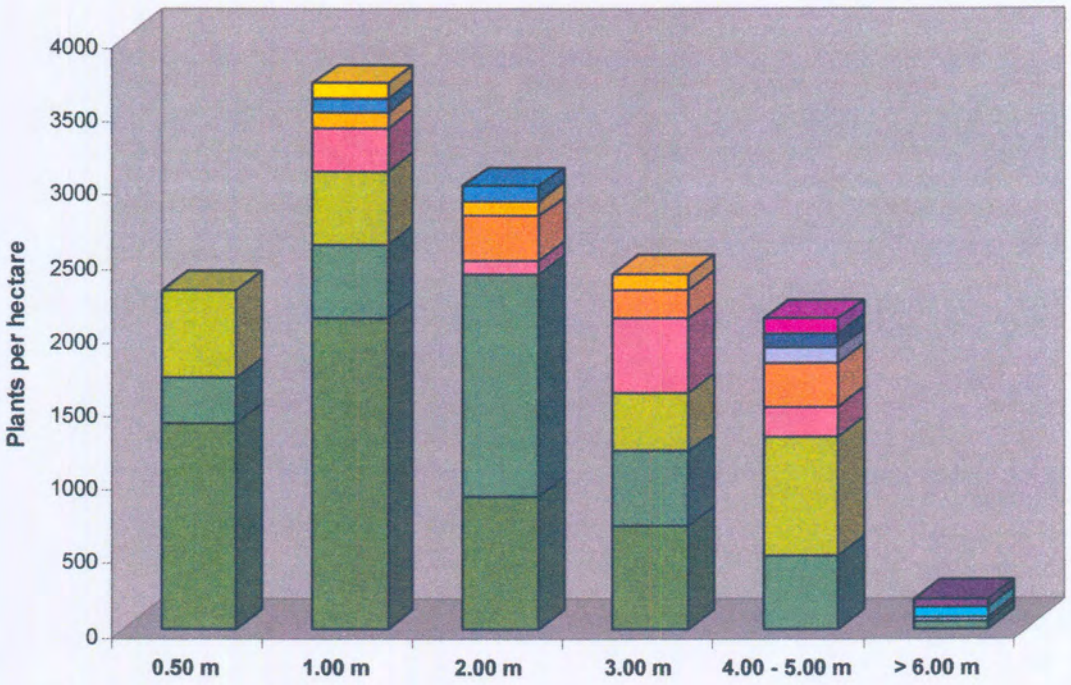

Figure 6.19: Density of trees (plants per hecatre) according to height class and species in plot 3.

- "Unidentified species"
- *Oxyanthus speciosus*
- *Entandrophragma utile*
- *Clitandra species 1*
- *Canarium schweinfurthii*
- *Macaranga monandra*
- *Dracaena fragrans*
- *Pachystela brevipes*
- *Tetrorchidium didymostemon*
- *Galinera saxifraga*
- *Albizia gumnifera*
- *Guarea cedrata*
- *Aframomum angustifolium*

With 7 625 trees per hectare plot 4 lies below the mean number of 8 529 trees per hectare for the whole island and has only the fifth highest density of trees per hectare of the eight sample plots (Table 6.5 -6.8 & Figure 6.5). With ten different tree species this plot has also a species richness below the average of all sample plots (Figure 6.14, 6.15, 6.19, 6.20, 6.24, 6.25, 6.29 & 6.30). With 5 725 plants per hectare *Albizia gumnifera* is the most prominent representative of this growth form and it has representatives in all six height classes (Figure 6.20). *Ficus ovata* (FICOVA) follows far behind with 600 plants per hectare as second most prominent species (Figure 6.20). While *Ouratea hiernii*, *Guarea cedrata*, *Galinera saxifraga* and *Coffea canephora* follow suit with 300, 225, 200 and again 200 plants per hectare each, respectively (Figure 6.20). The remaining four species have between 75 - 100 plants per hectare in this growth form (Figure 6.20). The 3.0 m height class with 2 100 plants per hectare has the highest density of trees, while all other height classes have densities of between 1 000 to 1 700 plants per hectare (Table 6.6 & Figure 6.20). Only the > 6.0 m height class has a more than tenfold lower density with only 125 plants per hectare (Table 6.6 & Figure 6.20). The highest number of different species can be found in the 2.0 m height class, namely five (Figure 6.20).

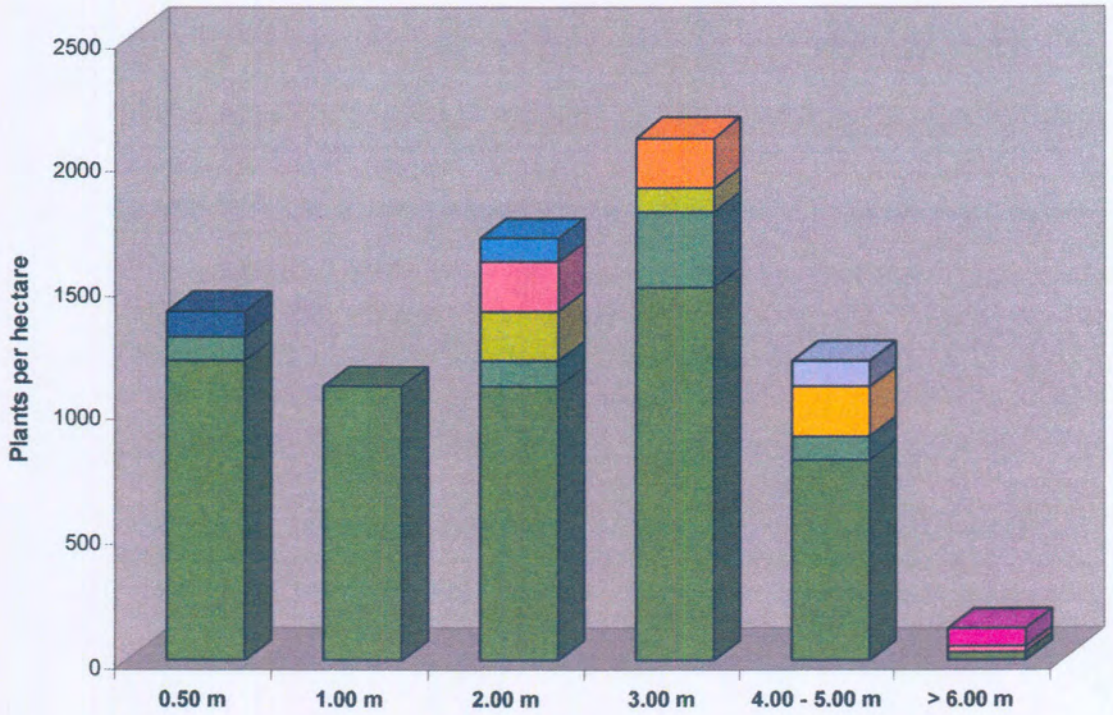

Figure 6.20: Density of trees (plants per hectare) according to height class and species in plot 4.

