

UTILIZATION PATTERNS IN SOME INDIGENOUS COASTAL FOREST
PATCHES IN THE TRANSKEI - The role of different
management practices on forest structure.

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ECOLOGY PROJECT

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ABSTRACT

The structure and floristics of a few indigenous coastal forests in the Transkei were examined. The effect of two different management strategies, government and tribal, on forest dynamics, was assessed. Forests under both management regimes (demarcated and headman's) were found to be utilised for live wood, with the headman's forests being more heavily utilised. It is suggested that floristic shifts have taken place in headman's forests, following canopy removal. Headman's forests were also found to be structurally different from demarcated forests with fewer intermediate - sized trees and a high percentage of tree stems being coppice resprouts.

INTRODUCTION

The indigenous forests of the Transkei cover an area of about 100 000 ha and are divided into two main groups;

- 1) Coastal forest, occurring in patches along the coast and as far inland as the coastal escarpment,
- 2) Afromontane forest on the inland mountainous regions (Cooper and Swart, in prep).

Of the total area of indigenous forest, 70 000 ha has been 'demarcated' by the government (in the 1920's) and falls under the control of the Department of Forestry and Nature Conservation. The remaining 30 000 ha are termed 'headman's forests' and are controlled by local tribal authorities (Cooper and Swart, in prep).

In both of these forest types, only dead wood may be collected without permission. If live wood is to be cut, permission must either be obtained from the Dept. of Forestry or the local headman, depending on forest type. However, not all species may be utilised. There are 74 species of tree which may not be cut down under any circumstances, according to the laws of the Dept. of Forestry. These species are listed in Appendix 1.

According to Cooper and Swart (in prep.), demarcated forests are generally in better condition and comprise larger patches than headman's forests. Due to increasing population pressures, demarcated forests in addition to headman's forests, are beginning to become overexploited (Cawe, 1990). Also, many of the so-called protected trees (Appendix 1) are being cut live in both demarcated and headman's forests (pers. obs.). The problem of the over-exploitation of these forests is also exacerbated by a lack of suitable alternatives (e.g.. eucalyptus plantations which are found at the larger demarcated forests but not at smaller patches) and the lack of foresters (forest 'guards') in many areas.

The Energy Research Institute of U.C.T. set up a field station , the Rural Technology Unit (R.T.U.) in early 1989. This is situated approximately 7 km inland from Hole in the Wall, in the Mqanduli district of the Transkei. It is both a research and development station, involving water systems, alternative energy supplies and agroforestry. The agroforestry enterprise comprises a nursery and an extension service for the supply of trees and shrubs which are utilised mainly for fruit and wind breaks.

The R.T.U. is situated in an area of the Transkei with very traditional land use practises and consists of undulating hills of grazing and crop lands, dotted with homesteads and interspersed with forest patches. Many of these patches, both demarcated and headman's, are very small, the largest demarcated forests in the vicinity (within 10 km of the R.T.U.) being Mpame forest (458 ha) and Gxwaleni forest (183 ha under indigenous forest).



Plate 1. Kumbula demarcated forest on the left and Kumbula headman's forest on the right, giving an example of the kinds of forest examined in this study.

In this study I examine a few of the forest patches within the vicinity of the R.T.U. (see Plate 1) to establish how different management practises (government vs tribal) may influence forest condition in terms of structure, floristic composition and regeneration patterns. The demarcated forests studied (Figure 1) have been under government control since the late 1920's. It is assumed that prior to this, harvesting by local people was similar in both forest types . For the demarcated forests sampled, it is further assumed that no commercial exploitation took place as the plots sampled were in steep or inaccessible locations.

Two main questions were posed:

- 1) Is there a difference (structurally and floristically) between demarcated and headman's forests?
- 2) What is the future of these forests?

METHODS

Thirty-four 10 x 10 m plots were sampled, 14 in demarcated forests and 20 in headman's forests. In total, four demarcated and five headman's forests were sampled. The location of the forests is shown in Figure 1. The names I have used for the headman's forests were chosen for ease of reference. Forests were, as far as possible, chosen for homogeneity, aspect being either south-west or west-south-west and slopes being mainly between 20 and 36 degrees.

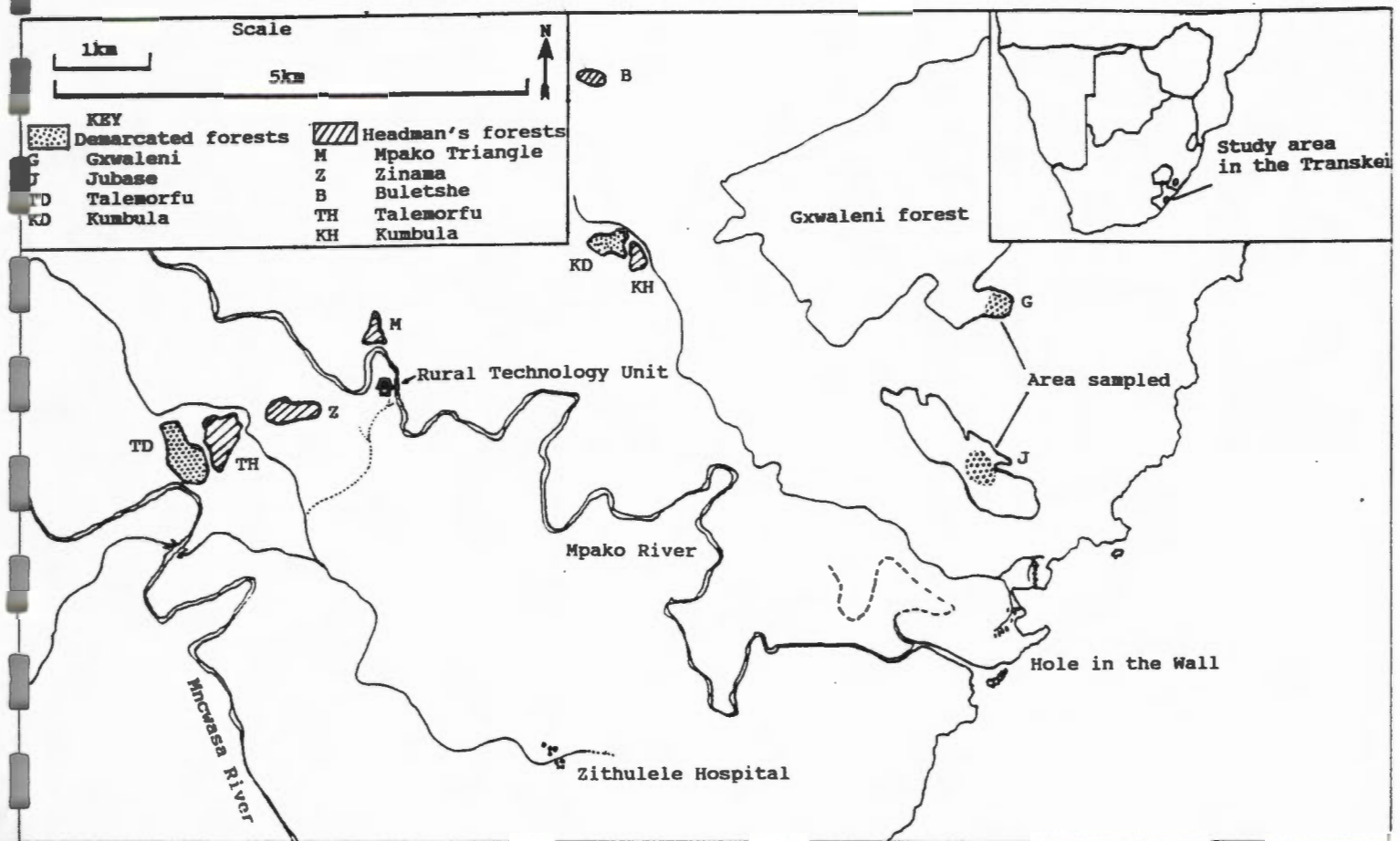


Figure 1. Map showing the location of forests sampled in this study.

Gxwaleni forest was originally intended to be a "control", a large forest which from the outside appears to be in better condition than some of the smaller forest patches. However, initial sampling indicated human exploitation of this forest. The data obtained from this forest were, therefore included with the rest of the results.

None of the forests studied were fenced off from livestock and it was assumed that accessibility to both humans and livestock (especially goats) was equal for all forests. Soils (0-10cm) from each representative forest patch were analysed for organic content and pH values. In each 10 x 10 m plot the following information was recorded:

- * the dbh (diameter at breast height) measurement of all trees greater than 1 cm;
- * trees were identified;
- * incidences of cut, dead and resprouting trees were noted;
- * the height of canopy trees was estimated;
- * ground cover of plants less than 1 m tall was estimated.

Trees were divided into seven size classes. After initial observations, it was clear that many trees had small stem diameters and large trees were scarce. The classification into the smallest two size classes was also decided upon by the representative wood usage around homesteads, often small size classes being selected for weaving into animal enclosures (pers. obs.). The size classes were as follows;

1a = 1-2 cm, 1b = 2-5 cm, 2 = 5-10 cm, 3 = 10-15 cm, 4 = 15-20 cm, 5 = 20-30 cm, 6 = 30-40 cm.

The number of trees with dbh's greater than 40 cm was so low, that these were included in size class six.

Total basal area of all trees was calculated using the formula, πr^2 (r = radius at breast height).

Ground cover values were given by line-of-sight estimates at 0-50 cm and 50-100 cm above ground from which cover classes were created as follows: class 1 - bare, class 2 - small amount of cover, class 3 - fair amount of cover, class 4 - thick cover.

Discriminant analysis (Statgraphics, Graphic Software Systems Inc., U.S.A., 1989) was performed on the stem density data for the headman's and demarcated forests. Discriminant analysis allows the study of the differences between two or more groups of objects with respect to several variables simultaneously (Klecka 1980). Results from such a test are used to establish how well groups discriminate from each other, and which characteristics are the most powerful discriminators (Klecka 1980).

A second discriminant analysis (BMDP) was performed with some of the floristic data, this time using presence or absence of species which occurred in 4 or more plots.

RESULTS

Table 1. Forest names, plot numbers, approximate sizes, soil pH and % organic matter, site aspect and slope, canopy height and cover classes for vegetation below 1m in height (1=lowest cover, 4=maximum cover).

