Phytosociological study of the Kruger National Park, south of the Sabie River, Mpumalanga Province, South Africa

by

Rachel Elizabeth Mostert

Submitted in partial fulfilment of the requirements
for the degree

MAGISTER SCIENTIAE

in the Faculty of Natural & Agricultural Science
University of Pretoria
Pretoria

Supervisor:
Prof G.J. Bredenkamp

January 2007

"All honour, all glory, all power to Him..."

(Rev. 5:13)

Thanks to my Creator, who has guided me, every step of the way.

Thanks to Theo: my husband, my friend, my companion and above all, my soul mate.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

I, **Rachel Elizabeth Mostert**, declare that the dissertation, which I hereby submit for the degree **Magister Scientiae** at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

SIGNATURE: ___________________________ DATE: _________________

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Table of Contents

List of Figures and Tables

INTRODUCTION

"The environment crisis is an outward manifestation of a crisis of mind and spirit. There could be no greater misconception of its meaning than to believe it is concerned only with endangered wildlife, human-made ugliness, and pollution. These are part of it, but more importantly, the crisis is concerned with the kind of creatures we are and what we must become in order to survive".

- Lynton K. Caldwell

Savannas are one of the world's major biomes and are the dominant vegetation of Africa (Scholes 1997), occupying 20% of the land surface of the world, 40% of Africa (Scholes & Walker 1993) and 46% of southern Africa (Low & Rebelo1998). Conservation of savannas in South Africa is good, largely due to the presence of parks such as the Kruger National Park (KNP) in this biome. The KNP is the second oldest formally conserved area in Africa and, at 1,948,528 hectares, one of the largest (Dennis & Scholes 1995). The KNP also forms part of the newly proclaimed Great Limpopo Transfrontier Park, which incorporates 35 000 km^2 of land into one of the worlds largest formally conserved wilderness area.

SANParks (South African National Parks) can be considered the epitome of conservation within the South African borders. Their mission is: "To acquire and manage a system of national parks that represents the indigenous wildlife, vegetation, landscape and associated cultural assets of South Africa for the pride and benefit of the nation". The Kruger National Park provides various opportunities for conservation, education and research. Their quest in wildlife-research is to understand the ecological functioning of natural systems, and how to conserve the driving ecological processes shaping these systems. The understanding of these processes enables them to manage and conserve not only nature reserves, but more importantly human inhabited environments and the precious natural resources our very existence depend on.

In the present age, where all that is "natural" seems threatened by man's daily activities, the call for conservation is even greater. With the growing fear of gene loss through loss of species and a decrease in species richness, the consideration of ecologically based environmental planning and management is critical in order to preserve valuable natural assets. Studying and understanding ecological patterns and processes will reveal the importance of the environment's irreplaceable service and functions it provides humans. Scientifically based appreciation for the living environment is of vital importance in the battle to conserve ecosystems and natural resources for future generations.

The study of vegetation is not only fascinating; it is also vital since vegetation makes up an important component of any ecosystem. The importance in this is threefold. First of all, vegetation is the most obvious physical representation of an ecosystem (Kent & Coker 1992). One cannot immediately see what soil or geology is present in a specific vicinity, but at a glance one can see the type of vegetation present and often draw valuable conclusions. Secondly, vegetation represents the base of the trophic pyramid (being primary producers plants transform solar energy by means of photosynthesis into plant tissue). And thirdly, vegetation acts as the habitat of other organisms. Plants are critical to the survival of all species. In man's daily life he depends on plants for food, clothing, shelter, fuel, the oxygen he breathes. Since all animals ultimately depend on plants, it follows that the earth's ecosystems are also dependent on plants (Given 1994).

Savanna Determinants of Southern Africa

Savannas are ecosystems that are characterized by the coexistence of trees and grasses. Savannas include all ecosystems in which C4 grasses potentially dominate the herbaceous stratum and where woody plants, usually fire-tolerant, vary in density from widely scattered individuals to a closed woodland (Huntley 1982). Rainfall occurs in the warmer, summer months with a dry period of between two to eight months. The main determinants of savannas are: plant available moisture, plant available nutrients, fire, herbivory and rainfall (Skarpe 1992, Sankaran *et al*. 2005). These factors play a variable role in the different types of savannas and cannot be separated from each other in most instances. A distinction can be made between two main functional savanna types: fine-leaved (thorny) savannas in arid nutrient-rich environments, and broad-leaved savannas in moist, nutrient-poor environments (Bredenkamp & Brown 2006). Often both functional types occur in a mosaic distribution pattern in slightly undulating landscapes, with broad-leaved savanna on sandy, leached crests and fine-leaved savannas on clayey, nutrient-rich valley bottoms (Bredenkamp & Brown 2006). The dynamics of these systems are complex. Ecosystems are considered in equilibrium when plant-growing conditions are relatively stable over time, with low inter-annual variation in rainfall (Bredenkamp & Brown 2006). These moister systems quickly return to the point of equilibrium after a disturbance. Non-equilibrium systems on the other hand are controlled by external mechanisms or abiotic factors such as droughts. These unstable, non-equilibrium systems are event-driven and often follow unpredictable patterns (Bredenkamp & Brown 2006).

Elephants and fire do not bring about a change in species diversity, but rather a change in structural diversity as far as woody plants are concerned (Trollope *et al*. 1998). Elephants push over tall trees in a desire to reach foliage or fruits in the upper canopy, but sometimes also push trees over for no apparent reason (Scholes *et al*. 2003). Between 1960 and 1989 there has been a decline in the density of large trees in all major landscapes of the KNP (Scholes *et al*. 2003). With a continued rise in elephant numbers in the KNP, this is a growing concern.