Key:

- *Macaranga monandra*
- *Trichilia species 1*
- *Tetrorchidium didymostemon*
- *Beilschmedia ugandensis*
- *Galinera saxifraga*
- *Coffea canephora*
- *Guarea cedrata*
- *Ouratea hiernii*
- *Ficus ovata*
- *Albizia gumnifera*

Figure 6.21 summarises the mean number of plants per hectare over all species present, including dead plants, for quadrat II. Twenty different species are present in quadrat II, five of which - *Albizia gumnifera*, *Guarea cedrata*, *Galinera saxifraga*, *Tetrorchidium didymostemon* and *Macaranga monandra* - appear in both sample plots and thus seem to be more evenly distributed throughout the quadrat (Figure 6.21). The mean number of plants for this quadrat is 11 913 per hectare (Table 6.6). The most prominent plant in this quadrat is *Albizia gumnifera* with 4 063 plants per hectare (Figure 6.21), followed by *Aframomum angustifolium* with a density of 2 850 plants per hectare and hence 0.7 times the density of the former species. *Aframomum angustifolium* is also only present in plot 3 indicating a more patchy distribution throughout the quadrat (Figure 6.21). Another prevalent representative is *Guarea cedrata* with 1 788 plants per hectare (Figure 6.21). Also important are *Galinera saxifraga* and *Ouratea hiernii* with 700 plants per hectare each, as well as *Tetrorchidium didymostemon* (450 plants per hectare), *Ficus ovata* (300 plants per hectare) and *Coffea canephora* (200 plants per hectare) (Figure 6.21). All remaining species contribute between 12 - 150 plants per hectare (Figure 6.21). An important feature in this quadrat is the high mean number of "Fallen dead" trees with 79 plants per hectare which occur mainly in plot 4 (Figure 6.21).

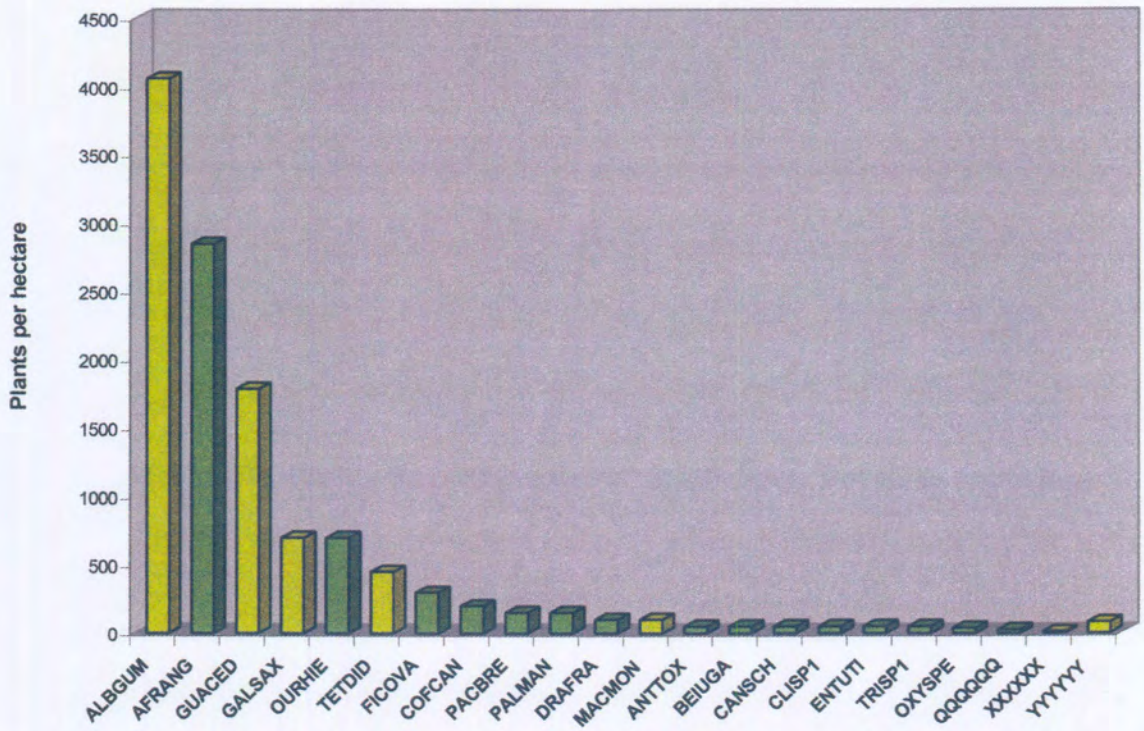

Figure 6.21: Mean density (plants per hectare) per species in quadrat II.

ALBGUM	=	*Albizia gumnifera*	ENTUTI	=	*Entandrophragma utile*
AFRANG	=	*Aframomum angustifolium*	TRISP1	=	*Trichilia species 1*
GUACED	=	*Guarea cedrata*	OXYSPE	=	*Oxyanthus speciosus*
GALSAX	=	*Galinera saxifraga*	QQQQQQ	=	Unidentified species
OURHIE	=	*Ouratea hiernii*	XXXXXX	=	Standing dead tree
TETDID	=	*Tetrorchidium didymostemon*	YYYYYY	=	Fallen dead tree
FICOVA	=	*Ficus ovata*		=	Plant species present
COFCAN	=	*Coffea canephora*			in both sample plots
PACBRE	=	*Pachystela brevipes*		=	Plant species only
PALMAN	=	*Palisota mannii*			present in one
DRAFRA	=	*Dracaena fragrans*			sample plot
MACMON	=	*Macaranga monandra*			
ANTTOX	=	*Antiaris toxicara*			
BEIUGA	=	*Beilschmedia ugandensis*			
CANSCH	=	*Canarium schweinfurthii*			
CLISP1	=	*Clitandra species 1*			

Quadrat III

The only representative of the shrubs growth form in plot 5 is *Palisota mannii* in the two lowest height classes (400 and 200 plants per hectare, respectively). In plot 6 three species constribute to the shrub growth form, each of them in a different height class, namely *Palisota schweinfurthii* (0.5 m), *Oxyanthus speciosus* (1.0 m) and *Aframomum angustifolium* (3.0 m) (Table 6.7 & Figure 6.22 & 6.23).

