The Classification of Plant Communities and the Evaluation of Restoration Technologies in Different Land-Use Areas in the Vhembe-Dongola National Park, Northern Province, South Africa

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Dedicated to my wife Esmé, and Hugo, Dalene and Stuart

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ABSTRACT

The establishment of the Vhembe-Dongola National Park has been an objective of the South African National Parks for many years. The ultimate objective is that the Vhembe-Dongola National Park would become a major component of a trans-frontier national park shared by Botswana, Zimbabwe and South Africa. The aims of this study was firstly to identify, classify and describe the plant communities on different land types in the park, secondly to identify areas in the park that show high levels of degradation and should be restored and to make relevant recommendations regarding such restoration and rehabilitation activities. The final aim was to identify and map ecologically sound management units on which the optimal management of the park can be based.

Sampling was done by means of the Braun-Blanquet method and land types were used as a means of stratification of the study area. A total of 220 stratified random relevés were sampled. All relevé data was imported into the database TURBOVEG after which the numerical classification technique TWINSPAN was used as a first approximation. Subsequently Braun-Blanquet procedures were used to refine data and construct phytosociological tables using the visual editor, MEGATAB. From the phytosociological tables 12 plant communities were identified and described in five different land types. The ordination algorithm, DECORANA, was applied to the floristic data in order to illustrate floristic relationships between plant communities, to detect possible gradients in and between communities and to detect possible habitat gradients and/or disturbance gradients associated with vegetation gradients.

A synthesis of all the vegetation data was performed and a synoptic table constructed. Eight different vegetation groups were identified and described. The vegetation groups were combined into seven ecologically sound management units, based on plant species composition, environmental variables and anthropogenic influences in every vegetation group and mapped on management unit maps. A number of management proposals were also made. Degraded areas in need of restoration and/or rehabilitation were identified and described, and recommendations made with regard to restoration/rehabilitation of all anthropogenically disturbed and degraded areas in the park.

UITTREKSEL

Die totstandkoming van die Vhembe-Dongola Nasionale Park was vir baie jare 'n doelstelling van die Suid-Afrikaanse Nasionale Parke. Die einddoel is dat die Vhembe-Dongola Nasionale Park 'n belangrike deel sal vorm van 'n transfrontale park tesame met aangrensende dele in Botswana en Zimbabwe. Die doelstellings van hierdie studie is eerstens daarop gerig om die plantgemeenskappe op verskillende landtipes in die park te identifiseer, klassifiseer en te beskryf. Tweedens, om gedegradeerde gedeeltes in die park wat restorering benodig, te identifiseer en dan aanbevelings te maak met betrekking tot die restorering en/of rehabilitering daarvan en derdens, om ekologies gegronde bestuurseenhede, wat gebruik kan word in die optimale bestuur van die park, te identifiseer, te beskryf en te karteer.

Opnames is gedoen met behulp van die Braun-Blanquet metode en landtipes is gebruik om die studiegebied te stratifiseer. 'n Totale hoeveelheid van 220 gestratifiseerd-ewekansige relevés is gebruik. Alle relevédata is in die TURBOVEG databasis ingevoer, waarna die numeriese klassifikasie tegniek TWINSPAN as 'n eerste benadering gebruik is. Daarna is Braun-Blanquet prosedures gebruik om die data te verfyn en om fitososiologiese tabelle te construeer met behulp van die visuele redigeerder MEGATAB. Uit die fitososiologiese tabelle is 12 plantgemeenskappe in vyf verskillende landtipes geïdentifiseer en beskryf. Die ordenings algoritme DECORANA is op die floristiese data toegepas om die floristiese verwantskappe tussen plantgemeenskappe te illustreer, om moontlike gradïente in en tussen gemeenskappe op te merk en om moontlike habitatsgradïente en/of versteuringsgradïente wat met die plantegroeigradïente geassosieer is, te bespeur.

'n Sintese is gedoen op al die plantegroei data en in 'n sinoptiese tabel saamgevat. Aan die hand van die sinoptiese tabel is agt verskillende plantegroeigroepe geïdentifiseer en beskryf. Hierdie plantegroeigroepe is saamgevat in sewe ekologies gegronde bestuurseenhede, wat op plantspesiesamestelling, omgewingsveranderlikes en antropogeniese invloede op die omgewing, gebaseer is. Hierdie bestuurseenhede is uiteindelik ook gekarteer en sekere bestuursaanbevelings is gemaak. Verder is gedegradeerde gebiede in die park geïdentifiseer en bespreek. Verskeie aanbevelings is gemaak met betrekking tot die restorering/rehabilitering van alle antropogenies versteurde en gedegradeerde gebiede in die park.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

In the past decade conservation management has moved more in the direction of environmental management. This has to do with the effect of human activities on the quality of mankind's physical environment, especially air, water and terrestrial features. Emphasis is not on strictly policed, protected areas, primarily for large mammals anymore, but on sustainable resource use, maintenance of ecological processes and conservation of genetic diversity (Winterbach, 1998). A country's ability to conserve, protect and manage its natural vegetation and water resources determines its industrial potential and the standard of living of its people. It stands to reason that any injudicious utilization of these natural resources will disturb the delicate balance between man, animals and vegetation, which can then have catastrophic results (Aucamp & Danckwerts, 1989; Brown, 1997). Nature reserves and national parks provide reservoirs of a country's fauna and flora (Greyling & Huntley, 1984; Brown, 1997). A sound knowledge of the vegetation ecology of areas of conservation significance is essential for the establishment of efficient wildlife and environmental management programs and the compilation of conservation policies (Bredenkamp & Theron 1978; Bredenkamp *et al* 1993; Bezuidenhout 1996; Van Rooyen *et al* 1981). Edwards (1972) stated that the optimal use of natural resources cannot be taken care of without adequate knowledge of the ecosystems involved.

One of the primary goals of nature conservation should be focused on preserving diversity and the persistence of species (Walker, 1989). When the natural habitats of plants have been destroyed, it is possible to cultivate and conserve plants in botanical gardens, but little genetic variation, as found between plants in their natural habitats, exists in botanical gardens (McNaughton, 1989). Therefore, in order to conserve nature and its resources, it is important that nature reserves/national parks be upgraded and well managed (Brown, 1997).

Different ecosystems react differently to certain management practices (Bredenkamp & Theron, 1976) and therefore, in order to formulate a management policy, where proper land use is emphasized, the classification of the vegetation is essential (Van Rooyen *et al*, 1981; Bezuidenhout, 1993). It is widely recognized that a detailed description, identification, classification and mapping of the vegetation, form the basis for sound land-use planning and management (Foran *et al*, 1986; Bosch *et al*, 1987; Tueller, 1988; Fuls *et al*, 1992; Fuls, 1993; Bezuidenhout, 1996; Brown, 1997).

The establishment of the Vhembe-Dongola National Park has been an objective of the South African National Parks for many years. This is mainly based on the rich biodiversity of the area, its great scenic beauty and the cultural importance of the archaeological treasures of Mapungubwe. The artifacts found at this site rank among the

most important pieces of ancient history yet found in sub-Saharan Africa (Willcox, 1966). The significance of this proposed park and its surrounding areas is further enhanced by the potential role of the area as a sanctuary for some of the most endangered mammals on earth, such as the Black Rhino and the African wild dog (Robinson 1996). The ultimate objective is that the Vhembe-Dongola National Park would become a major component of a Trans-frontier National Park shared by Botswana, Zimbabwe and South Africa. The total area of this trans-frontier park could potentially amount to 2530 km² (Robinson 1996).

Due to many anthropogenic influences, such as mining, cultivation of lands, overgrazing and trampling by livestock as well as other management malpractices, the area of the proposed park is extremely degraded in places. A large military base of the former SADF was also situated on the farm Greefswald, and contributed to the disturbance and degradation of the area. Old campsites litter the proposed area and the scars left by forgotten roads, quarries and dumpsites are a cruel sight to the eye. It is therefore most evident that specific restoration practices should be implemented in an attempt to restore the land to a higher potential for the conservation of our precious fauna and flora.

Combating degradation in natural rangeland has recently become a priority in large parts of South Africa (Coetsee 1992; Van der Merwe & Kellner 1999). Climatic variability, erratic rainfall patterns and injudicious management strategies contribute to the over exploitation and degradation of the land. Realizing that conservation of existing ecosystems is simply not enough to ensure the future of living populations, and that degraded systems takes a long period of time to recover by natural succession processes in arid and semi-arid systems, restoration has become an absolute necessity (Kellner *et al*, *sine anno*).

Knowledge of the vegetation and soil of a country provides the basic foundation, which supports the agricultural, industrial, commercial and cultural pillars of human society. The vegetation and soil are interdependent in so far that the destruction of the one leads to the loss of the other. Since the settlement of Europeans on this subcontinent three centuries ago, the exploitation of the natural vegetation has resulted in its general deterioration and in the loss of soil (Louw, 1951; Bezuidenhout, 1993). However, it is not all to be blamed on the land users, but also on the unpredictable weather, the erratic distribution of rainfall and sometimes-untimely frosts (Weather Bureau, 1986). Restoring degraded rangelands first involves identifying areas where restoration is needed and then having the ecological understanding to predict which of the many restoration techniques can most effectively be applied (Ludwig 1994).

1.2 AIMS OF THIS STUDY

The aims of this study are:

- To identify, classify and describe the plant communities of the study area based on plant species composition, environmental variables and anthropogenic influence.
- To identify plant communities in specific land types which show high levels of degradation and should be restored.
- To recommend specific practices most suitable for the restoration of degraded areas within the park.
- To identify and map ecologically sound management units on which the optimal management of the park can be based.

1.3 CONTENTS OF THIS THESIS

In Chapter 2 an overview of the study area is given with particular reference to the history of the park, the climate, hydrology, geology and geomorphology, vegetation, and cultural historical assets. Chapter 2 further includes a description of the scientific methods that were implemented in the execution of this study.

In Chapters 3, 4, 5 and 6 the classification and description of the vegetation of the Db218, Ia155, Ib395, Fb143 and Ae309 land types are discussed. Each of these chapters is treated as a separate paper including an Introduction, Results and a Conclusion.

In Chapter 7 a synthesis of the total data set of all the land types in the park, is described. Chapter 8 contains the identification and description of management units in the Vhembe-Dongola National Park. Chapter 9 includes the identification of disturbed and degraded areas in the park and recommendations with regard to the restoration of these areas. Finally Chapter 10 concludes this thesis with an overview of, and remarks concerning the study as a whole.

CHAPTER 2

MATERIALS & METHODS

2.1 STUDY AREA

2.1.1 Proposed area

The proposed area for the Vhembe-Dongola National Park is centered on the confluence of the Limpopo and Shashi Rivers, in the Limpopo Valley in the Northern Province of South Africa, on the international borders between Botswana, Zimbabwe and South Africa (Robinson 1996) (Figure 1). The primary core area spans from Pontdrift in the west to Weipe in the east incorporating 22 farms (Figure 2) with a surface area of 28 000 ha (Robinson 1996).

2.1.2 Historical overview

In 1922, at the initiative of General J.C. Smuts, a block of nine farms was set aside to form the Dongola Botanical Reserve. The aim of this was to study the vegetation and assess the agricultural and pastoral potential of the area (Carruthers, 1992). In the early 1940s this was extended to the concept of the Dongola Wildlife Sanctuary. The possibility of linking this sanctuary with conservation areas in Botswana and Zimbabwe was considered at this stage. Due to disputes and controversy in the National Government, the Dongola Botanical Reserve/Wildlife Sanctuary was abolished and the land allocated for settlement by white farmers in 1948 (Robinson, 1996).

Mr. A.R. Willcox brought another proposal for a national park in the area to the attention of the National Parks Board, in the form of a memorandum in 1966. In 1967 the Vhembe Nature Reserve (8746 ha) was proclaimed, comprising the farm Greefswald, which was state owned and two privately owned properties Samaria and Den Staat (Figure 2). This conservation effort was, however, undermined in the early 1980s when intensive irrigation schemes were developed on the farms Samaria and Den Staat, thus destroying part of the riparian woodland (Willcox, 1966; Robinson, 1996)

In 1986 the Minister of Environment and Water Affairs, at the suggestion of Prof. J.D. Skinner of the University of Pretoria, requested NACOR (National Committee for Nature Conservation, later called Southern African Plan for Nature Conservation) to, once again, investigate the possibility of a national park in the region. This task group subsequently proposed and motivated the resurrection of the Dongola Reserve as a national park (Hall-Martin, 1988). This was opposed by the Administrator of the Transvaal, who laid claim to the area for the provincial Department of Nature Conservation and by the former South African Defence Force on the grounds that a national park would not be suitable for what was then a sensitive security zone (Robinson, 1996).

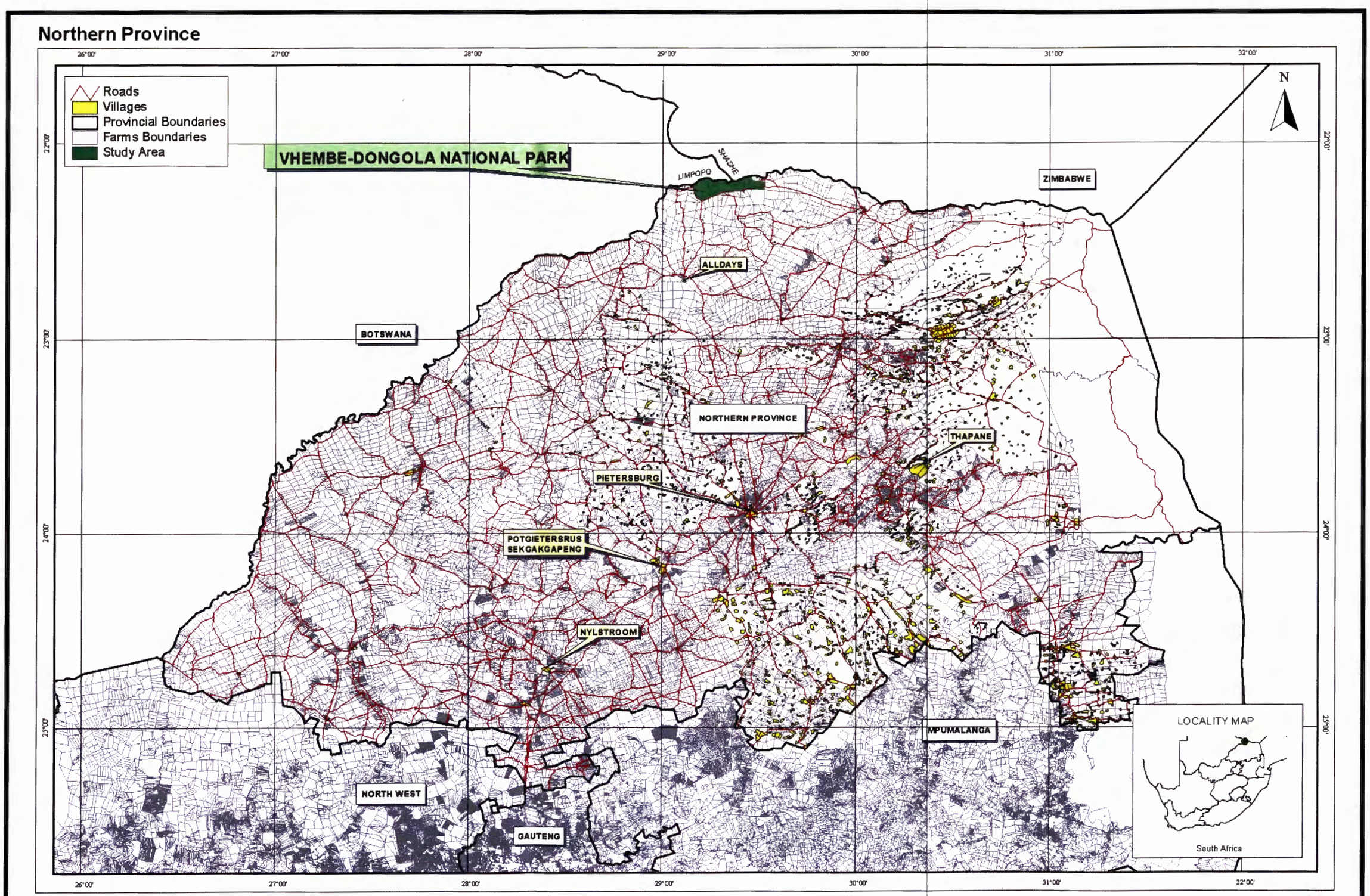
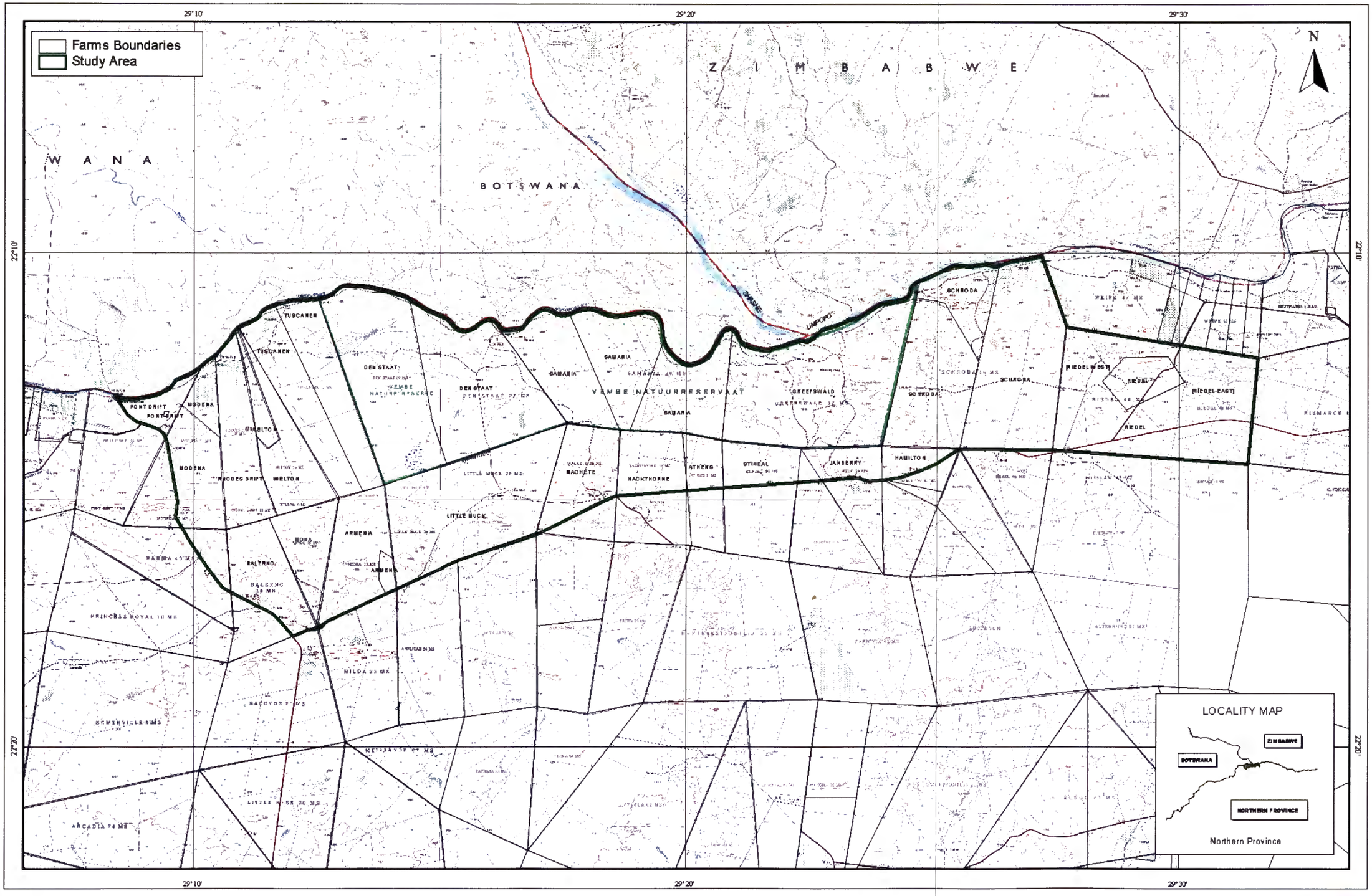


FIGURE 1 : LOCALITY OF VHEMBE-DONGOLA NATIONAL PARK

Fig 1.

Northern Province



Geographic Coordinates : WGS84

2 0 2 Kilometers

FIGURE 2 : THE CORE AREA OF THE VHEMBE-DONGOLA NATIONAL PARK

Fig 2.

A recent initiative for the establishment of a national park came from De Beers Consolidated Mining in December 1993. De Beers established the Venetia Limpopo Reserve (36 000 ha) in 1990. At its northern end, this reserve borders the farm Greefswald and includes the farm Schroda that lies on the Limpopo River. The proposal came from De Beers to purchase the state owned property Greefswald and include it in the Venetia Limpopo Reserve as a contractual national park. This, *inter alia*, convinced the National Parks Board of the value of the Dongola area, and in particular Mapungubwe, and at a meeting of the board in June 1994, it was decided to pursue the objective of proclaiming the area as a national park (Robinson, 1996).

Between 1994 and the present, the management of state owned farm Greefswald was taken over from the provincial Nature Conservation by the South African National Parks. A number of farms were purchased, mostly with funds made available by the Peace Parks Foundation, which is also under the management of SANP (Filmalter, pers. comm.) [1]

2.1.3 Climate

The climate is semi-arid with the long-term mean annual rainfall ranging from 350 mm to 400 mm per annum (Willcox, 1966; Robinson, 1996). Rainfall is highly variable and usually falls during the summer months between October and March. Evaporation from free water surfaces is in excess of 2 500 mm per annum for the largest part of the area. In summer the temperatures rise as high as 45 °C. The winters are mild, although frost may occur in low-lying areas (Robinson, 1996).

2.1.4 Hydrology

Surface drainage is mostly in a northerly direction towards the Limpopo River. None of the rivers in the area, including the Limpopo, are perennial. Ground water supplies are generally poor in the region except where these occur along well-developed fault lines (Van den Heever, 1983; Robinson, 1996).

2.1.5 Geology, geomorphology and soils

According to Robinson (1996), extensive descriptions of surface relief, geology and soils for the area are available (TPA, 1989; O'Connor, 1991a), and only a brief outline of the main elements is given here. More detail with regard to the geology, geomorphology and soils will be given in the descriptions of the vegetation of the different land types of the Vhembe-Dongola National Park in Chapters 3 – 6 of this thesis.

The area is between 300 m and 780 m above sea level. South of the Limpopo the ground tends to be flat with sandstone and conglomerate ridges and koppies. Nearer the Limpopo the flats give way to a more rugged, hilly terrain. The soils of the Limpopo Valley are derived from rocks of the Archaean granite formations in the south and, more

[1] Johan Filmalter. Former park manager, Vhembe-Dongola National Park.

generally, from the Karoo-system (Stormberg, Ecca and Beaufort Series). The soils vary from red-brown sandy loam to dark brown clays with high silt content. Large areas are characterized by sandy, lime-rich soils (Robinson, 1996). As an agricultural resource the soils have a low potential and are easily degraded by overgrazing (TPA, 1989).

2.1.6 Vegetation

According to Van Rooyen & Bredenkamp (1996), the area is situated in vegetation type no. 10, Mopane Bushveld while Acocks (1988) placed it in, veld type no.15, also Mopane Veld. According to Acocks (1988) there are two major blocks of *Colophospermum mopane* veld. One of these blocks of *Colophospermum mopane* is situated in the Limpopo Valley north of the Soutpansberg and the other to the east of the Soutpansberg. The conservation of the status of the eastern block, which occurs in the Kruger National Park is sound with 89% of the area protected, and the western block, which is less well represented in conservation areas with only 0,36% being formally protected (Berry, 1994; Robinson, 1996).

The vegetation of the region is further characterized by a fairly dense growth of *Colophospermum mopane* and mixtures of *C. mopane, Combretum apiculatum, Acacia nigrescens, A. tortilis, Adansonia digitata, Commiphora* spp., *Boscia albitrunca, Terminalia prunioides, Kirkia acuminata* and *Sclerocarya birrea*. The shrub layer is well developed and individuals of *Grewia* spp., *Acacia senegal, Ximenia americana, Commiphora africana, Dichrostachys cinerea* and *Boscia foetida* occur. The grass layer includes *Enneapogon cenchroides, Aristida congesta, Schmidtia pappophoroides, Stipagrostis uniplumis Cenchrus ciliaris* and *Panicum maximum*. The sandy-loam soils, low rainfall, high temperatures, little frost in the winter and incidence of fire influence the distribution of this vegetation type (Van Rooyen & Bredenkamp, 1996).

The former Transvaal Provincial Administration (TPA) (1989) recognized three main vegetation units in the region: the riparian fringe along the Limpopo River and its tributaries, the *Acacia-Salvadora* communities of the Limpopo flats (including flood plains) and wetland areas, and the mixed mopane veld on ridges and flats south of the riparian fringe and flood plains. Referring specifically to the farm Greefswald (Figure 2) and surroundings, Willcox (1966) listed common species including *Sclerocarya birrea*, large specimens of *Adansonia digitata* and picturesque *Ficus* spp. on the sandstone koppies (Robinson 1996).

Other vegetation studies done in the Vhembe-Dongola National Park and the surrounding areas in the past, include a terrain and vegetation evaluation by the former South African Defence Force (SADF, 1986 a & 1986 b), a study by O'Connor (1991) of vegetation types in the Limpopo-Venetia Nature Reserve and a vegetation survey by Timberlake & Mapaure (1999) of the Maramani/Tuli Area, across the Limpopo River in Southwestern Zimbabwe.

2.1.7 Cultural historical assets

Robinson (1996) stated that the proposed park has numerous archaeological sites dating from the Early Stone Age to the present. Many of these sites, which are concentrated in

the area of the confluence of the Limpopo and Shashi Rivers, are of major importance and scientific value. Of particular interest is the Zhizo site (AD 700-900) on the farm Schroda, and Mapungubwe Hill and the adjoining Bambandyanalo (AD 1100-1250) situated on the farm Greefswald. According to Voigt & Plug (1981) the Mapungubwe site is considered to be of major importance in Sub-Saharan Africa and is the most remarkable Iron Age site in South Africa. Additional features of importance are the numerous rock paintings and petroglyphs found in the area.

2.2 MATERIALS AND METHODS

2.2.1 Sampling

With the aid of 1:50 000 topographical maps, geological maps, vegetation and soil maps compiled by the old SADF (1986a & 1986b), a land type map of the area and aerial photographs, a preliminary evaluation of the study area was made. In conjunction with this a detailed reconnaissance of the area was done to determine homogeneous areas in the vegetation, before sampling commenced. Making visual estimates, sampling was done by means of the Braun-Blanquet method (Mueller-Dombois & Ellenberg, 1974). A total of 220 stratified random relevés, each covering an area of 50 x 50m, were sampled. Braun-Blanquet cover abundance values were appointed to all plant species encountered in the relevés (Table 1).

Plant species identification was done by following Arnold & De Wet (1993) and soil classification according to the Soil classification Work Group (1991). Trees and shrubs were distinguished from each other using the guidelines set by Edwards (1983). Trees are classified as rooted, woody, self-supporting plants over 2 m high and with one or a few definite trunks and shrubs are classified as rooted, woody, self-supporting, multi-stemmed or single-stemmed plants less than 2 m high (Edwards, 1983).

The habitat conditions including geology, soil forms and other edaphic factors, slope, aspect and the rockiness of the soil surface, of each relevé, were qualitatively described. This information was used in the description of the different plant communities. The coordinates of each relevé was determined and noted with the use of a GPS.

TABLE 1: Braun-Blanquet cover abundance scale used in this study (Mueller-Dombois & Ellenberg, 1974)

SCALE	DESCRIPTION
r	One or few individuals with less than 1% cover of the total sample plot area
+	Occasional and less than 1% cover of the total sample plot area
1	Abundant with low cover, or less abundant but with higher cover, 1 – 5% cover of the total sample plot area
2	Abundant with >5 – 25% cover of the total sample plot area, irrespective of the number of individuals
2a	>5 – 12,5% cover
2b	>12.5 – 25% cover
3	>25 – 50% cover of the total sample plot area, irrespective of the number of individuals
4	>50 – 75 cover of the total sample plot area, irrespective of the number of individuals
5	>75% cover of the total sample plot area, irrespective of the number of individuals

2.2.2 Stratification

Land types (Figure 3) were used as a means of stratification of the study area. A land type is a class of land with specified characteristics. In South Africa it has been used as a map unit denoting land, mappable at 1 : 250 000 scale, over which there is marked uniformity of climate, terrain form and soil pattern (Van der Walt & Van Rooyen, 1990).

The following land types (Land Type Survey Staff, 2000) were studied in the Vhembe-Dongola National Park:

1. **Ae309** Mostly found on a plateau with deep sandy soils.
2. **Db218** Flood plain unit with deep to moderately deep soils with high silt content.
3. **Fb143** Undulating terrain with moderately deep to shallow sandy to loamy soils.
4. **Ia155** Riverine and non-perennial wetland vegetation with deep to moderately deep soils with a high silt and clay content.
5. **Ib395** Sandstone ridges with shallow sandy soils.

The vegetation of the different land types was classified and described separately (Chapters 3 – 6) and then combined in a synoptic table (Chapter 7).

Northern Province

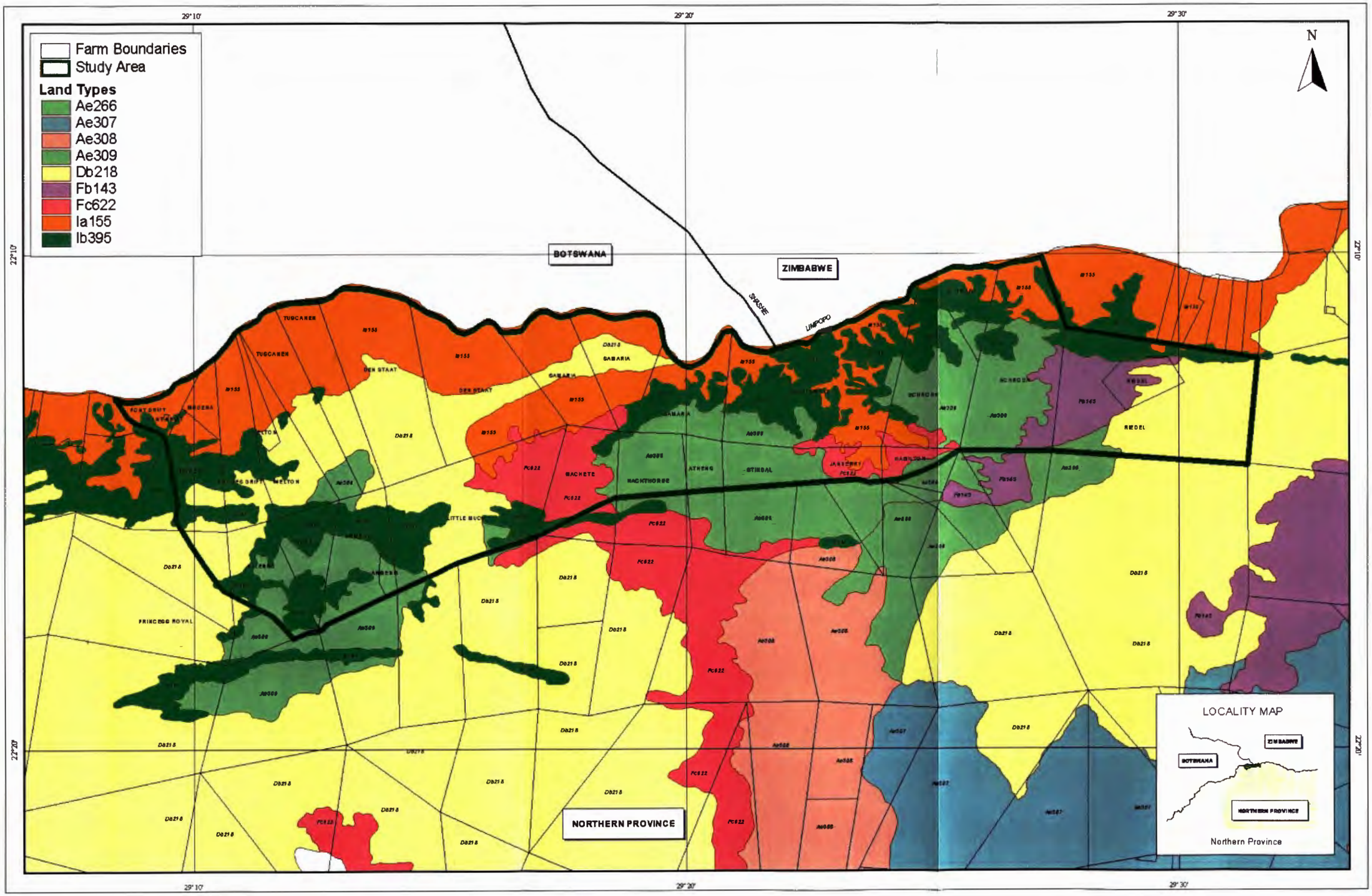


FIGURE 3 : LAND TYPE MAP OF THE VHEMBE-DONGOLA NATIONAL PARK

Fig 3.

2.2.3 Data processing

All relevé data has been imported into the database TURBOVEG (Hennekens 1996a). The numerical classification technique TWINSPAN (Hill, 1979a), which is regarded as a successful approach for classification by several phytosociologists (Mucina & Van Der Maarel, 1989; Bredenkamp & Bezuidenhout, 1995; Cilliers, 1998) was used as a first approximation for the floristic data. Subsequently Braun-Blanquet procedures (Bezuidenhout *et al.*, 1996) were used to refine data and construct phytosociological tables (Tables 2 – 6) using a visual editor, MEGATAB (Hennekens, 1996b). In the heading of each phytosociological table a TURBOVEG (Hennekens 1996a) number is given, which makes the data easy to trace for future use in other studies. Other headings include the number of species per relevé and a relevé number given to a specific relevé during the process of sampling. Using the phytosociological tables and the habitat information gathered during the sampling period, the different plant communities was identified and described.

An ordination algorithm, DECORANA (Hill, 1979b), was applied to the floristic data in order to illustrate floristic relationships between plant communities, to detect possible gradients in and between communities and to detect possible habitat gradients and/or disturbance gradients associated with vegetation gradients.

Using the visual editor for phytosociological tables, MEGATAB (Hennekens, 1996b), a synoptic table was compiled from 220 relevés, representing a total of 32 plant communities, sub-communities and variants, identified in five different land types in the Vhembe-Dongola National Park. The objective classification technique TWINSPAN (Hill, 1979a) was used complimentary to the Braun-Blanquet method. The ordination algorithm, DECORANA (Hill, 1979b) was also applied to the synoptic data set, to indicate floristic relationships and how the vegetation gradient relates to the habitat gradient. A synoptic table, in which each community, sub-community and variant found in the different land types, was summarized in a single column, was made in order to identify larger vegetation groups and to make comparisons between the larger vegetation groups and the communities of the study area. Plant species, which did not belong to a specific vegetation group of the synoptic table and occurred less than five times in the data set, were omitted from the synoptic table. With the assistance of the identified vegetation groups, management units were identified and mapped on management unit maps (Figures 14 – 16, Chapter 8).

Throughout the chapters in which the vegetation of the Vhembe-Dongola National Park is described, comparisons were made between the plant communities that were identified during this study and previous studies done by the former South African Defence force (SADF, 1986a; 1986b) and Timberlake & Mapaure (1999). The studies done by the former SADF were not based on the Braun-Blanquet approach (Mueller-Dombois & Ellenberg, 1974), but dominant species in each vegetation type identified were mentioned and a cover value for each species was estimated. The main purpose of the study by the SADF was to develop a terrain evaluation map.

CHAPTER 3

CLASSIFICATION AND DESCRIPTION OF THE VEGETATION OF THE DB218 LAND TYPE OF THE VHEMBE-DONGOLA NATIONAL PARK

3.1 INTRODUCTION

The geology of the Db218 land type (Figure 4) consists mainly of mudstone of the Bosbokpoort Formation, sandstone and siltstone of the Clarens Formation and shale of all the formations of the Karoo Sequence (Land Type Survey Staff, 2000). The soils are mostly deep, red/brown clayey soils, often with a duplex character (sandy topsoils over clayey subsoil) such as the Valsrivier and Swartland soil forms. In some areas the soil forms were found to be deep red sandy Hutton soils. As a whole this land type is heavily grazed and trampled. Overgrazing by cattle, sheep and goats and harsh droughts in the past primarily caused the degradation in the area. Currently game occupies the area and a more recent severe dry period has contributed to the degradation of the land. As a result of the above mentioned degradation factors soil compaction and surface erosion has set in, which leads to the further demise of the vegetation in certain areas of this land type.

The terrain units found in the Db218 land type (Figure 4) are a crest (Terrain Unit 1), foot slope (TU4) and floodplain (TU5). In this study, however, only TU4 and TU5 were encountered. The landscape tends to be flat with slightly undulating areas and dry streambeds occurring on a regular basis (Land Type Survey Staff, 2000).

This land type covers a large portion of the Vhembe-Dongola National Park and has the highest plant diversity of all the land types in the park. During the time of the study a total of 226 plant species were identified in the Db218 land type. The vegetation consists of woody plant communities with trees of moderate height and in some instances shrubby vegetation. *Colophospermum mopane* and *Salvadora australis* (Species groups A & U, Table 2) dominate the woody vegetation of this land type. The following three plant communities were identified in this land type on the farm Den Staat and the eastern area of the farm Riedel:

1. The *Colophospermum mopane* Community
2. The *Salvadora australis – Acacia stuhlmannii* Community
3. The *Salvadora australis – Acacia grandicornuta* Community

Northern Province

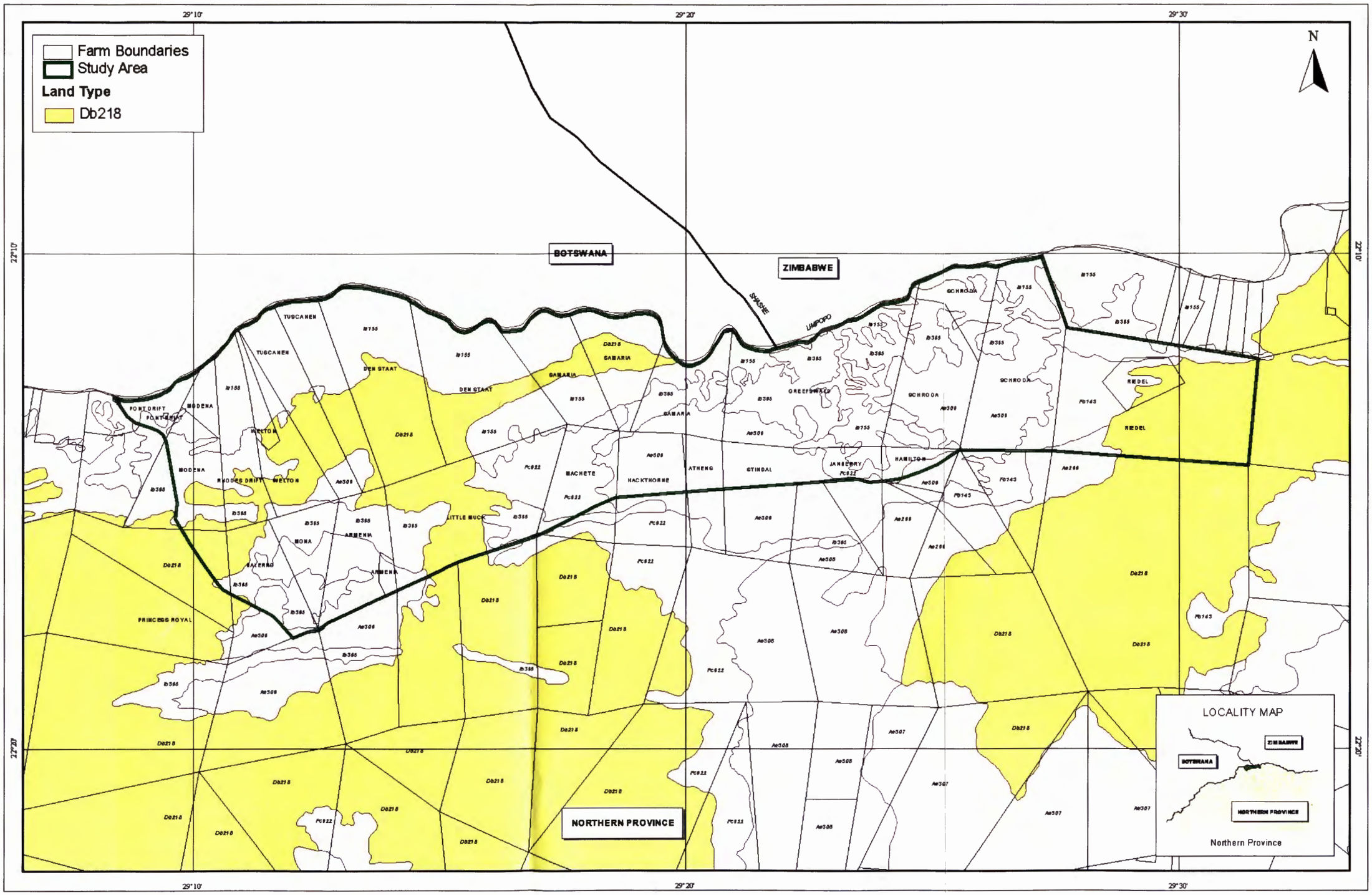


FIGURE 4 : Db 218 LAND TYPE OF THE VHEMBE-DONGOLA NATIONAL PARK

Fig 4.

3.2 DESCRIPTION OF PLANT COMMUNITIES

1. The *Colophospermum mopane* Community

Soil forms found in this community include very deep red sandy to shallower Hutton soils, shallow Glenrosa and Mispah (Lithosols), clayey, silt rich Oakleaf soils and Swartland duplex soils. This community covers the largest area of the Db218 land type and makes a valuable contribution towards the grazing and browsing capacity of the park as a whole.

This is a broad plant community with a number of different vegetation structures, habitats and landscapes. The *Colophospermum mopane* Community has high plant diversity with 210 plant species identified in the course of this study. The seven different sub-communities that were identified in this community further indicate the high diversity and multiple habitats of this community. The vegetation of this community is more generally known as the Mopane-Veld (Acocks, 1988; Low and Rebelo, 1996).

The diagnostic species of this community are found in Species group A of Table 2, and include the woody species *Colophospermum mopane* in the form of trees and shrubs and *Grewia bicolor* mostly as shrubs as well as the grass species *Cenchrus ciliaris*. The absence or low occurrence of the species of Species groups M, S and U (Table 2) further differentiates this community from the other two communities in this land type.

The seven sub-communities, which were identified in the *Colophospermum mopane* community, are:

1.1 The *Digitaria eriantha – Schmidtia pappophoroides* Sub-community

1.2 The *Abutilon austro-africanum – Acalypha indica* Sub-community

1.3 The *Dichrostachys cinerea – Tephrosia purpurea* Sub-community

1.4 The *Boscia foetida – Commiphora pyracanthoides* Sub-community

1.5 The *Commiphora mollis – Grewia bicolor* Sub community

1.6 The *Salvadora australis - Sporobolus ioclados* Sub-community

1.7 The *Barleria sinensis – Cyathula orthacantha* Sub-community

TABLE 2: PHYTOSOCIOLOGICAL TABLE OF THE VEGETATION OF THE DB218 LAND TYPE IN THE VHEMBE-DONGOLA NATIONAL PARK

TURBOVEG no.	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1
	9	9	9	9	9	9	9	9	9	9	9	9	9	0	9	9	9	9	9	0	9	8	8	9	9	0	8	9	8	9	9	9	0	9	8	9	9	9	9	9	9	9	9	8	9	9	0	9	9	0	8	8	9	0	9	9	9	8	0	8	9	9	9	9	9	9	9	9	0	8	9	8	9	0	9	9	0
	6	6	6	6	6	6	6	4	5	6	6	6	8	3	8	4	4	9	4	4	2	7	8	2	3	4	7	3	7	2	3	3	5	3	7	1	3	0	2	2	3	4	2	8	1	1	3	2	1	3	7	7	1	4	1	1	2	8	3	8	2	2	7	7	7	7	7	7	3	6	7	6	8	3	7	8	3
	4	0	5	6	7	8	9	3	9	1	2	3	1	9	0	4	5	6	2	7	7	7	0	8	2	2	6	5	8	9	0	1	1	7	0	9	6	9	3	5	3	9	6	2	6	4	6	1	5	7	5	9	3	0	7	8	2	1	8	5	0	4	1	2	4	6	8	7	4	1	5	2	8	2	9	9	3
Relevé no.	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	2	0	0	0	2	0	0	0	0	2	0	0	0	1	1	1	1	1	1	2	0	1	0	1	2	1	1	2
	7	6	7	7	7	7	7	3	6	6	7	7	6	2	6	3	3	2	2	3	3	4	4	3	3	4	4	3	4	3	3	3	5	4	5	2	3	0	2	2	3	3	2	4	1	1	2	2	1	2	4	4	1	2	1	1	2	4	2	5	2	2	5	5	5	5	5	5	1	0	5	0	8	1	6	8	1
	4	8	5	6	7	8	9	0	0	9	0	3	3	4	2	1	2	9	8	4	0	3	6	1	5	9	2	8	4	2	3	4	0	0	3	2	9	6	6	8	6	7	9	8	6	1	1	4	5	2	1	5	0	5	7	8	5	7	3	2	3	7	2	3	5	7	9	8	9	3	6	4	0	7	1	1	8
No. of species per relevé	4	1	2	2	1	2	2	2	2	3	2	2	2	2	2	3	3	4	4	4	3	2	2	2	2	2	2	3	3	3	3	3	2	3	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	3	1	1	2	2	2	1	2	2	2	1	1	2	3	3	3	2	2	2	3	2	3	2	2	2	1	2	2
	0	4	4	5	9	6	5	8	4	0	2	6	3	3	8	0	0	4	4	4	0	7	7	9	7	6	3	5	4	2	3	0	8	0	8	4	9	8	4	3	3	1	7	7	5	3	8	0	5	3	4	7	2	3	5	9	2	3	7	2	7	2	0	2	2	5	7	8	2	6	8	7	2	6	8	5	9
Communities	1																																																		2																						3				
Sub-communities	1.1							1.2							1.3						1.4									1.5				1.6												1.7					2.1									2.2			2.3														
Species group A																																																																													
Colophospermum mopane -trees	3	4	b	4	3	3	3	b	3	3	3	3	3	3	3	4	+	a	3	b	4	b	4	a	a	b	3	a	b	a	1	3	b	3	+	a	4	1	a	b	1	1	b	a	1	4	4	3	4	4	1	1	.	.	.	+	.	.	1	.	.	.	.	.	.	.	.	.	.		.		b	.	.	.	.
Colophospermum mopane -shrubs	.	1	b	a	a	a	b	a	b	b	a	1	b	a	b	a	a	a	a	a	1	b	+	a	+	b	a	+	a	b	b	b	b	1	.	b	+	3	3	3	1	3	3	.	3	.	+	.	.	.	+	+	.	.	.	+	+	+	1	.	.	.	.	.	.	.	.	.	.		.		a	.	.	.	.
Cenchrus ciliaris	1	.	.	.	.	.	.	3	.	.	.	.	+	.	.	.	a	1	1	a	a	.	b	+	.	+	.	1	.	+	+	+	1	.	a	.	a	a	.	1	.	1	1	.	+	+	1	1	+	b	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.		.		.	.	.	.	.
Grewia bicolor	a	.	1	.	.	.	.	1	.	.	.	.	.	+	.	.	.	+	.	+	+	.	.	.	+	+	.	1	+	1	1	a	1	.	3	.	a	+	.	.	.	1	.	.	.	a	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Species group B																																																																												
Digitaria eriantha	a	a	a	b	a	1	a	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Schmidtia pappophoroides	a	+	1	1	a	a	a	.	.	.	.	.	.	1	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Stipagrostis uniplumis	1	+	1	a	1	b	b	.	.	.	.	.	.	.	.	.	b	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Indigofera daleoides var. *daleoides*	+	a	.	1	a	a	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Pentarrhinum insipidum	+	1	.	+	+	a	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Acrotome inflata	+	.	1	+	.	+	+	1	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Momordica balsamina	+	.	+	1	+	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.		.		.	+	.	.	.
Acacia erioloba	a	.	.	a	.	b	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	1
Ximenia americana	a	.	a	.	.	1	1	.	.	.	.	.	.	1	.	a	.	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	a	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Dichilus lebeckioides	+	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Chamaesyce mossambicensis	+	r	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+		.		.	.	.	.	.
Pupalia lappacea	a	.	+	+	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		+		a	.	+	.	+
Striga gesnerioides	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Species group C																																																																												
Dichrostachys cinerea	.	.	a	.	.	.	.	+	.	.	.	.	.	.	.	+	b	a	+	a	.	.	.	.	.	.	r	.	.	.	+	+	.	.	1	.	a	.	.	.	.	.	.	.	.	.	.	a	+	a	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.		.		.	.	1	.	a
Tephrosia purpurea	.	.	1	.	.	1	1	.	.	.	.	.	.	.	1	+	1	b	.	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.		.		+	.	.	.	.
Ptycholobium contortum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	a	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Cleome angustifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	.	+	1	+	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	+	.	+	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Phyllanthus angolensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Oropetium capense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Calostephane divaricata	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.		.		.	.	.	.	.
Combretum apiculatum	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	.	a	.	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
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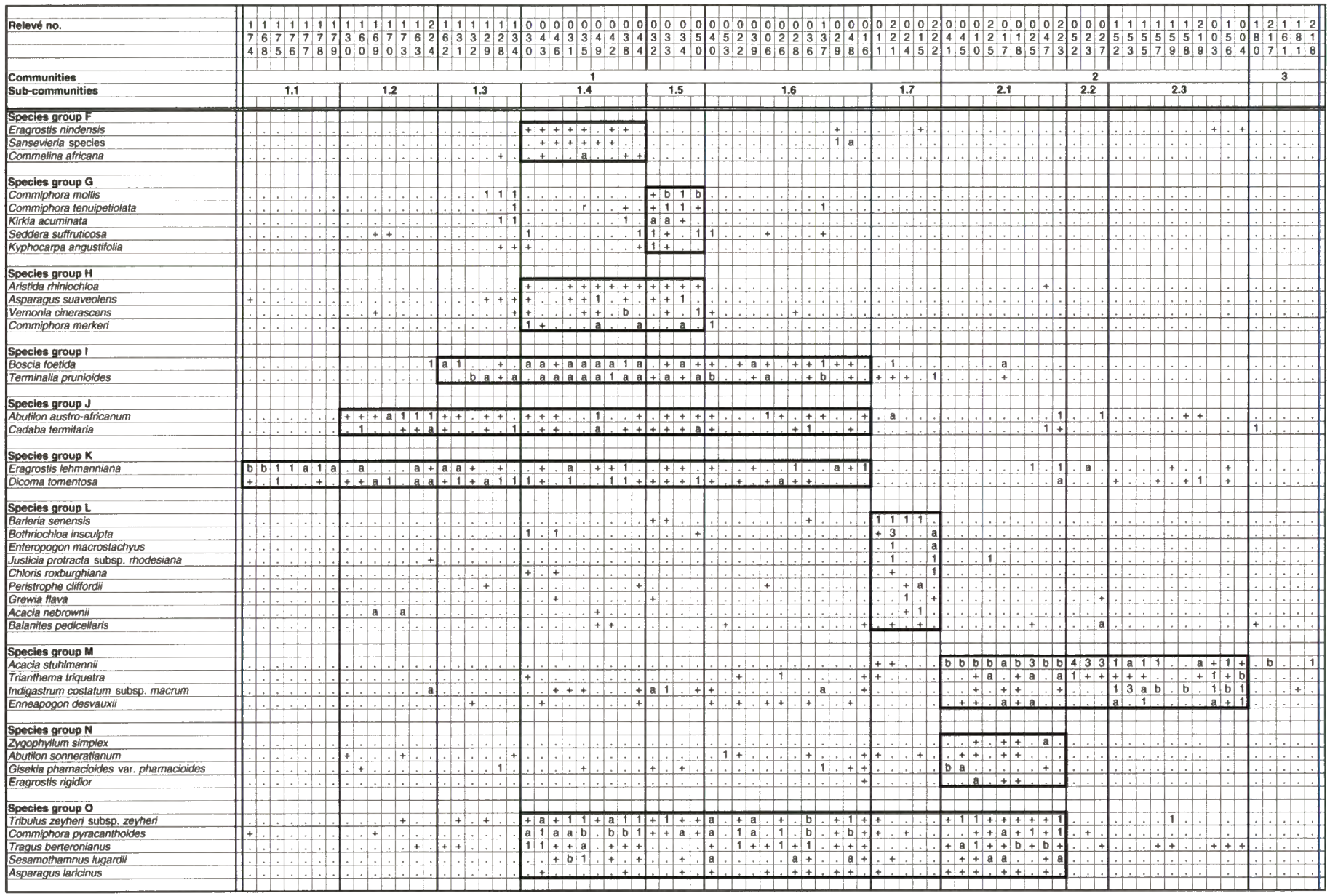
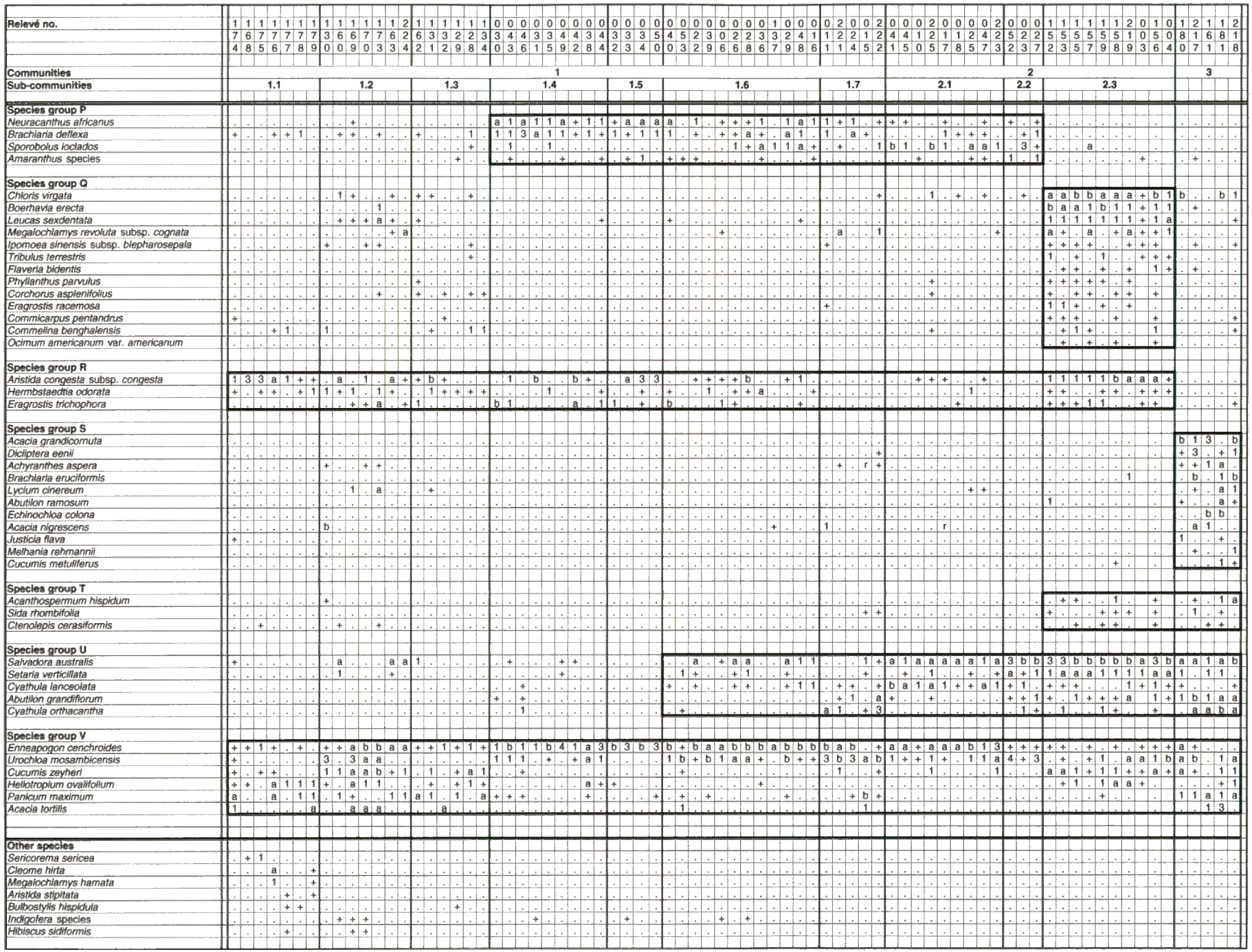
Urochloa stolonifera	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	a	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.
Species group D																																																																												
Aristida adscensionis	.	.	.	+	.	.	.	+	a	1	1	.	a	3	a	+	+	.	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1		.	+	+	.	.	.	1
Acalypha indica	+	.	.	+	.	.	.	1	1	1	1	+	a	+	1	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	+	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.		.		.	.	.	.	.
Aptosimum lineare	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	+	+	+	.	.	.	.	.
Geigeria burkei subsp. *fruticulosa*	.	.	.	.	.	.	.	.	.	+	1	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	r	+		.	.	.	.	.
Species group E																																																																												
Hibiscus micranthus	+	.	+	.	+	+	+	+	1	+	+	.	1	1	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.		+		1	+	1	.	.
Rhigozum zambesiacum	1	.	1	.	.	+	.	.	.	.	.	.	.	+	.	.	+	.	.	1	+	.	+	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.		.	.	.	.	.