Climate affects all the savanna determinants, i.e. plant available moisture, plant available nutrients, large herbivore concentrations and fire. The complex interplay between soil available moisture, fire and herbivory determines the structure and species composition of the southern African savanna biome. High summer rainfall is crucial for grass dominance, which, with its fine material, fuels near-annual fires (Low & Rebelo 1996). Additionally, climate is one of the five major factors that control the formation of soils (among parent materials, biota, topography and time) (Brady & Weil 1999). The type of soil will in turn influence the plant available soil moisture and the plant available nutrients. This combination of climate and soil has a major influence on the distribution of savanna types as well as animals, with special reference to large herbivores.

Plant available moisture

Competition exists between the grassy / field layer and the woody layer for plant available soil moisture. Knoop & Walker (1985) demonstrated that both the grassy and the woody component have access to both the surface and the deeper soil layers; however, grasses are found to be the superior competitors in the surface layer of soil, and trees/shrubs the superior competitors in the deeper soil layer. Kraaij & Ward (2006) concluded that grasses are more efficient than trees in terms of the exploitation of available soil water because they maintain their populations at lower levels of soil water availability, while significant tree germination occurs under adequate rainfall conditions only, since trees have a higher water requirement. Plant available moisture is a function of the amount and timing of precipitation, the rate of moisture evaporation from the environment and the water retention capabilities of different soils. Rainfall in most of the southern African savanna areas is variable from year to year. These variable conditions fluctuate from favouring first one vegetation component, then the other (Knoop & Walker 1985).

Plant available nutrients

In essence savannas are the result of interactions between soil water and nutrient availability with fire & herbivores acting as modifiers (Medina 1987, Skarpe 1992). Fundamentally it is difficult to separate soil water and available nutrients. The combination of high rainfall and silica saturated parent materials (such as granite) often leads to leached soils with low fertility. These soils select for species with low nutritional requirement and these plants are generally of low palatability and nutrient content (Medina 1987), i.e. “sourveld”. On the other hand, low rainfall and silica unsaturated parent materials (such as basalt) experience less dramatic leaching of nutrients from the soil, often resulting in more fertile soils. Such soils give rise to palatable and nutrient rich vegetation types, which are capable of sustaining large biomasses of herbivores (Knoop & Walker 1985), i.e. “sweetveld”.

The presence of trees allows for a complex mosaic of microenvironments within the savanna system. These microenvironments include crown zones (below tree canopies) and rooting zones. Traditionally, trees in temperate and tropical savannas were thought to reduce understory plant productivity through competition for light, water and nutrients (Belsky 1994). A number of studies, however, have documented that isolated trees may also improve understory productivity (Stuart-Hill & Tainton 1989, Belsky 1994). Ludwig *et al*. (2001) found an increase in nutrient concentrations under tree canopies. This increase in productivity is localized under or near tree crowns and is found most often in the tropics and subtropics and in communities with low tree density (e.g. Knoop & Walker1985). In contrast, trees occurring in communities with high tree density, high rainfall, or extremely nutrient-poor soils display the more expected pattern of reduced understory productivity (Belsky 1994), and tree removal increases herbaceous productivity (Belsky 1994).

Differences in productivity between below-crown and open-grassland habitats have been attributed primarily to three factors (Belsky 1994):

(1) Improved fertility and structure of soils below tree crowns,
(2) Improved water relations of shaded plants, and
(3) Competition between trees and understory plants for soil moisture and nutrients.

Large herbivores

The degree to which large herbivores effects a system will depend on the species present and on their size and number (Cumming 1982). Large herbivores influence soils directly by trampling and digging. While these activities may increase heterogeneity on a localized scale their impact will be low. By far the greatest influence large mammals have on soils is reducing plant cover and litter (Cumming 1982). Herbivores can be divided into grazers (eating primarily the leaves of grasses and sedges – such as zebra and wildebeest) and browsers (feeding primarily on the leaves and stems of woody plants and dicotyledonous herbs –such as the black rhinoceros) as well as mixed feeders (eating the leaves of both grasses and trees – such as impala) (Owen-Smith 1988).

Grazers consume large quantities of grass and form the base of many food chains. Grazers play an important role by removing moribund grassy material, stimulating new growth, and providing fertilizer in the form of manure (Van Oudtshoorn 1999); thus playing a role in nutrient cycling. Normally grazing acts as a stimulus for grass growth, causing very little damage, since the growth points of the grass is situated at or very close to ground level, out of reach of the grazing animal. Many grass species are further adapted to tolerate grazing by storing reserve energy and nutrients in their roots and culm bases, which are used for leaf production (Van Oudtshoorn 1999). As the plant grows, reserve nutrients are once more sent to the roots and culm bases to be stored there (Van Oudtshoorn 1999).

Another impact that grazers have on savannas is that of overgrazing. Overgrazing is the repeated utilisation of the grass until the reserve nutrients in the roots are exhausted (Van Oudtshoorn 1999). This lack of energy causes the plant's root system to become weak and compromises its ability to absorb water effectively, which could lead to death (Van Oudtshoorn 1999). In typical savanna ecosystems, this will lead to a reduction in the competition for water between the grass and woody layer. The absences of a dense grass sward will leave more water available for the establishment of woody seedlings. If overgrazing continues, bush encroachment or thickening may occur.

Vegetation recovers slowly from overgrazing and trampling by animals, and usually needs time to "rest". There are several problems associated with continuous or selective grazing on a section of land (Acocks 1988): Changes in the species composition occur - good grazing species are eaten and are replaced by less palatable species in the wetter parts, or possibly not replaced at all in the drier parts, so that soil becomes exposed. Erosion of soils might occur with water run-off and exposure to wind. Loss of soils seriously deteriorates an ecosystem by further reducing infiltration of water into the soil.

Savannas contain a significant variety of large herbivores. According to Tainton and Walker (1993), the most important grazers in the semiarid savannas, with regards to abundance and consumption of grass are: impala, red hartebeest, blue wildebeest, tsessebe, zebra, roan antelope, elephant and eland. Other important species include buffalo and white rhinoceros. Most of these are pure grazers, the exceptions being impala, elephant, and eland, which can alternate between browsing and grazing, depending on the availability of fodder (Tainton & Walker 1993).

