An ecological study of the plant communities of Marakele National Park

by

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Submitted in partial fulfillment of the requirements for the degree

MAGISTER SCIENTIAE

Center for Wildlife Management

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Pretoria

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November 2002

"Waterberg had always been associated with all the wonders of unpeopled veld, and so to us who were born and grew up on the outskirts of the wilderness it represented the ideal theatre of manly adventure, of great endeavours and the possibility of princely wealth. Before us like a gapless wall lay a range of black hills. These, Dolf explained to me, were the barrier-hills of the first plateau.... There was a splashing of water, a steep rise, and we were on a straight, white road through straggling syringa and boekenhout trees."

Eugene Marais,
The Road to Waterberg

I dedicate this dissertation to my wife Assi, and children, Carissa and Pieter.

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CHAPTER 1

INTRODUCTION

The primary objective when proclaiming a National Park is to conserve parts of pristine natural ecosystems for future generations (Gertenbach 1987). Marakele National Park (MNP) is one of 17 National Parks in South Africa. It covers an area of 290,51 km² in the southwestern part of the Northern Province and is managed as a National Park since 1988, but was officially proclaimed a National Park on 11 February 1994.

MNP is situated mainly in the Waterberg Moist Mountain Bushveld (Low & Rebelo 1996) in the Savanna Biome (Rutherford & Westfall 1986) that is synonym to Acocks's (1988) Sour Bushveld, which is listed by Edwards (1972) as one of 52 of South African Veld Types extremely lacking in conservation. The Sour Bushveld covers 18 306 km², occurring in mountainous areas in the previous Transvaal Province (Coetzee 1975; Coetzee et al. 1981). Previous plant ecological studies in the Sour Bushveld (Acocks 1988) include those by Van Vuuren & Van der Schijff (1970); Coetzee (1975); Coetzee et al. (1981), Westfall (1981) and Westfall et al. 1985. Differences in methodology preclude extrapolation of these data to the Waterberg area, where the largest part of this veld type occurs (Westfall 1981).

The vegetation of the study area includes Acocks's (1988) Sour Bushveld (Veld Type 20), Mixed Bushveld (Veld Type 18), Sourish Mixed Bushveld (Veld Type 19), Sour Bushveld (Veld Type 20) and North-Eastern Mountain Sourveld (Veld Type 8) and cognizance of these veld types will have to be taken in any study of the Waterberg vegetation. Plant ecological work in these vegetation types include those of Van der Meulen (1979) who described the vegetation of the bushveld south of the Waterberg, Theron (1973) who described the vegetation of the Loskopdam Nature Reserve, Westfall (1981) who described the vegetation of the Sour Bushveld and remnants of the North-Eastern Mountain Sourveld, Van Rooyen (1983) who described the vegetation of Roodeplaat Dam Nature Reserve, Brown (1997) who described the vegetation of Borakalalo Game Reserve and Coetzee et al.1994 who described the vegetation in the pretoria area..

In order to manage and conserve any National Park, a profound knowledge of the ecology is a prerequisite, and to achieve that prerequisite, an inventory of the biotic and the abiotic components of that National Park must be undertaken. The "natural systems" as it occurs today cannot be viewed and conserved as "natural" any more, because of the influence of man. Thus, management recommodations can only be made on the basis of interpreted

ecological knowledge to restore the balance of the original natural system. The influence of management recommendations on the system must also be regularly monitored to determine if the aims that were set were achieved satisfactorily. Efficient monitoring systems also depend upon an inventory of the biotic and abiotic components (Gertenbach 1987).

The primary aim of this study was to classify and describe the vegetation of the Marakele National Park in the Waterberg of the Northern Province. The purpose of the classification can be described as to form a basis for inventory and mapping or as a basis of management. The secondary aim of this study is to obtain a basis to establish procedural guidelines for a management plan for MNP through a range condition assessment, rainfall data and annual game counts.

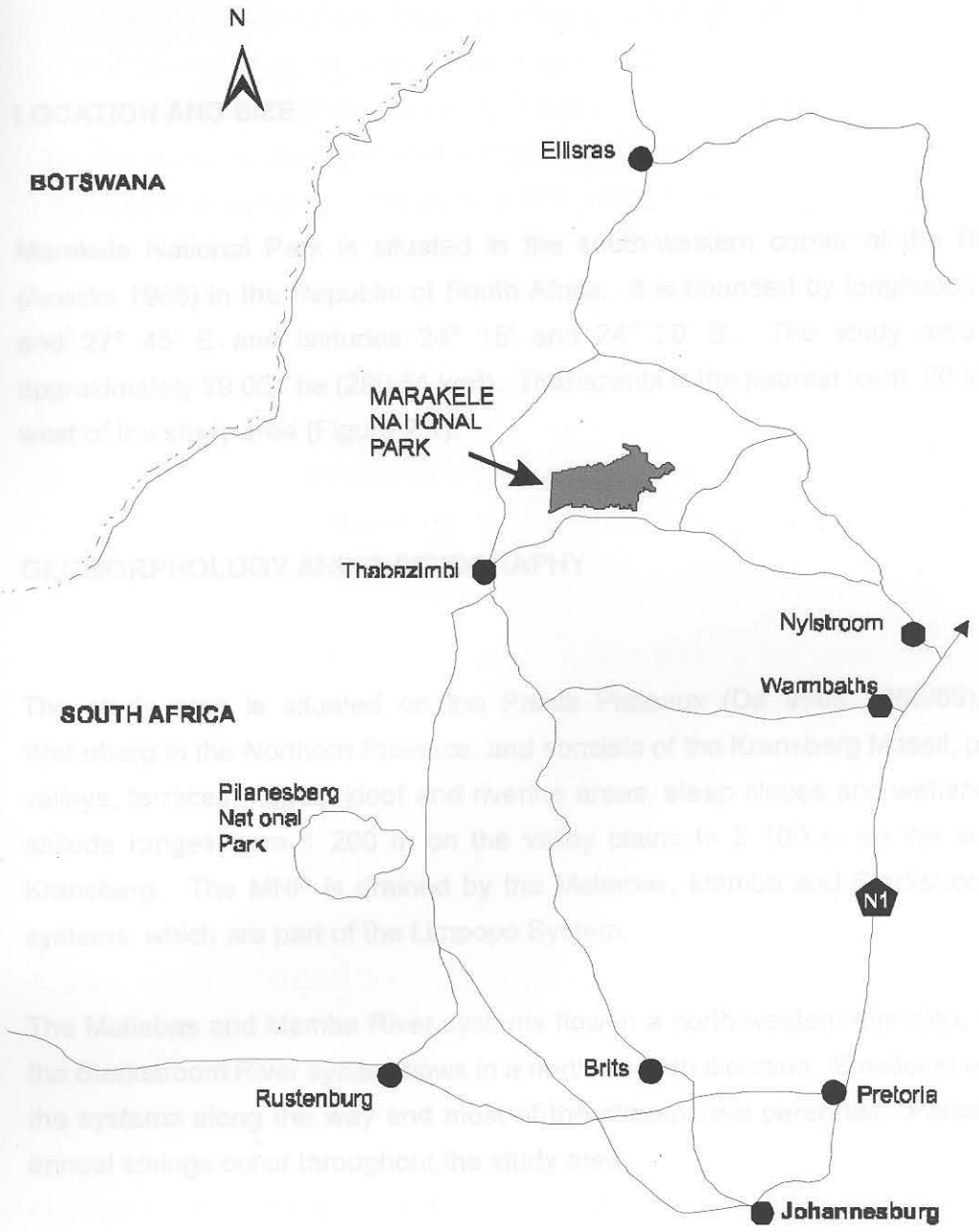

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Figure 2.1 A map indicating the location of the study area in relation to towns.

CHAPTER 2

STUDY AREA

2.1 LOCATION AND SIZE

Marakele National Park is situated in the south-western corner of the Bushveld (Acocks 1988) in the Republic of South Africa. It is bounded by longitudes 27° 30' and 27° 45' E and latitudes 24° 15' and 24° 30' S. The study area covers approximately 29 051 ha (290,51 km²). Thabazimbi is the nearest town, 20 km south west of the study area (Figure 2.1).

2.2 GEOMORPHOLOGY AND PHYSIOGRAPHY

The study area is situated on the Palala Plateaux (De Vries 1968/69), of the Waterberg in the Northern Province, and consists of the Kransberg Massif, plateaux, valleys, terraces, ridges, kloof and riverine areas, steep slopes and wetlands. The altitude ranges from 1 200 m on the valley plains to 2 100 m on the summit of Kransberg. The MNP is drained by the Matlabas, Mamba and Sterkstroom River systems, which are part of the Limpopo System.

The Matlabas and Mamba River systems flow in a north-western direction, whereas the Sterkstroom River system flows in a north-eastern direction. Smaller streams join the systems along the way and most of the streams are perennial. Perennial and annual springs occur throughout the study area.

2.3 GEOLOGY AND SOIL

2.3.1 Geology

The South African Commitee for Stratigraphy (SACS 1980) undertook a reclassification of the geology and according to this, the rocky outcrops in the study

area are, therefore, named in terms of the new classification (SACS 1980; Westfall 1981; Gertenbach 1987; Table 2.1).

Sedimentary deposits of the Waterberg Group of the Mokolian Erathem (1 080 - 2 070 Ma) are found in the study area (Figure 2.2). Large part of the study area consists of sandstone of the Kransberg Subgroup, Sandriviersberg Formation (Figure 2.2). The south-western and southern parts of the study area consists of sandstone of the Matlabas Subgroup, Aasvoëlkop Formation overlying shale and mudstone of the Matlabas Subgroup, Aasvoëlkop Formation, Groothoek Mudstone Member. Shale outcrops occur where the overlying sandstone has been completely eroded. At the western boundary of the study area occur conglomerate outcrops of the Matlabas Subgroup, Aasvoëlkop Formation (Table 2.1, Figure 2.2). Post-Waterberg diabase dykes and sills of the Mokolian age are exposed in the south-western part and at the northern boundary of the study area (Figure 2.2; SACS 1980; Westfall 1981). In figure 2.3 a north-south profile of the geological formations and terrain morphology of the study area is presented.

The different geological formations erode to form spesific soil types with associated vegetation, which is clearly visible on aerial photographs (Gertenbach 1987).

2.3.2 Soil

The soil in the study area is related to the rocky outcrops from which it was derived, and therefore the soil can be discussed on the basis of their geological origin (Gertenbach 1987). The soils derived from sedimentary outcrops from the Waterberg Group, vary from a yellowish coarse-grained sandstone, locally gritty, with ferruginous laminae on cross bedding planes on the Sandriviersberg Sandstone Formation, to a reddish and brownish medium- and coarse-grained sandstone, pebbly in places with intercalated flows of trachytic lava, tuffaccous graywacke, siltstone, shale, pebble and boulder conglomerate on the Swaershoek Sandstone Formation (SACS, 1980).

According to the South-African Soil Classification (MacVicar et al. 1977), the A horizons can be qualified as orthic. The soil derived from diabase is reddish and brownish in colour with a higher clay content.

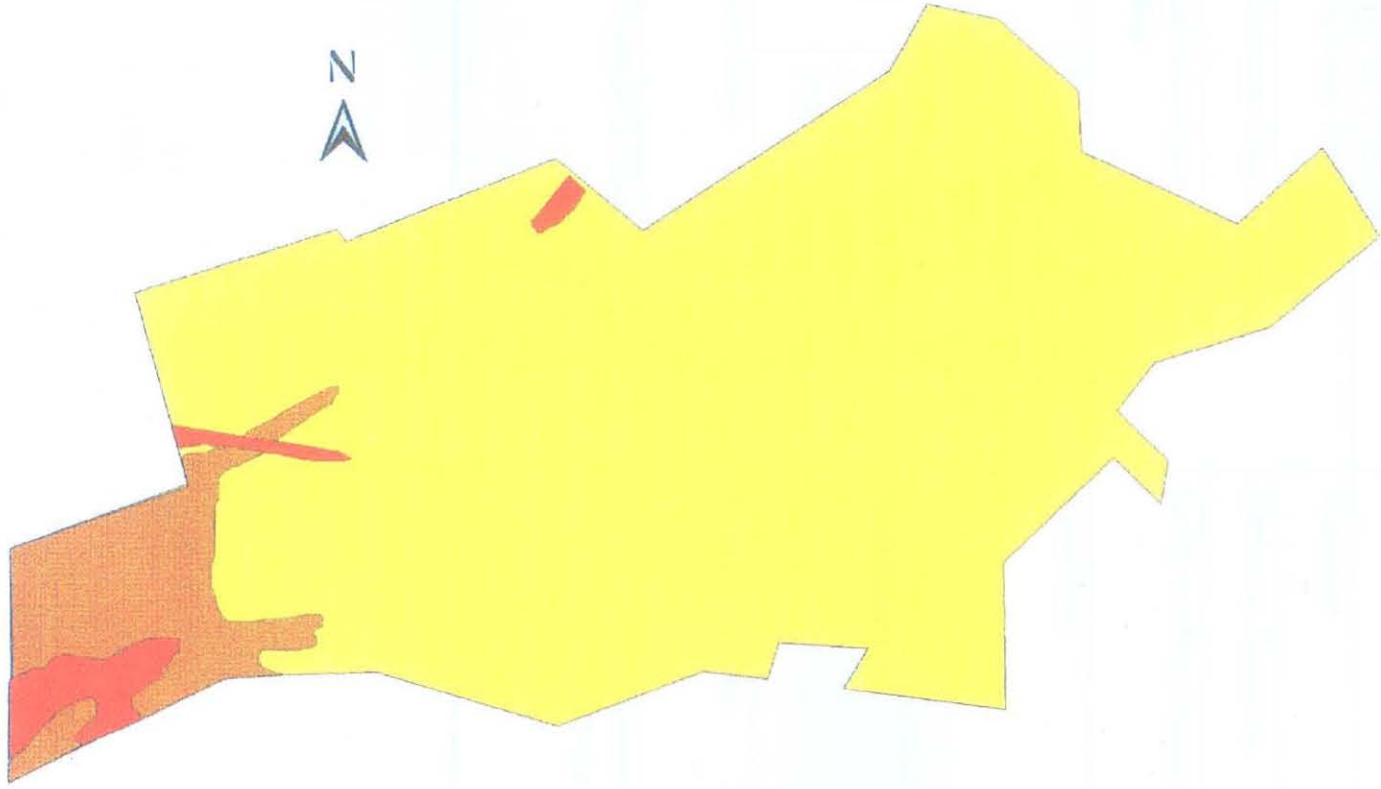

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Figure 2.2 Geological map of the study area (adapted from Geological series, Thabazimbi 2426, Department of Mines).

- Sandstone – Sandriviersberg Stage
- Siltstone, shale, sandstone, conglomerate and grit – Langkloof Stage
- Diabase

Table 2.1 Lithostratigraphy of the Waterberg Group in the study area (SACS 1980).

	Previous subdivision (DeVries 1968-69)		Subgroup	Formation	Member
Kransberg Series	Vaalwater Stage		Kransberg ("Upper Waterberg")	Vaalwater	None
	Cleremont Stage			Cleremont Sandstone	None
	Sandriviersberg Stage			Sandriviersberg Sandstone	None
Nylstroom Series	Langkloof Stage	Upper Langkloof Substage	Matlabas ("Middle Waterberg")	Aasvoëlkop	None
					Groothoek Mudstone
		Lower Langkloof Substage		Skilpadkop Grit	None
	Alma Stage		Nylstroom ("Lower Waterberg")	Alma Graywacke	None
	Swaershoek Stage			Swaershoek Sandstone Swaershoek Sandstone	None

The soils can be classified into the following soil forms: Mispah, Glenrosa, Cartref, Hutton, Clovelly, Inanda, Kranskop, Magwa, Griffin, Longlands, Dundee, Fernwood, Oakleaf, Katspruit, Avalon, Westleigh and Champagne (Land Type Survey Staff 1988; MacVicar et al. 1977).

2.4 LAND TYPES

A land type denotes an area that can be shown on a 1:250 000 scale map and displays a marked degree of uniformity with respect to terrain form, soil pattern and climate. One land type differs from another in terms of soil pattern or climate (Land Type Survey Staff 1988; Kooij et al. 1990).

Three different land types are recognised in the study area, namely the A, F and I land types (Figure 2.4). In figures 2.5, 2.6 and 2.7, 1 represents crest, 2 a scarp, 3 a midslope, 4 a footslope, and 5 a valley bottom (Land Type Survey Staff 1988). Each of these land types can be further sub-divided. The A land types refer to freely drained, yellow to red apedal soils with no water table.

Within the study area the A land type inludes only the Ad land type. This land type occurs in the western, north-eastern and eastern parts of the study area (Figure 2.4). Plinthic catenas do not occur in the Ad land type and one or more of the following soil forms occupy at least 40 % of the area, viz. Inanda, Kranskop, Magwa, Hutton, Griffin and Clovelly (Land Type Survey Staff 1988; Kooij et al. 1990). The entire A land type is suitable for agronomy (Kooij et al. 1990), and the north-eastern part of the study area has been ploughed for the cultivation of mainly maize. In the Ad land type yellow soils occupy less than 10 % of the area while dystrophic and/or mesotrophic soils occupy a larger area than the high base status red-yellow apedal soils. The Ad land type occurs mainly on sandstone of the Waterberg Group. The predominant soil form in this land type is the Clovelly Form with a soil depth between 300 - 1 200 mm and < 30 % clay in the B-horizon. The terrain units are 1, 3, 4 and 5 with terrain unit 3, (45 %) as the dominant unit in this land type (Land Type Survey Staff 1988; Figure 2.5).

Within the study area the F land type includes only the Fa land type. The Fa land type accommodates pedologically young landscapes that are not predominantly

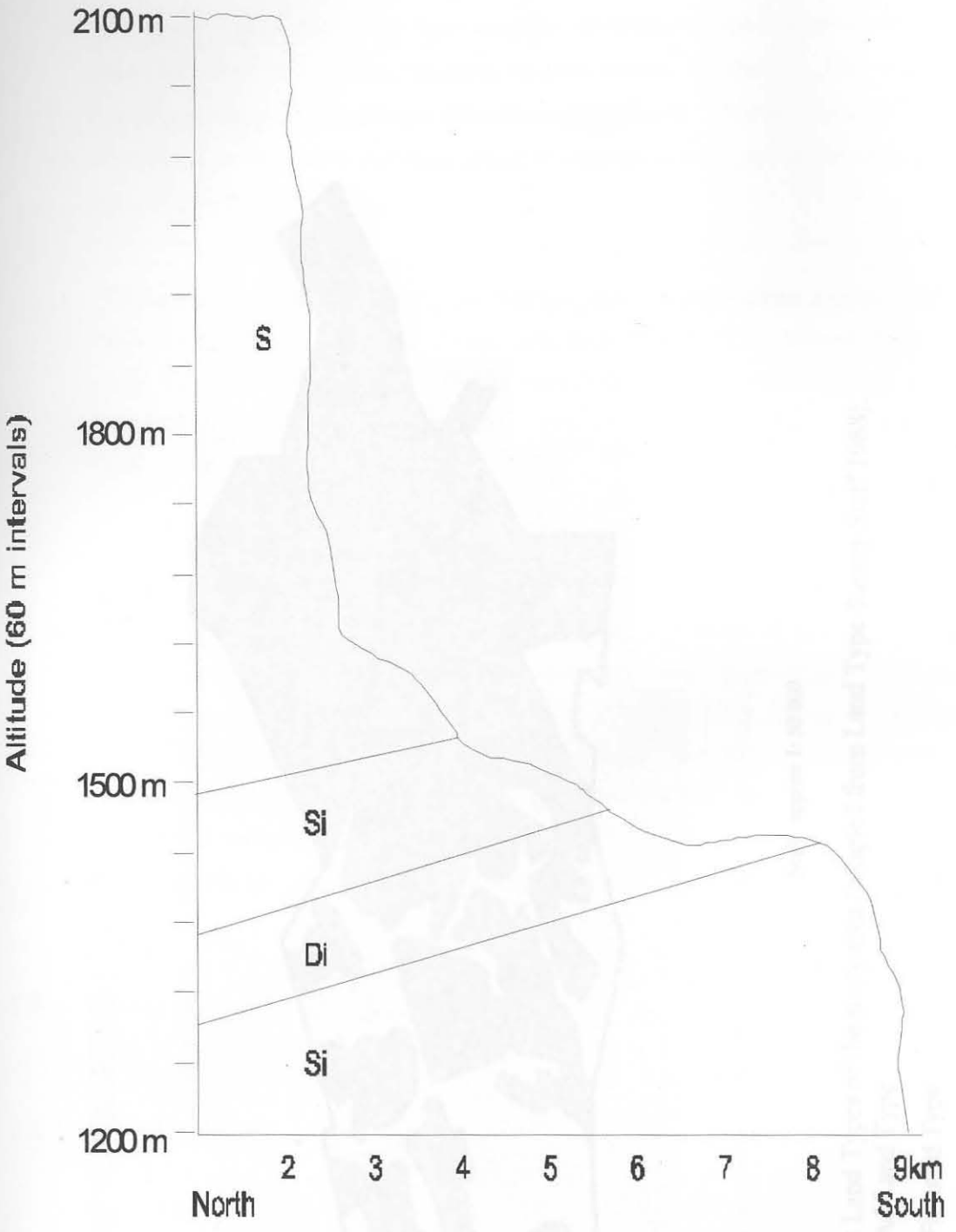

Figure 2.3 A North - South profile of geological formations of Marakele National Park.
S - Sandstone - Sandriviersberg Stage
Si - Siltstone, shale, sandstone, conglomerate & grit - Langkloof Stage
Di - Diabase

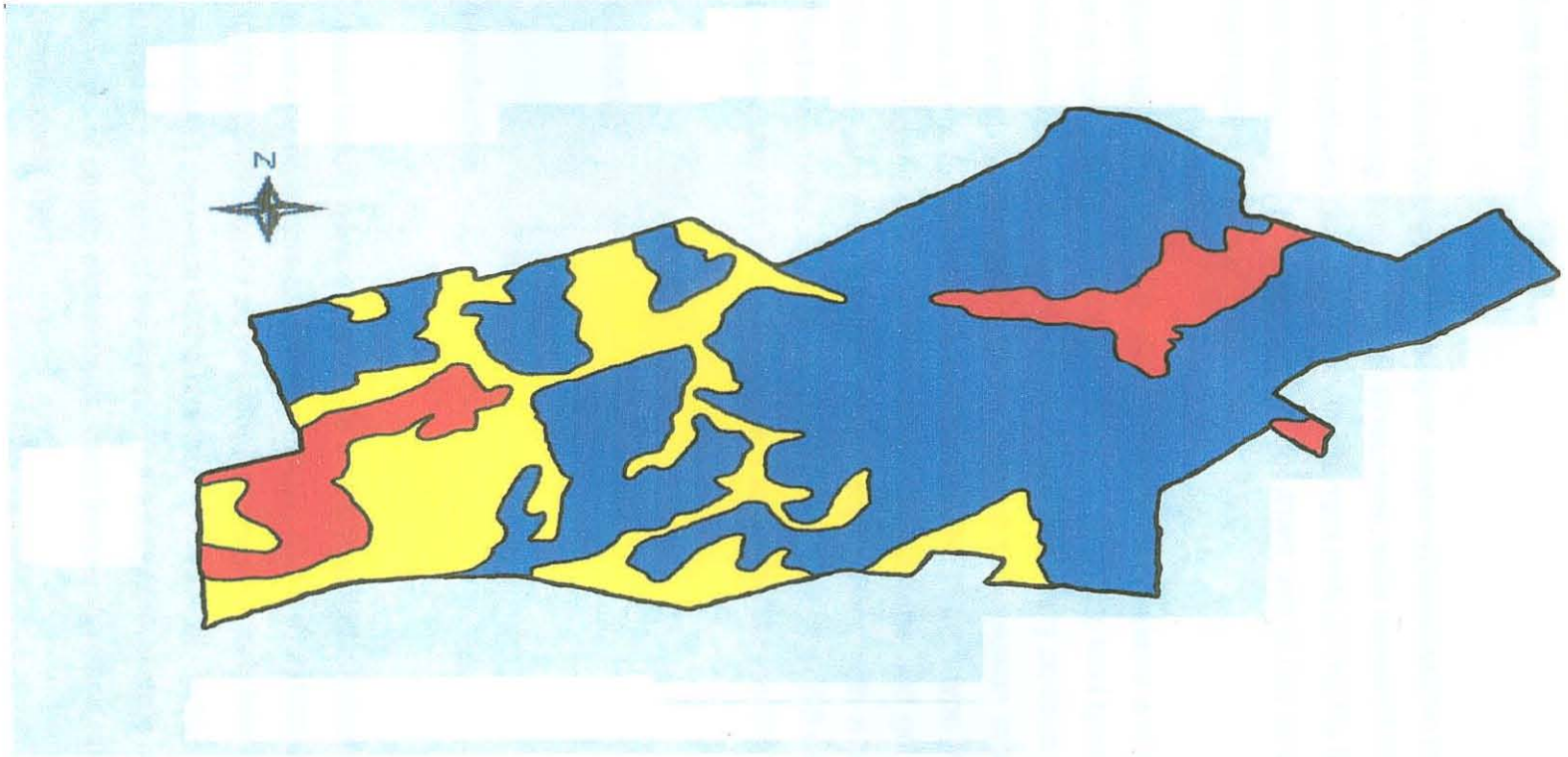

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Figure 2.4 The different Land Types of the study area (adapted from Land Type Survey Staff 1988).

The Ad Land Type

The Fa Land Type

The Ib Land Type

rocky and not alluvial or aeolian, and in which the dominant soil forming processes have been rock weathering, the formation of orthic topsoil horizons and, commonly, clay illuviation, giving rise typically to lithocutanic horizons. The soil forms that epitomise these processes are Glenrosa and Mispah. This land type refers to land in which lime in the soil is not encountered regulary in any part of the landscape (Land Type Survey Staff 1988).

The Fa land type occurs mainly on coarse-grained yellow cross-bedded sandstone of the Waterberg Group. These lithocutanic soils represent the Mispah Form with a soil depth between 50 - 300 mm. The terrain units of the Fa land type are 1, 3, 4 and 5 with terrain unit 3, (69 %) as the dominant unit in this land type (Land Type Survey Staff 1988; Kooij et al. 1990; Figure 2.6).

The I land types refer to miscellaneous land classes and within the study area the I land type includes only the Ib land type. In the Ib land type exposed rock, stones and boulders cover 60 - 80 % of the area. The rocky portions of Ib may be underlain by soil which would have qualified the unit for inclusion in another broad soil pattern were it not for the surface rockiness. The Ib land type is found on coarse-grained yellow cross-bedded sandstone, shale, siltstone and grit of the Waterberg Group. The shallow rocky soils are of the Mispah Form with a soil depth of 50 - 300 mm. The terrain units of the Ib land type are 1, 2, 3, 4 and 5 with terrain unit 3, (65 %) as the dominant unit in this land type (Land Type Survey Staff 1988; Figure 2.7).

2.5 CLIMATE

2.5.1 Introduction

Abiotic factors have an influence on the regional distribution of vegetation, and of these abiotic factors climate is a primary factor (Schultze & McGee 1978; Gertenbach 1987). Climate could be described as the physical state of the atmosphere, and is considered the result of the radiation influence of the sun on the atmosphere which enfold the surface of the earth. This total physical state atmosphere namely climate, consists of certain elements of which temperature and rainfall are the most important (Gertenbach 1987).

According to Köppen's classification, the Waterberg area is classified as a Cwa climate (Schultze 1947). This climate zone receives approximately 730 mm rain per annum, mainly during the summer and autumn (Westfall 1981). Rainfall and temperature records have been kept for the study area since July 1988. Rainfall records have been kept by the South African Iron and Steel Industrial Corporation Ltd., (ISCOR) at
Thabazimbi (24° 38' S, 27° 24' E; altitude 945 m) since 1947 (Westfall 1981).

2.5.2 Temperature

According to Gertenbach (1987) the influence of temperature on the regional distribution of vegetation types is not significant. Temperature can however contribute to floristic variations on a meso- and microscale, but caution must be taken that the influence of temperature on the local distribution of vegetation must not be generalised.

Table 2.2 shows the mean daily maximum and minimum air temperature for three weather stations in the vicinity of the study area. In spite of a difference of 460 m above sea level between the weather stations, the differences in temperature are not significant.

Frost has been observed along the watercourses in the study area.

2.5.3 Rainfall

According to Gertenbach (1987), rainfall is the single most important component of climate, which can have an influence on the vegetation. The rainfall of a study area must be derived from a number of representative weather stations in and around the immediate vicinity of that specific area (Gertenbach 1987).

The area receives rain mainly during the summer months (October to April) in the form of heavy thunderstorms (Westfall 1981). Rainfall data for three weather stations are given in Table 2.3, according to which the study area is getting sufficient rain in

the months October to April, where effective rain are considered to be sufficient for the active growth of vegetation.

Studies by Dyer (1976), Dyer & Tyson (1977) and Tyson & Dyer (1978) showed a cyclic phase in the rainfall of the summer rainfall areas in South Africa. The whole cycle lasts about 20 years with 10 years under average and 10 years above average rainfall. Gertenbach (1980) found a similar cycle of the rainfall data of the Kruger National Park. According to Gertenbach (1987), the peak of precipitation moves more to the end of the rainy season during dry cycles, and that the dry period (May to September) are more pronounced during wet cycles than dry cycles. The existence of these rainfall cycles is of great importance for long-term management planning (Gertenbach 1987).

Rainfall as such plays an important role, but in combination with temperature data, a better notion can be formulated on the implications of the climate in a certain area (Walter & Leith 1960; Gertenbach 1987).

Qualified climatic diagrams according to Walter & Leith (1960) of two weather stations namely, Thabazimbi and Waterhoutboom are shown in Figure 2.8. The mean monthly rainfall for Thabazimbi exceeds the 100 mm limit from December to March that is normally the very wet period. The wet period for Thabazimbi occurs from October to March and the dry period from May to July.

The climatic diagrams show that July is the driest month. December to February are the months with the highest rainfall and the highest temperatures, whereas the period May to August represents the dry cool months. Another important factor of the climate of the study area is the occurrence of "dry thunderstorms" just before the rainy season at the end of September and during October. Veld fires started by lightning usually occur during such "dry thunderstorms" and can reach high intensities, because of the high fuel load that accumulated since the previous rainy season. During the period 1988 to 1993, 90 % of the study area burned. This phenomena is important for management planning for MNP. These natural veld fires are a "natural fire regime" which contributed to the development of the vegetation of the Waterberg Mountains.

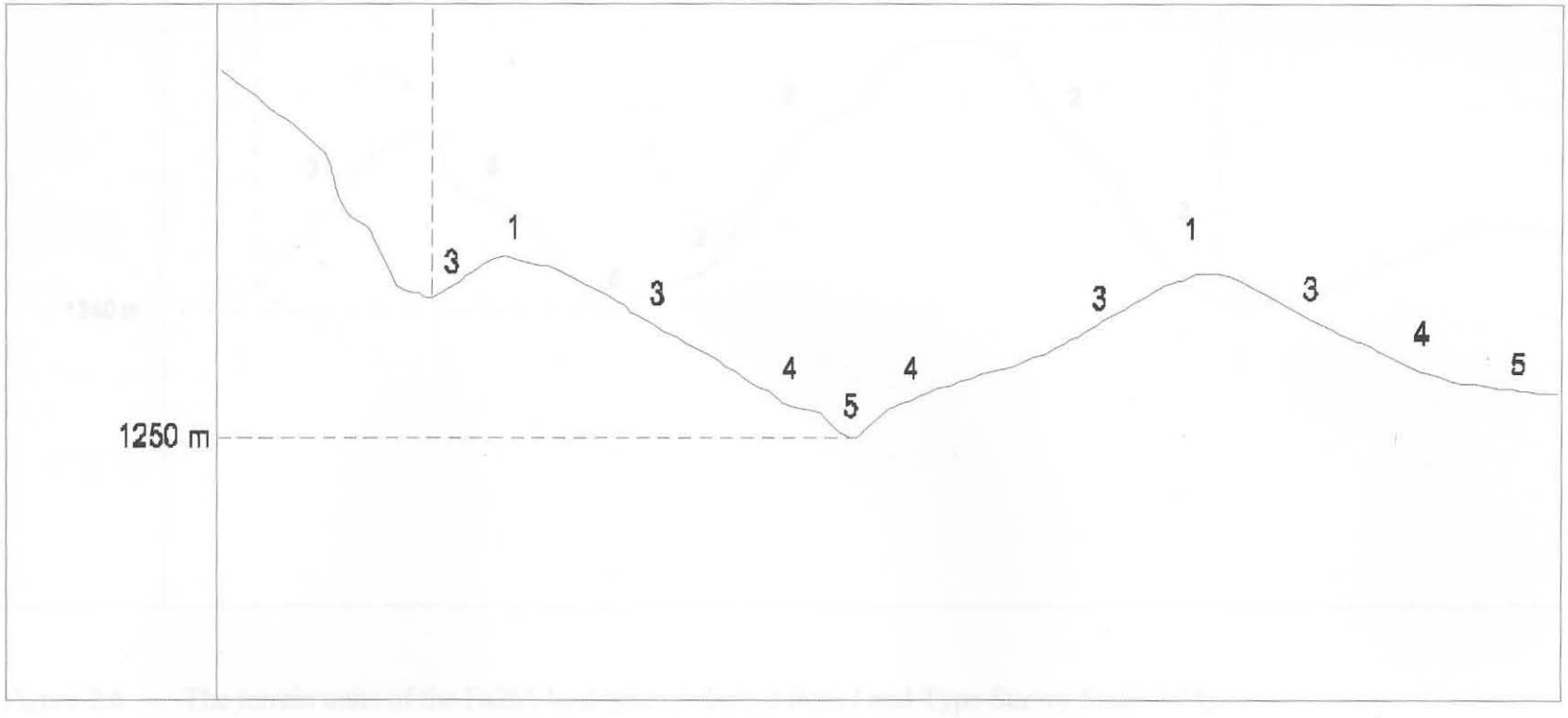


Figure 2.5 The terrain units of the Ad20 & -21 land type (adapted from Land Type Survey Staff 1988).