Plot no.	Forest	Type	Area (ha)	pH	org %	Aspect	Slope	Canopy (meters)	Old canopy	Floor cover	
1	Gxwaleni	demarc.	183	6.4	21.6	ws	24	15		3	
2	Gxwaleni	demarc.				ws	24	15		2	
3	Gxwaleni	demarc.				ws	27	15		3	
4	Gxwaleni	demarc.				ws	31	20		2	
5	Gxwaleni	demarc.				ws	33	15-20		2	
6	Jubase	demarc.	70	4.8	8.02	ws	36	10		3	
7	Talemorfu	demarc.	20	5.5	8.54	sw	30	3-15	15	2	
8	Talemorfu	demarc.				ws	32	absent		2	
9	Talemorfu	demarc.				ws	30	4-12		2	
10	Talemorfu	demarc.				ws	32	5-9		1	
11	Kumbula	demarc.	5	6.7	9.02	sw	31	20		4	
12	Kumbula	demarc.				sw	39	15-20		2	
13	Kumbula	demarc.				sw	36	15		4	
14	Kumbula	demarc.				sw	31	absent		15-20	4
15	Mpako triangle	headman	3	4.1	5.79	ws	31	3-4		4	
16	Mpako triangle	headman				ws	28	4-10		3	
17	Mpako triangle	headman		5.4	9.27	ws	36	12-15		1	
18	Mpako triangle	headman				ws	34	8		2	
19	Zinama	headman	8	5.2	11.44	sw	25	8-10		2	
20	Zinama	headman				sw	28	8-10		2	
21	Zinama	headman				sw	28	absent		15	1
22	Zinama	headman				sw	34	10-15		2	
23	Zinama	headman				sw	28	5-6		15	3
24	Zinama	headman				ws	31	4-5		15	4
25	Buletshe	headman	3	5.4	12.4	ws	18	15		4	
26	Buletshe	headman				ws	19	15		4	
27	Talemorfu	headman	15	5.4	9.87	sw	30	10-15		1	
28	Talemorfu	headman				sw	28	5		15	2
29	Talemorfu	headman				sw	30	absent		17	3
30	Talemorfu	headman				sw	30	absent		15	3
31	Kumbula	headman	3	5.3	13.14	sw	26	20		4	
32	Kumbula	headman				sw	24	6		20	4
33	Kumbula	headman				sw	30	8		15-20	4
34	Kumbula	headman				sw	27	4		15	3

Abiotic information

Gxwaleni forest was found to have a much higher soil organic content than the other forests (Table 1). This forest is situated on a dolerite sill, whereas the other forests are on shales. The pH values indicate acidic soils with Gxwaleni and Kumbula demarcated forests being the least acidic. Variations of over one pH value within one patch (Mpako triangle, Table 1) suggest that pH differences are influenced by specific microclimatic differences within forest patches.

Biotic information

Structural

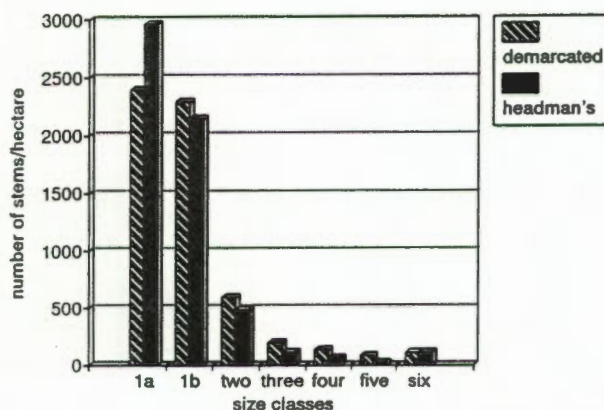


Figure 2. Total stem density values (stems hectare⁻¹) for demarcated and headman's forests for different size classes (1a = 1-2 cm, 1b = 2-5 cm, two = 5-10 cm, three = 10-15 cm, four = 15-20 cm, five = 20-30 cm, six = 30-40 cm). values

This figure indicates a general decrease in stem number per unit area from the smaller to the larger size classes. There do not seem to be major differences between the headman's and demarcated forests, except that there are more stems in class 1a (1-2 cm) in the headman's forests, and more stems in the larger size

classes in demarcated forests. This latter trend is more obvious in Figure 3.

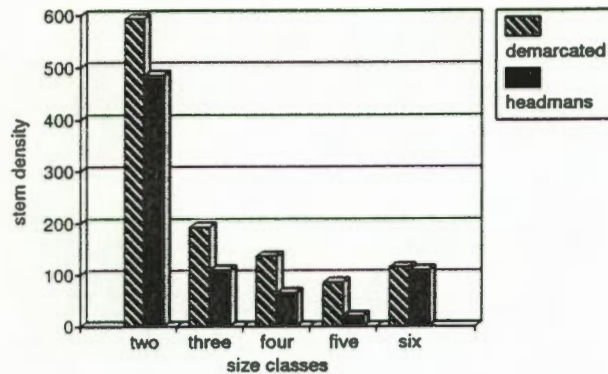


Figure 3. Total stem density values (stems hectare⁻¹) for trees > 5 cm DBH, for demarcated and headman's forests.

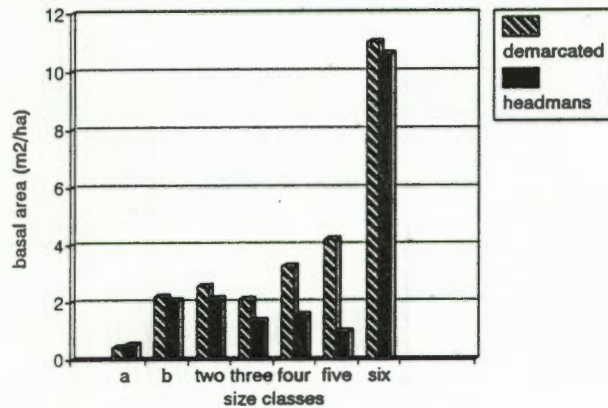


Figure 4 Basal area values (m² hectare⁻¹) for demarcated and headman's forests for all size classes.

In Figure 4 the important contribution of a few large trees to the total wood volume is reflected in the general pattern of increase from the smaller to the larger size classes. Differences between headman's and demarcated forests are more noticeable in this figure than in Figure 2, the largest differences occurring in the size classes three, four and five where the demarcated forests showed higher basal area values than headman's forests.

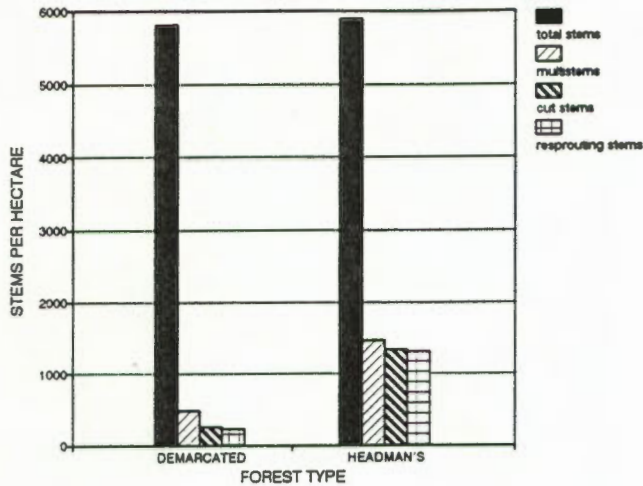


Figure 5. Total stem density, total number of multistemmed trees, number of cut scars and number of resprouting stems in demarcated and headman's forests.

Figure 5 indicates some forests utilization patterns. Although there were similar values for the total number of trees in each forest type, the number of these which were multistemmed was higher in the headman's forests (Figure 5). This figure shows the number of multistemmed trees which had been cut, and the number of stems which were resprouting.

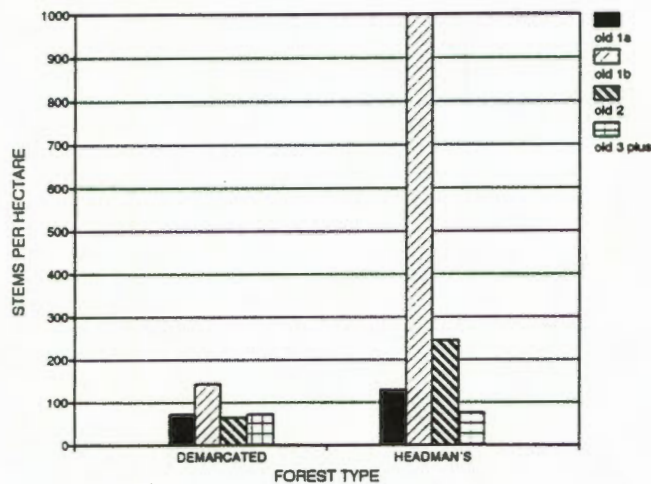


Figure 6. Stems harvested from living trees (stems hectare⁻¹), measured as cut scars in size class 1a (1-2 cm), 1b (2-5 cm), 2 (5-10 cm) and 3 and above (> 10 cm).

The most obvious trend in Figure 6 is the larger number of stems removed from headman's forests, especially in size class 1b (2-5 cm).

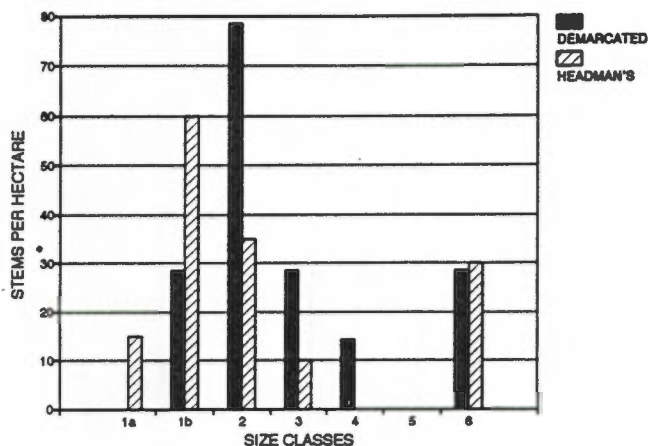


Figure 7. The number of dead stumps (stems hectare⁻¹) encountered in this study for all size classes for demarcated and headman's forests.

Figure 7 shows low numbers of dead stumps. For the smallest size classes (1a and 1b) more stems had been killed in the headman's forests and for classes 2, 3 and 4, more in the demarcated forests. Equal numbers of dead stumps in the biggest size classes were noted.

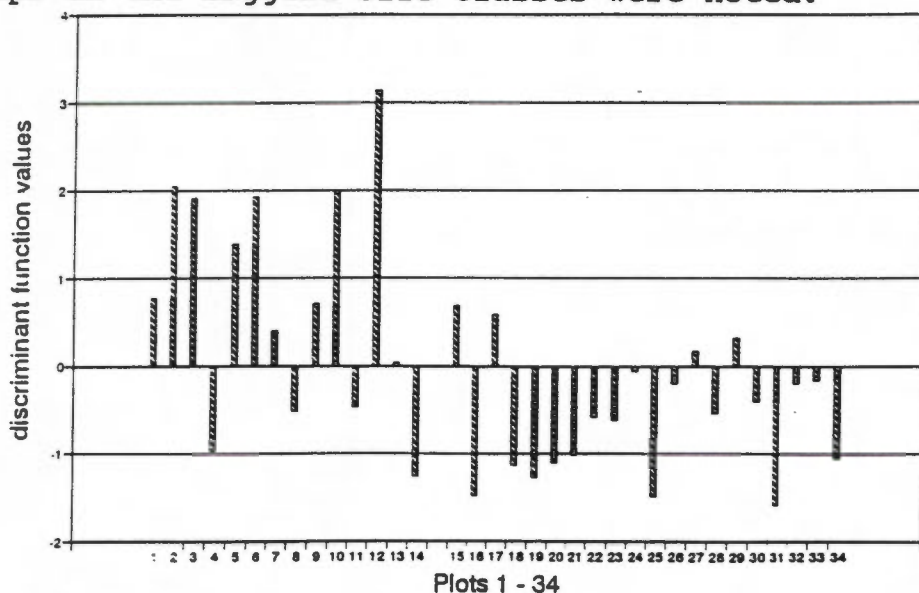


Figure 8. Histogram showing discriminant function values resulting from an analysis of stem density numbers in different size classes for 34 plots (1-14 = demarcated forests, 15-34 = headman's forests).