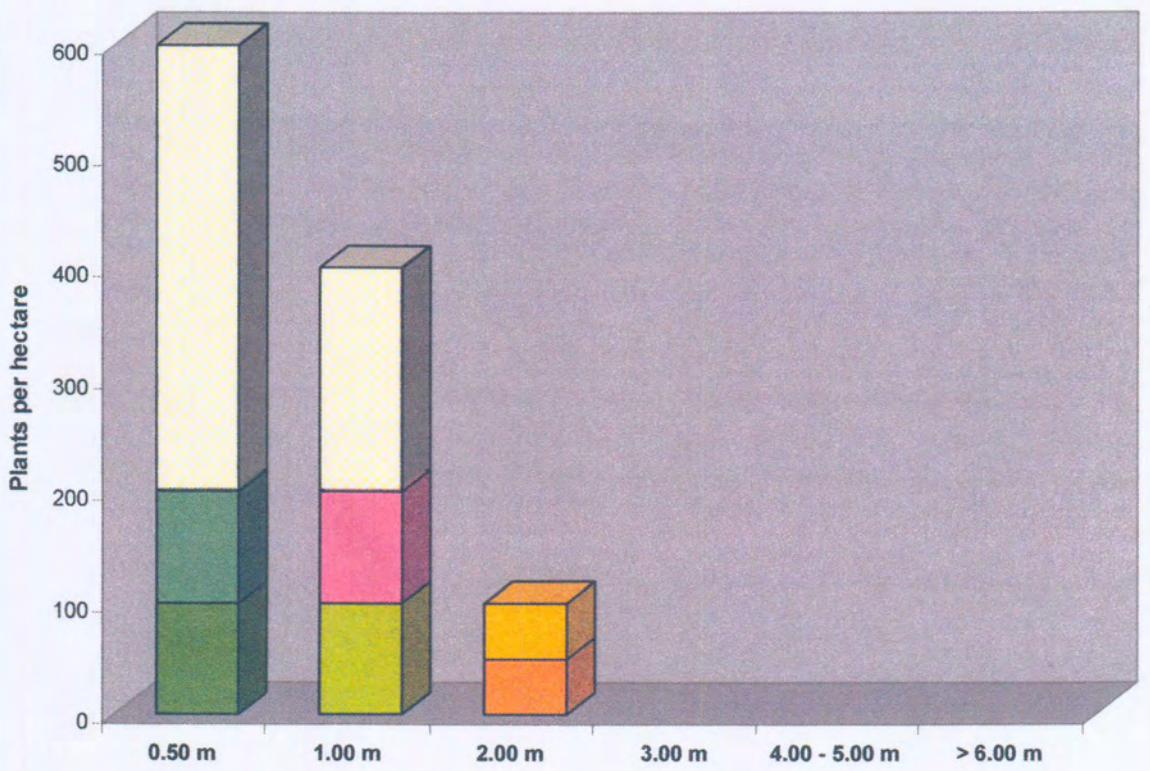

Figure 6.22: Density (plants per hectare) of sparse shrub ((full colour) and shrub (chequered colour) according to height class and species in plot 5.

Key:

- *Palisota mannii*
- *Dracaena fragrans*
- *Aframomum angustifolium*
- *Oxyanthus speciosus*
- *Eugenia capensis*
- *Millettia dura*
- *Guarea cedrata*

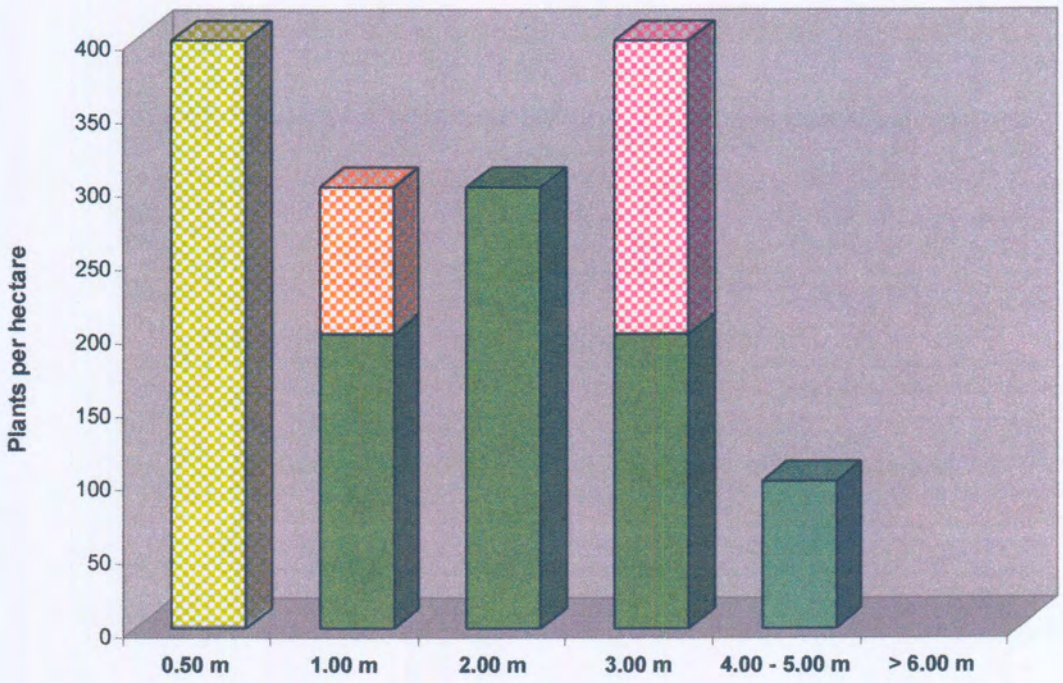

Figure 6.23: Density (plants per hectare) of sparse shrub (full colour) and shrub (chequered colour) according to height class and species in plot 6.

Key:

- *Oxyanthus speciosus*
- *Aframomum angustifolium*
- *Palisota schweinfurthii*
- *Peddiea fischeri*
- *Aframomum angustifolium*

While plot 5 has representatives of the sparse shrub growth form in the three lowest height classes, this growth form is represented in plot 6 in the four height classes from 1.0 m to 4.0 - 5.0 m (Figure 6.22 & 6.23). There are six different species in plot 5, each of them only represented in one height class, namely *Guarea cedrata*, *Millettia dura* (both in the 0.5 m height class), *Eugenia capensis*, *Oxyanthus speciosus* (both in the 1.0 m height class), *Aframomum angustifolium* and *Dracaena fragrans* (both in the 2.0 m height class) (Figure 6.22). In plot 6 only two species are present in the sparse shrub growth form, namely *Aframomum angustifolium* and *Peddiea fischeri*, the latter of which only occurs in the 4.0 – 5.0 m height class (Figure 6.23).

Thirteen different tree species are present in plot 5 (Figure 6.24). The number of plants declines steadily from the 0.5 m height class to the 4.0 – 5.0 m height class (from 2 300 to 275 plants per hectare), the latter of which contains only one-tenth of the number of trees of the former (Table 6.7 & Figure 6.24). Even though plot 5 has the highest number of different tree species it is with only 6 200 trees per hectare far below the mean number for all sample plots (Table 6.5 – 6.8 & Figure 6.14, 6.15, 6.19, 6.20, 6.24, 6.25, 6.29 & 6.30). The > 6.0 m height class of plot 5 is represented by *Pachystela brevipes* (600 plants per hectare) and *Eugenia capensis* (100 plants per hectare). Both of these species occur again only once in any of the lower height classes (Figure 6.24). The most prominent tree species in this plot is *Dracaena fragrans* (2 250 plants per hectare) followed by *Oxyanthus speciosus* (1 150 plants per hectare). The 2.0 m height class with nine different tree species contains the greatest species richness in this plot (Figure 6.24).