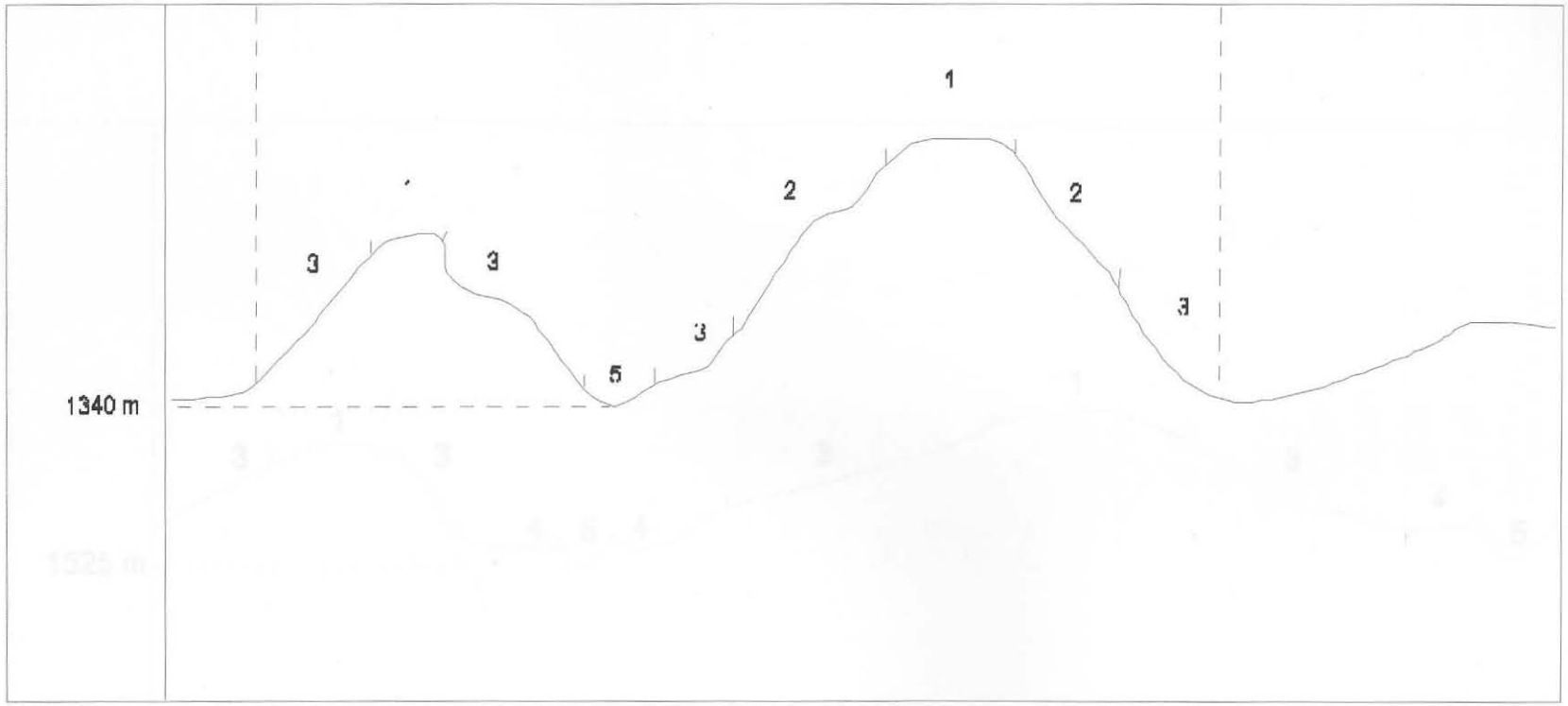


Figure 2.6 The terrain units of the Fa286 land types (adapted from Land Type Survey Staff 1988).

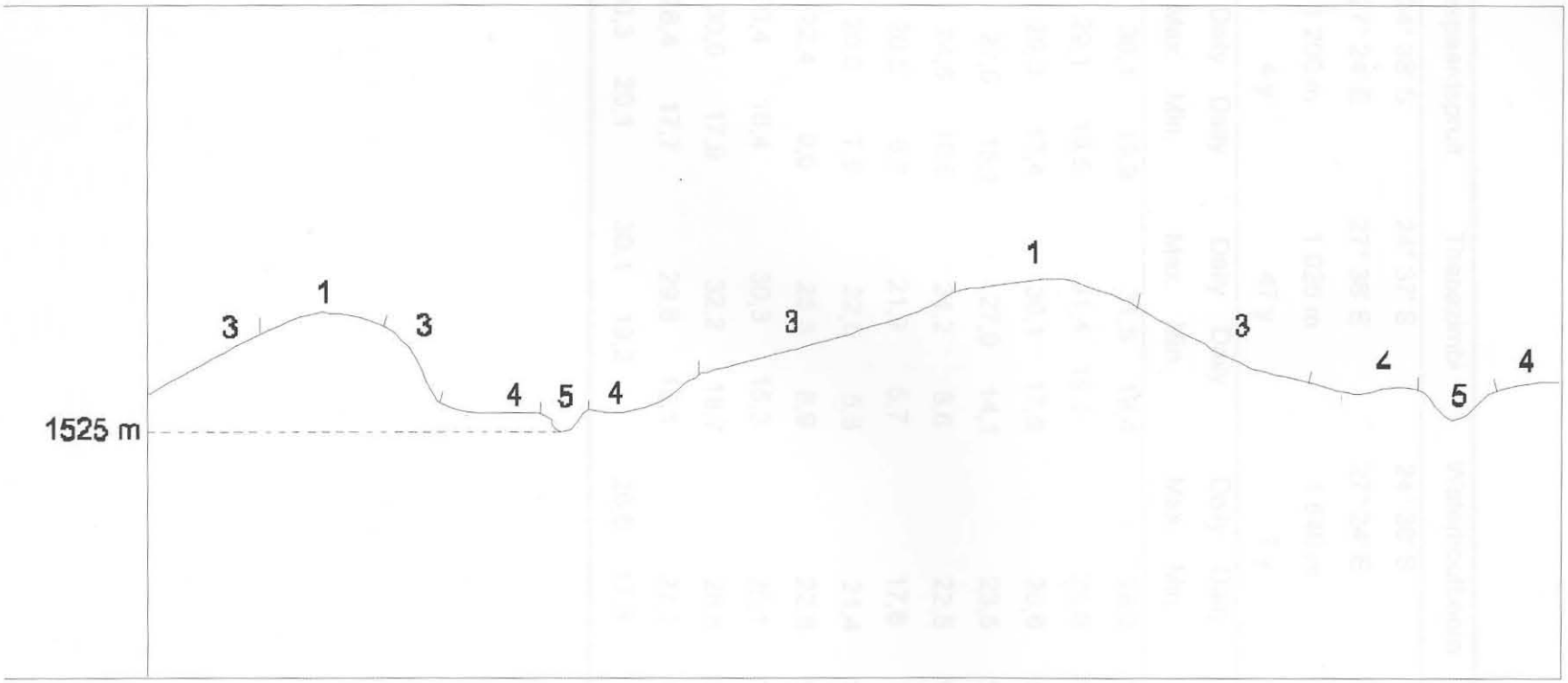


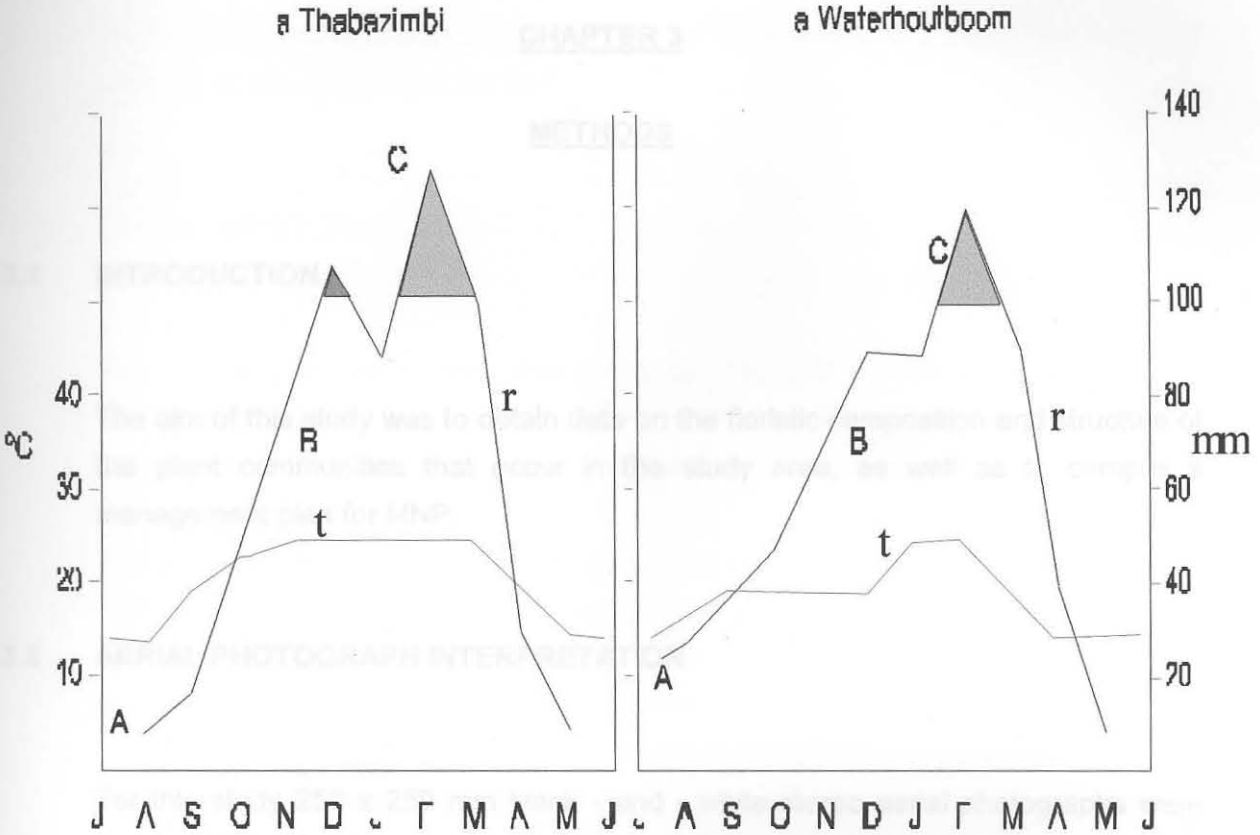
Figure 2.7 The terrain units of the Ib280, -305 & -310 land types (adapted from Land Type Survey Staff 1988).

Table 2.2 The mean maximum and minimum air temperature in °C for three weather stations in the vicinity of the study area.

Station	Blespaardspruit		Thabazimbi		Waterhoutboom	
Longitude	24° 38' S		24° 37' S		24° 38' S	
Latitude	27° 24' E		27° 38' E		27° 24' E	
Altitude	1 200 m		1 026 m		1 540 m	
Duration	4 y		47 y		7 y	
Month	Daily Max.	Daily Min.	Daily Max.	Daily Min.	Daily Max.	Daily Min.
January	30,1	19,9	31,5	19,4	28,2	19,4
February	29,1	19,5	31,4	19,3	28,6	19,6
March	29,3	17,4	30,1	17,6	26,6	16,6
April	27,0	15,1	27,0	14,1	23,5	14,9
May	24,6	10,6	24,2	8,6	22,5	12,2
June	20,5	6,7	21,9	5,7	17,8	9,6
July	20,6	7,8	22,0	5,8	21,4	10,4
August	22,4	9,0	25,3	8,9	22,8	10,5
September	30,4	16,4	30,3	15,3	25,1	13,4
October	30,0	17,9	32,2	18,7	26,6	16,3
November	28,4	17,7	29,8	18,1	27,7	17,5
December	30,3	20,1	30,1	19,2	26,6	17,3

Table 2.3 The total annual rainfall (mm) for three weather stations in the vicinity of the study area.

Weather tation	Blespaardspruit	Thabazimbi	Waterhoutboom
Longitude	24° 38'	24° 37'	24° 38'
Latitude	27° 24'	27° 24'	27° 24'
Altitude	1 200 m	1 026 m	1 540 m
1977	-	840,5	-
1978	-	765,0	-
1979	-	666,0	-
1980	-	661,0	-
1981	-	553,5	-
1982	-	656,4	-
1983	-	554,1	-
1984	-	609,4	-
1985	-	504,2	-
1986	-	632,5	-
1987	-	577,5	-
1988	-	776,0	547,7
1989	-	672,5	671,8
1990	-	460,4	713,9
1991	429,2	924,0	464,6
1992	506,7	451,1	388,0
1993	566,1	706,1	550,7
1994	439,4	440,2	633,5
Mean	485,4	636,1	567,2



a Weather station	Thabazimbi	Waterhoutboom
b Altitude (m)	1 026	1 540
c Period of observation (yr)	30 - 47	6 - 7
First number for temperature and the second for precipitation		
d Mean annual temperature (°C)	28,1	24,8
e Mean annual precipitation (mm)	631,0	556,0

A Dry period
B Wet period
C Very wet period
t Temperature curve
r Rainfall curve

Figure 2.8 Climatic diagrams (Walter & Lieth 1960) for two weather stations in the vicinity of the study area.

CHAPTER 3

METHODS

3.1 INTRODUCTION

The aim of this study was to obtain data on the floristic composition and structure of the plant communities that occur in the study area, as well as to compile a management plan for MNP.

3.2 AERIAL PHOTOGRAPH INTERPRETATION

For this study 250 x 250 mm black - and - white stereo aerial photographs were used, obtained from the office of the Surveyor General, Private Bag, Mowbray, 7705. The most recent photographs, namely Task 874 of 1984 on a scale of 1:50 000 were used. These stereo photographs were studied by using a stereoscope and homogeneous units were delineated on the basis of physiography and physiognomy (vegetation structure) (Bredenkamp & Theron 1978; Westfall 1981; Gertenbach 1987).

These homogeneous physiographic-physiognomic units were outlined and compared to one another and representative vegetation sampling was made in most of these units.

3.3 SAMPLING

3.3.1 Sample plot number

The number of sample plots is determined by the scale of the survey, the variation in the vegetation composition of the area and the accuracy required (Werger 1973; Gertenbach 1987). A total of 130 sample plots were surveyed throughout the study area. The number of sample plots for each delineated physiographic-physiognomic

unit was determined according to the size of each delineated unit. The sampling intensity is one sample per 2,2 km².

3.3.2 Sample plot location

The sample plot location was determined by means of stratified-random sampling (Westfall 1981). The sample plots were distributed within the stratified physiographic- physiongnomic units over the entire study area (Gertenbach 1987).

The exact position of the sample plots was thus determined before hand and if it was found that a position was not homogeneous according to the survey requirements, the sample plot was moved subjectively to be more representative of the immediate vegetation and environment. This is according to Werger (1974), Coetzee (1975) and Gertenbach (1987) in accordance with the requirements for the traditional Braun-Blanquet-type of vegetation surveys. The position of a sample plot was only moved for the following reasons:

(i) If the sample plot was placed in an area where the vegetation was not homogeneous (Mueller-Dombois & Ellenberg 1974);

(ii) If the structure of the vegetation in the sample plot is not representative of the plant community (Werger 1974); and

(iii) If the sample plot was placed in disturbed areas such as gravelpits, roads and agricultural lands that were made after the photographs were taken.

Ecotones and obvious habitat and vegetation heterogeneity were avoided, as homogeneous vegetation is a prerequisite for sample plot location (Werger 1977; Gertenbach 1987). Thus to stratify and then to sample subjectively, the maximum data in reference to the vegetation were obtained.

Termitarium and riparian vegetation was not included in the placing of the sample plots. Separate sample plots were identified for the termitarium and riparian vegetation and sampling was done in these vegetation types.

3.2.3 Sample plot size and form

The minimal area of a sample plot was obtained by means of the species-area-curve (Coetzee & Werger 1975; Westfall 1981; Gertenbach 1987). For the purpose of this study a standard sample plot size of 10 m x 20 m was used throughout the study area, as this size exceded the minimum plot size. This size is also considered adequate for surveys in savanna vegetation by Coetzee (1975), Coetzee et al. (1976), Westfall (1981), Van Rooyen (1983) and Gertenbach (1987).

3.4 THE ZÜRICH-MONTPELLIER-APPROACH FOR THE CLASSIFICATION OF PLANT COMMUNITIES

The Zürich-Montpellier approach to the study of vegetation is commonly used in South Africa (Werger 1973; Coetzee et al. 1976; Bredenkamp & Theron 1978; Westfall 1981; Behr & Bredenkamp 1988; Du Preez et al. 1991; Kooij et al. 1992; Bezuidenhout 1993). The classification presented here is based on the Braun-Blanquet method of vegetation survey, discussed in detail by Westhoff & Van der Maarel (1973); Mueller-Dombois & Ellenberg (1974) and Werger (1974).

According to Westhoff & Van der Maarel (1973) and Gertenbach (1987) the basic principles of the Zürich-Montpellier approach can be summarised as follows:

a) Plant communities are recognized as vegetation units on the basis of their floristic composition. The complete floristic composition of a community gives a better reflection of the mutual alliances as well as the environment, than any other characteristic.

b) The species comprising the floristic composition of a plant community have certain mutual relationships. These species are called diagnostic or differential species.

c) These diagnostic species are used to organize communities in a hierarchical classification of which the association are the basic unit.

The definition of an association was adopted in 1910 at the Third International Botanical Congress in Brussels. A plant association is a "plant community of definite

floristic composition, presenting a uniform physiognomy and growing in uniform habitat conditions" (Daubenmire 1968; Werger 1974; Gertenbach 1987).

In practice the Zürich-Montpellier approach consists of the following:

a) Sampling of selected, representative, homogeneous plots of a certain minimum size.

b) Recording all species and rating them on a cover-abundance and, optionally, a sociability scale.

c) Other analytical characters of the vegetation in the plot might also be recorded, such as density, production, etc.

d) The samples are entered in a table from which the vegetation units are extracted.

e) The composition, differentiation and characterization of associations (Werger 1974; Gertenbach 1987).

3.5 COVER-ABUNDANCE

At each sample plot a list is compiled of all the species occurring. A cover-abundance value is given to each species according to the cover-abundance scale, used by Braun-Blanquet and given by Mueller-Dombois & Ellenberg (1974) and Werger (1974).

5 - Any number of plants, with cover more than 75 percent of the sample plot.

4 - Any number of plants, with cover more than 50 to 75 percent of the sample plot.

3 - Any number of plants, with cover more than 25 to 50 percent of the sample plot.

2 - Any number of plants, with cover more than 5 to 25 percent of the sample plot.

1 - Numerous, with cover of 5 percent or less.

+ - Individuals with cover of less than 1 percent.

r - Usually a single individual with a cover of less than 1 percent.

According to Barkman et al. (1964) the definition of scale-unit 2 was too broad. Without altering the basic units, modifications were made by adding the following secondary symbols to the scale-unit:

2a - Covering between 5 and 12 percent of the sample plot area independent of abundance (indicated as A in the tables).

2b - Covering between 13 and 25 persent of the sample plot area independent of abundance (indicated as B in the tables).

The plant species in each sample plot were therefore evaluated according to a 8-point scale and not according to the traditional 7-point scale of Braun-Blanquet (Werger 1973; Gertenbach 1987).

3.6 VEGETATION STRUCTURE

3.6.1 Introduction

Dansereau (1957) defined vegetation structure as "the organization in space of the individuals that form a stand (and by extension a vegetation type or a plant association) and the primary elements of structure are growth-form, stratification and coverage".

The structural classification proposed here is independent of, but complementary to floristic, habitat and ecological classifications of vegetation (Edwards 1983).

Shimwell (1971); Mueller-Dombois & Ellenberg (1974) and Gertenbach (1987) divided vegetation structure into three categories viz.

a) Vertical structure (stratification into layers)
b) Horizontal structure (crown cover)
c) Quantitative structure (abundance of each species in the community).

The floristic composition as well as the vegetation structure are important components of a specific plant community (Gertenbach 1987). According to Westfall (1981) vegetation structure refers to the spacing and height of plants that forms the matrix of a vegetation cover.

Edwards (1983) used growth form, cover classes and height classes in his structural classification. The structural classification for this study was based on the broad-scale structural classification system of Edwards (1983).

3.6.2 Height classes

Vertical structure or stratification was determined in three height classes (Figure 3.2) viz.

a) Herbaceous stratum 0 - 1 m
b) Shrub stratum > 1 - 3 m
c) Tree stratum > 3 m

The first height class includes all the grasses and other forbs between 0 - 1 metres. The shrub stratum includes all single- and multi-stemmed woody vegetation between 1 m and 3 m. The tree stratum includes all single- and multi-stemmed woody vegetation higher than 3 m (Figure 3.2). The comparison of the height classes used in this study and the systems of Westfall (1981); Edwards (1983) and Gertenbach (1987) is given in Table 3.1.

3.6.3 Cover classes

Cover is defined as the vertical projection of the crown per height class (Mueller-Dombois & Ellenberg 1974; Edwards 1983; Gertenbach 1987). The crown: gap ratio used by Edwards (1983) and Gertenbach (1987) is a handy index to determine the percentage crown cover, and was used to determine the cover classes. According to Westfall (1981) the Domin-Krajina cover-abundance scale was considered more suitable for the veld condition assessment because of its greater detail, but it was not used in this study.

The cover classes for the different strata are as follows:

Cover	% Cover	Crown: Gap
Scattered	0,1 -1	> 30 - 8,5
Sparse	> 1 - 5	> 8,5 - 3,3
Open	> 5 - 10	> 3,3 - 2
Moderate	> 10 - 20	> 2 - 1
Closed	> 20	> 1

A comparison between the cover classes of Edwards (1983), Gertenbach (1987) and of this study is given in Table 3.2.

3.6.4 Primary growth form

Edwards (1983) used four types of growth forms that determine the essential spatial geometry of vegetation, viz. trees, shrubs, grasses and herbs. Gertenbach (1987) used the following growth forms, viz. fieldlayer - including grasses and non-graslike herbs, shrubs (high- and low stratum) and trees. For the purpose of this study only three layers were used, viz. trees, shrubs and herbaceous layer.

3.6.5 Structure classes

The structural classification used for this study consists of the following cover classes, viz. closed, open and sparse (Table 3.2) and the following height classes, viz. tree (>3 m), shrub (>1 - 3 m) and herbaceous (0 - 1 m) (Table 3.1).

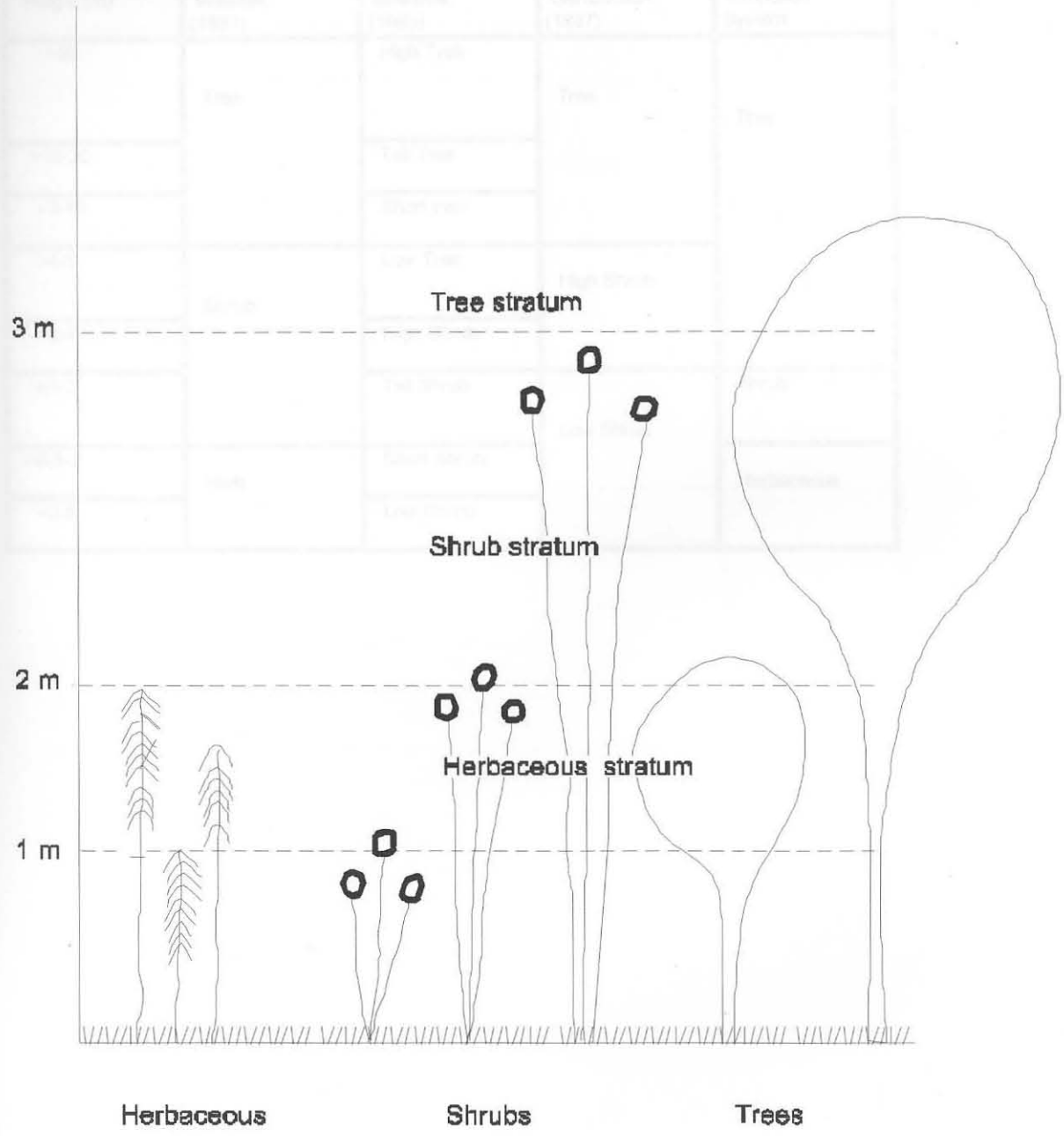


Figure 3.2 Diagramatic presentation of the different height classes for the vegetation of Marakele National Park.

Table 3.1 A comparison of height classes according to the systems of Westfall (1981), Edwards (1983), Gertenbach (1987) and the proposed system for this study.

Height (m)	Westfall, (1981)	Edwards, (1983)	Gertenbach, (1987)	Proposed System
>20	Tree	High Tree	Tree	Tree
>10-20		Tall Tree		
>5-10		Short tree		
>4-5	Shrub	Low Tree	High Shrub	
>2-4		High Shrub		
>1-3		Tall Shrub	Low Shrub	Shrub
>0,5-2	Herb	Short Shrub		Herbaceous
<0,5		Low Shrub		

Table 3.2 A comparison of the cover classes of the structural classification systems of Edwards (1983), Gertenbach (1987) and the proposed system of this study.

<table>
<tr><th>% Cover</th><th>Crown: Gap</th><th>Edwards, (1983)</th><th>Gertenbach, (1987)</th><th>Proposed System</th></tr>
<tr><td>> 75 – 100</td><td rowspan="4">0 - 1</td><td rowspan="6">Closed</td><td rowspan="4">Dense</td><td rowspan="6">Closed</td></tr>
<tr><td>> 60 - 75</td></tr>
<tr><td>> 25 - 60</td></tr>
<tr><td>> 20 - 25</td></tr>
<tr><td>> 15 - 20</td><td rowspan="2">< 2 - 1</td><td rowspan="2">Moderate</td></tr>
<tr><td>> 10 - 15</td></tr>
<tr><td>> 5 - 10</td><td>< 3,3 - 2</td><td rowspan="2">Open</td><td>Open</td><td rowspan="2">Open</td></tr>
<tr><td>> 1 - 5</td><td>< 8,5 - 3,3</td><td rowspan="3">Sparse</td></tr>
<tr><td><0,1 - 1</td><td>> 30 - 8,5</td><td>Sparse</td><td rowspan="2">Sparse</td></tr>
<tr><td><0,1</td><td></td><td>Scattered</td></tr>
</table>

3.7 HABITAT DATA

3.7.1 Introduction

It is not always the aim of casual-analytical vegetation research to study the reaction of plants to individual site factors, but to analyse their reaction to the combination of all factors. In particular, it is important to recognize the factors that are primarily responsible for the control of the species combination of the plant community under study (Mueller-Dombois & Ellenberg 1974). The following habitat information was recorded at each sample plot:

3.7.2 Terrain morphology

The terrain morphological classes where each sample plot is situated, was recorded. The following classes were used (Gertenbach 1987):

Symbol	Class
A	Summit
B	Plateau
CF	Cliff face
D	Upper slope
E	Lower slope
H	Steep bank / kloof
V	Valley floor

3.7.3 Altitude

The altitude of each sample plot was recorded using an altimeter and is given in metres (Table 4.2).

3.7.4 Slope

The slope of the terrain of each sample plot was measured in degrees, using an optical clinometer (Table 4.2). The following classification of slope units (Westfall 1981), were used in this study:

Symbol	Description	Class
L	level	0,00° - 3,49°
G	gentle	3,50° - 17,62°
M	moderate	17,63°- 36,39°
S	steep	36,40°

3.7.5 Aspect

The aspect of the terrain where each sample plot is situated was determined using a compass. Aspect is given in the eight compass directions (Table 4.2), namely:

N - North	**S** - South
NE - Northeast	**SW** - Southwest
E - East	**W** - West
SE - Southeast	**NW** - Northwest

3.7.6 Surface rock cover

The surface rock cover in each sample plot was estimated as a percentage stones (larger than 20 mm diameter), boulders and rocky outcrops. The following five classes (Table 4.2) were used, based on its potential influence on mechanical use (ploughing) (Van der Meulen 1979; Westfall 1981):

Symbol	Class	Description
O	< 1 %	No limitation on mechanical utilization
L	1 - 4 %	Low limitation on mechanical utilization
M	5 - 34 %	Moderate limitation on mechanical utilization

H	35 - 84 %	High limitation on mechanical utilization
V	5 - 100 %	No mechanical utilization possible

3.8 DATA PROCESSING

A first approximation of the vegetation classification was obtained by the application of the Two-Way Indicator Species Analysis (TWINSPAN) (Hill 1979). Using Braun-Blanquet procedures the result was further refined by the procedure described by Bezuidenhout et al. (1996). The results are presented in a phytosociological table and a synoptic table.

3.9 RANGE CONDITION

Veld management can be described as the science that deals with the utilization and conservation of the natural veld to improve maximal animal production, without being prejudicial to the vegetation. The quality and production of the vegetation must thus be maintained or be improved (Bredenkamp & Van Rooyen 1991 a&b, Barnes 1992).

The planning of veld management in this study depends upon thorough knowledge of the vegetation, the fluctuation of the vegetation, plant succession, carrying capacity (stocking rate) and the quality of the veld and the reaction of the vegetation to grazing, fire, bush clearing and other practices.

Veld condition refers to the condition of the vegetation in relation to some functional characteristics, normally sustained forage production and resistance of the veld to soil erosion (Trollope et al. 1989). The assessing of veld condition has proven very valuable for formulating veld management practices like stocking rate, rotational grazing, rotational resting and veld burning (Trollope et al. 1989).

The vegetation of the study area is representative of Acocks's (1988) North-Eastern Mountain Sourveld (Veld Type 8), Mixed Bushveld (Veld Type 18), Sourish Mixed Bushveld (Veld Type 19) and Sour Bushveld (Veld Type 20), thus, the grazing was from a sweet to sourveld. In the past the study area was utilised for cattle farming and where no veld management had been applied, the sweet veld was often heavily

overgrazed, which led to bush encroachment and weakening of the veld. Drought has also lead to the retrogression of the veld (Bredenkamp & Van Rooyen 1991 a&b).

In the phytosociological classification 16 different plant communities were identified (see Chapter 4) and each of these plant communities are found in different habitats with different species composition and therefore having its own grazing capacity and stocking rate. The different plant communities also represent specific habitats for certain game species that might have an influence on the stocking rate of the different game species for MNP.

The veld condition and grazing capacity will fluctuate from season to season depending on drought and the amount and period of rainfall and the present stocking rate (Bredenkamp & Van Rooyen 1991 a&b).

In this study the present grazing capacity of 10 plant communities, which include four variations was determined. The grazing capacity of the following plant communities was not determined because of the small size, low grazing potential and/or inaccessibility of the communities (Table 4.1):

Widdringtonia nodiflora-Podocarpus latifolius Short Forest.
Podocarpus latifolius-Rothmannia capensis Tall Forest.
Buxus macowanii-Kirkia wilmsii Low Forest.
Rhus leptodictya-Mimusops zeyheri Termitarium Thickets.
Olea europaea-Calpurnia aurea Tall Closed Woodland.
Syzygium cordatum-Miscanthus junceus Short Thicket.

The different grass species and forbs (non grassy herbaceous plants) that were recorded by the point surveys in the different plant communities were arranged by virtue of their % frequency. The grass species and other forbs were categorized by virtue of their palatibility, grazing potential and reaction upon grazing (Bredenkamp & Van Rooyen 1991 a&b):

D = **Decreaser species**: grass and other herbaceous species that tend to decrease when the veld is under or overutilised;

I1 = **Increaser 1 species**: grass and other herbaceous species that tend to increase when the veld is underutilised;

I2a&b = **Increaser 2a&b species**: grass and other herbaceous species that tend to increase when the veld is selectively overutilised;

I2c = **Increaser 2c species**: grass and other herbaceous species that tend to increase when the veld is heavily overutilised and/or disturbed (Trollope et al. 1989).

With the aid of the above-mentioned categories an ecological index of veld condition was determined. The maximum theoretical index value which could be obtained is 1 000, for example if all the grass species were Decreasers (constant scale of 10 = Decreasers; 7 = Increaser 1; 4 = Increaser 2a&b and 1 = Increaser 2c). Veld in good condition with a high grazing capacity has a high percentage Decreaser and Increaser 1 grass species composition. The grazing capacity is calculated from the ecological index, grass cover, degree of bush, rainfall and fire regimé (Bredenkamp & Van Rooyen 1991 a&b).

The grazing capacity of the study area was determined for:

* the veld in present condition, with the average rainfall of 556 mm per annum (see Chapter 2),
* a year with below average rainfall (23 % or 429 mm per annum) (see Chapter 2).

With the calculation of grazing capacity for game species, the availability of leaves, habitat characteristics (for example hills, plains and rivers) as well as the selective grazing habits of many game species were considered.

CHAPTER 4

RESULTS AND DISCUSSION

A. The vegetation of Marakele National Park

4.1 Introduction

The vegetation composition of the study area is summarised in a plant sociological table (Table 4.2) and a synoptic table (Table 4.1). The synoptic table summarizes the relationship between the plant communities of the plant sociological table. By means of the synoptic table, (Table 4.1) and plant sociological table (Table 4.2) five major plant communities were recognized. These are:

A. *Olea europaea-Diospyros whyteana* Major Community;
B. *Acacia caffra-Heteropogon contortus* Major Community;
C. *Protea caffra-Loudetia simplex* Major Community;
D. *Burkea africana-Setaria lindenbergiana* Major Community; and
E. *Andropogon huilensis-Xyris capensis* Major Community.

The phytosociological classification of the vegetation in the study area resulted in the identification of 16 plant communities with three of the communities having variations (Tables 4.1 & 4.2). A vegetation map of the study area showing the distribution of the plant communities is given in Figure 4.1. Westfall (1981) described the plant communities adjacent to the study area and Coetzee (1975), Coetzee et al. (1976), Bloem (1988), Bloem et al. (1993 a&b), Du Preez et al. (1991) and Coetzee et al. (1993) described related vegetation.

4.2 *Olea europaea* subsp. *africana-Diospyros whyteana* Major Community

The species composition of the *Olea europaea* subsp. *africana-Diospyros whyteana* major community is given in Table 4.1. This major community is differentiated by the

following diagnostic plant species (species group A, Table 4.1 & 4.2 & species group I):

Diospyros whyteana	***Ochna holstii***
Euclea natalensis	***Olea capensis***
Euphorbia ingens	***Olea europaea* subsp. *africana***
Ficus sur	***Osyris lanceolata***
Grewia occidentalis	***Rhoicissus tridentata***
Mimusops zeyheri	

This major community occurs in the kloofs, as bushclumps on south and east facing slopes and as bushclumps on termitaria. The kloofs are the least exposed of the geomorphology classes (Appendix I) found in the study area with water in the spruits. Coetzee (1975) described a related community as *Hypoestes verticillaris-Mimusops zeyheri* Forests, and Westfall (1981) described a related community as Kloof Forest Communities on moderately deep soils in moist, sheltered habitats. Du Preez et al. (1991a&b) described this type of forest as typical Afromontane Forests, where these forests occur in specific niches in deep valleys, protected gorges, crevices and ravines along the eastern and western slopes of the Drakensberg mountain range.

According to White (1978) the majority of the tree species in these forests are very widespread. Amongst them are *Podocarpus latifolius, Ilex mitis* and *Halleria lucida* that occur in the study area.

The abovementioned assemblage of species could almost be used to define the Afromontane region as a whole. Not one species occurs throughout, but most species of the assemblage are represented on virtually every "island" of Afromontane forest.