The result of the discriminant analysis on stem density is depicted in Figure 8. The X-axis numbers are plot numbers which correspond with those in Table 1. The Y-axis represents discriminant function values, which were calculated using the unstandardised discriminant coefficient values. These values were multiplied by the stem density values for each plot in each size class.

Figure 8 indicates a general separation of the two forest types into two groups with the exception of four demarcated plots (Gxwaleni plot 4, Talemorfu plot 8, Kumbula plot 11, Kumbula plot 14) and four headman's plots (Mpako Triangle plot 15, Mpako Triangle plot 17, Talemorfu plot 27, Talemorfu plot 29). The overall discriminant analysis for the data was not significant ($p = 0.13$), probably as a result of these exceptions. However for the purposes of this study, it is useful to use this information in further analysing the data collected.

To determine which size classes were most important in discriminating between the different forest types, a correlation analysis (Statgraphics, Graphics Software Systems Inc., U.S.A., 1989) was performed between each stem size class and the discriminant function score for each plot. The results of this analysis are summarised in Table 2, in order of decreasing correlation of size class with discriminant function value.

Table 2. Results of a correlation analysis performed between discriminant function score and stem density numbers in each DBH size class for 34 forest plots.

Size Class	Corr. Coefficient	Significance level
Five	0.8212	p < 0.001
Four	0.4559	p < 0.01
Three	0.3902	p < 0.05
1a	0.3048	not significant
Two	0.2415	not significant
1b	0.0818	not significant
Six	0.0400	not significant

From this table it can be seen that the numbers of stems in size class five (20-30cm) was the most important discriminating variable between the two forest types. The next most important discriminating variable was the number of stems in size class four (15-20 cm), followed by size class three (10-15 cm). These results suggest that although there may be clear differences in the number of stems between forests in certain size classes (Class 1a, Figure 2), the presence or absence of larger trees is more important in discriminating between the two forest types (See also Figure 4).

Floristic Composition

Appendix 2 gives a full list of the trees recorded in the study. The number of species per plot was found to be 15 ± 3.7 for the demarcated forests and 12 ± 3.6 for the headman's forests which was found to be significantly different ($t = 2.15$, $P < 0.05$).

Table 3. Patterns of species found resprouting, following cutting. Species are arranged in ascending order of total stem number for each forest type (Demarcated = 14 plots, Headman's = 20 plots). The number and percentage of resprouting stems (per total stem number) for each species, is shown.

DEMARCATED				HEADMAN'S			
SPECIES	TOTAL NUMBER	%		SPECIES	TOTAL NUMBER	%	
	STEMS	RESPR.	RESPR.		STEMS	RESPR.	RESPR.
Buxusmac.	114	3	2.6	Millettia	199	41	20.6
Buxusnat.	91	2	2.2	Cestrum	188	70	37.2
Dalbergar.	39	1	2.6	Oxyanthus	166	38	22.9
Strychnos	38	3	7.9	Trycalysia	138	42	30.4
Croton	34	2	5.9	Dalberg.ar.	90	8	8.9
Homalium	31	1	3.2	Buxusnat.	52	1	5.8
Rawsonia	24	1	4.2	Teclea	32	6	18.8
Cussonia	22	2	9.1	Maytenus	28	2	7.1
Teclea	20	1	5.0	Dalberg.ob.	23	6	26.1
Oxyanthus	16	3	18.8	Strychnos	19	2	10.5
Dombeya	15	3	20.0	Cussonia	17	1	5.9
Chaetachme	13	1	7.7	Vepris	16	1	6.3
Ficusnat.	8	1	12.5	Dombeya	15	3	20.0
Acokanth.	6	1	16.7	Allophdec.	13	3	23.1
Ekebergia	6	1	16.7	Trimeria	11	6	54.5
Cassine	5	1	20.0	Ekebergia	11	3	27.3
Canthium	3	1	33.3	Croton	11	1	9.1
Nuxia	3	1	33.3	Putterlik.	9	3	33.3
Apodytes	2	1	50.0	Trichilia	8	1	12.5
Caloden.	2	1	50.0	Homalium	7	4	57.1
				Canthium	6	2	33.3
				Celtis	6	2	33.3
				Cassine	5	1	20.0
				Pavetta	4	1	25.0
				Caloden.	4	2	50.0
				Rothmanii	4	2	50.0
				Erythrina	3	2	66.7
				Combretum	2	2	100.0
				Ficus sur	2	1	50.0
				Mimusops	2	1	50.0
				Trycalcap.	1	1	100.0
				Rauvolfia	1	1	100.0

Table 3 gives floristic information on species which were resprouting, following cutting. In the demarcated forests the number of resprouting stems was not skewed to include only a few species as was observed in the headman's forests.

Although statistical analyses were performed with the floristic information, it should be borne in mind that different communities are being dealt with. Cawe (1990) described many communities within Transkei coastal forests based on abundance values for specific indicator species, often with different communities within a single forest.

Table 4. Thirty two species which occurred in at least four plots which were used for discriminant analysis (BMDP), based on presence or absence in demarcated and headman's forests.

SPECIES	Number of plots in which species occurred		% of total number of plots	
	DEM	HEAD	DEM	HEAD
1 allophdre	6	0	43	0
2 allophdec	1	6	7.1	30
3 tricalys	8	11	57	55
4 buxusmac	8	0	57	0
5 buxusnat	11	6	79	30
6 rawsonia	5	0	36	0
7 olea	4	0	29	0
8 teclea	9	9	64	45
9 cussonia	8	9	57	45
10 croton	6	6	43	30
11 ekebergia	2	4	14	20
12 calodendr	1	4	7.1	20
13 canthium	3	7	21	35
14 milletia	4	18	29	90
15 chaetach	5	4	36	20
16 vepris	4	9	29	45
17 bequertio	5	0	36	0
18 strychnos	11	6	79	30
19 dalberg.obo.	1	8	7.1	40
20 homalium	6	4	43	20
21 maytenus	4	7	29	35
22 bersama	4	0	29	0
23 carissa	4	4	29	20
24 dalberg.arm.	5	15	36	75
25 acokanth	4	0	29	0
26 protorhus	4	0	29	0
27 cassine	4	5	29	25
28 oxyanthus	2	8	14	40
29 cestrum	1	9	7.1	45
30 trimeria	1	5	7.1	25
31 colanat	0	4	0	20
32 erythrina	0	4	0	20

The results of the discriminant analysis performed on the presence or absence of species represented in at least four plots (32 species, Table 4) may be seen in Figure 9.

(15-34) = HEADMAN'S PLOTS

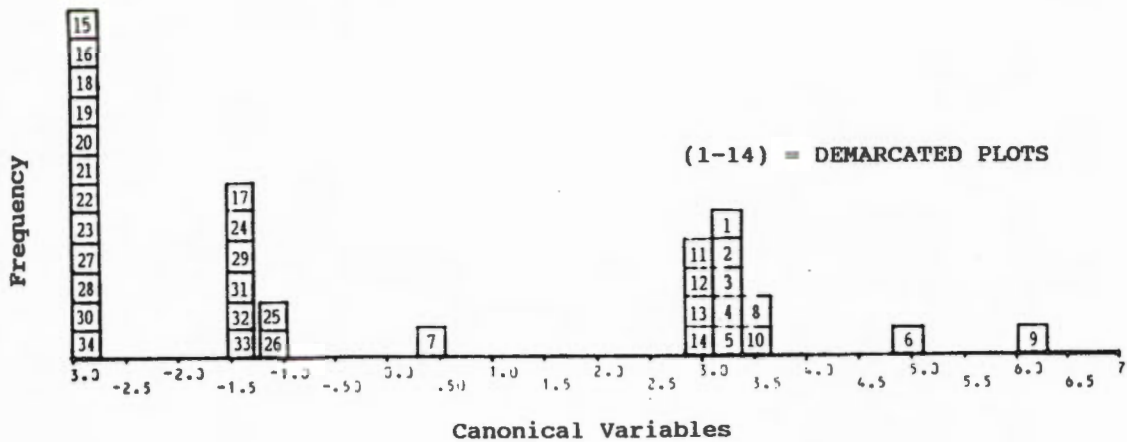


Figure 9. Histogram showing the frequency of 34 plots, plotted against their canonical variables; the result of a discriminant analysis of headman's and demarcated forests, based on the presence or absence of 32 species (Table 4) where four species *Allophylous dregeanus*, *Buxus macowanii*, *Buxus natalensis* and *Milletia grandis* significantly discriminated between forest types.

This analysis (BMDP) was different to that performed by the Statgraphics program, in that it used only those variables which combined would predict a significant grouping of the data into categories which were originally assumed for the discriminant function. Only four species significantly discriminated between headman's and demarcated forests (demarcated 92.9%, headman's 100%).

Figure 9 depicts the relationships of the plots to their canonical variables (discriminant function scores) based on these four species. The four principal species in decreasing importance as discriminators were *Allophylous dregeanus*, *Buxus macowanii*, *Buxus natalensis* and *Milletia grandis*. Possible reasons for this discrimination are discussed below.

Regeneration patterns

Canopy species data is presented in Table 5. Because of the low height of the canopy in many of these forests (Table 1), size classes five (20-30cm) and six (30-40cm) were taken as representative of canopy trees. This table indicates the similar number of canopy species in headman's and demarcated forests, but also shows the higher representation of trees in size class five for demarcated forests.

Table 5. Canopy species recorded in demarcated and headman's forest plots. These were represented by trees in size class 5 (20 - 30 cm) and 6 (30 - 40 cm).