In a study by Guy (1981) in the Sengwa Wildlife Research Area in Zimbabwe, elephant was shown to have a dramatic influence on woodlands. Their feeding habits often keep the woody layer within the fire-trap, increasing the role of fire in determining the structure of vegetation. Continuous damage and the ultimate removal of large trees from a system by elephants produce changes in the biomass, annual production and age structure of the woodlands (Guy 1981). As pressure from the elephants mount, progressive changes in the habitats results, woody plants decrease, with an increase in grasses; this causes an increase in fire due to the higher fuel load and the result is a lowering in species diversity (Laws *et al.* 1975).

Fire

In savannas, fire is recognized as a valuable tool in management of the ecosystem in terms of species composition and vegetation structure. One of the most important functions of fires in savanna is control and reduction of woody vegetation in moist savannas. The susceptible parts of woody plants (buds and leaves) are usually killed if they occur within the flame zone of the fire (Scholes & Walker 1993), thereby inhibiting the development and growth of trees and shrubs. This acts as a grass-dependent recruitment control for woody plants, since the frequency and intensity of fires depends on the fuel load provided by the herbaceous layer (Scholes & Walker 1993).

Several factors contribute to the occurrence of fire in natural vegetation (Van Wilgen & Scholes 1997): enough fuel of the right kind has to be present to support a fire, favourable climatic conditions must be present, as well as a source of ignition. Herbivory competes with fires for the available grass fuels, and may prevent fires in some cases, as fuels are eaten before they can burn (Van Wilgen & Scholes 1997).

The drier savannas burn only when above-average rainfall has allowed the production and accumulation of enough grass fuel, and even then fires are not intense (Skarpe 1992). Intermediate savannas burn more often and more intensely, while the wetter savannas only burn when a prolonged dry season has caused the grass to dry up (Skarpe 1992). Most species in savannas are adapted to survive fire, with less than 10% of plants (in the grass and tree layer) killed by fire (Low & Rebelo 1996). Even with intense burning, most species can resprout from the stem bases (Low & Rebelo 1996).

The season (time) of burning plays an important role in the type of fire applied. A cool fire can be achieved by burning after rain, when the sward and soil surface are moist or when cool moist atmospheric conditions reduce the intensity of fires (Swart & Martens 1994). Such fires are often used to remove only some of the unpalatable of moribund grass parts and to stimulate new grass growth. A hot fire is achieved by burning before the start of the growing season or when atmospheric conditions are dry and hot (Swart & Martens 1994).

Three broad types of fires are based on the layers in which the vegetation burns (Swart & Martens 1994): Ground fires: burn well below the surface of the ground in deep layers of organic material; surface fires: burn in the herbaceous surface vegetation; and crown fires: burn in the canopies of trees. Besides these types of fires, differences in fire intensity can be distinguished. Fires burning with the wind or upslope are termed head-fires, and fires burning against the wind or downslope are termed back-fires (Swart & Martens 1994). It is recommended that head fires be used in savanna management since they cause least damage to the grass sward and can cause maximum damage to woody vegetation if required (Trollope 1990).

The most common types of fires that occur in the KNP are surface head-fires burning with the wind but back-fires and crown fires also occur (Trollope 1993). The KNP's fire history has been highly variable and a summary can be found in Van Wilgen *et al.* (2000) and Govender *et al.* (2006): Between 1941 and 1957 limited prescribed burning and protection from fire took place. Between 1957 and 1980, regular prescribed burning was conducted at 3 year intervals, in spring after the first rains. Between 1981 and 1991, regular prescribed burning was replaced by a regime in which intervals between prescribed fires were more flexible and were timed to take fuel loads, post-fire age and mean annual rainfall into account. Between 1992 to 2001, a “natural” fire policy was in place, in which all lightning-ignited fires were allowed to burn freely while at the same time attempts were made to prevent, suppress or contain all other fires, however, despite this policy, 76% of the area burnt in this period came from unplanned fires started by people.

MOTIVATION FOR THE STUDY

In the 1970's management of the Kruger National Park (KNP) realised the need for a semi-detailed vegetation classification. The level of detail was set at the association- or community-level. The decision to focus on the association as an appropriate scale for classification, was summarised by Coetzee, Gertenbach and Nel in 1977, as follows (Coetzee 1983); "Before results obtained from monitor plots (and experimental plots generally) can be interpreted and generalized more successfully, it is essential that plant communities be described and mapped at semi-detailed level and on total species composition; also that communities be related to habitat and that the hierarchical and reticulate relationships between communities be described, floristically as well as ecologically."

Vegetation Surveys have since been completed and floristic data were classified by Gertenbach (1978), Van Rooyen (1978) and Coetzee (1983) covering the entire region of the Kruger National Park, north of the Sabie River. The late Piet Van Wyk surveyed the vegetation south of the Sabie River. However, this floristic data set was never analysed. Although the floristic data were captured electronically, the original data sheets containing the environmental data as well as locality points were lost.

Vegetation classification was partly done on the floristic data, but ecological confirmation and interpretation could not be done due to the loss of the accompanied environmental data. The ecological interpretation of floristic data with regard to its environmental drivers forms an indispensable part of vegetation analysis. Initially this project was aimed at locating the original sample plots marked on aerial photographs, in order to collect environmental data that would compliment the floristic data. Dr. Holger C. Eckhardt of the KNP suspected that the locations of the sample plots were available on aerial photographs within the archives of the KNP. However, the search for these photographs proved to be of no avail.

The decision was then made to approach the problem from a different angle. During 2002 and 2003 the study area was resampled, which included a record of the total floristic as well as environmental data for each plot. The aim was to link environmental data to the 1970's floristic dataset. The following hypotheses and assumptions were made: The hypothesis states that if classification of the combined 1970's dataset and 2002/2003 datasets reveal grouping of spatially similar sample plots, then meaningful plant community descriptions could follow, since it would indicate plant community resemblances between the two datasets, despite their temporal separation.