Coetzee et al. (1976) and Coetzee et al. (1981) described termitaria bushclump communities at Nylsvley Nature Reserve, which have diagnostic species similar to the bushclump communities on termitaria in the study area.

In the phytosociological classification, the following plant communities are classified under the *Olea europaea*-subsp. *africana-Diospyros whyteana* Major Community (Tables 4.1 & 4.2):

4.2.1 *Widdringtonia nodiflora-Podocarpus latifolius* Short Forest.

4.2.2 *Podocarpus latifolius-Rothmannia capensis* Tall Forest.

4.2.3 *Buxus macowanii-Kirkia wilmsii* Low Forest.

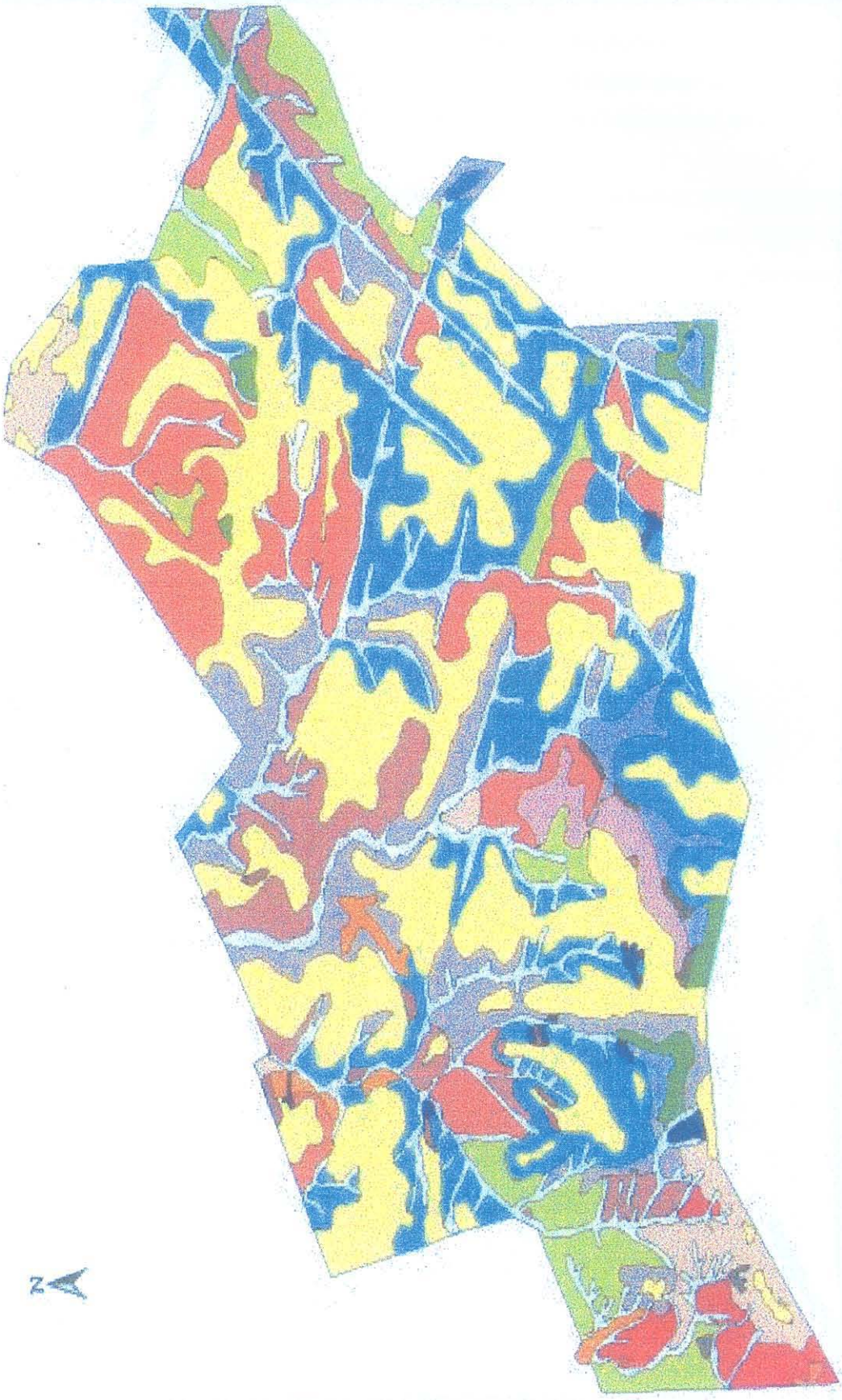
4.2.4 *Rhus leptodictya-Mimusops zeyheri* Termitaria Thickets.

4.2.4.1 *Rhus leptodictya-Carissa bispinosa* **variation**

4.2.4.2 *Rhus leptodictya-Berchemia zeyheri* **variation**

4.2.5 *Olea europaea-Calpurnea aurea* Tall Closed Woodland.

A dendrogram showing the habitat relationships of the various plant communities classified under the *Olea europaea* subsp. *africana-Diospyros whyteana* Major Community is shown in Figure 4.2.



Scale 1: 50 000

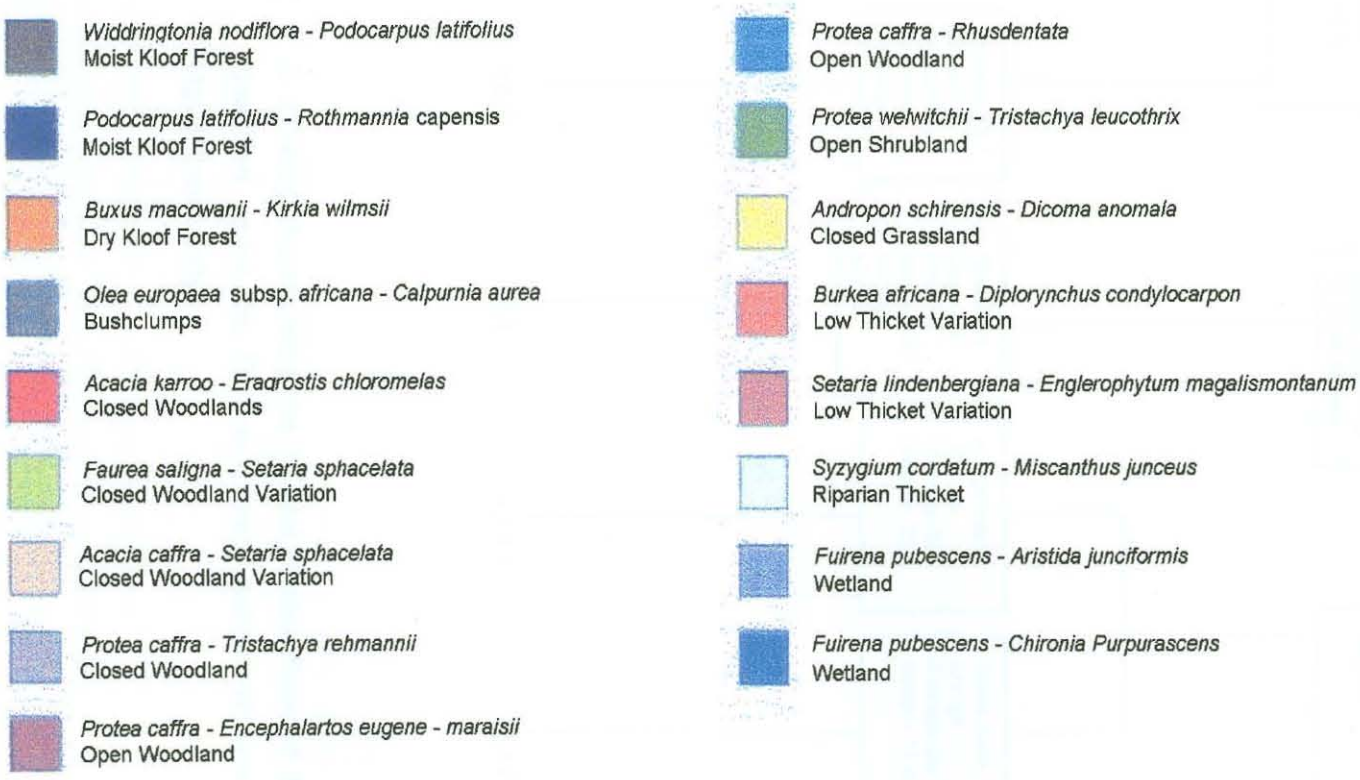


Figure 4.1 Vegetation map of Marakele National Park

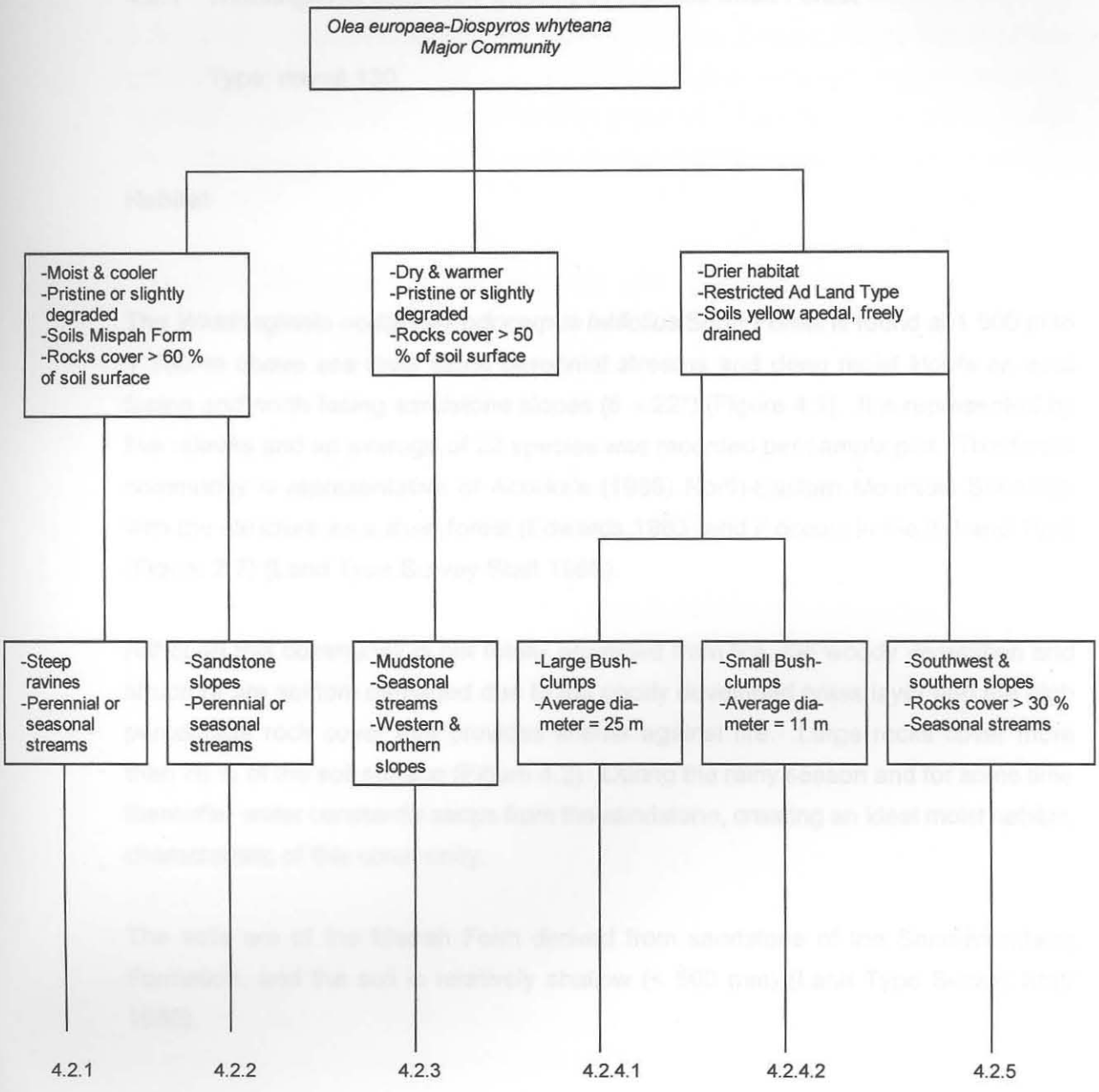


Figure 4.2 A dendrogram showing the habitat relationships of the plant communities classified under the *Olea europaea*- subsp. *africana-Diospyros whyteana* Major Community.

4.2.1 *Widdringtonia nodiflora-Podocarpus latifolius* Short Forest

Type: relevé 130

Habitat

The *Widdringtonia nodiflora-Podocarpus latifolius* Short Forest is found at 1 500 m to 1 730 m above sea level along perennial streams and deep moist kloofs on east facing and north facing sandstone slopes (6 - 22°) (Figure 4.1). It is represented by five relevés and an average of 22 species was recorded per sample plot. This forest community is representative of Acocks's (1988) North-Eastern Mountain Sourveld, with the structure as a short forest (Edwards 1983) and it occurs in the Ib Land Type (Figure 2.7) (Land Type Survey Staff 1988).

Although this community is not totally protected from fire, the woody vegetation and structure are seldom damaged due to the poorly developed grass layer and the high percentage rock cover that provides shelter against fire. Large rocks cover more than 76 % of the soil surface (Figure 4.2). During the rainy season and for some time thereafter water constantly seeps from the sandstone, creating an ideal moist habitat, characteristic of this community.

The soils are of the Mispah Form derived from sandstone of the Sandriviersberg Formation, and the soil is relatively shallow (< 500 mm) (Land Type Survey Staff 1988).

Floristics

The *Widdringtonia nodiflora-Podocarpus latifolius* Short Forest is differentiated by the following plant species (species group A, Table 4.2):

Asplenium splendens	***Phylica paniculosa***
Blechnum giganteum	***Pittosporum viridiflorum***
Clutia pulchella	***Pteridium aquilinum***
Halleria lucida	***Widdringtonia nodiflora***

The tree layer is on average 8,4 m tall with an average canopy cover of 79 % (Table 4.2). Other prominent trees are *Podocarpus latifolius, Curtisia dentata* and *Canthium gilfillanii* (species group C), *Olea capensis* (species group I) and *Syzygium cordatum, Cliffortia linearifolia* and *Ilex mitis* (species group CC, Table 4.2). The latter species also differentiates the *Syzygium cordatum-Miscanthus junceus* Riparian Vegetation (Table 4.2).

The shrub layer is on average 1,4 m tall, with an average canopy cover of 22 % (Table 4.2). Prominent shrubs occurring in this community are *Myrsine africana* (species group C), *Ochna holstii* and *Osyris lanceolata* (species group I), (Table 4.2). The woody liane *Secamone alpinii* is frequently found in the tree and shrub strata and the sedge *Cyperus albostriatus* as ground cover in the more open areas among the trees.

The herbaceous layer has an average height of 0,5 m and an average canopy cover of 11,0 % (Table 4.1). It is dominated by the ferns *Blechnum giganteum, Pteridium aquilinum* and *Asplenium splendens* as the differential species in species group A. The tree fern, *Cyathea dregei*, which was not recorded in the sample plots, also occurs in such forests in the study area. These tree ferns are very susceptable to fire and some were in the past badly damaged by fire.

General

The *Widdringtonia nodiflora-Podocarpus latifolius* Short Forest has many characteristic species in common with the *Ilex mitis-Pittosporum viridiflorum* Forest Community described by Coetzee (1975) and the *Pittosporetalea viridiflorii* described by Du Preez et al. (1991 a&b). The habitats are also quite similar. This community occupies the most mesic habitats of sheltered parts of kloofs on the eastern side of the mountain. The dominant woody species *Widdringtonia nodiflora* and *Podocarpus latifolius* are however absent from the forest communities described by Coetzee (1975) and Du Preez et al. (1991 a&b).

Communities 4.2.1 and 4.2.2 are related to each other through the mutual presence of the *Podocarpus latifolius* species group (Table 4.1) and communities 4.2.3, 4.2.4 and 4.2.5 are related to community 4.2.1 through the *Olea europaea* subsp. *africana* species group (Table 4.2).

4.2.2 *Podocarpus latifolius-Rothmannia capensis* Tall Forest.

Type: relevé 109

Habitat

The *Podocarpus latifolius-Rothmannia capensis* Tall Forest is found at 1 300 m to 1 660 m above sea level along perennial or seasonal streams and moist kloofs on south-east facing, north facing, north-east and east facing sandstone slopes (4 - 30°) (Figures 4.1). It is represented by five relevés and an average of 30 species was recorded per sample plot. This forest community is a representative of Acocks's (1988) North-Eastern Mountain Sourveld, with the structure as a tall forest (Edwards 1983) and it all occurs in the Ib Land Type (Figure 2.7) (Land Type Survey Staff 1988).

During the rainy season and for some time thereafter water constantly seeps from the sandstone, creating an ideal moist habitat, characteristic for this community. The soils are of the Mispah Form derived from sandstone of the Sandriviersberg Formation, and the average soil depth is relatively shallow (< 500 mm) (Land Type Survey Staff 1988). Large rocks cover more than 70 % of the soil surface (Figure 4.2).

Floristics

The *Podocarpus latifolius-Rothmannia capensis* Tall Forest is differentiated by the following plant species (species group B, Table 4.2)

Celtis africana
Combretum moggii
Diospyros lycioides
Dovyalis zeyheri
Nuxia congesta
Oplismenus hirtellus
Pavetta gardeniifolia
Asparagus setosum
Pterocelastrus echinatus
Rothmannia capensis
Solanum giganteum
Strychnos usambarensis
Tetradenia brevispica

The tree layer is on average 12,0 m tall with an average canopy cover of 79 % (Table 4.2). Other prominent trees are *Pittosporum viridiflorum* (species group A), *Podocarpus latifolius* and *Curtisia dentata* (species group C), *Cussonia paniculata* and *Ficus thonningii* (species group F), *Calodendron capensis* (species group G), *Olea europaea* subsp. *africana, Euphorbia ingens, Mimusops zeyheri, Ficus sur* and *Olea capensis* (species group I) and *Syzygium cordatum* and *Ilex mitis* (species group CC, Table 4.2). The latter species also differentiates the *Syzygium cordatum-Miscanthus junceus* Short Thickets (Table 4.2).

The shrub layer is on average 1,7 m tall with an average canopy cover of 49 % (Table 4.2). Prominent shrubs occurring in this community are *Myrsine africana* and *Canthium gilfillanii* (species group C), *Ochna pretoriensis* and *Acacia ataxacantha* (species group D), *Calpurnia aurea* and *Maytenus undata* (species group G), *Pappea capensis* and *Zanthoxylum capense* (species group H) and *Ochna holstii, Osyris lanceolata, Diospyros whyteana, Grewia occidentalis, Rhoicissus tridentata* and *Euclea natalensis* (species group I, Table 4.1). The woody liane *Secamone alpinii* and *Cryptolepis transvaalensis* are frequently found in the tree and shrub strata and the sedge *Cyperus albostriatus* as ground cover in the more open areas.

The herbaceous layer has an average height of 0,5 m and an average canopy cover of 22 % (Table 4.2). It is dominated by *Cyperus albostriatus, Tetradenia brevispica, Solanum giganteum* and *Oplismenus hirtellus*. The tree fern, *Cyathea dregei*, which was not recorded in the sample plots, also occurs in this community.

General

The *Podocarpus latifolius-Rothmannia capensis* Tall Forest is similar to the *Widdringtonia nodiflora- Podocarpus latifolius* Short Forest and was discussed under the latter. The difference in habitat between the *Podocarpus latifolius-Rothmannia capensis* Tall Forest and the *Widdringtonia nodiflora-Podocarpus latifolius* Short Forest lies in the terrain where each plant community occurs (Figure 4.2). This community is closely related to the *Celtis africana-Osyris lanceolata* Kloof Forest described by Westfall (1981). These two communities have many distinctive habitat features and many, distinctive species in common.

4.2.3 *Buxus macowanii-Kirkia wilmsii* Low Forest

Type: relevé 64

Habitat

The *Buxus macowanii-Kirkia wilmsii* Low Forest is found at 1 110 m to 1 250 m above sea level (Figure 4.1). This Low Forest occupies a relatively drier and warmer habitat than the *Widdringtonia nodiflora-Podocarpus latifolius* Short Forest and the *Podocarpus latifolius -Rothmannia capensis* Tall Forest. The *Buxus macowanii-Kirkia wilmsii* Low Forest is restricted to hot dry kloofs of north facing, east and northwest facing slopes (2 - 29°) of the study area (Figure 4.1)

The structure of this forest community is a low forest (Edwards 1983) and it occurs in the Ib Land Type (Figure 2.7) (Land Type Survey Staff 1988). It is represented by four relevés and an average of 28 species was recorded per sample plot. The soils are of the Mispah Form derived from sandstone of the Sandriviersberg Formation, and the soil is relatively shallow (< 500 mm) (Land Type Survey Staff, 1988). Rocks cover more than 50 % of the soil surface (Figure 4.2).

Floristics

The *Buxus macowanii-Kirkia wilmsii* Low Forest is differentiated by the following plant species (species group D, Table 4.2):

Acacia ataxacantha	***Heteromorpha trifoliata***
Buxus macowanii	***Kirkia wilmsii***
Croton gratissimus	***Ochna pretoriensis***
Euphorbia turicalli	

The tree layer is on average 7,8 m tall, with an average canopy cover of 35 % (Table 4.2). Other prominent trees are *Rhus leptodictya* and *Ficus thonningii* (species group F) and *Olea capensis, Mimusops zeyheri, Olea europaea* subsp. *africana, Euphorbia ingens* and *Ficus sur* (species group I, Table 4.2).

The shrub layer is on average 2,3 m tall, with an average canopy cover of 83,8 % (Table 4.2). Prominent shrubs occurring in this community are *Dovyalis zeyheri* (species group B), *Canthium gilfillanii* (species group C), *Psiadia punctulata* (species group E), *Securinega virosa* (species group F), the liana, *Cryptolepis transvaalensis, Maytenus undata* and *Tricalysia lanceolata* (species group G), *Ochna holstii, Diospyros whyteana, Osyris lanceolata* and *Grewia occidentalis* (species group I) and *Apodytes dimidiata* and *Heteropyxis natalensis* (species group B, Table 4.2).

The herbaceous layer has an average height of 0,3 m and an average canopy cover of 6,5 % (Table 4.2). The herbaceous layer is poorly represented and is dominated by the xerophytic ferns *Cheilanthes viridis* and *Pellaea calomelanos* (species group BB) and the sedge *Cyperus leptocladus*.

General

Westfall (1981) described an *Erythrina lysistemon-Celtis africana* Kloof Forest with *Buxus macowanii* as a conspicuous woody species with more than 5 % mean canopy cover and occurring in more than 50 % of the relevés. This community is similar to the community found in the study area. The distribution of the shrub, *Buxus macowanii*, is restricted to warm valleys and coastal dunes in the Eastern Cape, with the Transvaal population as an unexpected outlier (Palgrave 1988). These shrubs are often gregarious, forming pure stands (Table 4.2).

4.2.4 *Rhus leptodictya-Mimusops zeyheri* Termitarium Thickets

Type: relevé 18

Habitat

The *Rhus leptodictya-Mimusops zeyheri* Termitarium Thickets are found from 1 160 m to 1 300 m above sea level. This widespread community occupies an even more dry habitat than that of the *Buxus macowanii-Kirkia wilmsii* Low Forest. These

bushclumps on termitaria are restricted to the Ad Land Type (Land Type Survey Staff 1988) (Figure 2.5).

It usually occurs on north facing, northwest facing, north-east facing, east and southeast facing level and gentle slopes (see section 3.7.4).

This community is a representative of Acocks's (1988) Sour Bushveld, with the structure as a short closed woodland (Edwards 1983) and it occurs in the Ad Land Type (Figure 2.5) (Land Type Survey Staff 1988). It is represented by 11 relevés and an average of 37 species was recorded per sample plot.

All units on the 1: 50 000 aerial photographs with an area of less than one square millimeter where omitted. It means that plant community units such as the *Rhus leptodictya-Mimusops zeyheri* Termitarium Thickets with an area of less than two hectares were not indicated on the vegetation map (Figure 4.1). The limited factor in the mapping of these vegetation units is the scale of the map and not the classification of the plant community.

Before proclamation of MNP, this community was subjected to heavy grazing by cattle and the field layer varies in height and cover depending on soil salinity and the amount of grazing (Coetzee et al. 1981). This community developed on huge termite mounds to form a specific plant community. The size of these termitaria determines the type of vegetation that occurs here. The trees are usually very tall because of the depth and aeration and the finer texture and higher nutrient status of the soil (Coetzee et al. 1976).

Floristics

The *Rhus leptodictya-Mimusops zeyheri* Termitarium Thickets are differentiated by the following plant species (species group F, Table 4.2):

Cussonia paniculata
Euclea crispa* subsp. *crispa
Ficus thonningii
Grewia flavescens
Pavetta zeyheri
Rhus leptodictya
Schistostephium heptalobum
Securinega virosa
Tagetes minuta

This community is divided into the following variations, based on floristic composition:

4.2.4.1 *Rhus leptodictya-Carissa bispinosa* **variation**

Type: relevé 18

Habitat

The *Rhus leptodictya-Carissa bispinosa* **variation** is found at 1 160 m to 1 300 m above sea level. This variation occurs on southeast facing, east facing, northeast facing, north facing, northwest and west facing level and gentle slopes (1 - 16) (see section 3.7.4). The soils are yellow apedal and well drained, belonging to one of the following forms: Inanda, Kranskop, Magwa, Hutton, Griffin and/or Clovelly. The soil is relatively deep (> 500 mm) (Land Type Survey Staff 1988) (Figure 4.2).

The average diameter of the *Rhus leptodictya-Carissa bispinosa* **variation** bushclumps is 25 metres. It is represented by seven relevés and an average of 37,4 species was recorded per sample plot (Table 4.2, Figure 4.6).

Floristics

The *Rhus leptodictya-Carissa bispinosa* **variation** is differentiated by the following plant species (species group E, Table 4.2):

Adenia glauca
Aloe marlothii
Carissa bispinosa
Clerodendrum glabrum
Eragrostis rigidior
Gardenia volkensii
Hemizygia pretoriae
Ipomoea magnusiana
Kalanchoe rotundifolia
Lippia javanica
Maerua angolensis
Maytenus heterophylla
Panicum maximum
Pavonia burchelli
Psiadia punctulata
Scadoxus puniceus
Schkuhria pinnata
Scolopia zeyheri
Sida cordiifolia
Sida dregei

The tree layer is on average 7,0 m tall with an average canopy cover of 78,6 % (Table 4.2). Other prominent trees are *Pappea capensis* and *Schotia brachypetala* (species group H), *Olea capensis, Mimusops zeyheri, Olea europaea* subsp. *africana* and *Euphorbia ingens* (species group I, Table 4.2) and *Acacia karroo* (species group J). The latter species also differentiates the *Acacia karroo-Eragrostis chloromelas* Short Closed Woodland (Table 4.2). *Dombeya rotundifolia* subsp. *rotundifolia, Berchemia zeyheri* and *Ziziphus mucronata* (species group N, Table 4.2) show strong affinities with the *Rhus leptodictya-Carissa bispinosa* **variation**.

The shrub layer is on average 1,4 m tall, with an average canopy cover of 45,7 % (Table 4.2). Prominent shrubs are *Calpurnia aurea, Maytenus undata and M. polyacantha (species group G). The latter species also differentiates the Olea europaea subsp. africana-Calpurnia aurea Tall Closed Woodland (Table 4.2). Other shrubs include Zanthoxylum capense (species group H), Osyris lanceolata, Diospyros whyteana, Grewia occidentalis, Rhoicissus tridentata* and *Euclea natalensis* (species group I) and *Dichrostachys cinerea* subsp. *cinerea* (species group N, Table 4.2).

The herbaceous layer has an average height of 0,4 m and an average canopy cover of 20 % (Table 4.2). It is dominated by the grass *Panicum maximum* and the forbs *Pavonia burchelli, Sida dregei, S. cordiifolia, Adenia glauca, Eragrostis rigidior, Kalanchoe rotundifolia, Schkuhria pinnata* and *Lippia javanica* (species group E, Table 4.2). Other herbaceous plant species are *Eragrostis curvula, E. lehmanniana* and *Aristida congesta* subsp. *congesta* (species group N, Table 4.2).

General

Coetzee et al. (1976) described similar communities from flat bottomlands and from termitaria at Nylsvley Nature Reserve, and two variations were recognized: *Pappea capensis-Acacia tortilis* **variation**, and *Acacia nilotica-Acacia tortilis* **variation**. Floristically the *Pappea capensis-Acacia tortilis* **variation** shows strong affinities with the *Rhus leptodictya-Carissa bispinosa* **variation**, with the most common differential plant species as *Carissa bispinosa* and *Pappea capensis*. The difference between the *Rhus leptodictya-Carissa bispinosa* **variation** and the *Rhus leptodictya-Berchemia zeyheri* **variation** is the structure, but they are floristically

similar and the difference in the table is that the one variation has more species than the other variation.

The structure of the *Rhus leptodictya-Berchemia zeyheri* **variation** is denser and sometimes virtually impenetrable because trees, shrubs and climbers interlock (Figure 4.6), especially the smaller termitarium bushclumps.

4.2.4.2 *Rhus leptodictya-Berchemia zeyheri* **variation**

Type: relevé 16

Habitat

The *Rhus leptodictya-Berchemia zeyheri* **variation** is found at 1 250 m to 1 360 m above sea level. It is represented by four relevés and an average of 34 species was recorded per sample plot. The soils are the same as for the *Rhus leptodictya-Carissa bispinosa* **variation** (see section 4.2.4.1).

Floristics

Although it seems that no differential species occur in this variation, it can be distinguished from the *Rhus leptodictya-Carissa bispinosa* **variation** by the absence of species in the species group E and the presence of species in species group F (Table 4.2).

The tree layer is on average 6,5 m tall with an average canopy cover of 66,3 %. The shrub layer is on average 1,6 m tall with an average canopy cover of 46,0 %. The herbaceous layer has an average height of 0,4 m and an average canopy cover of 10,3 % (Table 4.2).

General

The average diameter of the *Rhus leptodictya-Berchemia zeyheri* **variation** is less (11 metres) than that of the *Rhus leptodictya-Carissa bispinosa* **variation** (25 metres).

4.2.5 *Olea europaea-Calpurnea aurea* Tall Closed Woodland

Type: relevé 97

Habitat

The *Olea europaea-Calpurnea aurea* Tall Closed Woodland is found from 1 180 m to 1 500 m above sea level in deep kloofs on southwest facing and south facing sandstone slopes (2 - 25°) (see section 3.7.4) (Table 4.2, Figure 4.1 & 4.2). It is represented by four relevés and an average of 34 species was recorded per sample plot.

This bushclump community is a representative of Acocks's (1988) Sour Bushveld, with the structure as a tall closed woodland (Edwards 1983) with two relevés (96 and 97) occurring in the Ad Land Type (Figure 2.5) and two relevés (87 and 86) occurring in the Ib Land Type (Figure 2.7) (Land Type Survey Staff 1988). The soils are of the Mispah Form derived from sandstone of the Sandriviersberg Formation and large rocks cover more than 31 % of the soil surface (Figure 4.2; Land Type Survey Staff 1988).

Floristics

The *Olea europaea* subsp. *africana-Calpurnea aurea* Tall Closed Woodland is differentiated by the following plant species (species group G, Table 4.2):

Calodendron capense	***Maytenus polyacantha***
Calpurnia aurea	***Asparagus virgatus***

Cryptolepis transvaalensis ***Tricalysia lanceolata***
Maytenus undata ***Vepris undulata***

The tree layer is on average 10,5 m tall with an average canopy cover of 56 % (Table 4.2). Other prominent trees are *Pappea capensis* and *Schotia brachypetala* (species group H), *Mimusops zeyheri, Olea europaea* subsp. *africana* and *Ficus sur* (species group I, Table 4.2).

The shrub layer is on average 1,8 m tall with an average canopy cover of 41 % (Table 4.2). Prominent shrubs occurring in this community are *Zanthoxylum capense*, *Ochna holstii, Diospyros whyteana, Grewia occidentalis* (species group H) and *Rhoicissus tridentata* and *Euclea natalensis* (species group I, Table 4.2).

The herbaceous layer has an average height of 0,4 metres and an average canopy cover of 21 % (Table 4.2). The herbaceous layer is dominated by the grass, *Setaria lindenbergiana* and the forb H*ypoestes forskaolii* (species group X, Table 4.2).

General

The *Olea europaea* subsp. *africana-Calpurnia aurea* Tall Closed Woodland has floristically very strong affinities with the *Rhus leptodictya-Berchemia zeyheri* **variation**, especially indicated by species group G and species group H (Table 4.2). The difference between these two bushclump communities is the general absence of termitaria in the *Olea europaea* subsp. *africana-Calpurnia aurea* Tall Closed Woodland and the occurrence of rocks in the latter community.

4.3 *Acacia caffra-Heteropogon contortus* Major Community

The species composition of the *Acacia caffra-Heteropogon contortus* Major Community is given in Table 4.1. This major community is differentiated by the following diagnostic plant species (species group B, Table 4.1):

Acacia caffra ***Heteropogon contortus***
Elionurus muticus ***Pogonarthria squarrosa***

Faurea saligna ***Solanum incanum***

This major community occurs on level surfaces and on slopes that are probably nutritionally enriched and in some places relatively mesic, due to water accumulation (Coetzee 1975). The soils are mainly of the Mispah-, Glenrosa-, Hutton- or Clovelly Form. The soil depth varies from 100 mm to more than 1 000 mm (Land Type Survey Staff 1988).

Coetzee (1975) described a similar community as *Eustachys mutica-Acacia caffra* Woodlands and Westfall (1981) described a similar community as Woodland, representative of Acocks's (1988) Sour Bushveld, on moderately deep to deep soils in moderately exposed habitats. Coetzee (1974) described *Acacia caffra* Savannas on diabase and in sheltered valleys that belong to the same syntaxon as the *Acacia caffra-Heteropogon contortus* Major Community described here. Many of the sample plots occur on diabase, which forms the substrate of this major community.

The *Rhus leptodictya-Mimusops zeyheri* Termitarium Thickets and the *Olea europaea* subsp. *africana-Calpurnia aurea* Tall Closed Woodland (Table 4.2) are related to the *Acacia caffra-Heteropogon contortus* Major Community through the mutual presence of species group N (Table 4.2).

A dendrogram to illustrate the habitat relationship of the plant communities classified under the *Acacia caffra-Heteropogon contortus* Major Community is shown in Figure 4.3.

In the phytosociological classification, the following plant communities are classified under the *Acacia caffra- Heteropogon contortus* Major Community (Tables 4.2):

4.3.1 *Acacia karroo-Eragrostis chloromelas* Short Closed Woodland
4.3.2 *Acacia caffra-Setaria sphacelata* Short Closed Woodland
4.3.2.1 *Faurea saligna-Setaria sphacelata* **variation**
4.3.2.2 *Acacia caffra-Setaria sphacelata* **variation**

4.3.1 *Acacia karroo-Eragrostis chloromelas* Short Closed Woodland Type: relevé 111

Habitat

The *Acacia karroo-Eragrostis chloromelas* Short Closed Woodland is found at 1 200 m to 1 280 m above sea level (Figure 4.1) on level and gentle slopes (1 - 6) (see section 3.7.4). It is represented by five relevés and an average of 35 species was recorded per sample plot. This community is a representative of Acocks's (1988) Sourish Mixed Bushveld, with the structure described as a short closed woodland (Edwards 1983), and it occurs in the Ad Land Type (Figure 2.5) (Land Type Survey Staff 1988).

The soils are very rocky (all sizes) and gravelly and of the Mispah- and Glenrosa Forms. The soils are derived from sandstone of the Sandriviersberg Formation and of Post-Waterberg diabase dykes and sills. Rocks cover more than 12 % of the soil surface. The soil is relatively shallow (< 500 mm) (Land Type Survey Staff 1988) (Figure 4.3).