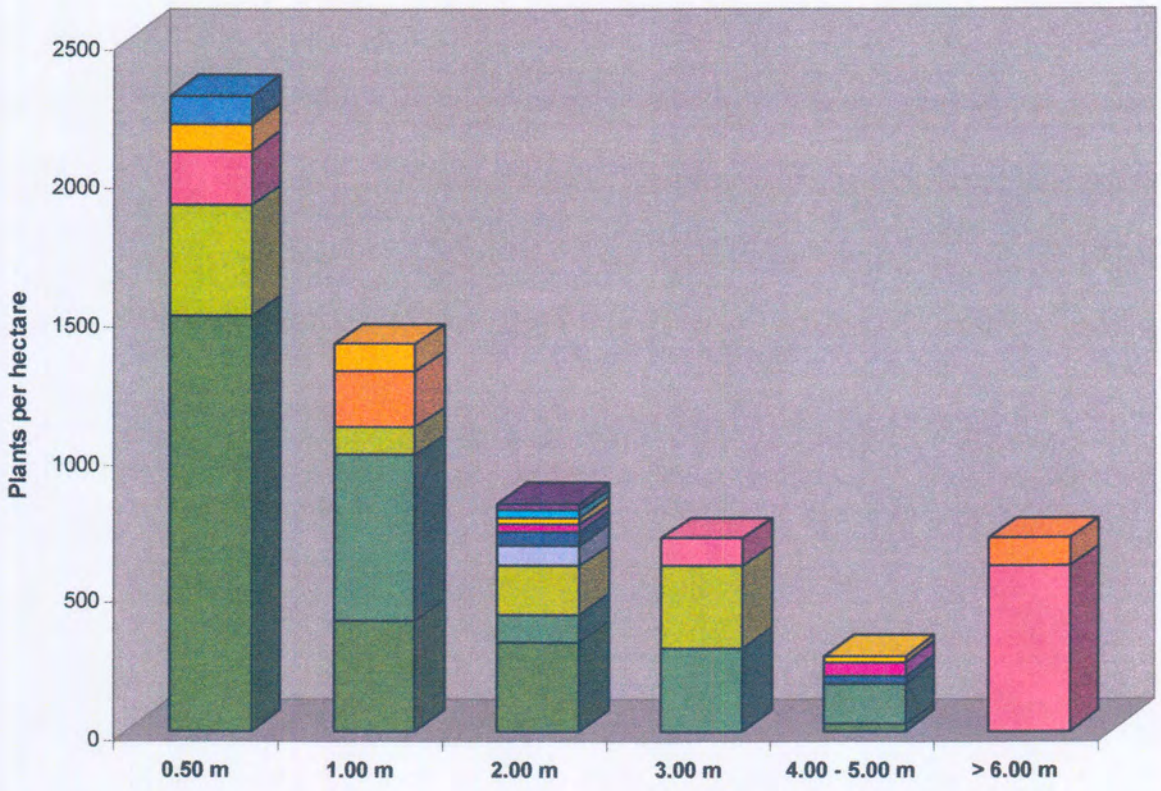

Figure 6.24: Density of trees (plants per hectare) according to height class and species in plot 5.

Key:

- *Trilepsium madagascariense*
- *Psychotria mannii*
- *Albizia gumnifera*
- *Rinorea brachypetala*
- *Beilschmedia ugandensis*
- *Psychotria peduncularis*
- *Psychotria species 1*
- *Canthium species 1*
- *Eugenia capensis*
- *Pachystela brevipes*
- *Guarea cedrata*
- *Oxyanthus speciosus*
- *Dracaena fragrans*

In contrast to plot 5, plot 6 has with 9 500 trees per hectare a density which is higher than the mean density of all sample plots (Table 6.5 – 6.8 & Figure 6.14, 6.15, 6.19, 6.20, 6.24, 6.25, 6.29 & 6.30). Even though, this plot only contains eight different tree species (Figure 6.25). Here again *Dracaena fragrans* is the most prominent tree species with 4 100 plants per hectare, followed by *Aframomum angustifolium* with 2 800 plants per hectare. All but the > 6.0 m height class contain either three or four different tree species (Figure 6.25). The highest tree density with 3 100 plants per hectare is in the 1.0 m height class, followed by 2 500 plants per hectare in the 0.5 m height class. All other height classes have a density below 1 500 trees per hectare. The > 6.0 m height class has, with 500 plants per hectare, the lowest density of all height classes and consists of only one species, *Guarea cedrata* (Table 6.7 & Figure 6.25).

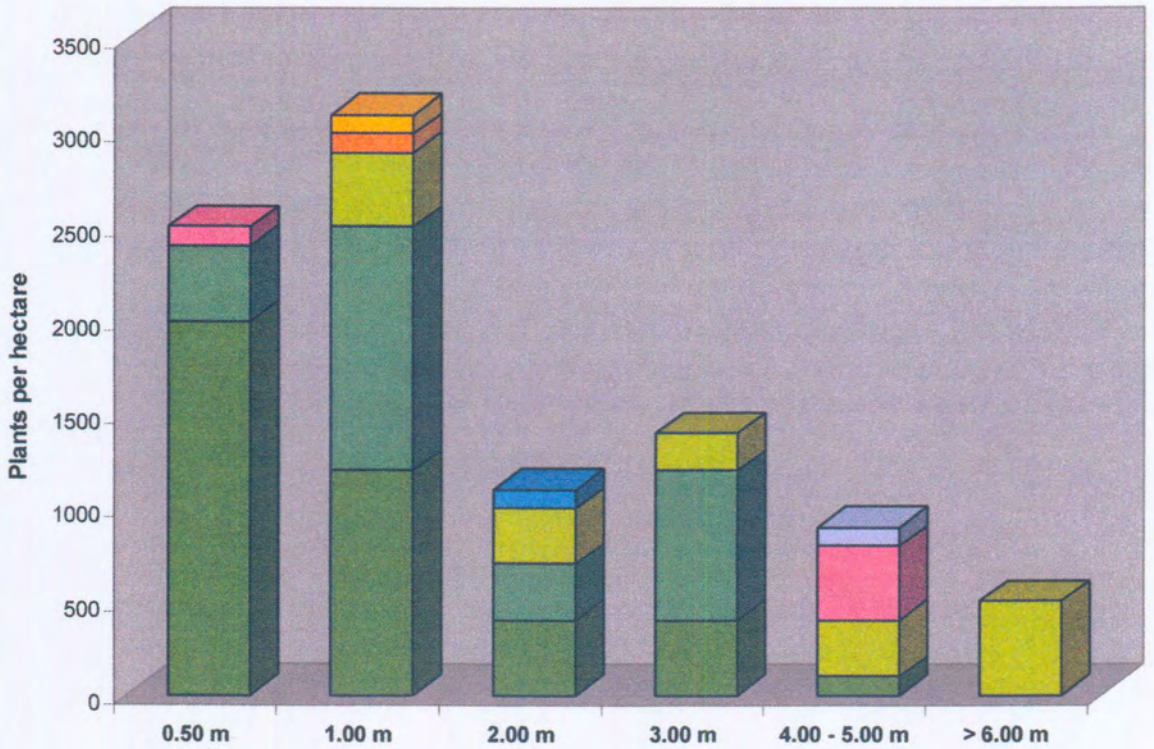

Figure 6.25: Density of trees (plants per hectare) according to height class and species in plot 6.

Key:

- *Albizia gumnifera*
- *Psychotria peduncularis*
- *Ouratea hiernii*
- *Clerodendrum formicarum*
- *Oxyanthus speciosus*
- *Guarea cedrata*
- *Aframomum angustifolium*
- *Dracaena fragrans*

Figure 6.26 summarises the mean number of plants per hectare over all species present, including dead plants, for quadrat III. There are 20 different species present in this quadrat and the mean number of plants per hectare over all live vegetation types is 9 150 (Table 6.7 & Figure 6.26). The four most prominent species, which also occur in both sample plots and are thus rather evenly distributed throughout the quadrat, are *Dracaena fragrans* (3 200 plants per hectare), *Aframomum angustifolium* (1 775 plants per hectare), *Guarea cedrata* (1 388 plants per hectare) and *Oxyanthus speciosus* (925 plants per hectare) (Figure 6.26). Four less prominent species, which are present in only one sample plot and hence show a more patchy distribution throughout quadrat III, are *Pachystela brevipes* (450 plants per hectare), *Palisota mannii* (300 plants per hectare), *Eugenia capensis* (200 plants per hectare) and *Palisota schweinfurthii* (200 plants per hectare) (Figure 6.26). All remaining species have a density of only 100 plants per hectare or below (Figure 6.26). "Fallen dead" trees are conspicuous with 46 plants per hectare (Figure 6.26).