CANOPY SPECIES	CLASS 5	CLASS 6	PLOT NO.
DEMARCATED			
Bersama swinnyi	1		12
Canthium inerme		1	5
Croton sylvaticus	1		5
Cussonia sphaeroce.		2	2;5
Ficus natalensis		1	1;6
Ficus sur		1	7
Homalium dentatum	1	1	7;9
Margaritaria disc.	2	1	3;6
Milletia grandis	1	1	12
Mimusops obovata	1	1	12;14
Nuxia floribunda	1		13
Protorhus longifolia		1	12;13
Strychnos henning.	2	1	1;6
Teclea natalensis	1	2	2;11
Vepris undulata		1	12
Zanthoxylum	1		10
n = 16			
HEADMAN'S			
Canthium inerme		1	16
Cassine papillosa		1	20
Celtis africana		1	26
Combretum kraussii		2	20;26
Croton sylvaticus		2	17;25
Cryptocaria latifolia		1	34
Erythrina caffra		2	21;22
Euclea natalensis		1	24
Euphorbia grandid.	2		27;29
Ficus natalensis		1	27
Ficus sur	1	1	22;26
Heywoodii lucens		3	31
Milletia grandis	1		15
Unidentified		1	16
Vepris undulata		4	19;27;28
n = 15			

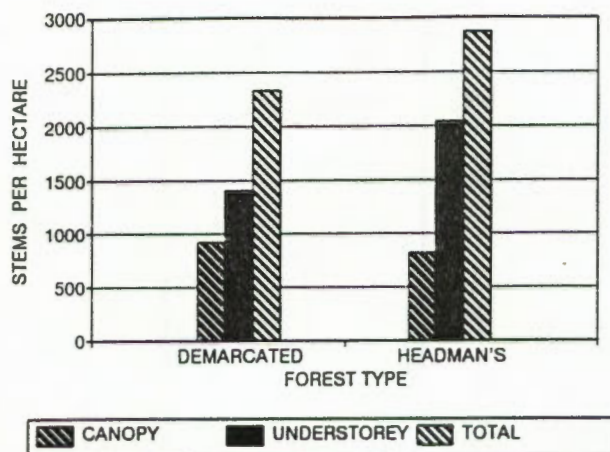
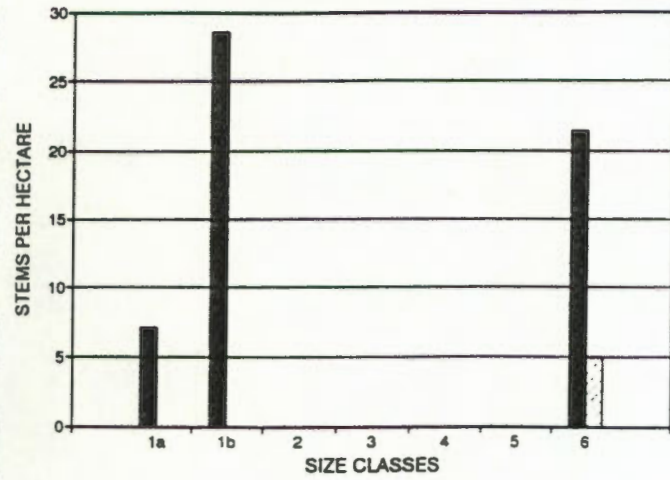


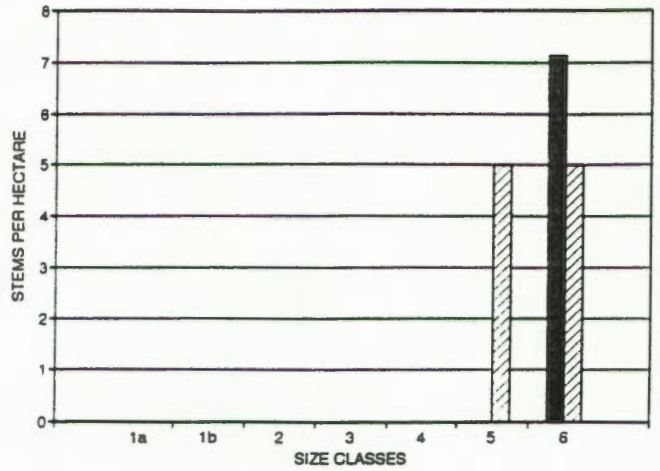
Figure 10. Total stem number, and the number of these which are canopy or understorey species, recorded in the smallest size class (1a, 1-2 cm dbh) for demarcated and headman's forests.

As seedling regeneration was not examined in this study, recruitment patterns were examined using small saplings, trees in size class 1a (1-2cm), as being indicative of recruitment trends. The results of this examination are given in Figure 10. Species were divided into one of two groups, canopy and understorey, and the stem number in each of these classes converted to a value per hectare. Because of the low nature of the canopy in many plots (Table 1), canopy species were considered as being trees that attained heights upwards of 10 m. The ratio of canopy trees to understorey trees was found to be higher in the demarcated than the headman's forests (Figure 10) but the absolute numbers of canopy trees was found to be similar for both forest types.

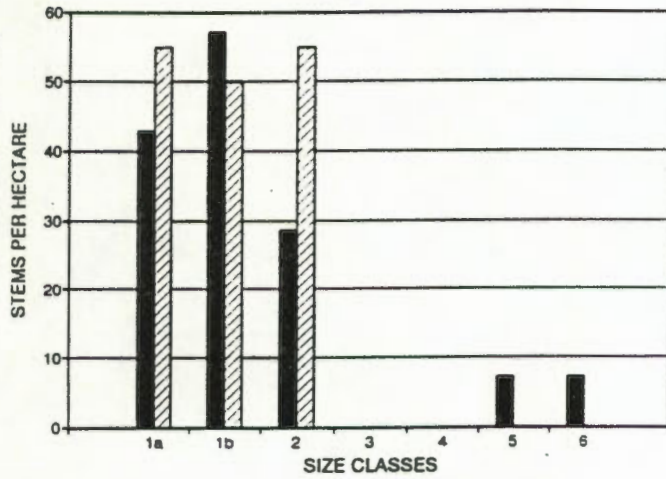
Ficus natalensis



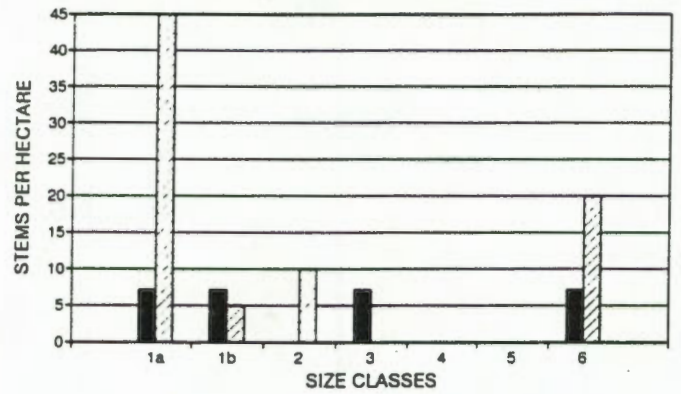
Ficus sur



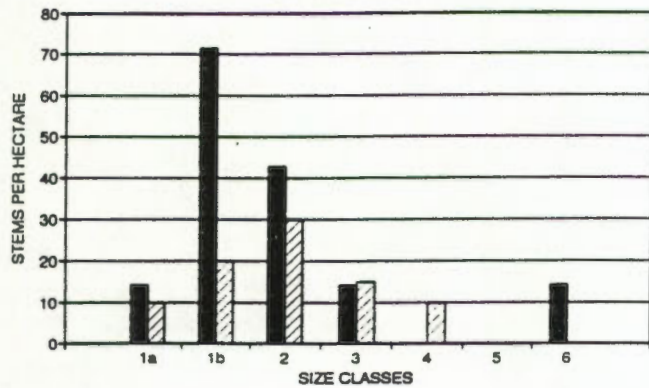
Teclea



Vepris undulata



Cussonia



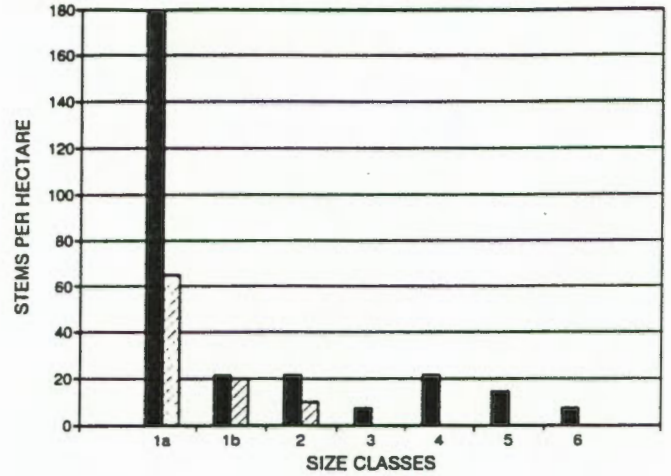
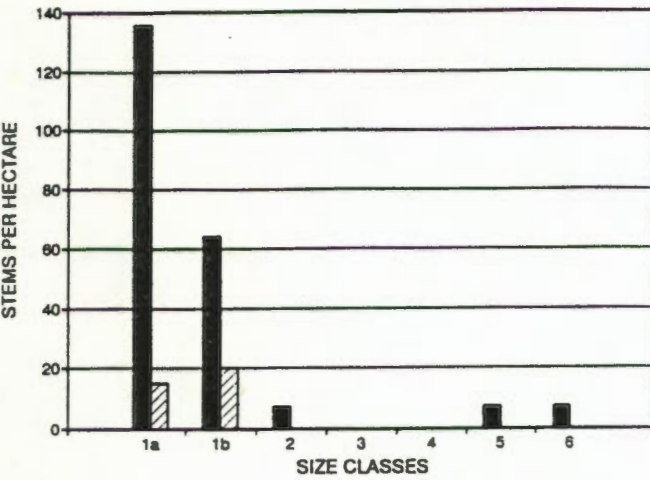
■ DEMARCATED ▨ HEADMAN'S

Figure 11. Stem density distributions of the canopy species; *Ficus natalensis*, *F. sur*, *Teclea natalensis*, *Vepris undulata* and *Cussonia sphaerocephala*.

Figure 11 indicates the regeneration patterns of a few tree species which are commonly found in both forest types, but seem to be less exploited, being represented in the canopy of many forests (pers. obs.). This figure illustrates the low number of stems for these species with no clear pattern of stem density distribution across the size classes.

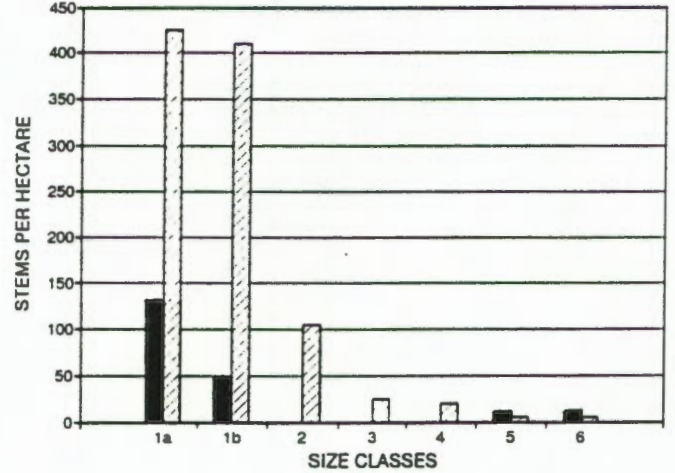
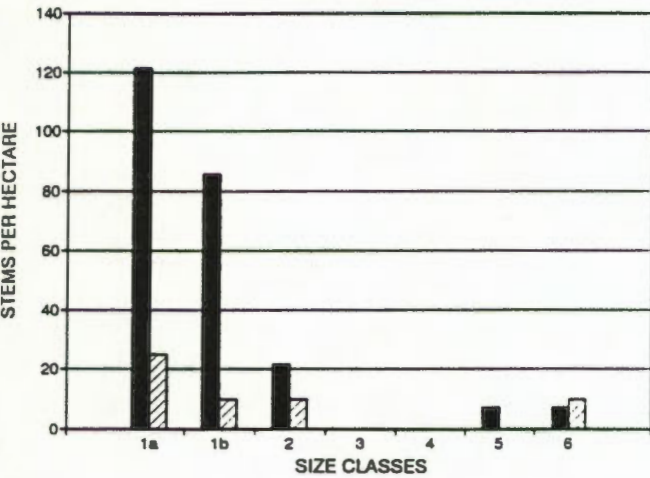
Homalium

Strychnos spp.