Floristics

The *Acacia karroo-Eragrostis chloromelas* Short Closed Woodland is differentiated by the following plant species (species group J, Table 4.2):

Acacia karroo	***Eragrostis capensis***
A. permixta	***E. chloromelas***
Aristida rhiniochloa	***Grewia bicolor***
Combretum apiculatum	***Peltophorum africanum***
C. hereroense	***Sclerocarya birrea*** subsp ***caffra***
Digitaria eriantha	

The dominant tree stratum is between five metres and eight metres tall with an average canopy cover of 46 % (Table 4.2). *Acacia karroo* is the dominant tree on west facing, north facing and northwest facing slopes. Other prominent trees are *A.*

caffra and *Faurea saligna* (species group M), *Dombeya rotundifolia, Berchemia zeyheri* and *Ziziphus mucronata* (species group N,) and *Lannea discolor* (species group X, Table 4.2). The latter species also differentiates the *Burkea africana-Setaria lindenbergiana* Major Community (Table 4.2).

The shrub stratum, which is on average 1,8 metres tall, has an average canopy cover of 9 % (Table 4.2). The dominant shrubs are *Combretum apiculatum* and *Dichrostachys cinerea* on western and north-western slopes. Grasses and forbs cover 39 % with an average height of 0,8 metres.

The dominant plant species in the herbaceous layer is *Heteropogon contortus, Elionurus muticus* and *Pogonarthria squarrosa* (species group M), *Aristida congesta* subsp. *congesta* and *Eragrostis lehmanniana* (species group N), *Themeda triandra, Eragrostis racemosa* and *Brachiaria serrata* (species group AA, Table 4.2).

General

The *Acacia karroo-Eragrostis chloromelas* Short Closed Woodland has many characteristic species in common with the *Eustachys mutica-Acacia caffra* Woodland described by Coetzee (1975) in the Rustenburg Nature Reserve. Communities 4.2.4, 4.2.5 and 4.3.1 are related to each other through the mutual presence of the *Dombeya rotundifolia* subsp. *rotundifolia* species group (species group M, Table 4.2) and communities 4.3.1 and 4.3.2 are related through the mutual presence of the *Heteropogon contortus* species group (species group M, Table 4.2).

4.3.2 *Acacia caffra-Setaria sphacelata* Short Closed Woodland

Type: relevé 91

Habitat

The *Acacia caffra-Setaria sphacelata* Short Closed Woodland is found at 1 180 m to 1 400 m above sea level (Figure 4.1) on level to gentle slopes (1 - 5) (see section 3.7.4).

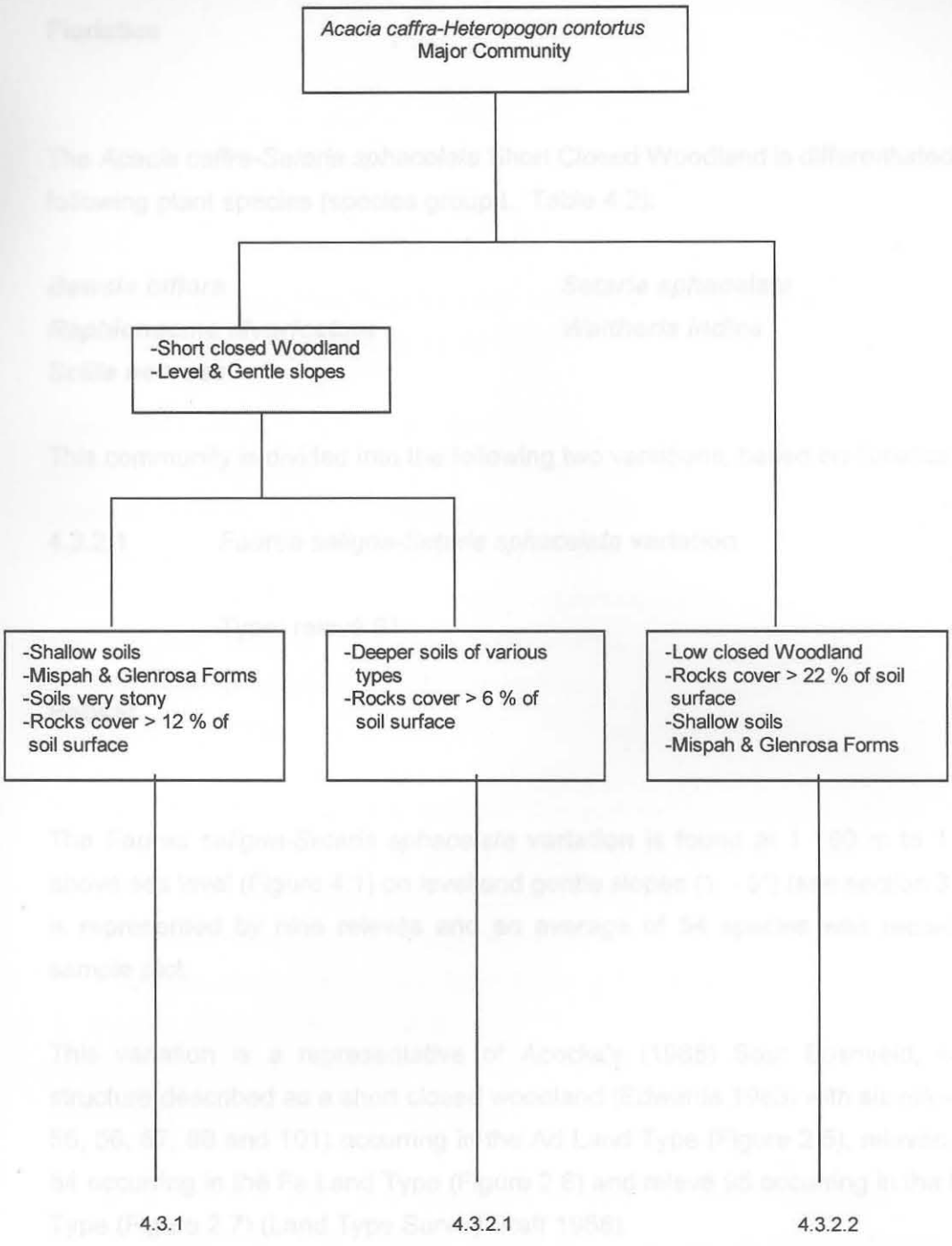


Figure 4.3 A dendrogram to illustrate the habitat relationships of the plant communities classified under the *Acacia caffra-Heteropogon contortus* Major Community.

Vries 1968/69) and the soil is relatively deep (> 500 mm) (Land Type Survey Staff 1988).

Floristics

The *Faurea saligna-Setaria sphacelata* **variation** is differentiated by the following plant species (species group K, Table 4.2):

Acrotome hispida	***Perotis patens***
Callilepis leptophylla	***Pollichia campestris***
Digitaria monodactyla	***Solanum panduriforme***
Drimiopsis burkei	***Terminalia sericea***
Eragrostis gummiflua	***Trichoneura grandiglumis***
Evolvulus alsinoides	***Triumfetta sonderi***
Hermannia depressa	***Walleria nutans***
Indigofera comosa	

The dominant tree stratum is between five and eight metres tall with an average height of 6,0 metres. The average canopy cover is 39 % (Table 4.2). *Burkea africana* and *Faurea saligna* are the dominant trees on the plains and the north facing and northwest facing slopes. Other prominent trees are *Acacia caffra* (species group M), *Dombeya rotundifolia* subsp. *rotundifolia* and *Berchemia zeyheri* (species group N, *Burkea africana, Ochna pulchra* and *Combretum molle* (species group X, Table 4.2). The latter species also differentiates the *Burkea africana-Setaria lindenbergiana* Major Community (Table 4.2).

The shrub stratum, which is on average 1,0 metres tall, has an average canopy cover of 7 % (Table 4.2). The dominant shrubs are *Dichrostachys cinerea* subsp. *cinerea* (species group N, Table 4.2), *Elephantorrhiza elephantina* (species group S, Table 4.2), on north facing and northwest facing slopes. The latter species also differentiates the *Protea welwitchii-Tristachya leucothrix* Low Open Woodland Community (species group S, Table 4.2).

Other prominent shrubs are *Lantana rugosa* and *Ozoroa paniculosa* (species group X, Table 4.1). Grasses and forbs cover 22 % with an average height of 0,7

metres. The dominant plant species in the herbaceous layer are *Setaria sphacelata* subsp. *sphacelata* and *Bewsia biflora* (species group L), *Heteropogon contortus* and *Pogonarthria squarrosa* (species group M, Table 4.2). Other prominent herbaceous species are *Xerophyta retinervis* (species group V) and *Cryptolepis oblongifolia* (species group W, Table 4.2).

General

The *Faurea saligna-Setaria sphacelata* **variation** has many characteristic species in common with the *Burkea africana-Ochna pulchra* Woodland described by Coetzee (1975) in the Rustenberg Nature Reserve and the *Combretum molle-Euclea crispa* Closed Woodland described by Westfall (1981) on the farm Groothoek, south of the study area. Variation 4.3.2.1 is related to community 4.2.4 through the mutual presence of the *Dombeya rotundifolia* subsp. *rotundifolia* species group (species group N, Table 4.2) and the *Protea caffra-Loudetia simplex* Major Community through the mutual presence of the *Loudetia simplex* species group (species group Z, Table 4.2).

4.3.2.2 *Acacia caffra-Setaria sphacelata* **variation**

Type: relevé 89

Habitat

The *Acacia caffra-Setaria sphacelata* **variation** is found at 1 300 m to 1 600 m above sea level (Figure 4.1) on level surfaces and gentle slopes (1 - 16°) (see section 3.7.4). It is represented by nine relevés and an average of 35 species was recorded per sample plot.

This variation is a representative of Acocks's (1988) Sour Bushveld, with the structure as a low closed woodland (Edwards 1983) with six relevés (51, 85, 48, 89, 92 and 52) occurring in the Ad Land type (Figure 2.5) and with three relevés (41, 90 and 93) occurring in the Ib Land Type (Figure 2.7) (Land Type Survey Staff 1988).

The soils on the fairly level surfaces (2 and 5), (see section 3.7.4), (relevés 52 & 90), (Figures 2.5 & 2.7) are of the Hutton, Clovelly and Glenrosa Forms derived from sandstone of the Sandriviersberg Formation (De Vries 1968/69). The soil is relatively shallow (< 500 mm) (Land Type Survey Staff 1988). Soils of the Shortlands Form, derived from diabase of the post-Waterberg Group, are also found in this variation, (see section 3.7.4), (relevés 51, 89 & 92), (MacVicar et al. 1977; Westfall 1981). Rocks cover more than 22 % of the soil surface (Figure 4.3).

The soils on the gentle slopes (15 - 16°), (see section 3.7.4), (relevés 41, 85 & 93), (Figures 2.5 & 2.7) are of the Clovelly, Glenrosa and Mispah Forms derived from sandstone of the Sandriviersberg Formation (De Vries 1968/69). The soil is relatively shallow (< 500 mm) (Land Type Survey Staff 1988). Soils of the Shortlands Form, derived from diabase of the post-Waterberg Group, are also found in this variation (relevé 48), (see section 3.7.4), (MacVicar et al. 1977; Westfall 1981). Rocks cover more than 26 % of the soil surface.

Floristics

Although no differential species occur in this variation, it can be distinguished from the *Faurea saligna-Setaria sphacelata* **variation** by the absence of species in species group K and the presence of species in species group L (Table 4.2).

The dominant tree stratum is between three and five metres tall with an average canopy cover of 53 %. *Acacia caffra* is the dominant tree on nearly all the slopes. Other prominent trees are *Combretum apiculatum* (species group J), which also differentiates the *Acacia karroo- Eragrostis chloromelas* Closed Woodland, *Dombeya rotundifolia* subsp. *rotundifolia, Berchemia zeyheri* and *Ziziphus mucronata* (species group N), *Lannea discolor* (species group X,) and *Vangueria infausta* and *Vitex rehmannii* (species group BB, Table 4.2).

The shrub stratum, which is on average 1,2 metres tall, has an average canopy cover of 14 % (Table 4.2). The dominant shrubs are *Acacia caffra, Dombeya rotundifolia* subsp. *rotundifolia* (species group M), *Dichrostachys cinerea* (species group N), *Lannea discolor* (species group X) and *Vangueria infausta* (species group BB, Table 4.2). Grasses and forbs cover 52 % of the area with an average height of 0,7 metres.

The dominant plant species in the herbaceous layer are *Elionurus muticus* (species group M), *Eragrostis curvula* and *E. lehmanniana* (species group N,), *Andropogon schirensis* (species group Z,) and *Themeda triandra, Eragrostis racemosa, Melinis nerviglume, Cymbopogon plurinodis, Pearsonia cajanifolia, Vernonia oligocephala* and *Gerbera piloselloides* (species group AA, Table 4.2).

General

The *Acacia caffra-Setaria sphacelata* **variation** is related to community 4.2.4 through the mutual presence of the *Dombeya rotundifolia* subsp. *rotundifolia* species group (species group N, Table 4.2) and has many characteristic species in common with the *Eustachys mutica-Acacia caffra* Woodland described by Coetzee (1975) from the Rustenburg Nature Reserve. This closed woodland variation has many characteristic species in common with the *Combretum molle-Themeda triandra* Open Woodland described by Westfall (1981) from the farm Groothoek, south of the study area.

4.4 *Protea caffra-Loudetia simplex* Major Community

The species composition of the *Protea caffra-Loudetia simplex* Major Community is given in Table 4.1. This major community is differentiated by the following diagnostic plant species (species group C, Table 4.1):

Acalypha angustata
Anthospermum hispidula
Chaetacanthus costatus
Helichrysum kraussii
H. setosum
Indigofera burkeana
I. mollicoma
Monocymbium ceresiiforme
Panicum natalense
Rhus magalismontana
Rhynchosia monophylla
R. nitens
Xerophyta retinervis

This major community is related to the *Loudetia simplex- Aristida aequiglumis* Woodlands, Shrublands and Grasslands described by Coetzee (1975) in the Rustenburg Nature Reserve. The *Loudetia simplex-Aristida aequiglumis* Woodlands, Shrublands and Grasslands includes *Protea caffra* - dominated evergreen

woodlands, *Protea welwitchii* and *P. gaguedi* - dominated evergreen shrublands and seasonal grasslands (Coetzee 1975).

The *Protea caffra-Loudetia simplex* Major Community is representative of Acocks's (1988) Sour Bushveld on moderately deep to deep soils in moderately exposed habitats. The Grassland is representative of Acocks's (1988) North-eastern Mountain Sourveld on shallow rocky soils in exposed habitats, as described by Westfall (1981) on the farm Groothoek south of the study area. Similar vegetation was described by Matthews et al. (1991) and Du Preez (1992 a&b).

The soils are mainly of the Mispah-, Glenrosa-, Clovelly- and/or Hutton Forms. The soil depth varies from 10 mm to more than 1 000 mm (Land Type Survey Staff 1988).

The *Acacia caffra-Heteropogon contortus* Major Community is related to the *Protea caffra-Loudetia simplex* Major Community through the mutual presence of the *Themeda triandra* species group (species group AA, Table 4.2).

A dendrogram to illustrate the habitat relationship of the plant communites of the *Protea caffra-Loudetia simplex* Major Community is shown in Figure 4.4.

In the phytosociological classification, the plant communites identified within the *Protea caffra-Loudetia simplex* Major Community are the following (Tables 4.1 & 4.2):

4.4.1 *Protea caffra-Tristachya rehmannii* Low Open Shrubland
4.4.2 *Protea caffra-Encephalartos eugene-maraisii* Low Open Woodland
4.4.3 *Protea caffra-Rhus dentata* Low Open Woodland
4.4.4 *Protea welwitchii-Tristachya leucothrix* Low Open Shrubland
4.4.5 *Andropogon schirensis-Dicoma anomala* Short Closed Grassland

4.4.1 *Protea caffra-Tristachya rehmannii* Low Open Shrubland
Type: relevé 33

Habitat

The *Protea caffra-Tristachya rehmannii* Low Open Shrubland is found at 1 240 m to 1 880 m above sea level (Figure 4.1) on gentle to moderate slopes (16 - 32°) (see

section 3.7.4). It is represented by 18 relevés and an average of 44 species was recorded per sample plot.

This community is a representative of Acocks's (1988) Sour Bushveld, with the structure as a low closed woodland (Edwards 1983). Two relevés (40 & 47) occur in the Ad Land Type (Figure 2.5), three relevés (44, 14 & 49) in the Fa Land Type (Figure 2.6) and 13 relevés in the Ib Land Type (Figure 2.7) (Land Type Survey Staff 1988).

The soils are very rocky (all sizes) and rocks cover an average of 50 % of the soil surface. The soils are classified as Mispah- and Glenrosa Forms, derived from sandstone of the Sandriviersberg Formation. The soil is relatively shallow (< 500 mm) (Land Type Survey Staff 1988) (Figure 4.4).

Floristics

The *Protea caffra-Tristachya rehmannii* Low Open Shrubland is differentiated by the following plant species (species group O, Table 4.2):

Becium obovatum
Berkheya zeyheri
Castalis spectabilis
Crassula capitella
Enneapogon pretoriae
Erica drakensbergensis
Eriosema cordatum
Gerbera viridifolia
Gladiolus atropurpureus
Helichrysum cephaloideum
H. coriaceum
H. dasymallum
Helichrysum nudifolium
Hypoxis acuminata
Indigofera hedyantha
I. hilaris
Kohautia amatymbica
Pentanisia angustifolia
Polygala uncinata
Psammotropha myriantha
Scabiosa columbaria
Tristachya rehmannii
Urelytrum agropyroides

The tree stratum is between two and four metres tall with an average canopy cover of 28 % (Table 4.2). *Protea caffra* is the dominant tree on south facing, southeast facing and southwest facing slopes. In two relevés, (79 & 83), *Protea caffra* occurs on the northeast facing and northwest facing steep slopes (27 & 23°) at 1 700 m and

1 850 m respectively. It seems that the occurrence of *Protea caffra* on the north facing slopes is associated with altitude (> 1 700 m) and temperature, because dominant trees in this community on the north facing slopes are *Acacia caffra* and *Englerophytum magalismontanum* and they occur at lower altitudes (1 400 m), where it may be warmer (Table 4.2).

The shrub stratum, which is on average 0,7 metres tall, has an average canopy cover of 11 % (Table 4.2). The dominant shrubs are *Protea caffra, Rhus dentata* and *Erica drakensbergensis* on south facing, southeast facing and southwest facing slopes. The herbaceous layer covers 40 % of the soil surface with an average height of 0,9 metres. The dominant plant species in the herbaceous layer are the xerophytic fern *Cheilanthus hirta* and *Athrixia elata* (species group R), *Loudetia simplex, Diheteropogon amplectens* and *Aristida transvaalensis* (species group Z) and *Themeda triandra, Eragrostis racemosa, Bulbostylis burchellii* and *Trachypogon spicatus* (species group AA, Table 4.2).

General

The *Protea caffra-Tristachya rehmannii* Low Open Shrubland has many characteristic species in common with the *Tristachya biseriata-Protea caffra* Woodland (Coetzee 1975) and the *Combretum molle-Heteropogon contortus* closed and open woodlands (Westfall 1981). Communities, 4.4.1, 4.4.2 and 4.4.3 are related through the mutual presence of the *Protea caffra-Loudetia simplex* Major Community.

Protea caffra species group (species group R, Table 4.2) and communities 4.4.1, 4.4.4 and 4.4.5 are related through the mutual presence of the *Panicum natalense* species group (species group V, Table 4.2).

4.4.2 *Protea caffra-Encephalartos eugene-maraisii* Low Open Woodland

Type: relevé 120

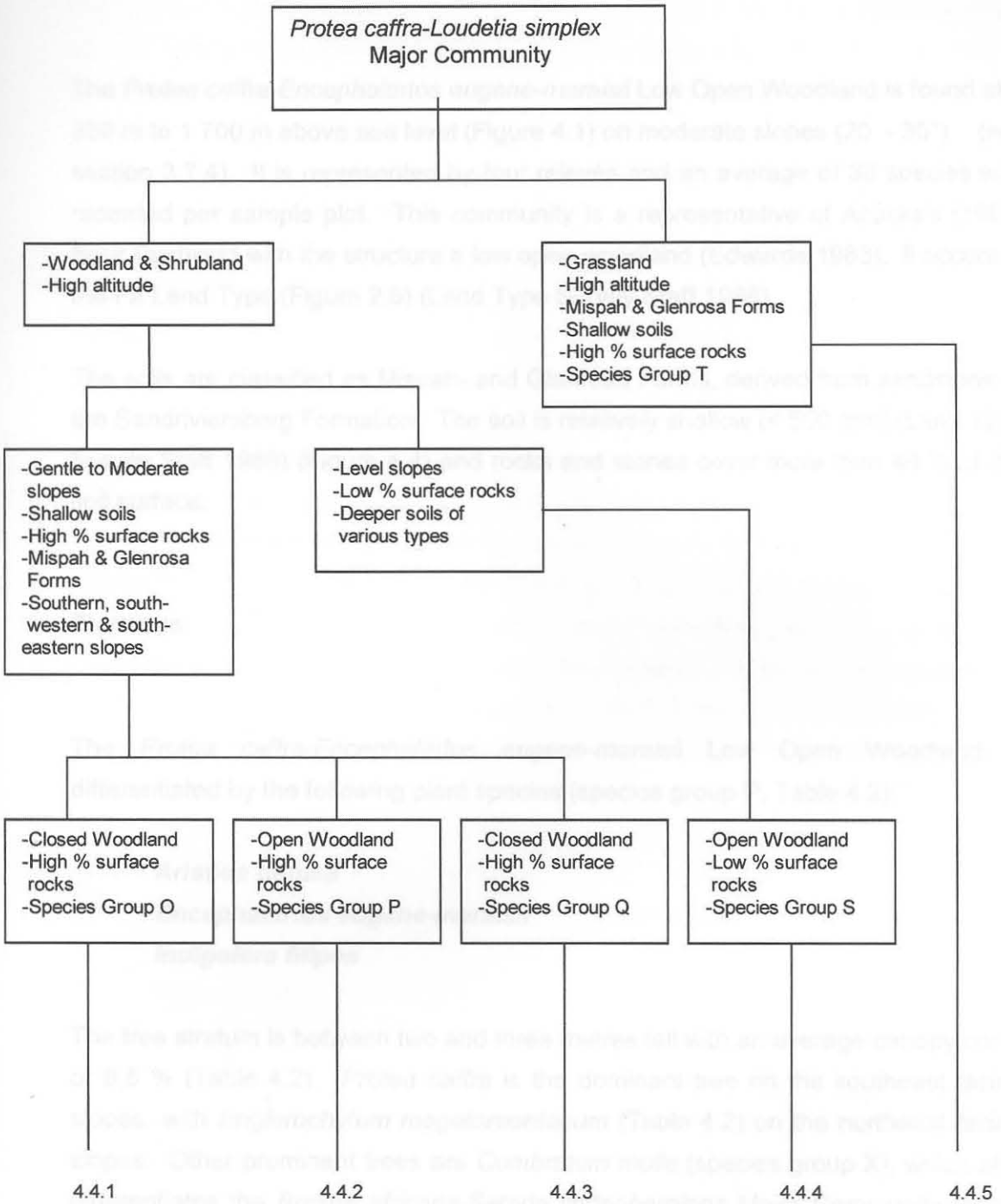


Figure 4.4 A dendrogram to illustrate the habitat relationships of the plant communities classified under the *Protea caffra-Loudetia simplex* Major Community.

Habitat

The *Protea caffra-Encephalartos eugene-maraisii* Low Open Woodland is found at 1 380 m to 1 700 m above sea level (Figure 4.1) on moderate slopes (20 - 30°) (see section 3.7.4). It is represented by four relevés and an average of 38 species was recorded per sample plot. This community is a representative of Acocks's (1988) Sour Bushveld with the structure a low open woodland (Edwards 1983). It occurs in the Fa Land Type (Figure 2.6) (Land Type Survey Staff 1988).

The soils are classified as Mispah- and Glenrosa Forms, derived from sandstone of the Sandriviersberg Formation. The soil is relatively shallow (< 500 mm) (Land Type Survey Staff 1988) (Figure 4.4) and rocks and stones cover more than 48 % of the soil surface.

Floristics

The *Protea caffra-Encephalartos eugene-maraisii* Low Open Woodland is differentiated by the following plant species (species group P, Table 4.2):

Aristida diffusa
Encephalartos eugene-maraisii
Indigofera filipes

The tree stratum is between two and three metres tall with an average canopy cover of 8,5 % (Table 4.2). *Protea caffra* is the dominant tree on the southeast facing slopes, with *Englerophytum magalismontanum* (Table 4.2) on the northeast facing slopes. Other prominent trees are *Combretum molle* (species group X), which also differentiates the *Burkea africana-Setaria lindenbergiana* Major Community (Table 4.2).

The shrub stratum, which is on average 1,8 metres tall, has an average canopy cover of 10 % (Table 4.2). A conspicuous shrub is *Encephalartos eugene-maraisii* on southeast facing slopes and northeast facing slopes. Other prominent shrubs are *Rhus dentata* (species group R), *Ozoroa paniculosa* (species group X) and *Ancylobotrys capensis* (species group Y, Table 4.2).

The herbaceous layer covers 29 % with an average height of 1,0 metre (Table 4.1). The dominant plant species in this layer are *Andropogon schirensis* (species group Z) and *Trachypogon spicatus* (species group AA, Table 4.2). Other plant species in this layer are *Panicum natalense*, *Rhynchosia monophylla, Indigofera mollicoma* and *Helichrysum setosum* (species group V) and *Littonia modesta* (species group X, Table 4.2). The latter species also differentiate the *Burkea africana-Setaria lindenbergiana* Major Community.

General

The *Protea caffra-Encephalartos eugene-maraisii* Low Open Woodland has many characteristic species in common with the *Tristachya biseriata-Protea caffra* Woodland (Coetzee 1975) and the *Combretum molle-Protea caffra* Open Woodland (Westfall 1981). Communities, 4.4.2 and 4.4.3 are related through the mutual presence of the *Protea caffra* species group (species group R, Table 4.2). Communities, 4.4.2, 4.4.4 and 4.4.5 are related through the mutual presence of the *Panicum natalense* species group (species group V, Table 4.2). Community 4.4.2 is related to the *Burkea africana-Setaria lindenbergiana* Major Community through the mutual presence of the *Rhynchosia totta* species group (species group Y, Table 4.2).

4.4.3 *Protea caffra-Rhus dentata Low* Open Woodland

Type: relevé 27

Habitat

The *Protea caffra-Rhus dentata* Low Open Woodland is found at 1 400 m to 1 540 m above sea level (Figure 4.1) on gentle to moderate slopes (12 - 28°) (see section 3.7.4). It is represented by seven relevés and an average of 48 species was recorded per sample plot. This community is a representative of Acocks's (1988) Sour Bushveld with the structure, a low closed woodland (Edwards 1983). All the relevés occur in the Fa Land Type (Figure 2.6) except relevé 34, which occurs in the Ib Land Type (Figure 2.7) (Land Type Survey Staff 1988).

The soils are classified as Mispah- and Glenrosa Forms, derived from sandstone of the Sandriviersberg Formation. The soil is relatively shallow (< 500 mm) (Land Type Survey Staff 1988) (Figure 4.4) and rocks and stones cover more than 40 % of the soil surface.

Floristics

The *Protea caffra-Rhus dentata* Low Open Woodland is differentiated by the following plant species (species group Q, Table 4.2):

Argyrolobium transvaalensis
Crassula swaziensis
Mundulea sericea
Silene burchellii

The tree stratum is between two and five metres tall with an average canopy cover of 19 % (Table 4.2). *Protea caffra* is the dominant tree on the southeast facing slopes and southwest facing slopes, with *Englerophytum magalismontanum*, *Burkea africana, Strychnos pungens* and *Lannea discolor* on the northeast facing slopes (Table 4.2). Other prominent trees are *Combretum molle* (species group X), which also differentiates the *Burkea africana-Setaria lindenbergiana* Major Community, *Vangueria infausta* and *Vitex rehmannii* (species group BB, Table 4.2).

The shrub stratum is between 0,5 metres and 1,5 metres tall with an average canopy cover of 11 % (Table 4.2). The dominant shrubs are *Elephantorrhiza burkei* (species group X) and *Rhoicissus revoilii* (species group BB, Table 4.2). Young individuals of *Protea caffra* (0,5 - 1 metres tall) may be present. A prominent shrub is *Ozoroa paniculosa* (species group X), which also differentiates the *Burkea africana-Setaria lindenbergiana* Major Community (Tables 4.1 & 4.2). *Apodytes dimidiata* and *Heteropyxis natalensis* (species group BB, Table 4.2) are also conspicuously present.

The herbaceous layer covers 34 % with an average height of 0,9 metres (Table 4.2). The dominant plant species in this layer are *Andropogon schirensis, Aristida transvaalensis, Loudetia simplex* and *Diheteropogon amplectens* (species group Z, Table 4.2).

General

The *Protea caffra-Rhus dentata* Low Open Woodland has many characteristic species in common with the *Rhus dentata- Heteropogon contortus-Combretum molle* Closed Woodland **variation** (Westfall 1981). Communities, 4.4.3, 4.4.4 and 4.4.5 are related through the mutual presence of the *Panicum natalense* species group (species group V, Table 4.2). Community 4.4.3 is related to the *Burkea africana-Setaria lindenbergiana* Major Community through the mutual presence of the *Rhynchosia totta* species group (species group Y, Table 4.2).

4.4.4 *Protea welwitchii-Tristachya leucothrix* Low Open Shrubland.

Type: relevé 123

Habitat

The *Protea welwitchii-Tristachya leucothrix* Low Open Shrubland is found at 1 480 m to 1 500 m above sea level (Figure 4.1) on level ground (1 - 5°) (see section 3.7.4). It is represented by three relevés and an average of 56 species was recorded per sample plot. This community is a representative of Acocks's (1988) Sour Bushveld, with a short open shrubland structure (Edwards 1983). It occurs in the Fa Land Type (Figure 2.6) (Land Type Survey Staff 1988).

The soils are of the Hutton-, Clovelly- or Avalon Forms, derived from sandstone of the Sandriviersberg Formation and no rocks and stones occur in this community. The soil depth varies between 400 mm - 1 200 mm (Land Type Survey Staff 1988) (Figure 4.4).

Floristics

The *Protea caffra-Tristachya leucothrix* Low Open Shrubland is differentiated by the following plant species (species group S, Table 4.2):

Aster harveyanus
Cymbopogon excavatus
Cynodon dactylon
Dicoma zeyheri
Elephantorrhiza elephantina
Eragrostis plana
Gladiolus pretoriensis
Gnidia kraussiana
Hyparrhenia hirta
Hypoxis rigidula
Indigofera acuticephala
***Ledebouria* sp.**
Protea welwitchii
Triraphis andropogonoides
Tristachya leucothrix
Vernonia natalensis
Walafrida densiflora

The dominant woody species in this community are the shrubs *Protea welwitchii* and *Elephantorrhiza elephantina*, with an average canopy cover of 10% and average height of 0,7 metres (Table 4.2). The dwarf deciduous shrub *Parinari capensis* subsp. *capensis*, which forms large stands, forms part of this community (species group U, Table 4.2). The herbaceous layer covers 18 % of the area with an average height of 1,0 metre (Table 4.2). The dominant species are *Tristachya leucothrix, Hyparrhenia hirta, Gnidia kraussiana* and *Cynodon dactylon* (Table 4.2).

General

The *Protea welwitchii-Tristachya leucothrix* Low Open Shrubland has many characteristic species in common with the *Digitaria brazzae-Tristachya rehmannii* Woodlands and Shrublands (Coetzee 1975). Communities, 4.4.4 and 4.4.5 are related through the mutual presence of the *Parinari capensis* species group (species group U, Table 4.2).

4.4.5 *Andropogon schirensis-Dicoma anomala* Short Closed Grassland.

Type: relevé 1

Habitat

The *Andropogon schirensis-Dicoma anomala* Short Closed Grassland is found at 1 620 m to 2 010 m above sea level (Figure 4.1) on level slopes (1 - 3°) (see section

3.7.4). It is represented by 12 relevés and an average of 45 species was recorded per sample plot. This community is a representative of Acocks's (1988) North-eastern Mountain Sourveld, with a short closed grassland structure (Edwards 1983). This community occurs in the Ad -, Fa - and Ib land types (Figure 2.4). The soils are of the Mispah and Glenrosa Forms derived from sandstone of the Sandriviersberg Formation (De Vries 1968/69). The soil depth varies between 10 - 300 mm (Land Type Survey Staff 1988) and rocks cover more than 33 % of the soil surface (Figure 4.4).

Floristics

The *Andropogon schirensis-Dicoma anomala* Short Closed Grassland is differentiated by the following plant species (species group T, Table 4.2):

Babiana hypogea
Chamaecrista mimosoides
Cleome maculata
Crassula lanceolata
Cyanotis speciosa
Cyperus rupestris
Dicoma anomala
Digitaria brazzae
Gazania krebsiana
Kohautia cynanchica
Lotononis calycina
Microchloa caffra
Osteospermum junceus
Polycarpaea corymbosa
Polygala hottentotta
Protea gaguedi
Rhus gracillima
Thunbergia atriplicifolia
Vernonia staehelinoides

No trees were recorded in the sample plots, but isolated individuals of *Podocarpus latifolius* are found in boulder clumps in this community. The *Podocarpus latifolius* trees are on average 3,0 metres tall with an average canopy cover of less than 0,1 %, resulting in the grassland classification (Edwards 1983) for this community.

The shrub layer is on average 1,5 metres tall with an average canopy cover of 1,5 % (Table 4.2). Prominent shrubs occurring in this community are *Protea roupelliae* and *Passerina montana*. Grasses and forbs cover 29 % of the area, with an average height of 0,8 metres. The dominant plant species in the herbaceous layer are *Panicum natalense, Anthospermum hispidula, Rhynchosia monophylla, Acalypha*

angustata and *Monocymbium ceresiiforme* (species group V), *Andropogon schirensis, Loudetia simplex, Diheteropogon amplectens* and *Aristida transvaalensis* (species group Z) and *Eragrostis racemosa, Trachypogon spicatus, Bulbostylis burchellii, Schizachyrium sanguineum* and *Fadogia homblei* (species group AA, Table 4.2).

General

The *Andropogon schirensis-Dicoma anomala* Short Closed Grassland has many characteristic species in common with the *Loudetia simplex-Aristida aequiglumis* Woodlands, Shrublands and Grasslands (Coetzee 1975) and the *Protea roupelliae-Helichrysum nudifolium* Sparse Woodland and the *Trachypogon spicatus-Eragrostis racemosa* Grassland (Westfall 1981). The community is exposed, being situated at a high altitude and a considerable temperature variation could be expected. Mist occurs frequently on the summit of the Kransberg massif and together with a high rainfall, contribute to the moisture regime in this exposed community, which was observed during the course of the fieldwork.

4.5 *Burkea africana-Setaria lindenbergiana* Major Community

The species composition of the *Burkea africana-Setaria lindenbergiana* Major Community is given in Table 4.1. This major community is differentiated by the following diagnostic plant species (species group D, Table 4.1):

Burkea africana	***Ochna pulchra***
Combretum molle	***Ozoroa paniculosa***
Elephantorrhiza burkei	***Pseudolachnostylis maprouneifolia***
Hypoestes forskaolii	***Setaria lindenbergiana***
Kalanchoe paniculata	***Strychnos pungens***
Lannea discolor	***Stylochiton natalense***
Lantana rugosa	***Tapiphyllum parvifolium***
Littonia modesta	

This major community occurs on gentle to moderately steep slopes of rocky sandstone hills, where soils are litholitic and rocks cover 53 % of the soil surface (Figure 4.5). The soils occur mainly in the Ad-, Fa- and Ib land types (Land Type Survey Staff 1988) (Figure 2.5, 2.6 & 2.7) and are mainly of the Mispah-, Glenrosa-, Clovelly-, Hutton- and Cartref Forms. The soil varies from 10 mm to more than 1 200 mm in depth (Land Type Survey Staff 1988).