- The major plant communities that were sampled by Van Wyk in the 1970's still exist at present.
- The new floristic dataset will therefore be relatively similar to the old dataset.
- A classification and ordination of the combined datasets will therefore produce groupings of relevés (plant communities) that contain relevés from both the old and new datasets.
- The assumption can then be made that the environmental data associated with the new relevés are also relevant to similar relevés from the old dataset.
- This deductive approach can then be used to interpret the old floristic dataset ecologically.

This vegetation classification will add to understanding ecosystems in the southern district of the KNP on a finer scale than landscape level. Information arising from this study will aid in understanding and maintaining biodiversity as stipulated in the terrestrial ecosystem management objective of the KNP. The Terrestrial Ecosystem Objective of the KNP Mission Statement aims: *To develop an integrated understanding of ecosystem diversity and dynamics, and where necessary intervene with appropriate strategies, in order to conserve and restore terrestrial biodiversity and natural processes*. A subobjective of the Terrestrial Ecosystem Objective looks at composition, structure and pattern: *To adequately inventorise our biodiversity heritage, understand the ecology of important elements, and of unnatural threats leading to compositional or structural changes deemed beyond accepatble flux limits, and respond appropriately*. This study falls in line with community listings.

Key Questions

This study attempts to address a number of questions:

- Can the combined dataset be classified and interpreted ecologically?
- Can the classified vegetation data be delineated (mapped) spatially?
- If not, is any additional information required to make ecological interpretation and mapping meaningful?
- Can any other conclusions be drawn from comparisons between historical and recent data? (temporal and spatial vegetation change)

This study should be viewed as an attempt to breathe new life into historical data. The major objective for this study is to give a detailed historical floristic dataset ecological meaning. In a country with few resources and few people to spare for nature conservation and wildlife-research, every available resource should be used optimally and stretched to the limit in order to gain as much knowledge about the environment for the good of both man and the environment. This study aims to prevent repeating work already done and therefore utilise a valuable resource to its full potential.

STUDY AREA

The study area includes the area south of the Sabie River and north of the Crocodile River in the KNP (Figure 1). It ranges in altitude from 170 m above sea level (a.s.l.) in the vicinity of Crocodile Bridge to 847 m a.s.l. at Khandizwe. In depth studies have been done on climate (Gertenbach 1980), geology (Schutte 1974, 1982), soils (Harmse & Van Wyk 1972; Harmse *et al*. 1974; Webber 1979; Venter 1981, 1990) and vegetation at landscape scale (Gertenbach 1983).

Physical environment

Due to the size and heterogeneity of the study area, the physical environment associated with each plant community will be described in more detail under separate headings in the 'results and discussion' section.

Geomorphology

The geology is characterised by north – south running strips/bands of rock exposed after the breaking up of Gondwanaland (135 million years ago). From west to east the geology sequence is granite/gneiss, gabbro, granite/gneiss, Ecca-shale, basalt and rhyolite (Figure 2). The western higher lying parts are dotted with Granite koppies, while the north-south running Lebombo Mountain range borders the eastern-most parts. The central landscape (between the western highlands and the eastern Lebombo range) is relatively flat with undulating plains on the granite/gneiss complex and flat open plains on the gabbros, Ecca-shales and basalts.