Croton

Milletia grandis



■ DEMARCATED ▨ HEADMAN'S

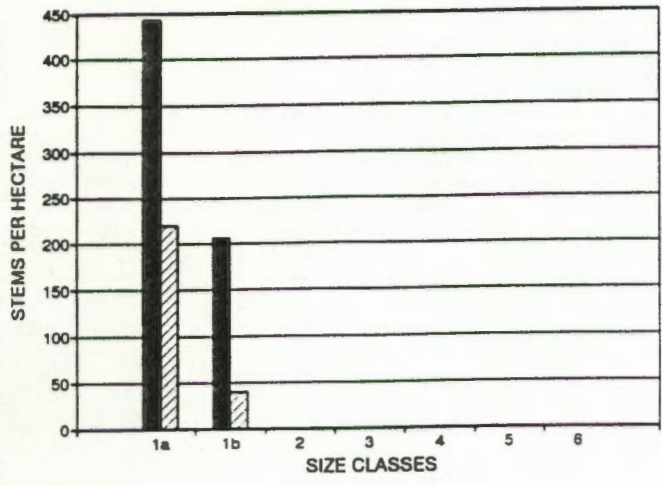
Figure 12. Stem density distributions of the canopy species *Homalium dentatum*, *Strychnos spp.*, *Croton sylvaticus* and *Milletia grandis*.

Figure 12 represents the regeneration pattern of a few species which are more favoured for their wood. Here there is a general trend of decreasing stem density with increasing size class for *Homalium dentatum*, *Strychnos spp.* (three species combined) and *Croton sylvaticus* in the demarcated forests and for *Millettia grandis* in headman's forests. The trend for these species is accompanied by higher stem density values. In Figures 11 and 12, plots were assumed to have an equal chance of having the canopy species represented except in the case of *Millettia grandis*. This species was not found in Gxwaleni and Jubase forests as would be expected, being restricted to xeric habitats (Cawe 1990). These forests were therefore excluded when calculating values represented in Figure 12.

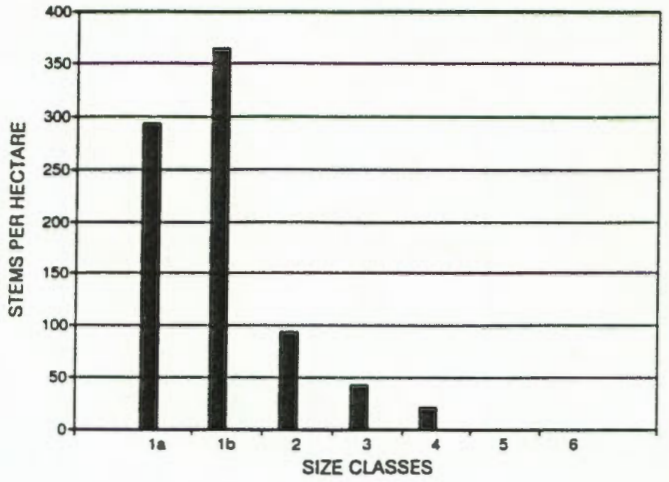
Figure 13 shows regeneration patterns for six understorey species. The most notable trend is the higher stem densities recorded when compared to canopy densities (Figures 11 and 12). *Buxus macowanii* was not found to occur at all in headman's forests but was well represented over a range of size classes in demarcated forests (Figure 13).

Buxus natalensis had greater stem densities in the demarcated forests and *Tricalysia lanceolata* and *Oxyanthus speciosus* had higher values in the headman's forests. The plots in the wetter forests (Gxwaleni and Jubase) were excluded from the calculations for *Dalbergia obovata* represented in Figure 13, as this species seems to be associated with dryer sites.

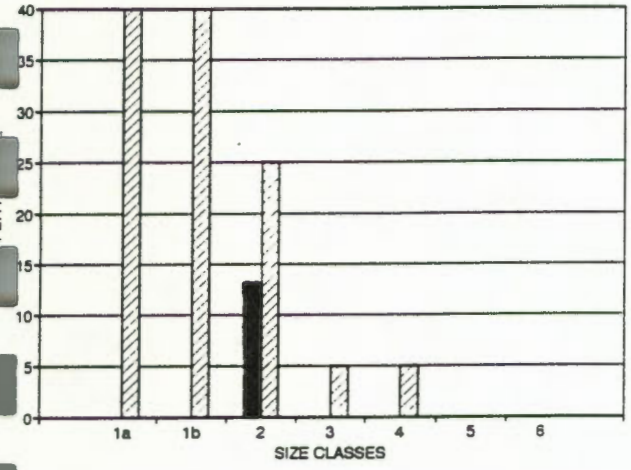
Buxus natalensis



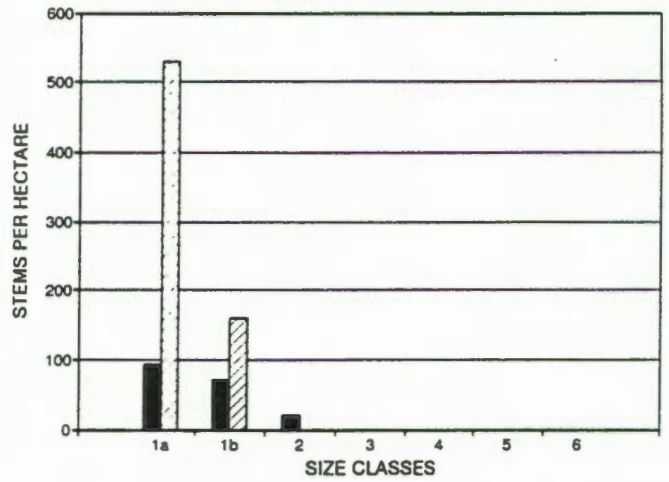
Buxus macowanii



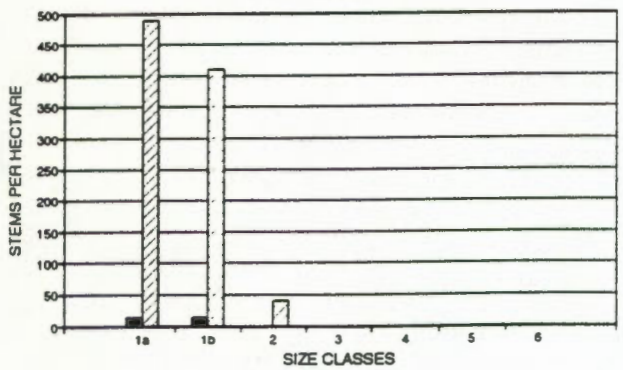
Dalbergia



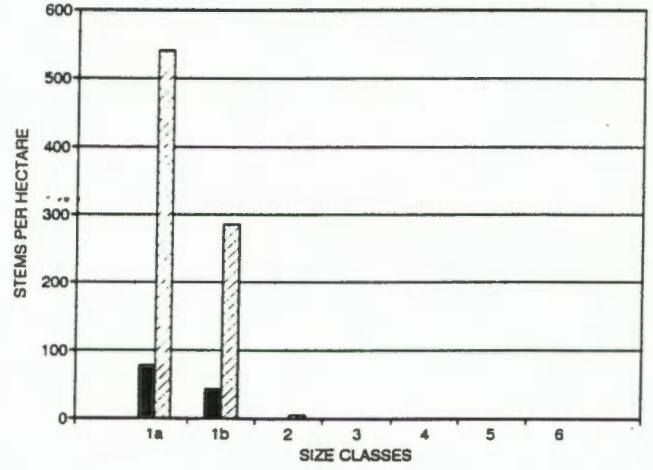
Tricalysia lanceolata



Cestrum



Oxyanthus



■ DEMARCATED ▨ HEADMAN'S

Figure 13. Stem density distributions for the understorey species; *Buxus natalensis*, *Buxus macowanii*, *Dalbergia obovata*, *Tricalysia lanceolata*, the alien species *Cestrum laevigatum* and *Oxyanthus speciosus*.

DISCUSSION

During the course of the fieldwork for this project I have come to realise that although a forest may look good from the outside, this is often deceiving, and on closer examination what one is actually seeing is a shell of large, old canopy trees with very few intermediate sized trees replacing them. This observation has also been made by Muir (1990), who points out that forests that may appear intact from aerial photographs might actually be less secure owing to the failure of canopy regeneration.

Structural features

A useful way of looking at forest structure and regeneration patterns is to examine how the number of trees change with increasing size of the tree. Figure 14 gives a representation of these trends for a pristine forest, Bloukrans, in the southern Cape (van Laar and Geldenhuys 1975). Although based on a different forest community, this general form of stem diameter distribution may be useful as a yardstick when looking at stem distribution patterns in other indigenous forests.

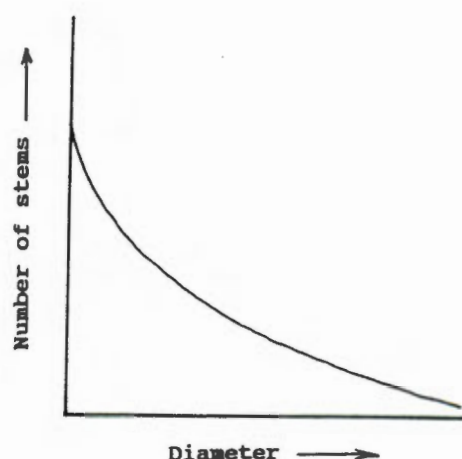


Figure 14. General form of a stem diameter distribution. (After Van Laar and Geldenhuys, 1975).

Factors explaining the shape of this curve are complex but may include longevity, as many species in the smaller size classes are not potential canopy species and will not live long enough to attain larger size classes. The picture is further complicated by species-specific requirements in terms of shade tolerance and growth rates. In a study of a neotropical rainforest, (Lieberman *et al.* 1990), understory species were found to have slow maximum growth rates and short lifespans and sub-canopy species had slow maximum growth rates with long lifespans. Most canopy species were found to have rapid maximum growth rates and long lifespans (shade tolerant species), whereas others showed very rapid growth rates and short lifespans (shade intolerant species which react opportunistically to increased light levels).

The overall shape of the stem density distributions obtained in this study (Figures 2 and 3) reflects the shape predicted by the curve for a more pristine forest (Figure 11). However, the Figures 2 and 3 indicate low numbers of large trees in both forest types. The high stem densities in the two smallest size classes would suggest either a large number of reseedling saplings and/or a large number of resprouting coppices.

From Figure 5 we can see that fewer trees (8.5%) were multistemmed in the demarcated forests compared to the headman's forests (25%). Considering that the largest numbers of stems are contained in size classes 1a and 1b (Figure 2), this information suggests that there are more multistemmed individuals in the headman's than in the demarcated forests, for these size classes. Figure 5 also indicates that fewer of the multistemmed trees had been cut in the demarcated forest (53%), as opposed to the headman's forests (91%). This means that a higher percentage of the multistemmed trees in demarcated forests are naturally multistemmed due to their specific biology (e.g.. branching pattern), whereas the

multistemmed trees in headman's forests appear to have been "forced" into this coppicing life-form by cutting (See Plate 2).

What is interesting is that in both forest types there was almost a complete replacement (89%) of cut stems by resprouting stems (Figure 5).