Coetzee et al. (1976) described a similar community as the *Barleria bremekampii-Diplorhynchus* Tree Savanna and Westfall (1981) described a similar community as a Woodland, representative of Acocks's (1988) Sour Bushveld, on moderately deep to deep soils in moderately exposed habitats.

The *Burkea africana-Setaria lindenbergiana* Major Community is related to the *Acacia caffra-Heteropogon contortus* Major Community and the *Protea caffra-Loudetia simplex* Major Community through the mutual presence of species group AA (Table 4.2).

A dendrogram to illustrate the habitat relationship of the plant communities classified under the *Burkea africana-Setaria lindenbergiana* Major Community is shown in Figure 4.5. In the phytosociological classification, the plant communities classified under the *Burkea africana-Setaria lindenbergiana* Major Community (Table 4.1) is:

4.5.1 *Burkea africana-Setaria lindenbergiana* Low Thicket
4.5.1.1 *Burkea africana-Diplorhynchus condylocarpon* **variation**
4.5.1.2 *Burkea africana-Englerophytum magalismontanum* **variation**

4.5.1 *Burkea africana-Setaria lindenbergiana* Low Thicket

Type: relevé 43

Habitat

The *Burkea africana-Setaria lindenbergiana* Low Thicket is found at 1 320 m to 1 620 m above sea level (Figure 4.1) on gentle to moderate slopes (11 - 33°) (see section 3.7.4).

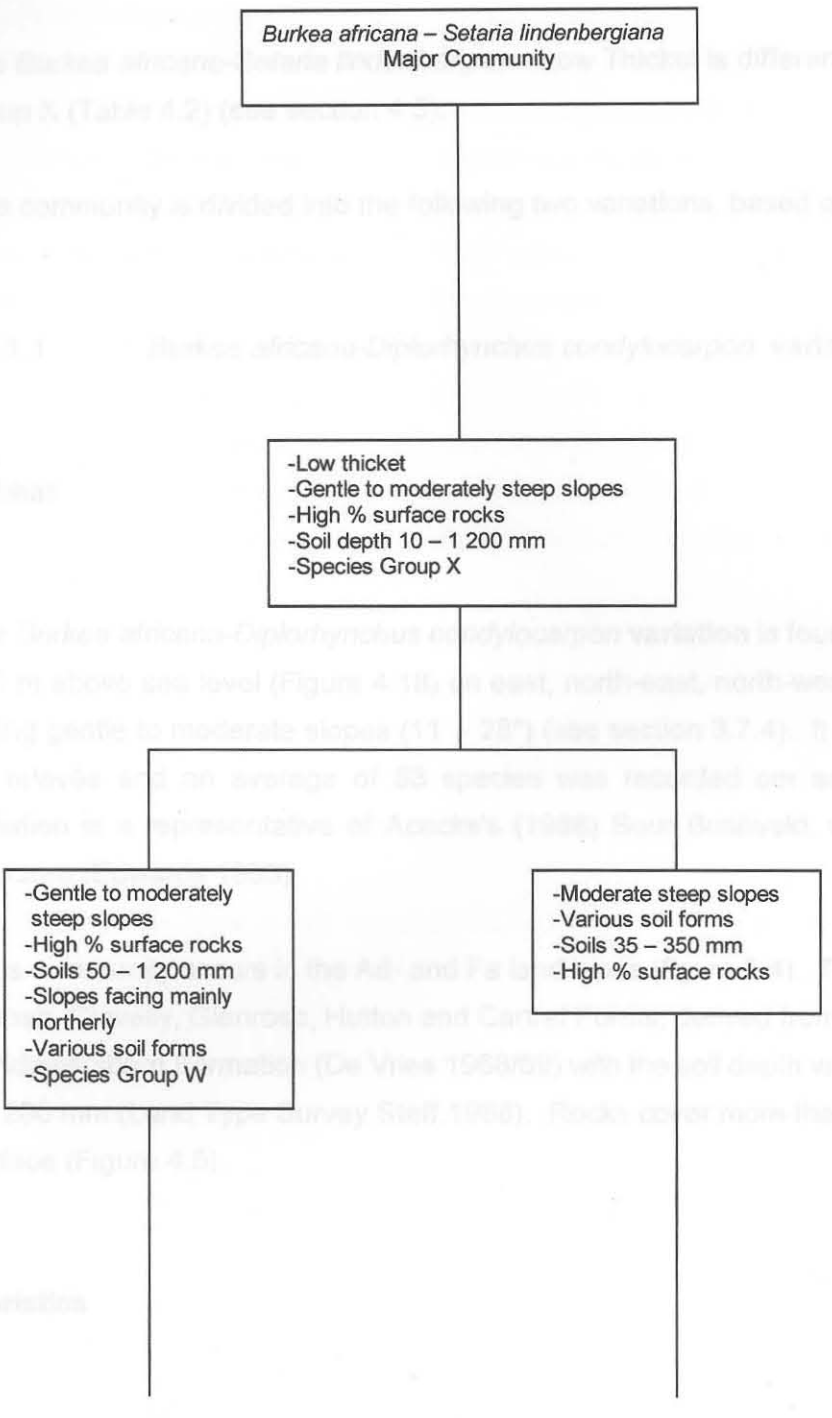


Figure 4.5 A dendrogram to illustrate the habitat relationships of the plant communities classified under the *Burkea africana-Setaria lindenbergiana* Major Community

Floristics

The *Burkea africana-Setaria lindenbergiana* Low Thicket is differentiated by species group X (Table 4.2) (see section 4.5).

This community is divided into the following two variations, based on floristics:

4.5.1.1 *Burkea africana-Diplorhynchus condylocarpon* **variation**

Habitat

The *Burkea africana-Diplorhynchus condylocarpon* **variation** is found at 1 320 m to 1 520 m above sea level (Figure 4.18) on east, north-east, north-west and south-west facing gentle to moderate slopes (11 - 28°) (see section 3.7.4). It is represented by 10 relevés and an average of 53 species was recorded per sample plot. This variation is a representative of Acocks's (1988) Sour Bushveld, with a low thicket structure (Edwards 1983).

This community occurs in the Ad- and Fa land types (figure 2.4). The soils are of the Mispah, Clovelly, Glenrosa, Hutton and Cartref Forms, derived from sandstone of the Sandriviersberg Formation (De Vries 1968/69) with the soil depth varying between 50 - 1 200 mm (Land Type Survey Staff 1988). Rocks cover more than 58 % of the soil surface (Figure 4.5).

Floristics

The *Burkea africana-Diplorhynchus condylocarpon* **variation** is differentiated by the following plant species (species group W, Table 4.2):

Acalypha petiolaris ***Ipomoea transvaalensis***
Achyranthus aspera ***Jasminum multipartitum***

Andropogon chinensis	***Jatropha zeyheri***
Aristida scabrivalvis	***Lablab purpurea***
Blepharis subvolubilis	***Leonotis microphylla***
Brachiaria nigropedata	***Limeum viscosum***
Clerodendron myricoides	***Macrotyloma axilare***
Crossandra greenstockii	***Pavonia transvaalensis***
Cryptolepis oblongifolia	***Tephrosia rhodesica***
Cyphostemma lanigerum	***Turraea obtusifolia***
Diplorhynchus condylocarpon	***Vitex pooara***
Ipomoea obscura	***Viscum combreticola***

The tree layer is on average 4,0 metres tall with an average canopy cover of 39 % (Table 4.2). Other prominent trees are *Englerophytum magalismontanum* (species group Z) and *Vangueria infausta, Vitex rehmannii* and *Heteropyxis natalensis* (species group BB, Table 4.2). The above-mentioned species occur as shrubs in the community as well.

The shrub layer is on average 1,0 metres tall with an average canopy cover of 33 % (Table 4.2). Prominent shrubs occurring in this community are *Ancylobotrys capensis* (species group Y), *Maytenus tenuispina* (species group Z) and *Asparagus transvaalensis* and *Rhoicissus revoilii* (species group BB, Table 4.2).

The herbaceous layer is well represented in this community, with an average canopy cover of 34 % and an average height of 0,8 metres. The dominant plant species are *Commelina africana, Aristida transvaalensis, Brachiaria serrata, Phyllanthus parvulus* and *Diheteropogon amplectens* (species group Z), *Melinis repens* (species group AA) and the xerophytic ferns *Cheilanthus viridis* and *Pellaea calomelanos* (species group BB, Table 4.2).

General

The vegetation of the *Burkea africana-Diplorhynchus condylocarpon* **variation** is a broad-leaved low thicket. Uneven broken areas carry a dense woody vegetation whereas, on more even terrain, trees are less dense. Trees and shrubs of varying age and height occur in all parts of the thicket. The *Burkea africana-Diplorhynchus condylocarpon* **variation** has many characteristic species in common with the

Barleria bremekampii-Diplorhynchus Tree Savanna (Coetzee et al. 1976) and the *Combretum molle-Aristida diffusa* open woodland (Westfall 1981).

4.5.1.2 *Burkea africana-Englerophytum magalismontanum* **variation**

Habitat

The *Burkea africana-Englerophytum magalismontanum* **variation** is found at 1 400 m to 1 620 m above sea level (Figure 4.1) on moderate slopes (20 - 33°) (see section 3.7.4). It is represented by eight relevés and an average of 41 species was recorded per sample plot. This variation is representative of Acocks's (1988) Sour Bushveld, with the structure a low thicket (Edwards 1983).

This community occurs in the Fa and Ib land type (Figure 2.4), with only one relevé (78) in the Ib land type. The soils are of the Mispah, Hutton and Glenrosa Forms derived from sandstone of the Sandriviersberg Formation (De Vries 1968/69) with the soil depth varying between 10 - 350 mm (Land Type Survey Staff 1988). Rocks cover more than 48 % of the soil surface, which is lower than that of the *Burkea africana- Diplorhynchus condylocarpon* **variation.**

Floristics

Although no differential species were identified for this variation, it can be distinguished from the *Burkea africana-Diplorhynchus condylocarpon* **variation** by the absence of species in species group W and the presence of species in species group X (Table 4.2).

The tree stratum is between three and five metres tall, with an average of 3,5 metres, and with an average canopy cover of 13 % (Table 4.2). The most prominent trees are *Burkea africana* (species group X) and *Diplorhynchus condylocarpon* (species group W) and *Apodytes dimidiata* and *Heteropyxis natalensis* (species group BB, Table 4.2).

The shrub stratum, which is on average 0,8 metres tall, has an average canopy cover of 12 % (Table 4.2). Grasses and forbs cover 29 % of the area with an average height of 0,6 metres. The dominant species in the herbaceous layer are *Setaria lindenbergiana* (species group X), *Andropogon schirensis* (species group Z) and *Fadogia homblei* (species group AA, Table 4.2).

General

The *Burkea africana-Englerophytum magalismontanum* **variation** has many characteristic species in common with the *Combretum molle-Aristida diffusa* open woodland described by Westfall (1981) and the *Barleria bremekampii- Diplorhynchus* Tree Savanna described by Coetzee et al. (1976). This variation is very similar to the *Burkea africana- Diplorhynchus condylocarpon* **variation** on other rocky sandstone areas, and because of the similarity of these two variations, they are mapped as a single unit on the vegetation map (Figure 4.1).

4.6 *Andropogon huilensis-Xyris capensis* Major Community

The species composition of the *Andropogon huilensis-Xyris capensis* Major Community is given in Table 4.2. This major community is differentiated by the following diagnostic plant species (species group FF, Table 4.2):

Andropogon huillensis	***Kohautia virgata***
Cyperus leptocladus	***Xyris capensis***

Many streams arise in seepage areas, for instance on mountain slopes. These are seasonally or perennially waterlogged, with vegetation dominated by sedges and other hygrophilous angiosperms and perhaps mosses and are termed sponges (Noble & Hemens 1978).

This major community occurs along streams and tributaries of the Matlabas-, Mamba- and Sterkstroom Rivers and shallow submerged marshy areas or sponges (Figures 4.1).

The soils are mainly of the Avalon, Hutton, Katspruit, Oakleaf and Westleigh Forms, derived from sandstone of the Sandriviersberg Formation (De Vries 1968/69). The soil depth varies between 300 - 1 200 mm (Land Type Survey Staff 1988). Coetzee (1975) described similar communities as the *Aristida junciformis- Arundinella nepalensis* Grassland and the *Pteridium aquilinum-Phragmites mauritianus* Reedswamp.

A dendrogram to illustrate the habitat relationship of the plant communities classified under the *Andropogon huilensis-Xyris capensis* Major Community is shown in Figure 4.6.

In the phytosociological classification, the plant communities classified under the *Andropogon huilensis-Xyris capensis* Major Community are classified as follows (Tables 4.1 & 4.2):

4.6.1 *Syzygium cordatum-Miscanthus junceus* Short Thicket
4.6.2 *Fuirena pubescens-Aristida junciformis* Low Closed Grassland
4.6.3 *Fuirena pubescens-Chironia purpurascens* Low CLosed Grassland

4.6.1 *Syzygium cordatum-Miscanthus junceus* Short Thicket

Type: relevé 61

Habitat

The *Syzygium cordatum-Miscanthus junceus* Short Thicket is found at 1 300 m to 1 420 m above sea level (Figure 4.1) on level and gentle slopes (1 - 3°) (see section 3.7.4).

This plant community occurs on the banks of the Matlabas-, Mamba- and Sterkstroom Rivers, as well as along the streams contributing to these rivers. The watercourses are not particularly rich in plant species, being mostly dominated by a few herbaceous species. It is represented by seven relevés and an average of 22 species was recorded per sample plot.

This plant community is situated within the Sour Bushveld (Acocks 1988), with the structure as a short thicket (Edwards 1983). All the relevés occur in the Fa Land Type, with one relevé (107) occurring in the Ib Land Type (Figure 2.4).

The soils are of the Mispah-, Katspruit and/or Glenrosa Forms, derived from sandstone of the Sandriviersberg Formation. The soil is relatively shallow (50 - 350 mm) (Land Type Survey Staff 1988) (Figure 4.6) and rocks cover more than 54 % of the soil surface (De Vries 1968/69).

This plant community is restricted to relatively fast-draining watercourses and is associated with intermediate or deep streambed incision (Fuls et al. 1992 a&b).

Floristics

The *Syzygium cordatum-Miscanthus junceus* Short Thicket is differentiated by the following plant species (species group CC, Table 4.2):

Agrostis lachnantha	***Miscanthus junceus***
Andropogon eucomus	***Osmunda regalis***
Cliffortia linearifolia	***Polygonum pulchrum***
Coleochloa setifera	***Pseudognaphalium luteo-album***
Dissotis debilis	***Schoenoplectus corymbosus***
Hemarthria altissima	***Setaria megaphylla***
Ilex mitis	***S. pallide-fusca***
Ischaemum fasciculatum	***Syzygium cordatum***
Lycopodium cercuum	***S. guineense***

Shrubs and trees are encountered in the deeper incised watercourses (Fuls et al. 1992 a&b). The tree stratum is between four and 10 metres tall with an average canopy cover of 70 % (Table 4.2). The most conspicuous tree species that may be found are *Syzygium cordatum* and *S. guineense* (species group CC, Table 4.2). The shrub stratum, which is on average 1,4 metres tall, has an average canopy cover of 42 % (Table 4.2). The dominant shrubs are *Syzygium cordatum, Cliffortia linearifolia* and *Ilex mitis* (species group CC, Table 4.2).

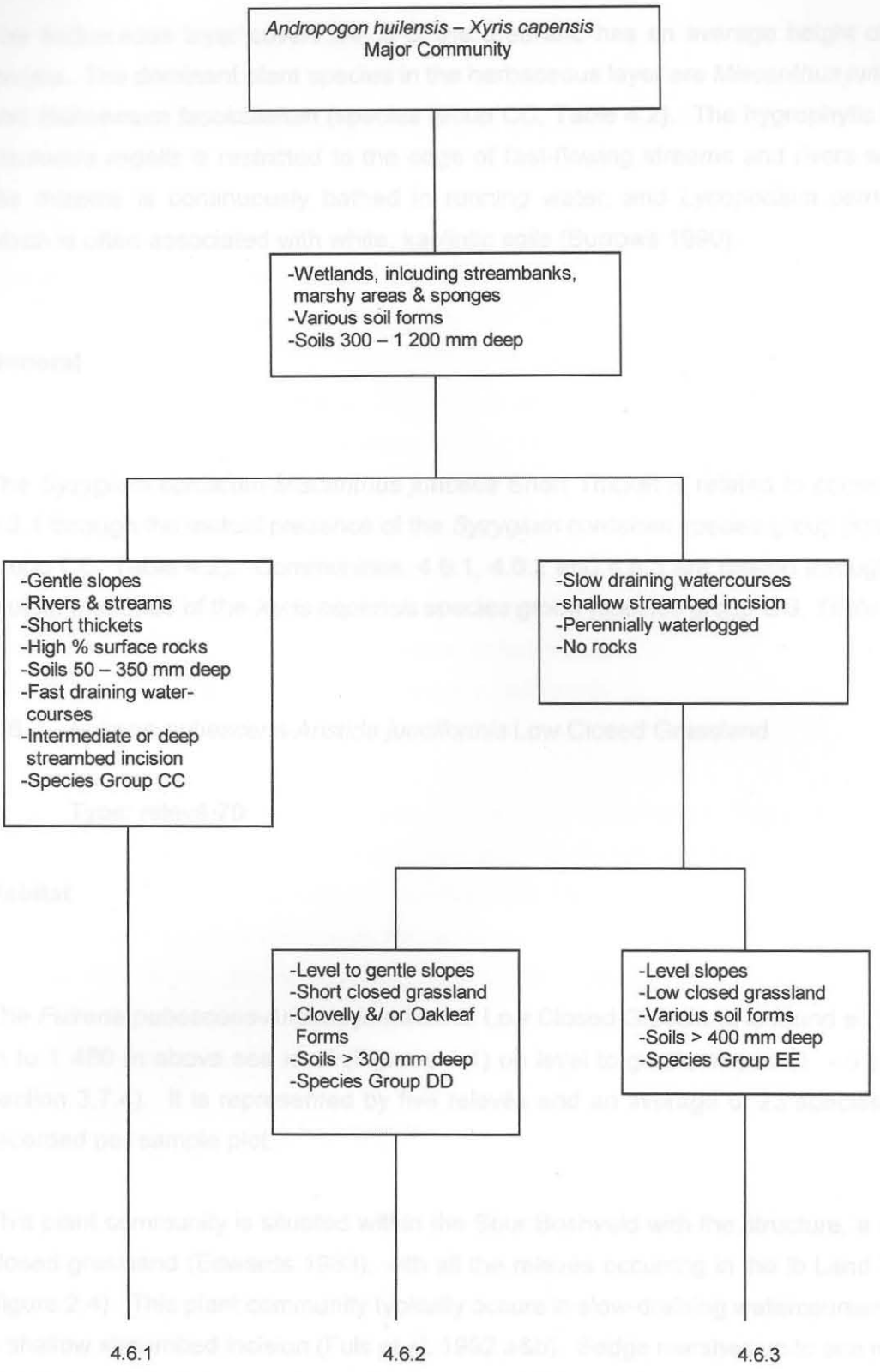


Figure 4.6 A dendrogram to illustrate the habitat relationships of the plant communities classified under the *Andropogon huilensis-Xyris capensis* Major Community

The herbaceous layer covers 54 % of the area and has an average height of 1,1 metres. The dominant plant species in the herbaceous layer are *Miscanthus junceus* and *Ischaemum fasciculatum* (species group CC, Table 4.2). The hygrophytic fern, *Osmunda regalis* is restricted to the edge of fast-flowing streams and rivers where the rhizome is continuously bathed in running water, and *Lycopodium cernuum,* which is often associated with white, kaolintic soils (Burrows 1990).

General

The *Syzygium cordatum-Miscanthus junceus* Short Thicket is related to community 4.2.1 through the mutual presence of the *Syzygium cordatum* species group (species group CC, Table 4.2). Communities. 4.6.1, 4.6.2 and 4.6.3 are related through the mutual presence of the *Xyris capensis* species group (species group GG, Table 4.2).

4.6.2 *Fuirena pubescens-Aristida junciformis* Low Closed Grassland

Type: relevé 70

Habitat

The *Fuirena pubescens-Aristida junciformis* Low Closed Grassland is found at 1 460 m to 1 480 m above sea level (Figures 4.1) on level to gentle slopes (1 - 5°) (see section 3.7.4). It is represented by five relevés and an average of 23 species was recorded per sample plot.

This plant community is situated within the Sour Bushveld with the structure, a short closed grassland (Edwards 1983), with all the relevés occurring in the Ib Land Type (figure 2.4). This plant community typically occurs in slow-draining watercourses with a shallow streambed incision (Fuls et al. 1992 a&b). Sedge marshes up to one metre in height, which are perennially waterlogged, intergrade with river source sponges on mountain slopes (Noble & Hemens 1978). This plant community is perennially waterlogged, with the vegetation dominated by sedges and other hygrophilous angiosperms. The area represents sponges and these are the source of water for the Matlabas River.

The soils are of the Clovelly- and/or Oakleaf Forms, derived from sandstone of the Sandriviersberg Formation (De Vries 1968/69). No rocks occur in this plant community and the soil is relatively deep (300 - 1 000 mm) (Land Type Survey Staff 1988)(Figure 4.6).

Floristics

The *Fuirena pubescens-Aristida junciformis* Low Closed Grassland is differentiated by the following plant species (species group DD, Table 4.2):

Aristida junciformis	***Cyperus dedunatus***
Arundinella nepalensis	***Eriochrysis pallida***
Ascolepis capensis	***Helichrysum epapposum***
Berkheya radula	***Pennisetum sphacelatum***
Brachiaria bovinae	***Pycnostachys reticulata***
Carex cernua	***Sopubia simplex***

Large woody species do not occur in this plant community (Table 4.2). The herbaceous layer covers 78 % of the area and has an average height of 0,9 metres (Table 4.2). The most conspicuous diagnostic species is *Fuirena pubescens*, a perennial herb species commonly encountered in moist habitats. Other diagnostic species include the grasses *Leersia hexandra* and *Diplachne fusca* as well as the forbs *Monopsis decipiens, Helichrysum aureonitens, Sebaea leiostyla* and *Hypericum lalandii* (species group FF, Table 4.2).

General

Plant communities, 4.6.2 and 4.6.3 are related to each other through the mutual presence of the *Fuirena pubescens* species group (species group FF, Table 4.2). In the past this plant community was intensively overgrazed by cattle and annually burnt by farmers to induce new grass growth for the cattle through the period before the summer rains start. This practice led to the dessication of the sponges and the introduction of woody plants that already occur on the fringes of this community.

The management of this plant community is very important because the sponges are the source of the Matlabas River, and overutilization would lead to the dessication and the degrading of the Matlabas River System.

4.6.3 *Fuirena pubescens-Chironia purpurascens* Low Closed Grassland

Type: relevé 103

Habitat

The *Fuirena pubescens-Chironia purpurascens* Low Closed Grassland is found at 1 410 m to 1430 m above sea level (Figure 4.1) on level slopes (2 - 3°) (see section 3.7.4). It is represented by four relevés and an average of 27 species was recorded per sample plot.

This plant community is situated within the Sour Bushveld, with the structure a low closed grassland (Edwards 1983). All the relevés occur in the Fa Land Type (Figure 2.4). This plant community typically occurs in slow-draining watercourses with a shallow streambed incision (Fuls et al. 1992 a&b). This plant community occurs as sponges, perennially waterlogged, with the vegetation dominated by sedges and other hygrophilous angiosperms. This plant community occurs at the source of the Sterkstroom River.

The soils are of the Hutton-, Clovelly-, Avalon-, Westleigh- and/or Katspruit Forms, derived from sandstone of the Sandriviersberg Formation (De Vries 1968/69). No rocks occur in this plant community and the soil is relatively deep (400 mm - 1 200 mm) (Land Type Survey Staff 1988)(Figure 4.6).

Floristics

The *Fuirena pubescens-Chironia purpurascens* Low Closed Grassland is differentiated by the following plant species (species group EE, Table 4.2):

Aristida bipartita ***Kyllinga alba***

Asclepias brevipes	***Lobelia erinus***
Chironia purpurascens	***Nemesia fruticans***
***Cyperus* sp.**	***Panicum dregeanum***
Cyperus thorncroftii	***Senecio affinis***
Dierama medium	***S. erubescens***
Disa woodii	***S. polyodon***
Drosera madagascariensis	***Verbena bonariensis***
Eragrostis inamoena	

Large woody species do not occur in this plant community (Table 4.2). The herbaceous layer covers 88 % of the area with an average height of 0,5 metres (Table 4.2). The most conspicuous diagnostic species is *Fuirena pubescens*, a perennial herb species commonly encountered in moist places. Other diagnostic species occur in species group FF (Table 4.2).

General

This plant community has also been described, similarly to the *Fuirena pubescens-Aristida junciformis* Short Closed Grassland due to the grazing and burning of the sponges (see section 4.6.2).

B RANGE MANAGEMENT

Introduction

The grazing capacity of 10 of the 16 plant communities, which include four variations, was determined using the Graze Program (Bredenkamp & van Rooyen 1991 a&b). The grazing capacity of the following plant communities was not determined because of the small size, low grazing potential an/or inaccessibility of this specific communities (Table 4.2; Section 3.8):

Widdringtonia nodiflora-Podocarpus latifolius Short Forest.
Podocarpus latifolius-Rothmannia capensis Tall Forest.
Buxus macowanii-Kirkia wilmsii Low Forest.

Rhus leptodictya-Mimusops zeyheri Termitaria Thickets.
Olea europaea subsp.*africana-Calpurnia aurea* Tall Closed Woodland.
Syzygium cordatum-Miscanthus junceus Short Thicket.

4.7 *Acacia karroo-Eragrostis chloromelas* Short Closed Woodland

The size of this plant community is 385 ha and covers 1,3 % of the study area. The grazing capacity is 5,5 ha/LSU (Table 4.3).

The ecological index of the veld is at present 841, which shows that it is in good condition, because of the high percentage Decreaser species present in this veld (Table 4.3). According to Trollope et al. (1989), veld that has a high forage and fuel production potential is indicative of veld that is being moderately utilised by grazing animals. This veld is subjected to frequent lightning fires that help to maintain the present veld condition. During a year with below average rainfall, the grazing capacity would decrease from 5,5 ha/LSU to 7,8 ha/LSU (Table 4.3). The grasses with the highest frequency are as follows:

Species	**% Frequency**
Themeda triandra	36 %
Heteropogon contortus	20 %
Eragrostis chloromelas	18 %
Brachiaria serrata	9 %
Aristida canescens	4 %
Panicum coloratum	4 %
Bothriochloa insculpta	3 %

Table 4.3 Grazing capacity of *Acacia karroo-Eragrostis chloromelas* Short Closed Woodland

SIZE (ha) = 385

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	46	46
	SHRUBS:	9	9
		.8	.8
% DECREASERS		77	77
% INCREASERS 1		3	3
% INCREASERS 2a&b		10	10
% INCREASERS 2c		10	10
TOTAL		100	100
ECOLOGICAL INDEX		841	757
% GRASS COVER		39	48
AVERAGE RAINFALL (mm/year)		551	441
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		5.5 (ha/LSU)	7.8 (ha/LSU)

4.8 *Faurea saligna-Setaria sphacelata* variation

The size of this plant community is 1 675 ha and covers 5,8 % of the study area. The grazing capacity is 7,4 ha/LSU (Table 4.4).

The ecological index of the veld is at present 760, which shows that it is in a fairly good condition, because of the high percentage Decreaser species present in this veld. The total of 19 % for the Increaser 2c species show that this veld will degrade if the grazing capacity of 7,4 ha/LSU for an average rainfall is exceeded (Table 4.4). Lightning fires occur regularly in this veld that help with maintaining the present veld condition.

During a year with below average rainfall, the grazing capacity would decrease from 7,4 ha/LSU to 11,5 ha/LSU (Table 4.4). The grasses with the highest frequency are as follows:

Species	**% Frequency**
Digitaria eriantha	25 %
Themeda triandra	18 %
Setaria sphacelata	15 %
Melinis repens	8 %
Diheteropogon amplectens	6 %
Elionurus muticus	3 %

Table 4.4 Grazing capacity of *Faurea saligna-Setaria sphacelata* variation

SIZE (ha) = 1675

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	39	39
	SHRUBS:	7	7
		.7	.7
% DECREASERS		67	67
% INCREASERS 1		5	5
% INCREASERS 2a&b		9	9
% INCREASERS 2c		19	19
TOTAL		100	100
ECOLOGICAL INDEX		760	684
% GRASS COVER		22	18
AVERAGE RAINFALL (mm/year)		551	468
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		7.4 (ha/LSU)	11.5 (ha/LSU)

4.9 *Acacia caffra-Setaria sphacelata* variation

The size of this plant community is 743 ha and covers 2,6 % of the study area. The grazing capacity is 5,1 ha/LSU (Table 4.5).

The ecological index of the veld is at present 835, which shows that the veld is in good condition, because of the high percentage Decreaser species present in the veld (Table 4.5). The total of 12 % for Increaser 2c species shows that this veld will degrade if the grazing capacity of 5,1 ha/LSU for an average rainfall is exceeded (Table 4.5).

This veld is subjected to frequent lightning fires that help to maintain the present veld condition. During a year with below average rainfall, the grazing capacity would decrease from 5,1 ha/LSU to 7,3 ha/LSU (Table 4.5). The grasses with the highest frequency are as follows:

Species	**% Frequency**
Setaria sphacelata	31 %
Themeda triandra	27 %
Heteropogon contortus	16 %
Melinis repens	8 %
Elionurus muticus	4 %
Eragrostis chloromelas	3 %
Trachypogon spicatus	3 %

Table 4.5 Grazing capacity of *Acacia caffra-Setaria sphacelata* variation

SIZE (ha) = 743

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	53	53
	SHRUBS:	14	14
		.6	.6
	% DECREASERS	76	76
	% INCREASERS 1	5	5
	% INCREASERS 2a&b	7	7
	% INCREASERS 2c	12	12
	TOTAL	100	100
ECOLOGICAL INDEX		835	752
% GRASS COVER		52	42
AVERAGE RAINFALL (mm/year)		551	468
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		5.1 (ha/LSU)	7.3 (ha/LSU)

4.10 *Protea caffra - Tristachya rehmannii* Low Open Shrubland

The size of this plant community is 2 458 ha and covers 8,5 % of the study area. The grazing capacity is 5,4 ha/LSU (Table 4.6).

The ecological index of the veld is at present 772, which shows that it is in moderately good condition, because of the fairly high percentage Decreaser species and high percentage Increaser 1 species present in this veld. The percentage of the Increaser 2a+2b & 2c species is very low which is also an indication that this veld is in good condition (Table 4.6).

During a year with below average rainfall, the grazing capacity would decrease from 5,4 ha/LSU to 7,8 ha/LSU (Table 4.6). The grasses with the highest frequency are as follows:

Species	**% Frequency**
Tristachya rehmannii	19 %
Panicum natalense	16 %
Trachypogon spicatus	12 %
Urelytrum agropyroides	8 %
Loudetia simplex	7 %
Setaria sphacelata	6 %
Andropogon schirensis	5 %
Monocymbium cerisiiforme	5 %
Themeda triandra	5 %
Eragrostis racemosa	4 %
Schizachyrium sanguineum	4 %
Tristachya leucothrix	4 %

Table 4.6 Grazing capacity of *Protea caffra-Tristachya rehmannii* Low Open Shrubland

SIZE (ha) = 2 458

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	28	28
	SHRUBS:	11	11
		.8	.8
% DECREASERS		33	33
% INCREASERS 1		60	60
% INCREASERS 2a&b		5	5
% INCREASERS 2c		2	2
TOTAL		100	100
ECOLOGICAL INDEX		772	695
% GRASS COVER		40	32
AVERAGE RAINFALL (mm/year)		551	468
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		5.4 (ha/LSU)	7.8 (ha/LSU)

4.11 *Protea caffra-Encephalartos eugene-maraisii* Low Open Woodland

The size of this plant community is 180 ha and covers 0,6 % of the study area. The grazing capacity is 6,7 ha/LSU (Table 4.7).

The ecological index of the veld is at present 769, which shows that it is in a good condition, because of the moderate percentage Decreaser species and high percentage Increaser 1 species present in this veld. According to Bredenkamp & Van Rooyen (1991 a&b), veld with a high percentage Decreaser and Increaser 1 species, is a veld in good condition with a high grazing capacity. This veld however, is not very accessible for grazing animals and is therefore *under*utilised. *Under*-utilised veld has a moderate to low forage production potential but a very high fuel production potential (Trollope et al. 1989).

This veld condition only develops in the Sour Bushveld (Acocks 1988). Grass species like *Loudetia simplex, Trachypogon spicatus, Tristachya rehmannii* and *Urelytrum agropyroides* become dominant as a result of undergrazing caused by grasses becoming unpalatable in the absence of regular burning or with protection from fire (Trollope et al. 1989). During a year with below average rainfall, the grazing capacity would decrease from 6,7 ha/LSU to 9,8 ha/LSU (Table 4.7). The grasses with the highest frequency are as follows:

Species	**% Frequency**
Trachypogon spicatus	23 %
Loudetia simplex	17 %
Panicum natalense	11 %
Tristachya rehmannii	11 %
Urelytrum agropyroides	9 %
Andropogon schirensis	8 %
Themeda triandra	5 %
Brachiaria serrata	4 %
Eragrostis racemosa	3 %
Schizachyrium sanguineum	3 %
Setaria sphacelata	3 %

Table 4.7 Grazing capacity of *Protea caffra-Encephalartos eugenemaraisii* Low Open Woodland

SIZE (ha) = 180

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	19	19
	SHRUBS:	11	11
		.8	.8
% DECREASERS		26	26
% INCREASERS 1		71	71
% INCREASERS 2a&b		3	3
% INCREASERS 2c		0	0
TOTAL		100	100
ECOLOGICAL INDEX		769	692
% GRASS COVER		34	27
AVERAGE RAINFALL (mm/year)		551	468
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		6.7 (ha/LSU)	9.8 (ha/LSU)

4.12 *Protea caffra-Rhus dentata* Low Open Woodland

The size of this plant community is 5 555 ha and covers 19,1 % of the study area. The grazing capacity is 6,7 ha/LSU (Table 4.8).

The ecological index of the veld is at present 790 (see sections 4.7 - 4.11). This community occurs mostly on gentle to moderate slopes and the soils are very rocky and rocks cover more than 40 % of the soil surface (see section 4.4.3). This could contribute to the *under*utilization of this specific community.

During a year with below rainfall, the grazing capacity would decrease from 6,7 ha/LSU to 9,9 ha/LSU (Table 4.8). The grasses with the highest frequency are as follows:

Species	**% Frequency**
Trachypogon spicatus	23 %
Panicum natalense	16 %
Loudetia simplex	11 %
Tristachya rehmannii	11 %
Urelytrum agropyroides	11 %
Andropogon schirensis	9 %
Monocymbium ceresiiforme	8 %
Themeda triandra	4 %

Table 4.8 Grazing capacity of *Protea caffra-Rhus dentata* Low Open Woodland

SIZE (ha) = 5 555

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	23	23
	SHRUBS:	10	10
		.8	.8
% DECREASERS		31	31
% INCREASERS 1		68	68
% INCREASERS 2a&b		1	1
% INCREASERS 2c		0	0
TOTAL		100	100
ECOLOGICAL INDEX		790	711
% GRASS COVER		29	23
AVERAGE RAINFALL (mm/year)		551	468
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		6.7 (ha/LSU)	9.9 (ha/LSU)

4.13 *Protea welwitchii-Tristachya leucothrix* Low Open Shrubland

The size of this plant community is 438 ha and covers 1,5 % of the study area. The grazing capacity is 10,9 ha/LSU (Table 4.9).