Relevé no.
Communities
Sub-communities
1
2
3
1.1
1.2
1.3
1.4
1.5
1.6
1.7
2.1
2.2
2.3
Species group F
Eragrostis nindensis
Sansevieria species
Commelina africana
Species group G
Commiphora mollis
Commiphora tenuipetiolata
Kirkia acuminata
Seddera suffruticosa
Kyphocarpa angustifolia
Species group H
Aristida rhiniochloa
Asparagus suaveolens
Vernonia cinerascens
Commiphora merkeri
Species group I
Boscia foetida
Terminalia prunioides
Species group J
Abutilon austro-africanum
Cadaba termitaria
Species group K
Eragrostis lehmanniana
Dicoma tomentosa
Species group L
Barleria senensis
Bothriochloa insculpta
Enteropogon macrostachyus
Justicia protracta subsp. rhodesiana
Chloris roxburghiana
Peristrophe cliffordii
Grewia flava
Acacia nebrownii
Balanites pedicellaris
Species group M
Acacia stuhlmannii
Trianthema triquetra
Indigastrum costatum subsp. macrum
Enneapogon desvauxii
Species group N
Zygophyllum simplex
Abutilon sonneratianum
Gisekia pharnacioides var. pharnacioides
Eragrostis rigidior
Species group O
Tribulus zeyheri subsp. zeyheri
Commiphora pyracanthoides
Tragus berteronianus
Sesamothamnus lugardii
Asparagus laricinus


Relevé no.
Communities
Sub-communities
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
2
2.1
2.2
2.3
3
Species group P
Neuracanthus africanus
Brachiaria deflexa
Sporobolus ioclados
Amaranthus species
Species group Q
Chloris virgata
Boerhavia erecta
Leucas sexdentata
Megalochlamys revoluta subsp. cognata
Ipomoea sinensis subsp. blepharosepala
Tribulus terrestris
Flaveria bidentis
Phyllanthus parvulus
Corchorus asplenifolius
Eragrostis racemosa
Commicarpus pentandrus
Commelina benghalensis
Ocimum americanum var. americanum
Species group R
Aristida congesta subsp. congesta
Herrmbstaedtia odorata
Eragrostis trichophora
Species group S
Acacia grandicornuta
Dicliptera eenii
Achyranthes aspera
Brachiaria eruciformis
Lycium cinereum
Abutilon ramosum
Echinochloa colona
Acacia nigrescens
Justicia flava
Melhania rehmannii
Cucumis metuliferus
Species group T
Acanthospermum hispidum
Sida rhombifolia
Ctenolepis cerasiformis
Species group U
Salvadora australis
Setaria verticillata
Cyathula lanceolata
Abutilon grandiflorum
Cyathula orthacantha
Species group V
Enneapogon cenchroides
Urochloa mosambicensis
Cucumis zeyheri
Heliotropium ovalifolium
Panicum maximum
Acacia tortilis
Other species
Sericorema sericea
Cleome hirta
Megalochlamys hamata
Aristida stipitata
Bulbostylis hispidula
Indigofera species
Hibiscus sidiformis

Relevé no.	174	168	175	176	177	178	179	130	160	169	170	173	163	224	162	131	132	129	128	134	030	043	046	031	035	049	042	038	044	032	033	034	050	040	053	022	039	006	026	028	036	137	029	048	016	011	221	024	015	222	041	045	010	225	017	018	025	047	223	052	023	027	152	153	155	157	159	158	219	003	156	004	180	217	161	181	218
Communities	1																																																	2																							3				
Sub-communities	1.1							1.2							1.3						1.4									1.5				1.6												1.7					2.1									2.2			2.3														
Indigofera charleriana															+	+																																																								+								
Blepharis leendertziae																																																		+	+																									
Cordia monoica																										+		+						+																											+															
Chamaesyce glanduligera																			+																						+																																				
Ceratotheca triloba				+		+												1		+											+																																														
Catophractes alexandri																1																																																													
Pycreus pelophilus																1																																																													
Acacia nilotica																+																																																													
Fingerhuthia africana																																									+																																				
Gisekia africana var. *africana*																																																										+																	
Hemizygia petrensis																																									1																																				
Aristida junciformis																	+																																																												
Brassica rapa																																																																				+								
Hermannia modesta																																																					+					+											+	a		+					
Ocimum gratissimum subsp. *gratissimum*																																																																												1
Ipomoea magnusiana var. *magnusiana*			+																																																																									
Melhania acuminata var. *agnosta*						+		+																																																																					
Chenopodium album				+																																																																			+	+					
Indigofera bainesii	1																																																																											
Pergularia daemia var. *daemia*	+																																																												+															1	
Justicia matammensis	+																																																																											
Cullen obtusifolia																																																													+														
Cadaba termitaria																																																											1													+					
Nemesia fruticans																																																																				+							+			
Sansevieria hallii																																																			1																								
Euphorbia cooperi																																								4																																			
Sterculia rogersii								+																			1						+																																												
Acacia robusta																											+																																																
Evolvulus alsinoides var. *linifolius*																			+				+		1																																																			
Eragrostis superba																																										r																																		
Mariscus rehmannianus																		+																																																									
Cordia grandicalyx																									+																																																			
Abutilon species											+																																																																
Ophioglossum costatum																																																										r																	
Aspalathus suaveolens																																+																																											
Hypertelis bowkeriana																																																										+																	
Crotalaria lotoides																		+																																																									
Ipomoea tenuipes																																			+																																								
Commelina africana																											+																																																
Chamaesyce eylesii																																									+																																				
Adansonia digitata																								1				+																																															
Combretum imberbe																																		b																																									
Grewia flavescens																																		a		+																																							
Solanum panduriforme								+																																																																		1		
Flueggea virosa subsp. *virosa*																																		+													+																												
Indigofera laxeracemosa																	+																																																												
Tarchonanthus camphoratus																			+																																																										
Albizia harveyi																	+																																																												
Ipomoea papilio																																																																											+	
Verbesina encelioides var. *encelioides*																																																																+											
Kyllinga alba																	+																																																												
Albizia anthelmintica																																																																								a				
Barleria transvaalens																											+										+																																						
Senecio species																																																																				+								
Sida ovata																	+																																																												
Xerophyta viscosa																	+																																																												
Monsonia glauca																			+																																																										
Decorsea schlechteri																			+				+								1																																														
Hibiscus trionum																																																																r											
Blepharis subvolubilis var. *subvolubilis*																							+						+																																															
Commelina species																				+																	+																																								
Nuxia oppositifolia																																																																													
Ziziphus mucronata																																																																													

Relevé no.	1 1 1 1 1 1 1	1 1 1 1 1 1 2	1 1 1 1 1 1	0 0 0 0 0 0 0 0 0	0 0 0 0	0 0 0 0 0 0 0 0 1 0 0 0	0 2 0 0 2	0 0 0 2 0 0 0 0 2	0 0 0	1 1 1 1 1 1 2 0 1 0	1 2 1 1 2
	7 6 7 7 7 7 7	3 6 6 7 7 6 2	6 3 3 2 2 3	3 4 4 3 3 4 3 4	3 3 3 5	4 5 2 3 0 2 2 3 3 2 4 1	1 2 2 1 2	4 4 1 2 1 1 2 4 2	5 2 2	5 5 5 5 5 5 1 0 5 0	8 1 6 8 1
	4 8 5 6 7 8 9	0 0 9 0 3 3 4	2 1 2 9 8 4	0 3 6 1 5 9 2 8 4	2 3 4 0	0 3 2 9 6 6 8 6 7 9 8 6	1 1 4 5 2	1 5 0 5 7 8 5 7 3	2 3 7	2 3 5 7 9 8 9 3 6 4	0 7 1 1 8
Communities				1					2		3
Sub-communities	1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	2.3	
Dinebra retroflexa	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . .	. . . . .	. a . .
Vernonia fastigiata	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . .	. + ...	. . . .
Digitaria sanguinalis	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . .	. . + ...	. . . .
Sesamum triphyllum	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . .	. + ...	. . . .
Eragrostis curvula	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . + ...	+	. . + ...	. . .	. . . . .	. . . .
Acacia schweinfurthii	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. + ...	. . . . .	. . . . .	. . .	. . . . .	. . . .
Indigofera schimperi	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . +	. . . . .	. . .	. . . . .	. 1 . . .
Pavonia burchellii	. . . . .	. . . . .	. . . . .	. . + . . + .	. + . .	. . . . .	. 1 . . 1	. . . + ...	. . .	. . . . .	. . . . .
Tetrapogon tenellus	. . . . .	. . . . .	. . . . +	. . . . .	. . . . .	. . . . + ...	. + . . .	. . . . .	. . .	. . . . .	. . . . .
Albizia versicolor	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . 1 . .	. . . . .	. . .	. . . . .	. . . . .
Indigofera trita subsp. *subulata*	. . . . .	. . . . .	. . + . a	. . . . .	. . . . .	. . . . .	. + . . .	. . . . .	. . .	. . . . .	. . . . .
Grewia monticola	. . . . .	. . . . .	. . . . .	. . . . .	. + . . .	. . . . .	. . + . .	. . . + ...	. . .	. . . . .	. . . . .
Panicum coloratum var. *coloratum*	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	 1	. . . . .	. . .	. . . . . +	. . . . .
Xanthocercis zambesiaca	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. 3	. . . . .	. . . . .	. . .	. . . . .	. . . . .
Combretum microphyllum	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. a	. . . . .	. . . . .	. . .	. . . . .	. . . . .
Combretum mossambicens	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . a .	. . . . .	. . .	. . . . .	. . . . .
Maytenus senegalensis	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . + .	. . . . .	. . .	. . . . .	. . . . .
Euphorbia species	. . . . .	. . . . .	. . . . .	. . + . . + .	. . . . .	. . . . . + . . + .	. . . . .	. . . + . . + .	. . .	. . . . .	. . . . .
Boscia albitrunca	. . . . .	. . . . .	. . + . .	. . . . + .	. . . . .	. . . + + ...	. a . . .	. . + . . + .	. . .	. . . . .	. . . . .
Indigofera circinnata	. . . . .	. . . . .	+ . + . .	+ . . . + .	. . . + .	. . . . . + . .	+	. . . . .	. . .	. . . . .	. . . . .
Acacia senegal var. *rostrata*	. . . . .	. . . . + .	. . . . .	. + ...	. . . + .	. . . . . + . .	. . . . .	. . . . . 1 .	. . .	. . . . 1 . .	. . 1 . a
Loudetia simplex	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . + . + + . .	. . . . .	. . . . . + .	. + .	. . . . .	. . . . .
Lonchocarpus capassa	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. + ...	. . . . .	. . . . .	. . .	. . . . .	. . . . .
Panicum schinzii	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. 1	. . . . .	. . . . .	. . .	. . . . .	. . . . .
Grewia occidentalis	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. + ...	. . . . .	. . . . .	. . .	. . . . .	. . . . .
Plumbago zeylanica	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. a	. . . . .	. . . . .	. . +	. . . . .	. . . . .
Grewia villosa	. . . . .	. . . . .	. . + . .	. . + . . + .	. . . . .	. . . . .	. . . + .	. . . . .	. . .	. . . . .	. . . . .
Corchorus olitorius	. . . . .	+	. . . . .	. . . . .	. . . . .	. . . . .	. . . . +	. . . . .	. . .	. . . . .	. . 1 . .
Commiphora glandulosa	. . . . .	1	. . 1 . .	. . . 1 . . .	. . . a	. . . . .	. . . . .	. . . . .	. . .	. . . . .	. . . . .
Asparagus africanus	. . . . .	+	. . . . +	. . . . .	. . . . .	+	. . . . .	. . . 1	. . .	. . . . .	. . . . .
Dactyloctenium aegyptium	. . . . .	. . . . . +	. . + . .	. . + . . .	. . . . .	. . . . . + . .	. . . . .	. . + ...	. + .	. + . + + . .	. . . . .
Sida alba	. . . . .	. + ...	+	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . .	. . . . .	. . . + .
Becium filamentosum	. . . . .	. . . . + .	. . . . +	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . .	. . . . .	. . . . .
Geigeria acaulis	. . . . .	. . . . .	+	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . .	+ . . . . + .	. . . . .
Solanum kwebense	. . . . .	. . . . .	. . + . 1	. . . . +	. . . . .	. . . . .	+	. . . . .	. . .	1 . . . + . .	. . . . .
Xanthium strumarium	. . . . .	. . . + . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . .	. . . . .	. + + . .
□											

1.1 The *Digitaria eriantha – Schmidtia pappophoroides* Sub-community

The *Digitaria eriantha – Schmidtia pappophoroides* Sub-community is most commonly found on the farm Den Staat in the Vhembe-Dongola National Park on TU5 of the Db218 land type. The soil forms in the sub-community are dominated by deep red sandy Hutton soils. The soil surface is sandy with a loose texture and no signs of soil compaction. The area is moderately grazed and heavily trampled by the large numbers of game that frequent the area for sustenance and cover. As a whole the degree of land degradation in this sub-community was low and of no serious concern.

Diagnostic species to the *Digitaria eriantha – Schmidtia pappophoroides* Sub-community are found in Species group B (Table 2). This includes the tree species *Acacia erioloba* and *Ximenia americana*, the grasses *Digitaria eriantha, Schmidtia pappophoroides* and *Stipagrostis uniplumis*, the forbs *Indigofera daleoides* var. *daleoides* and *Acrotome inflata* as well as the twining forbs *Pentarrhinum insipidum* and *Momordica balsamina*. Other species, which have high cover abundance values in this sub-community, are the grass species *Eragrostis lehmanniana* (Species group K, Table 2) and *Aristida congesta* subsp. *congesta* (Species group R, Table 2). This sub-community is further differentiated from the other sub-communities in the *Colophospermum mopane* Community by the absence of the species found in Species group J (Table 2).

The tree layer has an average height of 4.1 m and covers between 20 and 60% of the surface area of this sub-community. The shrub layer reaches an average height of 1.5 m and has an average crown cover of 14% and is dominated by *Colophospermum mopane* (Species group A, Table 2). The herbaceous layer covers between 50 and 70% of the area and has an average height of 0.7 m.

1.2 The *Abutilon austro-africanum – Acalypha indica* Sub-community

This sub-community is found on the foot slope (TU4) and floodplain (TU5) of the Db218 land type, often in dry streambeds. The main soil form is a moderately deep sandy Hutton and in some instances the B-horizon of the soil showed a high percentage of gravel and a compacted soil surface. The degree of grazing and trampling is moderate with no serious signs of degradation.

There are no diagnostic species to the *Abutilon austro-africanum – Acalypha indica* sub-community. There are however species, which differentiate this sub-community through high cover abundance values or by their mere presence. These species include the tree species *Acacia tortilis* (Species group V, Table 2) and *Salvadora australis* (Species group U, Table 2) as well as the shrubby *Abutilon austro-africanum* (Species group J, Table 2). Prominent herbaceous species include *Cucumis zeyheri* (Species group V, Table 2), *Acalypha indica* (Species group D, Table 2) and *Leucas sexdentata* (Species group Q, Table 2). This sub-community is differentiated from the *Digitaria eriantha – Schmidtia pappophoroides* Sub-community (1.1) and the *Dichrostachys*

cinerea – Tephrosia purpurea Sub-community (1.3) trough the presence of the grass species *Urochloa mosambicensis* (Species group V, Table 2) and the general absence of the species of Species groups B and C (Table 2).

The tree layer has an average height of 3.4 m (sometimes as high as 7 m) and a crown cover varying between 35 and 55%. The shrub layer is poorly developed with a crown cover of 10 to 20% and an average height of 1.4 m. The dominant shrubs are *Colophospermum mopane* (Species group A, Table 2) and *Cadaba termitaria* (Species group J, Table 2). The crown cover of the herbaceous layer is between 50 and 85% with an average height of 0.6 m.

1.3 The *Dichrostachys cinerea – Tephrosia purpurea* Sub-community

This sub-community is found on shallow soils of the Hutton and Glenrosa soil forms. It is mainly situated on the crest (TU1) and foot slope (TU4) of the Db218 land type with one sample plot found in a small streambed. The area is disturbed with a high degree of overgrazing and trampling and the occurrence of bare patches in the vegetation cover, a high measure of soil compaction and evidence of surface soil erosion in certain localities. The rockiness of the soil surface lies between 20 and 70%.

The species of Species group C (Table 2) are diagnostic to this disturbed sub-community. These include the tree species *Dichrostachys cinerea* and *Combretum apiculatum*, the grass species *Oropetium capense, Urochloa stolonifera* and *Melinis repens* and the forbs *Tephrosia purpurea, Ptycholobium contortum, Cleome angustifolia* and *Phyllanthus angolensis*. The presence of the species of Species group I (Table 2) further differentiates the *Dichrostachys cinerea – Tephrosia purpurea* Sub-community (1.3) from the *Digitaria eriantha – Schmidtia pappophoroides* Sub-community (1.1) and the *Abutilon austro-africanum – Acalypha indica* Sub-community (1.2). Similarities in the three above-mentioned sub-communities are found in the presence of the species of Species group E (Table 2).

The tree cover of this sub-community is between 25 and 55% with an average height of 3.7 m. The shrub layer is dominated by *Colophospermum mopane* (Species group A, Table 2) and *Dichrostachys cinerea* (Species group C, Table 2) and covers between 10 and 30% of the sub-community area and has an average height of 1.5 m. The height of the herbaceous layer is on average 0.6 m with a crown cover of between 50 and 70%.

1.4 The *Boscia foetida – Commiphora pyracanthoides* Sub-community

This sub-community is found on the foot slope (TU4) and floodplain (TU5) of this land type and occurs on moderately deep to shallow soils of the Hutton and Oakleaf soil forms. The soils have a higher clay percentage than is the case in the *Digitaria eriantha – Schmidtia pappophoroides* Sub-community (1.1) and the *Abutilon austro-africanum – Acalypha indica* Sub-community (1.2). A moderate degree of veld degradation was observed during the time of the study. This includes bare patches in the vegetation

cover and compaction of the soil surface. Although this sub-community is not overgrazed as a whole, there are certain areas that are overgrazed to a lesser or greater degree. The rockiness of the soil surface is 2% on average with one isolated case of 40%.

The grass species *Eragrostis nindensis* and the forbs *Sanseviera* species and *Commelina africana* are diagnostic to this sub-community (Species group F, Table 2). Species, which differentiate this sub-community through high cover abundance values, include the tree species *Boscia foetida, Terminalia prunioides* (Species group I, Table 2) and *Commiphora pyracanthoides* (Species group O, Table 2), the grasses *Tragus berteronianus* (Species group O, Table 2) and *Brachiaria deflexa* (Species group P, Table 2) as well as the annual forb *Tribulus zeyheri* subsp. *zeyheri* (Species group O, Table 2).

The crown cover of the tree layer is relatively high with an average height of 4.4 m and a varying cover of 30 to 68%. The shrub layer is dominated by *Colophospermum mopane* (Species group A, Table 2) and reaches an average height of 1.6 m and covers between 12 and 48% of this sub-community. The herbaceous layer is well developed with an average height of 0.9 m and a crown cover of between 50 and 90%.

1.5 The *Commiphora mollis – Grewia bicolor* Sub community

This sub-community is found on shallow sandy and loamy soils of the Hutton, Mispah, Glenrosa, and Oakleaf soil forms. A foot slope (TU4) and floodplain (TU5) dominate the landscape of this sub-community. The area is not heavily grazed and trampled and as a result the veld-condition was good. The rocky soil surface showed few signs of compaction and no evidence of erosion.

Diagnostic species of the *Commiphora mollis – Grewia bicolor* Sub community are found in Species group G (Table 2). These diagnostic species include the tree species *Commiphora mollis, C. tenuipetiolata* and *Kirkia acuminata* as well as the forbs *Seddera suffruticosa* and *Kyphocarpa angustifolia*. The woody species *Grewia bicolor* (Species group A, Table 2), which mainly occurs in shrub form, the grass species *Aristida congesta* subsp. *congesta* (Species group R, Table 2) and the forb species *Indigastrum costatum* subsp. *macrum* (Species group M, Table 2) are all differential to this sub-community. Similarities between this sub-community and the *Boscia foetida – Commiphora pyracanthoides* Sub-community (1.4) is found in the form of the species of Species group H (Table 2).

The tree layer reaches an average height of 4.8 m and a crown cover of 25 to 60%. The shrub layer covers between 30 and 40% and has an average height of 1.5 m, while the herbaceous layer reaches heights of 0.9 m and a crown cover varying between 40 and 80%.

1.6 The *Salvadora australis - Sporobolus ioclados* Sub-community

This sub-community mostly occurs on the floodplain (TU5) and to a lesser extent on the foot slope (TU4) of the Db218 land type. Shallow, compacted Hutton, Glenrosa and Oakleaf soil forms dominate the soils in this sub-community. The area is overgrazed and many signs of degradation are present. These degradation signs include large bare areas in the herbaceous layer and head and surface erosion in and around the drainage courses, which cross the area.

There are no diagnostic species for this sub-community. It is distinguished from the other sub-communities in the *Colophospermum mopane* Community (1) by the absence of Species groups B – H (Table 2) and specifically from the *Barleria sinensis – Cyathula orthacantha* Sub-community (1.7) by the presence of the species of Species groups I, J and K (Table 2) and the absence of Species group L (Table 2).

The tree layer reaches an average height of 3.7 m and covers between 10 and 60% of the area. The shrub layer, which in some instances dominates the tree layer, has an average height of 1.6 m and a varying crown cover of 25 to 65%. The herbaceous species have a crown cover varying between 40 and 80% and an average height of 0.7 m.

The presence of the grass species *Setaria verticillata* (Species group U, Table 2) further confirms that the area is degraded to a certain degree as this grass species commonly flourishes on disturbed soils (Van Oudtshoorn, 1999).

1.7 The *Barleria sinensis – Cyathula orthacantha* Sub-community

This sub-community is situated on the floodplain (TU5) of this land type in and around non-perennial streams. The soils found in this sub-community vary from deep to moderately deep Hutton, Oakleaf and Swartland soil forms. In some cases it was found that a layer of alluvial sand had been washed over the soils surrounding the drainage courses. The area is extremely trampled due to the fact that game frequently graze in the area and seek it out for shelter during the heat of the day and at night. In spite of the intense trampling, this sub-community does not appear to be much degraded. Rockiness of the soil surface is limited to alluvial gravel.

Diagnostic species of the *Barleria sinensis – Cyathula orthacantha* Sub-community are found in Species group L (Table 2). These include the woody species *Balanites pedicellaris, Acacia nebrownii*, the shrub species *Peristrophe cliffordii* and *Grewia flava,* the grass species *Enteropogon macrostachyus, Chloris roxburghiana* and *Bothriochloa insculpta* and the forb species *Barleria sinensis* and *Justicia protracta* subsp. *rhodesiana.* The absences of the species of Species groups I, J and K further differentiate this sub-community from most of the other sub-communities in the *Colophospermum mopane* Community (1).

Large specimens of *Colophospermum mopane*, which dominates the shrub layer by a big margin, dominate the tree layer. The tree layer reaches an average height of 5.8 m and covers between 55 and 70% of the area. The shrub layer is poorly developed and

covers only 2 to 15% of the sub-community at an average height of 1.6 m. The well-developed herbaceous layer has an average height of 0.8 m and a crown cover varying between 50 and 85%.

2. The *Salvadora australis – Acacia stuhlmannii* Community

This community is commonly found on the foot slope (TU4) and floodplain (TU5) of the Db218 land type. The soil forms found in this community vary from moderate deep Hutton to moderate deep to shallow Oakleaf and Swartland soils. The soils are generally silt and clay rich with a compacted soil surface. The rockiness of the soil surface varies from having no rocks to a percentage of rockiness as high as 50%. As a whole the *Salvadora australis – Acacia stuhlmannii* community is overgrazed and trampled and as a result is degraded to a certain degree with signs of erosion in certain heavier disturbed areas.

The diagnostic species of this community are found in Species group M (Table 2), and include the tree species *Acacia stuhlmannii*, the grass species *Enneapogon desvauxii* and the forb species *Indigastrum costatum* ssp *macrum* and *Trianthema triquetra*. Species group R (Table 2) shows affinities between the *Colophospermum mopane* Community (1) and the *Salvadora australis – Acacia stuhlmannii* Community (2).

Based of upon habitat and structural differences, three sub-communities were identified in the *Salvadora australis – Acacia stuhlmannii* Community:

2.1 The *Cyathula lanceolata – Tragus berteronianus* Sub-community

2.2 The *Setaria verticillata – Urochloa mosambicensis* Sub-community

2.3 The *Chloris virgata – Boerhavia erecta* Sub-community

2.1 The *Cyathula lanceolata – Tragus berteronianus* Sub-community

This sub-community is found on the floodplain (TU5) of the Db218 land type on clayey and silt-rich Swartland and Oakleaf soil forms and is situated in and around drainage courses on the eastern part of the farm Riedel in the Vhembe-Dongola National Park. The area appears to be highly overgrazed and the soil surface compacted by a large degree of trampling. A thick soil surface crust, which prevents proper penetration of water during a rain event, and thus promotes surface run-off of rainwater is a further degrading factor observed in this sub-community. There are also large bare patches to be found in the vegetation cover. The soil surface is rocky with a rockiness percentage of between 10 and 50%. The stones on the soil surface are mostly large rounded pebbles.

The diagnostic species to this community are found in Species group N (Table 2) and include the grass species *Eragrostis rigidior* and the forb *Zygophyllum simplex*. The species of Species group O (Table 2) differentiate this sub-community from the *Setaria*

verticillata – Urochloa mosambicensis Sub-community (2.2) and the *Chloris virgata – Boerhavia erecta* Sub-community (2.3). These species include, amongst others, the tree species *Sesamothamnus lugardii* and *Commiphora pyracanthoides*, the shrubby *Asparagus laricinus*, the grass species *Tragus berteronianus* and the annual forb *Tribulus zeyheri* subsp. *zeyheri*. Other species, which are differential in this sub-community through their presence or high cover abundance values, include the woody species *Colophospermum mopane* (Species group A, Table 2), the grass species *Sporobolus ioclados* (Species group P, Table 2) and the forb *Cyathula lanceolata* (Species group U, Table 2). Other species, which are important due to their absence or low occurrence in this sub-community but are present in the other two sub-communities of the *Salvadora australis – Acacia stuhlmannii* Community (2), are the grass species *Setaria verticillata* and the forbs *Abutilon grandiflorum* and *Cyathula orthacantha* (Species group U, Table 2).

The tree layer has an average height of 2.9 m and a crown cover varying between 10 and 35%. The shrub layer also covers between 10 and 35% of the area and reaches an average height of 1.6 m. The herbaceous layer is sparse with a crown cover ranging from 30 to 55% and an average height of 0.5 m.

2.2 The *Setaria verticillata – Urochloa mosambicensis* Sub-community

This sub-community occurs in dry streambeds bisecting the floodplain (TU5) of the Db218 land type. It mainly occurs on the eastern part of the farm Riedel in the Vhembe-Dongola National Park. The main soil form is clayey silt-rich Oakleaf soils of which the surface is compacted in places. This sub-community is not as badly overgrazed as the *Cyathula lanceolata – Tragus berteronianus* Sub-community (2.1). It is, however, trampled by game, which seek shelter in the higher tree cover of this sub-community. As a whole the *Setaria verticillata – Urochloa mosambicensis* Sub-community (2.2) is moderately disturbed. The average rockiness of the soil surface is less than 10%.

There are no diagnostic species in this sub-community. It is however differentiated by the absence of the species of Species groups N, O and Q (Table 2). Species group P (Table 2) indicates a similarity concerning species composition of the *Cyathula lanceolata – Tragus berteronianus* Sub-community (2.1) and the *Setaria verticillata – Urochloa mosambicensis* Sub-community (2.2) and some of the sub-communities of the *Colophospermum mopane* Community (1).

The tree layer is better developed than that of the *Cyathula lanceolata – Tragus berteronianus* Sub-community (2.1) and the *Chloris virgata – Boerhavia erecta* Sub-community (2.3). The trees in this sub-community have an average height of 3.7 m and covers between 30 and 60 % of the area. The shrub layer covers between 20 and 50% and has an average height of 1.9 m. The herbaceous layer shows an average height of 0.6 m and a crown cover varying between 60 and 70%.

2.3 The *Chloris virgata – Boerhavia erecta* Sub-community

This sub-community is found on the farm Den Staat in the Vhembe-Dongola National Park on the foot slope (TU4) and floodplain (TU5) of the Db 218 land type. Loamy to clayey, silt-rich Oakleaf and Hutton soil forms dominate the soils of this area. It was observed that calcareous concretions covered the soil surface in certain localities. The area is heavily grazed and trampled by game and the soil surface is compacted to a large degree. Bare patches and surface erosion are further evidence of the degree of degradation in this sub-community.

Diagnostic species for this sub-community are found in Species group Q (Table 2). These include the grass species *Chloris virgata* and *Eragrostis racemosa* and the forb species *Boerhavia erecta, Leucas sexdentata, Megalochlamys revoluta* subsp. *cognata, Ipomoea sinensis* subsp. *blepharosepala* and *Tribulus terrestris* as well as the invasive alien species *Flaveria bidentis*. Other species with higher cover abundance in this sub-community than in the other two sub-communities of the *Salvadora australis – Acacia stuhlmannii* Community (2), are the forb species *Cucumis zeyheri, Heliotropium ovalifolium* (Species group V, Table 2), *Sida rhombifolia* and *Acanthospermum hispidum* (Species group T, Table 2) as well as the species of Species group R (Table 2). The absence of the species of Species group P (Table 2) further distinguishes this sub-community from, the *Cyathula lanceolata – Tragus berteronianus* (2.1) and *Setaria verticillata – Urochloa mosambicensis* Sub-communities (2.2).

The tree layer is characterized by bush-clumps with an average height of 2.7 m and a crown cover varying between 10 and 30%. The shrub layer is poorly developed and has an average height of 0.9 m and a crown cover in the region of 5 to 15%. The herbaceous layer covers between 50 and 80% of the area of the sub-community and reaches an average height of 0.4 m.

3. The *Salvadora australis – Acacia grandicornuta* Community

This community is found in dry streambeds and directly adjacent areas on the floodplain (TU5) of the Db218 land type. The soil forms found in this community are shallow to moderately deep clayey Arcadia, Valsrivier and Sepane soils. Because of the high clay contents of the soil cracks appear on the soil surface. The area is moderately grazed and heavily trampled by game, which seek out the dense tree cover for shelter against the elements. It may be worth mentioning that this area is usually flooded during wet periods.

The diagnostic species to this community are found in Species group S (Table 2), and include the tree species *Acacia grandicornuta* and *A. nigrescens*, the shrub *Lycium cinereum*, the grass species *Brachiaria eruciformis* and the forb species *Abutilon ramosum, Justicia flava* and *Melhania rehmannii*. Other species of this community with high cover abundance values than in the other two communities of the Db218 land type are the grass species *Panicum maximum* (Species group V, Table 2) and the forb

Cyathula orthacantha (Species group U, Table 2). The absence of the species of Species group M (Table 2) further differentiates this community from the other communities in this land type. The *Salvadora australis – Acacia grandicornuta* Community (3) is similar to the *Salvadora australis – Acacia stuhlmannii* Community (2) with regard to the species of Species groups T and U (Table 2), but they differ greatly with respect to habitat factors such as soil texture, soil forms and to where they are situated with regard to terrain units. These species include the tree species *Salvadora australis* and the grass *Setaria verticillata.*

The tree layer covers between 40 and 60% of this community and reaches an average height of 4.0 m. The shrub layer has an average height of 1.6 m and a crown cover varying between 15 and 35%. The herbaceous layer reaches an average height of 0.6 m and covers between 60 and 80% of the community area.

3.3 ORDINATION

A scatter diagram (Figure 5) of a DECORANA ordination is used in an attempt to show possible environmental gradients and relationships between the different communities and sub-communities of the Db218 land type.

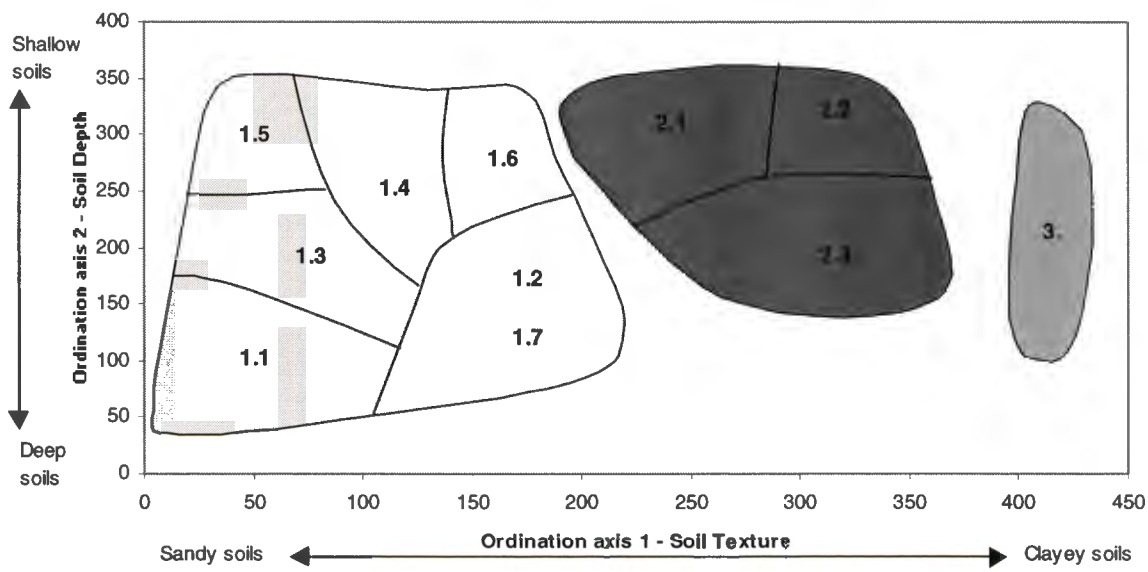


Figure 5. The relative positions of the communities and sub-communities along the first two axes of the ordination of the relevés sampled in the Vhembe-Dongola National Park on the **Db218 land type.**

A discontinuity is recognized between the three communities identified in the Db218 land type along ordination axis one of the scatter diagram (Figure 5). Discontinuity between the different sub-communities of the *Colophospermum mopane* Community (1) and the *Salvadora australis – Acacia stuhlmannii* Community (2) is evident along both of the ordination axes. The gradient illustrated along the first ordination axis could be ascribed to difference in soil texture with sandy soils to the left of the diagram and clayey soils to the right. The second ordination axis illustrates a gradient of soil depth with deeper soils lying at the bottom and shallower soils at the top of the scatter diagram (Figure 5).

The *Colophospermum mopane* Community (1), which lies on the left of the diagram, is associated with sandy to loamy soils with varying depth. The *Salvadora australis – Acacia stuhlmannii* Community (2), which lies in the middle of the diagram, is associated with loamy to clayey soils, which are moderately deep to shallow. The *Salvadora australis – Acacia grandicornuta* Community (3) is presented on the far right of the scatter diagram and is found only on soils with high clay content on moderately deep to shallow soils.

3.4 CONCLUSIONS

Some of the vegetation types described in the Db218 land type is similar to others previously described.

With exception of the *Salvadora australis - Sporobolus ioclados* Sub-community (1.6), the *Colophospermum mopane* Community (1) is similar to a plant community described by Timberlake and Mapaure (1999). The *Colophospermum – Terminalia* Woodland/Shrubland Vegetation Type, which is divided into two main sub-types: (a) The *Colophospermum – Terminalia* Shrubland and (b) the *Colophospermum – Terminalia – Commiphora* Woodland, is similar to the *Colophospermum mopane* Community (1) and most of its sub-communities with respect to habitat and vegetation composition.

In a phytosociological synthesis of the Mopaneveld, performed by Du Plessis (2001), the *Eragrostis viscosa – Colophospermum mopane* major plant community, which is found within the *Boscia foetida – Colophospermum mopane* vegetation type, shows similarities to the habitat and vegetation of the *Digitaria eriantha – Schmidtia pappophoroides* Sub-community (1.1) described in this study. The *Leucosphaera bainesii - Colophospermum mopane* major plant community, also found in the *Boscia foetida – C. mopane* vegetation type as well as the *Commiphora glandulosa – Enneapogon cenchroides* Community, which is found in the *Acacia nigrescens – C. mopane* major community, shows similarities toward the vegetation and habitat of the *Boscia foetida – Commiphora pyracanthoides* (1.4) and the *Commiphora mollis – Grewia bicolor* Sub communities (1.5) described in the current study.

In a vegetation report of the area, which was performed by the former South African Defence Force (SADF, 1986b), the *Colophospermum mopane* Community (1) is described under a number of vegetation units ranging from a Pure *C. mopane* Veld to a

Mixed *C. mopane*, *Combretum apiculatum*, *Commiphora* spp. and *Terminalia prunioides* Veld.

The *Salvadora australis* - *Sporobolus ioclados* Sub-community (1.6), the *Salvadora australis – Acacia stuhlmannii* Community (2) and the *Salvadora australis – Acacia grandicornuta* Community (3) all show similarities towards the habitat and vegetation composition of the *Salvadora australis* veld described in the vegetation report of the former South African Defence Force (SADF, 1986b).

CHAPTER 4

CLASSIFICATION AND DESCRIPTION OF THE VEGETATION OF THE IA155 LAND TYPE OF THE VHEMBE DONGOLA NATIONAL PARK

4.1 INTRODUCTION

The vegetation of the Ia155 land type (Figure 6) is mainly situated in the riparian zone along the banks of the Limpopo River and its side-branches. The Ia155 land type (Figure 6) also occurs in and around most other water systems such as pans and wetlands in the area. The geology of the Ia155 land type consists of sand and alluvium from the Quaternary System (Land Type Survey Staff, 2000). Deep red/brown, alluvial soil forms (Oakleaf) and some duplex soils (Valsrivier & Arcadia) dominate the soil types of this land type. Only two terrain units are specified for the land type along the banks of the Limpopo River. These are floodplains (TU4.1), river banks (TU4.2) and drainage lines (TU5). A total of 194 plant species were identified in the Ia155 land type.

The riparian zone is the area of land adjacent to a stream or river, which is, at least periodically, influenced by fluctuations of the water level (Mitsch & Gosselink, 1986; Rogers, 1995). Three major features separate riparian ecosystems from other wetland ecosystem types (Brinson *et al.*, 1981):

- They have a linear form as a consequence of their proximity to rivers and they form a boundary between the terrestrial and aquatic ecosystems.
- Energy and materials from the surrounding landscape converge and pass through riparian ecosystems in greater amounts per unit area than with any other ecosystem
- Riparian ecosystems are connected hydrologically to both upstream and down stream ecosystems, at least intermittently.

Furthermore, riparian zones warrant special attention since their positioning in the landscape ensures that they play direct roles in the functioning of both the river system and the terrestrial landscape and are one of the major centers of biodiversity in the global context (Naiman *et al.*, 1993). The narrow spatial dimensions and open endedness of riparian wetlands make them highly sensitive to landscape changes, with major consequences to the river ecosystems which they buffer from terrestrial influences (Naiman & Décamps, 1990; Holland & Risser, 1991; Rogers, 1995).

Of all the land types in the Vhembe-Dongola National Park it seems as if the Ia155 land type is by far the most disturbed. This is mainly due to the high fertility of the soils, the extensiveness of the landscape and the consequent establishment of irrigation lands. Over-utilization in this land type comes in the form of small and large livestock as well

Northern Province

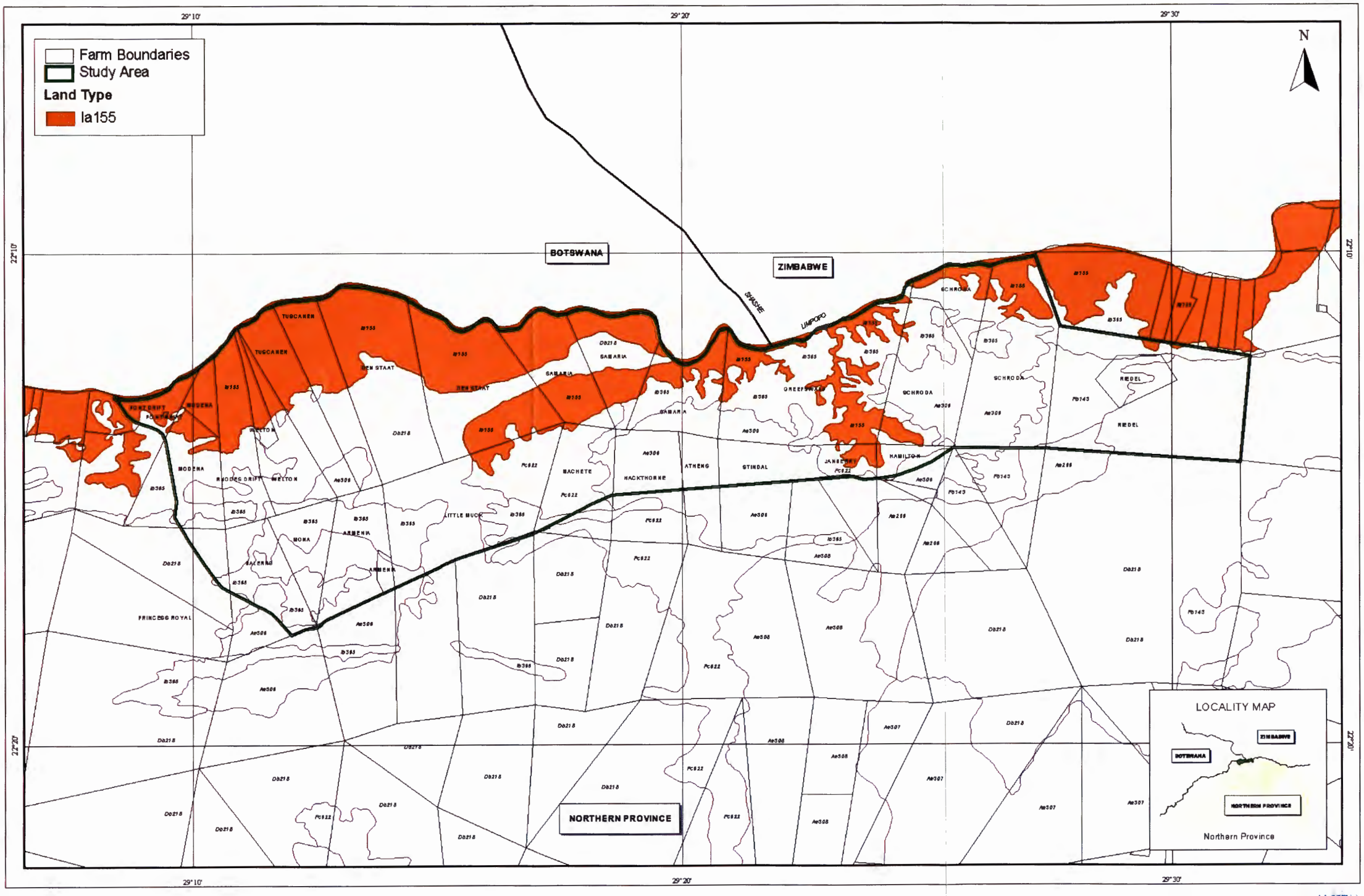


FIGURE 6 : Ia 155 LAND TYPE OF THE VHEMBE-DONGOLA NATIONAL PARK

Fig 6.

as elephants. In some places the destruction caused by migratory Tuli Elephants, from neighboring Botswana, is cause for concern.

The following four communities were distinguished in the Ia155 land type:

1. The *Salvadora australis – Cucumis zeyheri* Community
2. The *Hyphaene petersiana – Acacia tortilis* Community
3. The *Croton megalobotrys – Combretum microphyllum* Community
4. The *Diplachne fusca – Acacia xanthophloea* Community

4.2 DESCRIPTION OF PLANT COMMUNITIES

1. The *Salvadora australis – Cucumis zeyheri* Community

This community mostly occurs on the floodplain (TU4.1), toward the outskirts of the lush riverine forest belt found along the main river systems in the study area. A wide spectrum of soil types was found, with Oakleaf being the dominant soil form, with Hutton, and Valsrivier soil forms in close support. With the exception of one sub-community, the soils that are found in this community have a high silt and moderate clay content.

This community is situated higher above the annual flood level than its neighboring communities, and as a result appears to be drier. The slight slope is generally in the main direction leading towards the Limpopo River. A further observation was that the soil surface is compacted through years of overgrazing by cattle and a large number of game that frequent the area, and therefore a high degree of surface runoff is apparent. In some extreme cases this has led to a degree of surface erosion.

The vegetation of the *Salvadora australis – Cucumis zeyheri* Community varies between open woodland, thickets and forests. The diagnostic species of this community are found in Species group A (Table 3), and include the forbs *Cucumis zeyheri, Boerhavia erecta, Heliotropium ovalifolium, Phyllanthus parvulus* and *Ipomoea sinensis* subsp. *blepharosepala*. *Salvadora australis* (Species group K, Table 3) and the herbaceous *Cucumis zeyheri*, *Boerhavia erecta* (Species group A, Table 3) and *Setaria verticillata* (Species group P, Table 3) dominate the vegetation of this community. The absence of the species that are found in Species group O (Table 3) differentiates this community from most of the other communities in the Ia155 land type.

Three sub-communities were identified in this community:

1.1 The *Colophospermum mopane – Eragrostis trichophora* Sub-community.

1.2 The *Indigastrum costatum* subsp. *maculata – Setaria verticillata* Sub-community.

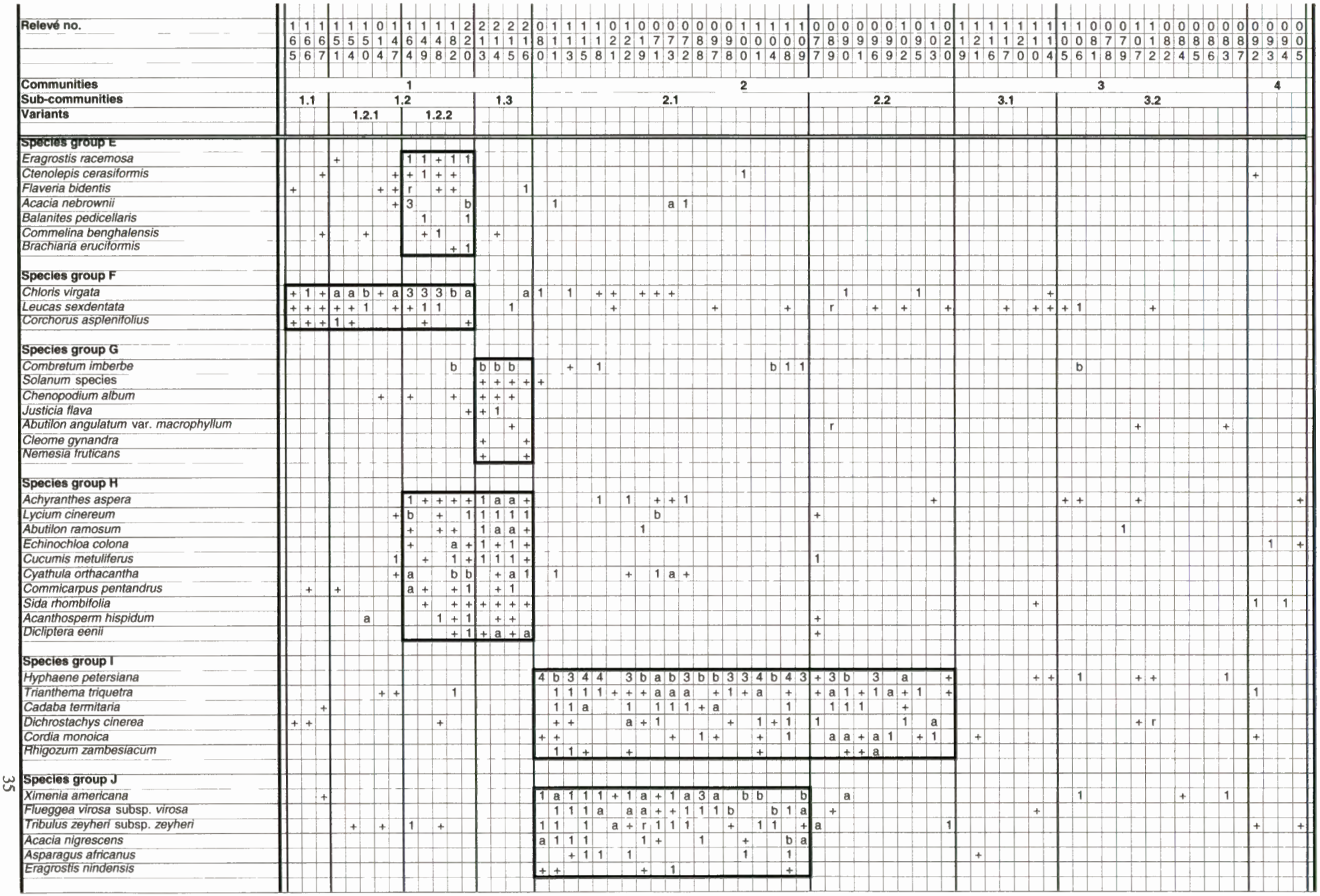
1.3 The *Combretum imberbe – Abutilon ramosum* Sub-community.