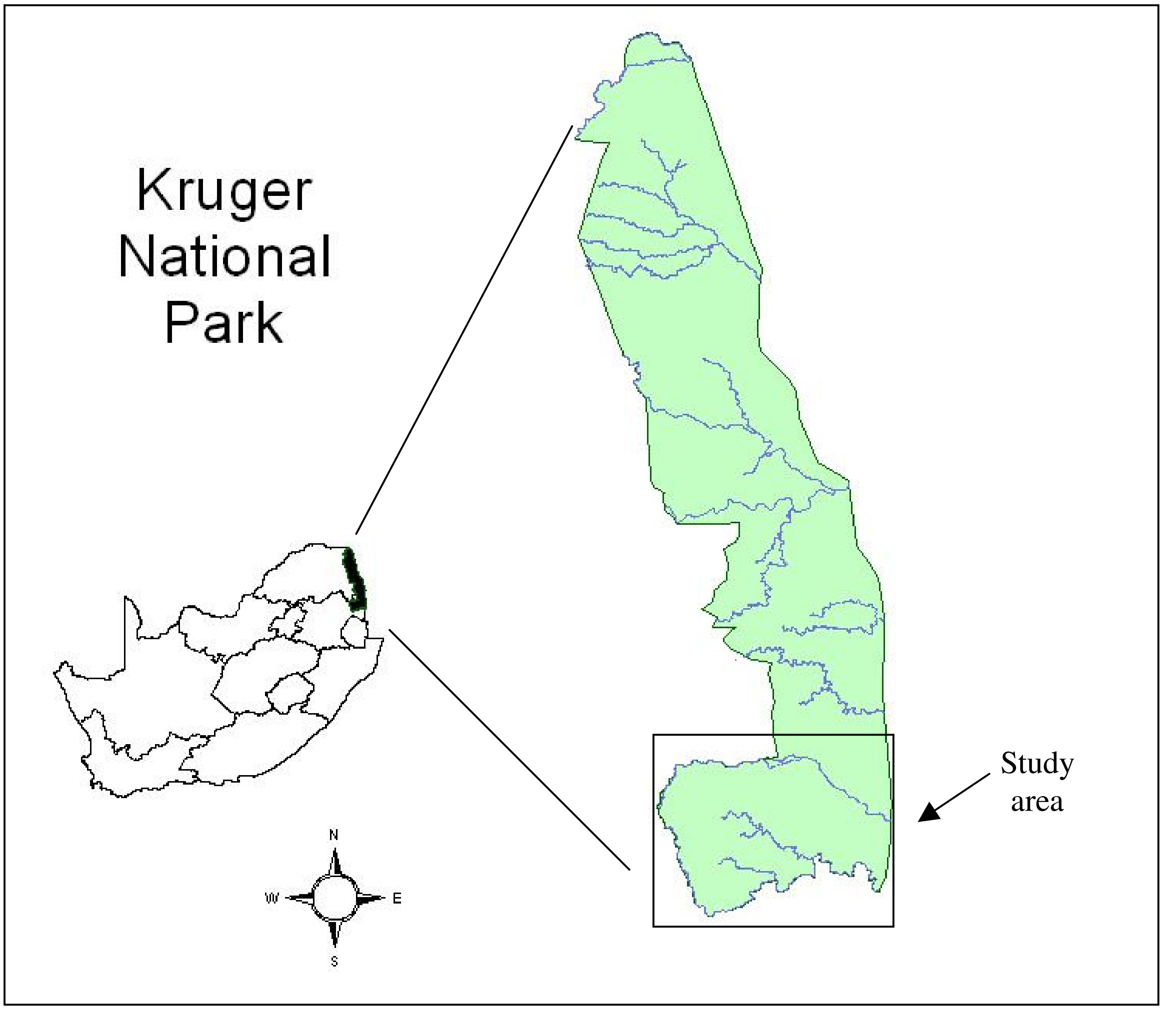


Figure 1 Kruger National Park, showing the study area.

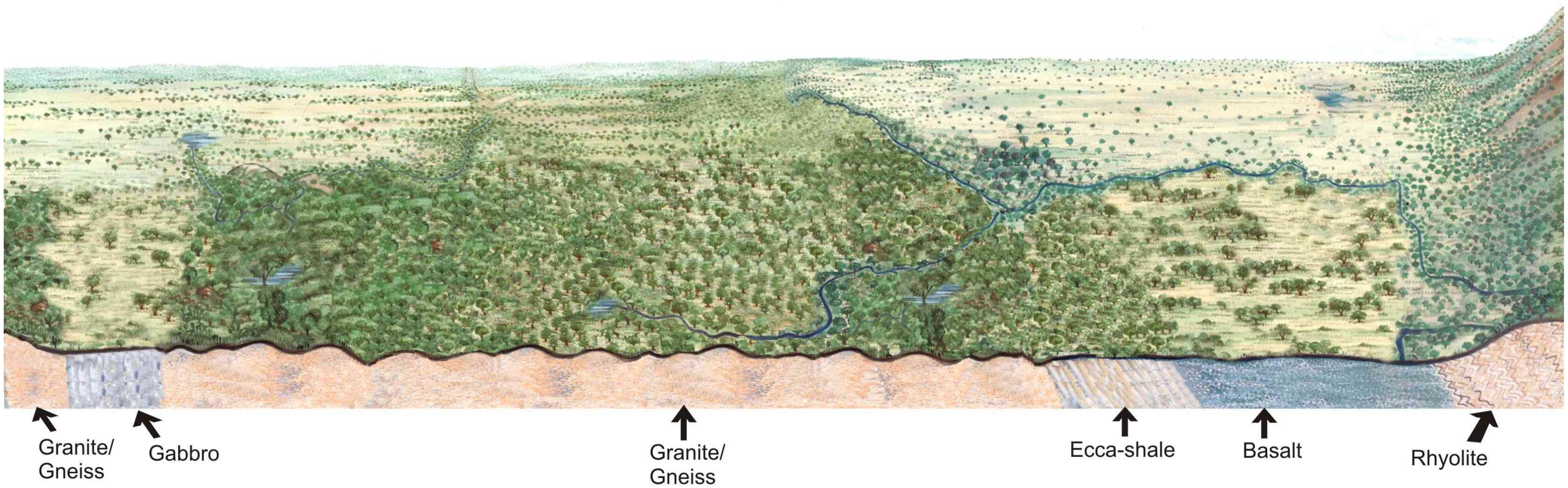


Figure 2 Geology of study area. (Taken from Jacana Education (1995) with modifications)

Soils

The underlying parent material influences the soil and its associated characteristics. Granite, for instance, is a coarse-grained, quartz-rich parent material, and soils formed from this material inherit a sandy texture. Also, movement of water through the soil profile is controlled by soil texture, thereby affecting the translocation of fine soil particles and plant nutrients. Furthermore, parent material influences the chemical and mineralogical composition of the soils as well as the quantity and type of clay minerals present in the soil profile; hence soils have a direct influence on the vegetation that occurs in specific area.

Rainfall and Temperature

Annual precipitation for this summer rainfall area ranges from 550 mm to more than 700 mm in the southern district. The rainfall data used was collected at the following weather stations in the KNP: Pretoriuskop, Crocodile bridge, Lower Sabie, Malelane and Skukuza (Figure 3). This included the data from 1969 till 2006. Incomplete data sets were discarded. It can clearly be seen that higher rainfall was recorded during collection of the first floristic dataset in the late 1970's (rainfall indicated in red) as opposed to the lower rainfall recorded during collection of the second vegetation dataset in 2002 and 2003 (indicated in blue).

Maximum summer temperatures throughout the study area are high, with 40°C not being uncommon. Winter temperatures are mild, with occasional frost being more of an exception than the rule.