The ecological index of the veld is at present 739, which shows that it is in a good condition, because of the high percentage Decreaser species and Increaser 1 species. In the past this veld was extensively grazed by cattle and since it has been part of MNP, little or no grazing occurred in this veld, because of the lack of grazing animals.

Grazing animals were recently introduced into this part of MNP. During the time that little or no grazing occurred in this veld, MNP burnt every second year because of lightning fires. The accumulation of moribund material did not occur which helped to maintain the present status of this veld.

During a year with below average rainfall, the grazing capacity would decrease from 10,9 ha/LSU to 17,9 ha/LSU (Table 4.9). The grasses with the highest frequency are as follows:

Species	**% Frequency**
Andropogon schirensis	14 %
Trachypogon spicatus	12 %
Panicum dregeana	10 %
Loudetia simplex	9 %
Themeda triandra	8 %
Tristachya rehmannii	8 %
Schizachyrium sanguineum	7 %
Hyparrhenia hirta	4 %
Panicum coloratum	4 %

Table 4.9 Grazing capacity of *Protea welwitchii-Tristachya leucothrix* Low Open Shrubland

SIZE (ha) = 438

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	0	0
	SHRUBS:	10	10
		1.0	1.0
% DECREASERS		31	31
% INCREASERS 1		57	57
% INCREASERS 2a&b		6	6
% INCREASERS 2c		6	6
TOTAL		100	100
ECOLOGICAL INDEX		739	665
% GRASS COVER		18	14
AVERAGE RAINFALL (mm/year)		551	468
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		10.9 (ha/LSU)	17.9 (ha/LSU)

4.14 *Andropogon schirensis-Dicoma anomala* Short Closed Grassland

The size of this plant community is 9 635 ha and covers 33,2 % of the study area. The grazing capacity is 10,5 ha/LSU (Table 4.10).

The ecological index of the veld is at present 718, which shows that this veld is in good condition, because of the moderate percentage Decreaser species and high percentage Increaser 1 species present in this veld. The condition of the vegetation for this veld (plant community) was described by Westfall (1981) and during that time the vegetation was grazed by cattle that were driven to the summit by a road.

This veld was grazed periodically because the cattle could not reach the summit of their own accord, due to fences. Westfall (1981) found low proportion Decreaser species and a high proportion Increaser 2a+2b and Increaser 2c species. Since this veld became part of MNP, no or very little grazing occurred in this veld, because the only grazing animals that occurred in this veld was Mountain Rhebuck. The grass was not moribund due to periodically natural fires (lightning), which changed the species composition from high Increaser 2a+2b & 2c species to high Increaser 1 species (Table 4.10).

Grass species like *Loudetia simplex, Trachypogon spicatus, Tristachya leucothrix* and *Andropogon schirensis* become dominant as a result of undergrazing. Grasses became unpalatable in the absence of regular burning or with protection from fire (Trollope et al. 1989). During a year with below average rainfall, the grazing capacity would decrease from 10,5 ha/LSU to 15,8 ha/LSU (Table 4.10).

The grasses with the highest frequency are as follows:

Species	**% Frequency**
Trachypogon spicatus	23 %
Andropogon schirensis	20 %
Loudetia simplex	17 %

Table 4.10 Grazing capacity of *Andropogon schirensis-Dicoma anomala* Short Closed Grassland

SIZE (ha) = 9 635

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	1	1
	SHRUBS:	2	2
		1.0	1.0
% DECREASERS		13	13
% INCREASERS 1		81	81
% INCREASERS 2a&b		5	5
% INCREASERS 2c		1	1
TOTAL		100	100
ECOLOGICAL INDEX		718	646
% GRASS COVER		29	23
AVERAGE RAINFALL (mm/year)		551	468
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		10.5 (ha/LSU)	15.8 (ha/LSU)

Species	% Frequency
Tristachya leucothrix	10 %
Panicum natalense	8 %
Urelytrum agropyroides	7 %
Eragrostis racemosa	4 %
Schizachyrium sanguineum	4 %
Monocymbium ceresiiforme	3 %
Themeda triandra	3 %

4.15 *Burkea africana-Diplorhynchus condylocarpon* variation

The size of this plant community is 3 106 ha and covers 10,7 % of the study area. The grazing capacity is 7,9 ha/LSU (Table 4.11).

The ecological index of the veld is at present 556. The frequency of Decreaser species is 19 %, Increaser 1 species 44 % and Increaser 2c species 30 % (Table 4.11). This veld occurs on gentle to moderate slopes and it was heavily grazed on the gentle slopes whereas, on the moderate slopes, no grazing or little grazing occurred. With the correct veld management and adequate rainfall the grass species composition may improve from Increaser species to Decreaser species.

During a year with below average rainfall, the grazing capacity would decrease from 7,9 ha/LSU to 12,4 ha/LSU (Table 4.11). The grasses with the highest frequency are as follows:

Species	% Frequency
Schizachyrium sanguineum	15 %
Andropogon schirensis	14 %
Melinis repens	12 %
Aristida transvaalensis	11 %
Setaria sphacelata	10 %
Loudetia simplex	9 %
Aristida scabrivalvis	6 %

Table 4.11 Grazing capacity of *Burkea africana-Diplorhynchus condylocarpon* variation

SIZE (ha) = 3 106

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	39	39
	SHRUBS:	33	33
		.6	.6
% DECREASERS		19	19
% INCREASERS 1		44	44
% INCREASERS 2a&b		7	7
% INCREASERS 2c		30	30
TOTAL		100	100
ECOLOGICAL INDEX		556	500
% GRASS COVER		34	27
AVERAGE RAINFALL (mm/year)		551	468
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		7.9 (ha/LSU)	12.4 (ha/LSU)

Species	% Frequency
Trachypogon spicatus	5 %
Digitaria eriantha	3 %

4.16 *Burkea africana-Englerophytum magalismontanum* variation

The size of this plant community is 1 428 ha and covers 4,9 % of the study area. The grazing capacity is 8,3 ha/LSU (Table 4.12).

The ecological index of this veld is at present 664. The veld is in a moderate condition, because the frequency of Decreaser species are 37 % and the Increaser 1 species are 31 % (Table 4.12). The percentage Increaser 2a+2b & 2c species is also moderately high, which shows that this veld was extensively grazed in the past. The grass species composition in this veld will improve through correct veld management and adequate rainfall.

During a year with below average rainfall, the grazing capacity would decrease from 8,3 ha/LSU to 12,8 ha/LSu (Table 4.12).

The grasses with the highest frequency are as follows:

Species	% Frequency
Setaria sphacelata	13 %
Digitaria eriantha	10 %
Brachiaria nigropedata	8 %
Melinis repens	8 %
Schizachyrium sanguineum	8 %
Andropogon schirensis	7 %
Eragrostis rigidior	6 %
Loudetia simplex	5 %
Trachypogon spicatus	5 %
Enneapogon cenchroides	4 %
Eragrostis curvula	4 %
Tristachya leucothrix	4 %
Diheteropogon amplectens	3 %
Eragrostis chloromelas	3 %
Pogonarthria squarrosa	3 %

4.17 *Fuirena pubescens-Aristida junciformis* Low Closed Grassland

The size of this plant community is 408 ha and covers 1,4 % of the study area. The grazing capacity is 9,2 ha/LSU (Table 4.13).

The ecological index of the veld is at present 562. There is an equally high percentage Decreaser species (40 %) and Increaser 2c species (42 %) present in this veld. In the past this veld was severely grazed by cattle and it was frequently burned. The fact that it is a wetland that have permanent water, it was suitable for grazing just after the winter months when the farmers burned the veld. New grass would emerge shortly after the fire and the cattle were driven onto the veld.

This plant community must not be burned frequently, because it could lead to the drying out of the wetland. During a year with below average rainfall, the grazing capacity would decrease from 9,2 ha/LSU to 14,0 ha/LSU (Table 4.13). The grasses with the highest frequency are as follows:

Species	**% Frequency**
Aristida junciformis	39 %
Panicum dregeanum	12 %
Monocymbium ceresiiforme	11 %
Andropogon huilensis	10 %
Miscanthus junceus	7 %
Brachiaria bovonei	6 %
Panicum volutans	4 %
Aristida bipartita	3 %

Table 4.12 Grazing capacity of *Burkea africana-Englerophyton magalismontanum* variation

SIZE (ha) = 1428

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	13	13
	SHRUBS:	12	12
		.9	.9
% DECREASERS		37	37
% INCREASERS 1		31	31
% INCREASERS 2a&b		15	15
% INCREASERS 2c		17	17
TOTAL		100	100
ECOLOGICAL INDEX		664	598
% GRASS COVER		29	23
AVERAGE RAINFALL (mm/year)		551	468
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		8.3 (ha/LSU)	12.8 (ha/LSU)

Table 4.13 Grazing capacity of *Fuirena pubescens-Aristida junciformis* Low Closed Grassland.

SIZE (ha) = 408

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	0	0
	SHRUBS:	0	0
		1.0	1.0
% DECREASERS		40	40
% INCREASERS 1		16	16
% INCREASERS 2a&b		2	2
% INCREASERS 2c		42	42
TOTAL		100	100
ECOLOGICAL INDEX		562	506
% GRASS COVER		78	63
AVERAGE RAINFALL (mm/year)		551	468
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		9.2 (ha/LSU)	14.0 (ha/LSU)

Species	% Frequency
Arundinella nepalensis	3 %
Pennisetum sphacelatum	3 %

4.18 *Fuirena pubescens-Chironia purpurascens* Low CLosed Grassland

The size of this plant community is 45 ha and covers 0,3 % of the study area. The grazing capacity is 8,2 ha/LSU (Table 4.14).

The ecological index of the veld is at present 634. The frequency Decreaser species is 29 %, the Increaser 1 species 36 %, the Increaser 2a+2b species 19 % and the Increaser 2c species 16 % (Table 4.14). The grass cover for this veld is high, but a fair amount of the grass species become unpalatable for grazing animals. To increase the Decreaser species this veld could be burned more often, but from a management point of view, this would be detrimental for the wetland community. Care should be taken not to attract large numbers of grazing animals to this veld because it could be detrimental for the veld.

During a year with below rainfall, the grazing capacity would decrease from 8,2 ha/LSU to 12,1 ha/LSU (Table 4.14). The grasses with the highest frequency are as follows:

Species	% Frequency
Miscanthus junceus	22 %
Eragrostis inamoena	19 %
Panicum dregeanum	17 %
Andropogon huilensis	14 %
Monocymbium ceresiiforme	12 %
Aristida bipartita	9 %
A. junciformis	7 %

4.19 Summary

The total grazing capacity for the study area as a whole, was determined from the grazing capacities for each plant community (except for the six plant communities discussed in section 4.7), and is summarized in Tables 4.15 and 4.16. The present average grazing capacity for the study area is 7,8 ha/LSU (Table 4.15). The results show that the veld is at present in a moderate to good condition. It must be emphasized that the grazing capacity decreases during years with low rainfall, so the numbers of the game must be adjusted in accordance with the veld condition at that specific stage. If the rainfall decrease to 468 mm per annum, the grazing capacity decreases from 7,8 ha/LSU to 11,7 ha/LSU.

The game numbers are at present very low for the study area, because a relocation program of game for MNP was only introduced two years ago and the numbers reintroduced are still low. Aerial censuses must be conducted annually to accurately determine the number of game present in the study area. This is necessary for effective veld management and nature conservation of MNP.

The game species composition and game numbers recommended for the study area (MNP) are shown in Table 4.17. According to Table 4.17 the study area is understocked with game so the veld will not be overutilised and might get a chance to further improve. Presently only 73,86 % of the grazing capacity of the area is achieved, giving opportunity for further increases in game numbers.

Table 4.14 Grazing capacity of *Fuirena pubescens-Chironia purpurascens* Low Closed Grassland.

SIZE (ha) = 45

		AVERAGE RAINFALL	BELOW AVERAGE RAINFALL
% BUSH COVER	TREES:	0	0
	SHRUBS:	0	0
		1.0	1.0
% DECREASERS		29	29
% INCREASERS 1		36	36
% INCREASERS 2a&b		19	19
% INCREASERS 2c		16	16
TOTAL		100	100
ECOLOGICAL INDEX		634	571
% GRASS COVER		88	71
AVERAGE RAINFALL (mm/year)		551	468
ACCESSIBILITY (.9 =hills / 1 =plains)		.9	.9
FIRE (1 =regular/ never= .8)		1	1
GRAZING CAPACITY FOR GAME		8.2 (ha/LSU)	12.1 (ha/LSU)

Table 4.15 Total present grazing capacity for Marakele National Park.

Unit Number	Hectare	Grazing Cap. ha/LSU: Game	LSU Game
1	385	5.40	71
2	1 675	7.40	226
3	743	5.10	146
4	2 458	5.40	455
5	180	6.70	27
6	5 555	6.70	829
7	438	10.90	40
8	9 635	10.50	918
9	3 106	7.90	393
10	1 428	8.30	172
11	408	9.20	44
12	45	8.20	5
TOTAL	26 056		3 326

Total Grazing capacity for game = 7,8 ha/LSU

Table 4.16 Total grazing capacity for an under average year for Marakele National Park.

Unit Number	Hectare	Grazing Cap. ha/LSU: Game	LSU Game
1	385	7.80	49
2	1 675	11.50	146
3	743	7.30	102
4	2 458	7.80	315
5	180	9.80	18
6	5 555	9.90	561
7	438	17.90	24
8	9 635	15.80	610
9	3 106	12.40	250
10	1 428	12.80	112
11	408	14.00	29
12	45	12.10	4
TOTAL	26 056		2 220

Total Grazing capacity for game = 11,7 ha/LSU

Table 4.17 Current numbers of game for Marakele National Park

(Modified from Graze, Bredenkamp & van Rooyen 1991 a&b)

Maximum LSU Game:- 3326

Species	Number	LSU	LSU Conversion	% of Max. equivalent	Capacity
A. Grazers					
Non-selective Feeders					
Buffalo	20		1.00	20.00	0.60
Bushpig	50		4.00	200.00	6.01
Hippo	3		0.55	0.00	0.00
Ostrich	12		3.50	42.00	1.26
White Rhino	29		0.41	11.89	0.36
Zebra	280		1.84	515.20	15.49
	***			******	*****
	391			789.09	23.72
Selective Feeders					
Blue wildebeest	35		2.65	92.75	2.79
Reedbuck	20		6.14	122.80	3.69
Redhartebeest	35		2.61	91.35	2.75
Roan antilope	0		2.28	0.00	0.00
Sable antilope	80		1.95	156.00	4.69
Gemsbuck	0		2.30	6.09	1.78
Waterbuck	15		2.17	32.55	0.98
	***			******	*****
	185			501.54	16.68
Mixed Feeders					
Eland	24		1.23	29.52	0.89
Impala	60		6.14	368.40	11.08
Njala	6		3.91	23.46	0.71
Warthog	30		5.62	168.60	5.07
	***			*******	*****
	120			589.98	17.75
B. Browsers					
Black Rhino	10		0.64	6.40	0.19
Bushbuck	20		7.62	152.40	4.58
Duiker	12		12.00	144.00	4.33
Giraffe	19		0.68	12.92	0.39
Kudu	60		2.45	147.00	4.42
Steenbuck	4		15.00	60.00	1.80
	***			******	*****
	125			522.72	15.71
Total	821			2403.33	73.86

CHAPTER 5

MANAGEMENT RECOMMENDATIONS

5.1 Introduction

The present study resulted in a classification of the vegetation and an assessment of the main environmental factors influencing the vegetation. The range management with respect to grazing capacity and carrying capacity was also described. In order to develop a management plan for MNP the following aspects should be considered, namely: the combination of related plant communities into management units, a sound burning program, monitoring of vegetation condition, game numbers and the placing of roads and other infrastructure in the park.

5.2 Management Units

Individual plant communities and/or an ecological related group of plant communities are used for the delimitation of management units. The management units could be separated from one another by roads for management purposes where possible (Bredenkamp & Van Rooyen 1991 a&b).

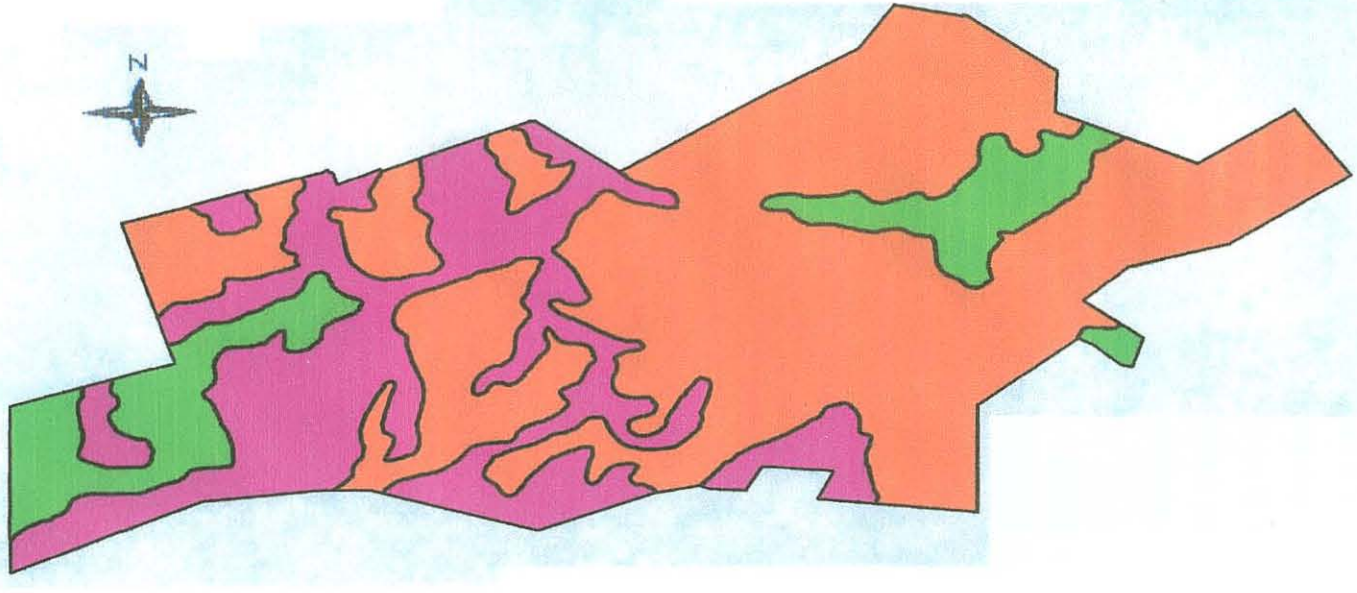
Coetzee (1983) defined a landscape as an area with a recurrent pattern of plant communities with their associated fauna and abiotic habitat. Gertenbach (1983) defined a landscape as an area with a specific geomorphology, macroclimate, soil and vegetation pattern and associated fauna. The five components that characterize a landscape (Gertenbach 1987), serve as the basis for the discussion of the landscapes identified in MNP.

The geomorphology was discussed from the geological discriptions from De Vries (1968/69), SACS (1980), Westfall (1981) and the 1:250 000 geological map of Thabazimbi. Information on the climate was collected from two stations in MNP and from the station at Thabazimbi where rainfall and limited temperature data were measured.

The discription of the different soil types was done according to the Land Type Survey Staff (1988). Vegetation discriptions were done by Coetzee (1975), Coetzee et al. (1976) and Westfall (1981). These descriptions, together with the data contained in Chapter 4 of this study, were used for the classification and discription of the landscapes for MNP. The discussion of the associated fauna of the study area was done according to the past and present geographical distribution of the Perissodactyla and Artiodactyla in Southern Africa (Du Plessis 1969)(See sections 5.2.1; 5.2.2 & 5.2.3). The geographical distribution of each of the landscapes is given in Figure 5.1.

It cannot be expected that the subdivision of the study area into landscapes is a demarcation of homogeneous units. Heterogeneity does occur in a landscape, but the most dominant abiotic and biotic components were grouped together as relatively homogeneous units in a specific area (Gertenbach 1987). The names of the landscapes were derived from the Land Types of Thabazimbi area (Land Type Survey Staff 1988), in combination with the underlying geological formations (SACS 1980), the most conspicuous woody plant species (Chapter 4) and the plant structural classification (see section 3.6). A summary of the sizes of the landscapes in the study area, as well as the percentage each represent of the study area and MNP, are given in Table 5.1.

According to Gertenbach (1983) landscapes can be considered as functional management units, and that any form of wildlife management could be based on the stratification of an area into landscapes. Landscapes can be used as management units in MNP.



Scale approx 1: 50 000

Figure 5.1 Landscapes of the study area

- Red-yellow apedal, well drained soils with *Acacia caffra* short closed woodland.
- Shallow lithocutanic soils of the Mispah Form with *Burkea africana* low woodland.
- Shallow lithocutanic soils of the Mispah Form with *Podocarpus latifolius* forests.

Table 5.1 Areas of the different landscapes of the study area and the areas expressed as a % of MNP and the study area.

	Area (km²)	% of MNP	% of Study area
1	59,81	13,3	20,6
2	136,40	30,3	47,0
3	94,30	21,0	32,4
Total	290,51	64,6	100,0

5.2.1 Red-yellow apedal, freely drained soils with *Acacia caffra* short closed woodland

Typical landscape: Zwarthoek

Location and geomorphology

This landscape is discontinuous because it is interrupted by other landscapes. One part of the landscape occurs in the southwestern part of the study area and the other part in the northeastern part (Figure 5.1). The underlying rock is sandstone of the Matlabas Subgroup, Aasvoëlkop Formation with dykes and sills of Post-Waterberg diabase, which cut throught the dykes and sills (Figure 2.2; SACS 1980).

This landscape occurs mainly on lower slopes to valley floors (see section 3.7.2). The landscape is found at 1 160 m to 1 600 m above sea level and occupies 59,81 km² or 13,3 % of MNP and 20,6 % of the study area (Table 5.1).

Climate

This landscape experiences a moderate to warm climate with frost occasionally in the low lying areas. In Table 2.2 the temperature data are given for Blespaardspruit and Waterhoutboom, which is also relevent for this landscape. The rainfall differs between 440 mm to 924 mm per annum with the average rainfall for Blespaardspruit, Thabazimbi and Waterhoutboom as 500,7 mm, 636,1 mm and 556,1 mm respectively (Table 2.3).

Soils

The soils are sandy with a clay content between 10-20 % in the A-horizon. The dominant soil form in this landscape is Clovelly and is between 300-1 200 mm deep (Land Type Survey Staff 1988).

Vegetation

The following plant communities occur in this landscape: *Rhus leptodictya-Mimusops zeyheri* Termitaria Thickets in the valleys with the following trees as characteristic: *Rhus leptodictya, Mimusops zeyheri, Olea europaea* subsp. *africana, Clerodendrum glabrum* and *Euphorbia ingens* (see section 4.2.4);

Acacia karroo-Eragrostis chloromelas Short Closed Woodland on the lower slopes with the following trees as characteristic: *Acacia karroo, A. caffra, Pterocarpus rotundifolius* subsp. *rotundifolius, Combretum apiculatum, C. imberbe, Ziziphus mucronata and Dombeya rotundifolia* (see section 4.3.1);

Acacia caffra-Setaria sphacelata Low Closed Woodland on the valley floor and lower slopes with the following trees as characteristic: *Acacia caffra, Burkea africana, Faurea saligna, Vangueria infausta* and *Ochna pulchra* (see section 4.3.2) with the two variations (see section 4.3.2.1 and 4.3.2.2).

A part of *Olea europaea* subsp. *africana-Calpurnia aurea* Tall Closed Woodland (see section4.2.5) and a part of *Burkea africana-Setaria lindenbergiana* Low Thicket (see section 4.5.1) also occur in this landscape.

The predominant grass species occurring in this community are *Andropogon schirensis, Aristida congesta* subsp. *barbicollis, A. congesta* subsp. *congesta, Brachiaria serrata, Cynodon dactylon, Digitaria eriantha, Elionurus muticus, Eragrostis curvula, E. rigidior, Heteropogon contortus, Panicum maximum, Setaria lindenbergiana, S. sphacelata* and *Themeda triandra*. The following conspicuous forbs are *Fadogia homblei, Hypoestes forskaolii, Ipomoea magnusiana, Pavonia burchelli, Schistostephium heptalobum* and *Sida dregei*.

Fauna

The following game species occur in this landscape: impala (*Aepyceros melampus*), Burchell's zebra (*Equus burchelli*), kudu (*Tragelaphus strepsiceros*), eland (*Taurotragus oryx*), tsessebe (*Damaliscus lunatis*), red hartebeest (*Alcelaphus buselaphus*), giraffe (*Giraffa camelopardalis*), elephant (*Loxodonta africana*), blue

wildebeest (*Connochaetus taurinus*), warthog (*Phacochoerus aethiopicus*), bushpig (*Potamochoerus porcus*), black rhinoceros (*Dicornis bicornis*), white rhinoceros (*Ceratotherium simum*) and sable antilope (*Hippotragus niger*). Predators such as leopard (*Panthera pardus*), caracal (*Felis caracal*), spotted hyaena (*Crocuta crocuta*) and brown hyaena (*Hyaena brunnea*) are also present in this landscape.

5.2.2 Shallow lithocutanic soils of the Mispah Form with *Burkea africana* low woodland.

Typical landscape: Mamiaanshoek

Location and geomorphology

This landscape is discontinuous because it is interrupted by other landscapes. The biggest part of this landscape occurs in the eastern part of the study area with small sections in the western parts of the study area (Figure 5.1). The underlying rock is sandstone of the Kransberg Subgroup, Sandriviersberg Formation (Figure 2.2).

This is a moderately undulating landscape with a pronounced crest, seepage zone, upper slope, lower slope and valley floor (see section 3.7.2). The landscape is found at 1 300 m to 1 700 m above sea level and occupies 136,40 km² or 30,3 % of MNP and 47,0 % of the study area (Table 5.1).

Climate

This landscape experiences a moderate to cool climate with frost occurring occasionally in the low-lying areas. In Table 2.2 the temperature data are given for Blespaard- spruit and Waterhoutboom, which is also relevent for this landscape. The rainfall varies from 440 mm to 924 mm per annum with the average rainfall for Blespaardspruit, Thabazimbi and Waterhoutboom as 500,7 mm, 636,1 mm and 556,1 mm respectively (Table 2.3).

Soils

The soils are sandy with a clay content between 6-10 % in the A-horizon. The dominant soil form in this landscape is Mispah and is between 50-300 mm deep (Land Type Survey Staff 1988).

Vegetation

The following plant communities occur in this landscape: *Protea caffra-Encephalartos eugene-maraisii* Low Open Woodland on the upper slopes with the following trees as characteristic: *Englerophyton magalismontanum, Protea caffra, Combretum molle, Brachylaena rotundata, Vitex rehmannii* and *Heteropyxis natalensis* (see section 4.4.2). The predominant grass species on the upper slopes are *Andropogon schirensis, Diheteropogon amplectens, Eragrostis racemosa, Loudetia simplex, Setaria lindenbergiana, Themeda triandra* and *Trachypogon spicatus*. The most prominent forb species are *Rhynchosia monophylla, R. totta, Littonia modesta* and *Sphenostylis angustifolia* (see section 4.4.2).

The *Protea caffra-Rhus dentata* Low Open Woodland occurs on upper to lower slopes with the following trees as characteristic: *Lannea discolor, Strychnos pungens, Mimusops zeyheri, Burkea africana, Elephantorrhiza burkei, Apodytes dimidiata, Maytenus undata, Ancylobotrys capensis* and *Ozoroa paniculosa*. The most prominant grass species are *Andropogon schirensis, Cymbopogon validus, Diheteropogon amplectens, Loudetia simplex, Melinis nerviglume* and *Schizachyrium sanguineum*.

The most prominant forb species are *Commelina africana, Cyperus leptocladus, Leonotis microphylla, Crassula swaziensis, Fadogia homblei, Indigofera mollicoma, Cheillanthus hirta, Tephrosia rhodesica, Xerophyta retinervis* and *Silene burchelli* (see section 4.4.3).

Burkea africana-Setaria lindenbergiana Low Thickets present on lower to upper slopes with the following trees as characteristic: *Diplorhynchus condylocarpon, Maytenus tenuispina, Pseudolachnostylis maprouneifolia, Combretum apiculatum, C. molle, Croton gratissimus, Pterocarpus rotundifolius* subsp. *rotundifolius, Ochna*

pulchra, Strychnos pungens, Ziziphus mucronata and *Dombeya rotundifolia*. The most prominant grass species are *Andropogon chinensis, A. schirensis, Aristida scabrivalvis, Brachiaria serrata, Diheteropogon amplectens, Eustachys paspaloides, Heteropogon contortus, Schizachyrium sanguineum, Setaria lindenbergiana* and *S. sphacelata* var. *sphacelata*. The most prominant forbs are *Hypoestes forskaolii, Cheilanthus viridis, Rhynchosia totta, Commelina africana, Ipomoea transvaalensis, Tephrosia rhodesica, Indigofera comosa, Talinum caffrum, Cyperus leptocladus* and *Fadogia homblei* (see section 4.5.1), with the two variations (see section 4.5.1.1 and 4.5.1.2);

Protea welwitchii-Tristachya leucothrix Low Open Woodland situated in the valley floor with the following shrubs as characteristic: *Protea welwitchii, Elephantorrhiza elephantina* and *Parinari capensis* (see section 4.4.4). The most dominant grass species are *Brachiaria serrata, Cymbopogon excavatus, Cynodon dactylon, Hyparrhenia hirta, Eragrostis plana, E. racemosa, Heteropogon contortus, Trachypogon spicatus, Tristachya leucothrix* and *Urelytrum agropyroides*. The most prominent forb species are: *Gnidia kraussiana, Senecio coronatus* and *Pygmaeothamnus zeyheri* (see section 4.4.4).

Syzygium cordatum-Miscanthus junceus Short Thickets present along the banks of watercourses with the following tree species: *Syzygium cordatum, S. guineense, Ilex mitis, Curtisia dentata* and *Cliffortia linearifolia*. The predominant grass species are *Ischaemum fasciculatum, Miscanthus junceus, Phragmites australis* and *P. mauritianus*. The predominant forb species are: *Polygonum pulchrum, Lycopodium cernuum, Xyris capensis, Osmunda regalis* and *Cyperus leptocladus* (see section 4.6.1).

Fuirena pubescens-Chironia purpurascens Low Closed Grassland situated in the valley floor with the characteristic grass species as *Monocymbium ceresiiforme, Aristida bipartita* and *Andropogon huilense*. The most prominent forbes are *Fuirena pubescens, Drosera madagascariensis, Xyris capense, Hypericum lalandii, Monopsis decipiens, Kyllinga alba, Chironia purpurascens, Nemesia fruticans* and *Disa woodii* (see section 4.6.3). A part of the *Andropogon schirensis-Dicoma anomala* Short Closed Grassland (see section 4.4.5) occurs in this landscape with *Podocarpus latifolius* and *Protea roupelliae* sparsely distributed in the grassland.

Fauna

The following game species occur in this landscape: kudu (*Tragelaphus strepsiceros*), bushpig (*Potamochoerus porcus*), black rhino (*Dicornis bicornis*), white rhino (*Ceratotherium simum*), klipspringer (*Oreotragus oreotragus*), bushbuck (*Tragelaphus scriptus*), reedbuck (*Redunca arundinum*), mountain reedbuck (*Redunca fulvorufula*), elephant (*Loxodonta africana*), Burchell's zebra (*Equus burchellii*) and red hartebeest (*Alcelaphus buselaphus*). Predators such as leopard (*Panthera pardus*), brown hyaena (*Hyaena brunnea*) and caracal (*Felis caracal*) are also present in this landscape.

5.2.3 Shallow lithocutanic soils of the Mispah Form with *Podocarpus latifolius* Forests

Typical Landscape: Bergfontein

Location and geomorphology

This landscape is discontinuous because it is interrupted by other landscapes. This landscape occurs in the southern and northern parts of the study area (Figure 5.1). The underlying rock is sandstone of the Matlabas Subgroup, Aasvoëlkop Formation (see section 2.3.1). This landscape occurs mainly on slopes, kloofs and vlei areas and is found at 1 110 m to 1 880 m above sea level and occupies 94,30 km² or 21,0 % of MNP and 32,4 % of the study area (Table 5.1).

Climate

This landscape experiences a moderate to warm climate with frost occasionally in the low-lying areas. In Table 2.2 the temperature data are given for Blespaardspruit and Waterhoutboom, which are also relevent for this landscape. The rainfall varies from 440 mm to 924 mm per annum with the average rainfall for Blespaardspruit,

Thabazimbi and Waterhoutboom as 500,7 mm, 636,1 mm and 556,1 mm respectively (Table 2.3).

Soils

The soils are sandy with a clay content between 10-20 % in the A-horizon. The dominant soil form in this landscape is Mispah and is between 50-300 mm deep (Land Type Survey Staff 1988).

Vegetation

The following plant communities occur in this landscape: the *Widdringtonia nodiflora-Podocarpus latifolius* Short Forest in deep ravines with the following trees as characteristic: *Widdringtonia nodiflora, Podocarpus latifolius, Ilex mitis, Syzygium cordatum* and *Pittosporum viridiflorum* (see section 4.2.1). Very little grass species occur in this plant community, with *Oplismenus hirtellus* and *Setaria lindenbergiana* as the only species. The following conspicuous forbs found in this landscape are *Asparagus setaceus, Agapanthus campanulatus, Cyperus albostriatus, Tetradenia brevispica, Blechnum giganteum, Secamone alpinii* and *Pteridium aquilinum* (see section 4.2.1).

The *Podocarpus latifolius-Rothmannia capensis* Tall Forest plant community present on the upper slopes occurs in this landscape with the following trees as characteristic: *Podocarpus latifolius, Diospyros whyteana, Grewia occidentalis, Celtis africana, Strychnos usambarensis, Nuxia congesta, Combretum moggii, Trema orientalis, Obetia tenax, Calodendrum capense, Curtisia dentata, Pittosporum viridiflorum, Rothmannia capensis, Ficus sur, Mimusops zeyheri, Myrsine africana* and *Pterocelastrus echinatus* (see section 4.2.2). The following grass species predominant in this community is *Oplismenus hirtellus*, the forbs which are well represented in this landscape includes *Tetradenia brevispica, Clematis brachiata, Cyperus albostriatus, Asparagus setaceus, Cyphostemma lanigerum* and *Solanum giganteum* (see section 4.2.2).

The *Buxus macowanii-Kirkia wilmsii* Low Forest Community situated on lower western and northern slopes with the following trees characteristic in this landscape: *Buxus macowanii, Kirkia wilmsii, Mimusops zeyheri, Olea europaea* subsp. *africana, Euphorbia turicalli, Ficus thonningii, Berchemia zeyheri* and *Combretum zeyheri* (see section 4.2.3). The following forbs are characteristic: *Cyperus leptocladus, Cryptolepis transvaalensis* and *Psiadia punctulata* (see section 4.2.3).