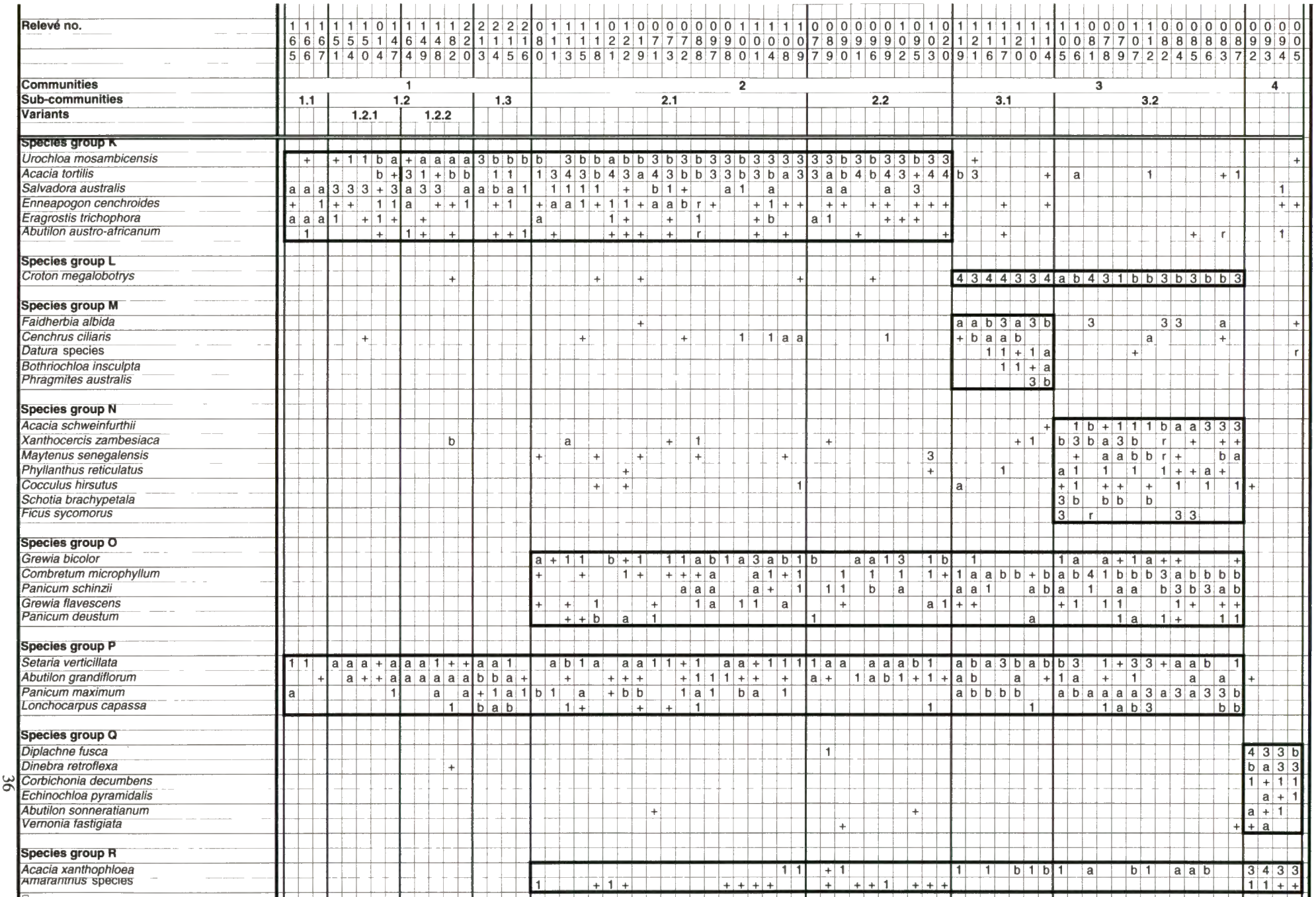
TABLE 3: PHYTOSOCIOLOGICAL TABLE OF THE VEGETATION OF THE IA155 LAND TYPE IN THE VHEMBE-DONGOLA NATIONAL PARK

TURBOVEG no.	50983	50984	50985	50970	50973	50990	50866	50993	50982	50991	50992	50994	51035	51028	51029	51030	51031
Relevé no.	165	166	167	151	154	150	014	147	164	149	148	182	220	213	214	215	216
No. of species per releve	38	35	33	28	21	23	24	37	30	32	32	38	33	24	32	34	28
Communities	1																
Sub-communities	1.1			1.2										1.3			
Variants				1.2.1					1.2.2								
Species group A																	
Cucumis zeyheri	1	1	1	1		1	+	a	1	a	a	b	1	a	1	+	
Boerhavia erecta	+	+		a	a			b	1	b	a	a	a	1	1	+	1
Heliotropium ovalifolium		+	1	1		a		+	1	+	+	+		a	a	b	+
Phyllanthus parvulus			+	+				+	+	+	+	+	+			+	
Acalypha indica	1	+	1			+		1		+	+				+	+	
Ipomoea sinensis subsp. *blepharosepala*	+				+	+	+	+	+	+	+			+	+	+	
Pupalia lappacea	+	+						+			+		+		+		
Pergularia daemia var. *daemia*			+						1							+	+
Acacia grandicornuta			3														3
Species group B																	
Colophospermum mopane	4	4	4														1
Aristida adscensionis	1	1	1													+	
Brachiaria deflexa	+	+	+											+			
Hibiscus micranthus	+	+	+						+								+
Tragus berteronianus	+	+	+	+													
Eragrostis lehmanniana		a	a								+						
Aptosimum lineare	1		+	+													
Phyllanthus angolensis	+		+														
Becium filamentosum	+	+															
Melhania rehmannii		+	+														
Sida species	+	+										+					
Species group C																	
Indigastrum costatum subsp. *macrum*				+	3	b	1	3	+	a	a		+				
Tribulus terrestris		+		+		+		+		1	+	+	+				
Kedrostis limpompensis		+		+				+		+	+		+				
Species group D																	
Aristida congesta subsp. *congesta*	3	3	a	b	b	b	+	+									
Hermbstaedtia odorata	+	1	+	+	+	+	1	+									
Unknown species	+	1	+	a	+	+		1		+							
Dicoma tomentosa	1	a	1		+	b		+									
Geigeria burkei subsp. *fruticulosa*	1	1	1			1	+	1									
Geigeria acaulis	+	+		+		+											

TURBOVEG no.	50818	50849	50851	50853	50856	50869	50860	50867	50871	50873	51041	50826	50835	50836	50838	50839	50842	50846	50847	50874	50827	50828	50829	50834	50837	50840	50833	50841	50868
Relevé no.	080	111	113	115	118	021	122	019	071	073	072	088	097	098	100	101	104	108	109	077	089	090	091	096	099	102	095	103	020
No. of species per releve	25	24	27	23	23	25	32	33	28	30	24	21	19	12	18	20	22	28	24	27	25	18	13	17	16	19	16	22	28
Communities	2																												
Sub-communities	2.1																			2.2									
Variants																													
Species group A																													
Cucumis zeyheri																													
Boerhavia erecta																													
Heliotropium ovalifolium																							+	1					
Phyllanthus parvulus																													
Acalypha indica											+																		
Ipomoea sinensis subsp. *blepharosepala*																													
Pupalia lappacea																													
Pergularia daemia var. *daemia*																													
Acacia grandicornuta																													
Species group B																													
Colophospermum mopane	+																1	+		a			+						
Aristida adscensionis			+																										
Brachiaria deflexa						+					+		a						+		+								+
Hibiscus micranthus																													+
Tragus berteronianus						1			+	+			+												+		1		
Eragrostis lehmanniana						+											+		+	+	+				+			+	+
Aptosimum lineare																													
Phyllanthus angolensis																													
Becium filamentosum																													
Melhania rehmannii																													
Sida species																													
Species group C																													
Indigastrum costatum subsp. *macrum*						+		+	+											b									+
Tribulus terrestris																													
Kedrostis limpompensis																													
Species group D																													
Aristida congesta subsp. *congesta*	1	a				+	+			+								+											
Hermbstaedtia odorata		+		+		1														+						1		+	+
Unknown species																													
Dicoma tomentosa																													
Geigeria burkei subsp. *fruticulosa*																													
Geigeria acaulis																													

TURBOVEG no.	50857	50859	50854	50855	50858	50848	50852	50843	50844	50819	50816	50817	50845	50850	50820	50822	50823	50824	50821	50825	50830	50831	50832	50863
Relevé no.	119	121	116	117	120	110	114	105	106	081	078	079	107	112	082	084	085	086	083	087	092	093	094	005
No. of species per releve	13	15	09	13	12	18	18	20	20	09	17	16	19	16	12	18	14	12	22	16	18	12	16	24
Communities	3																				4			
Sub-communities	3.1							3.2																
Variants																								
Species group A																								
Cucumis zeyheri																					1	+		+
Boerhavia erecta																								
Heliotropium ovalifolium																					+	+	+	+
Phyllanthus parvulus																								
Acalypha indica												+												
Ipomoea sinensis subsp. *blepharosepala*																								
Pupalia lappacea																								
Pergularia daemia var. *daemia*																								
Acacia grandicornuta																								
Species group B																								
Colophospermum mopane																								
Aristida adscensionis																								
Brachiaria deflexa																								
Hibiscus micranthus																								
Tragus berteronianus																						+	1	
Eragrostis lehmanniana																								
Aptosimum lineare																								
Phyllanthus angolensis																								
Becium filamentosum																								
Melhania rehmannii																								
Sida species																								
Species group C																								
Indigastrum costatum subsp. *macrum*																								
Tribulus terrestris																								
Kedrostis limpompensis																								
Species group D																								
Aristida congesta subsp. *congesta*																								
Hermbstaedtia odorata																								
Unknown species																								
Dicoma tomentosa																								
Geigeria burkei subsp. *fruticulosa*																							+	
Geigeria acaulis																								


Relevé no.
Communities
Sub-communities
Variants
Species group E
Eragrostis racemosa
Ctenolepis cerasiformis
Flaveria bidentis
Acacia nebrownii
Balanites pedicellaris
Commelina benghalensis
Brachiaria eruciformis
Species group F
Chloris virgata
Leucas sexdentata
Corchorus asplenifolius
Species group G
Combretum imberbe
Solanum species
Chenopodium album
Justicia flava
Abutilon angulatum var. macrophyllum
Cleome gynandra
Nemesia fruticans
Species group H
Achyranthes aspera
Lycium cinereum
Abutilon ramosum
Echinochloa colona
Cucumis metuliferus
Cyathula orthacantha
Commicarpus pentandrus
Sida rhombifolia
Acanthosperm hispidum
Dicliptera eenii
Species group I
Hyphaene petersiana
Trianthema triquetra
Cadaba termitaria
Dichrostachys cinerea
Cordia monoica
Rhigozum zambesiacum
Species group J
Ximenia americana
Flueggea virosa subsp. virosa
Tribulus zeyheri subsp. zeyheri
Acacia nigrescens
Asparagus africanus
Eragrostis nindensis


Relevé no.
Communities
Sub-communities
Variants
1
2
3
4
1.1
1.2
1.3
2.1
2.2
3.1
3.2
1.2.1
1.2.2
Species group K
Urochloa mosambicensis
Acacia tortilis
Salvadora australis
Enneapogon cenchroides
Eragrostis trichophora
Abutilon austro-africanum
Species group L
Croton megalobotrys
Species group M
Faidherbia albida
Cenchrus ciliaris
Datura species
Bothriochloa insculpta
Phragmites australis
Species group N
Acacia schweinfurthii
Xanthocercis zambesiaca
Maytenus senegalensis
Phyllanthus reticulatus
Cocculus hirsutus
Schotia brachypetala
Ficus sycomorus
Species group O
Grewia bicolor
Combretum microphyllum
Panicum schinzii
Grewia flavescens
Panicum deustum
Species group P
Setaria verticillata
Abutilon grandiflorum
Panicum maximum
Lonchocarpus capassa
Species group Q
Diplachne fusca
Dinebra retroflexa
Corbichonia decumbens
Echinochloa pyramidalis
Abutilon sonneratianum
Vernonia fastigiata
Species group R
Acacia xanthophloea
Amaranthus species

Relevé no.	1 1 1	1 1 1 0 1	1 1 1 1 2	2 2 2 2	0 1 1 1 1 0 1 0 0 0 0 0 0 0 0 1 1 1 1 1	0 0 0 0 0 0 1 0 1 0	1 1 1 1 1 1 1	1 1 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0
	6 6 6	5 5 5 1 4	6 4 4 8 2	1 1 1 1	8 1 1 1 1 2 2 1 7 7 7 8 9 9 0 0 0 0 0 0	7 8 9 9 9 9 0 9 0 2	1 2 1 1 2 1 1	0 0 8 7 7 0 1 8 8 8 8 8 8 9 9 9 0
	5 6 7	1 4 0 4 7	4 9 8 2 0	3 4 5 6	0 1 3 5 8 1 2 9 1 3 2 8 7 8 0 1 4 8 9	7 9 0 1 6 9 2 5 3 0	9 1 6 7 0 0 4	5 6 1 8 9 7 2 2 4 5 6 3 7 2 3 4 5
Communities	**1**				**2**		**3**	**4**
Sub-communities	**1.1**	**1.2**		**1.3**	**2.1**	**2.2**	**3.1**	**3.2**
Variants		**1.2.1**	**1.2.2**					
Other Species								
Tephrosia purpurea	+	+						
Acacia senegal var. *rostrata*	+							
Calostephane divaricata	+							
Commicarpus fallacissimus	+		+					
Holubia saccata	+							
Melinis repens	+							+
Crotalaria species	+							
Megalochlamys revoluta subsp. *cognata*		1 a						
Acacia stuhlmannii		1 +		+		1		
Sesamum triphyllum		+	+					
Enneapogon desvauxii		1			+			
Cyathula lanceolata		1						
Barleria transvaalensis		+			+			
Alternanthera pungens			+					
Leonotis leonurus			1	1				
Dactyloctenium aegyptium		1	+			+		
Ocimum americanum var. *americanum*			+					
Withania somnifera			+					
Dovyalis caffra			+					
Justicia matammensis			+					
Hermannia modesta								
Leucas neuflizeana								
Sporobolus ioclados		+ b			+			
Bidens pilosa				+				
Croton pseudopulchellus			+					
Eragrostis rigidior			+					
Waltheria indica				+				
Senecio species				+				
Ceratotheca triloba			+			r		
Commelina africana								
Stipagrostis uniplumis								
Tephrosia polystachya var. *polystachya*								
Terminalia prunioides					+ +			
Plumbago zeylanica					+ 1	+		
Aristida rhiniochloa					+ 1			
Vernonia cinerascens					1 1			
Dicoma zeyheri					a			
Gardenia volkensii					1			
Schmidtia pappophoroides					+			
Gymnema sylvestre					+			
Sterculia rogersii						+		
Acacia nilotica						+		
Albizia harveyi						+		
Decorsea schlechteri					+			
Boscia albitrunca					+	+ +		
Mollugo cerviana var. *spathulifolia*					+			
Commiphora pyracanthoides					+			
Sericorema sericea					+			
Aptosimum lugardiae					+			
Cordia grandicalyx					+ + 1			
Gisekia pharnacioides var. *pharnacioides*	+		+		+ r +			

Relevé no.	1 1 1	1 1 1 0 1	1 1 1 1 2	2 2 2 2	0 1 1 1 1 0 1 0 0 0 0 0 0 0 1 1 1 1 1	0 0 0 0 0 0 1 0 1 0	1 1 1 1 1 1 1	1 1 0 0 0 1 1 0 0 0 0 0 0	0 0 0 0
	6 6 6	5 5 5 1 4	6 4 4 8 2	1 1 1 1	8 1 1 1 1 2 2 1 7 7 7 8 9 9 0 0 0 0 0 0	7 8 9 9 9 9 0 9 0 2	1 2 1 1 2 1 1	0 0 8 7 7 0 1 8 8 8 8 8 8	9 9 9 0
	5 6 7	1 4 0 4 7	4 9 8 2 0	3 4 5 6	0 1 3 5 8 1 2 9 1 3 2 8 7 8 0 1 4 8 9	7 9 0 1 6 9 2 5 3 0	9 1 6 7 0 0 4	5 6 1 8 9 7 2 2 4 5 6 3 7	2 3 4 5
Communities	1				2			3	4
Sub-communities	1.1	1.2		1.3	2.1	2.2	3.1	3.2	
Variants		1.2.1	1.2.2						
Boscia foetida	1				+	+ a +			
Heliotropium species					+	a + +			
Verbesina encelioides var. *encelioides*						a			
Sida ovata						1			
Asparagus laricinus						+			
Litogyne gariepina						+			
Lagynias dryadum					+	+			
Maerua angolensis						1			
Solanum kwebense			+		+	+ + +			+
Ehretia rigida					+	+			
Grewia flava					+ a + +	a +			
Pseudognaphalium undulatum						+			
Pseudoconyza viscosa							+ +		
Hermannia glanduligera				+			+		
Combretum mossambicense					1			1	
Ziziphus mucronata					+			1	+
Cynodon dactylon							+		
Cordia sinensis								+ +	
Azanza garckeana								+	
Berchemia discolor								r	
Lannea schweinfurthii								+	
Megalochlamys hamata					+ + 1	+	1		
Barleria senensis						+	+		
Sclerocarya birrea								b a	
Momordica balsamina			+	+	+	+ + a		+ a	+
Grewia occidentalis							+ +		
Abutilon species									1
Cleome angustifolia						+			+
Corchorus olitorius									+
Hibiscus pusillus									+
Tragia rogersii									+
Xanthium strumarium									+
Solanum panduriforme	+		+			+			+
Datura ferox							+		
Conyza bonariensis									
Laggera decurrens									
Bulbostylis hispidula						+			
Sida chrysantha		+							
Leonotis species									

1.1 The *Colophospermum mopane – Eragrostis trichophora* Sub-community

This sub-community is situated on the very outskirts of the floodplain (TU4.1) of the Ia155 land type. It is situated on sandy Hutton soils with surface erosion clearly visible as there are usually drainage systems running off towards the Limpopo River, bisecting this vegetation unit.

Diagnostic species to this sub-community are found in Species group B (Table 3), which includes the tree species *Colophospermum mopane* the grass *Aristida adscensionis* and the forbs *Phyllanthus angolensis*, *Becium filamentosum* and *Melhania rehmannii*. The tree layer is dominated by *Colophospermum mopane* (Species group B, Table 3) and to a lesser extent *Salvadora australis* (Species group K, Table 3). The shrub layer is sparse. The grass species *Eragrostis trichophora* (Species group K, Table 3) and the annual grass *Aristida congesta* subsp. *congesta* (Species group D, Table 3) dominate the herbaceous layer. Herbaceous species with high cover abundance values, which distinguish this sub-community from the *Indigastrum costatum* subsp. *maculata – Setaria verticillata* sub-community (1.2) and the *Combretum imberbe – Abutilon ramosum* sub-community (1.3), are *Hibiscus micranthus* (Species group B, Table 3), *Geigeria burkei* subsp. *fruticulosa* (Species group D, Table 3) and *Eragrostis lehmanniana* (Species group B, Table 3).

The tree layer of this sub-community reaches heights of between 2.5 and 4.0 m and an average crown cover of 35%. The shrub layer (taken as woody species no higher than 2 m) has an average height of 1.4 meters and the cover varies between 10 and 35%. The herbaceous layer reaches an average height of 0.5 m and crown cover of between 45 and 65%.

1.2 The *Indigastrum costatum* subsp. *maculata – Setaria verticillata* Sub-Community

The soil forms occurring in this sub-community are Hutton, Oakleaf and Valsrivier. The sub-community is situated on a level floodplain (TU4.1) of which the soil surface gets trampled to a fine dust during the dry season. The area is targeted by high degree of grazing by game and, therefore the area shows signs of degradation through the appearance of bare patches in the grass layer.

The vegetation of this sub-community varies between open woodlands and thickets. The species that are diagnostic to this sub-community are found in Species group C (Table 3) and include *Indigastrum costatum* subsp. *maculata*, *Tribulus terrestris* and the scarce herbaceous climber *Kedrostis limpompensis*. The species of Species group F (Table 3) indicates a similarity between this sub-community and the *Colophospermum mopane – Eragrostis trichophora* Sub-community (1.1).

The tree layer of this sub-community reaches heights of between 2.2 and 8 m (in some cases higher than 8 m). The crown cover of the tree layer varies between 20 and 45%. The shrub layer has an average height of 1.4 m and the crown cover varies between 5 and 25%. The herbaceous layer is well developed with an average crown cover of 80% and heights varying from 0.2 to 0.9 m.

The *Indigastrum costatum* subsp. *maculata* – *Setaria verticillata* sub-community has two variants, which differ from each other with respect to soil types and vegetation structure:

1.2.1 The *Aristida congesta* – *Leucas sexdentata* Variant.

1.2.2 The *Eragrostis racemosa* – *Acacia tortilis* Variant

1.2.1 The *Aristida congesta* – *Leucas sexdentata* Variant

This variant comes in the form of open woodlands with *Salvadora australis* (Species group K, Table 3) occurring in bush-clumps. The soils that are found in this variant have a high silt content and consist of the Hutton and Oakleaf soil forms.

There are no diagnostic species to this variant. The absences of Species groups E and H (Table 3) as well as a low frequency of the tree species *Acacia tortilis* and the shrub *Abutilon austro-africana* (Species group K, Table 3) do, however, differentiate this variant. It is further distinguishable from the *Eragrostis racemosa* – *Acacia tortilis* Variant (1.2.2) by Species group D (Table 3) and the presence of the woody species *Acacia stuhlmannii*, the forb *Megalochlamys revoluta* subsp. *cognata* (Other species, Table 3) and a high abundance of the grass *Eragrostis trichophora* (Species group K, Table 3).

The tree cover of this variant is between 20, and 35%, and the height of the trees alternating between 2.2 to 4.0m. In some isolated places there is no tree cover at all. The shrub layer reaches an average height of 1.3 m and the crown cover varies between 5 and 20%. The herbaceous layer covers between 60 and 90% of the variant area and reaches an average height of 0.5 m.

1.2.2 The *Eragrostis racemosa* – *Acacia tortilis* Variant

This thicket variant of the *Indigastrum costatum* subsp. *maculata* – *Setaria verticillata* sub-community forms a boundary between the open woodlands of the *Aristida congesta* – *Leucas sexdentata* Variant (1.2.1) and the other riverine forest communities and sub-communities. The Valsrivier and Oakleaf soil forms found in this variant have high clay content and appear to be less dry compared to the open woodland communities.

The species of Species group E (Table 3) are diagnostic to this variant, which include the grass species *Eragrostis racemosa* and the forb *Ctenolepis cerasiformis*. A species with high abundance that further differentiate this variant from the *Aristida congesta* –

Leucas sexdentata Variant (1.2.1) is the woody species *Acacia tortilis* (Species group K, Table 3).

The vegetation cover of this variant is markedly higher than that of the *Aristida congesta – Leucas sexdentata* variant (1.2.1). *Salvadora australis* and *Acacia tortilis* (Species group K, Table 3) dominate the tree layer. The tree cover is 40% on average and it reaches heights of between 3.5 and more than 8 m. The shrub layer has an average height of 1.4 m with an average crown cover of 20%. The herbaceous layer has an average crown cover of 82% and reaches an average height of 0.5 m.

1.3 The *Combretum imberbe – Abutilon ramosum* Sub-community

This sub-community is situated in the riverine forest and in some cases on the fringes of the *Acacia xanthophloea - Diplachne fusca* Community (4) on the floodplain (TU4.1) of this land type. Soil forms include Valsrivier, Oakleaf and Arcadia. In most cases the aspect is towards the middle of the adjacent water system, the slope is usually not to steep (2 -5°) and the soil surface is normally free of rocks.

Tall *Combretum imberbe* (Species group G, Table 3), *Lonchocarpus capassa* (Species group P, Table 3) and to a lesser extent, *Acacia tortilis* (Species group K, Table2) trees and a high abundance of the shrub *Abutilon ramosum* (Species group H, Table2) and the grass *Urochloa mosambicensis* (Species group K, Table 3) dominate the vegetation in this sub-community. Diagnostic species of the *Combretum imberbe – Abutilon ramosum* Sub-community is found in Species group G (Table 3), which includes the tree species *Combretum imberbe* and the herbaceous *Solanum* species. The absence of the species that are found in Species group F (Table 3) differentiates this sub-community from the other two in the *Salvadora australis – Cucumis zeyheri* Community (1). Species with high cover abundance values that further differentiate this sub-community from the *Colophospermum mopane – Eragrostis trichophora* Sub-community (1.1) and the *Indigastrum costatum* subsp. *maculata – Setaria verticillata* Sub-community (1.2) are *Lycium cinereum* (Species group H, Table 3) in the woody component and the shrub *Abutilon austro-africanum* (Species group K, Table 3). The grasses *Echinochloa colona* (Species group H, Table 3) and *Panicum maximum* (Species group P, Table 3) and the forbs *Cucumis metuliferus* and *Dicliptera eenii* (Species group H, Table 3) also differentiate this sub-community.

Trees with an average height of more than 7 m and a crown cover of approximately 50% dominate the vegetation of this sub-community. The shrub layer reaches an average height of 1.4 m and the shrub cover varies between 5 and 30%. The herbaceous layer covers between 30 and 70% of the sub-community with an average height of 0.4 m.

2. The *Hyphaene petersiana – Acacia tortilis* Community

This community occurs on the flood plains (TU4.1) adjacent to the dense forest belt that occurs on the banks (TU4.2) of the main rivers in the area. Soils of the Oakleaf form are the main soil type found in this community, with a number of Arcadia and Valsrivier soils occurring on a more sporadic basis. The aspect and extremely gradual slope are mostly in a northerly direction as this is the general direction of the Limpopo River in respect to this community. Rockiness of the soil surface is 1 - 6% and the rocks and/or pebbles are often of a calcareous origin. This area is frequented by elephants and as a result is heavily utilized.

The diagnostic plant species of this community are found in Species group I (Table 3) and include the woody species *Hyphaene petersiana* and the forb *Trianthema triquetra.* Other species with high cover abundance values are *Acacia tortilis*, *Salvadora australis* (Species group K, Table 3) and *Grewia bicolor* (Species group O, Table 3) from the woody component as well as the grasses *Enneapogon cenchroides*, *Urochloa mosambicensis* (Species group K, Table 3) and *Setaria verticillata* (Species group P, Table 3).

The tree layer of this community covers between 10 and 60% of the area. The height of the tree layer varies between 3 and 9 m. The height of the shrub layer varies between 1.2 and 2.0 m and the crown cover between 10 and 60%. Grasses dominate the herbaceous layer. This layer has an average height of 0.5 m and a crown cover of between 37 and 82%.

This community is divided into two sub-communities:

2.1 The *Ximenia americana - Flueggea virosa* Sub-community

2.2 The *Cordia monoica* Sub-community

The vegetation of the two sub-communities mainly differs with regard to the structure of the vegetation. In the *Ximenia americana - Flueggea virosa* Sub-community (2.1) the shrub layer is dominant and in the *Cordia monoica* Sub-community (2.2) the tree layer is dominant.

2.1 The *Ximenia americana - Flueggea virosa* Sub-community

This sub-community covers the largest part of the *Hyphaene petersiana – Acacia tortilis* Community (2). The dominant soil forms are Oakleaf and Valsrivier with high silt content and a small number of the Arcadia soil form, which is a duplex soil with high clay content.

Diagnostic species of this sub-community are found in Species group J (Table 3) and include the woody species *Flueggea virosa* subsp. *virosa* and *Ximenia americana.* The dominant species are the tree species *Hyphaene petersiana* (Species group I, Table 3)

and *Acacia tortilis* (Species group K, Table 3) as well as the grass species *Urochloa mosambicensis* (Species group K, Table 3). Other species distinguishing this sub-community from the *Cordia monoica* Sub-community (2.2) is the woody *Acacia nigrescens* (Species group J, Table 3), the grass *Panicum maximum* (Species group P, Table 3) and the annual forb *Tribulus zeyheri* subsp. *zeyheri* (Species group J, Table 3).

The tree layer has an average height of 5 m (in some cases as high as 9 m) and the crown cover varies between 10 and 55%. The shrub layer on the other hand enjoys a crown cover of between 36 and 63% and an average height of 1.7 m. The herbaceous layer has an average height of 0.5 m and covers 38 to 80% of the sub-community area.

2.2 The *Cordia monoica* Sub-community

The habitat of this sub-community is in many ways similar to that of the *Ximenia americana - Flueggea virosa* Sub-community (2.1). The only difference being that this sub-community has established under drier conditions and mainly occurs on somewhat higher lying areas further away from the Limpopo River. The soils are also of the Oakleaf and Valsrivier forms with less occurrences of the Arcadia soil form.

There are no diagnostic species, which define this sub-community. The dominant species are *Acacia tortilis* and *Urochloa mosambicensis* (Species group K, Table 3) with *Hyphaene petersiana* (Species group I, Table 3) not as dominant as in the *Ximenia americana - Flueggea virosa* sub-community (3.1). Species that further differentiate this sub-community are the woody species *Cordia monoica* (Species group I, Table 3) and the absence of the tree species *Lonchocarpus capassa* (Species group P, Table 3) and the grasses *Panicum deustum* (Species group O, Table 3) and *P. maximum* (Species group P, Table 3).

In the *Cordia monoica* Sub-community (2.2) the tree layer dominates the shrub layer. The tree layer reaches an average height of 5 m and a crown cover of between 30 and 60% while the crown cover of the shrub layer varies between 10 and 45% and reaches an average height of 1.6 m. The herbaceous layer covers between 37 and 82% of the sub-community and has an average height of 0.4 m.

3. The *Croton megalobotrys - Combretum microphyllum* Community

This riverine community is mainly situated on the banks of the Limpopo River (TU4.2) and to a lesser extent on the floodplain (TU4.1). It is characterized by tall trees and sometimes a dense undergrowth of shrubs, climbers and various other forbs and grasses. The utilization by the Tuli elephants is of a big, but not totally destructive measure. The elephants trample the area as they frequent it, mainly for shelter at night. The soils of this unit consist of Oakleaf and Valsrivier soil forms. The aspect is once more chiefly in a northerly direction and the slope varies between gradual slopes (1-5°), leading from

the flood-plain unit to the river, and short steep inclines (10-20°) leading to the river itself.

The diagnostic species are found in Species group L (Table 3) and in this case it is the woody species *Croton megalobotrys*, which occurs in tree and shrub form. The woody species *Croton megalobotrys* (Species group L, Table 3), the creeper *Combretum microphyllum* (Species group O, Table 3) and the grass species *Panicum maximum* (Species group P, Table 3) dominate the vegetation of this community. Other species with high cover abundance values are the tree species *Acacia xanthophloea* (Species group R, Table 3) and the grass species *Setaria verticillata* (Species group P, Table 3) and *Panicum schinzii* (Species group O, Table 3). The community is further characterized by the absence of the species of Species groups I and K (Table 3) as well as the herbaceous *Amaranthus* sp. (Species group R, Table 3).

The *Croton megalobotrys - Combretum microphyllum* Riverine Community has a high tree layer with the height of the trees varying between 7.8 and 20.0 m and a crown cover of between 50 and 90%. The shrub layer has an average height of 1.6 m and covers between 18 and 68% of the total community area. The herbaceous layer reaches an average height of 0.7 m and a crown cover of between 8 and 90%.

This community is divided into two sub-communities:

3.1 The *Cenchrus ciliaris – Faidherbia albida* Sub-community.

3.2 The *Acacia schweinfurthii – Maytenus senegalensis* Sub-community.

3.1 The *Cenchrus ciliaris – Faidherbia albida* Sub-community

This sub-community is found on the riverbank (TU4.2) of the Ia155 land type. The dominant soil form is Valsrivier and to a lesser extent the Oakleaf soil form. The habitat differs from the *Acacia schweinfurthii – Maytenus senegalensis* Sub-community (3.2) because of it being more associated with low-lying areas that are frequently flooded during the annual flooding of the Limpopo River, and its side branches. In some areas a layer of alluvial sand and flood-debris cover the soil surface only to be disturbed and washed away during the next flooding.

The tree species *Faidherbia albida,* the grass species *Cenchrus ciliaris* and *Bothriochloa insculpta* and the herbaceous species *Datura* sp. and *Phragmites australis* are diagnostic to this sub-community (Species group M, Table 3). Tall, sometimes-dense trees dominate the vegetation of this sub-community, of which *Croton megalobotrys* (Species group L, Table 3) is by far the most dominant. Other species, which distinguish this sub-community from the *Acacia schweinfurthii – Maytenus senegalensis* Sub-community (3.2) through their absence or low abundance, are the tree species *Grewia bicolor, Grewia flavescens* (Species group O, Table 3) and *Lonchocarpus capassa* (Species group P, Table 3) and the grass species *Panicum deustum* (Species group O, Table 3).

The tree layer covers between 58 and 90% of this community and reaches a height of between 7.8 and 17.0 m. The shrub layer has an average height of 1.5 m and a crown

cover of between 18 and 60%. The herbaceous layer covers between 10 and 80% and has an average height of 0.5 m.

3.2 The *Acacia schweinfurthii – Maytenus senegalensis* Sub-community

The habitat of this sub-community is somewhat drier than that of the *Cenchrus ciliaris – Faidherbia albida* Sub-community (3.1). It is situated on the floodplain (TU4.1) and the riverbank (TU4.2) of the Ia155 land type on areas that are less frequently flooded. The soil forms are basically the same as in the *Faidherbia albida – Acacia xanthophloea* Sub-community (3.1) only with the Oakleaf soil form being more dominant than the Valsrivier soil form.

Diagnostic species to the *Acacia schweinfurthii – Maytenus senegalensis* sub-community are found in Species group N (Table 3). This includes the rambling woody species *Acacia schweinfurthii*, and the tree species *Xanthocercis zambesiaca, Maytenus senegalensis* and *Phyllanthus reticulatus* as well as the creeper *Cocculus hirsutus*. Tall trees with undergrowth, which proves to be impenetrable in places, dominate the vegetation of this sub-community. *Croton megalobotrys* (Species group L, Table 3) is less dominant in this sub-community and have lower cover abundance values than in the *Faidherbia albida – Acacia xanthophloea* Sub-community (3.1). Species, which further distinguish the *Acacia schweinfurthii – Maytenus senegalensis* Sub-community (3.2) from the *Cenchrus ciliaris – Faidherbia albida* Sub-community (3.1), are the tree species *Grewia bicolor, Grewia flavescens* (Species group O, Table 3) and *Lonchocarpus capassa* (Species group P, Table 3).

The tree layer of this sub-community covers between 50 and 88% of the area and the trees reach a height of between 8.0 and 20.0 m. The shrub layer has a higher crown cover in this sub-community than is the case in the *Cenchrus ciliaris – Faidherbia albida* Sub-community (3.1). The shrub layer covers between 30 and 63% of the sub-community and reaches an average height of 1.7 m. The herbaceous layer has an average height of 0.8 m and a crown cover varying between 8 and 90%.

4. The *Diplachne fusca – Acacia xanthophloea* Community

The *Diplachne fusca – Acacia xanthophloea* Community commonly occurs on heavy clayey duplex soils in non-perennial pans and wetlands (TU5) in the Ia155 land type. Soil types commonly found in these areas belong to the Rensburg, Arcadia, Valsrivier and Sepane soil forms. The soil surface, which is covered by cracks in the dry season, is mostly clear of rocks. Aspect and slope is of no great significance in this community. It can however be stressed that most of the wetland/pan systems in the area drain towards the Limpopo River.

The diagnostic species to this community are found in Species group Q (Table 3). They are the grasses *Diplachne fusca, Dinebra retroflexa, Echinochloa pyramidalis* and the

forbs *Corbichonia decumbens* and *Abutilon sonneratianum.* Dominant species are the woody species *Acacia xanthophloea* (Species group R, Table 3) and the grass *Diplachne fusca* (Species group Q, Table 3). The *Diplachne fusca – Acacia xanthophloea* Community is further characterized by the absence of the species found in Species groups O and P (Table 3), which occur in most of the other communities in this land type.

The tree layer has an average height of 8.2 m and a crown cover varying between 25 and 35%. The shrub layer is poorly developed with an average crown cover of only 3% and an average height of 1.0 m. The herbaceous layer on the other hand is well developed with an average height of 1.3 m and a crown cover varying between 60 and 90%.

4.3 ORDINATION

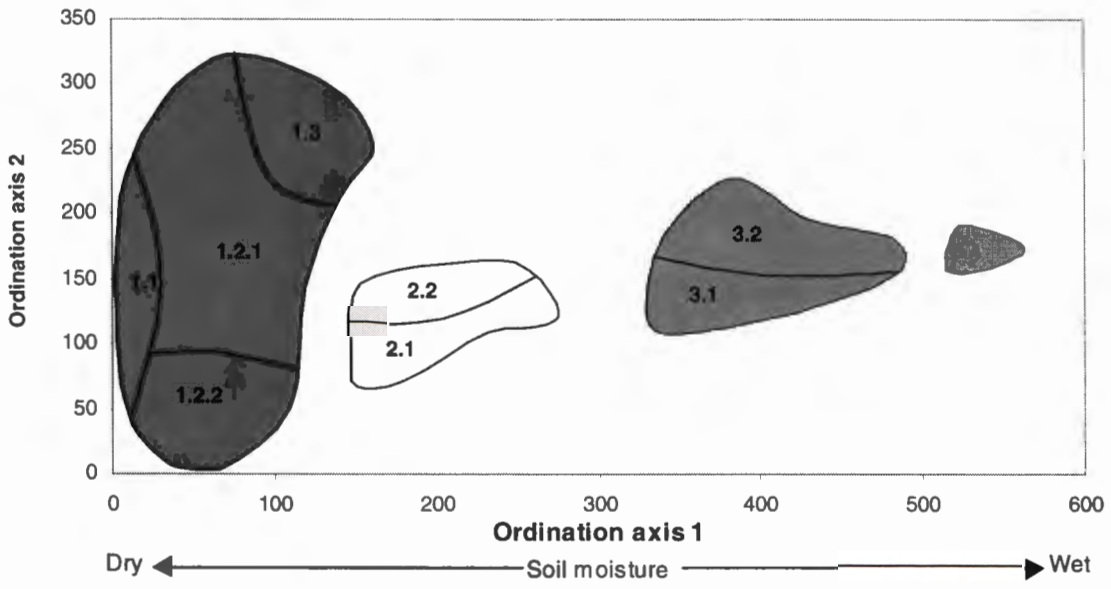


Figure 7. The relative positions of the communities and sub-communities along the first two axes of the ordination of the relevés sampled in the Vhembe-Dongola National Park on the **Ia155 land type.**

In the scatter diagram (Figure 7) the distribution of the relevés of the Ia155 land type along the first and second axes of the ordination is given. The distribution of the relevés

indicates a distinct discontinuity between the four communities identified in the Ia155 land type along ordination axis one of the scatter diagram. The gradient illustrated along the first ordination axis could be related to soil moisture.

The *Salvadora australis – Cucumis zeyheri* Community (1) is associated with flood plain areas on the outskirts of the riverine vegetation. On the scatter diagram (Figure 7) it is clear that the habitat of this community is virtually opposite to that of the *Acacia xanthophloea - Diplachne fusca* Community (4), with regard to the gradients stipulated along the first ordination axis. The *Acacia xanthophloea - Diplachne fusca* Community (4) is found in and around pans and other wetland systems in the Vhembe-Dongola National Park on soils that are waterlogged for a long period during the year. The *Croton megalobotrys - Combretum microphyllum* Community (3) is found on the very edge of the Limpopo River and its tributaries. In these parts the water table should certainly be higher than is the case further away from the river in the *Salvadora australis – Cucumis zeyheri* Community (1) and the *Hyphaene petersiana – Acacia tortilis* Community (2). This latter community is found on an area between the drier *Salvadora australis – Cucumis zeyheri* Community (1) and the wetter *Croton megalobotrys - Combretum microphyllum* Community (3).

4.4 CONCLUSIONS

Some of the vegetation types described in the Ia155 land type is similar to others previously described.

The vegetation and habitat of the *Salvadora australis – Cucumis zeyheri* Community (1) is similar to the *Salvadora australis* Veld described by SADF (1986b) in a vegetation report of the area to the former South African Defence Force. SADF (1986b) and SADF (1986a) did not distinguish between different communities in the riverine vegetation. The *Hyphaene petersiana –Acacia tortilis* Community (2) and the *Croton megalobotrys - Combretum microphyllum* Community (3) thus occurs in the same vegetation unit, which is referred to as Riverine vegetation, by SADF (1986a & b). SADF (1986b) described an *Eragrostis* Vlei Grass vegetation unit of which the habitat and vegetation compares well with the *Acacia xanthophloea - Diplachne fusca* Community (4).

The riverine vegetation is more accurately described by Timberlake & Mapaure (1999) than by SADF (1986a & b). The *Acacia/Faidherbia* Woodland Type described by Timberlake & Mapaure (1999) is further sub-divided into four sub-types namely: the *Faidherbia albida* Woodland, the *Xanthocercis – Scotia* Woodland, the *Acacia xanthophloea* woodland and the *Acacia tortilis* woodland. The *Faidherbia albida* Woodland shows similarities with the *Cenchrus ciliaris – Faidherbia albida* Sub-community (3.1) and the *Xanthocercis – Scotia* Woodland towards the *Acacia schweinfurthii – Maytenus senegalensis* Sub-community (3.2), which are both sub-communities of the *Croton megalobotrys - Combretum microphyllum* Community (3). In a phytosociological synthesis of the Mopane Veld Du Plessis (2001) described the *Croton megalobotrys – Colophospermum mopane* vegetation type. This vegetation type

and the *Croton megalobotrys - Combretum microphyllum* Community (3) described in the current study show similarities towards each other with respect to habitat and floristic composition.

The *Hyphaene petersiana –Acacia tortilis* Community (2) is comparable with the *Hyphaene* Shrubland and to a lesser extent to the *Acacia tortilis* woodland described by Timberlake & Mapaure (1999).

The dry pan and wetland areas in which the *Acacia xanthophloea - Diplachne fusca* Community (4) occur was not specifically described by Timberlake & Mapaure (1999). It does, however, to a certain degree, resemble the *Acacia xanthophloea* Woodland described by these researchers.

The habitats described in different vegetation types by Timberlake & Mapaure (1999) and the SADF (1986a & b) show similarities with the habitat descriptions of the different plant communities of the Ia155 land type in this study.

CHAPTER 5

CLASSIFICATION AND DESCRIPTION OF THE VEGETATION OF THE IB395 LAND TYPE OF THE VHEMBE-DONGOLA NATIONAL PARK

5.1 INTRODUCTION

The Ib395 land type (Figure 8) contains a unique habitat, which consists of rocky koppies with shallow lithosols of the Mispah and Glenrosa soil forms. The terrain occupied by this land type, is made up of ragged crest areas (TU1), vertical cliffs (TU2), foot slopes (TU3) and drainage areas at the very foot of the sandstone koppies (TU5). The geology is made up of sandstone and siltstone of the Clarens Formation of the Karoo Sequence (Land Type Survey Staff, 2000).

In the Vhembe-Dongola National Park the Ib395 land type (Figure 8) has the second highest plant diversity of all the land types in the park, with 219 plant species identified during the course of the study. There are a large number of microhabitats within each of the larger identifiable habitats, which contribute towards the high species diversity and the complex nature of the Ib395 land type. These microhabitats vary between depressions on the rock surface, where wind and water transported soil is trapped, vertical face-rock habitats as well as cracks and seams in the mother rock, to name just a few. Because of the complexity of the habitat within this land type the classification of the resulting complex vegetation proved to be a greater challenge than was thought at first. In this study two main communities were identified each with a number of sub-communities and variants.

The area is scattered with signs of the ancient civilization of the world-renowned Mapungubwe Hill. Rock paintings and petroglyphs, primeval building sites and age-old potsherds are commonly found in the area. Many archeological studies have been done in the past and these sites have been proclaimed as sites of national heritage. Notwithstanding the unique vegetation of the area, the archeological heritage is one of the reasons for the proclamation of the Vhembe-Dongola National Park (Robinson, 1996).

Not all the communities of the sandstone koppies of the Ib395 land type have been described in this thesis. One of the main aims of this study is to identify management units and, therefore the following description of the plant communities in the Ia 395 land type is thought to be acceptable. The two main communities, which were identified in the Ib395 land type, are:

1. The *Hexalobus monopetalus – Croton gratissimus* Community
2. The *Terminalia prunioides – Grewia bicolor* Community

Northern Province

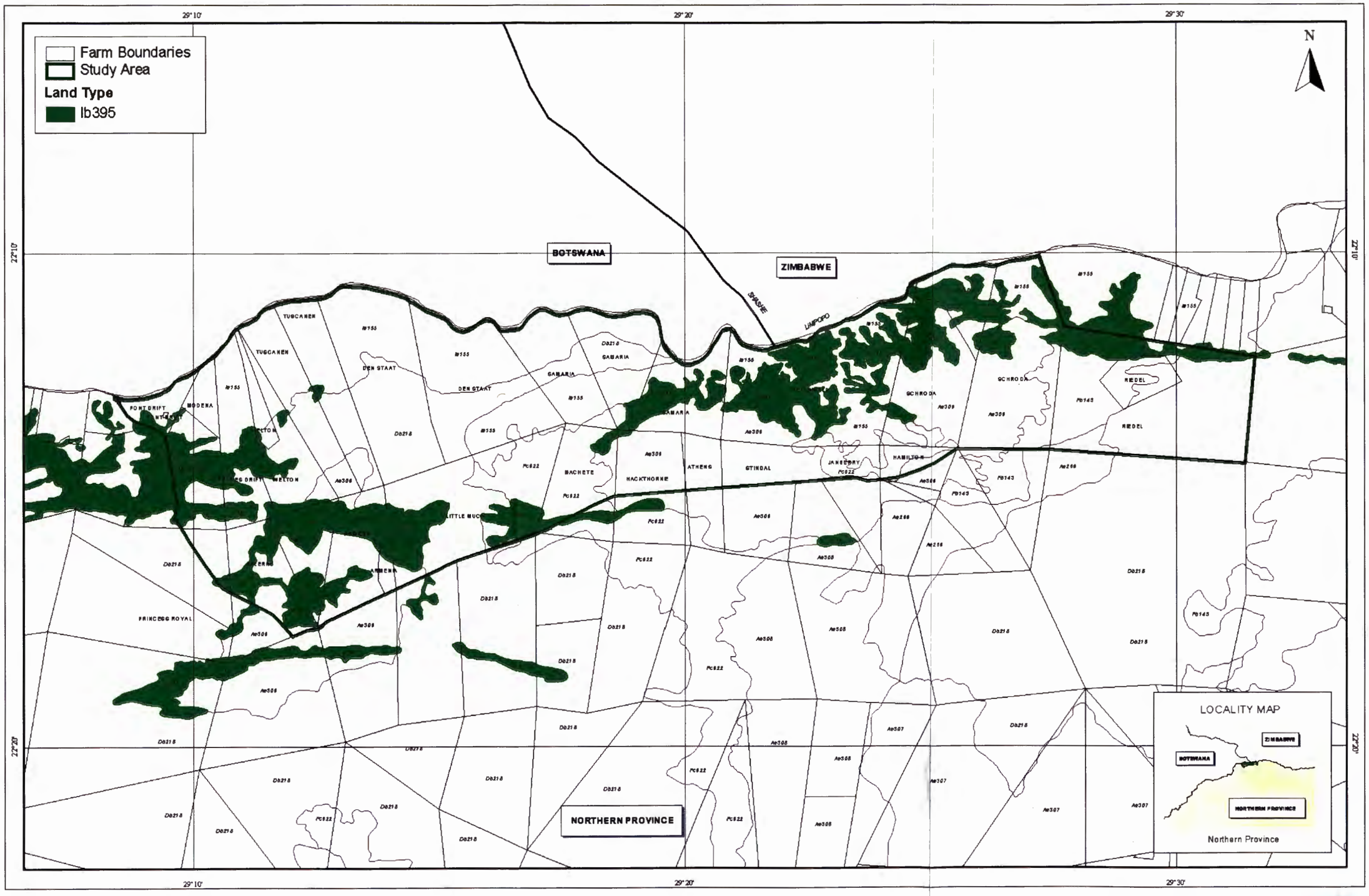


FIGURE 8 : Ib 395 LAND TYPE OF THE VHEMBE-DONGOLA NATIONAL PARK

Fig 8.

5.2 DESCRIPTION OF PLANT COMMUNITIES

1. The *Hexalobus monopetalus – Croton gratissimus* Community

The *Hexalobus monopetalus – Croton gratissimus* Community has a high diversity with more than 152 different plant species identified during this study. This complex mosaic of microhabitats is found on rocky outcrops in shallow sandy Mispah and Glenrosa soil forms. This community is mainly found on the farm Greefswald in the Vhembe-Dongola National Park.

Large areas of bare sandstone are a common appearance and constitute between 30 - 70% of the total surface area. The community is moderately grazed, mostly by small game and other small mammals. This is due to the fact that the largest part of this rocky community is inaccessible to most large mammals. This community is home to a healthy population of the nimble Klipspringer (*Oreotragus oreotragus*), which feeds on herbs and shrubs on or at the base of these rocky outcrops (Wynne-Jones, 1982). Apart from the natural weathering of the sandstone and the natural erosion of the resulting sand particles, no other erosion of a serious nature was observed in the area.

The diagnostic plant species of the *Hexalobus monopetalus – Croton gratissimus* Community are found in Species group A (Table 4). This includes the tree species *Hexalobus monopetalus* var. *monopetalus, Croton gratissimus* var. *subgratissimus, Ficus abutilifolia* and *Lonchocarpus capassa.* The shrub species include *Abutilon grandiflorum* and *Ochna inermis.* The diagnostic grasses are a *Trichoneura* sp., *Schmidtia pappophoroides, Aristida scabrivalvis* and *Brachiaria nigropedata* and the other herbaceous species include the sedge species *Bulbostylis hispidula* and the forbs *Evolvulus alsinoides* var. *linifolius, Cleome hirta* and *Barleria affinis.* This community is further differentiated from the *Terminalia prunioides – Grewia bicolor* Community (2) by the absence of the species of Species group I (Table 4).

The *Trichoneura* sp. (Species group A, Table 4) is in the process of being described and is probably a new species (Lynn Fish, pers. comm.)[2].

The tree cover of this community is 3.3 m on average and the crown cover varies from 10 to 50%. The shrub layer has an average height of 1.3 m and a crown cover of between 6 and 60%. The herbaceous layer varies in crown cover from 30 to 71% with an average height of 0.5 m.

Two sub-communities and four variants were identified in this community. The sub-communities are as follows:

1.1 The *Psydrax livida – Oropetium capense* Sub-community

1.2 The *Ficus tettensis – Waltheria indica* Sub-community

[2] Lynn Fish, National Herbarium, Private Bag X101, NBI, Pretoria, 0001.