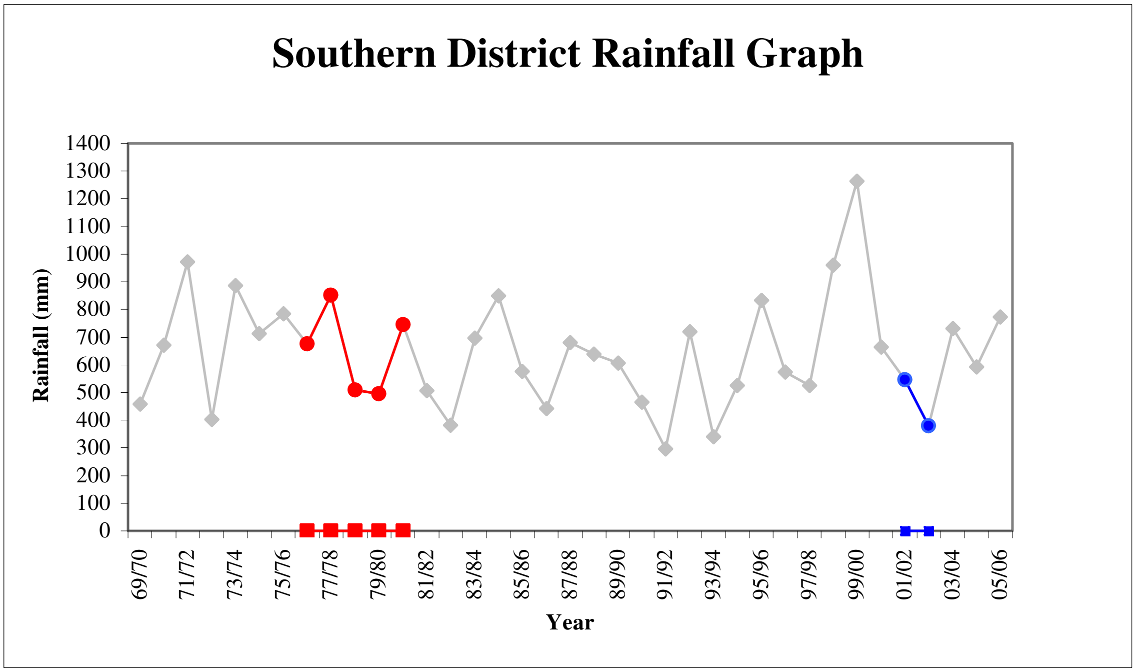


Figure 3 Mean annual rainfall recorded for the Southern District of the KNP from 1969 till 2006.

Drainage

The major rivers, running from west to east, are the Sabie River and the Crocodile River, with smaller tributaries such as the N'waswitshaka, N'watin'wambu, N'watimhiri, Vurhami, Bume, Biyamiti, Mlambane and Matjulu rivers acting as the main drainage channels for the study area.

Vegetation

The following is a summary of the broad-scale vegetation classifications relevant to the southern district of the KNP:

- Landscapes found in the study area (Gertenbach 1983):
  - Lowveld Sour Bushveld of Pretoriuskop (1);
  - Malelane Mountain Bushveld (2);
  - *Combretum collinum / Combretum zeyheri* Woodland (3);
  - Thickets of the Sabie and Crocodile Rivers (4);
  - Mixed *Combretum* species / *Terminalia sericea* Woodlands (5);
  - *Acacia welwitschii* Thickets on Karoo Sediments (13);
  - *Sclerocarya birrea / Acacia nigrescens* Savanna (17);
  - Thornveld on gabbro (19);
  - Lebombo South (29).
- Vegetation units found in the study area (Mucina *et. al.* 2005):
  - Granite Lowveld (SVI 3);
  - Delagoa Lowveld (SVI 4);
  - Tshokwane-Hlane Basalt Lowveld (SVI 5);
  - Gabbro Grassy Bushveld (SVI 6);
  - Pretoriuskop Sour Bushveld (SVI 10);
  - Malelane Mountain Bushveld (SVI 11);
  - Northern Lebombo Bushveld (SVI 15).
- Vegetation types found in the study area (Low & Rebelo 1996):
  - Lebombo Arid Mountain Bushveld (13);
  - Mixed Lowveld Bushveld (19);
  - Sweet Lowveld Bushveld (20);
  - Sour Lowveld Bushveld (21).
- Veld types found in the study area (Acocks 1988):
  - Lowveld Sour Bushveld (9);
  - Lowveld (10);
  - Arid Lowveld (11).

METHODS

This study attempts to combine and classify two savanna vegetation datasets that were collected thirty years apart. During the 1970's former KNP scientist, the late Piet Van Wyk collected vegetation data in the southern district of the KNP (referred to as the "first dataset"). This first dataset consists of 390 relevés. Although the floristic data gathered by Van Wyk were captured and stored electronically, the recorded environmental data and locality points were lost together with the original field forms. During 2002 and 2003 the study area was re-sampled (referred to as the "second dataset"). Thirty-nine new relevés were collected in March 2002 and 87 more relevés were collected in April 2003. These new relevés included a record of the total floristic as well as environmental data for each sample plot. The aim was to link environmental data from the second dataset to floristic data from the first dataset based on floristic overlap between the two floristic datasets.

Based on the assumption that floristically similar plant communities share similar environmental parameters, the environmental data gathered for the second dataset could be extrapolated to describe and explain the general ecology and abiotic environment of communities described from the first dataset. The following hypothesis was developed:

H1: Plant communities derived from the classification of the first dataset will resemble plant communities from the classification of the second dataset floristically.

If a classification of the combined datasets reveal grouping of spatially similar sample plots, then meaningful plant community descriptions could follow, since it would indicate plant community resemblances between the two datasets, despite their temporal separation.

The total research project was divided into eight different phases, as discussed below. Phases one and two were completed as part of a B.Sc. honours project in the year 2002. Phases three to eight formed part of an M.Sc. thesis commencing in the year 2003. The completion of all eight phases is an attempt to salvage the historical floristic data set gathered by Van Wyk.

Phase 1 Search for all available historical information and collected data, in particular the aerial photographs used by Van Wyk during his study.

Phase 2 A reconnaissance vegetation survey in the study area, with the emphasis on gathering environmental data.

- Stratified-random placing of sample plots within the Landscapes described by Gertenbach (1983).
- Vegetation surveys with emphasis on gathering detailed environmental data.
- Data Analysis and ecological interpretation of results.

Phase 3 Interpretation of the Van Wyk floristic data set

Phase 4 Ordination and classification of the "combined floristic datasets" (consisting of the new dataset and the Van Wyk dataset.).

Phase 5 Identifying and describing plant communities derived from the combined dataset.