The *Protea caffra-Tristachya rehmannii* Low Open Shrubland Community occurs along the upper slopes with the following trees as characteristic for this landscape: *Protea caffra, P. roupelliae, Erica drakensbergensis, Rhus dentata, Englerophytum magalismontanum, Vangueria infausta, Podocarpus latifolius* and *Passerina montana* (see section 4.4.1). The following grass species predominant for this community are *Andropogon schirensis, Diheteropogon amplectans, Eragrostis racemosa, Loudetia simplex, Monocymbium ceresiiforme, Panicum natalense, Themeda triandra, Trachypogon spicatus, Tristachya rehmannii* and *Urelytrum agropyroides* with *Rhynchosia nitens, Hypoxis obtusa, Xerophyta retinervis, Senecio venosus, Indigofera hedyantha, I. hilaris* and *Becium obovatum* as the most common forbs (see section 4.4.1).

The low-lying areas such as the vlei areas are characterised by a dense grass cover and the absence of woody vegetation. The following predominant grass species are *Andropogon huilensis, Aristida junciformis* subsp. *junciformis, Diplachne fusca, Miscanthus junceus* and *Monocymbium ceresiiforme.* The following predominant forbs are *Fuirena pubescens, Xyris capensis, Ascolepis capensis, Carex cernua, Cyperus leptocladus, C. dedunatus, Helichrysum epapposum, H. aureonitens, Sopubia simplex, Hypericum lalandii, Sebaea leiostyla* and *Haplocarpha scaposa* (see section 4.6.2).

Fauna

The following game species occur in this landscape: kudu (*Tragelaphus strepsiceros*), bushpig (*Potamochoerus porcus*), warthog (*Phacochoerus aethiopicus*), white rhino (*Ceratotherium simum*), black rhino (*Dicornis bicornis*), Reedbuck (*Redunca arundinum*), mountain reedbuck (*R. fulvorufula*). Predators such as leopard (*Panthera pardus*), brown hyaena (*Hyanea brunnea*) are also present in this landscape.

5.3 Fire Management

Fire is regarded as being a natural factor of the environment in southern Africa and it has been occurring since time immemorial (Scott 1966 & 1972, Trollope et al. 1991). The role of fire as a major factor in southern African ecology has long been recognized and research in this field has an extended history in South Africa (Westfall 1981, Hough 1993, Hunter 1993). Komarek (1971) states that Africa has a unique fire climate that accentuates the probability of lightning fires that occur most often at the end of the dry period (Barclay et al. 1993).

The most important factors to consider when planning a fire management program are the reasons for burning and the appropriate fire regime to be applied (Tainton 1978, Trollope 1984, Trollope & Potgieter 1985, Thompson 1992, Stander et al. 1993). There are basically two reasons for burning veld:

i) To remove moribund and/or unacceptable grass material, thereby stimulating new, fresh growth of the grass.

ii) To eradicate and/or prevent the encroachment of undesirable plants.

The fire regime refers to the type and intensity of fire and the season and frequency of burning (Trollope et al.1989). According to Trollope et al. (1991) the type and intensity of fire recommended is that head fires burning with the wind be used in controlled burning because they cause least damage to the grass sward but can cause maximum damage to woody vegetation.

Low intensity fires (<1 000 kJ/s/m) are recommended for the removal of moribund and/or unacceptable grass material, while high intensity fires (>2 000 kJ/s/m) are generally recommended to improve range condition by controlling undesirable plants and encouraging desirable forage species (Trollope et al. 1991).

In the past the study area was a rangeland for livestock and a reason for burning the rangeland was to stimulate out of season green grazing, especially in plant community 4.6.2 (see Chapter 4). This was often done during late autumn or late winter to provide green grazing for livestock. According to Trollope et al (1991) this practice is completely unacceptable and should be condemned because it:

- reduces the vigour of the grass sward;
- reduces the canopy and basal cover of the grass sward;

- increases the run-off of rain water;
- results in increased soil erosion.

5.3.1 Recommended burning program for MNP

Gertenbach & Potgieter (1979) and Brown (1997) maintain that the best fire management practices on nature reserves are those that most closely imitate natural processes (Trollope & Potgieter 1985). The exclusion of fire from savanna areas, and overgrazing has resulted in an increase in the density of woody species (Brown 1997).

Since 1988 the frequency of lightning fires occurring in MNP showed that the vegetation of the Park burned every second year (Table 5.2). These lightning fires are however, difficult to control and restrict to a specific area. The fires normally start at the end of September just before the rainy season, when dry thunder storms occur in the area.

The ideal fire management strategy would therefore, be to rely on lightning to set the veld alight, since it would cause a greater mosaic effect on the vegetation as a result of the different types and intensities of fires caused by lightning (Brown 1997). The study area is mountainous with very little or no access, which make the lightning fires difficult to control whilst requiring a large labour force.

Controlled burning along fires breaks and roads are necessary to curb lightning fires in order to prevent the burning of all grazing material.

To maintain a burning program it is important to take factors such as overgrazing, drought, rainfall and available plant material into consideration. According to Brown (1997), moribundness of grass and game pressure on an area should also be taken into account before deciding to burn. Areas with 20 percent or less moribundness of grasses, as well as selected areas with high game pressure where the amount of material is little, should therefore not be burned. Areas with 50 percent and higher could burn.

Since the abovementioned factors differ each year, it is important that the proposed burning program, as part of the management plan for MNP,

must not be a rigid, but flexible system, that can be adapted in order to accommodate the changes in the above mentioned factors.

The study area is mostly sourveld with only a small section that can be regarded as sweetveld (see Chapter 4). Thus, veld burning is especially important in situations where both sour and sweetveld occur in MNP. The proposed burning program make use of the management units described in 5.2, but it must be stressed that the whole study area burns every second year (Table 5.2), depending on the built-up of excess grass material of above 2 500 kg/ha.

The study area is very mountainous and remote therefore it is difficult to combat lightning fires when they occur. The aim of the program is to burn fire breaks around MNP to prevent lightning fires burning out of MNP into neighbouring farms and vice versa. Firebreaks along roads are also of importance, because it would prevent fires from spreading to plant communities that should be left unburned. The following plant community needs also to be protected against fires, viz. *Widdringtonia nodiflora-Podocarpus latifolius* Short Forest (Luger & Moll 1993). A firebreak should be made around all stands of this plant community. It is also recommended that the three tributaries of the Matlabas River in MNP be used as fire breaks.

The plant communities belonging to the *Fuirena pubescens-Chironia purpurascens* Low Closed Grassland and the *Fuirena pubescens-Aristida junciformis* Low Closed Grassland (see chapter 4.6), should not be burned unless the fuel load has been determined properly. These communities are associated with wetlands, and burning these areas unnecessary would have a negative effect on the basal cover of the grass in these communities. This is because it would attract large numbers of grazing animals that would compact the soil which would be detrimental to the flow of the water to the Matlabas River.

However, it is recommended that the wetland areas be burned alternatively every three years to prevent the encroachment of woody vegetation into the wetlands.

It is important that the veld be monitored before and after a burn. If it is found that the current burning program is not achieving the desired effect (e.g.

maintaining and/or increasing plant species diversity or controlling bush encroachment), it is important that the burning program and strategy be revised.

5.4 Monitoring

The recent development of techniques for assessing veld condition is one of the most important advances in the field of veld management. This is because veld condition data are not only important in the planning of a veld management program, but trends in veld condition monitored over time can be used to evaluate and adapt veld management practices when necessary (Trollope et al.1991) (see Chapter 3.8).

It is recommended that monitoring of the veld condition should be undertaken in the different management units, described in chapter 5.2, on an annual basis. An annual aerial census of the game and the annual rainfall data for MNP should be used to develop a sound management program. The carrying capacity for MNP can then be determined on an annual basis to determine if any game should be removed or not.

5.5 Roads

There are no permanent roads in MNP except a narrow tar road to the top of the mountain where the SABC and other companies have masts. The only roads that occur in MNP are jeep tracks and are used by 4x4 vehicles. A proper zonation of MNP should be undertaken for the planning, placement and construction of roads for a tourism road network, because ill-constructed and poorly planned roads may lead to, or enhance erosion.

The aim of tourist roads is to introduce the visitor to as wide a variety of habitats in MNP as possible. These roads should be winding through the bush, avoiding long stretches, while allowing for good game viewing. The roads that are planned for MNP, should be made along contours where possible, and that the roads should not be wider than six metres in total. The reason for narrower roads is that it is aesthetically more acceptable and it also force tourists to drive slower.

The present road infrastructure on MNP is inadequate to carry a large portion of vehicles, it is therefore recommended that a quota system be introduced to avoid overcrowding of vehicles in MNP.

It is recommended that no roads should be built in the wilderness areas (see 5.2) in MNP, that limited roads be permitted in natural areas and that a network of roads be made in the tourism areas, as soon as a zonation plan is compiled.

5.6 Fencing

The entire area of MNP is fenced off with a 2.4 m electrical game fence. In order to increase the efficiency of the electrical fencing, it is recommended that the vegetation along the fence lines of MNP, be removed (3 m on each side). This will allow for more effective patrolling as well as a more effective fire control.

It is recommended that two energisers per station are used to prevent the outbreak of animals if one of the energisers turns faulty. Regular patrolling and maintenance of the fence is of the utmost importance, especially the maintenance of the electrical fence, because if the electrical fence is not working, the elephants may break out.

5.7 Water

Water is an essential resource without which no life is possible. The survival of animals in nature reserves and national parks therefore, not only depends on the vegetation, but also on the availability of water (Brown 1997). It is therefore important that the water resources in MNP be assessed in terms of quality, quantity and distribution thereof. It is recommended that all boreholes and fountains be mapped for management purposes. The following data needs to be available for all the boreholes in MNP: depth of borehole, depth of watertable, type of equipment used (windmill, etc.) and water quality.

MNP is situated in the Waterberg mountain range, which is the catchment of the following rivers: Matlabas-, Mamba- and Sterkstroom Rivers (see chapter 2). Earthen dams were built in these rivers by previous landowners. These earthen

dams are mainly not very large, but large dams, with cement walls were built in the Matlabas River. Some of the earthen dams were not well constructed and broke over the years and it is recommended that these dams need to be rehabilitated.

There is sufficient natural water in MNP, so very little superficial waterholes need to be provided. In areas where there is no permanent water, it is recommended that borehole water be pumped into the natural watercourses, especially during the drier parts of the season, to create a natural effect.

Waterholes in sweetveld should be curb to the minimum, and should be distributed evenly throughout the area in order to achieve an even utilisation of the area.

Because of the presence of all the man-made dams, the Matlabas-, Mamba- and Sterkstroom Rivers and other smaller streams, it seems as though the provision of water satisfies the water requirements of game throughout the year. It is however recommended that the placement of more controllable waterholes in the northern and western section of MNP be investigated.

5.8 Exotic problem plants

The following exotic and/or alien vegetation occur over large areas in MNP: *Eucalyptus* spp., *Acacia* spp. (wattles), *Populus* spp., *Jacaranda mimosifolia*, *Melia azedarach*, *Cereus jamacura*, *Opuntia ficus-indica* and *Opuntia aurantiaca*.

It is recommended that all these exotics be eradicated from MNP, and where possible the wood could be sold or given to local communities for fuel. Monitoring and followup operations must be undertaken as well.

5.9 Erosion control

Very little man made erosion occurs in MNP, but some areas do pose a threat to become a problem. Mapping of erosion and identifying the degree of erosion is of the utmost importance. It is recommended that roads not to be built in such a manner to enhance erosion of the area (see section 5.5). Rehabilitatoin techniques includes

gabions (wire-mesh filled with rocks), lined with bidem (a type of cloth), which catch fine soil particles, be used to curb further erosion of existing areas. After the mapping results of the erosion, the current management plan for rehabilitation of erosion should be revised.

Table 5.2 Occurrence of lightning fires in MNP.

YEAR	FACTOR	AREA BURNT km²
1988	Lightning	290,51 km²
1990	Lightning & manmade	260,00 km²
1991	Lightning	25,15 km²
1992	Lightning	290,51 km²
1994	Lightning	65,95 km²
1995	Lightning	440,00 km²
1996	Manmade	30,00 km²

SUMMARY

AN ECOLOGICAL STUDY OF THE PLANT COMMUNITIES OF MARAKELE NATIONAL PARK

by

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MAGISTER SCIENTIAE

In order to manage and conserve any national park, a profound knowledge of the ecology is a prerequisite, and to achieve that an inventory of the biotic and abiotic components of that national park must be undertaken. As a contribution to such a program this information was collected for a chosen area in Marakele National Park.

The study area covers 290,51 km² in the southwestern part of the Northern Province between 27° 30' and 27° 45' east and 24° 15' and 24° 30' south. The underlying parent rock of the study area is sandstone of the Matlabas Subgroup, Aasvoëlkop Formation in the south-western and southern parts; shale and mudstone of the Matlabas Subgroup Aasvoëlkop Formation, Groothoek Mudstone Member; a conglomerate outcrop of the Matlabas Subgroup, Aasvoëlkop Formation in the west and with the biggest part of the study area consisting of sandstone of the Kransberg Subgroup, Sandriviersberg Formation.

The soils that have developed on these parent materials range from shallow to deep sandy soils on sandstone and clayey soils on diabase and mudstone. The rainfall varies from 556 mm to 630 mm per annum and occurs mainly during the summer months. The study area

experiences warm, wet summers with temperatures of up to 32° C and cool dry winters with frost in the lowlying areas.

The vegetation of the study area was classified in a hierarchical, plant sociological system by using the Braun- Blanquet technique. The floristic data from 130 relevés were classified to identify five major plant communities, 16 plant communities and six variations. These plant communities were ecologically interpreted by habitats, and a vegetation map was compiled. A list of all plant species that occur in the study area was included.

The vegetation structure at each sample plot was assessed on the basis of the broad-scale structural classification system adapted from Edwards (1983). Three height classes and five cover classes were used.

The grazing capacity and grazing potential of 10 plant communities were determined. A wildlife management plan for MNP was developed from the veld condition assessment, rainfall data and annual game counts. The management plan includes a burning program, road maintenance and construction, fencing maintenance, water management, erosion control and problem plant control.

ACKNOWLEDGEMENTS

Any research project can only be successfull with the help that the researcher gets from people and authorities. With this study it was no exception and it is therefore a privilege for me to thank the following people and authorities:

1. My supervisor Prof. Dr. G.J. Bredenkamp of the Department of Botany, University of Pretoria, for guidance, patience, and friendship and valuable criticism throughout the project.

2. My co-superviser Prof. Dr. N. van Rooyen for his guidance, encouragement and friendship when I needed it the most.

3. To Prof. Dr. J. du P. Bothma of the Centre for Wildlife Management for his encouragement and friendship when I needed it the most.

4. To South African National Parks in whose service I stood during the execution of the project.

5. To Dr. U. de V. Pienaar, previous Chief Executive of the National Parks Board and Dr. D. Ackerman, previous head of Inland Parks, for their faith in me and their friendship throughout all the years.

6. To Dr. A. Hall-Martin, previous Director Conservation Services, for his encouragement, guidance, friendship and inspiration throughout all the years.

7. To Dr. G.A. Robinson, previous Chief Executive of South African National Parks, for his guidance and encouragement during the execution of the project.

8. The Section Rangers and Field Rangers from MNP for their help with the field work, without them this project would not have been completed.

9. To the staff of the H.G.W.J. Schweikerdt Herbarium, University of Pretoria and the National Herbarium, N.B.I. for the identification of plant specimens.

10. To Dr. H. Bezuidenhout for his help and guidance throughout this project.

11. To all my friends for their encouragement during the execution of this project.

12. I wish to record my heartfelt gratitude to my wife, Assi, and children, Carissa and Pieter, for their encouragement and sacrifices to make the completion of this project possible.

13. Finally no project can be completed without the blessing from Him, to whom we owe everything.

CURRICULUM VITAE

Petrus Johannes van Staden was born on the 2nd July 1951, in Brakpan, Gauteng Province.

He completed high school at Stilfontein, North-West province in 1969. In 1974 he obtained a Teachers Higher Educational Diploma at the Potchefstroom College of Education with History and Physical Training as major subjects. He started as a school teacher at Skukuza Primary School, Kruger National Park in 1975. On 1st January 1976 he started as a clerk at the Human Resources Department, Skukuza, Kruger National Park. In 1977 he became a Junior Game Ranger stationed at Shangoni in the Kruger National Park.

In 1983 he obtained his B.Sc. degree at the University of South Africa with Botany and Zoology as major subjects. In 1987 he obtained his B.Sc.(Hons) in Wildlife Management at the University of Pretoria.

In 1988 he was transferred from Kruger National Park to develop a new National Park in the Thabazimbi district in the Waterberg Mountain Range, called the Marakele National Park. Work on his M.Sc thesis started in 1989 as part of the development and management plan for MNP.

He was married in 1975 and two children were born out of the marriage.

PLANT SPECIES CHECKLIST

The plant species in the study area were identified through the H.G.W.J. Schweikerdt Herbarium[1] at the University of Pretoria and the National Herbarium in Pretoria[2]. The 555 plant species were classified in 122 families and 394 genera. The Pteridophyta consist of 10 families, 15 genera and 18 species. The Gymnospermae consist of three families, three genera and three species. The monocotyledonae consist of 21 families, 113 genera and 200 species. The dicotyledonae consist of 88 families, 263 genera and 334 species. The plant families and genera were classified according to Arnold & De Wet (1993) and De Wet and the Staff of the National Herbarium (1989 & 1990). Species are listed alphabetically within each genus.

PTERIDOPHYTA

LYCOPODIACEAE

0000020 *Lycopodium* L.
300 *L. cernuum* L.

SELAGINELLACEAE

0000030 *Selaginella* Beauv.
100 *S. caffrorum* (Milde) Hieron.
200 *S. dregei* (Presl) Hieron.

OSMUNDACEAE

0000080 *Osmunda* L.
100 *O. regalis* L.

SCHIZAEACEAE

0000100 *Anemia* Swartz
200 *A. simii* Tardieu

0000120 *Mohria* Swartz
100 *M. caffrorum* (L.) Desv. var. *caffrorum*

HYMENOPHYLLACEAE

0000170 *Trichomanes* L.
500 *T. rigidum* Swartz

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[1] Schweikerdt Herbarium, University of Pretoria

[2] National Herbarium, Botanical Research Institute, Private Bag X101 Pretoria 0001

CYATHEACEAE

0000180 *Cyathea* J.E. Sm.
200 *C. dregei* Kunze

DENNSTAEDTIACEAE

0000260 *Pteridium* Gled ex Scop.
100 *P. aquilinum* (L.) Kuhn

ADIANTACEAE

0000290 *Actiniopteris* Link
200 *A. radiata* (Koenig ex Swartz) link

0000340 *Cheilanthes* Swartz
800 *C. hirta* Swartz var. *hirta*
1400 *C. parviloba* (Swartz) Swartz
1900 *C. viridis* (Forssk.) Swartz var. *viridis*

0000360 *Pellaea* Link
200 *P. calomelanos* (Swartz) Link var. *calomelanos*

0000380 *Pteris* L.
300 *P. cretica* L.

ASPLENIACEAE

0000520 *Asplenium* L.
300 *A. aethiopicum* (Burm. f.) Becherer

0000530 *Ceterach* DC.
100 *C. cordatum* (Thunb.) Desv.

BLECHNACEAE

0000690 *Blechnum* L.
100 *B. attenuatum* (Swartz) Mett. var. *giganteum* (Kaulf.) Bonap.

GYMNOSPERMAE

ZAMIACEAE

0005000 *Encephalartos* Lehm.
600 *E. eugene-maraisii* Verdoorn subsp. *eugene-marasii*

PODOCARPACEAE

0013000 *Podocarpus* L'Hérit. ex Pers.
400 *P. latifolius* (Thunb). R. Br. Ex Mirb.

CUPRESSACEAE

0038010 *Widdringtonia* Endl.
200 *W. nodiflora* (L.) Powrie

ANGIOSPERMAE

MONOCOTYLEDONAE

TYPHACEAE
0049000 *Typha* L.
20 *T. capensis* (Rohrb.) N.E. Br.

POACEAE

9900100 *Ischaemum* L.
200 *I. fasciculatum* Brongn.

9900170 *Urelytrum* Hack.
100 *U. agropyroides* (Hack.) Hack.

9900280 *Elionurus* Kunth ex Willd.
100 *E. muticus* (Spreng.) Kunth

9900370 *Imperata* Cirillo
50 *I. cylindrica* (L.) Raeuschel

9900380 *Miscanthus* Anderss.
500 *M. junceus* (Stapf.) Pilg.

9900460 *Sorghum* Moench.
3700 *S. versicolor* Anderss.
9900500 *Chrysopogon* Trin.
200 *C. serrulatus* Trin.

9900630 *Bothriochloa* Kuntze
150 *B. insculpta* (A. Rich.) A. Camus
500 *B. radicans* (Lehm.) A. Camus

9900680 *Schizachyrium* Nees
400 *S. sanguineum* (Retz.) Alst.

9900710 *Andropogon* L.
350 *A. chinensis* (Nees) Merr.
500 *A. eucomus* Nees
900 *A. huillensis* Rendle
1600 *A. schirensis* A. Rich.

9900720 *Cymbopogon* Spreng.
200 *C. excavatus* (Hochst.) Stapf ex Burtt Davy
400 *C. plurinodis* (Stapf) Stapf ex Burtt Davy

9900730 *Hyparrhenia* Fourn.

1000 *H. hirta* (L.) Stapf
1200 *H. newtonii* (Hack.) Stapf var. *newtonii*

9900731 *Hyperthelia* Clayton
100 *H. dissoluta* (Nees ex Steud.) Clayton

9900750 *Monocymbium* Stapf
100 *M. ceresiiforme* (Nees) Stapf

9900780 *Trachypogon* Nees
100 *T. spicatus* (L. f.) Kuntze

9900800 *Heteropogon* Pers.
100 *H. contortus* (L.) Roem. & Schult.

9900810 *Diheteropogon* (Hack.) Stapf
100 *D. amplectens* (Nees) Clayton

9900830 *Themeda* Forssk.
100 *T. triandra* Forssk.

9900890 *Digitaria* Haller
600 *D. brazzae* (Franch.) Stapf
1000 *D. diagonalis* (Nees) Stapf var. *diagonalis*
1400 *D. eriantha* Steud.
2700 *D. monodactyla* (Nees) Stapf
4400 *D. tricholaenoides* Stapf

9900940 *Alloteropsis* Presl.
250 *A. semialata* (R. Br.) Hitch. subsp. *semialata*
9901040 *Brachiaria* (Trin.) Griseb.
250 *B. bovonei* (Chiov.) Robyns
300 *B. brizantha* (A. Rich.) Stapf
1300 *B. nigropedata* (Fical. & Hiern) Stapf
1700 *B. serrata* (Thunb.) Stapf

9901070 *Paspalum* L.
100 *P. dilatatum* Poir.

9901100 *Urochloa* Beauv.
400 *U. mosambicensis* (Hack.) Dandy

9901150 *Oplismenus* Beauv.
200 *O. hirtellus* (L.) Beauv.

9901160 *Panicum* L.
800 *P. coloratum* L. var. *coloratum*
1200 *P. dregeanum* Nees
2800 *P. maximum* Jacq.
3100 *P. natalense* Hochst.

9901280 *Setaria* Beauv.
1050 *S. incrassata* (Hochst.) Hack.
1200 *S. lindenbergiana* (Nees) Stapf
1500 *S. nigrirostis* (Nees) Dur. & Schinz

1800	*S. pallide-fusca* (Schumach.) Stapf & C. E. Hubb.
2450	*S. saggittifolia* (A. Rich.) Walp.
2500	*S. sphacelata* (Schumach.) Moss var. *sphacelata*
3200	*S. verticillata* (L.) Beauv.
9901330	*Tricholaena* Schrad. ex Schult.
300	*T. monachne* (Trin.) Stapf & C. E. Hubb.
9901340	*Melinis* Beauv.
250	*M. nerviglume* (Franch.) Zizka
275	*M. repens* (Willd.) Zizka subsp.*repens*
9901380	*Anthephora* Schreb.
300	*A. pubescens* Nees
9901400	*Cenchrus* L.
300	*C. ciliaris* L.
9901730	*Arundinella* Raddi
100	*A. nepalensis* Trin.
9901740	*Tristachya* Nees
100	*T. biseriata* Stapf
450	*T. leucothrix* Nees
600	*T. rehmannii* Hack.
9901751	*Loudetia* Steud.
600	*L. simplex* (Nees) C. E. Hubb.
9902140	*Phragmites* Adanson.
100	*P. australis* (Cav.) Steud.
9902600	*Stipagrostis* Nees
3200	*S. uniplumis* (Licht.) De Winter var. *uniplumis*
9902620	*Aristida* L.
50	*A. adscensionis* L.
500	*A. canescens* Henr. subsp. *canescens*
800	*A. congesta* Roem. & Schult. subsp. *barbicollis* (Trin. & Rupr.) De Winter
850	*A. congesta* Roem. & Schult. subsp. *congesta*
2000	*A. junciformis* Trin. & Rupr. subsp. *junciformis*
2100	*A. meridionalis* Henr.
2700	*A. rhiniochloa* Hochst.
2900	*A. scabrivalvis* Hack. subsp. *scabrivalvis*
3300	*A. stipitata* Hack. subsp. *graciliflora* (Pilg.) Meld.
3550	*A. stipitata* Hack. subsp. *stipitata*
3700	*A. transvaalensis* Henr.
9902740	*Tragus* Haller
100	*T. berteronianus* Schult.
9902800	*Perotis* Aiton
200	*P. patens* Gand.
9902830	*Sporobolus* R. Br.
200	*S. africanus* (Poir.) Robyns & Tournay

1400 *S. fimbriatus* (Trin.) Nees
1700 *S. ioclados* (Trin.) Nees
2300 *S. nitens* Stent
2700 *S. pyramidalis* Beauv.

9902860 *Eragrostis* Wolf
1500 *E. capensis* (Thunb.) Trin.
1700 *E. chloromelas* Steud.
2300 *E. curvula* (Schrad.) Nees
3200 *E. gummiflua* Nees
4300 *E. lehmanniana* Nees var. *lehmanniana*
5000 *E. nindensis* Fical. & Hiern
5300 *E. pallens* Hack.
5800 *E. plana* Nees
6700 *E. racemosa* (Thunb.) Steud.
6900 *E. rigidior* Pilg.
8500 *E. trichophora* Coss. & Dur.

9902940 *Microchloa* R. Br.
100 *M. caffra* Nees

9902960 *Cynodon* Rich.
300 *C. dactylon* (L.) Pers.

9902980 *Harpochloa* Kunth
100 *H. falx* (L. f.) Kuntze

9903010 *Chloris* Swartz
200 *C. gayana* Kunth
350 *C. pycnothrix* Trin.
600 *C. virgata* Swartz

9903020 *Eustachys* Desv.
200 *E. paspaloides* (Vahl) Lanza & Mattei

9903310 *Eleusine* Gaertn.
300 *E. indica* (L.) Gaertn. subsp. *indica*

9903340 *Pogonarthria* Stapf
300 *P. squarrosa* (Roem. & Schutl.) Pilg.

9903442 *Bewsia* Goossens
100 *B. biflora* (Hack.) Goossens

9903500 *Triraphis* R. Br.
100 *T. andropogonoides* (Steud.) Phill.

9903530 *Trichoneura* Anderss.
200 *T. grandiglumis* (Nees) Ekman var. *grandiglumis*

9903570 *Enneapogon* Beauv.
100 *E. cenchroides* (Roem. & Schult.) C. E. Hubb.
300 *E. pretoriensis* Stent
500 *E. scoparius* Stapf

9903610 *Schmidtia* Steud.
200 *S. pappophoroides* Steud.

CYPERACEAE

0454000 *Ascolepis* Nees ex Steud.
100 *A. capensis* (Kunth) Ridley

0459000 *Cyperus* L.
100 *C. albostriatus* Schrad.
1200 *C. denudatus* L. f.
1900 *C. esculentus* L.
3400 *C. leptocladus* Kunth
4700 *C. obtusiflorus* Vahl. var. *obtusiflorus*
6400 *C. rupestris* Kunth var. *rupestris*
8200 *C. thorncroftii* McClean

0459030 *Mariscus* Gaertn.
500 *M. congestus* (Vahl) C.B. Cl.
2600 *M. rehmannianus* C.B. Cl.

0462000 *Kyllinga* Rottb.
200 *K. alba* Nees

0476000 *Fuirena* Rottb.
1100 *F. pubescens* (Poir.) Kunth

0471000 *Fimbristylis* Vahl
600 *F. ferruginea* L. (Vahl)

0471010 *Bulbostylis* Kunth
400 *B. burchellii* (Fical. & Hiern.) C.B. Cl.

0512000 *Coleochloa* Gilly
300 *C. setifera* (Ridley) Gilly

0525000 *Carex* L.
2000 *C. spicato-paniculata* C.B. Cl.

ARACEAE

0764000 *Stylochiton* Lepr.
100 *S. natalense* Schott

XYRIDACEAE

0826000 *Xyris* L.
400 *X. gerrardii* N.E. Br.

COMMELINACEAE

0896000 *Commelina* L.
100 *C. africana* L. var. *africana*
300 *C. benghalensis* L.

0904000 *Cyanotis* D. Don
500 *C. speciosa* (L. f.) Hassk.

COLCHICACEAE

0963000 *Gloriosa* L.
100 *G. superba* L.

0964000 *Littonia* Hook.
100 *L. modesta* Hook.

ASPHODELACEAE (PART A)

0985000 *Bulbine* Willd.
100 *B. abyssinica* A. Rich.
550 *B. capitata* V. Poelln.

0985010 *Trachyandra* Kunth
4800 *T. saltii* (Bak.) Oberm. var. *saltii*

0989000 *Anthericum* L.
300 *A. angulicaule* Bak.

HYACINTHACEAE (PART A)

1011000 *Bowiea* Harv. ex Hook. f.
100 *B. volubilis* Harv. ex Hook. f.

ERIOSPERMACEAE

1012000 *Eriospermum* Jacq. ex Willd.
100 *E. abyssinicum* Bak.

ASPHODELACEAE (PART B)

1024000 *Kniphofia* Moench
1400 *K. ensifolia* Bak. subsp. *ensifolia*

1026000 *Aloe* L.
800 *A. arborescens* Mill.
2700 *A. chabaudii* Schonl.
5200 *A. excelsa* Berger
9700 *A. marlothii* Berger var. *marlothii*
12500 *A. pretoriensis* Pole Evans
13500 *A. sessiliflora* Pole Evans
15600 *A. transvaalensis* Kuntze

ALLIACEAE

1046000 *Agapanthus* L'Herit
100 *A. africanus* (L.) Hoffmg.

HYACINTHACEAE (PART B)

1079000 *Albuca* L.
2900 *A. glauca* Bak.

1080000 *Urginea* Steinh.
3100 *U. sanguinea* Schinz

1084000 *Dipcadi* Medik.
500 *D. glaucum* (Ker-Gawl.) Bak.

1086000 *Scilla* L.
300 *S. nervosa* (Burch.) Jessop

1088000 *Eucomis* L'Herit.
300 *E. autumnalis* (Mill.) Chitt. subsp. *clavata* (Bak.) Reyneke

1089000 *Ornithogalum* L.
6300 *O. seineri* (Engl. & Krause). Oberm.

1090000 *Drimiopsis* Lindl.
200 *D. burkei* Bak.

1090010 *Ledebouria* Roth.
300 *L. cooperi* (Hook. f.) Jessop
1100 *L. ovalifolia* (Bak.) Jessop

DRACAENACEAE

1110000 *Sansevieria* Thunb.
200 *S. hyacinthoides* (L.) Druce
300 *S. pearsonii* N.E. Br.

ASPARAGACEAE

1113010 *Asparagus* Oberm.
3100 *A. krebsianus* (Kunth) Oberm.
5900 *A. setaceus* (Kunth.) Oberm.
6300 *A. suaveolens* (Burch.) Oberm.

AMARYLLIDACEAE

1167010 *Scadoxus* Raf.
400 *S. puniceus* (L.) Friis & Nordal

1168000 *Boophane* Herb.
100 *B. disticha* (L. f.) Herb.

1177000 *Brunsvigia* Heist.
1100 *B. natalensis* Bak.

1189000 *Crinum* L.
400 *C. buphanoides* Welw. ex Bak.

1190000 *Ammocharis* Herb.
100 *A. coranica* (Ker-Gawl.) Herb.

1202000 *Pancratium* L.
100 *P. tenuifolium* Hochst. ex A. Rich.

HYPOXIDACEAE

1230000 *Hypoxis* L.
1500 *H. filiformis* Bak.
2200 *H. iridifolia* Bak.
4200 *H. rigidula* Bak. var. *rigidula*

TECOPHILAEACEAE

1231000 *Walleria* Kirk
200 *W. nutans* Kirk

VELLOZIACEAE

1247010 *Xerophyta* Juss.
400 *X. retinervis* Bak.
800 *X. viscosa* Bak.

IRIDACEAE

1265000 *Moraea* Mill.
7455 *M. thomsonii* Bak.

1295000 *Aristea* Ait.
4200 *A. woodii* N.E. Br.

1299000 *Schizostylis* Backh. & Harv.
100 *S. coccinea* Backh. & Harv.

1303000 *Dierama* K. Koch.
1500 *D. medium* N.E. Br.

1306000 *Tritonia* Ker-Gawl.
2100 *T. nelsonii* Bak.

1306010 *Crocosmia* Planch.
100 *C. aurea* (Pappe ex Hook.) Planch. var. *aurea*

1310000 *Babiana* Ker-Gawl.
2400 *B. hypogea* Burch. var. *hypogea*

1311000 *Gladiolus* L.
1100 *G. atropurpureus* Bak.
3300 *G. crassifolius* Bak.
3550 *G. dalenii* Van Geel
4000 *G. ecklonii* Lehm. subsp. *ecklonii*
4300 *G. elliotii* Bak.
10200 *G. pretoriensis* Kuntze
14100 *G. woodii* Bak.

1314000 *Lapeirousia* Pourret

2950 *L. sandersonii* Bak.

1316010 *Anomatheca* Ker-Gawl.
200 *A. grandiflora* Bak.

ORCHIDACEAE

1407000 *Stenoglottis* Lindl.
100 *S. fimbriata* Lindl.

1408000 *Holothrix* L.C. Rich. ex Hook.
1600 *H. orthoceras* (Harv.) Reichb. f.

1422000 *Habenaria* Willd.
1250 *H. falciformis* (Burch. ex Lindl.) H. Bol. var. *caffra* (Schltr.) J.C. Manning

1430000 *Satyrium* Swartz
5050 *S. trinerve* Lindl.

1434000 *Disa* Berg.
3600 *D. nervosa* Lindl.
4300 *D. patula* Sond. var. *transvaalensis* Summerh.
7200 *D. woodii* Schltr.

1435010 *Herschelianthe* Rauschert
300 *H. baurii* (H. Bol.) Rauschert

1568000 *Ansellia* Lindl.
20 *A. africana* Lindl.

1648000 *Eulophia* R. Br. ex Lindl.
300 *E. angolensis* (Reichb. f.) Summerh.
2700 *E. ovalis* Lindl. subsp.*bainesii* (Rolfe) A.V.Hall
2800 *E. ovalis* Lindl. subsp. *ovalis*
3500 *E. streptopetala* Lindl.
3900 *E. welwitchii* (Reichb. f.) Rolfe

DICOTYLEDONAE

ULMACEAE

1898000 *Celtis* L.
100 *C. africana* Burm. f.

1902000 *Trema* Lour.
100 *T. orientalis* (L.) Blume

1906000 *Chaetacme* Planch.
100 *C. aristata* Planch.

MORACEAE

1961000 *Ficus* L.
1000 *F. glumosa* (Miq.) Del.

1200 *F. ingens* (Miq.) Miq. var. *ingens*
2250 *F. sur* Forssk.
2450 *F. thonningii* Blume

URTICACEAE

1979000 *Obetia* Gaudich.
200 *O. tenax* (N.E. Br.) Friis

1992000 *Pouzolzia* Gaudich.
100 *P. mixta* Solms

PROTEACEAE

2034000 *Faurea* Harv.
300 *F. saligna* Harv.