TABLE 4: PHYTOSOCIOLOGICAL TABLE OF THE VEGETATION OF THE IB395 LAND TYPE IN THE VHEMBE-DONGOLA NATIONAL PARK

TURBOVEG no.	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	1	0	1	0	0	1	0	0	1	1	1	1	1	0	0	1	1	1	1	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	8	8	8	8	8	8	0	8	0	9	8	0	9	8	0	0	0	0	0	9	9	0	0	0	0	0	0	8	9
	0	1	1	1	2	1	1	1	0	0	0	1	1	1	0	9	2	2	2	9	9	9	9	9	9	2	9	2	0	9	2	9	9	0	1	4	2	4	1	1	0	0	0	0	4	5	9	0
	3	1	4	6	7	2	5	7	7	8	5	8	3	9	2	8	6	1	5	1	5	2	4	0	6	0	3	3	0	7	2	9	9	4	0	4	4	5	1	2	6	0	1	9	3	0	8	2
Relevé no.	1	1	1	2	2	1	2	2	1	1	1	2	1	2	1	1	2	2	2	0	0	0	0	0	0	2	0	2	0	0	2	1	0	1	1	0	2	0	0	0	1	1	1	1	0	1	0	0
	8	9	9	0	1	9	0	0	9	9	9	0	9	0	8	8	1	0	1	6	7	6	6	5	7	0	6	0	7	0	0	8	7	8	9	6	0	0	0	0	9	8	8	9	5	3	0	6
	8	6	9	1	2	7	0	2	2	3	0	3	8	4	7	3	1	6	0	3	0	5	8	7	4	5	6	8	6	2	7	4	5	9	5	9	9	7	8	9	1	5	6	4	1	9	1	7
No. of species per releve	4	3	3	2	2	4	3	3	3	4	3	3	2	3	4	4	3	4	3	3	5	4	3	4	3	4	3	2	2	2	2	3	3	3	4	5	2	2	3	3	3	4	3	2	3	4	2	2
	5	4	1	7	9	0	7	9	8	4	7	0	9	3	8	7	0	7	2	5	3	0	3	2	7	1	1	8	8	0	7	3	2	8	0	3	7	1	7	4	3	6	2	9	0	4	4	4
Communities	1																															2																
Sub-communities	1.1																			1.2												2.1						2.2									2.3	
Variants	1.1.1							1.1.2												1.2.1					1.2.2																							
Species group A																																																
Trichoneura species	+	+	1	1	a	1	1	a	+	+	1	a	1	1	a	1	1	1	a	a	a	1	b	+	b	1	b	a	.	1	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bulbostylis hispidula	+	+	+	+	+	+	+	1	+	+	+	1	+	+	+	+	+	+	1	1	a	a	a	+	.	+	1	+	1	a	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hexalobus monopetalus var. *monopetalus*	.	+	1	+	1	1	+	a	+	1	a	1	a	1	+	1	.	1	1	a	b	1	1	a	.	a	b	1	1	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Croton gratissimus var.*subgratissimus*	.	1	a	.	a	a	.	a	.	a	a	a	.	a	1	1	a	a	b	a	+	+	a	.	b	a	b	a	b	a	a	.	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.
Schmidtia pappophoroides	+	.	a	+	b	.	+	1	1	.	+	1	.	.	+	+	.	.	.	+	1	b	+	a	1	1	1	a	.	.	a	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	.	.
Aristida scabrivalvis	+	+	.	.	1	1	+	.	.	+	+	b	+	1	.	1	a	a	.	.	+	.	+	1	+	a	1	.	.	a	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachiaria nigropedata	.	1	.	a	.	a	1	+	a	.	1	.	+	1	.	.	1	.	1	+	+	.	+	+	+	1	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ficus abutilifolia	.	a	1	1	a	a	1	.	.	a	a	.	1	1	1	1	.	a	1	.	1	1	1	1	.	.	r	1	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Evolvulus alsinoides var. *linifolius*	+	.	.	.	+	+	+	+	.	.	+	.	.	.	+	+	+	+	.	+	.	.	+	+	+	+	.	+	+	.	.	.	.	+	.	.	.	.	.	.	+	.	+	.	.	+	.	.
Cleome hirta	.	.	+	.	.	.	.	1	+	.	.	.	.	+	.	.	.	.	+	.	1	1	.	.	1	.	+	.	.	.	+	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.
Abutilon grandiflorum	1	.	a	.	1	.	.	a	a	.	.	+	.	.	.	.	+	.	.	+	+	b	.	.	+	+	.	+	+	.	1	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.	.	.
Ochna inermis	.	+	.	.	1	.	.	.	.	+	.	.	.	+	+	+	.	1	1	.	+	.	+	.	1	+	+	.	.	+	.	.	.	1	.	.	.	.	.	.	.	+	.	a	.	.	.	.
Lonchocarpus capassa	+	.	.	.	1	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	+	.	+	.	a	.	.	.	.	a	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Species group B																																																
Oropetium capense	+	1	+	+	+	+	+	+	+	+	+	+	1	.	1	+	+	+	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hibiscus engleri	+	1	1	1	1	+	a	1	1	1	1	.	+	+	.	+	1	.	1	.	.	.	.	.	.	1	.	1	.	.	a	+	.	+	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Psydrax livida	.	1	a	1	+	a	1	1	a	a	1	.	1	.	1	.	.	a	1	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sida cordifolia	.	+	1	.	+	+	.	1	+	1	.	1	+	+	.	.	+	1	+	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tephrosia euprepes	+	1	.	a	.	.	.	.	1	a	1	a	1	a	+	1	+	a	.	.	.	.	+	1	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Croton pseudopulchellus	.	.	.	a	.	.	a	+	.	a	.	.	1	a	+	+	.	.	.	.	1	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group C																																																
Mundulea sericea	a	b	a	a	b	a	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zornia glochidiata	+	+	.	.	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachylaena huillensis	.	.	1	+	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sclerocarya birrea subsp. *caffra*	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	b	.	.	+	.
Eragrostis viscosa	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Species group D																																																
Coleochloa pallidior	.	1	.	+	.	.	.	1	a	+	1	+	a	a	+	+	b	a	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Corchorus kirkii	1	1	.	.	.	.	.	+	+	+	.	+	+	.	1	+	1	+	+	+	.	.	.	a	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera laxeracemosa	.	.	.	.	.	+	+	+	+	+	+	.	.	+	1	+	+	.	.	.	+	.	+	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Digitaria eriantha	+	.	.	.	+	.	1	.	+	1	.	.	1	1	.	.	1	1	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	a	.	.
Euclea natalensis	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	+	+	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xerophyta retinervis	.	.	.	a	.	.	+	.	.	+	+	.	+	.	.	1	.	+	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pappea capensis	.	.	.	.	.	1	.	a	a	.	.	.	.	.	+	.	.	.	a	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pogonarthria squarrosa	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group E																																																
Eragrostis lehmanniana	a	a	1	+	.	+	+	+	1	1	1	+	a	+	a	b	+	a	+	1	+	1	1	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.
Aristida junciformis	.	a	.	a	1	.	a	a	+	1	1	+	+	a	+	+	1	+	a	1	+	.	+	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Melinis repens	1	+	b	1	.	1	a	.	1	1	+	+	.	.	+	1	.	+	.	+	1	+	a	a	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	+	.	.	1	.	.
Strychnos madagascariensis	1	.	.	.	.	.	1	+	.	1	a	a	1	+	a	a	.	+	.	.	1	.	1	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tephrosia rhodesica	.	1	.	1	.	a	1	.	.	.	1	.	1	+	.	.	1	+	+	.	+	.	a	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hemizygia petrensis	.	1	.	+	.	a	+	.	.	.	+	+	+	+	.	+	1	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Tephrosia virgata	.	.	.	.	+	.	.	.	.	1	.	.	.	.	+	.	.	1	+	1	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group F																																																
Ficus tettensis	.	.	.	.	.	1	1	1	+	.	+	.	.	.	.	.	.	.	1	1	+	1	.	+	1	a	.	a	a	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Waltheria indica	1	.	.	.	+	.	+	+	.	.	.	.	.	+	.	.	.	.	+	1	+	+	.	+	+	+	.	+	+	+	.	.	.	.	.	+	.	.	.	.	1	.	.	.	.	.	.	.
Sida ovata	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	+	+	1	+	.	+	.	1	.	.	1	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.
Hibiscus species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	1	.	a	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Momordica balsamina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	1	.	1	.	.	.	+	.	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group G																																																
Stipagrostis uniplumis	.	.	+	+	.	.	+	.	.	.	.	1	+	+	.	.	.	.	.	1	a	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+
Pavonia dentata	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acrotome inflata	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.
Combretum microphyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	b	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	a	.	.	.
Lannea schweinfurthii	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Blepharis subvolubilis var. *subvolubilis*	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group H																																																
Hibiscus coddii	.	.	.	.	a	.	.	.	+	.	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	a	+	a	a	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tragia rupestris	.	+	+	.	.	.	1	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	+	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Barleria affinis	.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	a	a	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sterculia rogersii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	1	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.
Commelina africana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	a	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.

Relevé no.	188	196	199	201	212	197	200	202	192	193	190	203	198	204	187	183	211	206	210	063	070	065	068	057	074	205	066	208	076	002	207	184	075	189	159	069	209	007	008	009	191	185	186	194	051	139	011	067
Communities	1																															2																
Sub-communities	1.1																			1.2												2.1						2.2									2.3	
Variants	1.1.1							1.1.2												1.2.1					1.2.2																							
Species group I																																																
Grewia bicolor	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	+	.	.	+	.	+	.	.	.	+	.	.	+	1	.	.	1	a	1	a	1	a	.	3	1	a	a	1	1	1	1	+	a
Terminalia prunioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	+	a	a	+	1	+	a	a	.	b	.	a	a	1	a	1
Commicarpus pentandrus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	1	1	.	+	.	+	.	+	.	+	.	1	.	a
Commiphora tenuipetiolata	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	b	.	a	.	1	1	.	1	.	+	+	a	.	b
Commiphora glandulosa	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	1	.	.	.	b	a	.	1	.	1	.	.	.	1
Ptycholobium contortum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	.	+	+	.	.	.	+	.	.	1	.	.	.	1	.	1
Aristida congesta subsp. *congesta*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	.	.	+	.	+	.	.	.	.	a	.	.	.	.	+	b
Acacia nigrescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	3	.	.	.	+	.	.	+	.	.	.	.	b
Species group J																																																
Tephrosia purpurea	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	a	a	.	a	.	.	1	1	a	a	a	.	b	.	.
Dicoma tomentosa	.	.	+	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	a	.	1	1	.	a	.	a	1	a	a	a	.	.	1	.	.
Leucas sexdentata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	1	1	.	3	1	1	.	+	.	1	.	.	.	.
Kyphocarpa angustifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+	.	.	.	.	+	.	+	1	1	.	.
Aristida adscensionis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	a	.	1	.	.	.	.	+	+	.	+	.	+	.	.	.	.
Cadaba termitaria	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	1	a	.	.	.	.	.	.	1	.	+	a	.	+
Hibiscus micranthus	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	+	+	.	.	+	.	.
Acacia senegal var. *rostrata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	1	.	.	.	1	.	.
Abutilon sonneratianum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	+	+	+	+	.	.	.	.	.	.	.	.
Kirkia acuminata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b	.	.	.	1	.	.	.	.	a	.	.	1	.	.	.
Species group K																																																
Acacia senegal var. *leiorhachis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	+	1	+	.	.	.	.	.	.	.	.	.	.	.
Barleria senensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	1	+	.	.	.	.	.	.	.	.	.	.	+
Achyranthes aspera	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	1	.	.	.	+	+	.	1	+	.	.	.	+	.	.	+	.	+	.	.
Cordia grandicalyx	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.
Abutilon austro-africanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	+	.	.	+	.	.	.	+	.	.	.	.	.	+
Aristida stipitata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	a	.	.	.	.
Megalochlamys hamata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.
Petalidium aromaticum var. *aromaticum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Commiphora mollis	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.
Species group L																																																
Colophospermum mopane	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	a	a	.	a	b	.	.	a	.	.
Vernonia cinerascens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	.	1	.	.	.
Seddera suffruticosa	.	+	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	+	+	.	.	.	+	.	1
Rhigozum zambesiacum	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	1	1	.	.	1	.	.
Phyllanthus angolensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	+	.	+	.	+	.	.
Corchorus asplenifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	+	.	.
Cenchrus ciliaris	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	a	.	1	.	.	.
Boscia foetida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	+	.	.	.	.	.	.	+	.	.
Species group M																																																
Ceratotheca triloba	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	1	+	+	+	+	+	+	1	.	.	.	.	+	.	+	+	.	1	.	+	+	.	+	.	1	+	a	.	.
Gisekia pharnacioides var. *pharnacioides*	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	+	+	1	.	a	.	.	+	.	.	a	.	.	1	.	+	+	+	.	.	.	.	+	.	1	.
Brachiaria deflexa	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	+	.	1	.	+	.	+	.	.	+	.	.	+	1	.	+	+	.	a	.	+	.
Tephrosia polystachya var. *polystachya*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	+	.	+	.	.	.	.	.	a	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.
Species group N																																																
Combretum apiculatum	1	+	1	.	1	a	a	a	a	a	.	a	1	a	+	a	a	a	1	.	+	.	a	b	.	1	.	1	.	+	1	a	b	b	+	1	a	.	a	1	a	1	a	b	+	3	.	.
Hermannia glanduligera	+	.	1	.	1	+	+	.	+	a	.	1	.	.	+	+	.	+	.	+	+	1	1	+	1	+	+	1	1	.	a	+	+	+	1	+	1	.	.	.	+	+	.	1	.	.	.	.
Acalypha indica	+	+	1	.	+	.	.	+	.	+	.	.	.	+	+	.	+	.	1	.	+	1	.	.	.	+	.	1	+	.	+	1	.	1	+	+	1	+	.	.	.	+	+	+	a	+	.	.
Panicum maximum	b	+	.	+	.	a	1	+	1	+	1	+	.	1	1	1	.	1	+	1	1	a	1	.	.	1	1	1	.	.	1	.	.	1	.	a	1	+	+	.	a	.	a	1	.	1	.	.
Albizia harveyi	+	1	.	1	.	.	a	.	.	1	1	b	+	1	.	+	+	.	.	1	a	.	.	b	+	.	b	.	.	.	.	1	.	+	1	+	+	.	.	.	.	.	.	1	b	.	.	.
Grewia flavescens	.	.	+	.	+	.	.	1	a	+	.	.	1	+	.	+	+	.	.	.	1	a	.	.	.	.	.	+	a	.	1	+	.	+	+	a	1	.	.	+	1	+	.	.	.	+	.	.
Cucumis zeyheri	+	.	+	.	.	+	+	+	+	+	.	1	.	.	+	+	+	.	.	+	.	.	.	.	+	.	1	+	.	.	.	+	1	+	+	a	.	.	+	.	+	1	+	+	.	+	.	.
Commelina benghalensis	+	.	.	.	1	.	.	1	+	.	.	.	.	.	+	.	.	.	+	.	1	a	.	.	a	+	.	1	.	.	1	.	.	+	+	1	.	.	+	.	.	1	+	+	.	.	.	.
Dichrostachys cinerea	a	.	.	.	.	+	+	.	.	.	.	a	.	.	.	.	.	.	.	+	.	a	.	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+	.	a	+	.	.	.	.	.	.
Commiphora edulis	+	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	1	.	a	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	a	.	.	.	.
Calostephane divaricata	+	.	+	.	.	1	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+	.	+	.	.
Acacia erubescens	b	.	.	.	.	.	.	.	.	a	.	.	.	.	a	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.	+	.	.	.	.	.	.	.	a	.	.	1	.	.
Species group O																																																
Hermbstaedtia odorata	+	.	.	.	.	.	.	.	.	.	.	1	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.	.	.	.	+	+	.	.	.	.	+	+
Heliotropium ovalifolium	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	+	.	.	1	+	+
Urochloa mosambicensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	b	.
Cordia monoica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	b
Tribulus zeyheri subsp. *zeyheri*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	+	+	+	.	.	.	.	+	.	a	.
Cleome angustifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	.	.	.	1	.	.	+	.	+	+	.	.	.	.	.	.	.	.	1
Species group P																																																
Enneapogon cenchroides	+	+	1	.	1	+	+	1	1	+	+	1	+	+	+	+	+	+	1	+	+	a	+	+	+	+	a	1	a	1	1	a	3	+	3	a	3	3	3	3	+	b	.	+	a	b	a	a
Boscia albitrunca	1	.	+	.	1	1	1	a	a	1	.	.	+	+	1	.	.	+	+	1	+	+	a	a	a	1	a	1	1	+	+	1	1	1	1	+	1	.	+	a	.	.	.	+	.	1	1	1
Solanum kwebense	+	1	1	.	.	1	1	+	1	1	.	+	.	.	+	+	+	+	.	+	.	+	.	+	.	.	+	.	+	.	+	1	a	1	+	a	.	1	a	+	+	.	+	1	a	1	.	+
Eragrostis trichophora	.	1	.	.	+	.	.	.	.	.	.	.	.	.	1	a	.	.	.	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	1	.
Other species																																																
Xanthium strumarium	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pellaea calomelanos	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Combretum mossambicense	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pupalia lappacea	+	.	.	.	+	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.
Blepharis aspera	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Aloe chabaudii	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flueggea virosa subsp. *virosa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xerophyta humilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Barleria species	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plicosepalus kalachariensis	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pycreus pelophilus	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia cooperi var. *cooperi*	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Ficus cordata subsp. *salicifolia*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sericorema sericea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Xerophyta viscosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.

Relevé no.	1 1 1 2 2 1 2	2 1 1 1 2 1 2 1 1 2 2 2	0 0 0 0 0 0	0 2 0 2 0 0 2	1 0 1 1 0 2	0 0 0 1 1 1 1 1 0 1	0 0
	8 9 9 0 1 9 0	0 9 9 9 0 9 0 8 8 1 0 1	6 7 6 6 5 7	0 6 0 7 0 0	8 7 8 9 6 0	0 0 0 9 8 8 9 5 3	0 6
	8 6 9 1 2 7 0	0 2 2 3 0 3 8 4 7 3 1 6 0	3 0 5 8 7 4	5 6 8 6 2 7	4 5 9 5 9 9	7 8 9 1 5 6 4 1 9	1 7
Communities	1					2	
Sub-communities	1.1		1.2		2.1	2.2	2.3
Variants	1.1.1	1.1.2	1.2.1	1.2.2			
Leonotis ocymifolia	. . . . . +	 1	. . . . .	. . . . .	. . . . .	. . . . .	. .
Abrus precatorius subsp. *africanus*	. . . . .	. . . . . +	. . . . .	. . . . .	. . . . .	. . . . .	. .
Maerua angolensis	. . . . .	. . . . . +	. . . . .	. . . . .	. . . . .	. . . . .	. .
Schizachyrium jeffreysii	. . . . .	. . . . . +	. . . . .	. . . . .	. . . . .	. . . . .	. .
Oxygonum delagoense	. . . . . +	. . . . . +	. . . . .	. . . . .	. . . . .	. . . . .	. .
Cleome monophylla	. . . . .	. . . . . r	. . . . .	. . . . .	. . . . .	. . . . .	. .
Geigeria burkei subsp. *fruticulosa*	. . . . . +	. . . . 1 . . +	. . . . .	. . . . .	. . . + . .	. + ...	. 1
Merremia pinnata	+	. . . + . + .	. . . . .	. . + . . .	. . . . .	. . . . .	. .
Vigna species	. . . . .	. . . . + . .	. . . . .	. . . . .	. . . . .	. . . . .	. .
Vigna frutescens subsp. *frutescens*	+	. . . . .	. . 1 . . .	. . + . . .	. . . . + .	. . . . .	. .
Sesamum triphyllum	. . . . .	. . . . .	. . + + . +	. . . . .	. + . . + .	. . . . .	. .
Cyperus rupestris var. *rupestris*	. . . . .	. . . . .	. + ...	. . . . .	. . . . .	. . . . .	. .
Gymnema sylvestre	. . . . .	. . . . .	. + ...	. . . . .	. . . . .	. . . . .	. .
Indigofera charlieriana	. . . . .	. . . . .	r + ...	. . . . .	. . . . .	. . . . . +	. .
Vangueria infausta	. . . . .	. . + . + . .	. . . + a .	. . . . .	. . . . .	. . . . .	. .
Cassia abbreviata	. . . . .	. . . + . . .	. . . . + .	. . . . .	. . . . .	. . . . .	. .
Monechma divaricatum	. . . . .	. . . . .	. . . . + .	. . . . .	. . . . .	. . . . .	. .
Panicum schinzii	. . . . .	. . . . .	. . . . 1 .	. . . . .	. . . . .	. . . . .	. .
Bridelia mollis	. . . . .	. . . . .	. . . . . +	. . . . .	. . . . .	. . . . .	. .
Steganotaenia araliacea	. . . . .	. . . . .	. . . . .	 1	. . . . .	. . . . .	. .
Grewia villosa	. . . . .	. . . . .	. . . . .	. . . . +	. . . . .	. . . . .	. .
Ctenolepis cerasiformis	. . . . .	. . . . .	. . . . .	. . . . . +	. . . . .	. . . . .	. .
Monsonia senegalensis	. . . . .	. . . . + . .	. . . . .	. . . . .	1 . . + . .	. . . . .	. .
Nemesia fruticans	. . . . .	. . . . .	. . . . .	. . . . .	+	. . . . .	. .
Ocimum americanum var. *americanum*	. . . . .	. . . . .	. . . . .	. . . . .	+	. . . . .	. .
Kohautia aspera	. . . . .	. . . . .	. . . . .	. . . . .	. + ...	. . . . .	. .
Hermannia modesta	. . . . .	. . . . .	. . . . .	. . . . .	. . . + . .	. . . . .	. .
Grewia tenax	. . . . .	. . . . .	. . . . .	. . . . .	. . . a . .	. . . . .	. .
Hibiscus sabiensis	. . . . .	. . . . .	. . . . .	. . . . .	. . . + . .	. . . . .	. .
Melhania rehmannii	. . . . .	. . . . .	. . . . .	. . . . .	+ . . + . .	. . . + . .	. .
Setaria sagittifolia	. . . . .	. . . . .	. . . . .	. . . . .	. . . . b .	. . . . .	. .
Panicum deustum	. . . . .	. . . . .	. . . . .	. . . . .	. . . . a .	. . . . .	. .
Justicia protracta subsp. *rhodesiana*	. . . . .	. . . . .	. . . . .	. . . . .	. . . . + .	. . . . .	. .
Decorsea schlechteri	. . . . .	. . . . .	. . . . .	. . . . . +	. . . . + .	. . . . . +	. .
Asparagus africanus	. . + . .	. . . . .	. . . . .	. . . . .	. . . . + 1	. . . . .	. .
Grewia occidentalis	. . . . .	. . . . .	. . + . . .	. . . . .	+	+	. +
Ipomoea sinensis subsp. *blepharocephala*	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. + ...	. .
Acacia mellifera	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. + a	. .
Loudetia simplex	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. + + ...	. .
Commiphora merkeri	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. + + ...	. .
Chamaesyce species	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . + ...	. .
Neuracanthus africanus	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . + ...	. .
Tinnea rhodesiana	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . + ...	. .
Chamaecrista absus	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. + + + . . .	. .
Adansonia digitata	. . . . .	. . . . .	. . . . .	. . . . .	. . . . b .	. . . b . . .	. .
Vahlia capensis	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . a . . .	. .
Acacia tortilis	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . 1 . . +	. .
Cucumis metuliferus	. . . . . +	. . . . .	. . . . .	. . . . .	. . . . .	. . . + . . .	. .
Crotalaria species	. . . . .	. . . . .	. . . . .	. . . . .	. . . . + .	. . . + . . .	. .
Bidens pilosa	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . + + . .	. .
Indigofera heterotricha	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . + . .	. .
Pavonia burchellii	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . + . .	. .
Grewia villosa	. . . . .	. . . . .	. . . . .	. . . . .	. . . + + .	. + . . + . .	. .
Commelina aspera	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . r . .	. .
Chamaesyce eylesii	. . . . .	. . . . . +	. . . . .	. . + . . .	. . . . .	. . . . + + . +	. .
Crotalaria virgulata	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . b . .	. .
Indigofera trita subsp. *subulata*	. . . . .	+	. . . . .	. . . . .	. . . . + .	. . . . 1 . .	. .
Maytenus species	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . + . .	. .
Merremia kentrocaulos	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . + . .	. .
Ximenia americana	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . + . .	. .
Ipomoea magnusiana var. *magnusiana*	. . . . . +	. . . . .	. + ...	. . . . .	. . . . .	. . . . + . .	. .
Melhania acuminata var. *agnosta*	+	. . . . + . .	. + ...	. . . . .	. . . . .	. . . . + . .	. .
Dichilus lebeckioides	+	. . . . .	. . . . .	. . . . .	. . . . .	. . . . + . .	. .
Monsonia glauca	. . . . .	. . . . + . .	. . . . .	. . . . .	. . . . .	. . . . + . .	. .
Asparagus suaveolens	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. + + . . . 1	. .
Balanites pedicellaris	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . . a	. .
Asparagus laricinus	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . . +	. .
Barleria transvaalens	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . . +	. .
Berchemia zeyheri	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . . +	. .
Cadaba aphylla	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . . +	. .
Aristida rhiniochloa	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . . +	. .
Becium filamentosum	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+ .
Bothriochloa insculpta	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+ .
Plumbago zeylanica	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+ .
Aptosimum lineare	+	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+ .
Amaranthus species	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. r + . . . +	. .
Alternanthera pungens	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+ .
Chenopodium carinatum	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+ .
Chloris virgata	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+ .
Dactyloctenium aegyptium	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+ .
Eleusine coracana subsp. *africana*	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+ .
Indigastrum costatum	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+	+ .
Schkuhria pinnata	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+ .
Setaria verticillata	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	+ .
Tragus berteronianus	. . . . .	. . . . .	. + ...	. . . . .	. . . . .	. . + ...	+ .
Enneapogon desvauxii	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. +
Indigofera circinnata	. . . . .	. . . . .	. . . . .	. . . . .	. . . 1 . .	. + ...	. +
Indigofera species	. . . . .	. . . . .	. . . . .	. . + . . .	. . . . + .	. . . . .	. .

1.1 The *Psydrax livida – Oropetium capense* Sub-community

This community is found almost exclusively on the Mispah soil form and in a few cases on the Glenrosa soil form, mostly on the crest (TU1) and to a lesser extent on cliff sides (TU2) and foot slope (TU3) of the Ib395 land type. Shallow soils with a soil depth of up to 20 cm are found in depressions of the rock surface. Herbaceous species and small shrubs are found in these depression-microhabitats. Deeper soils are found in run-off areas, crevices and seams in the rock, where a larger amount of soil has accumulated with a soil depth of up to 50cm, which is more suitable for the establishment of larger shrub and tree species as well as smaller herbaceous species. Grazing in the area is concentrated in the run-off areas, which is more accessible to game. It was also observed that these latter areas are utilized for shelter, by game.

A common microhabitat occurring in this variant is small depressions in the mother rock, which are filled by wind and water transported soil particles, where small herbaceous species have established. The grass species *Oropetium capense* and the sedge *Bulbostylis hispidula* (Species group B, Table 4), together with some other small herbs and grasses, occur in these depression-microhabitats.

Diagnostic species to this sub-community are found in Species group B (Table 4) and include the tree species *Psydrax livida* and the shrub *Croton pseudopulchellus* and *Hibiscus engleri*. The diagnostic species further include the grass species *Oropetium capense* and the forbs *Sida cordifolia* and *Tephrosia euprepes*. This sub-community is differentiated from the *Ficus tettensis – Waltheria indica* Sub-community (1.2) by the absence of the species of Species groups F and M (Table 4).

The tree species covers between 10 and 35% of the area with an average height of 3.0 m. The shrub layer has an average height of 1.3 m and crown cover varying between 6 and 26%. The average height of the herbaceous layer is 0.5 m and the crown cover varies between 30 and 60% of the sub-community area.

Two variants were identified in the *Psydrax livida – Oropetium capense* sub-community:

1.1.1 The *Mundulea sericea – Zornia glochidiata* Variant

1.1.2 The *Strychnos madagascariensis – Coleochloa pallidior* Variant

1.1.1 The *Mundulea sericea – Zornia glochidiata* Variant

This variant is most commonly found on crests (TU1) and less commonly on foot slopes (TU3) in the *Psydrax livida – Oropetium capense* Sub-community (1.1). The dominant soil form is Mispah and to a lesser extent Glenrosa. Overall the soils are shallow and sandy in texture. Approximately 35% of the area is overlain by solid sandstone and the rockiness of the available soil surfaces is between 55 and 70%. This variant shows signs of moderate grazing, because in some cases it is accessible to larger mammals.

Occasionally this variant was observed in the vicinity of natural seeps and rock pools filled with water during the rainy period.

The diagnostic species of the *Mundulea sericea – Zornia glochidiata* variant is found in Species group C (Table 4). This includes the tree species *Mundulea sericea, Brachylaena huillensis* and *Sclerocarya birrea* subsp. *caffra*, the grass species *Eragrostis viscosa* and the forb *Zornia glochidiata*. This variant is differentiated from the *Strychnos madagascariensis – Coleochloa pallidior* Variant (1.1.2) by the low cover abundance values or absence of the species of Species group D (Table 4). Large specimens of the tree species *Ficus abutilifolia* are also common in this variant.

The average height of the tree layer is 3.0 m and the crown cover ranges from 10 to 35%. The shrub layer has an average height of 1.3 m and crown cover varying between 10 and 25%. The herbaceous layer covers between 40 and 60% with an average height of 0.5 m.

1.1.2 The *Strychnos madagascariensis – Coleochloa pallidior* Variant

This variant makes out approximately 60% of the surface area of the *Psydrax livida – Oropetium capense* Sub-community (1.1). It mainly occurs on the undulating foot slopes (TU3) of the Ib395 land type, but also to a lesser extent on the crests of the terrain (TU1). The main soil forms are sandy Mispah and Glenrosa soils. Grazing levels are less than in the *Mundulea sericea – Zornia glochidiata* Variant (1.1.1) as this area is less accessible to large mammals. The plant diversity of this variant is marginally higher than that of the *Mundulea sericea – Zornia glochidiata* Variant (1.1.1). This is probably due to the larger number of microhabitats found in this variant due to the more undulating nature of the terrain, which causes more microclimates than in the more open, flat terrain of the *Mundulea sericea – Zornia glochidiata* Variant (1.1.1). It was noted that most of the larger tree species were found growing in seams and crevices in the sandstone. Rockiness of the soil surface varies between 50 and 75% and roughly 30% of the area consists of bare rock.

Diagnostic species include the tree species *Euclea natalensis*, which also occurs in shrub form, and *Pappea capensis*, the grasses *Digitaria eriantha* and *Pogonarthria squarrosa*, the sedge *Coleochloa pallidior* and the forbs *Corchorus kirkii, Indigofera laxeracemosa* and *Xerophyta retinervis* (Species group D, Table 4). Species with high cover abundance values are the tree species *Strychnos madagascariensis* (Species group F, Table 4), the shrubs *Croton pseudopulchellus* (Species group B, Table 4), and *Grewia flavescens* (Species group N, Table 4).

The tree layer has an average height of 3.0 m and a crown cover varying between 10 and 35%. The shrub layer covers between 6 and 26% of the variant area with an average height of 1.2 m. The herbaceous layer reaches an average height of 0.5 m and the crown cover varies between 30 and 60%.

1.2 The *Ficus tettensis – Waltheria indica* Sub-community

This sub-community of the *Hexalobus monopetalus – Croton gratissimus* Community (1) occurs on deeper Glenrosa and Mispah soil forms than was the case in the *Psydrax livida – Oropetium capense* Sub-community (1.1). This sub-community is situated on crests (TU1) steep cliff sides (TU2) and to a certain extent on the upper parts of the foot slopes (TU3) of the Ib395 land type. The so-called cliff sides on these sandstone ridges seldom have a vertical drop. The drop usually takes place in the form of small, sometimes narrow terraces. On the ledges formed by the terrace-like terrain, shallow to moderately deep soils have accumulated and serve as growth medium to tree species (especially the Wild Fig species such as *Ficus abutilifolia, F. tettensis* and *F. salicifolia*) and other vegetation, which then further penetrate the rock on its never-ending quest for sustenance.

Diagnostic species of this community are found in Species group F (Table 4). This includes the tree species *Ficus tettensis* and the forb species *Waltheria indica, Sida ovata, Hibiscus* species and the climber *Momordica balsamina*. The absence of Species group B (Table 4) differentiate this sub-community along with higher cover abundance values for the sedge species *Bulbostylis hispidula* (Species group A, Table 4) than compared to the *Psydrax livida – Oropetium capense* Sub-community (1.1). The presence of the species of Species group M (Table 4) further differentiates this sub-community from the other sub-community of the *Hexalobus monopetalus – Croton gratissimus* Community (1).

The tree layer has an average height of 3.8 m. On average this is 80 cm higher than the tree layer of the *Ficus tettensis – Waltheria indica* Sub-community. The tree cover of this sub-community varies between 5 and 50%. The shrub layer reaches an average height of 1.5 m and has a varying crown cover of 22 to 60%. The herbaceous layer covers between 35 and 70% of the area and has an average height of 0.6 m.

Two variants were identified in this sub-community:

1.2.1 The *Stipagrostis uniplumis – Pavonia dentata* Variant

1.2.2 The *Hibiscus coddii – Tragia rupestris* Variant

1.2.1 The *Stipagrostis uniplumis – Pavonia dentata* Variant

This variant is most commonly situated on the crest (TU1) and foot slope (TU3) of the Ib395 land type. The Glenrosa soil form dominates the area occupied by the variant and the Mispah soil form occurs on a less regular basis. The areas in which this variant is found have deeper soils than those of the *Hibiscus coddii – Tragia rupestris* Variant (1.2.2). The variant is minimally grazed and no serious signs of vegetation and soil degradation were observed. Large portions of bare rock surfaces are present and it covers approximately 35% of the area. The rockiness of the soil surface is between 30 and 40%.

The diagnostic species of the *Stipagrostis uniplumis – Pavonia dentata* variant is found in Species group G (Table 4). This includes the tree species *Lannea schweinfurthii,* the woody creeper *Combretum microphyllum,* the grass *Stipagrostis uniplumis* and the forbs *Pavonia dentata, Acrotome inflata* and *Blepharis subvolubilis* var. *subvolubilis.* Other species that differentiate this variant is the woody *Dichrostachys cinerea* (Species group N, Table 4) and the forb *Ceratotheca triloba* (Species group M, Table 4). The presence of the species of Species group E (Table 4) further differentiates this variant from the *Hibiscus coddii – Tragia rupestris* Variant (1.2.2)

The tree layer is well developed with an average height of 4.0 m and crown cover of 15 to 50%. The shrub layer has a crown cover ranging from 22 to 60% and an average height of 1.5 m. The herbaceous layer covers 35 to71% of the area and reaches an average height of 0.6 m.

1.2.2 The *Hibiscus coddii – Tragia rupestris* Variant

This variant is found on moderately deep and shallow soils on the crest (TU1) and cliff sides (TU2) of the Ib395 land type. The main soil forms are Glenrosa and Mispah. The variant is often found on the verges of cliff sides and also on ledges and crevices on steep inclines of the sandstone ridges. Grazing levels are low and the area, as a whole is not seriously degraded. Open rock surfaces cover in the region of 40 to 50% of the area of the variant and the rockiness of the soil surface is between 20 and 30%.

Diagnostic species of this variant is found in Species group H (Table 4) and include the tree species *Sterculia rogersii,* the shrubby *Hibiscus coddii* and the forbs *Tragia rupestris* and *Commelina africana.* The absence of the woody *Dichrostachys cinerea* (Species group N, Table 4) as well as the species of Species groups E and G (Table 4) further differentiate this variant from the *Stipagrostis uniplumis – Pavonia dentata* Variant (1.2.1).

The tree layer has a crown cover varying between 5 and 30% with an average height of 3.5 m. The shrub layer reaches an average height of 1.3 m and a crown cover varying from 5 to 50%. The crown cover of the herbaceous layer varies from 20 to 66% with an average height of 0.5 m.

2. The *Terminalia prunioides – Grewia bicolor* Community

This community is found on shallow and moderately deep soils on the crest (TU1) and foot slope (TU3) of the Ib395 land type. The community occurs on the two farms Greefswald and Riedel in the Vhembe-Dongola National Park. The common soil forms found in this community are shallow Mispah and deeper Glenrosa lithosols as well as moderately deep Hutton soils. The soils generally have a sandy texture and as a result are well drained. The largest portion of this community is underlain by sandstone as mother rock and a smaller portion is underlain by intrusions of dolomite. These

dolomite areas come in the form of long narrow intrusions often cropping out in jagged hilly formations or rocky flats. In the region of 10 to 30% of the area of the community is covered by exposed bedrock and between 20 and 50 % of the available soil surface are covered by rocks. The area is moderately grazed and in some places trampled by game. With the exception of one of the identified sub-communities of the *Terminalia prunioides – Grewia bicolor* Community, the community is generally in a good veld condition.

The diagnostic species of this community is found in Species group J (Table 4). These species include the tree species *Terminalia prunioides, Commiphora tenuipetiolata, C. glandulosa* and *Grewia bicolor* the latter occurring mostly in shrub form. Other diagnostic species include the grass species *Aristida congesta* subsp. *congesta* and the bushy forb *Commicarpus pentandrus.* The *Terminalia prunioides – Grewia bicolor* Community (2) is differentiated from the *Hexalobus monopetalus – Croton gratissimus* Community (1) trough the absence of the species of Species group A (Table 4). These two communities only have a few species in common, namely the general species of Species group P (Table 4).

The tree layer of this community has a crown cover of between 10 and 57% and an average height of 4.8 m. The shrub layer covers between 5 and 45% of the area with an average height of 1.4 m and the herbaceous layer has a varying crown cover of 32 to 90% and an average height of 0.5 m.

The three sub-communities that were identified in the *Terminalia prunioides – Grewia bicolor* Community (2) are as follows:

2.1 The *Acacia senegal – Barleria senensis* Sub-community

2.2 The *Colophospermum mopane – Vernonia cinerascens* Sub-community

2.3 The *Hermbstaedtia odorata – Heliotropium ovalifolium* Sub-community

2.1 The *Acacia senegal – Barleria senensis* Sub-community

This sub-community is found on dolomite outcrops and on areas with a mixture of sandstone and dolomite on the crest (TU1) and foot slopes (TU3) of the Ib395 land type on the farm Greefswald in the Vhembe-Dongola National Park. The soil forms that dominate this variant are Glenrosa and Mispah. The soils are shallow and have a sandy to loamy texture. Approximately 30% of the surface area of the variant is covered by solid rock and the rockiness of the soil surface is between 30 and 45%. The area is moderately grazed and animals utilize bush clumps for shelter.

Diagnostic species are found in Species group K (Table 4), and include the woody species *Acacia senegal* var. *leiorachis, Commiphora mollis* and *Cordia grandicalyx* of which the latter often occurs in shrub form. The diagnostic species further include the shrubby *Abutilon austro-africanum,* the grass species *Aristida stipitata* and the forbs *Barleria senensis, Achyranthes aspera, Megalochlamys hamata* and *Petalidium aromaticum* var. *aromaticum.* Other species that differentiate this variant from the *Colophospermum mopane – Vernonia cinerascens* Sub-community (2.2) and the

Hermbstaedtia odorata – Heliotropium ovalifolium Sub-community (2.3) are the tree species *Albizia harveyi* and the forbs *Hermannia glanduligera* (Species group N, Table 4) and to a lesser extent *Tephrosia polystachya* var. *polystachya* (Species group M, Table 4).

The height of the tree layer of the *Acacia senegal – Barleria senensis* Sub-community averages 4.4 m with a crown cover of 30 to 57%. The shrub layer has an average height of 1.3 m and the crown cover varies between 8 and 45%. The herbaceous layer has a crown cover ranging from 48 to 90% and an average height of 0.5 m.

2.2 The *Colophospermum mopane – Vernonia cinerascens* Sub-community

This sub-community is found on the farms Greefswald and Riedel in the Vhembe-Dongola National Park. As in the case of the *Acacia senegal – Barleria senensis* Sub-community (2.1) it occurs on the crest (TU1) and foot slope (TU3) of the Ib395 land type. The main soil forms found in this variant are shallow Mispah and moderately deep Glenrosa and Hutton soils. The soil has a sandy to loamy texture and the subsoil in the case of Hutton soils is rocky. The rockiness of the soil surface is between 20 and 50% and approximately 10 to 20% of the area is covered by exposed bedrock. Grazing levels are moderate to low depending on the accessibility of the landscape.

The diagnostic species to this variant are found in Species group L (Table 4). This includes the tree species *Colophospermum mopane* and *Boscia foetida,* the shrub species *Rhigozum zambesiacum,* the grass *Cenchrus ciliaris* and the forbs *Vernonia cinerascens, Phyllanthus angolensis, Seddera suffruticosa* and *Corchorus asplenifolius.* Similarities between the *Colophospermum mopane – Vernonia cinerascens* Sub-community (2.2) and the *Acacia senegal – Barleria senensis* Sub-community (2.1) comes in the form of the species of Species group J (Table 4).

The tree layer has an average height of 4.2 m and a crown cover varying between 10 and 45%. The shrub layer has a crown cover ranging from 5 to 40% and an average height of 1.4 m. The crown cover of the herbaceous layer varies between 45 and 68% with an average crown cover of 0.6 m.

2.3 The *Hermbstaedtia odorata – Heliotropium ovalifolium* Sub-community

This disturbed sub-community occurs mainly on the farm Greefswald in the Vhembe-Dongola National Park. The degradation was primarily caused by actions of the former South African Defence Force. This sub-community is commonly found on old campsites, which varied from permanent to temporary camps. In most of these areas a large degree of deforestation and landscaping has taken place. It was also observed that specimens of the majestic *Adansonia digitata,* which were removed from the surrounding areas, were transplanted in some of these areas. As a whole these areas are degraded to a large degree with large areas void of vegetation, an old dumping site and

a case of serious soil pollution at a former fueling station were recorded as some of the most atrocious sights in the area.

The main soil forms found in these areas vary from shallow Mispah, moderately deep Glenrosa and a small amount of Witbank soils of varying depths. The Witbank soil form is soils deposited by humans, usually for landfills or other landscaping works. The rockiness of the soil surface varies from 15 to 25%. Grazing levels are moderate, but the impact of the grazing in these areas is even more devastating due to the large degree of anthropogenic-induced degradation.

Diagnostic species to this degraded variant is found in Species group O (Table 4), and include the shrubby *Cordia monoica*, the grass species *Urochloa mosambicensis* and the forbs *Hermbstaedtia odorata, Heliotropium ovalifolium, Tribulus zeyheri* subsp. *zeyheri* and *Cleome angustifolia.* This variant is differentiated from the *Acacia senegal – Barleria senensis* Sub-community (2.1) and the *Colophospermum mopane – Vernonia cinerascens* Sub-community (2.2) by the absence or low cover abundance values of the species of Species groups' J – N (Table 4). Through the presence of the weed species *Amaranthus* species, *Alternanthera pungens, Chenopodium carinatum* and *Schkuhria pinnata* and the grass species *Tragus berteronianus* (Other species, Table 4), the low veld condition is further confirmed.

The tree layer reaches average heights of 6.0 m and a crown cover of between 12 and 45%. The shrub layer has an average height of 1.6 m and the crown cover varies between 1 and 30% while the herbaceous layer reaches an average height of only 0.3 m and a poor crown cover of between 30 and 45%.

5.3 ORDINATION

In the scatter diagram (Figure 9) the distribution of the relevés of the Ib395 land type along the first and second axes of the ordination are given. The distribution of the relevés indicates a distinct discontinuity between the two communities identified in the Ib395 land type along the first axis of the ordination. The cause of this discontinuity could however not be determined, as no clear gradients on which the discontinuity could be based could be identified. The scatter diagram (Figure 9) is included to show the discontinuity between the *Hexalobus monopetalus – Croton gratissimus* Community (1) and the *Terminalia prunioides – Grewia bicolor* Community (2) of these unique sandstone koppies in the Vhembe-Dongola National Park.

The communities of the Ib395 land type are situated on shallow sandy Mispah, Glenrosa and Hutton soil forms. The mother rock of these soil forms is mainly sandstone and secondarily dolomite. The *Hexalobus monopetalus – Croton gratissimus* Community (1) is found on TU1, TU2, TU3 and TU5 of the Ib395 land type while the *Terminalia prunioides – Grewia bicolor* Community (2) is mostly found only on TU1 and TU3.

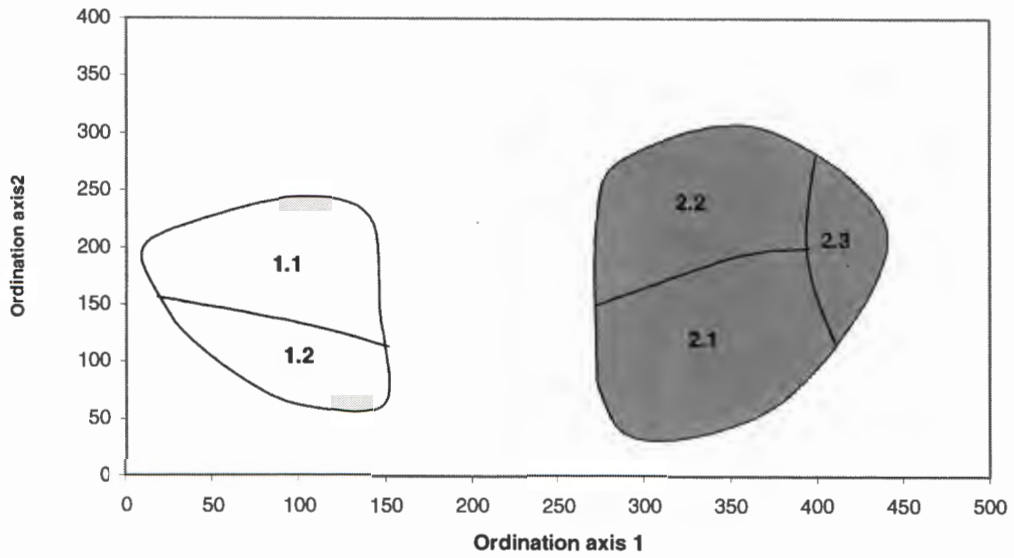


Figure 9. The relative positions of the communities and sub-communities along the first two axes of the ordination of the relevés sampled in the Vhembe-Dongola National Park on the **Ib395 land type**

Apart from the *Acacia senegal – Barleria senensis* Sub-community (2.1), which is found on dolomite intrusions in the region, all the other sub-communities of both the *Hexalobus monopetalus – Croton gratissimus* Community (1) and the *Terminalia prunioides – Grewia bicolor* Community (2) are found on sandstone areas.

5.4 CONCLUSIONS

Some of the vegetation types described in the Ib395 land type are similar to others previously described.

SADF (1986b) previously described the vegetation and habitat of the sandstone ridges of the Ib395 land type in a report on the vegetation of the maps of the areas Mapungubwe (2229AB) and Coila (2229AD). The Mixed *Colophospermum mopane, Combretum apiculatum, Commiphora* spp., *Terminalia prunioides* Community identified by SADF (1986b) was described on the same sandstone ridges of the study area in which the *Hexalobus monopetalus – Croton gratissimus* (1) and *Terminalia prunioides – Grewia bicolor* (2) Communities were identified. According to SADF (1986b) a feature of the landscape in which these communities are found is the steep irregular slopes, the shallow lithosols and the large number of large rocks (up to 30 cm in diameter) found on the soil surface.

In a study conducted by Timberlake & Mapaure (1999) across the Limpopo River in the southwestern parts of Zimbabwe, the *Albizia* – Combretaceae Open Woodland\Shrubland was identified and described. With respect to habitat and floristic composition, this vegetation unit shows similarities toward the *Hexalobus monopetalus – Croton gratissimus* (1) and *Terminalia prunioides – Grewia bicolor* (2) Communities, which were identified on the Ib395 land type, during the course of this study.

CHAPTER 6

CLASSIFICATION AND DESCRIPTION OF THE VEGETATION OF THE FB143 AND AE309 LAND TYPES OF THE VHEMBE-DONGOLA NATIONAL PARK

The vegetation of the Fb143 and the Ae309 land types (Figure 10) are discussed together in this chapter. This is because only small portions of these land types were encountered in the study area. The Ae309 land type on the southwestern part of the farm Greefswald and the Fb143 land type on the western parts of the farm Riedel.

6.1 INTRODUCTION TO THE FB143 LAND TYPE

This land type is mainly situated on the western part of the farm Riedel (Figure 10). The undulating terrain is characterized by moderately deep to shallow soils of the Hutton and Clovelly soil forms and shallow soils of the Oakleaf, Glenrosa and Mispah soil forms. The complex geology of the Fb143 land type is made up of metaquartzite, leucogneiss and pink gneiss of the Mount Dowe Group as well as leucogneiss, amphibolite and metapelite of the Malala Drift Group. The geology further consists of porphyroblastic biotite gneiss of the Bulai Gneiss Formation (Dominion Group) and all three groups of the Beit Bridge Complex (Land Type Survey Staff, 2000). A large part of the area is covered in small to medium sized quartzite pebbles and rocks and also rounded pebbles of other geological origins. Four terrain-units are known to be found in the Fb143 land and include crests (TU1), mid-slopes (TU3), foot slopes (TU4) and valley bottom (TU5).

The Fb143 land type (Figure 10) was moderately to heavily overgrazed and trampled by livestock in the past. Although a degree of veld degradation is found in the vicinity of old watering and feeding points in the area, the vegetation cover of the Fb143 land type is good. This could be ascribed to the fact that the land has been resting after commercial livestock farming was discontinued and a minimal amount of free roaming game now occupies the area.

Tree rich open woodlands characterize the vegetation of the Fb143 land type. During the time of the study a total number of 166 plant species was recorded in this land type. The vegetation is dominated by the woody species *Colophospermum mopane*, which occurs in tree and shrub form. Grand specimens of *Adansonia digitata*, *Kirkia acuminata* and *Pseudolachnostylis maprouneifolia* were encountered in this land type. Two other species, which were rarely encountered, are *Adenia spinosa* and a *Hoodia* species, which is thought to be *Hoodia lugardii*.

Only one plant community was identified in the Fb143 land type, namely the:

1. *Colophospermum mopane – Dicoma tomentosa* Community

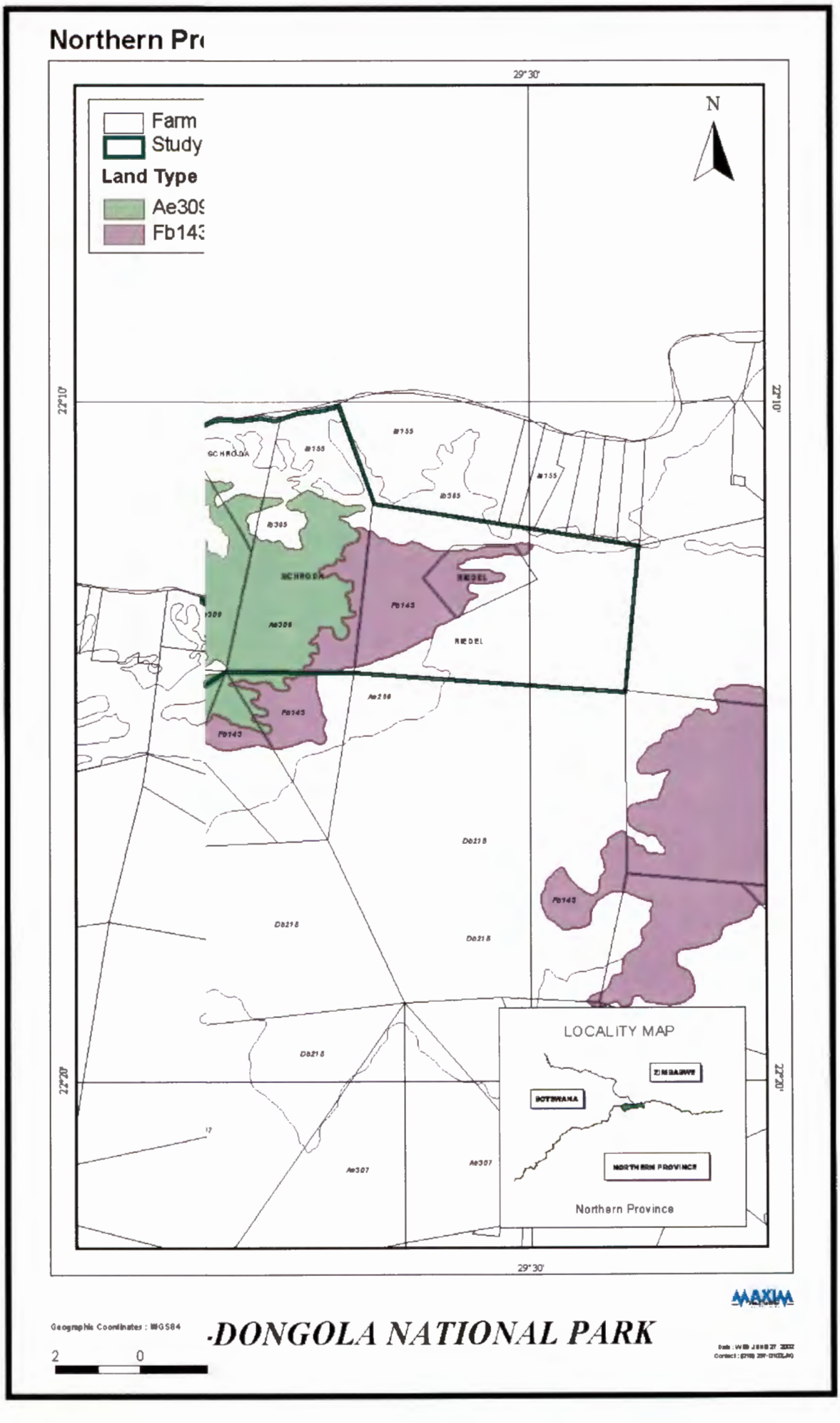

Northern Pr
29°30'
N
Farm
Study
Land Type
Ae30
Fb143
22°10'
22°20'
SCHRODA
RIEDEL
Ib155
Ib365
Ae306
Fb143
Ae256
Db218
Ae307
LOCALITY MAP
ZIMBABWE
BOTSWANA
NORTHERN PROVINCE
Northern Province
MAXIM
Geographic Coordinates : WGS84
DONGOLA NATIONAL PARK
2
0

Fig 10.