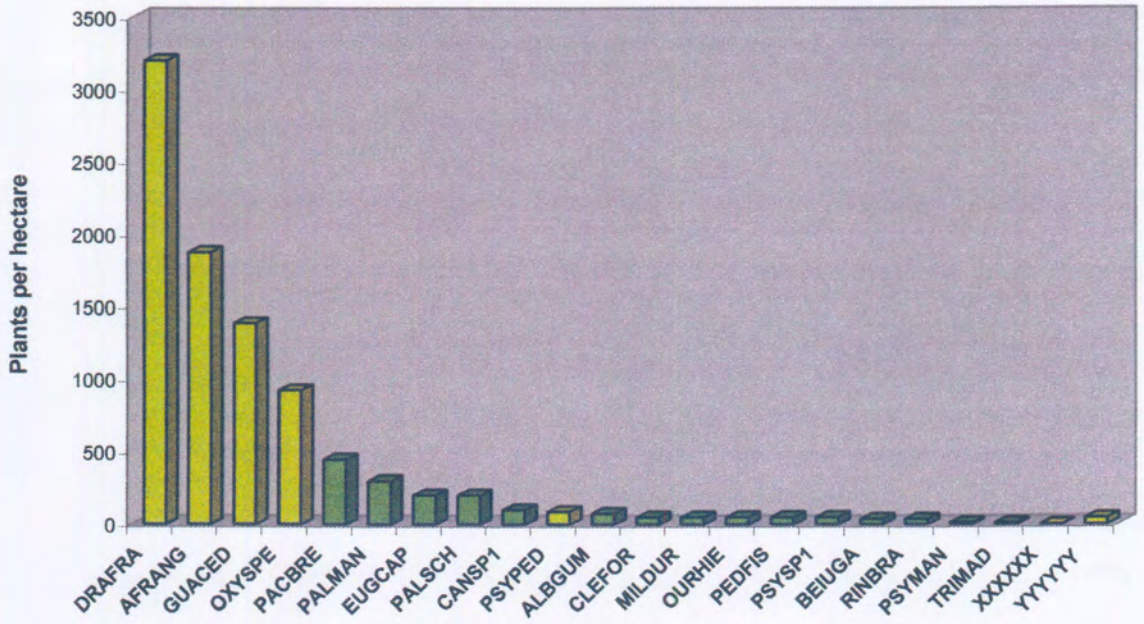

Figure 6.26: Mean density (plants per hectare) per species in quadrat III.

DRAFRA	=	*Dracaena fragrans*	PSYMAN	=	*Psychotria mannii*
AFRANG	=	*Aframomum angustifolium*	TRIMAD	=	*Trilepsium madagascariense*
GUACED	=	*Guarea cedrata*			
OXYSPE	=	*Oxyanthus speciosus*	XXXXXX	=	Standing dead trees
PACBRE	=	*Pachystela brevipes*	YYYYYY	=	Fallen dead trees
PALMAN	=	*Palisota mannii*		=	Plant species present in both sample plots
EUGCAP	=	*Eugenia capensis*			
PALSCH	=	*Palisota schweinfurthii*		=	Plant species only present in one sample plot
CANSP1	=	*Canthium species 1*			
PSYPED	=	*Psychotria peduncularis*			
ALBGUM	=	*Albizia gumnifera*			
CLEFOR	=	*Clerodendrum formicarum*			
MILDUR	=	*Millettia dura*			
OURHIE	=	*Ouratea hiernii*			
PEDFIS	=	*Peddiea fischeri*			
PSYSP1	=	*Psychotria species 1*			
BEIUGA	=	*Beilschmedia ugandensis*			
RINBRA	=	*Rinorea brachypetala*			

Quadrat IV

The shrub growth form in plot 7 is restricted to the 0.5 m, 3.0 m and 4.0 – 5.0 m height class. While the former is solely occupied by *Palisota mannii* (500 plants per hectare), *Aframomum angustifolium* is represented in both of the taller height classes, both times with 100 plants per hectare. *Dracaena fragrans* (25 plants per hectare) is the second representative in the 4.0 – 5.0 m height class (Table 6.8 & Figure 6.27). In plot 8 *Palisota mannii* and *Aframomum angustifolium* are the only representatives of the shrub growth form, the former only in the 0.5 m height class, the latter in the 1.0 m, 2.0 m and 3.0 m height class, contributing 500 plants per hectare to the tallest height class (Table 6.8 & Figure 6.28).

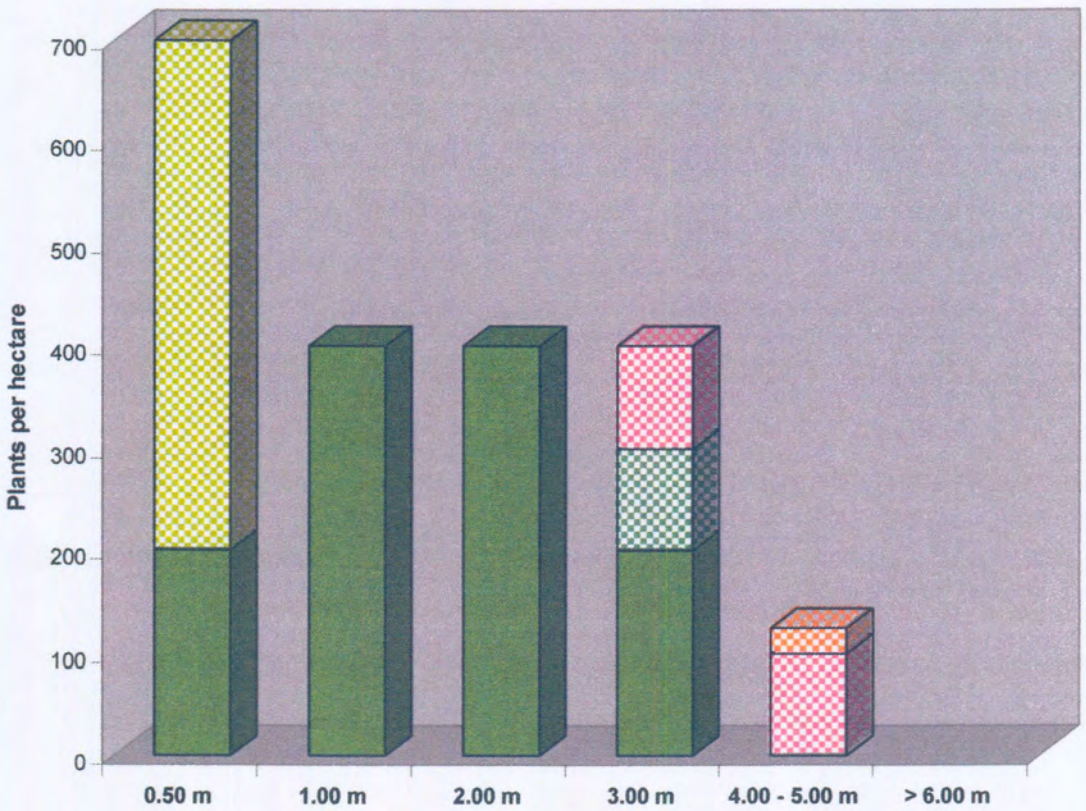

Figure 6.27: Density (plants per hectare) of sparse shrub (full colour) and shrub (chequered colour) according to height class and species in plot 7.