Phase 6 Interpret the described plant communities ecologically, based on the environmental data gathered for the new dataset. Thereby linking the environmental data of the new data set with the vegetation communities derived from the Van Wyk data set.

Phase 7 Critically comparing and evaluating the derived vegetation communities with the communities described by Coetzee (1983), Gertenbach (1978) and Van Rooyen (1978).

Phase 8 Evaluating the use of historical datasets in studies concerning vegetation classification, vegetation dynamics and vegetation management strategies.

Phase 1

Aerial photographs containing locations of the sample plots as indicated by Van Wyk would prove invaluable to this project. After classification of the data, selected ground-truthing would follow, by visiting the locations marked on the aerial photographs. This way the much-desired environmental data could be gathered for interpretation purposes. However, the search for these photographs, within the archives of the KNP Scientific Services, proved to be of no avail. This brought about a rapid change to the initial plans and proposed project methods. Phase two was re-planned and the methods were adjusted accordingly.

Phase 2

Fieldwork phase

A reconnaissance vegetation survey was done for the study area. The emphasis was placed on gathering detailed environmental data associated with specific plant communities. In order to make the new vegetation data compatible with the Van Wyk data set, the Zürich-Montpellier (Braun-Blanquet) method was used in this study, for the evaluation of the vegetation (Werger 1974; Westhoff & Van der Maarel 1978; Kent & Coker 1992), This method was used by numerous authors (Van Rooyen 1978; Gertenbach 1978; Coetzee 1983; Gertenbach 1983) to classify and describe the vegetation of the KNP.

The sample plots were placed in a stratified-random manner. Stratification of the study area was based on the Landscape classification done by Gertenbach (1983). Sample plots were placed randomly within these stratified vegetation units. Once in the field, the locality of these sample plots were assessed visually to ensure that sampling points occur within homogeneous vegetation units - avoiding ecotonal zones and areas with obvious differences such as soil type and moisture status. In instances where the randomly chosen sample plots fell within heterogeneous vegetation units, such as ecotones, the locality of the sample plots were subjectively moved to the nearest homogeneous and representative vegetation units. It is critically important that sample plots be placed within homogeneous vegetation units that are representative of a particular vegetation type (Werger 1974). Non-uniformity imposes differences in vegetation (Daubenmire 1968). The classification and ordination of such "mixed relevés" result in the homogenised and over-simplified interpretations of complex regional vegetation (Kent & Coker 1992). This pre-requisite is particularly important for landscapes with complex mosaics of alternating plant communities, such as the undulating granitic plains of the Lowveld.

In the Braun-Blanquet method one is neither bound to a fixed plot size, nor to a fixed plot form in sampling the vegetation of a region, since species are rated on a cover-abundance scale with relative values (Werger 1974). It is important that plot size be adapted to give a typical description of the vegetation and hence represent one vegetation type only (Werger 1974). Grasses and forbs were recorded in 10 m x 20 m sample plots. This size usually provides a useful picture of the species composition and dominants of the field layer in Tropical Plains Bushveld (Coetzee *et al.* 1979; Gertenbach 1978; Van der Meulen 1979, Bredenkamp 1982, Coetzee 1983). The sampling plot sizes for the woody layer varied between 200 m^2 and 500 m^2 depending on vegetation density and intra-community species diversity. Brown (1997) viewed sampling plots of 200 m^2 as sufficient for both the woody and the field layers of the southern African savannas.

In the Braun-Blanquet method a complete species list of vascular plants is normally compiled for each sample plot to derive a comprehensive floristic description. This requirement cannot always be met in semi-arid areas with unpredictable rainfall, where some species remain unidentifiable for long periods of time. In order to identify more species per sample plot, one can visit sample sites over extended periods and in the various seasons. However, multiple visits to a sample plot were not possible due to the limited time and resources available to cover such an extensive area. Consequently, an attempt was made to compile as complete a species list as possible in the time available (Appendix B). Plant species names follow Germishuizen & Meyer (2003).

One-hundred-and-twenty-six sample plots were surveyed (Figure 4). With each observation, the following data were recorded on the field form (see Appendix A):

(a) Date of sampling;
(b) Global Positioning System (GPS) locality reading, including latitude and longitude coordinates, as well as altitude;
(c) Slope angle of sample plots site;
(d) Landscape according to Gertenbach (1983);
(e) Details on soil, including rockiness, depth, clay content and Soil Form;
(f) Height and coverage of trees, shrubs and field layer, including total coverage;
(g) Species cover abundance values (Table 1);
(h) Other relevant notes (e.g. notes on grazing and burning).