6.2 DESCRIPTION OF THE PLANT COMMUNITIES OF THE FB143 LAND TYPE

1. The *Colophospermum mopane – Dicoma tomentosa* Community

This community is situated in the Fb143 land type on the western part of Riedel. The most important soils found in this area are moderately deep Hutton and Clovelly, shallow Glenrosa and Mispah, and moderately deep to shallow neocutanic Oakleaf soil forms. The soil surface is covered in rocks ranging from fine gravel to medium sized, rounded pebbles to larger rocks. The area is moderately grazed and trampled, but is not overgrazed.

The diagnostic species of this community are found in Species group A (Table 5). These include the tree species *Colophospermum mopane* (trees and shrubs), *Commiphora glandulosa, C. mollis, Dichrostachys cinerea* (trees and shrubs), the shrub *Rhigozum zambesiacum*, the grass species *Enneapogon cenchroides* and *Cenchrus ciliaris* and amongst others the forbs *Phyllanthus angolensis, Dicoma tomentosa, Tephrosia purpurea, Acalypha indica, Hermbstaedtia odorata* and *Acrotome inflata.*

The *Colophospermum mopane – Dicoma tomentosa* Community (1) is characterized by tall trees and a good grass cover. The tree layer reaches heights of up to 6.5 m with large specimens of *Adansonia digitata* and *Kirkia acuminata* that grow as high as 10 m. The crown cover of the tree layer varies between 12 and 65%. The shrub layer reaches an average height of 1.5 m, is dominated by *Colophospermum mopane, Dichrostachys cinerea* and *Rhigozum zambesiacum* (Species group A, Table 5), and has a crown cover varying between 5 and 40%. The herbaceous layer is well developed with a crown cover of between 45 and 90% and an average height of 0.6 m.

The *Colophospermum mopane – Dicoma tomentosa* Community (1) has two sub-communities:

1.1 The *Commelina benghalensis – Cucumis zeyheri* Sub-community

1.2 The *Terminalia prunioides – Combretum apiculatum* Sub-community

1.1 The *Commelina benghalensis – Cucumis zeyheri* Sub-community

The *Commelina benghalensis – Cucumis zeyheri* Sub-community is found on all four terrain-units (crest, mid-slope, foot slope & valley bottom) of the Fb143 land type. The dominant soil forms are Hutton and Clovelly with a smaller number of Oakleaf and Glenrosa soils. The soils are generally of moderate depth, the texture is predominantly sandy, and in some areas the soils tend to be calcareous. The rockiness of the soil surface lies between 5 and 20%. This sub-community shows signs of moderate degradation, with the exception of an old watering and feeding point, of which the immediate area surrounding this specific point is severely trampled and degraded. The

TABLE 5: PHYTOSOCIOLOGICAL TABLE OF THE VEGETATION OF THE FB143 LAND TYPE IN THE VHEMBE-DONGOLA NATIONAL PARK

TURBOVEG no.	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1
	9	9	0	9	9	9	9	0	9	9	9	9	9	9	9	9	0
	3	5	4	4	5	5	4	4	3	5	5	5	5	5	9	9	4
	9	0	6	0	6	2	1	9	4	3	5	7	4	8	5	7	8
Relevé no.	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
	2	3	2	2	4	4	2	3	3	4	4	4	4	4	2	3	3
	5	8	4	6	4	0	7	6	7	1	3	5	2	6	3	3	5
No. of species per relevé	2	2	4	3	2	2	4	4	3	5	4	4	5	2	3	4	4
	9	2	4	4	6	3	7	5	5	0	4	9	7	5	5	6	3
Community	1																
Sub-communities	1.1								1.2								
Variants									1.2.1						1.2.2		
Species group A																	
Colophospermum mopane -trees	1	4	b	4	a	b	a	a	+	b	b	1	1	a	1	b	3
Colophospermum mopane -shrubs	.	.	1	1	.	a	1	a	a	1	a	.	.	.	.	a	1
Phyllanthus angolensis	1	+	+	+	+	.	+	+	+	1	+	+	+	+	+	+	+
Dicoma tomentosa	+	1	1	1	1	.	+	a	+	a	a	1	1	a	.	1	1
Enneapogon cenchroides	.	.	.	b	3	1	+	a	b	1	a	1	1	a	1	1	a
Cenchrus ciliaris	1	a	.	.	a	.	1	.	+	1	a	1	.	1	+	b	a
Commiphora glandulosa	.	.	a	.	.	1	1	a	+	1	a	b	b	.	1	1	1
Tephrosia purpurea	+	.	.	1	.	1	+	1	.	1	.	1	1	1	3	b	b
Acalypha indica	.	1	+	+	1	.	+	.	.	1	1	1	+	.	+	.	1
Hermbstaedtia odorata	.	+	+	1	+	.	.	+	.	+	+	+	+	.	+	+	+
Acrotome inflata	1	.	a	.	.	1	a	1	.	.	1	.	+	.	.	+	+
Dichrostachys cinerea	a	.	+	a	.	.	a	+	+	.	.	.	.	.	+	a	.
Ptycholobium contortum	1	.	1	+	1	.	.	.	.	.	+	.	1	.	.	+	+
Commiphora mollis	.	.	a	.	.	.	+	a	.	a	.	.	a	1	.	.	1
Rhigozum zambesiacum	.	.	1	.	.	1	.	a	+	.	.	.	1	1	.	.	a
Limeum fenestratum var. *exaltum*	.	1	.	.	.	.	+	+	.	.	1	.	.	.	+	+	1
Bulbostylis hispidula	+	.	+	.	.	.	1	.	.	.	.	.	+	.	.	+	+
Species group B																	
Commelina benghalensis	1	1	1	+	.	1	1	1	.	1	.	.	1	.	.	.	+
Urochloa mosambicensis	1	b	a	.	.	a	.	a	.	.	.	.	.	.	.	.	.
Ipomoea magnusiana var. *magnusiana*	a	.	1	.	.	+	a	1	.	.	+	.	.	.	.	.	1
Catophractes alexandri	.	.	a	.	3	a	3	.	.	.	.	.	.	.	.	.	.
Indigofera charlieriana	.	.	1	.	1	.	+	1	.	.	.	.	.	.	.	.	.
Rhynchosia nervosa	+	.	+	.	.	+	1	.	.	.	.	.	.	.	.	.	.
Chloris virgata	+	.	.	1	.	4	.	.	.	.	.	.	.	.	.	.	.
Boscia foetida	.	1	.	1	+	.	.	.	+	.	.	.	.	.	+	.	.
Geigeria burkei subsp. *Fruticulosa*	1	.	.	.	.	.	+	1	.	.	.	.	.	.	+	.	.
Ipomoea sinensis subsp. *blepharosepala*	.	.	+	1	.	.	.	+	.	+	.	.	.	.	.	.	.
Decorsea schlechteri	+	.	+	.	.	.	1	.	.	.	.	+	.	.	+	.	.
Species group C																	
Terminalia prunioides	1	.	+	.	a	.	+	+	a	.	b	a	a	1	1	a	1
Combretum apiculatum	.	.	.	.	.	.	.	.	+	.	a	.	1	a	a	b	a
Melinis repens	.	.	.	.	.	.	+	1	.	+	+	+	+	b	+	a	.
Calostephane divaricata	.	+	.	.	.	.	.	+	.	+	+	1	1	+	+	+	.
Hibiscus micranthus	.	.	.	.	+	.	+	+	+	+	1	+	+	.	.	+	+
Solanum kwebense	.	.	.	.	.	.	.	.	+	.	+	.	1	.	.	1	a
Cadaba termitaria	.	.	+	.	.	.	.	.	.	1	+	+	.	.	1	1	.
Kyphocarpa angustifolia	.	.	.	.	.	.	.	+	.	+	.	+	+	.	.	1	+
Aptosimum lineare	.	.	.	.	1	.	+	.	.	+	+	.	1	.	.	+	+
Schmidtia pappophoroides	.	.	+	.	.	.	+	.	.	.	1	.	.	1	+	.	1

Relevé no.	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
	2	3	2	2	4	4	2	3	3	4	4	4	4	4	2	3	3
	5	8	4	6	4	0	7	6	7	1	3	5	2	6	3	3	5
Community	1																
Sub-communities	1.1								1.2								
Variants									1.2.1						1.2.2		
Species group D																	
Commiphora tenuipetiolata	.	.	.	.	.	.	.	.	3	+	1	b	a	.	.	.	.
Tricliceras glanduliferum	.	.	+	.	.	.	.	+	.	+	.	1	1	+	.	.	.
Datura species	.	.	.	.	.	.	.	.	.	+	.	+	+	+	.	.	.
Brachiaria deflexa	.	.	.	.	.	.	+	.	3	.	1	.	1	.	.	.	+
Kirkia acuminata	.	.	.	.	.	.	.	.	1	a	.	1	.	.	.	.	.
Chamaesyce eylesii	.	.	.	.	.	.	.	.	1	+	.	a	.	.	.	.	.
Aristida scabrivalvis	.	.	.	.	.	.	.	.	.	1	+	.	.	a	.	.	.
Grewia villosa	.	.	.	.	.	.	.	1	+	.	.	1	1	.	.	+	.
Commicarpus pentandrus	.	.	.	.	.	.	.	.	+	.	.	+	1	.	+	.	.
Indigofera heterotrich	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.
Corchorus asplenifolius	.	.	.	.	+	.	+	.	.	+	.	+	+	.	.	.	.
Indigofera nebrowniana	.	.	.	.	1	.	.	.	.	+	+	.	+	.	.	.	.
Becium filamentosum	.	.	.	+	.	.	.	+	.	+	.	+	+	.	.	.	.
Acacia senegal var. *rostrata*	a	.	.	.	.	.	.	.	.	a	.	b	.	.	.	.	.
Acacia senegal var. *leiorhachis*	.	.	.	.	.	.	.	.	.	a	.	a	.	.	.	.	.
Commiphora merkeri	.	.	.	.	.	.	.	.	.	.	.	1	a	.	.	.	.
Species group E																	
Cucumis zeyheri	a	1	a	a	1	a	1	1	.	+	1	+	1	.	.	+	1
Grewia bicolor	1	.	1	+	1	.	1	1	a	a	1	b	.	a	.	.	1
Aristida congesta subsp. *congesta*	b	.	.	a	+	b	b	.	.	+	+	1	1	1	.	+	.
Pavonia burchellii	+	.	1	1	.	+	+	.	.	+	+	+	+	.	.	.	.
Monsonia glauca	+	.	1	.	.	+	1	+	.	+	1	1	+	.	.	.	+
Aristida adscensionis	.	.	1	1	a	.	1	a	.	.	a	1	1	.	.	.	+
Abutilon austro-africanum	.	+	.	a	+	1	.	+	.	1	.	.	+	.	.	+	.
Zornia glochidiata	1	.	+	.	.	.	+	+	.	.	+	.	+	1	.	.	.
Sterculia rogersii	.	.	1	+	.	.	+	.	1	1	.	1	.	.	.	.	.
Indigastrum costatum subsp. *macrum*	.	.	.	a	a	.	+	.	a	.	+	.	.	.	.	.	.
Leucas sexdentata	.	.	+	+	1	.	.	.	.	.	+	1	.	.	.	.	.
Tragus berteronianus	.	.	+	+	.	.	.	.	+	.	+	.	+	.	.	.	.
Species group F																	
Cleome angustifolia	.	.	.	.	+	.	.	+	.	+	.	1	.	.	+	1	1
Gisekia pharnacioides var. *pharnacioides*	.	.	+	+	.	.	.	.	+	.	+	.	.	.	+	1	+
Ceratotheca triloba	.	.	.	.	.	.	.	.	+	.	.	.	+	.	a	.	1
Heliotropium ovalifolium	.	.	.	.	.	+	.	1	+	.	.	.	.	.	.	+	a
Asparagus africanus	.	+	.	.	.	.	1	.	.	.	+	.	.	.	.	+	a
Digitaria eriantha	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.
Ochna inermis	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	+	.
Stipagrostis uniplumis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1
Panicum maximum	.	a	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.
Melhania acuminata var. *agnosta*	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+
Chamaesyce glanduligera	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+
Hermannia glanduligera	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+
Other species																	
Achyranthes aspera	.	+	+	.	.	.	+	.	.	.	.	.	a	.	.	.	.
Vernonia cinerascens	.	+	.	.	+	.	+	.	.	.	.	+	.	.	.	.	.
Urochloa stolonifera	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.
Acacia tortilis	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Albizia anthelmintica	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis inamoena	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solanum panduriforme	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acacia tenuispina	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Asparagus species	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera circinnata	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigorera rhytidocarpa subsp. *rhytidocarpa*	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.
Tribulus terrestris	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.

Relevé no.	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
	2	3	2	2	4	4	2	3	3	4	4	4	4	4	2	3	3
	5	8	4	6	4	0	7	6	7	1	3	5	2	6	3	3	5
Community	1																
Sub-communities	1.1								1.2								
Variants									1.2.1						1.2.2		
Plumbago zeylanica	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flaveria bidentis	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pupalia lappacea	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Salvadora australis	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Commiphora africana	.	.	.	.	.	.	1	.	.	.	+	.	.	.	.	.	.
Commiphora pyracanthoides	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
Indigofera species	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Solanum species	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Boscia albitrunca	.	.	+	.	.	.	.	1	.	.	.	.	+	.	.	.	.
Crotalaria species	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.
Combretum molle	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Bothriochloa insculpta	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Dicliptera clinopodia	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Grewia flavescens	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Blepharis aspera	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Ipomoea magnusiana var. *eenii*	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Oropetium capense	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.
Sesamothamnus lugardii	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.
Sida ovata	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.
Monsonia senegalensis	.	.	.	.	.	.	.	.	.	1	.	.	+	.	.	1	.
Rhynchosia minima var. *minima*	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.
Cyathula orthacantha	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.
Lantana rugosa	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Cleome monophylla	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Indigofera trita subsp. *subulata*	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	+
Tetrapogon tenellus	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Cordia grandicalyx	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Disperis macowanii	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.
Ophioglossum costatum	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Mollugo species	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Abutilon angulatum	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.	.	.
Craterostigma plantaginium	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Hibiscus sidiformis	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Kyllinga alba	.	.	+	.	.	.	.	.	.	+	.	.	+	.	.	.	.
Indigofera vicioides var. *rogersii*	.	.	.	.	.	.	.	.	.	1	.	.	+	.	.	.	.
Mariscus rehmannianus	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.
Eragrostis trichophora	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.
Xerophyta humilis	.	.	.	.	.	.	.	.	.	.	.	.	+	a	.	.	.
Endostemon tereticaulis	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Eragrostis viscosa	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Geigeria acaulis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Abutilon grandiflorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Crotalaria lotoides	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	.	.
Croton pseudopulchellus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Panicum deustum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Sida species	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Vangueria infausta subsp. *infausta*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Abutilon sonneratianum	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.
Verbesina encelioides var. *encelioides*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Evolvulus alsinoides var. *linifolius*	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	+	+
Hemizygia petrensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Tribulus zeyheri subsp. *zeyheri*	.	.	+	.	.	.	.	.	+	.	.	.	.	.	+	.	.
Acacia nigrescens	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Momordica balsamina	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Ximenia americana	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vigna frutescens	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Commiphora edulis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	a	.	.
Seddera suffruticosa	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Asparagus suaveolens	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.
Chamaecrista absus	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis lehmanniana	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	+	.
Sesamum triphyllum	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.
Oxygonum delagoense	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Waltheria indica	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
□																	

herbaceous layer at this old watering point is patchy and poor to say the least and surface erosion was observed at this locality.

Diagnostic species of this sub-community are found in Species group B (Table 5). This includes the tree species *Boscia foetida*, the shrubby *Catophractes alexandri*, the grass species *Urochloa mosambicensis*, Chloris virgata, and the forb species *Commelina benghalensis, Indigofera charlieriana, Ipomoea magnusiana* var. *magnusiana, Ipomoea sinensis* subsp. *blepharosepala* and *Rhynchosia nervosa*. This sub-community is differentiated from the *Terminalia prunioides – Combretum apiculatum* Sub-community (1.2) by the absence or low cover abundance of the species of Species groups C, D and F (Table 5). High cover abundance of the herbaceous creeper *Cucumis zeyheri* (Species group E, Table 5) further differentiates the *Commelina benghalensis – Cucumis zeyheri* Sub-community from the other sub-communities in the *Colophospermum mopane – Dicoma tomentosa* Community (1).

The tree layer has an average height of 4.5 m and a crown cover ranging from 12 to 60%. The shrub layer has an average height of 1.5 m and covers between 5 and 40% of the Sub-community area. The crown cover of the well-developed herbaceous layer is between 60 and 90% and reaches an average height of 0.7 m.

1.2 The *Terminalia prunioides – Combretum apiculatum* Sub-community

This sub-community is found on the crest (TU1) and the mid-slope (TU3) of the Fb143 land type on moderately deep to shallow, rocky Hutton, Glenrosa and Mispah soil forms. The rockiness of the soil surface is between 20 and 50%. The area is not overgrazed or trampled and appears to be in a good condition.

Diagnostic species of the *Terminalia prunioides – Combretum apiculatum* Sub-community are found in Species group C (Table 5) and include the tree species *Terminalia prunioides* and *Combretum apiculatum*, the shrubs *Hibiscus micranthus, Solanum kwebense* and *Cadaba termitaria*. The diagnostic grass species are *Melinis repens* and *Schmidtia pappophoroides* and the forbs include *Calostephane divaricata, Kyphocarpa angustifolia* and *Aptosimum lineare*. This sub-community is differentiated from the *Commelina benghalensis – Cucumis zeyheri* Sub-community (1.1) by the absence or low cover abundance of the species of Species group B (Table 5).

The tree layer reaches an average height of 3.8 m and has a crown cover varying from 18 to 65%. The shrub layer has an average height of 1.5 m and a crown cover of 10 to 40% and the herbaceous layer with its crown cover varying between 45 and 75% has an average height of 0.6 m.

Two variants were identified in the *Terminalia prunioides – Combretum apiculatum* Sub-community (1.2):

1.2.1 The *Commiphora tenuipetiolata – Grewia bicolor* Variant

1.2.2 The *Cleome angustifolia – Tephrosia purpurea* Variant

1.2.1 The *Commiphora tenuipetiolata – Grewia bicolor* Variant

This variant is found in the *Colophospermum mopane – Dicoma tomentosa* Community (1) on the crest (TU1) and mid-slopes (TU3) of the Fb143 land type. The dominant soils in this variant are soils of the Hutton, Glenrosa and Mispah soil forms. The soils are shallower than those found in the *Commelina benghalensis – Cucumis zeyheri* Sub-community (1.1) and have more rocks on the soil surface with a rockiness percentage of between 20 and 40%. Although the grass cover of this variant is lower than in the *Commelina benghalensis – Cucumis zeyheri* Sub-community (1.1) it is less degraded. The lower grass cover is probably due to the shallower soils and the higher rockiness of the soil surface in this sub-community.

The diagnostic species of the *Commiphora tenuipetiolata – Grewia bicolor* Variant (1.2.1) are found in Species group D (Table 5). This includes the tree species *Commiphora tenuipetiolata, C. merkeri, Kirkia acuminata, Acacia senegal* var. *rostrata* and *A. senegal* var. *leiorachis*, the shrub *Grewia villosa*, the grasses *Brachiaria deflexa* and *Aristida scabrivalvis*, and the forbs *Tricliceras glanduliferum, Datura* species, *Chamaesyce eylesii, Commicarpus pentandrus, Indigofera heterotricha, I. nebrowniana* and *Becium filamentosum*. The absence or low cover abundance of the species of Species groups B and F (Table 5) further differentiate this variant from the *Commelina benghalensis – Cucumis zeyheri* Sub-community (1.1) and the *Cleome angustifolia – Tephrosia purpurea* Variant (1.2.2). Affinities between this variant and the *Commelina benghalensis – Cucumis zeyheri* Sub-community (1.1) come in the form of the high cover abundance of the species of Species group E (Table 5).

The tree layer has an average height of 4.0 m and a crown cover varying between 20 to 65%. The shrub layer, which is dominated by *Grewia bicolor* (Species group E, Table 5), reaches an average height of 1.4 m and has a crown cover of 12 to 40%. The herbaceous layer has a crown cover of between 45 and 75% and an average height of 0.6 m.

1.2.2 The *Cleome angustifolia – Tephrosia purpurea* Variant

The *Cleome angustifolia – Tephrosia purpurea* Variant is mainly situated on the crest rocky outcrops (TU1) of the Fb143 land type. The soils are dominated by shallow soils of the Glenrosa and Mispah soil forms. Shallow Hutton soil forms were also encountered on limited localities. The rockiness of the soil surface is between 30 and 50% and approximately 10% of the area is covered by bare mother rock. Some of the areas within the *Cleome angustifolia – Tephrosia purpurea* Variant (1.2.2) is degraded as a result of overgrazing, but on a larger scale this sub-community is in a good condition.

Diagnostic species of this sub-community are found in Species group F (Table 5). This includes the shrub species *Asparagus africanus* and *Ochna inermis*, the grasses *Digitaria eriantha, Stipagrostis uniplumis* and *Panicum maximum* and the forbs *Cleome angustifolia, Gisekia pharnacioides* var. *pharnacioides, Ceratotheca triloba,*

Heliotropium ovalifolium, Melhania acuminata var. *agnosta, Chamaesyce glanduligera* and *Hermannia glanduligera.* High cover abundance values of the tree species *Combretum apiculatum* (Species group C, Table 5) and the forb species *Tephrosia purpurea* (Species group A, Table 5) differentiate this variant from the *Commiphora tenuipetiolata – Grewia bicolor* Variant (1.2.1). This variant is affiliated to the *Commiphora tenuipetiolata – Grewia bicolor* variant (1.2.1) through the species of Species group C (Table 5).

The average height of the tree layer of this variant is 3.6 m with a crown cover varying between 18 and 40%. The shrub layer has an average height of 1.7 m and the crown cover varies between 10 and 30%. The herbaceous layer covers between 60 and 65% of this sub-community and has an average height of 0.5 m.

6.3 ORDINATION OF THE FB143 LAND TYPE

In the scatter diagram (Figure 11) the distribution of the relevés along the first and second axes of the ordination is given.

A discontinuity is evident between the two sub-communities of the *Colophospermum mopane – Dicoma tomentosa* Community (1) identified in the Fb143 land type along ordination axis one of the scatter diagram (Figure 11). The gradients illustrated along the first ordination axis could be related to soil depth and the rockiness of the soil surface. Shallower soils are associated with a high percentage of rocks on the soil surface and appear to the left of the diagram while deeper soils, which are associated with a low rockiness of the soil surface, are situated on the right of the scatter diagram.

The *Commelina benghalensis – Cucumis zeyheri* Sub-community (1.1) is situated on the right hand side of the scatter diagram (Figure 11) and is associated with moderately deep and deep soils and the rockiness of the soil surface is between 5 and 20 %. The *Terminalia prunioides – Combretum apiculatum* Sub-community (1.2) lies to the left of the diagram (Figure 11) and is strongly associated with moderately deep to shallow soils with a high percentage of rocks on the soil surface of between 20 and 50%

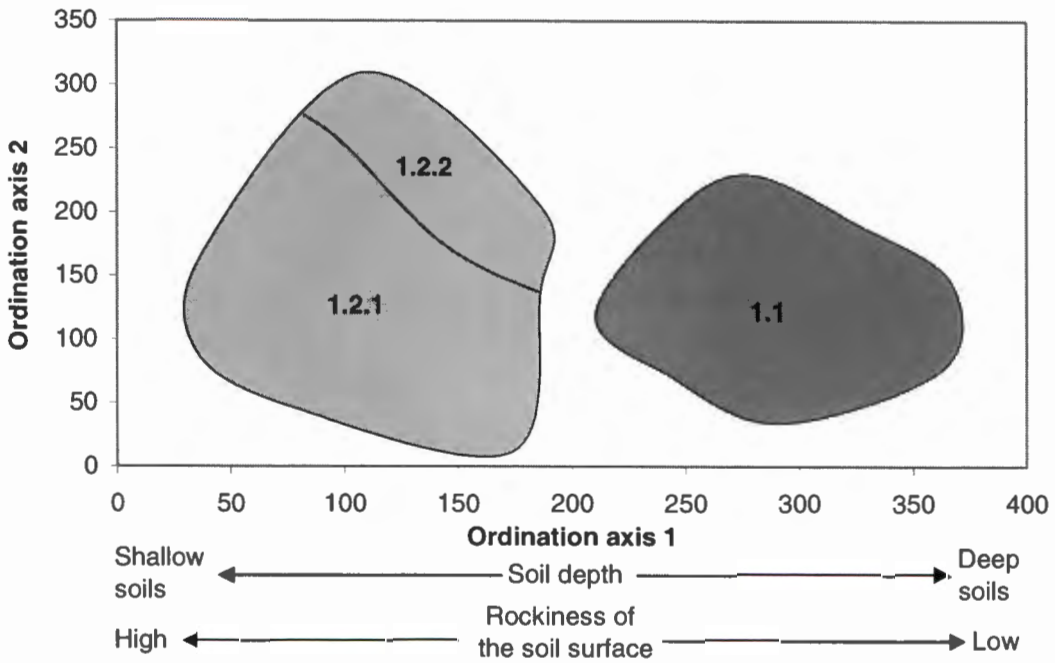


Figure 11: The relative positions of the communities and sub-communities along the first two axes of the ordination of the relevés sampled in the Vhembe-Dongola National Park on the **Fb143 land type**

6.4 INTRODUCTION TO THE AE309 LAND TYPE

The soils of the Ae309 land type are dominated by deep to moderately deep soils of the Hutton soil form and moderately deep to shallow soils of the Glenrosa soil form. Although the soil surface is generally free of rocks, calcareous concretions do occur on the soil surface of one of the communities in this land type. The geology of the Ae309 land type consists of Sandstone of the Clarens Formation of the Karoo Sequence (Land type survey staff, 2000). This land type was encountered in the southwestern plateau of the farm Greefswald. Three terrain-units are generally found in the Ae309 land type: crest (TU1), foot slopes (TU4) and valley bottom (TU5). Only the crest (TU1) of the Ae 309 land type was however found in the area in which the study was executed.

The area is moderately grazed and trampled by game. The general impression is that the veld condition is good with a good vegetation cover. There are however areas in the vicinity of small dams (Jack se Dam and Dubbel Dam), where the vegetation is poor and extremely trampled. Both these dams occur on the ecotone between the Ae309 land type (Figure 10) and the Ib395 land type (Figure 8).

The vegetation of this land type is characterized by woodland and in some areas shrubby vegetation occurring in clearings between the tree rich areas. The tree species *Terminalia prunioides* (Species group A, Table 6), *Colophospermum mopane* (Species group B, Table 6), the shrub *Solanum kwebense* (Species group A, Table 5), and a number of grass species dominate the vegetation of the Ae309 land type. Large specimens of *Adansonia digitata* are also present. The Ae309 land type has the lowest plant diversity compared to the other land types. Only 92 plant species was identified in this land type during the course of this study.

Two plant communities were identified in the Ae309 land type:

1. The *Colophospermum mopane – Eragrostis lehmanniana* Community
2. The *Catophractes alexandri – Boscia albitrunca* Community

6.5 DESCRIPTION OF THE PLANT COMMUNITIES OF THE AE309 LAND TYPE

1. The *Colophospermum mopane – Eragrostis lehmanniana* Community

This community is found on deep to moderately deep sandy soils of the Hutton soil form in the Ae309 land type. Although the area, in which sampling took place, only occurs on the crest (TU1) of this land type, the terrain is slightly undulating with a number of runoff streams bisecting the area. The rockiness of the soil surface is less than 1%. The area is moderately grazed and trampled but not overgrazed.

The diagnostic species of the *Colophospermum mopane – Eragrostis lehmanniana* Community are found in Species group A (Table 6). This includes the tree species *Colophospermum mopane* (trees and shrubs), *Combretum apiculatum*, *Dichrostachys cinerea* (trees and shrubs) and *Grewia bicolor* (shrubs), the grasses *Eragrostis lehmanniana, Schmidtia pappophoroides, Brachiaria deflexa, Melinis repens, Cenchrus ciliaris* and *Stipagrostis uniplumis*. The diagnostic forb species include *Tephrosia polystachya* var. *polystachya, Gisekia pharnacioides* var. *pharnacioides, Ipomoea magnusiana* var. *magnusiana, Acrotome inflata, Sesamum triphyllum, Limeum fenestratum* var. *exaltum* and *Oxygonum delagoense.*

Colophospermum mopane, Combretum apiculatum (Species group A, Table 6) and *Terminalia prunioides* (Species group C, Table 6) dominate the tree layer of this community. The tree layer reaches an average height of 3.9 m and has a crown cover varying between 22 and 45%. The shrub layer has an average height of 1.6 m and covers between 15 and 68% of the community area. The crown cover of the herbaceous layer varies from 43 to 85% and has an average height of 0.7 m.

TABLE 6: PHYTOSOCIOLOGICAL TABLE OF THE VEGETATION OF THE AE309 LAND TYPE IN THE VHEMBE-DONGOLA NATIONAL PARK

TURBOVEG no.	5	5	5	5	5	5	5	5
	0	0	0	0	0	0	0	0
	8	8	9	9	9	9	8	9
	8	8	0	0	0	0	8	0
	7	8	7	6	8	3	9	5
Relevé no.	5	5	6	6	6	5	5	5
	4	5	1	0	2	8	6	9
No. of species per relevé	5	3	4	3	3	2	2	2
	1	4	0	2	3	4	5	3
Communities			1				2	
Species group A								
Colophospermum mopane -trees	b	b	a	3	a	.	a	.
Colophospermum mopane -shrubs	+	3	a	a	a	.	a	.
Eragrostis lehmanniana	3	1	a	a	b	.	1	.
Combretum apiculatum	a	1	1	a	a	.	.	.
Schmidtia pappophoroides	a	a	+	+	+	.	.	.
Tephrosia polystachya var. *polystachya*	1	+	+	1	+	.	.	.
Gisekia pharnacioides var. *pharnacioides*	+	+	+	+	+	.	.	.
Ipomoea magnusiana var. *magnusiana*	+	+	+	+	+	.	.	.
Dichrostachys cinerea	1	b	.	b	+	.	.	.
Acrotome inflata	a	+	+	.	b	.	.	.
Brachiaria deflexa	.	+	1	1	+	.	.	+
Melinis repens	1	+	+	.	+	.	.	.
Sesamum triphyllum	+	+	+	.	+	.	.	.
Indigofera species	+	+	+	.	+	+	.	.
Limeum fenestratum var. *exaltum*	b	a	.	+	.	.	.	+
Cenchrus ciliaris	.	a	1	1	.	.	.	.
Stipagrostis uniplumis	a	.	+	.	a	.	.	.
Oxygonum delagoense	1	.	+	.	1	.	.	.
Calostephane divaricata	1	+	1	.	.	.	.	.
Grewia bicolor	+	.	1	+	.	.	1	.
Species group B								
Catophractes alexandri	.	.	.	.	.	b	1	3
Hermbstaedtia odorata	.	+	.	+	.	a	1	a
Boscia albitrunca	a	.	+	.	.	1	1	1
Ptycholobium contortum	.	.	.	.	.	1	+	a
Aristida rhiniochloa	.	.	.	+	.	+	1	a
Abutilon austro-africanum	.	.	.	+	.	+	+	1
Eragrostis trichophora	.	.	.	.	.	+	+	+
Indigofera circinnata	.	.	.	.	.	+	+	+
Leucas sexdentata	.	.	.	+	.	+	+	+
Tragus berteronianus	.	.	1	.	.	b	.	b
Enneapogon desvauxii	.	.	+	.	.	+	.	1
Commiphora glandulosa	.	.	.	.	.	+	1	.
Species group C								
Enneapogon cenchroides	+	+	a	b	+	+	a	+
Terminalia prunioides	1	1	b	a	.	a	a	a
Tribulus zeyheri subsp. *zeyheri*	+	+	1	a	.	b	b	1
Solanum kwebense	+	b	1	1	+	+	+	.
Aristida congesta subsp. *congesta*	.	+	+	1	1	.	a	+
Cleome angustifolia	+	+	+	+	.	+	.	+
Cadaba termitaria	1	+	.	1	.	+	a	.
Commicarpus pentandrus	.	.	+	+	.	+	.	1
Rhigozum zambesiacum	.	+	.	.	+	.	+	+

Relevé no.	54	55	61	60	62	58	56	59
Communities	1					2		
Other species								
Lannea schweinfurthii	a	.	.	.	.	.	.	.
Strychnos madagascariensis	a	.	.	.	.	.	.	.
Ximenia americana	1	.	.	.	.	.	.	.
Commelina africana	+	.	.	.	.	.	.	.
Rhynchosia nervosa	+	.	.	.	.	.	.	.
Convolvulus sagittatus subsp. *sagittatus*	+	.	.	.	.	.	.	.
Dicerocaryum eriocarpum	+	.	.	.	.	.	.	.
Monsonia glauca	+	.	.	.	.	.	.	.
Hermannia species	+	.	.	.	.	.	.	.
Ipomoea species	+	.	.	.	.	.	.	.
Limeum viscosum	+	.	.	.	+	.	.	.
Lonchocarpus capassa	+	.	.	.	.	.	.	.
Macrotyloma daltonii	+	.	.	.	.	.	.	.
Asparagus africanus	+	.	.	.	.	.	.	.
Momordica balsamina	+	.	.	.	.	.	.	.
Terminalia sericea	+	.	.	.	.	.	.	.
Cleome species	+	.	.	.	.	.	.	.
Vigna frutescens	+	+	.	.	.	.	.	.
Sclerocarya birrea	r	.	.	.	.	.	.	.
Commiphora edulis	.	1	+	.	.	.	.	.
Trichoneura species	.	r	.	.	.	.	.	.
Phyllanthus angolensis	.	+	.	.	.	+	.	.
Dicoma tomentosa	.	+	.	.	.	.	.	.
Dichilus lebeckioides	.	.	3	.	+	.	.	.
Sterculia rogersii	1	.	1	.	.	.	.	.
Commiphora mollis	.	1	1	.	.	.	.	.
Decorsea schlechteri	.	.	+	+	.	.	.	.
Barleria senensis	.	.	+	.	.	.	.	.
Combretum microphyllum	.	.	+	.	.	.	.	.
Asparagus suaveolens	.	.	+	.	.	.	.	.
Grewia flava	.	+	.	a	.	.	.	.
Seddera suffruticosa	.	.	+	1	.	.	.	.
Ochna inermis	.	.	+	+	.	.	.	.
Arististida stipitata	.	.	.	.	a	.	.	.
Cassia abbreviata	.	.	.	.	a	.	.	.
Zornia glochidiata	.	.	.	.	1	.	.	.
Panicum schinzii	.	.	.	.	1	.	.	.
Chamaecrista absus	+	.	.	.	1	.	.	.
Heliotropium species	+	.	.	.	1	.	.	.
Dicoma zeyheri	.	.	.	.	+	.	.	.
Waltheria indica	+	.	+	.	+	.	.	.
Cucumis zeyheri	.	+	+	.	+	.	.	.
Commelina benghalensis	+	.	.	.	+	.	.	.
Cordia monoica	.	.	.	.	.	1	.	.
Vernonia cinerascens	.	.	.	.	.	.	+	.
Acacia senegal var. *rostrata*	.	.	.	.	.	.	+	.
Aptosimum lineare	.	.	.	.	.	.	+	.
Acacia tortilis	.	.	.	+	.	.	+	.
Sida rhombifolia	.	.	.	.	.	.	.	+
Acacia nigrescens	.	.	.	.	.	.	.	r
Geigeria burkei subsp. *fruticulosa*	.	.	.	.	.	+	.	+
Acalypha indica	+	.	.	+	.	+	.	.
□								

2. The *Catophractes alexandri – Boscia albitrunca* Community

This disturbed community is situated on shallow Oakleaf, Glenrosa and Hutton soils on the crest (TU1) of the Ae309 land type. The *Catophractes alexandri – Boscia albitrunca* Community (2) form island communities within the other community of the Ae309 land type, and normally covers only small areas. The soil surface is compacted and covered with calcareous concretions and other rocks. The rockiness of the soil surface was estimated at an average of 15%. The community area is degraded as a result of overgrazing and trampling. It was further observed that some large trees, which are found in these areas, have died or are dying, probably as a result of lowered water infiltration, because of the soil compaction and a large degree of surface runoff. Shrubs dominate the woody layer of this community.

The diagnostic species of this community are found in Species group B (Table 6) and include the tree species *Boscia albitrunca*, the shrubby *Abutilon austro-africanum* and *Commiphora glandulosa,* the grass species *Aristida rhiniochloa, Eragrostis trichophora, Tragus berteronianus* and *Enneapogon desvauxii.* The diagnostic forbs include *Hermbstaedtia odorata, Ptycholobium contortum, Indigofera circinnata* and *Leucas sexdentata.* The low cover abundance of the shrubby *Solanum kwebense* (Species group C, Table 6) further differentiates this community from the *Colophospermum mopane – Eragrostis lehmanniana* Community (1).

The tree layer is sparse with a crown cover of only 5 to 15% and an average height of 3.8 m. The dominant shrub layer covers between 35 and 55% of the community area with an average height of 1.5 m and the herbaceous layer reaches an average height of only 0.3 m and has a crown cover varying between 40 and 60%.

6.6 ORDINATION OF THE AE309 LAND TYPE

In the scatter diagram (Figure 12) the distribution of the relevés along the first and second axes of the ordination is given.

A clear discontinuity can be recognized between the two communities of the Ae309 land type on ordination axis one of the scatter diagram (Figure 12). The gradients illustrated along the first ordination axis of the diagram could be related to the texture of the soil and the degree of degradation observed in this land type. From the scatter diagram it can be interpreted that the degree of degradation is strongly associated with the soil texture. This is probably due to the fact that clayey soils are frequently compacted due to the hoof action of animals and as a result less water penetrates the soil surface in a rain event. Hence the soil is drier and only species, which have the means of fiercely competing for water, survive in these barren environments.

The *Colophospermum mopane – Eragrostis lehmanniana* Community (1) is situated on the left side of the scatter diagram (Figure 12) and is associated with sandy soils and the community is not degraded to a large extent. The *Catophractes alexandri – Boscia*

albitrunca Community (2) on the other hand lies to the right of the diagram (Figure 12) and is strongly associated with highly degraded areas on compacted, clayey soils.

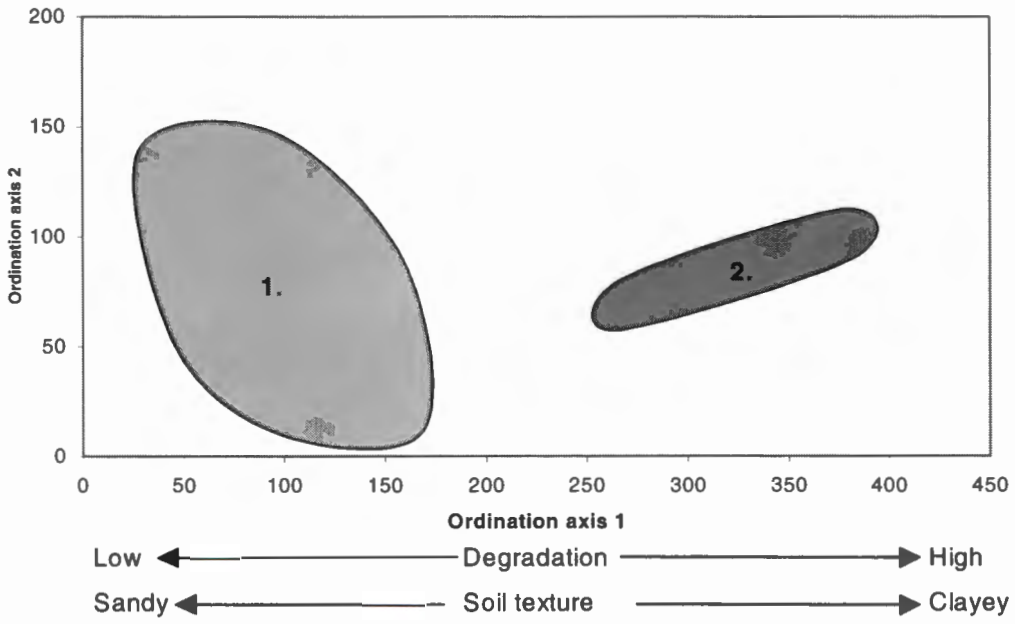


Figure 12: The relative positions of the communities and sub-communities along the first two axes of the ordination of the relevés sampled in the Vhembe-Dongola National Park on the **Ae309 land type**

6.7 CONCLUSIONS

In the Fb143 land type, the habitat and vegetation of the *Colophospermum mopane – Dicoma tomentosa* Community (1) compares well with the *Colophospermum mopane, Combretum apiculatum, Commiphora* spp., *Kirkia acuminata* Veld described in a vegetation report of the former South African Defence Force (SADF, 1986a). As a whole the floristic composition and most of the habitat characteristics of the *Colophospermum mopane – Dicoma tomentosa* Community (1) found in the Fb143 land type is comparable to the *Colophospermum – Terminalia – Commiphora* Woodland described by Timberlake and Mapaure (1999).

Du Plessis (2000) described the *Ptycholobium contortum – Colophospermum mopane* vegetation type, which according to Du Plessis (2000) is confined to the Mopaneveld north of the Soutpansberg in the Limpopo River Valley. This vegetation type is similar

in habitat features and vegetation, to the *Colophospermum mopane – Dicoma tomentosa* Community (1) in the Fb143 land type.

According to floristic composition, the *Colophospermum mopane – Eragrostis lehmanniana* Community (1) and the *Catophractes alexandri – Boscia albitrunca* Community (2) in the Ae309 land type is similar to that of the *Ptycholobium contortum – Colophospermum mopane* vegetation type described by Du Plessis (2000) as limited to the area north of the Soutpansberg in the Limpopo River Valley. The habitat and floristic characteristics of the communities of the Ae309 land type in the study area, is further closely related to that of the *Boscia foetida – Colophospermum mopane* vegetation unit described by Du Plessis (2000).

CHAPTER 7

SYNTHESIS OF THE VEGETATION OF THE VHEMBE-DONGOLA NATIONAL PARK

7.1 INTRODUCTION

The study area was divided into five main areas in which the vegetation was described. The five areas are the Db218 (Chapter 3; Figure 4), Ia155 (Chapter 4; Figure 6), Ib395 (Chapter 5; Figure 8), Fb143 and Ae309 (Chapter 6; Figure 10) land types. The vegetation of each of these areas was described and plant communities, sub-communities and variants were identified.

In this chapter the relationship between the communities of the different land types was investigated in order to classify the vegetation of the Park as a whole. In order to examine the whole data set it was grouped together in a synoptic table (Table 7). In this table the affinities between plant communities and the overall species composition of community groups is visualized. It is important to compare the vegetation of the different land types in order to point out overlapping communities and to which extent the vegetation of one area is related to another (Van Wyk, 1998).

7.2 DISCUSSION OF VEGETATION GROUPS.

In Table 8 a summary is given of the relationships between the various vegetation groups, land types and plant communities in the Vhembe-Dongola National Park.

Through the construction of the synoptic table eight different vegetation groups were identified:

1. The *Hexalobus monopetalus – Bulbostylis hispidula* Group
2. The *Acacia senegal* var. *leiorhachis – Barleria sinensis* Group
3. The *Colophospermum mopane – Brachiaria deflexa* Group
4. The *Boerhavia erecta – Salvadora australis* Group
5. The *Acacia stuhlmannii – Sporobolus ioclados* Group
6. The *Croton megalobotrys – Combretum microphyllum* Group
7. The *Heliotropium* sp. – *Sclerocarya birrea* Group
8. The *Diplachne fusca – Acacia xanthophloea* Group

In the discussion of the vegetation groups, a digit in square brackets (e.g. **[1]**, **[32]**) indicates the position of the different vegetation types on the synoptic table (Table 7).

TABLE 7: SYNOPTIC TABLE OF THE VEGETATION OF THE VHEMBE-DONGOLA NATIONAL PARK

Vegetation type	21	22	23	24	25	26	30	1	29	31	28	3	5	4	6	7	8	2	12	32	15	14	10	13	11	9	17	16	18	19	27	20
Number of relevés	7	12	5	7	6	9	3	7	6	5	8	6	4	9	12	5	9	7	3	3	4	5	10	5	5	3	10	19	7	13	2	4
Vegetation groups	1				2	3															4					5	6				7	8
Vegetation subgroups						3.1		3.2					3.3					3.4									6.1		6.2			
Species group A																																
Enneapogon cenchroides	86	100	100	100	100	89	100	71	100	100	63	100	100	100	100	80	100	100	67	100	50	80	70	80	20	100	70	90	29	.	100	50
Momordica balsamina	.	17	40	29	33	.	.	71	.	20	13	.	25	.	25	.	.	14	.	.	25	20	20	.	20	.	20	5	14	15	.	25
Cucumis zeyheri	57	58	20	43	83	67	67	43	67	60	100	67	.	11	8	40	22	100	100	.	75	100	100	60	80	.	.	.	.	.	.	75
Eragrostis trichophora	29	17	20	14	.	22	.	.	17	.	13	17	50	44	33	.	11	57	100	100	.	20	70	80	20	.	50	37	.	.	50	.
Tribulus zeyheri subsp. *zeyheri*	.	.	20	14	17	44	33	.	17	80	13	33	100	100	67	20	100	14	.	100	.	40	30	40	.	.	20	88	.	.	50	50
Solanum kwebense	71	67	60	43	83	89	67	.	50	100	.	33	.	11	.	20	.	.	.	67	.	.	20	20	.	.	30	5	.	.	50	25
Cleome angustifolia	.	.	40	14	33	22	100	.	33	80	25	83	25	11	33	.	.	14	.	67	.	.	.	.	.	.	10	.	.	.	50	25
Species group B																																
Bulbostylis hispidula	100	100	100	86	.	.	67	29	17	.	38	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trichoneura species	100	100	100	86	.	.	.	.	.	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hexalobus monopetalus var. *monopetalus*	86	92	100	71	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Croton gratissimus var. *subgratissimus*	57	83	80	100	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aristida junciformis	57	100	60	14	.	11	.	.	.	.	.	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ficus abutilifolia	86	67	80	43	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ficus tettensis	29	33	80	71	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	.
Brachiaria nigropedata	57	58	80	57	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tephrosia rhodesica	57	50	60	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tragia rupestris	43	17	20	86	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aristida scabrivalvis	71	67	60	71	.	.	.	.	50	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Corchorus kirkii	29	83	40	43	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Zornia glochidiata	57	8	60	29	.	.	.	.	50	20	50	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Croton pseudopulchellus	29	50	20	14	.	.	33	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	.	.	.	.	.	.	.
Indigofera laxeracemosa	29	67	40	29	.	11	.	.	.	.	.	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pappea capensis	14	33	20	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tephrosia euprepes	43	83	40	.	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oropetium capense	100	92	.	29	.	.	.	.	33	.	.	50	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Psydrax livida	86	67	.	29	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hibiscus coddii	14	17	.	86	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sida cordifolia	57	75	.	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Strychnos madagascariensis	29	75	60	.	.	.	.	.	.	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tephrosia virgata	.	33	40	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eragrostis viscosa	29	8	20	.	.	11	.	.	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xerophyta retinervis	29	42	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merremia pinnata	14	17	.	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Coleochloa pallidior	29	92	.	.	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pavonia dentata	14	.	80	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euclea natalensis	.	50	40	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Barleria affinis	.	25	.	43	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Blephans subvolubilis var. *subvolubilis*	14	.	40	.	.	.	.	.	.	.	.	.	25	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Vegetation type	21	22	23	24	25	26	30	1	29	31	28	3	5	4	6	7	8	2	12	32	15	14	10	13	11	9	17	16	18	19	27	20
Vegetation groups	1				2	3															4					5	6				7	8
Vegetation subgroups						3.1		3.2							3.3				3.4									6.1		6.2			
Species group C																																
Acacia senegal var. *leiorachis*	.	.	.	.	100	.	.	1	.	33	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group D																																
Albizia harveyi	57	58	60	29	83	22	.	.	.	.	.	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.
Grewia flavescens	29	58	40	43	83	44	.	.	17	.	.	.	.	.	17	.	.	.	.	.	.	.	.	.	.	.	30	47	29	62	.	.
Cleome hirta	14	33	40	43	17	11	.	29	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hibiscus engleri	100	75	.	43	33	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acacia erubescens	14	25	.	.	33	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group E																																
Hermannia glanduligera	71	50	100	86	100	33	67	.	.	.	13	.	.	.	.	.	.	.	.	.	.	20	.	.	.	.	.	.	14	.	.	.
Evolvulus alsinoides var. *linifolius*	57	50	80	57	17	33	67	.	.	.	25	17	.	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ochna inermis	29	50	40	57	17	22	67	.	17	40	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Commiphora edulis	29	17	20	29	17	11	33	.	.	40	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sida ovata	14	17	80	43	33	11	33	.	17	.	.	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	.	.	.	.	.
Hemizygia petrensis	57	58	40	.	17	.	33	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melhania acuminata var. *agnosta*	14	8	20	.	.	11	67	14	.	.	13	.	.	.	.	.	.	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group F																																
Schmidtia pappophoroides	71	50	100	71	17	11	67	100	33	100	25	33	.	.	17	.	.	14	.	.	.	.	.	.	.	.	.	5	.	.	.	.
Calostephane divaricata	43	17	20	.	17	33	67	14	83	60	25	50	.	.	.	.	.	.	33	.	.	.	10	.	.	.	.	.	.	.	.	.
Melinis repens	86	58	100	29	.	44	67	14	83	80	25	33	.	.	.	.	.	14	33	.	.	.	.	.	.	.	.	.	.	.	.	25
Acrotome inflata	29	8	60	14	.	22	67	71	33	80	63	50	.	.	.	.	.	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ipomoea magnusiana var. *magnusiana*	14	.	20	.	.	11	33	14	17	100	63	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phyllanthus angolensis	.	8	40	14	17	44	100	.	100	20	88	67	.	.	8	.	11	.	67	33	.	.	.	.	.	.	.	.	.	.	.	.
Asparagus africanus	14	.	.	.	33	.	67	.	17	20	25	17	.	.	8	.	11	14	.	.	.	.	.	.	.	.	.	32	14	.	.	.
Tephrosia purpurea	.	17	.	.	67	67	100	43	67	.	63	83	.	.	.	.	11	.	33	.	.	.	.	20	20	.	.	.	.	.	.	.
Tephrosia polystachya var. *polystachya*	.	.	40	29	33	11	.	.	.	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Waltheria indica	43	25	80	71	17	11	.	.	.	60	13	.	.	.	.	.	.	.	.	.	25	.	.	.	.	.	.	.	.	.	.	.
Vigna frutescens subsp. *frutescens*	14	.	20	14	17	.	.	.	.	40	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group G																																
Combretum apiculatum	86	92	60	57	100	89	100	14	67	100	.	33	25	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Commiphora mollis	14	8	.	.	33	11	33	.	50	40	38	50	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ceratotheca triloba	.	17	100	43	67	67	67	29	33	.	.	33	25	.	.	.	.	.	.	.	.	.	.	20	.	.	10	.	.	.	.	.
Stipagrostis uniplumis	43	25	100	14	.	11	67	100	.	60	.	17	25	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	.
Digitaria eriantha	43	50	20	14	.	22	67	100	.	.	.	33	25	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group H																																
Commiphora glandulosa	.	8	.	.	33	44	100	.	83	.	50	17	100	44	8	.	.	14	.	67	.	.	.	.	.	.	.	.	.	.	50	.
Grewia villosa	.	.	.	14	33	22	33	.	50	.	13	17	.	22	.	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Commiphora tenuipetiolata	14	17	.	.	67	67	.	.	83	.	.	17	100	22	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	.
Kirkia acuminata	.	.	.	.	33	22	.	.	50	.	.	33	75	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kyphocarpa angustifolia	.	.	.	.	67	44	67	.	50	.	13	33	50	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Decorsea schlechteri	.	.	.	14	17	11	33	.	17	40	38	17	25	11	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.
Indigofera species	.	.	.	14	17	.	.	.	.	80	.	.	25	11	17	.	.	43	.	33	.	.	.	.	.	.	.	.	.	.	.	.