Key:

- *Dracaena fragrans*
- *Aframomum angustifolium*
- *Palisota mannii*
- *Dracaena fragrans*
- *Aframomum angustifolium*

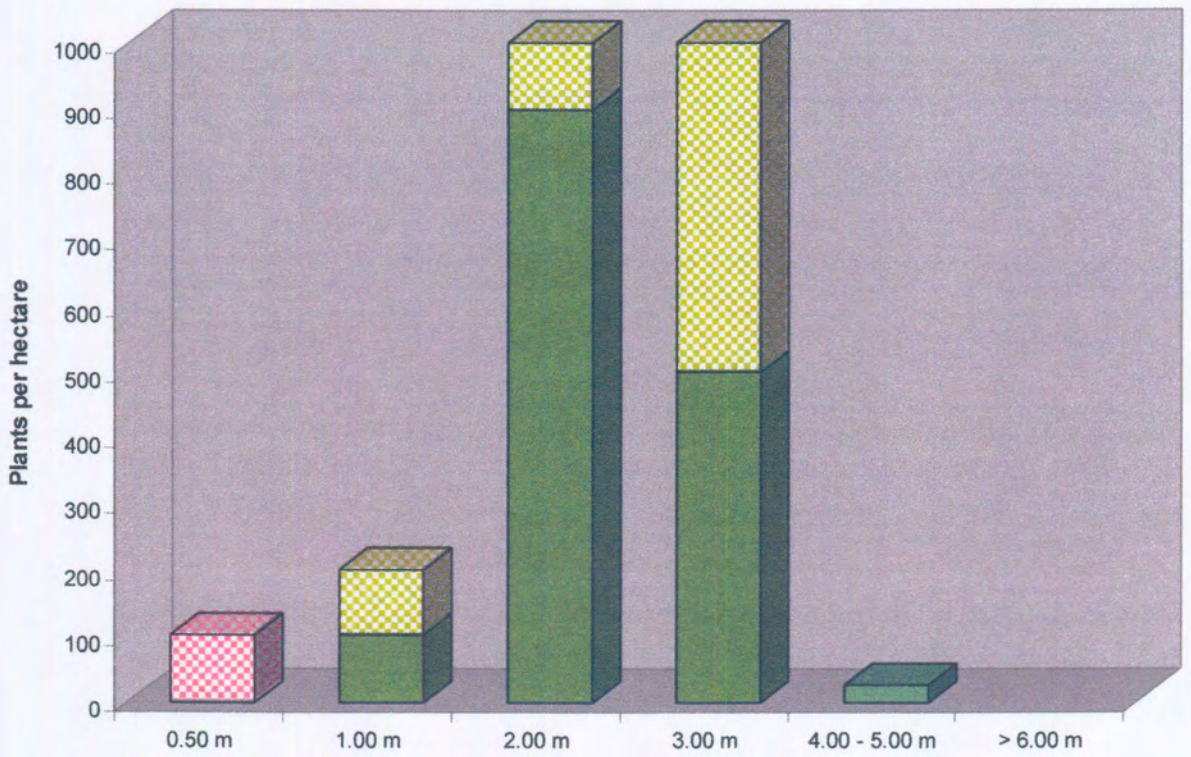

Figure 6.28: Density (plants per hectare) of sparse shrub (full colour) and shrub (chequered colour) according to height class and species in plot 8.

Key:

- *Palisota mannii*
- *Aframomum angustifolium*
- *Oxyanthus speciosus*
- *Aframomum angustifolium*

The sparse shrub growth form is represented in plot 7 in the first four height classes with *Dracaena fragrans* only occurring in the 3.0 m height class, while *Aframomum angustifolium* is represented in all of these height classes (Table 6.8 & Figure 6.27). In plot 8 *Aframomum angustifolium* is again the dominant sparse shrub with representatives in the 1.0 m up to the 3.0 m height class, and being most prominent in the 2.0 m height class with 900 plants per hectare (Table 6.8 & Figure 6.28). In the 4.0 – 5.0 m height class only *Oxyanthus speciosus* is represented as a sparse shrub, with 25 plants per hectare (Figure 6.28).

With nine different tree species, which altogether contribute 16 050 plants per hectare, plot 7 is the sample plot with the highest density for this growth form, having nearly twice as many trees per hectare as the mean for all sample plots (Table 6.8 & Figure 6.14, 6.15, 6.19, 6.20, 6.24, 6.25, 6.29 & 6.30). The highest number of trees occurs in the 0.5 m height class with 9 500 plants per hectare or 59% of the 16 050 trees. Of those 7 700 trees are represented by *Dracaena fragrans* alone (Figure 6.29). There is a decline to about one-third of this density to the 1.0 m height class, with 3 200 plants per hectare and *Dracaena fragrans* again being the most prominent representative (2 100 plants per hectare) (Table 6.8 & Figure 6.29). The 2.0 m height class has a similar density (2 400 plants per hectare) but now with *Aframomum angustifolium* as main representative (1 500 plants per hectare) (Figure 6.29). The three remaining height classes all have below 500 trees per hectare, with the > 6.0 m height class being the most prominent (425 plants per hectare). In this height class *Guarea cedrata* is the most prominent representative (350 plants per hectare), which occurs otherwise only in the 0.5 m height class (300 plants per hectare) (Figure 6.29).

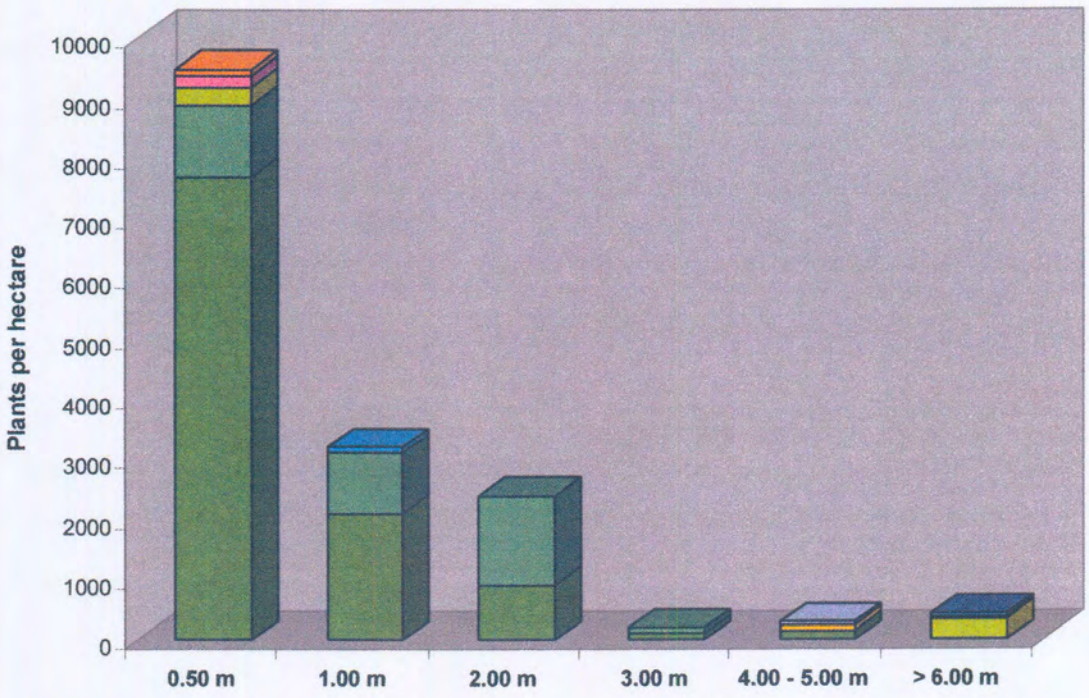

Figure 6.29: Density of trees (plants per hectare) according to height class and species in plot 7.