Plate 2. An example of an umzimbeet, *Millettia grandis* showing coppice regrowth following cutting.

The conclusions to be made here are:

- 1) the management status of the forest appears to have an effect on present utilisation patterns, less cutting is taking place in demarcated forests and
- 2) in headman's forests most multistemmed trees (25% of total) are coppicing resprouts.

In examining evidence of recent cutting, harvested stems were generally found to fall into the smaller size classes, with the greatest number being in size class 1b for headman's forests (Figure 6). This result indicates that this size class (2-5 cm) is the most popular stem size harvested from living trees. Some trees were found to have been harvested more than once and some bigger stumps were found to give rise to many stems following cutting (Plate 2). However, the size of the tree at first cutting would presumably be a very important factor in determining further survival of the tree. If a tree was allowed to reach a diameter of 2-5 cm before being cut it would have a greater chance of survival than if it had been cut at a smaller size.

Very few dead trees were recorded (Figure 7). The higher number of deaths in size class 1a and 1b for headman's forests suggests that not all stems utilised are capable of coppice survival. Interesting to note is that no dead saplings in size class 1a were recorded in the demarcated forests. The absence of dead stumps recorded for size classes 4 and 5 in headman's forests (Figure 7) are possibly due to the fact that stumps which have been exploited in the past (note low numbers in these size classes for Figure 3) have already rotted.

Past exploitation of trees in selected size classes may be noticeable years later in density distribution patterns of trees. Walker et al. (1986) found low numbers of *Burkea africana* trees in two intermediate size classes to reflect two episodes of exploitation of this species, some 50 and 80 years prior to the study. Reduced numbers of trees in certain size classes means the population of mature trees will fluctuate in the future, regardless of future conditions (Walker et al. 1986). In the present study, no signs of fresh cutting (apart from pollarding) of large trees was observed, and the dead stumps recorded for size class six (Figure 7) had been cut a long time previously, as was indicated by the advanced state of decomposition.

Total stem density values for the demarcated and headman's forests were found to be 5743 and 5895 (per hectare) respectively (57.43 and 58.95 per 100 m² plot) (Figure 5). Although there are structural differences between the two forest types (Figures 2, 3 and 4), the total number of stems does not reflect this. Stem density values from this study are more than twice those recorded by Cawe (1990), 2332 ± 748 per hectare, for twenty typical Transkei coastal forest communities.

In both Cawe's and the present study, 1 cm was taken as the lower DBH limit. A possible reason for the

discrepancy in stem density values is that Cawe (1990) may not have recorded *all* stems in the case of multistemmed trees. In a study on a forest in Natal (Muir 1990), stem density values were found to be higher than in this study, being of the order 7000-12000 stems per hectare, indicating a wide range within one large forest.

Figure 4 indicates differences in basal area values between demarcated and headman's forests, especially with respect to size classes 5, 4 and 3. As described in the results section, the presence or absence of trees in size class five (20-30 cm) is the factor which best discriminates between the two forest types. Size class six was not a significant discriminator between the forest types. It would appear that the largest trees, if they can reach the canopy are "safe", whereas smaller, but nevertheless substantial trees are being/have been more heavily exploited in headman's than in demarcated forests. This will be further dealt with under the section on regeneration.

Total basal area values were $25.74 \text{ m}^2 \text{ ha}^{-1}$ ($0.2574 \text{ m}^2 \text{ plot}^{-1}$) for the demarcated and $19.21 \text{ m}^2 \text{ ha}^{-1}$ ($0.1921 \text{ m}^2 \text{ plot}^{-1}$) for the headman's forest. These values are both substantially lower than those recorded by Cawe (1990, $37.12 \text{ m}^2 \text{ ha}^{-1}$) for his twenty typical coastal forest communities. His study covered a range of different communities on varying substrates and under varying moisture regimes. Forests studied by (Cawe 1990) with similar basal area values to demarcated forests were Cawe's communities number 5, 6 and 7 (26.32 ; 23.53 ; $28.75 \text{ m}^2 \text{ ha}^{-1}$). Representative forests of these communities are found in the vicinity of the R.T.U. (Gxwaleni and Bera) and contained similar species, and were all under pressure from humans and browsing animals (Cawe 1990).

The lower total basal area value for the headman's forests suggests even more severe overexploitation in these forest types than in demarcated forests.

In a comparison of figures for basal areas of forests from a range of geographical regions, Cawe and McKenzie (1989) noted a range from 30 to 50 m² ha⁻¹. Huntley (1984 in Cawe and McKenzie 1989) noted similar values for southern African forests and values of 10 - 16 m² ha⁻¹ for Miombo woodland.

The results of this study show that the basal area values were at the lower level normally associated with forests, and that values in headman's forests were more similar to those of a woodland.

The discriminant analysis has enabled the plotting of forests according to their discriminant function values (Figure 8). Demarcated plots classified in the "wrong" group in the discriminant analysis lacked trees in size class five. Misclassified headman's plots are explained either by the presence of specimens in size class five (plots 15, 27 and 29) or by a few specimens in size class four (plot 17).

Although there were fairly large differences in stem numbers between the forests for size class 1a (Figure 2) the strength of this size class as a discriminator was found to be statistically significant only at the 10% level ($p = .0797$). The fact that the overall discriminant analysis was not significant ($p = 0.13$), using a discriminating function based on the presence or absence of just a single tree per plot, suggests bigger plots and more replicates should have been used.

However, the importance of the potential to overexploit certain forests by removing smaller size classes should not be underestimated, as is given by the following example.



Plate 3. Piles of saplings which had been harvested in Talemorfu headman's forest.

In Talemorfu headman's forest, seven freshly cut piles of saplings, each containing 60 - 100 stems were observed (Plate 3). With an average of 80 stems per pile, this gives a total of 560 stems, which were all in size class 1b (2-5 cm). These stems (if found alone in a plot) would cover an area equivalent to 10 of my 100 m² plots. Calculations of the basal area of these saplings work out at 0.4 m². This is the equivalent of the basal area of two of my 100m² plots or equal to the basal area of 4 canopy trees in size class six. Quite a few instances of this kind of forest utilization have been noted. Although it seems that in the past larger trees were removed from forests, the impact that the present removal of smaller trees has on the forest should not be underestimated.

Having said this, the main species that had been cut, *Oxyanthus speciosus*, *Tricalysia lanceolata* and *Buxus natalensis* are all resprouting, understorey species. If this management of headman's forests as "woodlots" is

sustainable over time, it would be interesting and important to find out how the management is actually put into practice by the tribal authorities. A similar "woodlot"- type situation has been noted by Muir (1990) in a study on forest utilization in Maputaland in Natal. Here, it was noted that when the availability of an otherwise "ideal" pole species or size class declines, a shift is made towards the next most abundant size class, usually towards smaller size classes which commonly contain more stems. Muir (1990) found that the most popular lath (dbh = 1-5 cm) species, *Acalypha glabrata*, *Duvernoia adhatodoides* and *Buxus natalensis* coppice readily in response to harvesting.

A similar situation occurs in the Virunga forest in Uganda (Cunningham pers. comm.). In this case, small size classes of tree are harvested for bean poles in the forest understorey. Here, it is the size class that is important and not necessarily a choice for a particular species, as the demand for bean poles is so great. The result for forest ecology is a lack of regeneration of many canopy species and the survival of species which coppice easily (Cunningham pers. comm.).

Du Toit et al. (1984) in a survey on wood usage in Zimbabwe, found species preferred by local users, to be scarce. As a result of scarcities, a shift in the utilisation of species was noted. The indigenous species used for roofing were being replaced by *Eucalyptus* sp. (Du Toit et al. 1984). *Eucalyptus* sp. were also found to be the main roofing species in this study (Appendix 3).

Sustainable harvesting of wood has also been observed for large trees. An example was observed in Buletshe headman's forest. This forest has been reduced considerably in area over the past 40 years (M. Buletshe pers. comm). It would seem, however, that due to the present paucity of large trees, careful harvesting

techniques which ensure the survival of existing trees, are being employed. Four canopy trees (*Combretum kraussii*, *Celtis africana*, *Ficus sur* and *Teclea natalensis*) were found to have been cut at between 1.5 m and 4 m and large branches removed. Care had been taken that main growing stems were not damaged.

Floristic comparison

Although there are differences in the number of species per plot for the demarcated and headman's forests, not too much can be read into this considering the variation in communities between and within forests.

Discriminant analysis using *Allophylous dregeanus*, *Buxus macowanii*, *Buxus natalensis* and *Millettia grandis* grouped the plots into communities based on the presence or absence of these four species. From Table 4 it can be seen that *Allophylous dregeanus* occurred in 43% of demarcated plots but not in headman's plots. The plots in which this species occurred were confined to the doleritic soils of Gxwaleni forest and to the plot at Jubase, which is close to the coast and probably wetter than other forests.

The Cape box, *Buxus macowanii*, was found to occur in 57% of the demarcated plots but not in the headman's plots (Table 4), even though it is usually associated with dry sites (Cawe 1990). This species is popular for its coarse-grained timber, but is slow growing and is being exploited in many coastal forests (Cawe 1990). The absence of this species from the headman's counterparts of Talemorfu and Kumbula forests suggests that it has been overexploited in these forests. *Buxus macowanii* has been cited as a good fence pole species (Appendix 3). The Natal box *Buxus natalensis*, was found to occur in 79% of the demarcated plots and in 30% of the headman's plots

(Table 4). This understorey shrub or small tree, according to Cawe (1990) is mesophytic, and the wood is of an equal quality to that of *Buxus macowanii* (Coates Palgrave 1983). Not much can be said regarding this species in terms of its discriminating value, except that it would appear to reflect microclimatic differences in moisture regime across all forest patches.

The last species which discriminates between forest types is umzimbeet, *Millettia grandis*, which was found to occur in 90% of the headman's plots and 29% of the demarcated plots (Table 4). This species is commonly used (Appendix 3), produces a hard wood and is restricted mainly to dry sites (Cawe 1990). Under favourable conditions it may reach 15 m in height Cawe (1990). The fact that this species was recorded in all but two of the twenty demarcated plots suggests that careful management practices and/or biological attributes prevent it from becoming over-exploited. This species has the ability to coppice readily and was frequently found as a coppicing stump. *Millettia grandis*, along with other coppicing species, fits the "managed woodlot" idea of headman's forests.

Floristically, the load of total stem number was contained within relatively few species in the headman's forests (Table 3). The relative importance of only four resprouting species (*Millettia grandis*, *Cestrum laevigatum*, *Oxyanthus speciosus* and *Tricalysia lanceolata*) is noticeable. These four species combined accounted for 73% of the resprouting stem number and 59% of the total stem number in headman's forests. The importance of a few species as resprouters in the headman's plots (Table 3), has also been noted by Muir (1990). In his study, the top three coppicing lath species were found to account for 63% of a cut wood sample (Muir 1990).

Regeneration

In the example of sapling cutting in Talemorfu forest (Plate 3), although most stems observed were from coppicing understorey species, others were non-coppicing canopy species. These include *Strychnos henningsii*, *Strychnos mitis*, *Croton sylvaticus* and *Calodendrum capense*.