Vegetation type	21	22	23	24	25	26	30	1	29	31	28	3	5	4	6	7	8	2	12	32	15	14	10	13	11	9	17	16	18	19	27	20
Vegetation groups	1				2	3															4					5	6				7	8
Vegetation subgroups						3.1		3.2					3.3					3.4									6.1		6.2			
Species group I																																
Asparagus suaveolens	.	.	.	.	.	33	.	14	33	20	.	50	75	56	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Monsonia glauca	.	8	.	.	.	11	33	.	67	20	63	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sterculia rogersii	.	.	.	43	.	22	.	.	50	40	38	.	.	11	8	.	.	14	.	.	.	.	.	.	.	.	.	5	.	.	.	.
Dichilus lebeckioides	14	.	.	.	.	11	.	57	.	40	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group J																																
Neuracanthus africanus	.	.	.	.	.	11	.	.	.	.	.	.	100	100	75	80	44	14	.	.	.	.	.	.	.	67	.	.	.	.	.	.
Sesamothamnus lugardii	.	.	.	.	.	.	.	.	17	.	13	.	25	56	42	20	67	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asparagus laricinus	.	.	.	.	.	11	.	.	.	.	.	.	25	22	50	20	67	.	.	.	.	.	.	.	.	.	10	.	.	.	.	.
Commiphora merkeri	.	.	.	.	.	22	.	.	33	.	.	.	25	44	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Balanites pedicellaris	.	.	.	.	.	11	.	.	.	.	.	.	.	22	17	40	11	.	.	.	.	40	.	.	20	33	.	.	.	.	.	.
Bothriochloa insculpta	.	.	.	.	.	11	.	.	17	.	.	.	25	22	.	60	.	.	.	.	.	.	.	.	.	.	.	.	57	.	.	.
Eragrostis nindensis	.	.	.	.	.	.	.	.	.	.	.	.	.	78	8	20	.	.	.	.	.	.	20	.	.	.	.	26	.	.	.	.
Sansevieria species	.	.	.	.	.	.	.	.	.	.	.	.	.	67	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group K																																
Colophospermum mopane -trees	.	.	.	.	.	67	100	100	100	100	100	100	100	100	100	100	44	100	100	33	25	.	.	.	20	.	20	11	.	.	.	.
Colophospermum mopane -shrubs	.	.	.	.	.	44	67	86	50	100	63	100	100	100	83	20	67	100	100	33	.	.	.	.	20	.	10	5	.	.	.	.
Boscia foetida	.	.	20	.	.	33	33	.	17	.	38	50	75	100	75	20	11	14	33	.	.	.	.	.	.	.	30	5	.	.	.	.
Aristida adscensionis	.	.	20	.	33	44	33	14	50	.	63	67	.	11	33	40	11	86	100	.	25	.	20	.	40	.	.	5	.	.	.	.
Rhigozum zambesiacum	.	8	.	.	17	44	33	43	50	40	38	33	25	33	8	20	.	14	.	67	.	.	.	.	.	.	30	26	.	.	.	.
Vernonia cinerascens	.	.	.	.	.	56	.	.	17	.	38	17	50	44	17	.	.	14	.	33	.	.	.	.	.	.	.	11	.	.	.	.
Aristida rhiniochloa	.	.	.	.	.	11	.	.	.	20	.	.	100	78	.	.	11	.	.	100	.	.	.	.	.	.	.	11	.	.	.	.
Becium filamentosum	.	.	.	.	.	11	.	.	50	.	25	17	.	.	.	.	.	14	67	.	.	.	.	.	.	.	.	.	.	.	.	.
Species group L																																
Boerhavia erecta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	67	.	100	100	80	60	20	.	.	.	.	.	.	.
Sida rhombifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	40	.	.	.	33	100	60	50	20	40	.	.	.	14	.	.	50
Cucumis metuliferus	.	8	.	.	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	100	40	10	20	40	.	10	.	.	.	.	.
Acanthosperm hispidum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	50	60	40	20	60	.	10	.	.	.	.	.
Flaveria bidentis	.	.	.	.	.	.	.	.	.	.	13	.	.	.	.	.	.	.	33	.	25	60	60	40	20	.	.	.	.	.	.	.
Ipomoea sinensis subsp. *blepharosepala*	.	.	.	.	.	11	.	.	17	.	38	17	.	.	.	20	.	43	33	.	75	60	70	60	40	.	.	.	.	.	.	.
Lycium cinereum	.	.	.	.	.	.	.	.	.	.	.	17	.	.	.	.	22	29	.	.	100	60	.	20	60	.	10	5	.	.	.	.
Abutilon ramosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	100	60	10	.	60	.	.	5	.	8	.	.
Phyllanthus parvulus	.	.	.	.	.	.	.	.	.	.	.	17	.	.	.	.	11	.	33	.	25	100	60	40	.	.	.	.	.	.	.	.
Ctenolepis cerasiformis	.	.	.	14	.	.	.	14	.	.	.	.	.	.	.	.	.	29	33	.	.	80	40	20	40	.	.	5	.	.	.	25
Chenopodium album	.	.	.	.	.	.	.	14	.	.	.	.	.	.	.	.	.	.	.	.	75	40	20	20	.	.	.	.	.	.	.	.
Dicliptera eenii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	.	.	.	100	40	.	.	80	.	10	.	.	.	.	.
Echinochloa colona	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	100	60	.	.	40	.	.	.	.	.	.	50
Eragrostis racemosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	.	.	.	.	100	50	20	.	.	.	.	.	.	.	.
Tribulus terrestris	.	.	.	.	.	.	.	.	.	.	13	17	.	.	.	.	.	.	33	.	.	60	40	60	.	.	.	.	.	.	.	.
Justicia flava	.	.	.	.	.	.	.	14	.	.	.	.	.	.	.	.	.	.	.	.	50	20	.	.	40	.	.	.	.	.	.	.
Pergularia daemia var. *daemia*	.	.	.	.	.	.	.	14	.	.	.	.	.	.	.	.	.	.	33	.	50	20	.	.	20	33	.	.	.	.	.	.
Brachiaria eruciformis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	40	10	.	60	.	.	.	.	.	.	.
Nemesia fruticans	.	.	.	.	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	.	10	.	20	.	.	.	.	.	.	.
Dactyloctenium aegyptium	.	.	.	.	.	.	.	.	.	.	.	17	.	11	8	.	11	14	.	.	.	20	30	20	.	33	10	.	.	.	50	.

Vegetation type	21	22	23	24	25	26	30	1	29	31	28	3	5	4	6	7	8	2	12	32	15	14	10	13	11	9	17	16	18	19	27	20
Vegetation groups		1			2			3															4			5	6				7	8
Vegetation subgroups						3.1		3.2						3.3				3.4									6.1		6.2			
Species group M																																
Acalypha indica	57	50	40	57	83	67	67	29	67	40	63	33	.	11	42	20	.	100	100	33	50	40	30	40	.	.	.	5	.	8	.	.
Commelina benghalensis	29	33	40	57	50	44	33	29	33	40	88	50	.	.	.	.	11	14	33	.	25	40	40	20	20	.	.	.	.	.	.	.
Pupalia lappacea	29	25	.	14	17	11	33	43	.	.	13	17	.	.	.	.	.	14	67	.	25	40	10	20	60	.	.	.	.	.	.	.
Species group N																																
Dicoma tomentosa	14	17	.	14	67	67	67	43	100	20	88	100	100	67							.	.	60	60	.	.	.	.	.	.	.	.
Hibiscus micranthus	14	8	.	.	33	44	67	71	67	.	38	67	.	.							25	20	20	.	60	.	10	.	.	.	.	.
Acacia senegal var. *rostrata*	.	.	.	.	50	22	.	.	33	.	13	.	25	11	8	.	11	14	33	33	.	.	10	.	40	.	.	.	.	.	.	.
Commicarpus pentandrus	.	.	.	.	83	56	33	14	50	40	.	17	.	.	.	.	.	.	33	67	50	60	50	20	20	.	.	.	.	.	50	.
Species group O																																
Corchorus asplenifolius	.	.	.	.	.	44	.	.	50	.	25	67	.	.	.	.	11	14	100	.	.	40	60	40	.	.	.	.	.	.	.	.
Aptosimum lineare	14	.	.	.	.	11	67	.	50	.	25	67	.	.	.	.	.	43	67	33	.	.	60	20	.	.	.	.	.	.	.	.
Species group P																																
Indigastrum costatum subsp. *macrum*	.	.	.	.	.	11	.	.	33	.	38	.	75	44	25	.	44	14	.	.	.	60	80	100	20	.	20	16	.	.	50	.
Enneapogon desvauxii	.	.	.	.	.	.	.	.	.	20	.	17	.	22	50	.	56	.	.	67	.	.	50	20	.	.	.	5	.	.	50	.
Acacia nebrownii	.	.	.	.	.	.	.	.	.	.	.	.	.	11	.	40	.	29	.	.	.	60	.	20	.	.	.	16	.	.	.	.
Megalochlamys revoluta subsp. *cognata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	40	11	29	.	.	.	.	80	40	.	.	.	.	.	.	.	.
Species group Q																																
Acacia stuhlmannii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	40	100	.	.	.	25	.	80	40	40	100	10	.	.	.	.	.
Sporobolus ioclados	.	.	.	.	.	.	.	.	.	.	.	17	.	22	58	40	78	.	.	.	.	.	10	40	.	67	10	5	.	.	.	.
Cyathula lanceolata	.	.	.	.	.	.	.	.	.	.	.	.	.	11	58	60	100	.	.	.	.	.	70	20	40	67	.	.	.	.	.	.
Species group R																																
Urochloa mosambicensis	.	.	.	14	17	.	.	14	.	.	63	.	.	78	92	100	89	57	33	.	100	100	70	100	80	100	100	95	14	.	50	25
Salvadora australis	.	.	.	.	.	.	.	14	.	.	13	17	.	33	58	40	100	43	100	.	100	80	100	100	100	100	40	58	.	.	.	25
Trianthema triquetra	.	.	.	.	.	.	.	.	.	.	.	.	.	11	25	20	56	.	.	.	.	20	70	40	.	100	90	79	.	.	.	25
Cyathula orthacantha	.	.	.	.	.	.	.	.	17	.	13	.	.	11	8	80	.	.	.	.	75	60	40	20	80	67	.	26	.	.	.	.
Commiphora pyracanthoides	.	.	.	.	.	.	.	14	.	.	25	.	50	89	67	40	78	14	.	.	.	.	.	.	.	33	.	5	.	.	.	.
Species group S																																
Eragrostis lehmanniana	86	100	80	14	17	11	33	100	17	100	13	67	50	56	50	.	22	43	67	33	.	20	20	.	.	33	50	16	.	.	.	.
Achyranthes aspera	14	33	.	14	67	33	.	.	17	.	38	.	.	.	.	60	.	43	.	.	100	100	.	.	60	.	10	26	.	23	.	25
Dichrostachys cinerea	43	8	60	.	17	33	67	14	17	80	63	83	50	11	17	60	.	14	67	.	.	20	.	.	40	33	30	47	.	15	.	.
Species group T																																
Faidherbia albida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	100	31	.	25
Acacia schweinfurthii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	14	92	.	.
Datura species	.	.	.	.	.	.	.	.	67	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	71	8	.	25
Species group U																																
Combretum microphyllum	.	.	40	14	17	11	.	.	.	20	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	50	63	100	100	.	.
Croton megalobotrys	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	.	.	.	10	16	100	100	.	.
Hyphaene petersiana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	60	95	29	31	.	.
Panicum schinzii	.	.	20	.	.	.	.	.	.	20	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	40	32	71	77	.	.
Xanthocercis zambesiaca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	20	.	.	.	.	10	16	29	77	.	.
Panicum deustum	.	.	.	.	17	.	33	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	26	14	46	.	.
Phyllanthus reticulatus	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	5	14	69	.	.
Maytenus senegalensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	.	.	.	.	.	.	.	.	.	10	26	.	69	.	.
Flueggea virosa subsp. *virosa*	.	17	.	.	.	.	.	.	.	.	.	.	.	.	8	20	.	.	.	.	.	.	.	.	.	.	10	79	14	.	.	.

Vegetation type	21	22	23	24	25	26	30	1	29	31	28	3	5	4	6	7	8	2	12	32	15	14	10	13	11	9	17	16	18	19	27	20
Vegetation groups	1				2	3															4					5	6				7	8
Vegetation subgroups						3.1		3.2					3.3					3.4									6.1		6.2			
Species group V																																
Cenchrus ciliaris	14	.	.	.	.	33	100	14	83	60	50	67	100	56	58	100	.	29	.	.	.	.	.	20	.	33	10	32	71	15	.	.
Ximenia americana	.	.	.	.	.	11	.	57	.	20	13	33	25	.	17	.	.	14	33	.	.	.	.	.	.	.	10	84	.	23	.	.
Acacia tortilis	.	.	.	.	.	22	.	29	.	20	13	17	.	.	8	20	.	43	.	33	50	100	.	40	40	.	90	100	43	31	.	.
Species group W																																
Panicum maximum	71	83	80	57	50	67	67	57	.	.	13	67	25	44	25	60	.	57	33	.	100	40	10	20	100	.	.	63	71	100	.	.
Abutilon grandiflorum	43	33	60	71	17	11	33	.	.	.	.	.	22	.	60	22	.	.	33	.	100	100	70	60	100	100	80	58	57	46	.	25
Lonchocarpus capassa	29	17	40	29	17	.	.	.	.	20	.	.	.	.	8	.	.	.	.	.	75	20	.	.	.	.	10	26	14	46	.	.
Leucas sexdentata	.	.	.	14	67	56	.	.	33	20	38	17	.	11	17	.	.	71	100	100	25	60	100	80	20	.	40	16	43	23	.	.
Species group X																																
Heliotropium species	.	.	.	.	17	.	.	.	.	40	.	.	.	.	.	.	.	.	.	.	.	.	10	.	.	.	30	5	.	.	100	.
Sclerocarya birrea	29	.	.	.	33	11	.	.	.	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15	50	.
Chenopodium carinatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	.
Eleusine coracana subsp. *africana*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	.
Schkuhria pinnata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	.
Alternanthera pungens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	.	.	.	.	.	50	.
Grewia occidentalis	.	.	20	.	17	11	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15	50	.
Species group Y																																
Setaria verticillata	.	.	.	.	.	.	.	.	.	.	.	.	.	11	42	20	44	29	67	.	75	100	100	100	60	100	80	84	100	85	50	.
Chloris virgata	.	.	.	.	.	.	.	.	.	.	38	50	.	.	.	20	33	43	100	.	25	100	100	80	60	33	20	37	14	.	50	.
Species group Z																																
Terminalia prunioides	.	.	.	.	100	78	100	.	83	80	63	67	100	89	50	80	11	.	.	100	.	.	.	.	.	.	.	26	.	.	100	.
Indigofera circinnata	.	.	.	.	17	11	.	.	.	.	13	.	25	33	8	20	.	.	.	100	.	.	.	.	.	.	.	.	.	.	50	.
Aristida congesta subsp. *congesta*	.	.	20	14	50	11	.	100	83	80	50	50	75	44	58	.	44	57	100	67	.	.	100	80	.	.	.	32	.	.	100	.
Ptycholobium contortum	.	.	.	.	50	33	67	.	33	.	50	83	.	.	.	.	.	.	.	100	.	.	.	.	.	.	.	.	.	.	50	.
Acacia nigrescens	.	.	.	14	17	22	.	.	17	.	.	.	.	.	8	20	11	14	.	33	.	.	.	.	40	.	.	53	.	.	50	.
Barleria senensis	.	.	.	.	100	.	.	.	.	20	.	.	50	.	8	80	.	.	.	.	.	.	.	.	.	.	10	.	.	8	50	.
Species group AA																																
Brachiaria deflexa	.	17	20	43	33	56	33	57	50	80	13	33	100	100	67	60	44	43	100	33	25	.	10	.	.	67	20	21	.	.	50	.
Boscia albitrunca	71	67	100	100	100	44	.	.	17	40	25	17	.	11	17	20	22	.	.	100	.	.	10	.	.	.	20	5	.	.	100	.
Grewia bicolor	.	42	20	43	100	89	33	29	83	60	75	33	100	56	33	80	.	29	.	33	.	.	.	.	.	.	70	90	14	69	100	.
Hermbstaedtia odorata	14	17	20	14	33	22	100	71	67	40	63	83	25	22	50	.	11	71	100	100	.	.	70	100	.	.	40	16	.	.	100	.
Cadaba termitaria	14	25	20	14	33	33	67	.	50	60	13	50	100	56	33	.	22	57	33	67	.	.	.	.	20	33	40	53	.	.	50	.
Gisekia pharnacioides var. *pharnacioides*	.	8	60	43	33	44	100	.	33	100	25	17	50	11	25	.	33	14	33	.	.	.	.	20	.	.	.	16	.	.	50	.
Seddera suffruticosa	14	25	20	.	17	56	.	.	17	40	.	.	75	22	25	.	.	29	.	.	.	.	.	.	.	.	.	.	.	.	50	.
Species group BB																																
Diplachne fusca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	.	.	.	.	100
Dinebra retroflexa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	.	.	20	.	.	.	.	.	.	100
Corbichonia decumbens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	100
Echinochloa pyramidalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	75

Vegetation type	21	22	23	24	25	26	30	1	29	31	28	3	5	4	6	7	8	2	12	32	15	14	10	13	11	9	17	16	18	19	27	20
Vegetation groups	1				2	3															4					5	6				7	8
Vegetation subgroups						3.1		3.2					3.3					3.4									6.1		6.2			
Species group CC																																
Acacia xanthophloea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20	11	71	54	.	100
Cordia monoica	.	.	.	14	.	.	.	.	.	.	.	.	.	22	8	.	.	.	.	33	.	.	.	.	.	33	70	37	14	.	50	25
Cocculus hirsutus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	16	14	62	.	25
Species group DD																																
Abutilon austro-africanum	.	.	.	.	50	22	33	.	33	20	63	67	75	56	50	20	11	100	33	100	50	60	20	.	.	33	20	42	14	15	50	25
Geigeria burkei subsp. *fruticulosa*	14	17	.	.	17	11	33	.	.	.	38	17	.	11	.	.	.	43	100	67	.	.	40	40	.	.	.	.	.	.	50	25
Abutilon sonneratianum	.	.	.	14	33	33	33	.	.	.	13	17	.	.	33	40	44	29	.	.	.	.	.	20	.	.	10	5	.	.	.	75
Species group EE																																
Amaranthus species	.	.	.	.	.	33	.	.	.	.	.	17	50	33	42	.	33	.	.	.	.	.	10	.	20	67	70	42	.	.	50	100
Heliotropium ovalifolium	14	.	.	.	.	33	67	86	17	.	25	67	25	22	8	.	.	57	67	.	100	80	50	60	40	.	20	.	.	.	.	100
Tragus berteronianus	.	.	20	.	.	11	.	.	50	20	25	33	.	89	83	.	100	14	100	67	.	.	50	20	.	33	20	21	.	.	50	50
Other differential species																																
Mundulea sericea	100	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chamaesyce glanduligera	.	.	.	.	.	.	67	.	17	.	.	17	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Indigofera daleoides var. *daleoides*	.	.	.	.	.	.	.	86	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pentarrhinum insipidum	.	.	.	.	.	.	.	86	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acacia erioloba	.	.	.	.	.	.	.	57	.	.	.	.	25	.	.	.	.	.	.	.	.	.	.	.	20	.	.	.	.	.	.	.
Chamaesyce mossambicensis	.	.	.	.	.	.	.	57	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	.	.	.	.	.	.	.	.	.
Tricliceras glandulifera	.	.	.	.	.	.	.	.	67	.	25	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sesamum triphyllum	.	.	40	14	33	.	.	.	.	80	25	.	.	.	.	.	.	.	.	.	.	.	10	40	.	.	.	.	.	.	.	.
Oxygonum delagoense	14	8	.	.	.	.	.	.	.	60	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhynchosia nervosa	.	.	.	.	.	.	.	.	.	20	50	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pavonia burchellii	.	.	.	.	.	11	.	.	67	.	63	.	25	22	.	40	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melhania rehmannii	.	.	.	.	33	11	.	.	.	.	.	.	.	.	.	.	.	.	67	.	.	.	.	.	40	.	.	.	.	.	.	.
Geigeria acaulis	.	.	.	.	.	.	33	.	17	.	.	17	.	.	.	.	.	.	67	.	.	.	20	40	.	.	.	.	.	.	.	.
Catophractes alexandri	.	.	.	.	.	.	.	.	.	.	50	17	.	.	.	.	.	.	.	100	.	.	.	.	.	.	.	.	.	.	.	.
Solanum species	.	.	.	.	.	.	.	.	.	.	13	.	.	.	.	.	.	.	.	.	100	.	.	.	.	.	.	5	.	.	.	.
Combretum imberbe	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	75	20	.	.	.	.	.	26	.	8	.	.

Table 8: The relationship between the vegetation groups, land types and plant communities in the Vhembe-Dongola National Park.

VEGETATION GROUPS		VEGETATION TYPE *	LAND TYPE	COMMUNITY No.
No.	Name			
1	The *Hexalobus monopetalus – Bulbostylis hispidula* Group	21	Ib395	1.1.1
		22	Ib395	1.1.2
		23	Ib395	1.2.1
		24	Ib395	1.2.2
2	The *Acacia senegal* var. *leiorhachis – Barleria sinensis* Group	25	Ib395	2.1
3	The *Colophospermum mopane – Brachiaria deflexa* Group			
3.1	The *Combretum apiculatum – Terminalia prunioides* Sub-group	26	Ib395	2.2
		30	Fb143	1.2.2
3.2	The *Schmidtia pappophoroides – Acrotome inflata* Subgroup	1	Db218	1.1
		3	Db218	1.3
		28	Fb143	1.1
		29	Fb143	1.2.1
		31	Ae309	1
3.3	The *Neuracanthus africanus – Sesamothamnus lugardii* Subgroup	4	Db218	1.4
		5	Db218	1.5
		6	Db218	1.6
		7	Db218	1.7
		8	Db218	2.1
3.4	The *Leucas sexdentata – Abutilon austro-africanum* Subgroup	2	Db218	1.2
		12	Ia155	1.1
		32	Ae309	2
4	The *Boerhavia erecta – Salvadora australis* Group	10	Db218	2.3
		11	Db218	3
		13	Ia155	1.2.1
		14	Ia155	1.2.2
		15	Ia155	1.3
5	The *Acacia stuhlmannii – Sporobolus ioclados* Group	9	Db218	2.1
6	The *Croton megalobotrys – Combretum microphyllum* Group			
6.1	The *Salvadora australis – Urochloa mosambicensis* Subgroup	16	Ia155	2.1
		17	Ia155	2.2
6.2	The *Faidherbia albida – Panicum maximum* Subgroup	18	Ia155	3.1
		19	Ia155	3.2
7	*Heliotropium* sp. – *Sclerocarya birrea* Group	27	Ib395	2.3
8	The *Diplachne fusca – Dinebra retroflexa* Group	20	Ia155	4

* Vegetation types are indicated in the text as follows: **[1], [2]** etc.

1. The *Hexalobus monopetalus – Bulbostylis hispidula* Group

This vegetation group is associated with shallow lithosols of the Glenrosa and Mispah soil forms found on the sandstone ridges of the Ib395 land type (Chapter 5). The soils are generally sandy, a large amount of lose rocks are found on the soil surface and between 30 to 70% of the area is covered by bare rocky outcrops. The terrain is made up of ragged crest areas, vertical cliffs, foot slopes and drainage areas at the very foot of the sandstone koppies.

The diagnostic species of the *Hexalobus monopetalus – Bulbostylis hispidula* Group (1) are found in Species group B (Table 7). This includes the tree species *Hexalobus monopetalus* var. *monopetalus, Croton gratissimus* var. *subgratissimus, Ficus abutilifolia* and *F. tettensis*, the shrubby *Croton pseudopulchellus*, the grass species *Trichoneura* sp., *Aristida junciformis, A. scabrivalvis, Brachiaria nigropedata* and *Oropetium capense*. Other diagnostic herbaceous species include the sedges *Bulbostylis hispidula* and *Coleochloa pallidior* as well as the forbs *Tephrosia rhodesica, Tragia rupestris, Corchorus kirkii, Zornia glochidiata* and *Indigofera laxeracemosa*. The absence or low frequency of the species of Species groups H, N, Z and DD (Table 7) differentiate this vegetation group from the others in the Vhembe-Dongola National Park.

A total of 31 relevés and only one community with two sub-communities, which in turn each have two variants, are included in this vegetation group. The sub-communities and variants that are grouped together in the *Hexalobus monopetalus – Bulbostylis hispidula* Group (1) all belong to the *Hexalobus monopetalus – Croton gratissimus* Community (Chapter 5) and are the following:

Ib395 land type (Chapter 5):

- The *Psydrax livida – Oropetium capense* Sub-community, which includes:
  - § The *Mundulea sericea – Zornia glochidiata* Variant **[21]**
  - § The *Strychnos madagascariensis – Coleochloa pallidior* Variant **[22]**
- The *Ficus tettensis – Waltheria indica* Sub-community, which includes:
  - § The *Stipagrostis uniplumis – Pavonia dentata* Variant **[23]**
  - § The *Hibiscus coddii – Tragia rupestris* Variant **[24]**

2. The *Acacia senegal* var. *leiorhachis – Barleria sinensis* Group

This vegetation group is found on dolerite outcrops in the Ib395 land type (Chapter 5) on shallow sandy Glenrosa and Mispah soil forms on the foot slopes and valley bottom of the Ib395 land type (Chapter 5). This group is limited in distribution.

The diagnostic species of this vegetation group is the tree species *Acacia senegal* var. *leiorachis* (Species group C, Table 7). The *Acacia senegal* var. *leiorhachis – Barleria sinensis* Group (2) is differentiated from the *Hexalobus monopetalus – Bulbostylis*

hispidula Group (1) by the high frequency of the species of Species groups H, N, Z and DD (Table 7). Affinities between this vegetation group and the *Hexalobus monopetalus – Bulbostylis hispidula* Group (1) are found in the absence of the species of Species groups I, K, O, U and DD (Table 7).

Due to the fact that only one sub-community is included in the *Acacia senegal* var. *leiorhachis – Barleria sinensis* Group (2), the assumption could be made that this group is under sampled and more extensive sampling should be considered in future studies in this area.

One vegetation type and six relevés are included in this vegetation group:

Ib395 land type (Chapter 5):

- The *Terminalia prunioides – Grewia bicolor* Community
  - § The *Acacia senegal – Barleria sinensis* Sub-community **[25]**

3. The *Colophospermum mopane – Brachiaria deflexa* Group

The vegetation of this group is more commonly known as the Mopane Veld. It is situated on a variety of deep, red, sandy Hutton soil forms, shallower sandy Hutton and Glenrosa soil forms and moderately deep to shallow Oakleaf soil forms. The rockiness of the soil surface is generally low. There are however areas with calcareous concretions on the soil surface. These latter areas are commonly overgrazed, trampled, and as a result degraded to a certain degree.

The diagnostic species of the *Colophospermum mopane – Brachiaria deflexa* Group (3) are found in Species group K (Table 7). This includes the tree species *Colophospermum mopane* and *Boscia foetida*, the shrub *Rhigozum zambesiacum*, the grass species *Aristida adscensionis* and *A. rhinochloa* and the forbs *Vernonia cinerascens* and *Becium filamentosum*. The high frequency of the grass species *Brachiaria deflexa* (Species group AA, Table 7) and the presence of the species of Species groups O, V and EE (Table 7), differentiate this vegetation group from the *Hexalobus monopetalus – Bulbostylis hispidula* Group (1) and the *Acacia senegal* var. *leiorhachis – Barleria sinensis* Group (2).

A total of 93 relevés and 14 different communities, sub-communities and variants from a number of different land types, are included in the *Colophospermum mopane – Brachiaria deflexa* Group.

Three subgroups were identified in the *Colophospermum mopane – Brachiaria deflexa* Group (3), namely:

3.1 The *Combretum apiculatum – Terminalia prunioides* Sub-group

3.2 The *Schmidtia pappophoroides – Acrotome inflata* Subgroup

3.3 The *Neuracanthus africanus – Sesamothamnus lugardii* Subgroup

3.1 The *Combretum apiculatum – Terminalia prunioides* Sub-group

The main soil forms found in this sub-group are shallow Mispah and moderately deep Glenrosa and Hutton soils. The *Combretum apiculatum – Terminalia prunioides* Sub-group (3.1) is situated on rocky outcrops of the Ib395 (Chapter 5) land type and on similar outcrops on a small portion of the Fb143 (Chapter 6) land type. The rockiness of the soil surface is between 20 and 50% and approximately 10 to 20% of the area is covered by exposed bedrock. Grazing levels are moderate to high and certain areas in this sub-group are degraded as a result of overgrazing and trampling.

There are no diagnostic species in the *Combretum apiculatum – Terminalia prunioides* Sub-group (3.1). The high occurrence of the woody species *Combretum apiculatum* (Species Group G) and *Terminalia prunioides* (Species Group Z) the grass species *Panicum maximum* (Species Group W) and the forb *Tephrosia purpurea* (Species Group F) differentiates this sub-group from the other sub-groups of the *Colophospermum mopane – Brachiaria deflexa* Group (3). This sub-group is further differentiated by the absence of the species of Species Groups R and Y (Table 7) and the strong presence of the species of species group E (Table 7), which are virtually absent in the other three sub-groups of the *Colophospermum mopane – Brachiaria deflexa* Group (3). The species of Species Group D sub-divides the *Combretum apiculatum – Terminalia prunioides* Sub-group (3.1) in to two smaller sub-units, but for the purposes of this thesis it will not be discussed further.

Two vegetation types and a total of 12 relevés are included in this sub-group. The different vegetation types are as follows:

<u>Ib395 land type (Chapter 5):</u>

- The *Terminalia prunioides – Grewia bicolor* Community
  - § The *Colophospermum mopane – Vernonia cinerascens* Sub-community **[26]**

<u>Fb143 land type (Chapter 6):</u>

- The *Colophospermum mopane – Dicoma tomentosa* Community
  - § The *Terminalia prunioides – Combretum apiculatum* Sub-community
    - The *Cleome angustifolia – Tephrosia purpurea* Variant **[30]**

3.2 The *Schmidtia pappophoroides – Acrotome inflata* Subgroup

The largest part of this subgroup is found on moderately deep to shallow sandy to sandy-loam Hutton, Glenrosa, Oakleaf and Mispah soil forms mainly on the Db218 (Chapter 3), Fb143 and Ae309 (Chapter 6) land types and on a small portion of the Ib395 (Chapter 5) land type. The soils of this subgroup vary in rockiness from less than 1% up to 50%. The vegetation of the *Schmidtia pappophoroides – Acrotome inflata* Subgroup (3.2) covers the largest area of the Fb143 land type in the Vhembe-Dongola National Park.

There are no diagnostic species in the *Schmidtia pappophoroides – Acrotome inflata* Subgroup (3.2). This subgroup is, however, differentiated from the other two subgroups of the *Colophospermum mopane – Brachiaria deflexa* Group (3) by the species of Species group F (Table 7), which includes the grass species *Schmidtia pappophoroides* and *Melinis repens* and the forbs *Calostephane divaricata, Acrotome inflata, Ipomoea magnusiana* var. *magnusiana* and *Phyllanthus angolensis*. The high frequency of the forbs *Commelina benghalensis* (Species group M, Table 7) and *Hibiscus micranthus* (Species group N, Table 7) further differentiate this subgroup from the other two subgroups in the *Colophospermum mopane – Brachiaria deflexa* Group (3).

Five vegetation types and a total of 32 relevés are included in this subgroup. The different vegetation types are as follows:

Db218 land type (Chapter 3):

- The *Colophospermum mopane* Community
  - § The *Digitaria eriantha – Schmidtia pappophoroides* Sub-community **[1]**
  - § The *Dichrostachys cinerea – Tephrosia purpurea* Sub-community **[3]**

Fb143 land type (Chapter 6):

- The *Colophospermum mopane – Dicoma tomentosa* Community
  - § The *Commelina benghalensis – Cucumis zeyheri* Sub-community **[28]**
  - § The *Terminalia prunioides – Combretum apiculatum* Sub-community
    - The *Commiphora tenuipetiolata – Grewia bicolor* Variant **[29]**

Ae309 land type (Chapter 6)

- The *Colophospermum mopane – Eragrostis lehmanniana* Community **[31]**

3.3 The *Neuracanthus africanus – Sesamothamnus lugardii* Subgroup

This subgroup is found on sandy-loam, silt-rich, often calcareous, and clayey soils of the Hutton, Glenrosa, Oakleaf and Swartland soil forms in the Db218 land type (Chapter 3) of the Vhembe-Dongola National Park. In most cases the rockiness of the soil surface is negligible. This subgroup shows more signs of degradation through the presence of bare patches and surface erosion.

Diagnostic species of the *Neuracanthus africanus – Sesamothamnus lugardii* Subgroup (3.3) are found in Species group J (Table 7). This includes the tree species *Sesamothamnus lugardii, Commiphora merkeri* and *Balanites pedicellaris*, the grass species *Bothriochloa insculpta* and *Eragrostis nindensis* as well as the forbs *Neuracanthus africanus, Asparagus africanus* and *Sansevieria* species. The absence of the species of Species groups F differentiates this subgroup from the *Schmidtia pappophoroides – Acrotome inflata* Sub-group (3.2) and the *Hexalobus monopetalus – Bulbostylis hispidula* (1) and the *Acacia senegal* var. *leiorhachis – Barleria sinensis* (2) Groups. The high frequency of the species of Species group Q (Table 7) and the woody species *Commiphora pyracanthoides* and the forbs *Trianthema triquetra* and *Cyathula orthacantha* (Species group R, Table 7) as well as the absence of the species of Species group O (Table 7), differentiates this subgroup from the other two subgroups of the *Colophospermum mopane – Brachiaria deflexa* Group (3). The presence of the species of Species group P (Table 7) further differentiates this subgroup from the *Schmidtia pappophoroides – Acrotome inflata* Subgroup (3.2).

On the basis of the species of Species groups G, H, I and Q the *Neuracanthus africanus – Sesamothamnus lugardii* Subgroup (3.3) can be subdivided into three smaller units that will not be discussed further.

Five different vegetation types, which together consist of 39 relevés, are presented in this subgroup, namely:

Db218 land type (Chapter 3):

- The *Colophospermum mopane* Community
  - § The *Boscia foetida – Commiphora pyracanthoides* Sub-community **[4]**
  - § The *Commiphora mollis – Grewia bicolor* Sub community **[5]**
  - § The *Salvadora australis - Sporobolus ioclados* Sub-community **[6]**
  - § The *Barleria sinensis – Cyathula orthacantha* Sub-community **[7]**
- The *Salvadora australis – Acacia stuhlmannii* Community
  - § The *Cyathula lanceolata – Tragus berteronianus* Sub-community **[8]**

3.4 The *Leucas sexdentata – Abutilon austro-africanum* Subgroup

This subgroup is mostly associated with moderately deep sandy-loam soils of the Hutton and Oakleaf soil forms. The subgroup is often found in dry streambeds and calcareous patches on the Db218 (Chapter 3), Ia155 (Chapter 4) and Ae309 (Chapter 6) land types of the Vhembe-Dongola National Park. The rockiness of the soil surface is less than 1%.

There are no diagnostic species in this subgroup. The subgroup is, however, differentiated from the other subgroups in the *Colophospermum mopane – Brachiaria deflexa* Group (3) by the absence of the species of Species groups F – J (Table 7) and the high frequency of the forbs *Acalypha indica* (Species group M, Table 7), *Leucas sexdentata* (Species group W, Table 7) *Geigeria burkei* subsp. *fruticulosa* and the herbaceous shrub *Abutilon austro-africanum* (Species group DD, Table 7).

A total of 13 relevés in three different vegetation types are included in this subgroup:

Db218 land type (Chapter 3):

- The *Colophospermum mopane* Community
  - § The *Abutilon austro-africanum – Acalypha indica* Sub-community **[2]**

Ia155 land type (Chapter 4):

- The *Salvadora australis – Cucumis zeyheri* Community
  - § The *Colophospermum mopane – Eragrostis trichophora* Sub-community **[12]**

Ae309 land type (Chapter 6):

- The *Catophractes alexandri – Boscia albitrunca* Community **[32]**

4. The *Boerhavia erecta – Salvadora australis* Group

This vegetation group is generally situated on the floodplains adjacent to the riparian zone of the Limpopo River and its tributaries on the Db218 and Ia155 land types. The soils vary from moderately deep silt-rich Oakleaf soil forms to clayey Valsrivier, Sepane and Swartland soil forms. The soil surface is generally free of loose rocks and is compacted and trampled in certain areas. As a whole this vegetation group is overgrazed and shows signs of degradation.

The diagnostic species of this vegetation group are found in Species group L (Table 7). This includes the shrubs *Lycium cinereum* and *Abutilon ramosum*, the grasses *Echinochloa colona*, *Eragrostis racemosa*, *Brachiaria eruciformis* and *Dactyloctenium*

aegyptium and the forbs *Boerhavia erecta, Sida rhombifolia, Cucumis metuliferus, Acanthospermum hispidum, Ipomoea sinensis* subsp. *blepharosepala, Phyllanthus parvulus* and the alien weed *Flaveria bidentis*, which often grows on disturbed areas (Van Wyk & Malan, 1998).

A total of 29 relevés and five communities, sub-communities and variants are included in the *Boerhavia erecta – Salvadora australis* Group (4). These are as follows:

Db218 land type (Chapter 3):

- The *Salvadora australis – Acacia stuhlmannii* Community
  - § The *Chloris virgata – Boerhavia erecta* Sub-community **[10]**
- The *Salvadora australis – Acacia grandicornuta* Community **[11]**

Ia155 land type (Chapter 4):

- The *Indigastrum costatum* subsp. *maculata – Setaria verticillata* Sub-community
  - § The *Aristida congesta – Leucas sexdentata* Variant **[13]**
  - § The *Eragrostis racemosa – Acacia tortilis* Variant **[14]**
- The *Combretum imberbe – Abutilon ramosum* Sub-community **[15]**

5. *Acacia stuhlmannii – Salvadora australis* Group

This vegetation group is mostly found in dry streambeds on the eastern parts of the farm Riedel on the Db218 land type (Chapter 3). The dominant soils are silt-rich soils of the Oakleaf soil form. A moderate degree of degradation, in the form of bare patches, was noticed in the area during the time of the study. The rockiness of the soil surface is approximately 10%.

There are no diagnostic species in this group. The *Acacia stuhlmannii – Salvadora australis* Group (5) is differentiated from most of the vegetation groups in the Vhembe-Dongola National Park by the presence of the species of Species group Q (Table 7), which includes the tree species *Acacia stuhlmannii*, the grass *Sporobolus ioclados* and the forb *Cyathula lanceolata*, and the absence of the species of Species groups L – P, U and CC. Affinities between this group and the *Boerhavia erecta – Salvadora australis* Group (4) are found in the species of Species group R (Table 7), especially the tree species *Salvadora australis*, the grass species *Urochloa mosambicensis* and the forbs *Trianthema triquetra* and *Cyathula orthacantha*.

Only one sub-community is present in this vegetation group, which includes only three relevés. This area is under sampled and needs special attention in future studies. The vegetation type found in this vegetation group is:

Db218 land type (Chapter 3):

- The *Salvadora australis – Acacia stuhlmannii* Community
  - § The *Setaria verticillata – Urochloa mosambicensis* Sub-community **[9]**

6. The *Croton megalobotrys – Combretum microphyllum* Group

This vegetation group includes the vegetation of the riparian zone on the banks of the Limpopo River and its main tributaries on the Ia155 land type (Chapter 4). The habitat features of this vegetation group include deep to moderately deep clayey, silt-rich soils, which are subject to a varying water table through the year as a result of the annual flooding of the main rivers in the area. Swartland, Arcadia, Valsrivier and Sepane soil forms dominate the soils in this vegetation group. Tall trees and dense undergrowth are further characteristics of the vegetation of the *Croton megalobotrys – Combretum microphyllum* Group (6).

The diagnostic species of this vegetation group are found in Species group U (Table 7) and include the tree species *Croton megalobotrys, Hyphaene petersiana, Xanthocercis zambesiaca, Phyllanthus reticulatus, Maytenus senegalensis, Flueggea virosa* var. *virosa,* the woody creeper *Combretum microphyllum* and the grasses *Panicum deustum* and *P. maximum.*

A total of 49 relevés and two communities with two sub-communities each are included in this vegetation group.

Two subgroups were identified in the *Croton megalobotrys – Combretum microphyllum* Group (6), namely:

6.1 The *Salvadora australis – Urochloa mosambicensis* Subgroup

6.2 The *Faidherbia albida – Panicum maximum* Subgroup

6.1 The *Salvadora australis – Urochloa mosambicensis* Subgroup

This subgroup is found on the flood plains of the main river systems in the region. The dominant soils are silt-rich and clayey soils of the Oakleaf soil form. The rockiness of the soil surface is between 1 – 6%. The area is degraded with bare patches frequently appearing in the area.

There are no diagnostic species in this subgroup. The species of Species groups R and S (Table 7) differentiate this subgroup from the *Faidherbia albida – Panicum maximum* Subgroup (6.2). This includes the tree species *Salvadora australis* (Species group R, Table 7) and *Dichrostachys cinerea* (Species group S, Table 7), the grass species *Urochloa mosambicensis* (Species group R, Table 7) and *Eragrostis lehmanniana* (Species group S, Table 7) and the forbs *Trianthema triquetra* (Species group R, Table 7)

and *Achyranthes aspera* (Species group S, Table 7). High frequency of the tree species *Acacia tortilis* (Species group V, Table 7) and the shrub *Cadaba termitaria* (Species group AA, Table 7) as well as the presence of the tree species *Boscia albitrunca* (Species group AA, Table 7) and *Cordia monoica* (Species group CC, Table 7), the grass species *Brachiaria deflexa* (Species group AA, Table 7) and *Tragus berteronianus* (Species group EE, Table 7) and the forbs *Hermbstaedtia odorata* (Species group AA, Table 7) and *Amaranthus* species (Species group EE, Table 7), further differentiate this subgroup from the *Faidherbia albida – Panicum maximum* Subgroup (6.2).

The two vegetation types and 29 relevés, which are included in the *Salvadora australis – Urochloa mosambicensis* Subgroup (6.1), are as follows:

Ia155 land type (Chapter 4):

- The *Hyphaene petersiana – Acacia tortilis* Community
  - § The *Ximenia americana - Flueggea virosa* Sub-community **[16]**
  - § The *Cordia monoica* Sub-community **[17]**

6.2 The *Faidherbia albida – Panicum maximum* Subgroup

This subgroup includes the vegetation of the riverine forest, which is situated on the riverbanks of the Limpopo River and its largest tributaries. The dominant soils have a sandy-loam to a clayey texture with high silt content. The main soil forms that appear in this subgroup are Oakleaf and Valsrivier. The vegetation of the *Faidherbia albida – Panicum maximum* Subgroup (6.2) is characterized by tall trees with a dense undergrowth of shrubs, grasses, climbers, and other forbs.

Diagnostic species of this subgroup are found in Species group T (Table 7) and includes the tree species *Faidherbia albida*, the rambling *Acacia schweinfurthii* and the herbaceous weed *Datura* species. The subgroup is differentiated from the *Salvadora australis – Urochloa mosambicensis* Subgroup (6.1) by the absence of the species of Species groups R, S and EE (Table 7), and by the high frequency of the tree species *Acacia xanthophloea* (Species group CC, Table 7), and the grass species *Panicum maximum* (Species group W, Table 7). Affinities between this subgroup and the *Salvadora australis – Urochloa mosambicensis* Subgroup (6.1) are found in the species of Species groups V and W (Table 7).

A total of 20 relevés from two vegetation types are included in the *Faidherbia albida – Panicum maximum* Subgroup (6.2) and are as follows:

Ia155 land type (Chapter 4):

- The *Croton megalobotrys - Combretum microphyllum* Community
  - § The *Cenchrus ciliaris – Faidherbia albida* Sub-community **[18]**

§ The *Acacia schweinfurthii – Maytenus senegalensis* Sub-community **[19]**

7. The *Heliotropium* sp. – *Sclerocarya birrea* Group

The *Heliotropium* sp. – *Sclerocarya birrea* Group (7) is found in and around the vicinity of anthropogenically disturbed areas in the Ib395 land type (Chapter 5). The soils are dominated by moderately deep to shallow, sandy-loam soils of the Glenrosa and Mispah soil forms. The rockiness of the soil surface varies between 15 and 25%.

Diagnostic species of this vegetation group are found in Species group W (Table 7). This includes the tree species *Sclerocarya birrea* and *Grewia occidentalis*, the grass species *Eleusine coracana* subsp. *africana* and the forbs *Heliotropium* sp. and *Chenopodium carinatum*. This vegetation group is differentiated from the *Croton megalobotrys – Combretum microphyllum* Group (6) through the absence of the species of Species groups T, U, V and W (Table 7).

Only two relevés of one sub-community is included in this vegetation group:

Ib395 land type (Chapter 5):

- The *Terminalia prunioides – Grewia bicolor* Community
  - § The *Hermbstaedtia odorata – Heliotropium ovalifolium* Sub-community

8. The *Diplachne fusca – Acacia xanthophloea* Group

This vegetation group is found in perennial and non-perennial pans and other wetland systems in the Ia155 land type (Chapter 4) of the Vhembe-Dongola National Park. The dominant soil forms that are found in this vegetation group are clayey Arcadia, Rensburg and Swartland soils. These areas are waterlogged during, and for a period after, the rainy season.

The diagnostic species of this vegetation group are found in Species group BB (Table 7). This includes the grass species *Diplachne fusca, Dinebra retroflexa, Corbichonia decumbens* and *Echinochloa pyramidalis*. The absence of the species of Species groups X – AA (Table 7) differentiates the *Diplachne fusca – Dinebra retroflexa* Group (8) form the *Heliotropium* sp. – *Sclerocarya birrea* Group (7). The high frequency of the tree species *Acacia xanthophloea* (Species group CC, Table 7) and the forbs *Amaranthus* species and *Heliotropium ovalifolium* (Species group EE, Table 7) further differentiate the *Diplachne fusca – Dinebra retroflexa* Group (8) from the *Heliotropium* sp. – *Sclerocarya birrea* Group (7).

Four relevés and one community is included in the *Diplachne fusca – Dinebra retroflexa* Group (8), namely:

Ib395 land type (Chapter 4):

- The *Diplachne fusca - Acacia xanthophloea* Community **[20]**

7.3 ORDINATION

In the scatter diagram (Figure 13) the distribution of the vegetation groups along the first and second axes of ordination is given.

A discontinuity can clearly be recognized between the eight vegetation groups identified in the synoptic table (Table 7) along ordination axis one of the scatter diagram (Figure 13). The gradient illustrated on the first ordination axis could be related to soil texture with sandy soils to the left of the diagram and clayey soils to the right.

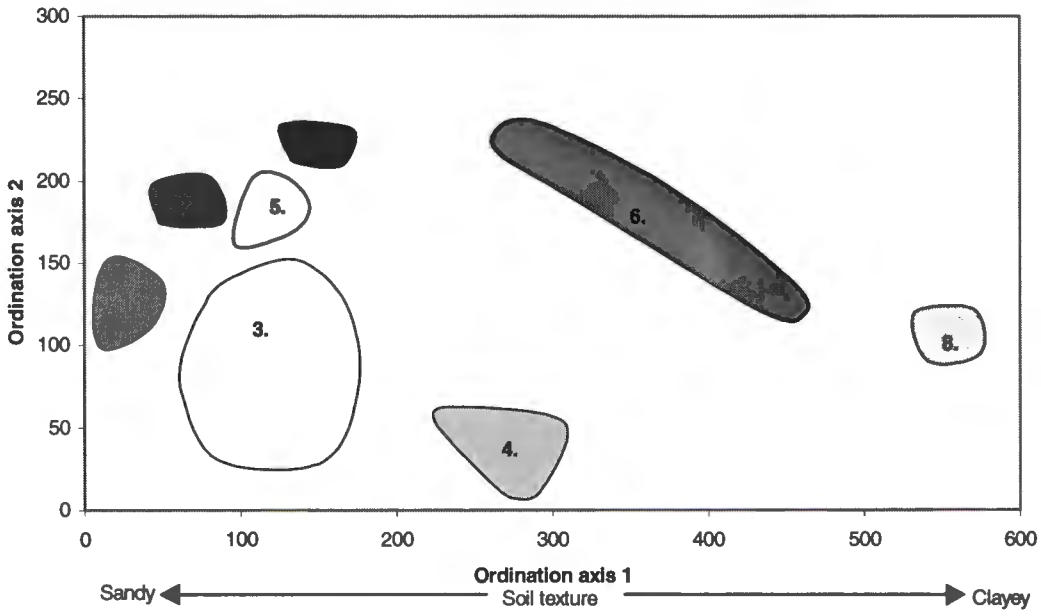


Figure 13: The relative positions of the different vegetation groups along the first two axes of the ordination of all the relevés sampled in the Vhembe-Dongola National Park

The *Hexalobus monopetalus – Bulbostylis hispidula* Group (1) is found on sandy soils on the sandstone ridges of the Park, the *Acacia senegal* var. *leiorhachis – Barleria sinensis* Group (2) is found on equally sandy soils on dolerite outcrops. The *Colophospermum mopane – Brachiaria deflexa* Group (3) is found on deep to moderately deep sandy to loamy soils and the same is true for the *Heliotropium* sp. – *Sclerocarya birrea* Group (7).

The *Boerhavia erecta – Salvadora australis* Group (4) is found on loamy silt-rich soils, the *Croton megalobotrys – Combretum microphyllum* Group (6) on loamy silt-rich to clayey soils and the *Diplachne fusca – Acacia xanthophloea* Group (8) on heavy clayey soils.

7.4 CONCLUSIONS

After the identification and description of plant communities in five different land types (Chapters 3 – 6) in the core area of the Vhembe-Dongola National Park, a synthesis was done on all the vegetation data collected. A synoptic table (Table 7) was compiled and resulted in the identification and description of eight broad vegetation groups, which notably differs with regard to plant species composition. The *Colophospermum mopane – Brachiaria deflexa* Group (3) and The *Croton megalobotrys – Combretum microphyllum* Group (6) showed small differences in plant species composition within the groups itself and were subsequently sub-divided into six sub-groups. In Vegetation Group 3, two of the four sub-groups (3.1 and 3.3) could possibly be further sub-divided into five smaller vegetation units (indicated by dotted vertical lines in Table 7), which was not described for the purpose of this study. Vegetation Group 7 (The *Heliotropium* sp. – *Sclerocarya birrea* Group) was formed as a result of an overexploiting land use and the disturbance caused as a result thereof.

Floristically the vegetation of the Vhembe-Dongola National Park is similar to the vegetation of the Commiphoro mollis – Colophospermetea mopani, a class described by Winterbach (1998). In a phytosociological synthesis of the Mopane Veld by Du Plessis (2001), the *Cissus cornifolia – Colophospermum mopane* and the *Ptycholobium contortum - Colophospermum mopane* Vegetation Types are floristically similar to the *Colophospermum mopane – Brachiaria deflexa* Group (3) identified and described in this study. The *Heliotropium* sp. – *Sclerocarya birrea* Group (7) shows floristic similarities toward the *Enneapogon scoparius – Colophospermum mopane* Vegetation Type (Du Plessis, 2001). These last two vegetation units share a further similarity as both show signs of degradation as a result of gross destruction caused to the habitat by the former SADF and as a result of overgrazing.

In Chapter 8, these vegetation groups will be used as guidelines for the identification and description of several ecologically based management units on which the sound management of the study area and other areas, which will be incorporated within the boundaries of the park in future, could be based.

CHAPTER 8

MANAGEMENT UNITS IN THE VHEMBE-DONGOLA NATIONAL PARK

8.1 INTRODUCTION

The objectives of veld management in a nature conservation area or national park will be dictated by prevailing paradigms such as, the maintenance of biotic diversity and natural ecological processes (Tainton, 1999). It is said that in nature reserves/national parks the intensity of management depends on the size of the area (Bothma, 1989). The larger the area, the less management it requires. Yet, veld management and the management of animal populations such as those of elephant (*Loxodonta africana*) and buffalo (*Syncerus caffer*) in particular are necessary. Even the vast area of the Kruger National Park is not large enough to allow a completely natural balance to evolve. The smaller the nature reserve/national park, the more intensive its management will be.

The requirement for a basic inventory of the resources before management objectives and targets can be set is common to all systems. From the point of view of the vegetation, it is essential to differentiate between areas with regard to varying bush density, species composition and grass layer condition. All these factors influence management decisions. For the compilation of effective, ecologically sound management units and management strategies, Bothma (1989), Stuart-Hill (1991), Brown (1997) and Tainton (1999) stress the importance of thorough ecological studies. This includes the classification of vegetation and soils.