2035000 *Protea* L.
1200 *P. caffra* Meisn. subsp. *caffra*
3000 *P. gaguedi* Gmel.
7300 *P. roupelliae* Meisn. subsp. *roupelliae*
9150 *P. welwitschii* Engl.

LORANTHACEAE

2074010 *Tapinanthus* Reichb.
1500 *T. natalitius* (Meisn.) Danser subsp. *zeyheri* (Harv.) Wiens
1600 *T. oleifolius* (Wendl.) Danser
1800 *T. rubromarginatus* (Engl.) Danser

VISCACEAE

2093000 *Viscum* L.
300 *V. combreticola* Engl.
1700 *V. rotundifolium* L. f.

SANTALACEAE

2108000 *Osyris* L.
100 *O. lanceolata* Hochst. & Steud.

2118000 *Thesium* L.
16700 *T. utile* A.W. Hill

OLACACEAE

2136000 *Ximenia* L.
150 *X. americana* L. var. *americana*
300 *X. caffra* Sond. var. *caffra*

AMARANTHACEAE

2293000 *Hermbstaedtia* Reichb.
400 *H. odorata* (Burch.) T. Cooke var. *odorata*

AIZOACEAE (PART A)

2376000 *Limeum* L.
1400 *L. fenestratum* (Fenzl) Heimerl var. *fenestratum*

2379000 *Psammotropha* Eckl. & Zeyh.
900 *P. myriantha* Sond.

PHYTOLACCACEAE (PART B)

2380000 *Phytolacca* L.
500 *P. octandra* L.

PORTULACACEAE

2406000 *Talinum* Adans.
200 *T. caffrum* (Thunb.) Eckl. & Zeyh.

2412000 *Anacampseros* L.
2400 *A. subnuda* V. Poelln.

CARYOPHYLLACEAE (PART A)

2455000 *Polycarpaea* Lam.
100 *P. corymbosa* (L.) Lam.

ILLECEBRACEAE

2467000 *Pollichia* Ait.
100 *P. campestris* Ait.

CARYOPHYLLACEAE (PART B)

2502000 *Dianthus* L.
1600 *D. mooiensis* F.N. Williams subsp. *mooiensis* var. *mooiensis*

NYMPHAEACEAE

2513000 *Nymphaea* L.
530 *N. nouchali* Burm. f. var. *carulea* (Sav.) Verdc.

RANUNCULACEAE

2542000 *Clematis* L.
100 *C. brachiata* Thunb.

2542010 *Clematopsis* Boj. ex Hutch.
100 *C. scabiosifolia* (D.C.) Hutch. subsp. *stanleyi* (Hook.) Brummitt

ANNONACEAE

2716000 *Hexalobus* A.DC.
100 *H. monopetalus* (A. Rich.) Engl. & Diels var. *monopetalus*

CAPPARACEAE

3082000 *Cleome* L.
900 *C. gynandra* L.
1000 *C. hirta* (Klotzsch) Oliv.
1500 *C. maculata* (Sond.) Szyszyl.

3106000 *Boscia* Lam.
100 *B. albitrunca* Gilg. & Ben. var. *albitrunca*
300 *B. foetida* Schinz. subsp. *foetida*

3109000 *Cadaba* Forssk.
100 *C. aphylla* (Thunb.) Wild

3112000 *Maerua* Forssk.
100 *M. angolensis* DC.

DROSERACEAE

3136000 *Drosera* L.
1300 *D. madagascariensis* DC.

CRASSULACEAE

3164000 *Cotyledon* L.
3230 *C. orbiculata* L. var. *oblonga* (Haw.) DC.

3165000 *Bryophylum* Salisb.
100 *B. delagoense* (Eckl. & Zeyh.) Schinz.

3166000 *Kalanchoe* Adans.
2100 *K. paniculata* Harv.
2700 *K. rotundifolia* (Haw.) Haw.
3450 *K. sexangularis* N.E. Br.

3168000 *Crassula* L.
300 *C. alba* Forssk. var. *alba*
5100 *C. capitella* Thunb. subsp. *nodulosa* (Schonl.) Tölken
11800 *C. expansa* Dryand. subsp. *fragilis* (Bak.) Tölken
16000 *C. lanceolata* (Eckl. & Zeyh.) Endl. ex Walp. subsp. *lanceolata*
23400 *C. perfoliata* L. var. *heterotricha* (Schinz) Tölken
30955 *C. swaziensis* Schonl.

PITTOSPORACEAE

3252000 *Pittosporum* Banks ex Gaertn.
300 *P. viridiflorum* Sims

MYROTHAMNACEAE

3282000 *Myrothamnus* Welw.
100 *M. flabellifolius* Welw.

ROSACEAE (PART A)

3388000 *Cliffortia* L.
5800 *C. linearifolia* Eckl. & Zeyh.

CHRYSOBALANACEAE

3405000 *Parinari* Aubl.
100 *P. capensis* Harv. subsp. *capensis*

FABACEAE

3443000 *Albizia* Durazz.
500 *A. brevifolia* Schinz
1000 *A. tanganyicensis* Bak. f. subsp. *tanganyicensis*

3446000 *Acacia* Mill.
90300 *A. ataxacantha* DC.
90600 *A. burkei* Benth.
90700 *A. caffra* (Thunb.) Willd.
91100 *A. erubescens* Welw. ex Oliv.
91500 *A. gerrardii* Benth. var. *gerrardii*
92300 *A. karroo* Hayne
93400 *A. nilotica* (L.) Willd. ex Del. subsp. *kraussiana* (Benth.) Brenan
93500 *A. permixta* Burtt Davy
94100 *A. robusta* Burch. subsp. *robusta*
95000 *A. tortilis* (Forssk.) Hayne subsp. *heteracantha* (Burch.) Brenan

3452000 *Dichrostachys* (A. DC.) Wight & Arn.
100 *D. cinerea* (L.) Wight & Arn. subsp. *africana* Brenan & Brumm. var. *africana*

3467000 *Elephantorrhiza* Benth.
100 *E. burkei* Benth.
200 *E. elephantina* (Burch.) Skeels

3474000 *Burkea* Benth.
100 *B. africana* Hook.

3506000 *Schotia* Jacq.
300 *S. brachypetala* Sond.
3536010 *Chamaecrista* Moench
600 *C. comosa* E. Mey. var. *comosa*

3561000 *Peltophorum* (Vogel) Benth.
100 *P. africanum* Sond.

3607000 *Calpurnia* E. Mey.
100 *C. aurea* (Ait.) Benth. subsp. *aurea*

3657000 *Lotononis* (DC.)
1800 *L. calycina* (E. Mey.) Benth.
3400 *L. eriantha* Benth.
4900 *L. laxa* Eckl. & Zeyh.
5150 *L. listii* Polhill

3657010 *Pearsonia* Dümmer
400 *P. cajanifolia* (Harv.) Polhill subsp.*cryptantha* (Bak.) Polhill
1000 *P. sessilifolia* (Harv.) Dümmer subsp. *sessilifolia*

3669000 *Crotalaria* L.
4700 *C. orientalis* Burtt Davy ex Verdoorn subsp. *orientalis*

3673000 *Argyrolobium* Eckl. & Zeyh.
2400 *A. pauciflorum* Eckl. & Zeyh. var. *pauciflorum*

3702000 *Indigofera* L.
300 *I. adenoides* Bak. f.
3800 *I. comosa* N.E. Br.
5200 *I. daleoides* Benth. ex Harv. var. *daleoides*
8300 *I. filipes* Benth. ex Harv.
10500 *I. hedyantha* Eckl. & Zeyh.
10800 *I. hilaris* Eckl. & Zeyh.
13900 *I. melanadenia* Benth. ex Harv.
14400 *I. mollicoma* N.E. Br.
15900 *I. oxalidea* Welw. ex Bak.

3718000 *Tephrosia* Pers.
1200 *T. capensis* (Jacq.) Pers. var. *capensis*
4400 *T. longipes* Meisn. subsp. *longipes*
7200 *T. rhodesica* Bak. f. var. *rhodesica*

3719000 *Mundulea* (DC.) Benth.
100 *M. sericea* (Willd.) A. Chev.

3793000 *Aeschynomene* L.
900 *A. rehmannii* Shinz var. *leptobotrya* (Harms ex Bak. f.) J.B. Gillet

3804000 *Zornia* J.F. Gmel.
400 *Z. milneana* Mohlenbr.

3828000 *Pterocarpus* Jacq.
400 *P. rotundifolius* (Sond.) Druce subsp. *rotundifolius*

3856000 *Abrus* Adans.
200 *A. precatorius* L. subsp. *africanus* Verdc.

3870000 *Erythrina* L.
900 *E. lysistemon* Hutch.

3897000 *Rhynchosia* Lour.
100 *R. adenodes* Eckl. & Zeyh.
4400 *R. monophylla* Schltr.
4700 *R. nitens* Benth.
7000 *R. totta* (Thunb.) DC. var. *totta*

3898000 *Eriosema* (DC.) G. Don
300 *E. burkei* Benth.
400 *E. cordatum* E. Mey.
1600 *E. salignum* E. Mey.

3907000 *Sphenostylis* E. Mey.
100 *S. angustifolia* Sond.

3909000 *Lablab* Adans.
200 *L. purpureus* (L.) Sweet subsp. *uncinatus* Verdc.

GERANIACEAE

3925000 *Monsonia* L.
200 *M. angustifolia* E. Mey. ex A. Rich.

3928000 *Pelargonium* L'Hèrit.
9700 *P. luridum* (Andr.) Sweet

OXALIDACEAE

3936000 *Oxalis* L.
5300 *O. depressa* Eckl. & Zeyh.
14800 *O. obliquifolia* Steud. ex Rich.

ZYGOPHYLLACEAE

3978000 *Tribulus* L.
400 *T. terrestris* L.

RUTACEAE

3991000 *Zanthoxylum* L.
100 *Z. capense* (Thunb.) Harv.

4035000 *Calodendrum* Thunb.
100 *C. capense* (L. f.) Thunb.
4076000 *Vepris* Comm. ex A. Juss.
150 *V. lanceolata* (Lam.) G. Don

SIMAROUBACEAE

4128000 *Kirkia* Oliv.
300 *K. wilmsii* Engl.

BURSERACEAE

4151000 *Commiphora* Jacq.
100 *C. africana* (A. Rich.) Engl.
1800 *C. mollis* (Oliv.) Engl.

MELIACEAE (PART B)

4171000 *Turraea* L.
200 *T. obtusifolia* Hochst.

4175000 *Melia* L.
100 *M. azedarach* L.

MALPIGHIACEAE

4206000 *Triaspis* Burch.
250 *T. hypericoides* (DC.) Burch. subsp. *nelsonii* (Oliv.) Immelman

4219000 *Sphedamnocarpus* Planch. ex Benth. & Hook. f.
500 *S. pruriens* (Juss.) Szyszyl. subsp. *pruriens*

POLYGALACEAE

4273000 *Polygala* L.
400 *P. amatymbica* Eckl. & Zeyh.
2900 *P. hottentotta* Presl
7300 *P. uncinata* E. Mey. ex Meisn.

4275000 *Securidaca* L.
100 *S. longepedunculata* Fresen.

EUPHORBIACEAE

4295000 *Pseudolachnostylis* Pax
150 *P. maprouneifolia* Pax var. *dekindtii* (Pax) Radcliffe-Sm.

4297000 *Flueggea* Comm. ex Juss.
100 *F. virosa* (Roxb. ex Willd.) Pax & K. Hoffm.

4299000 *Phyllanthus* L.
2100 *P. parvulus* Sond.

4345000 *Bridelia* Willd.
500 *B. mollis* Hutch.

4348000 *Croton* L.
200 *C. gratissimus* Burch. var. *grattisimus*
800 *C. pseudopulchellus* Pax

4407000 *Acalypha* L.
200 *A. angustata* Sond. var. *glabra* Sond.
1600 *A. peduncularis* E. Mey. ex Meisn.

4416000 *Tragia* L.
1200 *T. rupestris* Sond.

4433000 *Jatropha* L.
1800 *J. zeyheri* Sond. var. *subsimplex* Prain

4448000 *Clutia* L.
3200 *C. pulchella* L. var. *pulchella*

4478000 *Spirostachys* Sond.
100 *S. africana* Sond.

4498000 *Euphorbia* L.
4400 *E. clavarioides* Boiss var. *truncata* (N.E. Br.) White, Dyer & Sloane

5300 *E. cooperi* N.E. Br. ex Berger var. *cooperi*
13900 *E. ingens* E. Mey. ex Boiss.
23200 *E. schinzii* Pax
26400 *E. tricadenia* Pax

BUXACEAE

4533000 *Buxus* L.
100 *B. macowanii* Oliv.

ANACARDIACEAE

4558000 *Sclerocarya* Hochst.
100 *S. birrea* (A. Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro

4563000 *Lannea* A. Rich.
100 *L. discolor* (Sond.) Engl.
200 *L. edulis* (Sond.) Engl. var. *edulis*

4589010 *Ozoroa* Del.
1100 *O. paniculosa* (Sond.) R. & A. Fernandes var. *paniculosa*

4594000 *Rhus* L.
1500 *R. dentata* Thunb.
3000 *R. gracillima* Engl.
3900 *R. lancea* L. f.
4000 *R. leptodictya* Diels
4400 *R. magalismontana* Sond.
5600 *R. pyroides* Burch. var. *pyroides*
7500 *R. undulata* Jacq.

AQUIFOLIACEAE

4614000 *Ilex* L.
100 *I. mitis* (L.) Radlk. var. *mitis*

CELASTRACEAE

4626000 *Maytenus* Molina
400 *M. heterophylla* (Eckl. & Zeyh.) N.K.B. Robson
1300 *M. polyacantha* (Sond.) Marais
1600 *M. senegalensis* (Lam.) Exell
1700 *M. tenuispina* (Sond.) Marais
1800 *M. undata* (Tunb.) Blakelock

4641000 *Cassine* L.
1200 *C. transvaalensis* (Burtt Davy) Codd

4662000 *Salacia* L.
500 *S. rehmannii* Schinz

ICACINACEAE

4671000 *Cassinopsis* Sond.
100 *C. ilicifolia* (Hochst.) Kuntze

4686000 *Apodytes* E. Mey. ex Arn.
100 *A. dimidiata* E. Mey. ex Arn. subsp. *dimidiata*

SAPINDACEAE

4784000 *Pappea* Eckl. & Zeyh.
100 *P. capensis* Eckl. & Zeyh.

RHAMNACEAE

4861000 *Ziziphus* Mill.
100 *Z. mucronata* Willd. subsp. *mucronata*

4868000 *Berchemia* Neck. ex Dc.
200 *B. zeyheri* (Sond.) Grubov

4886000 *Phylica* L.
11800 *P. paniculata* Willd.

VITACEAE

4917000 *Rhoicissus* Planch.
300 *R. revoilii* Planch.
550 *R. tridentata* (L. f.) Wild & Drum. subsp. *cuneifolia* (Eckl. & Zeyh.) N.R. Urton

4918000 *Cissus* L.
700 *C. quadrangularis* L.

4918010 *Cyphostemma* (Planch.) Alston
1800 *C. lanigerum* (Harv.) Descoings ex Wild & Drum.

TILIACEAE

4953000 *Corchorus* L.
200 *C. asplenifolius* Burch.

4966000 *Grewia* L.
200 *G. bicolor* Juss.
600 *G. flava* DC.
700 *G. flavescens* Juss. var. *flavescens*
1600 *G. monticola* Sond.
1700 *G. occidentalis* L.

4975000 *Triumfetta* L.
1100 *T. sonderi* Ficalho & Hiern

MALVACEAE

4998000 *Sida* L.
400 *S. cordifolia* L.
500 *S. dregei* Burtt Davy
900 *S. rhombifolia* L.

5007000 *Pavonia* Cav.
100 *P. burchellii* (DC.) R.A. Dyer
1200 *P. transvaalensis* (Ulbr.) A. Meeuse

5013000 *Hibiscus* L.
2200 *H. engleri* K. Schum.
4300 *H. pusillus* Thunb.
5300 *H. trionum* L.

STERCULIACEAE

5053000 *Dombeya* Cav.
600 *D. rotundifolia* (Hochst.) Planch. var. *rotundifolia*

5056000 *Hermannia* L.
7100 *H. depressa* N.E. br.
28500 *H. tomentosa* (Turcz.) Schinz ex Engl.
5059000 *Waltheria* L.
100 *W. indica* L.

OCHNACEAE

5112000 *Ochna* L.
600 *O. holstii* Engl.
1100 *O. pretoriensis* Phill.
1200 *O. pulchra* Hook.

CLUSIACEAE

5168000 *Hypericum* L.
100 *H. aethiopicum* Thunb. subsp. *aethiopicum*
400 *H. lalandii* Choisy

FLACOURTIACEAE

5304000 *Scolopia* Schreb.
500 *S. zeyheri* (Nees) Harv.

5327000 *Flacourtia* Comm. ex L'Hérit.
100 *F. indica* (Burm. f.) Merr.

532800 *Dovyalis* E. Mey. ex Arn.
700 *D. zeyheri* (Sond.) Warb.

PASSIFLORACEAE

5370000 *Adenia* Forssk.
500 *A. glauca* Schinz

CACTACEAE

5417000 *Opuntia* Mill.
400 *O. ficus-indica* (L.) Mill.

THYMELAEACEAE

5435000 *Gnidia* L.
500 *G. capitata* L. f.
2700 *G. kraussiana* Meisn. var. *kraussiana*

5461000 *Passerina* L.
810 *P. montana* Thoday

COMBRETACEAE

5538000 *Combretum* Loefl.
200 *C. apiculatum* Sond. subsp. *apiculatum*
1400 *C. erythrophyllum* (Burch.) Sond.
1500 *C. hereroense* Schinz
1700 *C. imberbe* Wawra
1800 *C. kraussii* Hochst.
2000 *C. moggii* Exell
2100 *C. molle* R. Br. ex G. Don
3200 *C. zeyheri* Sond.

5544000 *Terminalia* L.
100 *T. brachystemma* Welw. ex Hiern
500 *T. sericea* Burch. ex DC.

MYRTACEAE

5583000 *Syzygium* Gaertn.
100 *S. cordatum* Hochst.
400 *S. guineense* (Willd.) DC.

5588010 *Heteropyxis* Harv.
100 *H. natalensis* Harv.

ARALIACEAE

5872000 *Cussonia* Thunb.
450 *C. paniculata* Eckl. & Zeyh. subsp. *sinuata* (Reyneke & Kok) De Winter
600 *C. spicata* Thunb.

APIACEAE

5992000 *Heteromorpha* Cham. & Schlectd.
600 *H. trifoliata* (Wendl.) Eckl. & Zeyh.

CORNACEAE

6156000 *Curtisia* Ait.
100 *C. dentata* (Burm. f.) C.A. Sm.

ERICACEAE

6237000 *Erica* L.
19800 *E. drakensbergensis* Guth. & Bol.

MYRSINACEAE

6313000 *Myrsine* L.
100 *M. africana* L.

PLUMBAGINACEAE

6343000 *Plumbago* L.
500 *P. zeylanica* L.

SAPOTACEAE

6377010 *Englerophytum* De Wild.
100 *E. magalismontanum* (Sond.) Heine & J.H. Hemsl.

6386000 *Mimusops* L.
300 *M. zeyheri* Sond.

EBENACEAE

6404000 *Euclea* Murray
400 *E. crispa* (Thunb.) Guerke subsp. *crispa*
800 *E. linearis* Zeyh. ex Hiern
1000 *E. natalensis* A. DC. subsp. *natalensis*
1700 *E. undulata* Thunb. var. *undulata*

6406000 *Diospyros* L.
1400 *D. lycioides* Desf. subsp. *lycioides*
2900 *D. whyteana* (Hiern) F. White

OLEACEAE

6422000 *Schrebera* Roxb.
100 *S. alata* (Hochst.) Welw.

6434000 *Olea* L.
300 *O. capensis* L. subsp. *enervis* (Harv. ex C.H. Wr.) Verdoorn
450 *O. europaea* L. subsp. *africana* (Mill.) P.S. Green
6440000 *Jasminum* L.
600 *J. multipartitum* Hochst.

LOGANIACEAE

6460000 *Strychnos* L.
100 *S. cocculoides* Bak.
400 *S. madagascariensis* Poir.
700 *S. pungens* Soler.
900 *S. usambarensis* Gilg

6469000 *Nuxia* Comm. ex Lam.
100 *N. congesta* R. Br. ex Fresen.
200 *N. floribunda* Benth.

GENTIANACEAE

6481000 *Sebaea* Soland. ex R. Br.
1700 *S. grandis* (E. Mey.) Steud.
2200 *S. leiostyla* Gilg

6503000 *Chironia* L.
1400 *C. palustris* Burch. subsp. *transvaalensis* (Gilg) Verdoorn
1700 *C. purpurascens* (E. Mey.) Benth. & Hook. f. subsp. *humilis* (Gilg) Verdoorn

APOCYNACEAE

6558000 *Acokanthera* G. Don
200 *A. oppositifolia* (Lam.) Codd

6559000 *Carissa* L.
200 *C. bispinosa* (L.) Desf. ex Brenan subsp. *bispinosa*

6562020 *Ancylobotrys* Pierre
100 *A. capensis* (Oliv.) Pichon

6589000 *Diplorhynchus* Welw. ex Fical. & Hiern
100 *D. condylocarpon* (MÜll. Arg.) Pichon

PERIPLOCACEAE

6740000 *Cryptolepis* R. Br.
200 *C. oblongifolia* (Meisn.) Schltr.
400 *C. transvaalensis* Schltr.

6747000 *Raphionacme* Harv.
100 *R. burkei* N.E. Br.

ASCLEPIADACEAE

6777000 *Xysmalobium* R. Br.
1500 *X. undulatum* (L.) Ait. f.

6791000 *Asclepias* L.
400 *A. aurea* (Schltr.) Schltr.
3100 *A. fruticosa* L.

6810000 *Pentarrhinum* E. Mey.
300 *P. insipidum* E. Mey.

6849000 *Sarcostemma* R. Br.
100 *S. viminale* (L.) R. Br.

6885000 *Stapelia* L.
4400 *S. gigantea* N.E. Br.

6885070 *Orbeopsis* Leach
700 *O. lutea* (N.E. Br.) Leach subsp. *lutea*

CONVOLVULACEAE

6973000 *Evolvulus* L.
100 *E. alsinoides* (L.) L. var. linifolius (L.) Bak.

6978000 *Seddera* Hocst.
100 *S. capensis* (E. Mey. ex Choisy) Hallier f.

6993000 *Convolvulus* L.
1800 *C. sagittatus* Thunb. subsp. *sagittatus* var. *hirtellus* (Hallier f.) A. Meeuse

6997000 *Merremia* Dennst.
900 *M. tridentata* (L.) Hallier f. subsp. *angustifolia* (Jacq.) Van Ooststr. var. *angustifolia*

7003000 *Ipomoea* L.
1100 *I. bolusiana* Schinz subsp. *bolusiana*
2800 *I. magnusiana* Schinz var. *eenii* (Rendle) A. Meeuse
3300 *I. obscura* (L.) Ker-Gawl. var. *obscura*
3500 *I. ommaneyi* Rendle
5000 *I. transvaalensis* A. Meeuse

BORAGINACEA

7043000 *Ehretia* P.Br.
200 *E. rigida* (Thunb.) Druce

7052000 *Heliotropium* L.
1600 *H. steudneri* Vatke

VERBENACEAE

7138000 *Verbena* L.
100 *V. bonariensis* L.
200 *V. brasiliensis* Vell.

7144000 *Lantana* L.
600 *L. rugosa* Thunb.

7145000 *Lippia* L.
100 *L. javanica* (Burm. f.) Spreng.
400 *L. rehmannii* H. Pearson

7148000 *Plexipus* Rafin.
600 *P. hederaceus* (Sond.) R. Fernandes var. *natalensis* (H. Pearson) R. Fernandes

7153000 *Priva* Adans.
300 *P. cordifolia* (L. f.) Druce var. *abyssinica* (Jaub. & Spach) Moldenke

7186000 *Vitex* L.
500 *V. mombassae* Vatke
900 *V. rehmannii* Guerke
7191000 *Clerodendrum* L.

800 *C. glabrum* E. Mey. var. *glabrum*
1100 *C. myricoides* (Hochst.) Vatke
1700 *C. triphyllum* (Harv.) H. Pearson var. *triphyllum*

LAMIACEAE

7236000 *Acrotome* Benth.
300 *A. hispida* Benth.

7264000 *Leonotis* (Pers.) R. Br.
1100 *L. leonurus* (L.) R. Br.
7281000 *Stachys* L.
2500 *S. natalensis* Hochst. var. *galpinii* (Briq.) Codd
2600 *S. natalensis* Hochst. var. *natalensis*

7339000 *Tetradenia* Benth.
300 *T. brevispicata* (N.E. Br.) Codd

7345000 *Aeollanthus* Mart. ex K. Spreng.
500 *A. parvifolius* Benth.

7347000 *Pycnostachys* Hook.
200 *P. reticulata* (E. Mey.) Benth.

7350000 *Plectranthus* L'Hérit.
1600 *P. hereroensis* Engl.
1950 *P. madagascariensis* (Pers.) Benth. var. *ramosior* Benth.

7365000 *Hemizygia* (Benth.) Briq.
400 *H. canescens* (Guerke) Ashby
2000 *H. pretoriae* (Guerke) Ashby subsp. *pretoriae*

7366010 *Becium* Lindl.
290 *B. grandiflorum* (Lam.) Pichi-Serm. var. *obovatum* (E. Mey. ex Benth.) Sebald

SOLANACEAE

7407000 *Solanum* L.
2700 *S. giganteum* Jacq.
3200 *S. incanum* L.
4900 *S. panduriforme* E. Mey.
6000 *S. sisymbrifolium* Lam.
7415000 *Datura* L.
600 *D. stramonium* L.

SCROPHULARIACEAE (PART A)

7476000 *Nemesia* Vent.
2500 *N. fruticans* (Thunb.) Benth.
7477000 *Diclis* Benth.
200 *D. reptans* Benth.

7519000 *Sutera* Roth

2500 *S. caerulea* (L. f.) Hiern
8500 *S. palustris* Hiern

7523000 *Zaluzianskya* F.W. Schmidt
1150 *Z. elongata* Hilliard & Burtt

7560000 *Craterostigma* Hochst.
200 *C. plantagineum* Hochst.

SELAGINACEAE

7566000 *Hebenstretia* L.
50 *H. angolensis* Rolfe

7568000 *Selago* L.
1400 *S. capitellata* Schltr.

7568010 *Walafrida* E. Mey.
3000 *W. tenuifolia* Rolfe

SCROPHULARIACEAE (PART B)

7616000 *Sopubia* Buch.-Ham. ex D. Don
100 *S. cana* Harv. var. *cana*
400 *S. simplex* (Hochst.) Hochst.

7625000 *Striga* Lour.
300 *S. bilabiata* (Thunb.) Kuntze
450 *S. elegans* Benth.

BIGNONIACEAE

7722000 *Rhigozum* Burch.
200 *R. obovatum* Burch.

7725000 *Jacaranda* Juss.
100 *J. mimosifolia* D. Don.

PEDALIACEAE

7777000 *Sesamum* L.
200 *S. alatum* Thonn.

7778000 *Ceratotheca* Endl.
500 *C. triloba* (Bernh.) Hook. f.

GESNERIACEAE

7823000 *Streptocarpus* Lindl.
2600 *S. micranthus* C.B. Cl.
4800 *S. vanderleurii* Bak. f. & S. Moore

ACANTHACEAE

7914000 *Thunbergia* Retz.
400 *T. atriplicifolia* E. Mey. ex Nees

7941000 *Chaetacanthus* Nees
200 *C. costatus* Nees

7965000 *Ruellia* L.
800 *R. patula* Jacq.

7972000 *Crabbea* Harv.
100 *C. acaulis* N.E. Br.
200 *C. angustifolia* Nees
300 *C. hirsuta* Harv.

7973000 *Barleria* L.
3200 *B. obtusa* Nees
3600 *B. pretoriensis* C.B. Cl.
5100 *B. transvaalensis* Oberm.

7980000 *Blepharis* Juss.
4900 *B. subvolubilis* C.B. Cl. var. *longifolia* Oberm.

7985000 *Crossandra* Salisb.
200 *C. greenstockii* S. Moore

8031000 *Dicliptera* Juss.
300 *D. eenii* S. Moore

8032000 *Hypoestes* Soland. ex R. Br.
200 *H. forskaolii* (Vahl.) R. Br.

8094000 *Justicia* L.
1400 *J. flava* (Vahl.) Vahl.

PLANTAGINACEAE

8116000 *Plantago* L.
400 *P. lanceolata* L.

RUBIACEAE

8136060 *Kohautia* Cham. & Schlechtd.
100 *K amatymbica* Eckl. & Zeyh.
800 *K. cynanchica* DC.
1600 *K. virgata* (Willd.) Brem.

8136200 *Oldenlandia* L.
750 *O. herbacea* (L.) Roxb. vr. *herbacea*

8285000 *Gardenia* Ellis
950 *G. volkensii* K. Schum. subsp. *spatulifolia* (Stapf & Hutch.) Verdc.

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8285010 *Rothmannia* Thunb.
100 *R. capensis* Thunb.

8308000 *Tricalysia* A. Rich.
700 *T. lanceolata* (Sond.) Burtt Davy

8348000 *Pentanisia* Harv.
100 *P. angustifolia* (Hochst.) Hochst.

8351000 *Vangueria* Juss.
400 *V. infausta* Burch. subsp. *infausta*

8351020 *Pygmaeothamnus* Robyns
400 *P. zeyheri* (Sond.) Robyns var. *zeyheri*

8351030 *Tapiphyllum* Robyns
100 *T. parvifolium* (Sond.) Robyns

8352000 *Canthium* Lam.
300 *C. gilfillanii* (N.E. Br.) O.B. Miller
600 *C. inerme* (L. f.) Kuntze
800 *C. mundianum* Cham. & Schlechtd.
1300 *C. suberosum* Codd

8352030 *Psydrax* Gaertn
200 *P. livida* (Hiern) Bridson

8359000 *Pachystigma* Hochst.
800 *P. triflorum* Robyns

8359010 *Fadogia* Schweinf.
50 *F. homblei* De Wild.

8383000 *Pavetta* L.
2030 *P. gardeniifolia* A. Rich. var. *gardeniifolia*
2900 *P. lanceolata* Eckl.
4300 *P. zeyheri* Sond.

8438000 *Anthospermum* L.
1100 *A. hispidulum* E. Mey. ex Sond.
8464000 *Richardia* L.
100 *R. brasiliensis* Gomes

8475000 *Spermacoce* Gaertn.
300 *S. senesis* (Klotzsch) Hiern

DIPSACACEAE

8546000 *Scabiosa* L.
600 *S. columbaria* L.

CUCURBITACEAE

8591000 *Momordica* L.
100 *M. balsamina* L.

8599000 *Cucumis* L.
1600 *C. zeyheri* Sond.

8628000 *Coccinia* Wight & Arn.
100 *C. adoensis* (A. Rich.) Cogn.

CAMPANULACEAE

8668000 *Wahlenbergia* Schrad. ex Roth.
1400 *W. buseriana* Schltr. & V. Brehm.

LOBELIACEAE

8694000 *Lobelia* L.
2800 *L. erinus* L.

8695000 *Monopsis* Salisb.
525 *M. decipiens* (Sond.) Thulin

ASTERACEAE

8751000 *Vernonia* Schreb.
1550 *V. galpinii* Klatt
2400 *V. natalensis* Sch. Bip. ex Walp.
3000 *V. oligocephala* (DC.) Sch. Bip. ex Walp.
3075 *V. poskeana* Vatke & Hildebr. subsp. *botswanica* Pope
3700 *V. staehelinoides* Harv.

8900000 *Aster* L.
1400 *A. harveyanus* Kuntze
2000 *A. peglerae* H. Bol.

8919000 *Felicia* Cass.
6900 *F. muricata* (Thunb.) Nees subsp. *muricata*

8923000 *Psiadia* Jacq.
100 *P. punctulata* (DC.) Oliver & Hiern ex Vatke

8925000 *Nidorella* Cass.
100 *N. anomala* Steez.
800 *N. hottentatica* DC.

8926000 *Conyza* Less.
300 *C. bonariensis* (L.) Cronq.

8929000 *Nolletia* Cass.
600 *N. rarifolia* (Turcz.) Steez

8936000 *Brachylaena* R. Br.
400 *B. huillensis* O. Hoffm.
700 *B. rotundata* S. Moore

8992050 *Pseudognaphalium* Kirp.

100	*P. luteo-album* (L.) Hilliard & Burtt
9006000	*Helichrysum* Mill.
70	*H. acutatum* DC.
2870	*H. cephaloideum* DC.
3700	*H. coriaceum* Harv.
4350	*H. dasymallum* Hilliard
5100	*H. epapposum* H. Bol.
7625	*H. harveyanum* Wild
8500	*H. kraussii* Sch. Bip.
12100	*H. nudifolium* (L.) Less.
14130	*H. pilosellum* (L. f.) Less.
16900	*H. setosum* Harv.
9037000	*Stoebe* L.
3300	*S. vulgaris* Levyns
9055000	*Athrixia* Ker-Gawl.
500	*A. elata* Sond.
9090000	*Geigeria* Griesellich
1500	*G. elongata* Alston
9094000	*Callilepis* DC.
600	*C. leptophylla* Harv.
914800	*Xanthium* L.
200	*X. strumarium* L.
9237000	*Bidens* L.
100	*B. bipinnata* L.
500	*B. pilosa* L.
9291000	*Schkuhria* Roth
100	*S. pinnata* (Lam.) Cabr.
9311000	*Tagetes* L.
200	*T. minuta* L.
9356000	*Schistostephium* Less.
200	*S. crataegifolium* (DC.) Fenzl. ex Harv.
600	*S. heptalobum* (DC.) Oliv. & Hiern
9406000	*Cineraria* L.
1900	*C. lobata* L'Hérit.
9411000	*Senecio* L.
1000	*S. affinis* DC.
2900	*S. babertonicus* Klatt.
6000	*S. consanguineus* DC.
6300	*S. coronatus* (Thunb.) Harv.
13100	*S. inaequidens* DC.
18800	*S. oxyriifolius* DC.
19800	*S. pentactinus* Klatt
24800	*S. sisymbriifolius* DC.
27500	*S. venosus* Harv.

9417000 *Euryops* Cass.
4700 *E. laxus* (Harv.) Burtt Davy

9426000 *Garuleum* Cass.
1100 *G. woodii* Schinz

9427000 *Osteospermum* L.
5900 *O. scariosum* DC. var. *scariosum*

9431000 *Ursinia* Gaertn.
2500 *U. nana* DC. subsp. *nana*
9434000 *Gazania* Gaertn.
800 *G. krebsiana* Less. subsp. *serrulata* (DC.) Rössl.

9438000 *Berkheya* Ehrh.
1900 *B. carlinopsis* Welw. ex O. Hoffm. subsp. *magalismontana* (H. Bol.) Rössl.
4700 *B. insignis* (Harv.) Thell.
6500 *B. radula* (Harv.) De Wild.
7500 *B. seminivea* Harv. & Sond.
9400 *B. zeyheri* (Sond. & Harv.) Oliv. & Hiern subsp. *zeyheri*

9501000 *Dicoma* Cass.
100 *D. anomala* Sond.
2700 *D. zeyheri* Sond. subsp. *zeyheri*

9528000 *Gerbera* L.
100 *G. ambigua* (Cass.) Sch. Bip.
1250 *G. piloselloides* (L.) Cass.
1700 *G. viridifolia* (DC.) Sch. Bip. subsp. *viridifolia*

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