Key:

- *Albizia gumnifera*
- *Peddiea fischeri*
- *Psychotria peduncularis*
- *Oxyanthus speciosus var. stenocarpus*
- *Ficus species 2*
- *Oxyanthus speciosus*
- *Guarea cedrata*
- *Aframomum angustifolium*
- *Dracaena fragrans*

In plot 8 *Aframomum angustifolium* is the most prominent of all eight represented tree species. It is mainly represented in the three lowest height classes, being most prominent in the 2.0 m height class (1 800 plants per hectare). There is a more than two-fold increase in density from the 0.5 m to the 2.0 m height class (from 1 000 to 2 100 plants per hectare) (Table 6.8 & Figure 6.30). This is followed by a sharp drop to the 3.0 m height class (800 plants per hectare) caused mainly by the sharp decline in density of *Aframomum angustifolium* (from 1 800 to 100 plants per hectare) (Figure 6.30). The two tallest height classes have below 400 plants per hectare each, with the > 6.0 m height class having the lowest density of this height class of all sample plots, i.e. 111 trees per hectare (Table 6.8 & Figure 6.30). This small number is still represented by four different species, namely *Guarea cedrata*, *Tetrorchidium didymostemon*, *Albizia gumnifera* and *Oxyanthus speciosus* (Figure 6.30). This plot has a tree density of only 6 061 plants per hectare, i.e. the second lowest number of trees per hectare of all sample plots, and hence below the mean density for trees per hectare (Table 6.8 & Figure 6.5).

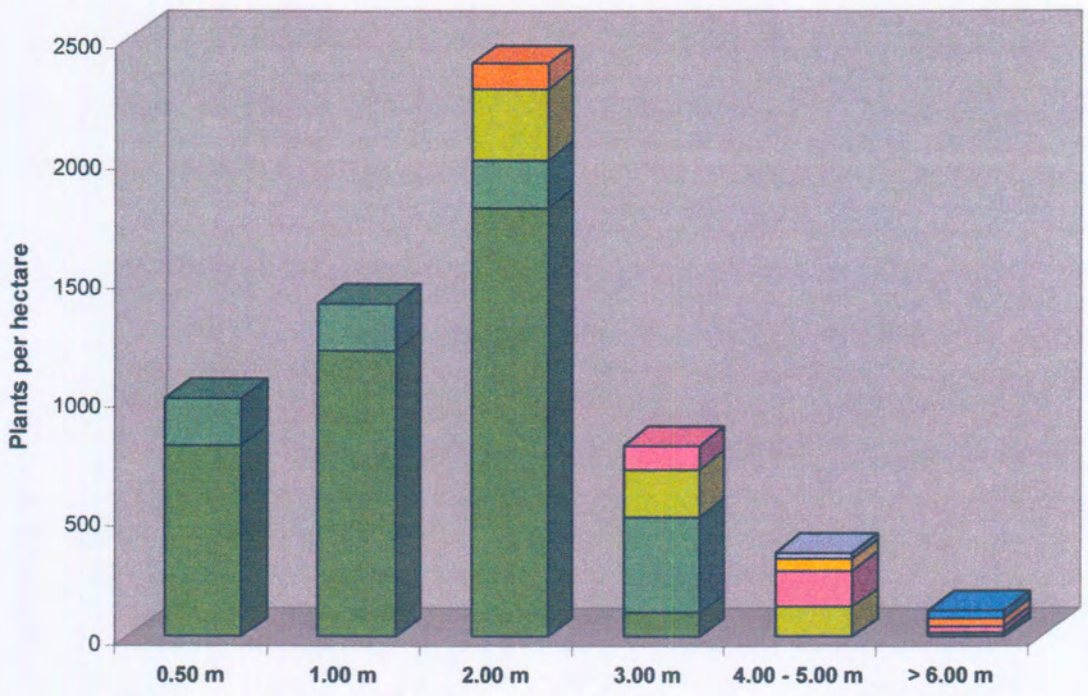

Figure 6.30: Density of trees (plants per hectare) according to height class and species in plot 8.

Key:

- *Galinera saxifraga*
- *Tetrorchidium didymostemon*
- *Ficus wildemanniana*
- *Guarea cedrata*
- *Oxyanthus speciosus*
- *Alchornea cordifolia*
- *Albizia gumnifera*
- *Aframomum angustifolium*

Figure 6.31 summarises the mean number of plants per hectare over all species present, including dead plants, for quadrat IV. There are 14 different species present in this quadrat and the mean number of plants per hectare over all live vegetation types is 13 218 plants per hectare (Table 6.8).The two most prominent species are *Aframomum angustifolium* with 5 650 plants per hectare and *Dracaena fragrans* with 5 538 plants per hectare (Figure 6.31). The former occurs in both sample plots and hence, again seems to be more evenly distributed throughout this quadrat (Figure 6.31); while the latter only occurs in plot 7, which indicates a more patchy distribution throughout the quadrat but at the same time a particularly high density of plants per hectare where it occurs (Figure 6.27 - 6.30). All other species have far lower densities in this quadrat. The next five important species are *Albizia gumnifera* (536 plants per hectare), *Guarea cedrata* (392 plants per hectare), *Alchornea cordifolia* (313 plants per hectare), *Palisota mannii* (300 plants per hectare) and *Oxyanthus speciosus* (249 plants per hectare) (Figure 6.31). Of those, only *Alchornea cordifolia* and *Oxyanthus speciosus* occur just in one of the sample plots (Figure 6.31). The remaining seven species all have densities of 50 plants per hectare or below (Figure 6.31). The number of "Dead Trees" is rather prominent in both categories with 41 "Fallen dead" trees per hectare and 44 "Standing dead" trees per hectare, and a more or less equal distribution of those trees in both sample plots (Figure 6.31).