The different plant communities occurring within a given area, e.g. those on rocky hills, slopes, plains, riparian areas and wetland ecosystems, often differ in their palatability, grazing/browsing capacity and accessibility (Bothma, 1989). The plant communities identified in an area, however, do not necessarily represent separate ecological management units. It would therefore be necessary to group these communities together in broad management units, which can be incorporated into a management plan (Van Wyk & Bredenkamp, 1986; Brown, 1997). Some of the criteria used to determine management units are plant communities, land types, broad soil patterns, geology, and topography and land use. Management objectives should be clearly defined before any management planning or actual management can take place. It is not enough to practice management for its own sake. Instead, management activities should be planned with clear-cut long-term objectives in view (Bothma, 1989).

8.2 DESCRIPTION OF MANAGEMENT UNITS

Phytosociological descriptions of the vegetation of the Vhembe-Dongola National Park (Chapters 3 – 6) resulted in a total of 32 vegetation types (communities, sub-communities and variants) being identified. Related vegetation types were grouped together in a synoptic table (Table 7, Chapter 7) to form vegetation groups and subgroups. These vegetation groups and subgroups were used as a basis for deriving management units. The compilation of management units in the Vhembe-Dongola National Park is based on ecological principles whereby not only the vegetation, but also the topography, land type, soil type and geology were taken into consideration. The proposed management units for the Vhembe-Dongola National Park are not seen as units standing on their own, but are rather seen as areas, which show similarities towards vegetation, habitat, topography, soil types etc. As a result these management units are not confined to one area alone, but are found in different areas of the park, which have the above, mentioned similarities and could therefore be similarly managed.

A total of seven different management units were identified and are indicated on three separate management unit maps, which represent the farms Den Staat (Figure 14), Greefswald (Figure 15) and Riedel (Figure 16).

Northern Province

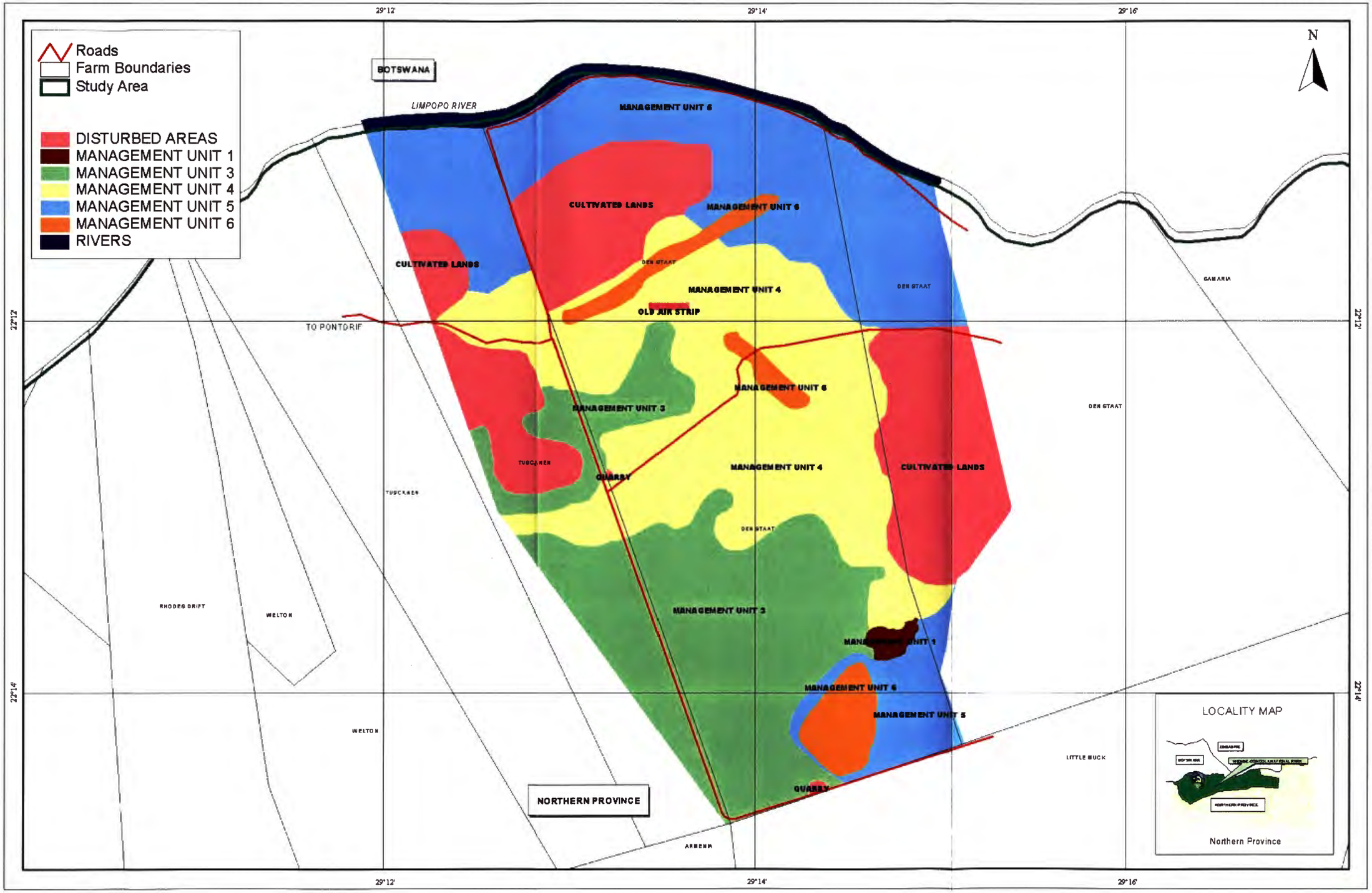


FIGURE 14 : MANAGEMENT UNITS ON DENSTAAT, VHEMBE-DONGOLA NATIONAL PARK

Fig 14.

Province

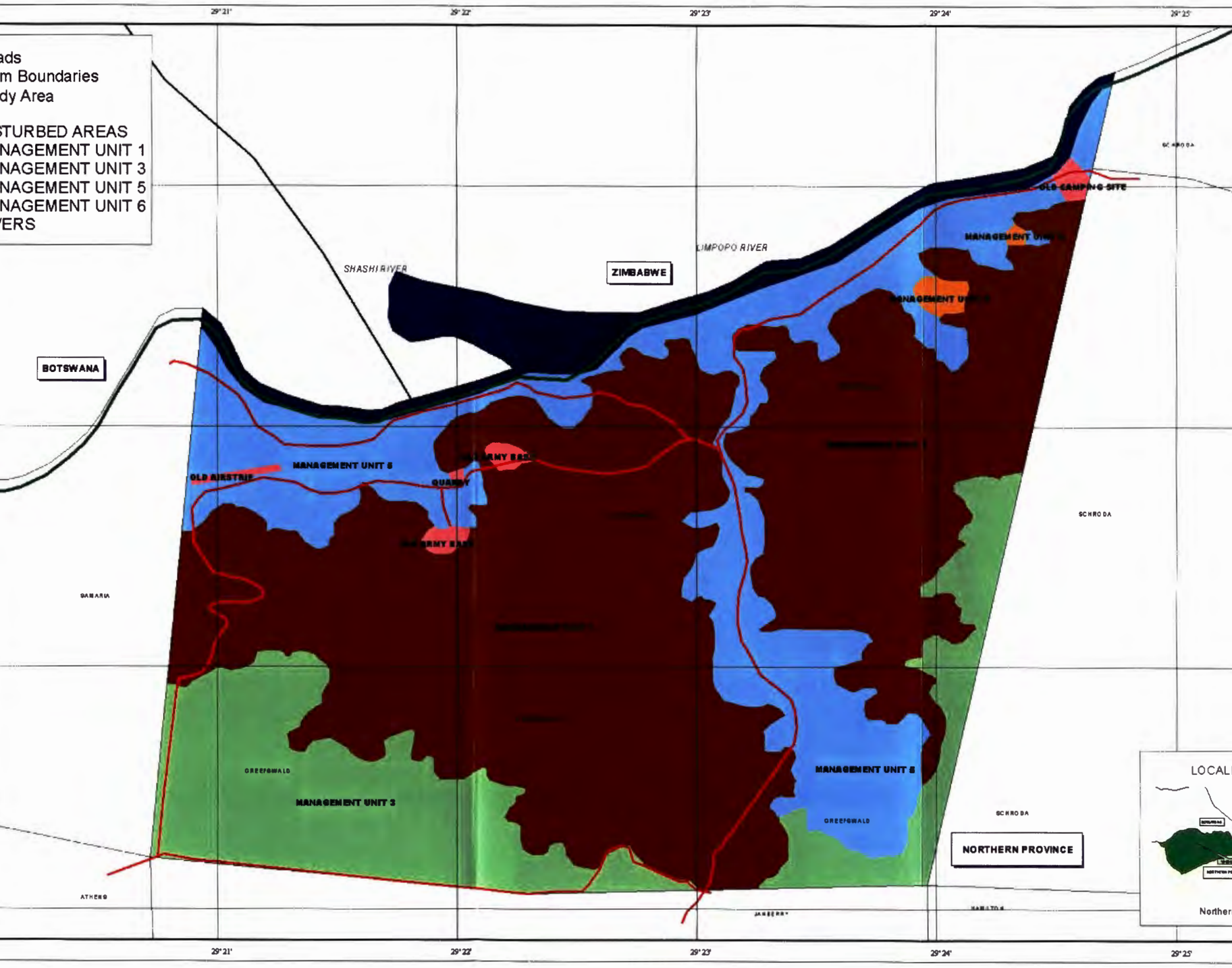


FIGURE 15 : MANAGEMENT UNITS ON GREEFSWALD, VHEMBE-DONGOLA NATIONAL PAR

Northern Province

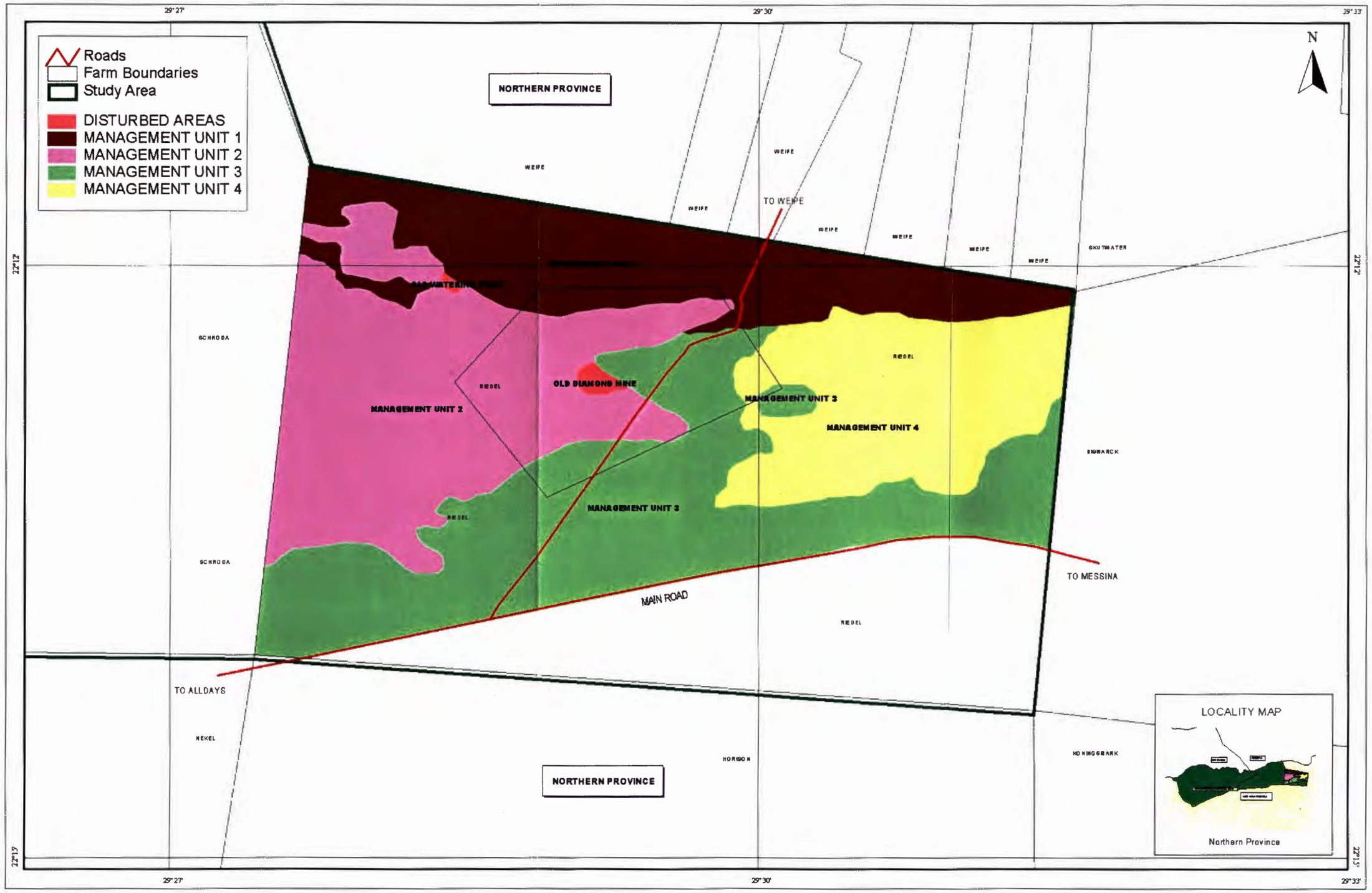


FIGURE 16 : MANAGEMENT UNITS ON RIEDEL, VHEMBE-DONGOLA NATIONAL PARK

Fig 16.

8.2.1 Management Unit 1

This management unit consists mainly of the areas covered by rocky sandstone ridges and plant communities of the Ib395 land type (Table 9). The largest area of this management unit is situated on sandstone outcrops and a smaller portion on dolerite outcrops. The main soil forms are the shallow lithosols Mispah and Glenrosa and large percentages of the area is covered in bare rock and loose rocks of varying sizes. Approximately one half of the farm Greefswald (Figure 15), one quarter of the farm Riedel (Figure 16) and a small portion of the farm Den Staat (Figure 14) is represented by Management Unit 1.

The floristic composition and habitat of the *Hexalobus monopetalus – Bulbostylis hispidula* (1), and the *Acacia senegal* var. *leiorhachis – Barleria sinensis* (2) Vegetation Groups are characteristic of this management unit. Woody species that dominate the tree layer in this management unit are *Hexalobus monopetalus* var. *monopetalus, Croton gratissimus* var. *subgratissimus, Ficus abutilifolia, F. tettensis, Albizia harveyi, Terminalia prunioides, Acacia senegal* var. *leiorhachis, Commiphora tenuipetiolata* and *Grewia bicolor*. The dominant grass species of Management Unit 1 include *Trichoneura* sp., *Schmidtia pappophoroides, Aristida scabrivalvis, Brachiaria nigropedata* and *Oropetium capense*. Forbs, which are prominent in this management unit, are *Hibiscus coddii, Barleria affinis, Tragia rupestris, Corchorus kirkii* and *Bulbostylis hispidula*.

Degradation in this management unit is characterized by the vegetation of the *Heliotropium* sp. – *Sclerocarya birrea* Vegetation Group (7) and was mainly caused by anthropogenic disturbances. Activities of the former South African Defence Force, left large scars in the environment in the form of large bare areas, derelict buildings, dumping sites and soil pollution at an old refueling point. Cleanup operations have commenced and should be considered as a priority in the management of Management Unit 1.

The following plant communities occur in Management Unit 1:

Ib395 land type (Chapter 5):

- The *Hexalobus monopetalus – Croton gratissimus* Community
  - The *Psydrax livida – Oropetium capense* Sub-community, which includes:
    - § The *Mundulea sericea – Zornia glochidiata* Variant **[21]**
    - § The *Strychnos madagascariensis – Coleochloa pallidior* Variant **[22]**
  - The *Ficus tettensis – Waltheria indica* Sub-community, which includes:
    - § The *Stipagrostis uniplumis – Pavonia dentata* Variant **[23]**
    - § The *Hibiscus coddii – Tragia rupestris* Variant **[24]**

Table 9: The relationship between vegetation groups, land types, plant communities and management units in the Vhembe-Dongola National Park.

VEGETATION GROUPS		LAND TYPE	COMMUNITY No.	MANAGE - MENT UNITS
No.	Name			
1	The *Hexalobus monopetalus – Bulbostylis hispidula* Group	Ib395 Ib395 Ib395 Ib395	1.1.1 1.1.2 1.2.1 1.2.2	1
2	The *Acacia senegal* var. *leiorhachis – Barleria sinensis* Group	Ib395	2.1	1
3	The *Colophospermum mopane – Brachiaria deflexa* Group			
3.1	The *Combretum apiculatum – Terminalia prunioides* Sub-group	Ib395 Fb143	2.2 1.2.2	2
3.2	The *Schmidtia pappophoroides – Acrotome inflata* Subgroup	Db218 Db218 Fb143 Fb143 Ae309	1.1 1.3 1.1 1.2.1 1	2 & 3
3.3	The *Neuracanthus africanus – Sesamothamnus lugardii* Subgroup	Db218 Db218 Db218 Db218 Db218	1.4 1.5 1.6 1.7 2.1	3
3.4	The *Leucas sexdentata – Abutilon austro-africanum* Subgroup	Db218 Ia155 Ae309	1.2 1.1 2	3
4	The *Boerhavia erecta – Salvadora australis* Group	Db218 Db218 Ia155 Ia155 Ia155	2.3 3 1.2.1 1.2.2 1.3	4
5	The *Acacia stuhlmannii – Sporobolus ioclados* Group	Db218	2.1	4
6	The *Croton megalobotrys – Combretum microphyllum* Group			
6.1	The *Salvadora australis – Urochloa mosambicensis* Subgroup	Ia155 Ia155	2.1 2.2	5
6.2	The *Faidherbia albida – Panicum maximum* Subgroup	Ia155 Ia155	3.1 3.2	5
7	*Heliotropium* sp. – *Sclerocarya birrea* Group	Ib395	2.3	1
8	The *Diplachne fusca – Dinebra retroflexa* Group	Ia155	4	6

- *Terminalia prunioides – Grewia bicolor* Community
  - *Acacia senegal – Barleria sinensis* Sub-community **[25]**
  - The *Hermbstaedtia odorata – Heliotropium ovalifolium* Sub-community (Disturbed)

8.2.2 Management Unit 2

This management unit is mainly situated on the western part of the farm Riedel (Figure 16), to the west of the road leading to Weipe and covers approximately one half of that area. The dominant soil forms are moderately deep to shallow sandy to sandy-loam Hutton, Glenrosa, and Oakleaf and Mispah soils. The soil surface is covered in lose stones and a small number of sandstone and dolerite outcrops.

The *Combretum apiculatum – Terminalia prunioides* Sub-group (3.1) and the *Schmidtia pappophoroides – Acrotome inflata* Subgroup (3.2), which is found in the *Colophospermum mopane – Brachiaria deflexa* Group (3), occurs in Management Unit 2. The vegetation of this area is dominated by the woody component of which the following species are prominent: *Colophospermum mopane, Combretum apiculatum, Terminalia prunioides, Commiphora glandulosa, C. mollis, Kirkia acuminata, Dichrostachys cinerea, Ochna inermis* and *Rhigozum zambesiacum.* The dominant herbaceous species in this management unit are the grasses *Schmidtia pappophoroides, Cenchrus ciliaris, Eragrostis lehmanniana* and *Aristida congesta* subsp. *congesta* and the forbs *Evolvulus alsinoides* var. *linifolius, Tephrosia purpurea* and *Phyllanthus angolensis.*

Some localized cases of extreme degradation are present in areas surrounding old watering points. These areas were trampled and overgrazed by livestock in the past to the extent that the soil surface exhibits large bare patches and sheet erosion.

The following plant communities occur in Management Unit 2:

Db218 land type (Chapter 3):

- The *Colophospermum mopane* Community
  - The *Digitaria eriantha – Schmidtia pappophoroides* Sub-community **[1]**
  - The *Dichrostachys cinerea – Tephrosia purpurea* Sub-community **[3]**

Fb395 land type (Chapter 5):

- The *Terminalia prunioides – Grewia bicolor* Community
  - The *Colophospermum mopane – Vernonia cinerascens* Sub-community **[26]**

Fb143 land type (Chapter 6):

- The *Colophospermum mopane – Dicoma tomentosa* Community
  - The *Commelina benghalensis – Cucumis zeyheri* Sub-community **[28]**
  - The *Terminalia prunioides – Combretum apiculatum* Sub-community
    - The *Commiphora tenuipetiolata – Grewia bicolor* Variant **[29]**
    - The *Cleome angustifolia – Tephrosia purpurea* Variant **[30]**

Ae309 land type (Chapter 6)

- The *Colophospermum mopane – Eragrostis lehmanniana* Community **[31]**

8.2.3 Management Unit 3

Management Unit 3 (Figures 14, 15 & 16) is situated on the southern plateau of the farm Greefswald, the southeastern area of the farm Den Staat and the southeastern and central parts of the farm Riedel, on a variety of deep, red, sandy Hutton soil forms, shallower sandy Hutton and Glenrosa soil forms and moderately deep to shallow Oakleaf soil forms. The rockiness of the soil surface is generally low. There are however areas with calcareous concretions on the soil surface.

The floristic composition of three of the four sub-groups of the *Colophospermum mopane – Brachiaria deflexa* Group (3), the *Schmidtia pappophoroides – Acrotome inflata* Subgroup (3.2), the *Neuracanthus africanus – Sesamothamnus lugardii* Subgroup (3.3) and the *Leucas sexdentata – Abutilon austro-africanum* Subgroup (3.4), is characteristic of this management unit. The fourth sub-group of the *Colophospermum mopane – Brachiaria deflexa* Group (3) is the *Combretum apiculatum – Terminalia prunioides* Sub-group (3.1) and is found in Management Unit 2 (Figure 16). Prominent plant species in this management unit include the woody species *Colophospermum mopane, Boscia foetida, Terminalia prunioides, Cadaba termitaria, Rhigozum zambesiacum* and *Dichrostachys cinerea.* The prominent herbaceous species includes the grasses *Enneapogon cenchroides, Aristida congesta subsp. congesta, A. adscensionis, Eragrostis lehmanniana, Brachiaria deflexa* and *Cenchrus ciliaris* and the forbs *Hermbstaedtia odorata* and *Abutilon austro-africanum.*

The *Catophractes alexandri – Boscia albitrunca* Community **[32]** in the Ae309 land type (Chapter 6) commonly occur on areas with shallow soils, which exhibit calcareous concretions on the soil surface. These areas are commonly overgrazed, trampled, and as a result degraded to a degree. Localized bush encroachment by woody *Dichrostachys cinerea* shrubs was also observed in certain areas in this management unit.

The following plant communities occur in Management Unit 3:

Db218 land type (Chapter 3):

- The *Colophospermum mopane* Community
  - The *Digitaria eriantha – Schmidtia pappophoroides* Sub-community **[1]**
  - The *Abutilon austro-africanum – Acalypha indica* Sub-community **[2]**
  - The *Dichrostachys cinerea – Tephrosia purpurea* Sub-community **[3]**
  - The *Boscia foetida – Commiphora pyracanthoides* Sub-community **[4]**
  - The *Commiphora mollis – Grewia bicolor* Sub community **[5]**
  - The *Salvadora australis - Sporobolus ioclados* Sub-community **[6]**
  - The *Barleria sinensis – Cyathula orthacantha* Sub-community **[7]**

- The *Salvadora australis – Acacia stuhlmannii* Community
  - The *Cyathula lanceolata – Tragus berteronianus* Sub-community **[8]**

Ia155 land type (Chapter 4):

- The *Salvadora australis – Cucumis zeyheri* Community
  - The *Colophospermum mopane – Eragrostis trichophora* Sub-community **[12]**

Ib395 land type (Chapter 5):

- The *Terminalia prunioides – Grewia bicolor* Community
  - The *Colophospermum mopane – Vernonia cinerascens* Sub-community **[26]**

Fb143 land type (Chapter 6):

- The *Colophospermum mopane – Dicoma tomentosa* Community
  - The *Commelina benghalensis – Cucumis zeyheri* Sub-community **[28]**
  - The *Terminalia prunioides – Combretum apiculatum* Sub-community
    - The *Commiphora tenuipetiolata – Grewia bicolor* Variant **[29]**

§ The *Cleome angustifolia – Tephrosia purpurea* Variant **[30]**

Ae309 land type (Chapter 6)

- The *Colophospermum mopane – Eragrostis lehmanniana* Community **[31]**
- The *Catophractes alexandri – Boscia albitrunca* Community **[32]**

8.2.4 Management Unit 4

This management unit is situated on the farm Den Staat (Figure 14) on the floodplains adjacent to the riparian zone of the Limpopo River and its tributaries on the Db218 and Ia155 land types and in dry streambeds on the eastern parts of the farm Riedel (Figure 16) on the Db218 land type. The main soils vary from moderately deep silt-rich Oakleaf soil forms to clayey Valsrivier soil forms. The soil surface is generally free of loose rocks and is compacted and trampled in certain areas. On the farm Riedel the rockiness of the soil surface is approximately 10%.

The vegetation of the *Boerhavia erecta – Salvadora australis* Group (4) and the *Acacia stuhlmannii – Sporobolus ioclados* Group (5) is typical of Management Unit 4. The woody species that are commonly found in the well-developed tree layer of the woodland vegetation of Management Unit 4 are *Salvadora australis, Acacia stuhlmannii, A. tortilis,* and *Lycium cinereum.* The dominant herbaceous species include the grasses *Setaria verticillata, Panicum maximum, Echinochloa colona, Chloris virgata* and *Urochloa mosambicensis* and the forb species *Cucumis zeyheri, C. metuliferus, Boerhavia erecta, Sida rhombifolia, Abutilon ramosum, A. grandiflorum, Leucas sexdentata, Heliotropium ovalifolium* and *Indigastrum costatum* subsp. *macrum.*

As a whole this management unit is degraded and bare patches and minor gully erosion and soil surface crusting are general degradation phenomena in the area. The area is frequented by game for grazing and as a result is often trampled to dust during dry periods. The question has arisen whether restoration is feasible on these areas or if it should be left as is for the natural succession to take course. It is, however, speculated that the animal population, which target the area for fodder, is too large, and management strategies should be implemented to address the problem. Such management strategies could include the control of game numbers through the capture and relocation of game and/or culling. It is also advised that no watering points be established in the area, other than those that occur naturally in the form of pans. The area could also be fenced off for a number of years in order to facilitate natural restoration in the area. The economic resources and intensive labor required for such an extreme measure is extremely high and is therefore not advised as a first option in the practical management of Management Unit 4.

The following plant communities occur in Management Unit 4:

Db218 land type (Chapter 3):

- ► The *Salvadora australis – Acacia stuhlmannii* Community
  - The *Setaria verticillata – Urochloa mosambicensis* Sub-community **[9]**
  - The *Chloris virgata – Boerhavia erecta* Sub-community **[10]**
- ► The *Salvadora australis – Acacia grandicornuta* Community **[11]**

Ia155 land type (Chapter 4):

- ► *Salvadora australis – Cucumis zeyheri* Community
  - The *Indigastrum costatum* subsp. *maculata – Setaria verticillata* Sub-community
    - § The *Aristida congesta – Leucas sexdentata* Variant **[13]**
    - § The *Eragrostis racemosa – Acacia tortilis* Variant **[14]**
  - The *Combretum imberbe – Abutilon ramosum* Sub-community **[15]**

8.2.5 Management Unit 5

Management Unit 5 (Figures 14 & 15) includes the vegetation of the riparian zone on the banks of the Limpopo River and its main tributaries on the Ia155 land type (Chapter 4). The habitat features of this vegetation group include deep to moderately deep clayey, silt-rich soils, which are subjected to a varying water table through the year as a result of the annual flooding of the main rivers in the area. Swartland, Arcadia, Valsrivier and Sepane soil forms dominate the soils in this management unit.

The floristic composition and habitat of the *Croton megalobotrys – Combretum microphyllum* Group (6), which includes the *Salvadora australis – Urochloa mosambicensis* Subgroup (6.1) and the *Faidherbia albida – Panicum maximum* Subgroup (6.2) are characteristic of this management unit. The most prominent plant species in Management Unit 5 include the woody *Combretum microphyllum, Croton megalobotrys, Hyphaene petersiana, Lonchocarpus capassa, Xanthocercis zambesiaca, Acacia tortilis, A. schweinfurthii, Faidherbia albida* and *Phyllanthus reticulatus.* The herbaceous species include the grasses *Panicum schinzii, P. deustum,* and *Setaria verticillata* and the forbs *Abutilon grandiflorum* and *Momordica balsamina.*

This management unit, especially the riparian fringe directly alongside the rivers in the area, should receive special attention in the management plan of the park due to a number of reasons. The vegetation of the riparian zone prevents extensive soil erosion from taking place on riverbanks and it further serves as a valuable food source and shelter for birds, insects and large and small grazing and browsing mammals. The

Hyphaene petersiana – Acacia tortilis Community, which is found in Management Unit 5 is overgrazed and shows signs of degradation in the form of bare patches. Large areas of this management unit are heavily utilized by elephants, which migrate between the park and neighboring Botswana. The pressure exerted on the environment by the elephants comes in the form of heavy grazing and browsing, trees being uprooted and bark being stripped from trees to the extent that some trees, especially specimens of *Acacia xanthophloea* and *Faidherbia albida*, have died. The long-term effect of the heavy utilization by the elephants is uncertain should be researched. The degradation phenomenon of bush encroachment was observed on an area, which was presumably cleared for an airstrip, but which fell into disuse. Presently a dense population of woody shrubs and small trees of *Acacia tortilis* and *Dichrostachys cinerea* cover the whole airstrip.

The largest destruction and over-utilization of the vegetation of Management Unit 5 is in the form of agricultural development. Large areas have been converted into cultivated lands and as a result the habitat of organisms, dependant on the specific conditions found in riparian areas, is shrinking. Strict control should be practiced on any deforestation planned by land users in future. Restoration practices recommended for this management unit are discussed in Chapter 9 of this thesis.

The following plant communities occur in Management Unit 5:

Ia155 land type (Chapter 4):

- The *Hyphaene petersiana – Acacia tortilis* Community
  - The *Ximenia americana - Flueggea virosa* Sub-community **[16]**
  - The *Cordia monoica* Sub-community **[17]**
- The *Croton megalobotrys - Combretum microphyllum* Community
  - The *Cenchrus ciliaris – Faidherbia albida* Sub-community **[18]**
  - The *Acacia schweinfurthii – Maytenus senegalensis* Sub-community **[19]**

8.2.6 Management Unit 6

Management Unit 6 (Figures 14 & 15) is found in scattered non-perennial pans and other wetland systems in the Ia155 land type (Chapter 4) of the Vhembe-Dongola National Park. These areas are mainly situated on the farm Den Staat and a number of smaller areas on the farm Greefswald. The dominant soil forms that are found in this management unit are clayey Arcadia, Rensburg and Swartland soils. These areas are generally waterlogged during, and for a period after, the rainy season.

The *Diplachne fusca – Acacia xanthophloea* Group (8), characterizes the floristic composition and habitat of this management unit. The most prominent plant species that

occur in Management Unit 6 include the woody *Acacia xanthophloea* and the grass species *Diplachne fusca, Dinebra retroflexa, Corbichonia decumbens* and *Echinochloa pyramidalis*. This management unit has the lowest plant species diversity in comparison to the other management units in the park. This is due to the varying habitat and the specific species, which are adapted to growing in such conditions.

The pans and wetland systems that are included in Management Unit 6 are mostly utilized by large mammals for grazing and water, other small mammals for water, food and shelter and a large variety of bird species for water, food and nesting. In the dry season these areas are subjected to a high grazing pressure, which has consequence of bare patches forming in the vegetation cover. This phenomenon was especially noticed in the non-perennial pans on the farm Greefswald (Figure 15).

The areas included in this management unit are to be regarded as sensitive areas and managed as such. Strict management policies should be implemented for the conservation and sustainable land use of these areas and close monitoring of the utilization by large mammals is proposed. In the event that signs of serious degradation through over utilization are noticed in these areas, measures should be taken to relieve the grazing pressure through the reduction of the animal population that frequent the pans and wetlands. This could be done through the relocation of animals or by fencing areas, which are worst effected by over grazing.

Local land users have also altered the habitat typical of Management Unit 6. On the properties to the south of the farm Den Staat, a large area of these pans and wetland systems have been dammed and is currently used for fish farming. If and when these fish farming areas are to be included in the Vhembe-Dongola National Park, a large study will have to be done in order to research the possible restoration and rehabilitation of these areas.

The following plant community occurs in Management Unit 6:

Ia155 land type (Chapter 4):

- The *Acacia xanthophloea - Diplachne fusca* Community **[20]**

8.2.7 Management Unit 7

Management Unit 7 (Figures 14, 15 & 16) represents all anthropogenically-disturbed areas in the core area of the Vhembe-Dongola National Park. This includes disused airstrips and quarries, old lands and currently cultivated croplands as well as old camping sites and army bases. All of the areas included under this management unit fall within the boundaries of other management units (Management Units 1 – 5). It was decided to include these areas into a separate management unit as they have the resemblance of being denuded of vegetation or poorly vegetated through anthropogenic land use practices and in dire need of intensive restoration and rehabilitation. These areas should

therefore be included in the restoration and rehabilitation management program of the park.

In time, as the disturbed areas of Management Unit 7 are restored and rehabilitated, they can be incorporated into the management plan for the specific management unit in which the particular area is situated. Management and restoration proposals for these degraded areas are discussed in Chapter 9 of this thesis.

7.1. CONCLUSIONS

The fencing of game ranches and nature reserves interferes with the natural migratory behavior of animals (Brown, 1997). This is also true in the case of the Vhembe-Dongola National Park. The park has not been entirely fenced and the area of the park is sub-divided into a number of land units. The sub-division of the study area is firstly due to the number of discontinuous land units the park is made up of, and secondly as a result of many pieces of land still belonging to private land owners. It is therefore important that adequate planning takes place with regard to the effective management of the park while it is not united as a large unbroken area. This includes a habitat analysis and mapping, as well as the determination of habitat utilization by animals and man (Brown, 1997).

In determining management units in the core area of the Vhembe-Dongola National Park, it was attempted to compile ecologically sound, manageable vegetation units, which could form an integral part of management plans and decisions for the park in future.

Due to the high plant diversity and rich cultural historical background of the sandstone ridges of Management Unit 1 (Figures 14, 15 & 16), sound management of this area is of great value. Rock art, petroglyphs and other archaeological sites are found in this area and should receive special attention regarding the preservation thereof. It is proposed that a more extensive study be made of the unique environment and the multitude of microhabitats found in the sandstone ridges of Management Unit 1. The plant species *Aloe chabaudii*, *Barleria affinis*, *Hibiscus coddii*, *Pavonia burchellii*, *P. dentata* and *Steganotaenia araliacea* (Carrot tree) are not threatened, but occur in small localized populations. Care should be taken to conserve the specific habitat required by each of these species.

Two less abundant species, which occur in Management Unit 2 (Figure 16) are, *Hoodia lugardii* and *Adenia spinosa*. These species should also receive special attention with regard to the conservation of the species and their habitat in the park and the populations of these species should be monitored over time.

A number of less abundant species are found in Management Unit 4 (Figures 14 &16). The most significant of these is found on the south eastern parts of the farm Riedel and is the shrubby forb *Peristrophe cliffordii*, which according to Hilton-Taylor (1996) has an indeterminate status, which means that insufficient knowledge exists on the taxon and that it is extinct, endangered or rare. Another species, which is not threatened, but according to Van Wyk & Smith (1996), should be protected in South Africa, is *Aloe littoralis*. *Aloe littoralis* was found on the central area of the eastern part of the farm

Riedel. The scrambling forb *Kedrostis limpompensis* was found on the flood plain area of the farm Den Staat and also has a small area of distribution in the Vhembe-Dongola National Park and surrounding areas.

No uncommon plant species of importance was found in Management Units 3, 5 and 6. These areas are however all unique and should all be conserved for the long-term persistence of the species that flourish in each individual habitat found in these management units. Management Unit 7 includes all anthropogenically-disturbed areas. The restoration and rehabilitation of these areas is discussed in Chapter 9 of this dissertation.

CHAPTER 9

IDENTIFICATION OF DEGRADED AND DISTURBED AREAS IN THE VHEMBE-DONGOLA NATIONAL PARK.

9.1 INTRODUCTION

In the Vhembe-Dongola National Park there are a number of areas that are disturbed through the impact of various factors, be it natural or unnatural. The term disturbance may be used to describe a wide range of phenomena pertinent to the field of land restoration. In its strict ecological sense, disturbance is any event, which causes a sudden change in the nutrient status of an ecosystem, which in turn causes a degree of stress on the plants in an ecosystem (Grime, 1979; Harris *et al*, 1996). Pickett & White (1985) define disturbance as any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate, or the physical environment. Stress is the term used to describe environmental factors (e.g. drought), which prevents the accumulation of additional biomass in an ecosystem (Harris *et al*, 1996). Disturbance in an ecosystem that, for instance, results in a loss of vegetation cover and/or a soil disturbance, in the form of erosion, ultimately start the process of degradation.

Land degradation and disturbance is a worldwide problem, leaving no continent unaffected. The need to address the global problem of land degradation is increasingly urgent. It is also known that land degradation is a major cause and mechanism of global loss of productive land resources and it contributes to loss of global biodiversity, loss of the earth's biomass and bio-productivity, and to global climatic change (UNEP, *sine anno*).

The aim of this chapter is to identify and discuss degraded areas in the Vhembe-Dongola National Park. Different categories of degradation and disturbance will be discussed and different proposals will be made in view of addressing the problems at hand. Priorities will also be given to the restoration of the different degraded areas in the park. The term degraded land, is used to denote land damaged as a result of human activities (Harris *et al*, 1996). The United Nations Environment Program (UNEP) (*sine anno*) defines degradation as a reduction of resource potential by one or a combination of processes acting on the land, such as:

- Soil erosion by wind and/or water.
- Deterioration of the physical, chemical and biological or economic properties of soil.
- Long-term loss of natural vegetation.

The United Nations Convention to Combat Desertification (UNCCD) defines the term land degradation as a process where a reduction in, or a loss of productivity, and a

change in rangeland status to a poorer condition, can be observed (Kellner, 2000). According to three working groups of a workshop held for the Desert Margins Program in Potchefstroom in March 1998, degradation is caused by a number of factors including human intervention, such as the abuse of the environment through ignorance, bad management, agriculture and other human activities, political, industrial and historical issues as well as climatic variability (Kellner, 2000). In the Vhembe-Dongola National Park, it was observed that the main causes of degradation are deforestation, bush encroachment, overgrazing, and trampling by commercial livestock combined with long periods of below average rainfall and other anthropogenic influences such as overall mismanagement and overexploitation.

Kellner and Shabangu (1998) state that a common feature of both developed and underdeveloped areas is the presence of ecosystems that have been degraded to such an extent that they have lost many of the structural and functional properties, which characterize a healthy environment. During an intensive study carried out in the late 1990's in South Africa, it was established that approximately 25% of the natural rangelands in South Africa are degraded (Hoffman *et al.*, 1999). By no means has the Vhembe-Dongola National Park (Figure 2, Chapter 2) evaded the above-mentioned effects of mismanagement and other malpractices. There are many areas in the park that are degraded to a greater or lesser degree as a result of different anthropogenic influences, as mentioned for the different land types in Chapters 3 – 6 of this thesis. This includes various land degrading influences such as deforestation in order to create cultivated lands, overgrazing by livestock and game, destruction of natural vegetation by heavy military vehicles and land disturbance and pollution (soil pollution by diesel fuel and old dumping sites) in the vicinity of old military camping sites.

The historical background of the study area may also provide answers with regard to the present degree of degradation in certain areas of the park. Many archaeological sites are concentrated in the Shashi-Limpopo confluence area. These sites date back from the Early Stone Age (1 million to 250 000 BP) to the present. The most significant of these archaeological sites are the Zhizo site (AD 700 – 900) on the farm Schroda, and Mapungubwe Hill and the adjoining Bambandyanalo (AD 1100 – 1250) situated on the farm Greefswald (Robinson, 1996).

Although no scientific proof exists on the condition of the natural environment in the above-mentioned period, it could be assumed that the impact of thousands of people living in close proximity to each other must have had some lasting effects on the environment. To which extent the degradation caused by the primeval inhabitants of the area, is still visible today, is uncertain. It could however, be speculated that a large degree of deforestation took place for a multitude of uses such as building material, fuel and craftwork. It was observed that the area around Mapungubwe Hill is poorly vegetated, possibly due to a high degree of soil compaction. It could be assumed that this is the direct result of the activities of the primitive human population of the area at the time (AD 1100 – 1250). Scientific proof of this assumption could not be obtained during the time of this study. The ancient peoples of Mapungubwe were also agriculturalists who practiced hoe agriculture for the cultivation of millet, groundnuts, beans and a variety of melon (Van Riet Lowe, 1936; Voigt, 1983). This is proof that a certain impact to the environment was caused by cultivation. Flocks and herds of cattle,

goats and sheep were also kept (Voigt, 1983) and suggest that a certain grazing pressure was exerted on the natural grazing land.

One of the different land degradation phenomena found in the Vhembe-Dongola National Park is the forming of bare patches and the resulting loss of vegetation cover. This phenomenon was observed in most management units (Chapter 8), but especially in Management Units 4, 5 and 6 (Table 10). Development of large bare patches in the vegetation, can be ascribed to natural causes such as drought conditions, combined with grazing practices such as patch selection, which occurs through selective grazing, or the overgrazing of vegetation with high grazing potential (Kellner & Bosch, 1992). Conditions of degradation occurring on a given area can be regarded as unique in terms of the soil, climate and the degree of degradation (Van der Merwe & Kellner 1999). Many clayey soils have shrink and expand characteristics and the bare patches that develop on these soils has an impenetrable crust, resulting in a high degree of compaction and an increase in the temperature of the soil surface (Coetzee, 1990, 1992; Du Toit, 1992). Although sandy soils do not become compacted, there is still a degree of crust forming on bare ground, which could have a negative impact on seed germination.

Bush encroachment and thickening can also be regarded as a land degradation problem and was also identified in the core area of the Vhembe-Dongola National Park, especially in Management Units 3 and 5 (Table 10). Bush encroachment is the term commonly used to describe the phenomenon of increasing tree and shrub density in southern Africa (Smit *et al,* 1996; Tainton, 1999). The suppressive effect of bush encroachment on herbaceous production, and thus on grazing capacity, is often the major reason why clearing of woody plants is considered as a management option (Smit *et al,* 1996). Teague and Smith (1992) stated that the determinant factors of bush encroachment might either be primary, such as climate and soil, or secondary, such as fire and the impact of herbivores. In the case of the impact of herbivores, bush encroachment is mainly brought about by the replacement of most of the indigenous browsers and grazers by domestic (largely grazing) livestock, often at alarmingly high stocking rates, the restriction of movement of herbivores by the erection of fences, poor grazing management practice, and by the provision of artificial watering points (Tainton, 1999). According to Smit & Rethman (1999) the major aim of the thinning or clearing of woody vegetation is usually to increase herbaceous production.

Irrigated cultivation was introduced to the area during the late 1940s (Robinson, 1996). In 1967 the Vhembe Nature Reserve (8746 ha), comprising of the properties Greefswald, Samaria and Den Staat, was proclaimed. The farm Greefswald was state-owned but the other two farms remained under private ownership. The conservation effort was however undermined in the early 1980s, when an extensive irrigation scheme was developed on the farms Den Staat and Samaria, thus destroying a large part of the riparian woodland. Ill-judged bush clearing took place and as a result, large areas of the floodplains on farms Den Staat and Samaria were extensively cultivated, despite the fact that they formed part of the reserve (Robinson, 1996). TPA (1989) recommended that, for ecological reasons, the intensive irrigated cultivation on these farms should be stopped. Cultivation practices have also left their mark on certain areas of the farm

Schroda, but were notably less extensive than those on the farms Samaria and Den Staat.

In an attempt to combat degradation different technologies for rangeland improvement has been developed and adopted. Restoration is the process by which an area is returned to its original state prior to degradation of any sort, i.e. back to a fully functioning self-sustaining ecosystem (Tainton, 1981; Harris *et al.*, 1996). The Society for Ecological Restoration (SER) (2002) states that ecological restoration is an international activity that initiates or accelerates the recovery of an ecosystem with respect to health, integrity and sustainability. The main aims of restoration are to achieve a higher plant biodiversity on the area that is being restored, to increase vegetation cover (especially grass species) and to ultimately increase the overall productivity of the land.

Restoration approaches are roughly divided into two main categories, firstly, passive management (withdrawal of livestock/game) and secondly, active intervention (browsing, burning, clearing, reseeding, and cultivation). Milton and Dean (1995) comments on the passive management approach, that the rate of restoration of palatable grasses on overgrazed grasslands are limited by seed availability and short seed-dispersal distances. Recovery times may exceed 70 years (O'Connor, 1991b; Milton & Dean, 1995). While the application of good grazing management methods may be a means of improving vegetation and bringing it back to its original condition, the techniques of restoration, amongst others, usually include soil disturbance, seeding and in some cases soil amelioration by fertilization (Tainton, 1981). The latter are forms of active intervention.

According to Gunn (1991) it has been argued that it is impossible to restore certain degraded natural habitats. Harris *et al.* (1996), however, argues that provided that the species has not been made extinct as a result of the degradation, then restoration is possible. In this regard, the soil seed bank plays an important role in the environment. A healthy soil seed bank can serve as an important buffer to ensure the persistence of a species and as a reservoir of genetic variation (De Wet, 2001).

The phytosociological study (Chapters 3 – 6) was used together with historic data, data sampling and interviews, to identify disturbed and degraded areas. With this information certain recommendations with regard to restoration methods could be made.

9.2 IDENTIFICATION OF DISTURBED AND DEGRADED AREAS

Degradation in the Vhembe-Dongola National Park is discussed according to the following areas:

- Natural rangeland (grazing land).
- Cultivated lands and old lands.
- Old army bases, air strips and quarries.
- Alien vegetation.

9.2.1 Natural rangeland (grazing land)

For the purposes of this thesis, natural rangelands include all areas in the park, which have not been directly altered as a result of cultivation or other intensive land use practices. In the past, the predominant form of land use on the natural rangelands in the core area of the Vhembe-Dongola National Park is, or was extensive cattle or combined cattle and game farming (Robinson, 1996; Smit & Rethman, 1998). The carrying capacity of the land is approximately 17 ha per large stock unit (Robinson, 1996). Although some of the private landowners still keep a limited amount of small and large livestock, the present focus is more on game farming.

It is evident that a certain degree of overstocking has taken place in the past (Smit *et al*, 1998). The largest concern in this regard is on the eastern side of the farm Riedel on Management Unit 4 (Chapter 8). Large bare patches and low grass cover are definite signs of degradation on this specific site. Although the area is currently populated by a small number of game species, such as *Aepyceros melampus* (Impala), *Tragelaphus strepsiceros* (Kudu), *Raphicerus campestris* (Steenbok), *Equus burchelli* (Burchell's Zebra) and *Oreotragus oreotragus* (Klipspringer), the scars of cattle ranching in the past are still clearly visible. Bare areas with dead or stunted *Colophospermum mopane* trees were observed (Management Units 3 & 4, Chapter 8). The cause of this phenomenon is uncertain. It can however be speculated that as a result of extreme overgrazing and trampling the soil surface is compacted and water infiltration therefore reduced. As a further result of this, surface erosion is a large concern, as the surface runoff of rainwater is extremely high on these areas (Snyman & Fouché, 1991; Snyman, 1993). The contribution of termites to the origin of these extreme bare areas cannot be excluded.

On Management Unit 1 (Chapter 8) on the farm Greefswald (Figure 15) a number of areas were noted as being degraded. After some consideration it was however decided that these areas could be of some archaeological importance and no attempts of restoration should be made before confirmation thereof is found.

Management Unit 4 (Chapter 8) on the farm Den Staat (Figure 14) also shows signs of serious degradation. Low grass cover and bare patches is a common site of this flood plain unit. According to the previous park manager Mr. Johan Filmalter (pers. comm.)[3]; the area is heavily grazed by game coming over the Limpopo River in search of forage. This is an ongoing phenomenon as a direct result of the extreme degradation visible on the Botswana and Zimbabwean sides of the river.

(1) Degradation in the Db218 land type

Management Unit 3 and Management Unit 4 (Chapter 8) are found in this land type. As a whole the Db218 land type (Figures 3 & 4) shows signs of degradation due to the effects of commercial stock and combined stock and game farming in the past. Overgrazing primarily by cattle and secondarily sheep, goats and game with the direct

[3] Johan Filmalter. Former park manager, Vhembe-Dongola National Park.

effect of harsh droughts in the past caused the degradation in the area. Currently, game occupies the area and a severe dry period, before 1999, has further contributed to the degradation of the land. As a result of the above mentioned degradation factors, soil compaction and surface erosion has set in, which leads to the further demise of the vegetation in certain areas of this land type.

The following sub-communities, which were identified in the Db218 land type (Chapter 3) show signs of disturbance and degradation:

The *Abutilon austro-africanum – Acalypha indica* Sub-community (1.2), the *Dichrostachys cinerea – Tephrosia purpurea* Sub-community (1.3) and the *Salvadora australis – Sporobolus ioclados* Sub-community (1.6) of the *Colophospermum mopane* Community (1). The *Cyathula lanceolata – Tragus berteronianus* Sub-community (2.1) and the *Chloris virgata – Boerhavia erecta* Sub-community (2.3) are found in the *Salvadora australis – Acacia stuhlmannii* Community (2). In these sub-communities bare patches occur on a regular basis. A high degree of soil surface compaction is present on these bare patches. In certain areas the woody *Colophospermum mopane* occurs mainly in the form of stunted shrubs, which probably exhibit this stunted growth form as a result of heavy browsing, lack of water infiltration, due to heavy crust forming on the soil surface, or a combination of the two.

The *Cyathula lanceolata – Tragus berteronianus* Sub-community (2.1) and the *Chloris virgata – Boerhavia erecta* Sub-community (2.3) are found in the *Salvadora australis – Acacia stuhlmannii* Community (2). More specifically, the *Cyathula lanceolata – Tragus berteronianus* Sub-community (2.1) is found on Terrain Unit 5 (TU5) (flood plain) of the eastern parts of the farm Riedel and the *Chloris virgata – Boerhavia erecta* Sub-community (2.3), is situated on the floodplain area of the farm Den Staat. Large denuded compacted soil surfaces, increased surface erosion and low cover of the herbaceous layer, characterize the degradation found in these sub-communities.

(2) Degradation in the Ia155 land type

The Ia155 land type includes Management Units 4, 5, 6 & 7 (Chapter 8). As a result of land clearing by intensive irrigation farming practices, as well as over-utilization by small and large livestock and game (especially elephants) it could be mentioned that all of the communities of the Ia155 land type (Figures 3 & 6) are under pressure of degradation. It is estimated that the over-utilization and destruction caused to the riparian zone by migratory Tuli Elephants, from neighboring Botswana, is a large cause for concern. The South African National Parks and the management of the Vhembe-Dongola National Park consider this in a serious light. According to Dr. Hugo Bezuidenhout (pers. comm.)[4], of the South African National Parks research office, in October 2001, a number of monitoring sites have been established all over the Vhembe-Dongola National Park and particularly in the riparian areas to monitor the utilization of these areas, specifically by elephants. Another concerning phenomenon, which was observed in the riparian woodland, is the damage caused to large trees by elephants through the stripping of tree bark to the extent where the trees are being "ring barked",

[4] Dr. Hugo Bezuidenhout. SANP, Kimberley

which will eventually lead to the death of these big trees. The trees mostly affected by this phenomenon are *Acacia xanthophloea, Faidherbia albida* and *Ficus sycomorus.*

The following communities and sub-communities show signs of degradation and disturbance in the Ia155 land type (Chapter 4):

The *Indigastrum costatum – Setaria verticillata* Sub-community (1.2) occurs in the *Salvadora australis – Cucumis zeyheri* Community (1) of the Ia155 land type, which is found on the floodplain area of the farm Den Staat (Figures 3 & 6). Large bare patches are visible in the vegetation and surface erosion has set in as a result of poor herbaceous cover. The large numbers of game that frequent the area tramples and overgrazes the area. Due to the flooding in high rainfall years, as well as the high resilience of this floodplain area, any restoration is uncertain at this stage.

The *Hyphaene petersiana – Trianthema triquetra* Community (2) shows signs of overgrazing and trampling and as a result the soil surface is compacted. Bare patches occur on soils with high silt and clay content.

In the *Acacia xanthophloea – Diplachne fusca* Community (4) the major degradation problems lie on the outside of the current boundaries of the Vhembe-Dongola National Park on privately owned farms where these wetland areas have been cleared for cultivation of *inter alia* citrus. Large dams have also been built for irrigation purposes. Large-scale fish farming is also practiced in these dams. Future studies will have to be implemented to determine the extent of the degradation and how to address the problems at hand. If and when restoration of these dams will be considered, it will require rehabilitation by landscaping, which will require heavy machinery and a great deal of economic and human resources.