Table 1 shows the various heights of the canopies in the plots sampled. Variation ranged from no canopy to canopies with heights of 20 m. There are also instances where the canopy has been lowered, suggesting the selective removal of large trees. Cawe (1990) found canopy heights of between 11.8 and 28.4 (mean = 19.09) for typical coastal forest patches.

The mean canopy height for the forests that I examined was 12.5 m (absent canopy was considered to be 3 m) for the demarcated forests and 8.4 m for the headman's forests. The lowest canopy values recorded by Cawe (1990) (11.8 - 13 m) were found to occur in forests in which extensive exploitation had occurred. In many of the headman's patches the old canopy could be seen as a few sparse trees or as an adjacent high canopy, at 15 - 20 m (Table 1).

Why are there so few species represented in the canopy (Table 5) and why these particular species?. By examining the biology of canopy species recorded it seems as if some canopy species are either too soft to be of use (*Cussonia sphaerocephala*, *Ficus natalensis*, *Ficus sur*, *Erythrina caffra*) or too hard to be of use once a certain size is obtained (*Heywoodii lucens*, *Vepris undulata*, *Teclea natalensis*).

Figure 11 indicates few clear regeneration trends for the "unpopular" canopy species, largely due to low stem densities. *Ficus natalensis* usually grows from the canopy downwards as a strangling epiphyte (Cawe 1990; pers. obs.) and would therefore not expect to show much understorey regeneration. *Ficus sur* was recorded only as a canopy tree in this study. In one instance (Buletshe headman's forest) the exploitation of this species by branch removal at a height of 4 m was observed.

Two canopy species which have very hard wood (*Teclea natalensis* and *Vepris undulata*) were found to be recruiting in the smaller size classes but there seemed to be few intermediate sized trees (Figure 11). *Cussonia sphaerocephala* a species with low fuel and timber value (Cawe 1990) was fairly well represented in both headman's and demarcated plots (Figure 11).

Regeneration patterns of three "popular" canopy species (Figure 12) show stem distribution patterns which are similar to that which is presented in Figure 13. These trends indicate a fairly complete distribution of stem density across size classes for *Millettia grandis* in headman's forests and *Homalium dentatum*, *Croton sylvaticus* and *Strychnos spp.* in demarcated forests. *Millettia grandis* was found to have large numbers of stems in the 1 - 5 cm range in headman's forests, mainly due to coppicing resprouts. *Homalium*, *Croton* and *Strychnos* seemed to be regenerating fairly well in the demarcated forests (except for size class 3 and 4), but seem to be under heavier exploitation in headman's forests (Figure 12).

Although only low few canopy trees were recorded in this study, it would appear that few valuable timber species are able to reach the canopy in both demarcated and headman's forests (Table 5). It seems that valuable

timber species are cut down at various stages of their regeneration and if they do not pass through this "window of vulnerability", they will fail to reach the canopy.

Examples of valuable timber species which were recorded as saplings (1-2 cm DBH) but not in the canopy include sneezewood, *Ptaeroxylon obliquum*, the Cape ash, *Ekebergia capensis* and the forest mahogany, *Trichilia dregeana*. In total only 50% of the canopy tree species (Table 5) were found to be represented by individuals in the smallest size class. Why is this the case? It is possible that certain potential canopy species have been removed at a young age (by humans or livestock), the composition of the forests being shifted towards more resilient (toxic/resprouting) species. A case in point is that of the highly-prized sneezewood, (*Ptaeroxylon obliquum*) which was observed frequently as a seedlings (< 1m, pers. obs.), but virtually never as a sapling. Sneezewood is a highly prized fencing species (Appendix 3).

The invasion of headman's forests by the alien species *Cestrum laevigatum* which is highly toxic (Watt and Breyer-Brandwijk 1962), following increased light penetration, indicates a shift in species composition in these forests. This species is used extensively in the construction of livestock enclosures and is kept in a coppicing state by cutting.

In addition, opening of the canopy by the removal of trees seemed to provide xeric microclimates in many of these gaps. Such microclimates are favoured by scrambling species such as *Dalbergia armata* and *D. obovata* which would suppress the regeneration of seedlings. *D. armata* was found to occur in 75% of the headman's plots (Table 3) and *D. obovata* in 40% of these plots (Table 3). The regeneration pattern of *Dalbergia obovata* (Figure 13) indicates stems over a wide size class range. Many of these, however, were part of the same plant, which

exhibits a climbing growth form. This species was commonly found in conjunction with *D. armata*.

Canopy removal seems to be shifting the species composition of the forest to an extent. *D. armata* and *D. obovata* are both forest margin or scrub species (Palgrave 1983) but were found to occur in the center of many headman's forests.

Another species encountered which reflects changes in species composition is *Dais cotinifolia*, a forest margin species which was recorded as a sapling in Talemorfu headman's forest. This species, in addition to those mentioned above seemed to be favoured by the high light conditions and xeric microclimates which result from canopy removal. The xeric microclimates in many of these forests seem to be enhanced by browsing by goats, the forest floor being almost bare ground in some instances.

Species richness would be expected to decrease with increasing size of tree, as not all species are potential canopy trees. Table 5 indicates a similar number of canopy species in demarcated and headman's forests. The number of species in the smallest sapling class (1a, 1-2 cm) was found to be 49 species (56% canopy) for demarcated forests and 44 species (48% canopy) for headman's forests. This suggests a similar number of regenerating species, including potential canopy species, for both forest types.

Canopy sapling densities (Figure 10) indicate similar numbers in both forest types which suggests an equal potential for canopy regeneration. However, the ratio of canopy:understorey stems is higher in demarcated forests (Figure 10), suggesting a more even spread of canopy and understorey stems. The greater number of understorey stems in the headman's forests in size class 1a is

largely attributable to species which have coppiced following cutting.

Patterns of regeneration for understorey trees (Figure 13) reflect utilization and the biological characteristics of these species. The regeneration patterns of *Tricalysia lanceolata*, *Oxyanthus speciosus* and *Cestrum laevigatum* show the importance of these resprouters in headman's forests. These species were only observed in the smaller size classes and were not recorded as intermediate-sized trees.

In comparison, another understorey tree species, *Buxus macowanii*, in demarcated forests, was found to have a stem distribution which included intermediate size classes (Figure 13). *Buxus natalensis* seems to be under pressure in both headman's and demarcated forests, as is reflected by absence of trees larger than 5 cm in diameter in either forest type (Figure 13).

The information on the cover classes of herbs and low shrubs (Table 1) shows a random pattern that does not seem to correlate with canopy height (light penetration) as might be expected. This is most likely due to the random patterns of browsing of this low vegetation by goats.

CONCLUSIONS

Floristic differences between demarcated and headman's forests were complicated to an extent by Gxwaleni and Jubase forest being closer to the coast (wetter) and Gxwaleni forest having a different soil type. However, the absence of certain species in headman's forests (e.g.. *Buxus macowanii*) and the relatively high presence of others (*Millettia grandis*, *Dalbergia spp.* and the alien, *Cestrum laevigatum*) suggests that the management of headman's forests is inducing shifts in species composition to a certain extent.

Structural differences between demarcated and headman's forests have been shown, with the presence of more intermediate-sized trees (10-30cm dbh) in the demarcated forests being the most important discriminating factor. This result reflected a substantial reduction in the total basal area of trees in the headman's forests, when compared to demarcated forests. In addition, a higher percentage of multistemmed trees was found in the headman's forests, many of these having been cut. Most cut stems were found to be replaced by coppice regrowth. Many intermediate-sized trees had been removed, and the current utilization of the forest is similar to that of a managed woodlot. A few species which are able to coppice readily (*Oxyanthus speciosus*, *Millettia grandis*, *Tricalysia lanceolata* and *Cestrum laevigatum*) are beginning to dominate, suggesting the employment of selective cutting practises on these species.

Many canopy species in both demarcated and headman's forests could *potentially* ensure the regeneration of these forests. However, if the current pressures on these forests continues, it is possible that the demarcated forests will tend towards the headman's "managed woodlots". The headman's forests, if not sustainably harvested (as is suspected for certain forests) might be

further degraded until they reach the stage of being a thicket of a few straggly trees and climbers.

The problem with overexploitation of indigenous forests is due to many factors and will not be solved by increasing the number of forest guards. In my opinion, the only way to reduce the pressure on indigenous forests is to provide alternative wood sources. This could be achieved with woodlots, which have had varying success in the past, but would be more effective in the long run if more trees were grown by local individuals. Steps aimed towards this end have been initiated by the Rural Technology Unit following requests from the community for advice concerning the growing of fruit and windbreak trees.

RECOMMENDATIONS FOR FUTURE RESEARCH

Indigenous knowledge concerning the management of forests, including information on favoured species and methods of harvesting is of vital importance in creating a full understanding of forest utilization. Such a study would need to be carried out in conjunction with the local communities over a long (2 - 3 year) period. Research would ideally be divided into three sections; a questionnaire which would examine the local trends in harvesting; a botanical survey, preferably including permanent experimental plots which could be monitored over extended periods; and an investigation into the provision of alternative wood sources.

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REFERENCES

Cawe S.G. 1990 Coastal Forest Survey. A classification of the coastal forests of Transkei and an assessment of their timber potential. Unpublished Report. University of Transkei, Umtata.

Cawe S.G. and McKenzie B. 1989 The afro-montane forests of Transkei, southern Africa. 111: A structural classification. *S. Afr. J. Bot.* 55(1):40-44.

Coates Palgrave K. 1983 *Trees of southern Africa*. C. Struik, Cape Town, Johannesburg.

Cooper K.H. and Swart W. (In Prep.) Transkei Forest Survey. Report to the Transkei Government on the condition of the indigenous forests of Transkei.

Du Toit R.F., Campbell B.M., Haney R.A. and Dore D. 1984 *Wood Usage and Tree Planting in Zimbabwe's Communal Lands*. Resource Studies, Harare.

Klecka W.R. 1980 *Discriminant Analysis*. Sage Publications, Beverly Hills, London.

Lieberman D., Hartshorn G.S., Lieberman M. and Peralta R. 1990 Forest Dynamics at La Selva Biological Station, Costa Rica, 1969-1985. In Gentry A.H. (Ed.), *Four Neotropical Rainforests*, Yale University Press, New Haven and London.

Muir D. 1990 Forest Utilisation in Kwazulu. A case study of Hlatikulu Forest Reserve, Maputaland. Unpublished Report. Institute of Natural Resources, Pietermaritzburg.

Van Laar A. and Geldenhuys C.J. 1975 Distribution and correlation patterns in an indigenous forest. *S. Afr. For. J.* 94:20-28.

Walker B.H., Stone L., Henderson L. and Vemede M. 1986 Size structure analysis of the dominant trees in a South African savanna. *S. Afr. J. Bot.* 52:397-402.

Watt J.M. and Breyer-Brandwijk M.G. 1962 *Medicinal and poisonous plants of southern and eastern Africa*. 2nd ed. E and S Livingstone Ltd., Edinburgh.

APPENDIX 1

Protected tree species in the Transkei .