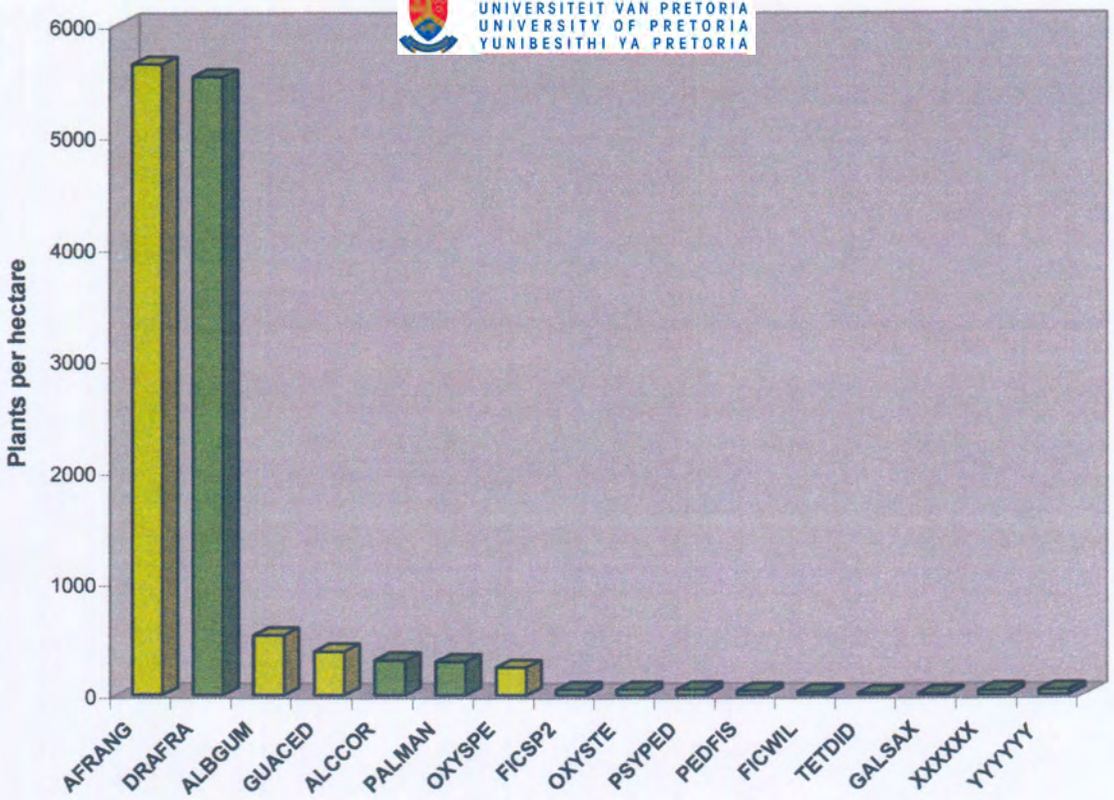

Figure 6.31: Mean density (plants per hectare) per species in quadrat IV.

AFRANG	=	*Aframomum angustifolium*
DRAFRA	=	*Dracaena fragrans*
ALBGUM	=	*Albizia gumnifera*
GUACED	=	*Guarea cedrata*
ALCCOR	=	*Alchornea cordifolia*
PALMAN	=	*Palisota mannii*
OXYSPE	=	*Oxyanthus speciosus*
FICSP2	=	*Ficus species 2*
OXYSTE	=	*Oxyanthus speciosus var. stenocarpus*
PSYPED	=	*Psychotria peduncularis*
PEDFIS	=	*Peddiea fischeri*
FICWIL	=	*Ficus wildemanniana*
TETDID	=	*Tetrorchidium didymostemon*
GALSAX	=	*Galinera saxifraga*
XXXXXX	=	Standing dead trees
YYYYYY	=	Fallen dead trees
	=	Plant species present in both sample plots
	=	Plant species only present in one sample plot

"Tree" density corrected for Aframomum angustifolium

Although, *Aframomum angustifolium* is classified as a herb (Lind & Tallantire 1962, Langdale-Brown *et al.* 1964, Katende *et al.* 1999) for the purpose of this study its single-stem representatives were listed under "Trees". Figure 6.32 shows the number of trees in each sample plot without single-stem *Aframomum angustifolium*.

Compared to Figure 6.5 the sequence of plots according to tree density changes as follows: from plot 7 — plot 3 – plot 6 – plot 4 – plot 1 – plot 5 – plot 8 – plot 2 to plot 7 – plot 3 – plot 4 – plot 6 – plot 5 – plot 1 – plot 2 – plot 8.

While the first two plots – both containing *Aframomum angustifolium* – hence keep their respective ranks the sequence of the next six plots changes pair wise. The following three pairs, e.g. plot 6 and plot 4, change places among each other since, after subtracting the plants per hectare of *Aframomum angustifolium*, the remaining tree density falls below the one of the plot directly following, i.e. plot 4 is now ahead of plot 6.

The three plots (2, 4, 5) not containing *Aframomum angustifolium* are distributed more or less on a straight line from the west to the east of the island (Figure 6.1).

While plot 2 and plot 4 are both characterised by wide-open spaces (see this Chapter - Description of sample plots) and are therefore also more exposed to wind, plot 5 has a dense and closed tree cover adjacent to the eastern shore of the island (Figure 6.1)

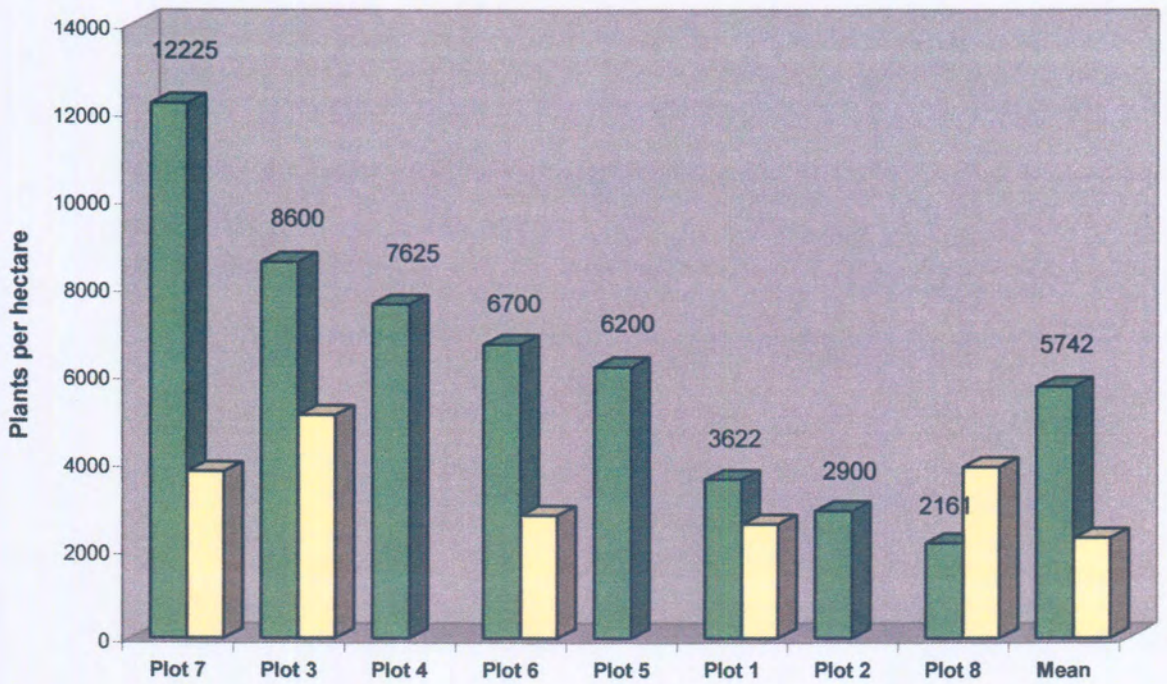

Figure 6.32: Number of woody "Trees" in each sample plot after correcting for *Aframomum angustifolium*.

Key:
- Number of subtracted *Aframomum angustifolium*
- Number of "Real Trees"