(3) Degradation in the Ib395 land type

The Ib395 land type is represented by Management Units 1 & 2 (Chapter 8). The primary cause of degradation in this land type has a direct anthropogenic origin. Overgrazing and trampling are not as common in this land type as in the other land types found in the Vhembe-Dongola National Park. This is largely because the largest parts of the Ib395 land type (Figures 3 & 8) are inaccessible to cattle and large game. The cover of the herbaceous vegetation of this land type is much lower than that of the other land types in the park and therefore the natural vegetation of these sandstone koppies is more suitable for small browsing animals than grazers. The main cause of degradation of the Ib395 land type is the impact, which the activities of the former South African Defence Force had on the environment. This is discussed in more detail under the heading of Old Army Bases (9.2.3).

The *Hermbstaedtia odorata – Heliotropium ovalifolium* Sub-community (2.3), which form part of the *Terminalia prunioides – Grewia bicolor* Community (2) is the most disturbed plant vegetation type in this land type. This community has established on sites of old army bases as a result of deforestation, trampling by troops, heavy military vehicles and pollution (see 9.2.3).

(4) Degradation in the Fb143 land type

The Fb143 land type (Figure 3 & 10), which includes Management Units 2 & 3 (Chapter 8) is mainly found on the western parts of the farm Riedel (Figures 2 & 10). This area is characterized by an undulating rocky terrain and a good tree and grass cover. With the exception of one localized point, the Fb143 land type is not overgrazed and trampled and appears to be in a good condition. The scars left behind by domestic livestock ranching in the past are, however, still visible on the western parts of the farm Riedel at an old watering point, approximately in the middle of this area. This particular area is heavily degraded through overgrazing and trampling, especially by cattle, which were kept on these parts. Evidence of deforestation was observed and signs of surface erosion are also present in the area. An observation was made, that after a good rain year, the cover of certain grass species can recover. These are however, mainly annual and low ecological status species such as *Aristida congesta* subsp. *congesta*, *Enneapogon cenchroides, Urochloa mosambicensis* and *Eragrostis lehmanniana.* This is a prime example of the resilience of the land when the soil seed bank is not depleted.

(5) Degradation in the Ae309 land type

This land type covers a small portion of the Vhembe-Dongola National Park and is found in the southwestern parts of the farm Greefswald (Figure 3 & 10) on Management Units 2 & 3 (Chapter 8). In the Ae309 land type (Figure 3 & 10) the *Catophractes alexandri – Boscia albitrunca* Community is extremely degraded. This community covers a small portion of the Ae309 land type and is found on clayey Oakleaf soils. The soil surface is compacted and is covered by calcareous concretions. Careful consideration should be taken when restoration is to be done in these areas as many of them occur on archaeological sites. One specific area in the *Catophractes alexandri – Boscia albitrunca* Community is thought to have been a watering or feeding point or an old livestock kraal.

9.2.2 Cultivated lands and old lands

These areas are represented by Management Unit 7 in Chapter 8.

(1) Cultivated lands

These are areas, which are currently under intensive cultivation. Potatoes, tomatoes, onions, watermelons, cotton, pumpkins and paprika are some of the crops planted on these lands. Sophisticated irrigation systems are in use on these lands and it should be taken into consideration that a certain degree of nutrient enrichment will have taken place in these cultivated areas. According to Harris *et al* (1996) this is known as an enrichment disturbance, in which case the carrying capacity is increased by the addition of nutrients from outside of the system.

These cultivated lands are mainly found along the banks of the Limpopo River and on the adjacent flood plain areas on the farms Welton, Rhodesdrift, Tuscanen and Den Staat (Figure 2, Chapter 2), which all occur in the core area of the proposed national park. These lands are mainly situated on sandy-loam to silt rich soils of the Hutton and Oakleaf soil forms. The vegetation of the areas adjacent to the lands consists mainly out of the communities of the riparian woodland and floodplains of the Ia155 land type and the floodplain communities of the Db218 land type. These areas should be considered as the number one priority for applying restoration practices, once cultivation is discontinued.

The area is divided into two main areas for restoration purposes. Firstly there is the area that lies on the clayey soils of the riparian zone on the banks and floodplain of the Limpopo River on the Ia155 land type. In these areas it will be necessary to restore the herbaceous as well as the tree layer. Secondly there are the areas further away from the river, some still on the greater floodplain, but in the Db218 land type on sandy-loam soils. In these parts it will only be relevant to restore the herbaceous layer with grasses occurring in the non-disturbed, adjacent plant communities.

(2) Old lands

Old lands are areas, which were previously cultivated and abandoned with no attempt to actively restore the area. The largest portions of old lands are found on the farms Schroda and Tuscanen (Figure 2, Chapter 2). Both these farms occur within the core area of the proposed national park, but were not included in this study. Thus, no phytosociological sampling took place on these farms. The state of the vegetation on these old lands is based on estimates made by observation during visits to these areas.

These old lands are not totally void of vegetation. Through the process of natural succession a number of different pioneer grasses, forbs and tree species have established and are flourishing. The grass species *Aristida congesta* subsp. *congesta*, *Enneapogon cenchroides*, *Eragrostis lehmanniana*, and the tree species *Acacia tortilis* are the main plant species, which have established on these old lands.

The veld condition has however not necessarily returned to the previous more optimal state and according to Kellner and Shabangu (1998) degraded systems will not recover optimally through succession processes in arid and semi-arid areas in a short period of time. Taking this into consideration, it is evident that these areas will take years to restore back to its original state through natural successional processes alone. The reintroduction of grass species with higher ecological status will have to be done by active restoration methods.

9.2.3 Old army bases, disused air strips and old quarries

These areas are represented by Management Unit 7 in Chapter 8.

(1) Old army bases

For an undisclosed period of years, the former South African Defence Force has been operating an army base and camps in the region and especially on the farm Greefswald in the Ib395 land type. This was because the area was, for a period of time, described as a sensitive security zone (Robinson, 1996). The current South African National Defence Force still keeps a presence in the area by patrolling along the South African borders with Botswana and Zimbabwe. Their base is situated at Hardekool Camp on the farm Greefswald.

The scars left behind, when the SADF scaled down their operations on the farm Greefswald, are mostly in the form of large spaces with little vegetation cover, derelict buildings and bunkers, old fueling stations and refuse dumps.

During the time of this study clean-up operations commenced on these old army bases. Buildings and bunkers were demolished and under ground fuel tanks removed. One extreme case of soil pollution, which was observed in the vicinity of an old refueling station, where fuel spills occurred in the past, must urgently be addressed.

These old army bases are situated mainly in the *Hexalobus monopetalus – Croton gratissimus* Community (1) and to a lesser extent in the *Terminalia prunioides – Grewia bicolor* Community (2) of the Ib395 land type (Chapter 5).

(2) Air strips

In the region of the lower boundary between the farms Greefswald and Samaria an old airstrip was observed. Naturally in the establishment of the airstrip the area was deforested and leveled. In the event of disuse, the strip was left and is currently covered by a dense growth of *Acacia tortilis* shrubs and trees. A certain degree of bush encroachment is visible in this area and should be addressed.

The old airstrip on the farm Greefswald is situated in the *Hyphaene petersiana – Trianthema triquetra* Community (2) of the Ia155 land type (Chapter 4).

(3) Old quarries

There are a number of old quarries in the Vhembe-Dongola National Park. Two large quarries were observed on the farm Den Staat. One of them lies on the boundary of the farms Den Staat and Tuscanen and the other on the boundary between the farms Den Staat and Little Muck (Figure 14). The latter was still in use by the local farming community late in 2000 for the maintenance of farm roads. Both these quarries are situated in the Db218 land type. A third quarry is situated on the farm Greefswald in the Ib395 land type. The history of this quarry is uncertain. It can however be assumed

that the former SADF excavated the material for use in the construction of army bases and camps, and the building and maintenance of roads in the area.

In the case of quarries there is usually insufficient overburden material to make good the original contours (Harris *et al.*, 1996). It is therefore difficult to restore a quarry to its original state. To further complicate matters, the original topsoil was not preserved in the event of initiating the quarries in the area of the Vhembe-Dongola National Park.

According to Harris *et al* (1996) quarries can be utilized as water bodies as an end-use. These quarries in the park can therefore be used as dams for supplying water to game and/or recreational uses.

9.2.4 Alien vegetation

The percentage of alien vegetation found in the proposed core area of the Vhembe-Dongola National Park, is low in comparison to that of the natural vegetation. A number of alien invasive species has however been identified in certain areas of the park, of which the most significant are the following:

- *Flaveria bidentis* (Smelter's bush) is found mostly on the farms Den Staat and Tuscanen. Common weed in crops, gardens and wastelands (Bromilow, 1995).
- *Nicotiana glauca* (Wild tobacco) was found on the farms Greefswald and Den Staat on the banks of the Limpopo River. Invades roadsides, road cuttings, wasteland, riverbanks and riverbeds. Declared weed (Henderson, 2001).
- *Opuntia ficus-indica* (Prickly pear) was observed on the farms Den Staat, Greefswald and the eastern part of the farm Riedel. Declared weed in South Africa (Bromilow, 1995 & Henderson, 2001).
- *Ricinus communis* (Castor-oil plant) was found in the riverbed and riverbanks of the Limpopo River on the farms Den Staat, Greefswald and Tuscanen. Invades Riverbanks, riverbeds, roadsides and wasteland. Declared invader (Henderson, 2001).
- *Sesbania bispinosa* (Spiny sesbania) was observed on the farms Den Staat and Tuscanen. Weed in crops, roadsides and waste-lands (Bromilow, 1995).

The total eradication of all alien vegetation found within the boundaries of the Vhembe-Dongola National Park and its surrounding areas should be considered a high priority (Table 10). Immediate action in this regard will prevent all alien vegetation from further spreading throughout the park.

9.3 RESTORATION RECOMMENDATIONS

9.3.1 Introduction

In this section it was attempted to make clear recommendations concerning the restoration of the degraded areas, which were identified in the sections prior to this one. Foremost it must be understood that no frequency data was collected in this study and all estimates on degradation that were made in this chapter, are based on visual observations by the author, the management team of the park and the local farming community. Primarily, ecological restoration should be clearly defined and understood. SER (2002) defines ecological restoration as the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Restoration represents an indefinitely long-term commitment of land and resources, and a proposal to restore an ecosystem requires thoughtful deliberation (SER, 2002).

When planning any restoration project, it is important to identify and clearly describe reference ecosystems. A reference ecosystem or reference serves as a model for planning a restoration project, and later for its evaluation. In its simplest form, the reference is an actual site, its written description, or both (SER, 2002).

SER (2002) mentions, *inter alia*, the following as sources of information that can be used in describing the reference:

- Ecological descriptions, species lists and maps of the project site prior to degradation.
- Historical and recent aerial and ground level photographs.
- Ecological descriptions and species lists of similar intact ecosystems.
- Historical accounts and oral histories by persons familiar with the project site prior to degradation.

In initiating any restoration project, it is important to clearly stipulate the aim of the restoration. The general aims of restoration for this study area are:

- To improve the vegetation cover of the degraded land to reduce and control erosion.
- To improve the grazing capacity of the land by inducing higher plant production on the degraded areas.
- To uphold and increase the biodiversity of the land.
- Deforestation and/or thinning of bush encroached areas.

In a national park the main goal of restoration will be more towards increasing the biodiversity and vegetation cover and not necessarily for higher production and grazing capacity.

9.3.2 Restoration planning

SER (2002) stipulate the following plans for restoration projects, which include, at the minimum, the following:

- A clear rationale as to why restoration is needed.
- An ecological description of the site designated for restoration.
- A statement of the goals and objectives of the restoration project.
- A designation and description of the reference.
- An explanation of how the proposed restoration will integrate with the landscape and its flows of organisms and materials.
- Explicit plans, schedules and budgets for site preparation, installation and post-installation activities, including a strategy for making prompt mid-course corrections.
- Well-developed and explicitly stated performance standards, with monitoring protocols by which the project can be evaluated.
- Strategies for long-term protection and maintenance of the restored ecosystem.

When feasible, at least one untreated control plot should be included at the project site, for the purpose of comparison with the restored ecosystem.

9.3.3 Restoration practices

In November 1999 the School of environmental Sciences and Development of the Potchefstroom University for Christian Higher Education (PU for CHE), in conjunction with the National Department of Agriculture, initiated a project in which two restoration demonstration sites were established nearby the Vhembe-Dongola National Park, to the west of Pontdrift, on the farms Hillstone and Vhembe Game Ranch (Van den Berg, 2001). These sites are both in the Mopane veld and the main aims of the restoration done on these sites are to improve the herbaceous cover and the plant production of the land for combined cattle and game farming. Different restoration practices were applied on the sites, which included rip cultivation, re-seeding, the introduction of organic material (cattle dung) and brush packing (Van den Berg, 2001). Re-seeding was done with a grass seed mixture including: *Anthephora pubescens* (Wool Grass/Borseltjiegras), *Cenchrus ciliaris* (Foxtail Buffalo Grass/Bloubuffelsgras), *Chloris gayana* (Rhodes Grass/Rhodes-gras), *Digitaria eriantha* (Common Finger Grass/Smutsvingergras) and *Panicum maximum* (Guinea Grass/ Buffelsgras) (Van den Berg, 2001).

In the preliminary results of Van den Berg (2001), it was observed that good results were obtained where ripping was combined with re-seeding (with the above mentioned seed mixture), organic matter (cattle dung) and brush packing. Although brush packing

serves as additional cover to preserve moisture and also as a barrier against heavy grazing while the seedlings are still young, it has to be mentioned that it is time-consuming, labor intensive and expensive. This is especially true where brush is not readily available in the proximity of the restoration site. Although the application of organic matter is a useful tool in restoration programs, as it introduces extra nutrients to the soil and acts as a sponge for moisture, it is not abundant in the area of the park, as only a small amount of farmers still keep livestock in pens or kraals.

In another project, Kellner (2001) set certain guidelines and made recommendations concerning the future restoration of currently cultivated lands on the farms Den Staat, Tuscanen and Rhodesdrift (Management Unit 7). To restore these cultivated lands, which are situated in areas formerly covered by floodplain and riverine vegetation (Management Units 4 and 5), to its original state, will take many years. This is mainly due to the fact that ultimately trees, which occur in the adjacent riverine forest, will have to be cultivated and planted. The restoration of the cultivated lands, which occur in former riverine areas are totally void of natural vegetation and will require careful planning as to which species should be used in the restoration process and in which ratios they should occur toward each other in the end result.

With respect to which tree species should be grown and planted in order to restore the riparian woodlands, it is valuable to be able to refer back to the natural vegetation as monitored for the phytosociological studies performed in these parts. In Chapter 4 the vegetation of the Ia155 land type is discussed. From these results, the following tree species were identified as species that could be cultivated and introduced into the restoration program of the riverine areas:

- *Acacia xanthophloea*
- *Acacia tortilis*
- *Combretum imberbe*
- *Croton megalobotrys*
- *Faidherbia albida*
- *Flueggea virosa*
- *Hyphaene petersiana*
- *Lonchocarpus capassa*
- *Schotia brachypetala*
- *Xanthocercis zambesiaca*

The activities proposed by Kellner (2001) for the restoration of the currently cultivated areas include:

1. Taking of soil samples for soil analysis (chemical and physical) and soil seed bank analysis.
2. Fencing of the proposed restoration areas with game fence.

3. Re-seeding of the previously cultivated areas with indigenous and locally purchased grass seeds. Restore lands where irrigation schemes are still in place first, mainly for seed production purposes.
4. Collection of grass seed from road verges and other areas for use in future restoration plans.
5. Cultivation of saplings of the proposed tree species.
6. Continuous monitoring of restored areas.

Only very short descriptions of possible restoration technologies that are proposed for the different degraded areas in the park are given.

Different active restoration practices by means of mechanical soil cultivation has been studied and promoted in the past (Rauzi, 1974; Griffith *et al*, 1984; Lochner, 1987; Schlesinger, 1989; Coetzee, 1990; Van Rooyen, 1990; Pretorius, 1991; Van der Merwe & Kellner, 1999; Van den Berg, 2001). The main reason for mechanical soil cultivation during restoration activities is to facilitate better water infiltration into the soil, where the water is stored in order to create a favorable micro-habitat for the optimal propagation of seedlings (Wight & White, 1974; Van der Merwe & Kellner, 1999).

For the purpose of this study only one mechanical cultivation method is recommended, i.e. furrow or subsoil cultivation with a ripper. Depending on the size of the tractor used during cultivation and the soil type, ripping is normally a deep cultivation method, which has to effect the good catchment of water and deep infiltration thereof. The rip furrows must be at least 200 mm deep to ensure the best effect of the latter (Van der Merwe & Kellner, 1999).

The procedure followed by Van den Berg (2001) of ripping, re-seeding, the introduction of organic material and brush packing, is recommended for the restoration of bare areas, which occur in the natural rangelands in all management units in the park (Table 10).

With regard to the floodplain area on the farm Den Staat (Management Units 4 and 5), the recommendation is to apply passive restoration (Table 10). According to Mr. Mees Neetling (pers. comm.)[5], a farmer in the area, restoration by means of ripping and re-seeding, was attempted on these silt rich areas with little or no success in the past. Formal results of this attempt could, however, not be obtained or confirmed. According to the current park manager, Mr. Bernard van Lente (pers. comm.)[6], this area should not be restored by active restoration methods, due to the annual flooding of the area in the rainy season and a high occurrence of geophytes. Mr. Van Lente believes that it is possible for this area to recover by means of a passive recovery process by natural succession over time. In a flooding event during the rainy summer months, the area is waterlogged for long periods of time, which causes the herbaceous cover to diminish, on account of it being smothered by the water on the floodplain. It is proposed that the most degraded areas on the floodplain be fenced off and a monitoring program be implemented to monitor the change in veld condition over time. This will also indicate

[5] Mr. Mees Neetling. Former owner of the farm Den Staat.

[6] Mr. Bernard van Lente. Park manager of the Vhembe-Dongola National Park.

whether active restoration methods have to be implemented, or whether these degraded rangelands can recover naturally.

The problem of bush encroachment (Table 10) on the old airstrip on the farm Greefswald and other areas should be addressed with care. The thinning or clearing of woody species should not take place without primarily determining the extent of the problem. This study did not include the actual measurement of woody densities and therefore no accurate assessment of bush encroachment was made. In studies done on the thinning of densely populated woody communities, it was found that where approximately 30% of the trees and shrubs were removed, the best yield in herbaceous vegetation was obtained (Smit & Swart, 1994).

During the thinning process, the woody plants selected for removal should be sawn off at ground level and removed from the plot. The stumps have to be treated chemically in order to suppress re-growth (Smit & Swart, 1994). A post-thinning management program will have to be implemented to monitor the progress being made, and to control any re-growth of the removed trees and/or shrubs (Smit *et al*, 1996).

9.3.4 Proposed actions for restoration

In Table 10 a summary and prioritizing of proposed actions with regard to restoration and rehabilitation of disturbed and degraded areas in different management units in the Vhembe-Dongola National Park is given. Table 10 is divided into five columns depicting the area in which the disturbance/degradation is found, a description of the specific disturbance/degradation, the proposed action to be taken, the management unit(s) concerned and finally, the priority with regard to restoration.

The degradation, which was identified in the natural rangeland of the park, is mainly overgrazing and trampling at old watering points and other areas, bare patches and possible bush encroachment. The proposed actions for the restoration of these areas include a soil seed bank analysis, followed by rip cultivation, re-seeding, brush packing and the application of organic matter. A passive approach is proposed for the degraded areas on the floodplain area on the farm Den Staat. This area should be fenced off in order to facilitate a lower grazing pressure. In the event of an area being bush encroached, deforestation should take place by the selective thinning of trees and shrubs.

The second area identified for restoration is the numerous cultivated lands on the farm Den Staat, Tuscanen etc. These areas have been investigated by Kellner (2001) and recommendations made with regard to the active restoration of these areas (9.3.3).

Old lands were mainly found on the farm Schroda. These areas mainly have a vegetation cover of low ecological status, which can be improved by active restoration, by means of rip cultivation, re-seeding and brush packing. A certain degree of bush encroachment was also observed on the old lands. This situation can also be improved by well-judged bush thinning.

Table 10: Summary and prioritizing of proposed actions with regard to restoration and rehabilitation of disturbed and degraded areas in different management units in the Vhembe-Dongola National Park.

Area	Description of disturbance/degradation	Proposed action	Management unit(s)	Priority *
Natural rangeland	(a) Overgrazing and trampling at old watering points or other areas.	Soil seed bank analysis. Cultivation: Rip, re-seed and brush packing. Application of organic matter if available Passive restoration on floodplain area of Den Staat (Fencing)	2, 3 & 5 4 & 5	**2**
	(b) Bare patches	Soil seed bank analysis. Light cultivation: Rip. Re-seeding depending on seed bank analysis	3, 4, 5 & 6	**3**
	(c) Bush encroachment	Tree and shrub thinning.	3 & 5	**2**
Cultivated lands	(a) Totally bare areas and destruction of the riparian zone	Guidelines as set by Kellner (2001) (9.3.3)	4 & 5	**1**
	(b) Nutrient enrichment	Should be seen as an advantage for the cultivation of grass and the eventual harvesting of seed for future use in restoration activities in the park.	4 & 5	
Old lands	(a) Low cover of climax grass species.	Soil seed bank analysis. Cultivation: Rip, seed and brush packing	4 & 5	**3**
	(b) Bush encroachment	Tree and shrub thinning.	4 & 5	**2**
Old army bases	(a) Bare areas and soil compaction	Soil seed bank analysis. Cultivation: Rip, seed and brush packing Application of organic matter if available	1 & 5	**1**
	(b) Soil and environmental pollution	Removal of all unnatural debris and soil replacement or chemical treatment of old refueling station.	1	**1**
Air strips	(a) Bare patches	Soil seed bank analysis. Light cultivation: Rip. Re-seeding depending on seed bank analysis Den Staat – passive restoration	4 & 5	**2**
	(b) Bush encroachment	Tree and shrub thinning.	5	**2**
Quarries	Bare areas	Alternative use: Watering points/dams or shooting range	1, 3, & 4	**3**
General	Alien vegetation	Eradication of all mentioned alien invasive species (9.2.4)	3, 4, 5 & 6	**1**

* **Priorities: 1** - High priority; **2** - Moderate priority; **3** - Low priority

A number of old army bases and camps have been observed on the farm Greefswald. Bare areas and soil compaction as well as soil and environmental pollution, are the main degrading factors, which were identified. In rectifying the bare areas and soil compaction, the method of rip cultivation, re-seeding, brush packing and the application of organic matter (if available) is proposed. All cases of environmental and soil pollution (old disposal sites, disused building material, fuel spills etc.) should be addressed with the appropriate technologies.

Two old air strips were noticed in the Vhembe-Dongola National Park, one on the farm Greefswald and the other on the floodplain area of the farm Den Staat. The former is bush encroached with a number of bare patches in between. The problem of bush encroachment can be addressed by thinning of trees and shrubs, while the bare patches can be ripped, re-seeded and brush packed with the thinned out trees and shrubs. The airstrip on the farm Den Staat should be included in the proposed passive restoration procedure, which is applicable to the other degraded areas on that particular floodplain unit.

Three quarry pits were observed in the core area of the park. Alternative uses, such as watering holes or dams, can be found for these quarries. Another alternative is that one of the old quarries (the one on the border between the farms Den Staat and Little Muck, Fig. 14) can be used as a shooting range for the training of field rangers.

As mentioned previously, all alien vegetation found within the boundaries of the Vhembe-Dongola National Park and its surrounding areas, should be eradicated to prevent all it from further spreading throughout the park.

9.4 CONCLUSIONS

Taking all natural rangelands into consideration, the proposed area of the Vhembe-Dongola National Park is moderately degraded. Disturbances and degradation in the natural rangeland include old watering/feeding points, bare patches/loss of vegetation cover, and sheet erosion as a result of the loss of vegetation cover, and bush encroachment and thickening. Sheet erosion was not identified as a large problem and as a result not discussed in detail. The cases of sheet erosion, which were encountered in the study area, can be rectified in the same active restoration approaches proposed in this chapter. This is due to the occurrence of the erosion at the same localities as some of the degraded areas. It should be stressed that no formal frequency data was collected in this study and all estimates on degradation that were made in this chapter, are based on visual observations by the author, the management team of the park and the local farming community.

Restoration requires many resources for the end result to be successful. Time, money, manpower, and good management strategies from the start and ongoing thereafter, are some of the essential elements in reaching success with any restoration program. In the Vhembe-Dongola National Park the emphasis of restoration activities should primarily be aimed on restoring the currently cultivated lands, which have left a negative impact on the riparian zone, and rectifying all other anthropogenic disturbance and degradation,

such as the old army bases. The environmental pollution at the latter should be addressed before any tourism activities take place within the park. Depending on the natural successional state of old lands, these wasteland areas should also receive serious attention with regard to reintroducing grass species with higher ecological status. The current and future stocking rate on the park and the subsequent grazing/browsing impact it will have, will determine all future restoration activities and management, and will further determine the successful restoration of all areas which will not be actively restored.

A properly planned restoration project attempts to fulfill clearly stipulated goals that reflect important attributes of the reference ecosystem. Goals are attained by pursuing specific objectives. The goals are ideals, and the objectives are concrete measures taken to attain these goals. Two fundamental questions should be asked with respect to the evaluation of a restored ecosystem. Were the objectives accomplished? Were the goals fulfilled? The answers to both these questions gain validity only if the goals and objectives were clearly stated prior to the implementation of the restoration project (SER, 2002). The implementation of sound post-restoration management strategies and monitoring, and the commitment of the park management of enforcing sound management strategies to keep the status quo of the undisturbed areas in tact will, greatly determines the success of restoration in the Vhembe-Dongola National Park.

CHAPTER 10

CONCLUDING REMARKS

The aims of this study were successfully achieved. The first aim was to identify, classify and describe the plant communities of the study area based on plant species composition, environmental variables and anthropogenic influences. The second aim was to identify and map ecologically sound management units on which the optimal management of the park can be based. Thirdly it was aimed to identify plant communities in specific land types, which show high levels of degradation and should be restored, and fourthly to recommend specific practices most suitable for the restoration of degraded areas within the park.

In the phytosociological classification of the Vhembe-Dongola National Park, 12 plant communities were identified and described, on five different land types on the areas Den Staat, Greefswald and Riedel, which comprised the study area. Each plant community was further divided into sub-communities, which were subdivided into a number of variants. Some of the plant communities described in this study are similar to communities previously described in a study by Timberlake & Mapaure (1999) in the southwestern parts of Zimbabwe. Similar plant communities were also described in a phytosociological synthesis of the Mopaneveld by Du Plessis (2001) and in two separate studies done by the former SADF (1986a & b), in a terrain evaluation of the topographical maps 2229AA, 2229AB, 2229AC, and 2229AD.

The Vhembe-Dongola National Park also has rich plant diversity, with approximately 400 plant species identified in the five different land types found in the study area. The Db218 land type, which is commonly found on floodplain areas and areas adjacent to the floodplains, has the highest plant diversity of all the land types in the park, with a total of 226 plant species identified in three plant communities. The Ib395 land type consists of the rocky sandstone ridges in the park. A total of 219 plant species were identified in the two plant communities of the Ib395 land type. The Ia155 land type includes the riparian vegetation on the banks of the Limpopo River and its main tributaries, as well as wetland systems in the park, and has 194 plant species occurring in four plant communities. The Fb143 land type has 166 plant species in one main plant community and occurs on undulating rocky terrain. The Ae309 land type, which occurs on high lying plateau areas in the park, has the lowest plant diversity of all the land types in the study area, with only 92 plant species present in two plant communities.

In a synthesis of all the vegetation data collected, eight different vegetation groups were identified and described. These vegetation groups, which individually share aspects such as similarities in vegetation, habitat, topography and soil types, were used as a basis for describing management units. As a result seven management units were identified, described and mapped. The management units were discussed individually, focusing on the vegetation, degradation and possible management strategies. It was attempted to compile ecologically sound, manageable vegetation units, which will form an integral

part of the management plans and decision making for the park and surrounding areas, in future.

The high plant diversity, the great scenic beauty and the uniqueness of the landscape, the cultural importance of the archaeological treasures of the area, and a rich population of mammals, birds and reptiles, gives this area a large claim to conservation. The significance of this park and its surrounding areas is further enhanced by the potential role of the area as a sanctuary for some of the most endangered mammals on earth, such as the Black Rhino and the African wild dog, as well as the continent's flagship species, the African Elephant (Robinson 1996). If proper management is not upheld, the consequences could be devastating to the environment and natural resources found within the park and the surrounding area.

The Limpopo Valley is renowned for large-scale irrigated crop farming. The negative impact on the riparian zone and adjacent floodplains is clearly visible in areas where natural veld was destroyed for cultivation purposes. The scars left by the activities of the former SADF on Greefswald are also conspicuous to the human eye. However, it is often difficult to estimate the total extent of damage caused to the environment by livestock, game, and natural drought events. It is nevertheless, most evident that management malpractice over the long term, has played a large role in the degradation of large parts of the study area. It is extremely important to restore these degraded areas in order to conserve and improve the rich bio-diversity and unique habitat of the Vhembe-Dongola National Park.

In this dissertation a number of degraded areas were identified and discussed. These areas include natural rangeland, cultivated lands and old lands as well as old army bases, airstrips and quarries. A number of restoration technologies were proposed and discussed for the restoration and/or rehabilitation of these degraded areas. In this study, degraded land was identified through observation during the phytosociological study and not measured through the collection of quantitative data. However, the plant communities described in this study form a sound basis for further detailed quantitative studies to determine the condition of each vegetation unit, to compliment restoration and rehabilitation activities planned for the park. It is also important that those degraded areas are carefully and systematically monitored in future.

In completion of this thesis it became evident that this study does not complete vegetation based studies in the core area of the Vhembe-Dongola National Park. Apart from the fact that the whole core area was not sampled (a large part of this area is still privately owned), the diversity of the vegetation and the mosaic of plant communities, especially in the sandstone ridges found on Greefswald (Ib395 land type), future scientific studies and investigations are essential for the long term management and conservation of this park. Another area, which will require in depth studies in future, is the large wetland system of the Kolope floodplain, of which the largest part falls within areas that are still privately owned. In certain areas the Kolope floodplain-wetland-system has been totally destroyed by farming activities. When these areas are eventually purchased by SANP, this in itself will hold a great challenge to restoration and rehabilitation planning and management in future. The data and results of this study will be of great importance and make a valuable contribution towards the

upgrading, development and management of the proposed Vhembe-Dongola National Park.

PLANT SPECIES CHECK LIST OF THE CORE AREA OF THE VHEMBE-DONGOLA NATIONAL PARK

1. PTERIDOPHYTA

ADIANTACEAE

Pellaea Link

P. calomelanos (Swartz) Link

OPHIOGLOSSACEAE

Ophioglossum L.

O. costatum R. Br.

2. ANGIOSPERMAE

2.1. MONOCOTYLEDONAE

ARECACEAE

Hyphaene Gaertn.

H. petersiana Klotzsch

ASPARAGACEAE

Asparagus L.

A. africanus Lam.

A. laricinus Burch.

A. suaveolens Burch.

ASPHODELACEAE

Aloe L.

A. chabaudii Schonl.

A. littoralis Bak.

A. lutescens Groenew. ex Pole Evans

A. marlothii Berger

COMMELINACEAE

Commelina L.

C. africana L.

C. aspera Benth.

C. benghalensis L.

CYPERACEAE

Bulbostylis Kunth.

B. hispidula (Vahl) R.W.Haines

Coleochloa Gilly

C. pallidior Nelmes

Cyperus L.

C. rupestris Kunth var. *rupestris*

Kyllinga Rottb.

K. alba Nees

Mariscus Gaertn.

M. rehmannianus C.B.Clarke

Pycreus Beauv.

P. pelophilus (Ridl.) C.B.Clarke

DRACAENACEAE

Sansevieria Thunb.

S. hyacinthoides (L.) Druce

S. pearsonii N. E. Br.

ORCHIDACEAE

Disperis Swartz

D. macowanii H. Bol.

POACEAE

Aristida L.

A. adscensionis L.

A. congesta Roem. & Schult subsp. congesta

A. junciformis Trin. & Rupr.

A. rhiniochloa Hochst.

A. scabrivalvis Hack.

A. stipitata Hack

Bothriochloa Kuntze

B. insculpta (A. Rich) A.Camus

Brachiaria Griseb.

B. deflexa (Schumach.) C.E. Hubb. ex Robyns

B. eruciformis (Sm.) Griseb.

B. nigropedata (Ficalho & Hiern) Stapf

Cenchrus L.

C. ciliaris L.

Chloris Swartz

C. roxburghiana Schult.

C. virgata Sw.

Cynodon Rich.

C. dactylon (L.) Pers.

Dactyloctenium Willd.

D. aegyptium (L.) Willd.

Digitaria Haller

D. eriantha Steud.

D. sanguinalis (L.) Scop.

Dinebra Jacq.

D. retroflexa (Vahl) Panz.

Diplachne Beauv.

D. fusca (L.) P.Beauv. ex Roem. & Schult.

Echinochloa Beauv.

E. colona (L.) Link

E. pyramidalis (Lam.) Hitchc. & Chase

Eleusine Gaertn.

E. coracana (L.) Gaertn. subsp. *africana* (K. O'Byrne) Hilu & De Wet

Enneapogon Beauv.

E. cenchroides (Roem. & Schult.) C.E.Hubb.

E. desvauxii P.Beauv.

Enteropogon Nees

E. macrostachyus (A.Rich) Benth.

Eragrostis Wolf

E. curvula (Schrad.) Nees

E. inamoena K.Schum.

E. lehmanniana Nees

E. nindensis Ficalho & Hiern

E. racemosa (Thunb.) Steud.

E. rigidior Pilg.

E. superba Peyr.

E. trichophora Coss. & Durieu

E. viscosa (Retz.) Trin.

Fingerhuthia Nees

F. africana Lehm.

Loudetia Steud.

L. simplex (Nees) C.E.Hubb.

Melinis Beauv.

M. repens (Willd.) Zizka

Oropetium Trin.

O. capense Stapf

Panicum L.

P. coloratum L. var. *coloratum*

P. deustum Thunb.

P. maximum Jacq.

P. schinzii Hack.

Phragmites Adanson

P. australis (Cav.) Steud.

Pogonarthria Stapf

P. squarrosa (Roem. & Schult.) Pilg.

Schizachyrium Nees

S. jeffreysii (Hack.) Stapf

Schmidtia Steud.

S. pappophoroides Steud.

Setaria Beauv.

S. sagittifolia (A.Rich.) Walp.

S. verticillata (L.) P.Beauv.

Sporobolus R. Br.

S. ioclados (Trin.) Nees

Stipagrostis Nees

S. uniplumis (Licht.) De Winter

Tetrapogon Desf.

T. tenellus (Roxb.) Chiov.

Tragus Haller

T. berteronianus Schult.

Trichoneura Anderss.

T. species [7]

Urochloa Beauv.

U. mosambicensis (Hack.) Dandy

U. stolonifera (Goossens) Chippind.

2.2. DICOTYLEDONAE

ACANTHACEAE

Acanthopsis Harv.

A. spathularis (E.Mey) Schinz.

Barleria L.

B. affinis C.B. Clarke

B senensis Klotzsch

B transvaalens Oberm.

[7] *Trichoneura* sp. is in the process of being described and is probably a new species (Lynn Fish, National Herbarium, NBI, Pretoria, pers. comm.)

Blepharis Juss.

B. aspera Oberm.

B. leendertziae Oberm.

B. subvolubilis C.B. Cl. var. *subvolubilis*

Dicliptera Juss.

D. clinopodia Nees

D. eenii S. Moore

Justicia L.

J. flava (Vahl) Vahl

J. matammensis (Schweinf.) Oliv.

J. protracta (Nees) T. Anders. subsp. *rhodesiana* (S. Moore) Immelman

Megalochlamys Lindau

M. hamata (Klotzsch) Vollesen

M. revoluta Lindau Vollesen subsp. *cognata* (N.E.Br.) Vollesen

Monechma Hochst.

M. divaricatum (Nees) C.B.Clarke

Neuracanthus Nees

N. africanus S.Moore

Peristrophe Nees

P. cliffordii K. Balkwill

Petalidium Nees

P. aromaticum Oberm. var. *aromaticum*

AIZOACEAE

Corbichonia Scop.

C. decumbens (Forssk.) Exell

Gisekia L.

G. africana (Lour.) Kuntze var. *africana*

G. pharnacioides L. var. *pharnacioides*

Hypertelis E. Mey. ex Fenzl

H. bowkeriana Sond.

Limeum L.

L. viscosum (Gay)

Mollugo L.

M. cerviana (L.) Ser. ex DC.

Trianthema L.

T. triquetra Rottler ex Willd.

AMARANTHACEAE

Achyranthes L.

A. aspera L.

Alternanthera Forssk.

A. pungens Humb.

Amaranthus L.

A. hybridus L.

Cyathula Blume

C. lanceolata Schinz.

C. orthacantha (Hochst. ex Aschers.) Schinz

Hermbstaedtia Reichb.

H. odorata (Burch.) T.Cooke

Kyphocarpa (Fenzl) Lopr.

K. angustifolia (Moq.) Lopr.

Pupalia A. Juss.

P. lappacea (L.) A. Juss.

Sericorema (Hook. f.) Lopr.

S. sericea (Schinz) Lopr.

ANACARDIACEAE

Lannea A. Rich.

L. schweinfurthii (Engl.) Engl.

Sclerocarya Hochst.

S. birrea (A.Rich.) Hochst. Subsp. *caffra* (Sond.) Kokwaro

ANNONACEAE

Hexalobus A. DC.

H. monopetalus (A. Rich.) Engl. & Diels

APIACEAE

Steganotaenia Hochst.

S. araliacea Hochst.

ASCLEPIADACEAE

Gymnema R. Br.

G. sylvestre (Retz.) Schult.

Hoodia Sweet ex Decne.

H. lugardii M.E. Br.

Pentarrhinum E.Mey

P. insipidum E.Mey

Pergularia L.

P. daemia (Forssk.) Chiov. var. daemia

ASTERACEAE

Acanthosperm Schrank

A. hispidum DC.

Bidens L.

B. pilosa L.

Brachylaena R. Br.

B. huillensis O.Hoffm.

Calostephane Benth.

C. divaricata Benth.

Dicoma Cass.

D. tomentosa Cass.

D. zeyheri Sond.

Flaveria Juss.

F. bidentis (L.) Kuntze

Geigeria Griesselich

G. acaulis(Sch.Bip.) Benth. & Hook.f. ex Oliv. & Hiern.

G. burkei Harv. subsp. *fruticulosa* Merxm.

Litogyne Harv.

L. gariepina (DC.) Anderb.

Pseudoconyza

P. viscosa

Pseudognaphalium Kirp.

P. undulatum (L.) Hillard & B.L.Burtt

Schkuhria Roth.

S. pinnata (Lam.) Cabrera

Tarchonanthus L.

T. camphoratus L.

Verbesina L.

V. encelioides Benth. & Hook. var. *encelioides*

Vernonia Schreb.

V. cinerascens Sch.Bip.

V. fastigiata Oliv. & Hiern

Xanthium L.

X. strumarium L.

BALANITACEAE

Balanites Del.

B. pedicellaris Mildbr. & Schltr

BIGNONIACEAE

Catophractes D. Don

C. alexandri D. Don

Rhigozum Burch.

R. zambesiacum Baker

BOMBACACEAE

Adansonia L.

A. digitata L.

BORAGINACEAE

Cordia L.

C. grandicalyx Oberm. *

C. monoica Roxb.

C. sinensis Lam.

Ehretia P. Br.

E. rigida (Thunb.) Druce

Heliotropium L.

H. ovalifolium Forssk.

BRASSICACEAE

Brassica L.

B. rapa L.

BURSERACEAE

Commiphora Jacq.

C. africana (A.Rich.) Engl.

C. edulis (Klotzsch) Engl.

C. glandulosa Schinz

C. merkeri Engl.

C. mollis (Oliv.) Engl.

C. pyracanthoides Engl.

C. tenuipetiolata Engl.

CACTACEAE

Opuntia Mill.

O. ficus-indica (L.) Mill.

CAPPARACEAE

Boscia Lam.

B. albitrunca (Burch.)

B. foetida Schinz

Cadaba Forssk.

C. aphylla (Thunb.) Wild

C. termitaria N.E.Br.

Capparis L.

C. tomentosa Lam.

Cleome L.

C. angustifolia (Forssk.)

C. gynandra L.

C. hirta (Klotzsch) Oliv.

C. monophylla L.

C. oxyphylla

Maerua Forssk.

M. angolensis DC.

CELASTRACEAE

Gymnosporia (Wight & Arn.) Hook. f.

G. senegalensis (Lam.) Loes.

CHENOPODIACEAE

Chenopodium L.

C. album L.

C. carinatum R.Br.

COMBRETACEAE

Combretum Loefl.

C. apiculatum Sond.

C. imberbe Wawra

C. microphyllum Klotzsch

C. molle R.Br. ex G.Don

C. mossambicense (Klotzsch) Engl.

Terminalia L.

T. prunioides M.A.Lawson

T. sericea Burch. ex DC.

CONVOLVULACEAE

Convolvulus L.

C. sagittatus Thunb. subsp. *sagittatus*

Evolvulus L.

E. alsinoides (L.) L.var. *linifolius* (L.) Bak.

Ipomoea L.

I. hochstetteri House

I. magnusiana Schinz var. *eenii* (Rendle) A. Meeuse

I. magnusiana Schinz var. *magnusiana*

I. papilio Haliier f.

I. sinensis (Desr.) Choisy subsp. *blepharosepala* (Hochst. ex A. Rich.) Verdc.

I. tenuipes Verdc.

Merremia Dennst.

M. kentrocaulos (C.B.Clarke) Rendle

M. pinnata (Hochst. ex Choisy) Hallier f.

Seddera Hochst.

S. suffruticosa (Schinz) Hallier f.

CUCURBITACEAE

Ctenolepis Hook.f.

C. cerasiformis (Stocks) Hook.f.

Cucumis L.

C. metuliferus Naudin

C. zeyheri Sond.

Kedrostis Medic.

K. limpompensis C. Jeffrey

Momordica L.

M. balsamina L.

EUPHORBIACEAE

Acalypha L.

A. indica L.

Bridelia Willd.

B. mollis Hutch.

Chamaesyce S.F. Gray

C. eylesii (Rendle) Koutnik

C. glanduligera (Pax) Koutnik

C. mossambicensis (Klotzsch & Garcke) Koutnik

Croton L.

C. gratissimus Burch.var. *subgratissimus* (Prain) Burtt Davy

C. megalobotrys Müll.Arg.

C. pseudopulchellus Pax.

Euphorbia L.

E. cooperi N.E. Br. ex Berger var. *cooperi*

Flueggea Willd.

F. virosa (Roxb. Ex Willd.) Pax & K. Hoffm.

Phyllanthus L.

P. angolensis Müll. Arg.

P. parvulus Sond.

P. reticulatus Poir.

Pseudolachnostylis Pax

P. maprouneifolia Pax sens. lat.

Ricinus L.

R. communis L.

Tragia L.

T. rogersii Prain

T. rupestris Sond.

FABACEAE

Abrus Adans.

A. precatorius L. subsp. *africanus* Verdc.

Acacia Mill.

A. erioloba E. Mey

A. erubescens Welw. ex Oliv.

A. grandicornuta Gerstner

A. mellifera (Vahl) Benth.

A. nebrownii Burt Davy

A. nigrescens Oliv.

A. nilotica (L.) Delile

A. robusta Burch

A. schweinfurthii Brenan & Exell

A. senegal (L.) Willd var. *leiorachis* Brenan

A. senegal (L.) Willd var. *rostrata* Brenan

A. stuhlmannii Taub.

A. tenuispina I. Verd

A. tortilis (Forssk.) Hayne

A. xanthophloea Benth.

Albizia

A. anthelmintica (A. Rich.) Brongn.

A. harveyi E. Fourn.

A. versicolor Welw. ex Oliv.

Cassia L. emend. Gaertn

C. abbreviata Oliv.

Chamaecrista Moench

C. absus (L.) Irwin & Barneby

Colophospermum Kirk ex J. Léonard

C. mopane (J.Kirk ex Benth.) J.Kirk ex J. Léonard

Crotalaria L.

C. lotoides Benth.

C. virgulata Klotzsch

Cullen Medik.

C. obtusifolia (DC.) C.H.Stirt.

Decorsea Viguier

D. schlechteri (Harms) Verdc.

Dichilus DC.

Dichilus lebeckioides DC.

Dichrostachys (A. DC.) Wight & Arn.

D. cinerea (L.) Wight & Arn.

Faidherbia A.Chev.

F. albida (Delile) A.Chev.

Indigastrum

I. costatum subsp. *macrum*

Indigofera L.

I. acanthoclada Dinter

I. bainesii Baker

I. charlieriana Schinz

I. circinnata Benth. ex Harv.

I. daleoides Benth. ex Harv.var. *daleoides*

I. heterotricha DC.

I. laxeracemosa Bak.f.

I. nebrowniana J.B.Gillet

I. rhytidocarpa Benth. ex Harv. subsp. *rhytidocarpa*

I. schimperi Jaub. & Spach.

I. trita L.f. subsp. *subulata* (Vahl ex Poir.) Ali

I. vicioides Jaub. & Spach var. *rogersii* (R.E. Fr.) Gillet

Lonchocarpus Kunth

L. capassa Rolfe

Macrotyloma (Wight & Arn.) Verdc.

M. daltonii (Webb) Verdc.

Mundulea (DC.) Benth.

M. sericea (Willd.) A.Chev.

Ptycholobium Harms.

P. contortum (N.E.Br.) Brummitt

Rhynchosia Lour.

R. minima (L.) DC. var. *minima*

R. nervosa Benth. & Harv.

Schotia Jacq.

S. brachypetala Sond.

Sesbania Scop.

S. bispinosa (Jacq.) W.f. Wight

Tephrosia Pers.

T. euprepes Brummitt

T.polystachya E. Mey. var. polystachya

T. purpurea (L.) Pers.

T. rhodesica Bak.f.

T. virgata H.M. Forbes

Vigna Savi

V. frutescens A. Rich. subsp. *frutescens*

Xanthocercis Baill.

X. zambesiaca (Baker) Dumaz-le-Grand

Zornia J.F. Gmel.

Z. glochidiata DC.

Z. linearis E.Mey.

Z. milneana Mohlenbr.

FLACOURTIACEAE

Dovyalis E. Mey. ex Arn.

D. caffra (Hook.f. & Harv.) Hook.f.

GERANIACEAE

Monsonia L.

M. glauca R.Kunth.

M. senegalensis Guill. & Perr.

LAMIACEAE

Acrotome Benth.

A. inflata Benth.

Becium Lindl.

B. filamentosum (Forssk.) Chiov.

Endostemon N.E. Br.

E. tereticaulis (Poir.) M.Ashby

Hemizygia (Benth.) Briq.

H. petrensis (Hiern.) M.Ashby

Leonotis (Pers.) R.Br.

L. leonurus (L.) R.Br.

L. ocymifolia (Burm. f.) Iwarsson

Leucas Burm. ex R. Br.

L. glabrata (Vahl) Sm. Var. *glabrata*

L. neuflizeana Courbon

L. sexdentata Skan

Ocimum L.

O. americanum non L.var. *americanum*

O. gratissimum subsp. *gratissimum*

Tinnea Kotschy ex Hook. f.

T. rhodesiana S.Moore

LOGANIACEAE

Strychnos L.

S. madagascariensis Poir.

LORANTHACEAE

Plicosepalus V. Tieghem

P. kalachariensis (Shinz) Danser

MALVACEAE

Abutilon Mill.

A. angulatum (Guill. & Perr.) Mast. var. angulatum

A. angulatum (Guill. & Perr.) var. macrophyllum (Bak. f.) Hochr.

A. austro-africanum Hochr.

A. grandiflorum G.Don

A. grandifolium (Willd.) Sweet

A. ramosum (Cav.) Guill. & Perr.

A. sonneratianum (Cav.) Sweet

Azanza Alef.

A. garckeana (F. Hoffm.) Exell & Hillc.

Hibiscus L.

H. coddii Exell

H. engleri K.Schum.

H. micranthus L.f.

H. pusillus Thunb.

H. sabiensis Exell

H. sidiformis Baill.

H. trionum L.

Pavonia Cav.

P. burchellii (DC.) R.A.Dyer

P. dentata Burtt Davy

Sida L.

S. cordifolia L.

S. dregei Burtt Davy

S. ovata Forssk.

S. rhombifolia L.

MENISPERMACEAE

Cocculus DC.

C. hirsutus (L.) Diels

MORACEAE

Ficus L.

F. abutilifolia (Miq.) Miq.

F. cordata Thunb. subsp. *salicifolia* (Vhal) C.C.Berg

F. sycomorus L.

F. tettensis Hutch.

NYCTAGINACEAE

Boerhavia L.

B. erecta L.

Commicarpus Standley

C. fallacissimus(Heimerl) Heimerl ex Oberm.

C. pentandrus (Burch.) Heimerl

NYMPHAEACEAE

Nymphaea L.

N. nouchali Burm. f.

OCHNACEAE

Ochna L.

O. inermis (Forssk.) Schweinf.

OLACACEAE

Ximenia L.

X. americana L.

PASSIFLORACEAE

Adenia Forssk.

A. spinosa Burtt Davy

PEDALIACEAE

Ceratotheca Endl.

C. triloba (Bernh.) Hook.f.

Dicerocaryum Boj.

D. eriocarpum (Decne.) Abels

Holubia Oliv.

H. saccata Oliv.

Sesamothamnus Welw.

S. lugardii N.E.Br. ex Stapf

Sesamum L.

S. triphyllum Welw. ex Aschers

PLUMBAGINACEAE

Plumbago L.

P. zeylanica L.

POLYGONACEAE

Oxygonum Burch. ex Campd.

O. delagoense Kuntze

RHAMNACEAE

Berchemia Neck. ex DC.

B. discolor (Klotzsch) Hemsl.

B. zeyheri (Sond.) Grubov

Ziziphus Mill.

Z. mucronata Willd.

RUBIACEAE

Anthospermum L.

A. hispidulum E. Mey. ex Sond.

Gardenia Ellis

G. volkensii K.Schum.

Kohautia Cham. & Schlechtd..

K. aspera (Heyne ex Roth) Brem.

Lagynias E. Mey.

L. dryadum (S.Moore) Robyns

Psydrax Gaertn.

P. livida (Hiern) Bridson

Vangueria Juss.

V. infausta Burch.

SALVADORACEAE

Salvadora Garcin ex L.

S. australis Schweick

SAPINDACEAE

Pappea Eckl. & Zeyh.

P. capensis Eckl. & Zeyh.

SAPOTACEAE

Euclea Murray

E. natalensis A. DC.

SCROPHULARIACEAE

Aptosimum Burch.

A. lineare Marloth & Engl.

A. lugardiae (N.E.Br.) E.Phillips

Craterostigma Hochst.

C. plantaginium Hochst.

Nemesia Vent.

N. fruticans (Thunb.) Benth.

Striga Lour.

S. gesnerioides (Willd.) Vatke ex Engl.

SIMAROUBACEAE

Kirkia Oliv.

K. acuminata Oliv.

SOLANACEAE

Datura L.

D. ferox L.

Lycium L.

L. cinereum Thunb. sensu lato

Nicotiana L.

N. glauca R.C. Grah.

Solanum L.

S. kwebense N.E.Br.

S. panduriforme E.Mey.

Withania Pauquy

W. somnifera (L.) Dunal

STERCULIACEAE

Hermannia L.

H. glanduligera K.Schum.

H. modesta (Ehrenb.) Mast.

Melhania Forssk.

M. acuminata Mast. var. *agnosta* (K. Schum.) Willd

M. rehmannii Szyszyl.

Sterculia L.

S. rogersii N.E.Br.

Waltheria L.

W. indica L.

TILIACEAE

Corchorus L.

C. asplenifolius Burch.

C. kirkii N.E.Br.

C. olitorius L.

Grewia L.

G. bicolor Juss.

G. flava DC.

G. flavescens Juss.

G. monticola Sond.

G. occidentalis L.

G. tenax (Forssk.) Fiori

G. villosa Willd.

TURNERACEAE

Tricliceras Thonn. ex DC.

T. glandulifera (Klotzsch) R.Fern.

VAHLIACEAE

Vahlia Thunb.

V. capensis (L.f.) Thunb. subsp. *vulgaris* Bridson var. *latifolia* Burtt Davy

VELLOZIACEAE

Xerophyta Juss.

X. humilis (Baker) T.Durand & Schinz

X. retinervis Baker

X. viscosa Baker

VERBENACEAE

Lantana L.

L. rugosa Thunb.

ZYGOPHYLLACEAE

Tribulus L.

T. terrestris L.

T. zeyheri Sond. subsp. Zeyheri

Zygophyllum L.

Z. simplex L.

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