Albizia adianthifolia (Flat crown)
Apodytes dimidiata (White pear)
Avicennia marina (White mangrove)
Bersama swinnyi (Coast bersama)
Bersama tysoniana (Common bersama)
Brugiera gymnorhiza (Black mangrove)
Buxus macowanii (Cape box)
Calodendrum capense (Cape chestnut)
Cassine aethiopica (Kooboo-berry)
Cassine crocea (Red saffronwood)
Celtis africana (White stinkwood)
Combretum caffrum (Cape bushwillow)
Combretum kraussii (Forest bushwillow)
Croton sylvaticus (Forest croton)
Cunonia capensis (Rooiels)
Curtisa dentata (Assegai tree)
Cussonia spicata (Cabbage tree)
Drypetes arguta (Water drypetes)
Ekebergia capensis (Cape ash)
Erythrina caffra (Coast erythrina)
Erythrina lysistemon (Common coral tree)
Euclea natalensis (Larged-leaved guarri)
Harpephyllum caffrum (Wild plum)
Heywoodia lucens (Stink ebony)
Ilex mitis (African holly)
Kiggelaria africana (Wild peach)
Linociera foveolata (Fine-leaved ironwood)
Linociera peglerae (Large-leaved ironwood)
Macaranga capensis (Wild poplar)
Margaritaria discoidea (Common pheasant-berry)
Maytenus penduncularis (Blackwood maytenus)
Millettia grandis (Umzimbeet)
Mimosops caffra (Coast red milkwood)
Mimosops obovata (Red milkwood)
Nuxia floribunda (Forest nuxia)
Ochna arborea (Cape plane)
Ochna holstii (Red ironwood)
Ochna natalitia (Natal plane)
Ocotea bullata (Stinkwood)
Olea africana (Wild olive)
Olea capensis (Ironwood)
Olea woodiana (Forest olive)
Olinia emarginata (Mountain olinia)
Olinia radiata (Natal olinia)
Pleurostyliia capensis (Coffee pear)
Podocarpus falcatus (Outeniqua yellowwood)
Podocarpus henkelii (Henkel's yellowwood)
Podocarpus latifolius (Real yellowwood)
Protea nitida (Waboom)
Protorus longifolia (Red beech)
Prunus africana (Red stinkwood)
Ptaeroxylon obliquum (Sneezewood)
Pterocelastrus tricuspidatus (Cherrywood)
Rapanea melanophloeos (Cape beech)
Rauvolfia caffra (Quinine tree)

Rhizophora mucronata (Red mangrove)
Rhus chirindensis (Bostaaibos)
Rothmannia capensis (Common rothmannia)
Schefflera umbellifera (Bastard cabbage tree)
Scolopia mundii (Red pear)
Scolopia zeyheri (Thorn pear)
Sideroxylon inerme (White milkwood)
Spirostachus africana (Tamboti)
Strychnos decussata (Cape teak)
Strychnos henningsii (Coffee-bean strychnos)
Strychnos mitis (Pitted-leaf strychnos)
Syzygium cordatum (Umdoni)
Syzygium gerrardii (Forest waterberry)
Tarchonanthus camphoratus (Camphor bush)
Trichilia dregeana (Forest Natal mahogany)
Vepris undulata (White ironwood)
Xymalos monospora (Lemonwood)
Zanthoxylum davyi (Knobwood)

In addition to the trees listed above , the Wild date palm (Phoenix reclinata) as well tree ferns , ferns , mosses and cycads are also protected .

The above list was drawn up as part of the Transkei Forest Act of 1969.

APPENDIX 2

Tree species encountered in this study.

SPECIES	FAMILY
1 <i>Acalypha glabrata</i>	Euphorbiaceae
2 <i>Acokanthera oppositifolia</i>	Apocynaceae
3 <i>Acridocarpus natalitius</i>	Malpighiaceae
4 <i>Allophylus decipiens</i>	Sapindaceae
5 <i>Allophylus dregeanus</i>	Sapindaceae
6 <i>Apodytes dimidiata</i>	Sapindaceae
7 <i>Bequaerti dendron natalense</i>	Sapotaceae
8 <i>Bersama swinnyi</i>	Melanthaceae
9 <i>Buxus macowanii</i>	Buxaceae
10 <i>Buxus natalensis</i>	Buxaceae
11 <i>Calodendrum capense</i>	Rutaceae
12 <i>Canthium inerme</i>	Rubiaceae
13 <i>Carissa bispinosa</i>	Apocyanaceae
14 <i>Cassia didymobotrya*</i>	Leguminosae
15 <i>Cassine papillosa</i>	Celastraceae
16 <i>Cassine sp.</i>	Celastraceae
17 <i>Cassipourea flanaganii</i>	Rhizophoraceae
18 <i>Celtis africana</i>	Ulmaceae
19 <i>Cestrum laevigatum*</i>	Solanaceae
20 <i>Chaetacme aristata</i>	Ulmaceae
21 <i>Clausena anisata</i>	Rutaceae
22 <i>Cola natalensis</i>	Sterculiaceae
23 <i>Combretum krausii</i>	Combretaceae
24 <i>Croton sylvaticus</i>	Euphorbiaceae
25 <i>Cryptocaria latifolia</i>	Lauraceae
26 <i>Cryptocaria woodii</i>	Lauraceae
27 <i>Cussonia spaerocephala</i>	Araliaceae
28 <i>Dais cotinifolia</i>	Thymelaeaceae
29 <i>Dalbergia armata</i>	Leguminosae
30 <i>Dalbergia obovata</i>	Leguminosae
31 <i>Diospyros sp.</i>	Ebenaceae
32 <i>Dombeya tiliacea</i>	Sterculiaceae
33 <i>Dovyalis longispina</i>	Flacourtiaceae
34 <i>Drypetes gerrardii</i>	Euphorbiaceae
35 <i>Ehretia rigida</i>	Boraginaceae
36 <i>Ekebergia capensis</i>	Meliaceae
37 <i>Erythrina caffra</i>	Leguminosae
38 <i>Euclea natalensis</i>	Ebenaceae
39 <i>Euphorbia grandidens</i>	Euphorbiaceae
40 <i>Ficus natalensis</i>	Moraceae
41 <i>Ficus sur</i>	Moraceae
42 <i>Gardenia thunbergia</i>	Rubiaceae
43 <i>Grewia lasiocarpa</i>	Tiliaceae
44 <i>Heywoodii lucens</i>	Euphorbiaceae
45 <i>Homalium dentatum</i>	Flacourtiaceae
46 <i>Kiggelaria africana</i>	Flacourtiaceae
47 <i>Margaritaria discoidea</i>	Euphorbiaceae
48 <i>Maytenus heterophylla</i>	Celastraceae
49 <i>Maytenus sp.</i>	Celastraceae
50 <i>Millettia grandis</i>	Leguminosae
51 <i>Mimusops obovata</i>	Sapotaceae
52 <i>Nuxia floribunda</i>	Loganiaceae

53	<i>Ochna natalita</i>	Ochnaceae
54	<i>Olea capensis</i> subsp. <i>enervis</i>	Oleaceae
55	<i>Orcia bachmannii</i>	Rutaceae
56	<i>Oxyanthus speciosus</i>	Rubiaceae
57	<i>Pavetta lanceolata</i>	Rubiaceae
58	<i>Protorhus longifolia</i>	Anacardiaceae
59	<i>Psychotria capensis</i>	Rubiaceae
60	<i>Ptaeroxylon obliquum</i>	Ptaeroxylaceae
61	<i>Putterlickia</i> sp.	Celastraceae
62	<i>Rauvolfia caffra</i>	Apocynaceae
63	<i>Rawsonia lucida</i>	Flacourtiaceae
64	<i>Rothmannii globosa</i>	Rubiaceae
65	<i>Scolopia zeyherei</i>	Flacourtiaceae
66	<i>Solanum giganteum</i>	Solanaceae
67	<i>Solanum mauritianum</i> *	Solanaceae
68	<i>Strychnos decussata</i>	Loganiaceae
69	<i>Strychnos henningsii</i>	Loganiaceae
70	<i>Strychnos mitis</i>	Loganiaceae
71	<i>Tarchonanthus trilobus</i>	Compositae
72	<i>Teclea natalensis</i>	Rutaceae
73	<i>Tricalysia capensis</i>	Rubiaceae
74	<i>Tricalysia lanceolata</i>	Rubiaceae
75	<i>Trichilia dregeana</i>	Meliaceae
76	<i>Trichocladus crinitus</i>	Hamamelidaceae
77	<i>Trimeria rotundifolia</i>	Flacourtiaceae
78	Un plot 1	
79	Un plot 14	
80	Un plot 19	
81	Un plot 23	
82	Un plot 28	
83	Un plot 3	Rubiaceae
84	Un 1 plot 7	
85	Un 1 plot 8	
86	Un 1 plot 10	
87	Un 1 plot 18	
88	Un 1 plot 24	
89	Un 1 plot 30	
90	Un 1 plot 31	
91	Un 2 plot 7	Rubiaceae
92	Un 2 plot 10	
93	Un 2 plot 18	
94	Un 2 plot 24	
95	Un 2 plot 31	
96	Un 3 plot 24	
97	Un 4 plot 6	
98	Un 5 plot 6	
99	<i>Vepris undulata</i>	Rutaceae
100	<i>Zanthoxylum capense</i>	Rutaceae
101	<i>Zanthoxylum davyi</i>	Rutaceae
102	<i>Ziziphus mucronata</i>	Rhamnaceae

* denotes alien species

APPENDIX 3

Some preferred woody species utilised at homesteads.
(Source; M. Buletshe pers. comm.)

Use	Local name	Botanical name
Roofing (main frame)		<i>Eucalyptus sp.*</i>
Roofing (struts)	uHlolo iYiinki uHlwehlwe inTozane	<i>Grewia lasiocarpa</i> <i>Cestrum laevigatum*</i> <i>Oxyanthus speciosus</i> <i>Dais cotinifolia</i>
Fencepoles	umThathi umSimbithi iGala-gala uHlwehlwe uBobo uThongothi umTyatyambane umHlakothi	<i>Pteroxylon obliquum</i> <i>Milletia grandis</i> <i>Buxus macowanii</i> <i>Oxyanthus speciosus</i> <i>Dalbergia armata</i> ? <i>Hypericanthus amoenus</i> ? ? <i>Rhus chinensis</i>
Kraals	umPenyane umZane umNyenye inTozane	<i>Tricalysia lanceolata</i> <i>Vepris undulata</i> <i>Rhamnus prinoides</i> <i>Dais cotinifolia</i>
Chicken coops	iYiinki uZungu umPenyane	<i>Cestrum laevigatum*</i> <i>Dalbergia obovata</i> <i>Tricalysia lanceolata</i>
Sleighs (basket)	uZungu uRotane	<i>Dalbergia obovata</i> ? <i>Flagellaria guineense</i>
Sleighs	umNyenye umSimbithi	<i>Rhamnus prinoides</i> <i>Milletia grandis</i>
Yokes	umTunzi umBaba umVumvu umLungumabele umQumsa	<i>Mimusops obovata</i> <i>Calodendrum capense</i> <i>Celtis africana</i> <i>Zanthoxylum spp.</i> ? <i>Scolopia</i>
Knopkerries	umSimbithi umNyenye umZane	<i>Milletia grandis</i> <i>Rhamnus prinoides</i> <i>Vepris undulata</i>

* denotes alien species