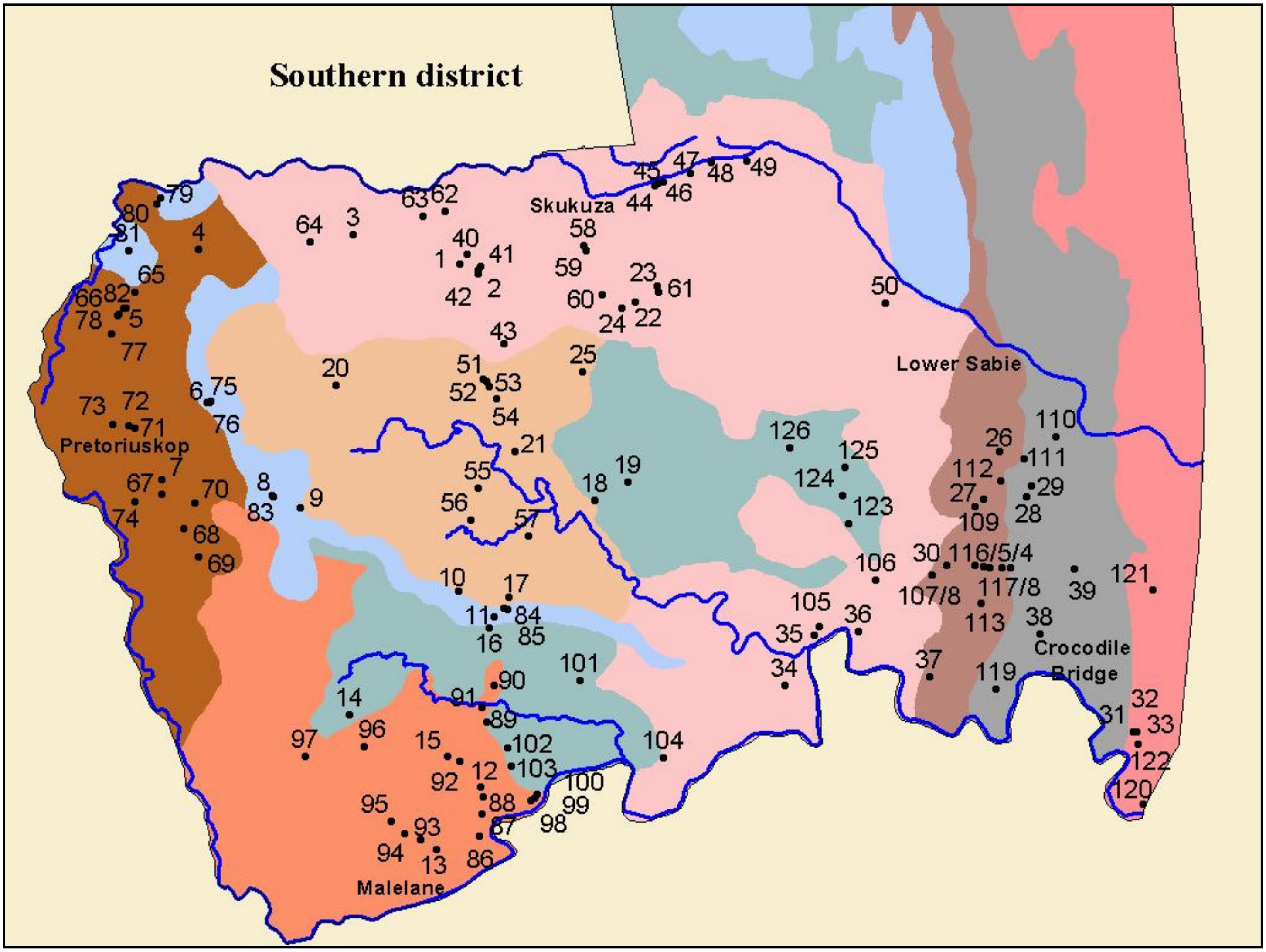


Figure 4 Sample plot points placed in the Gertenbach (1983) Landscapes.

Table 1 The Braun-Blanquet cover abundance scale reads as follows (Werger 1974):

Cover abundance value	**Description**
r	Very rare and with a negligible cover (usually a single individual.
+	Present but not abundant, with a small cover value (<1% of the quadrat).
1	Numerous but covering less than 1% of the quadrat, or not so abundant but covering 1-5% of the quadrat.
2a	Covering between 5-12% of the quadrat, independent of abundance.
2b	Covering between 13-25% of the quadrat, independent of abundance.
3	Covering 25-50% of the quadrat area, independent of abundance.
4	Covering 50-75% of the quadrat area, independent of abundance.
5	Covering 75-100 % of the quadrat area, independent of abundance.

Soils play an important role in plant growth and plant distribution. Soils are made up of sand and clay particles of various particle diameters. The particle composition determines the texture of a particular soil. Textural classes are defined by the size limits of the soil particles. Sand particles have a diameter of 2.0 to 0.05 mm; silt particles have a diameter of 0.05 to 0.002 mm; and clay particles have a diameter of less than 0.002mm (MacVicar *et al*. 1991). Soil texture is determined by the percentage of sand, silt and clay fractions present in the soils. When soil particle size decrease, surface area increase. Fine colloidal clay has up to 10,000 times as much surface area as the same weight of medium-sized sand (Brady & Weil 1999). The importance of soil texture lies in the way that water behaves with different soils. Water is retained in soils as thin layers on the surfaces of soil particles. The greater the surface area, the greater the soil's potential for holding water (Brady & Weil 1999). Hence soils with a high clay percentage tend to retain more hygroscopic water at its surface making the water unavailable for plant use. White (1995) defines the available soil water capacity as the amount of water in a soil that is available for plant growth.

A number of techniques are available to determine soil texture in the field, two of these techniques are:

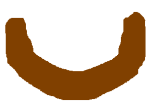
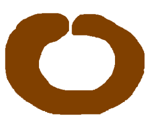
(1) the "feel" method, and

(2) the "sausage" method.

For the "feel" method (Barbour *et al*. 1987, White 1995, Brady & Weil 1999) the soil sample is kneaded between the fingers and thumb until the aggregates are broken down and the soil grains thoroughly wetted. Sand, silt and clay are estimated according to the following qualitative criteria: (i) coarse sand grains are large enough to grate against each other; (ii) fine sand grains comprising more than 10% of the sample can just be detected by feel; (iii) silt grains cannot be detected by feel but makes the soil feel smooth and soapy; (iv) clay is characteristically sticky.

Loxton originally described the "sausage" method test in 1963 (Fertilizer Society of South Africa 1974). A handful of moist soil is kneaded and rolled between the palms of the hand to form a "sausage". Texture can now be determined as follows (Table 2): (i) if no sausage can be rolled, the soil is sandy; (ii) if a "sausage" can just be formed but cracks upon bending, it is a loamy sand; (iii) if it bends a little, it is a sandy loam; (iv) if it bends readily before cracking, it is a sandy clay loam; (v) if it bends into a semi-circle, it is a sandy clay; (vi) if it bends into a circle, it is a clay soil. Photographs of these soil "sausages" were taken and can be seen in the 'Results and Discussion' section.

Table 2 Determination of clay percentage in the field

Soil unable to roll into a “sausage”.	Sand	<10% clay
	Loam Sand	10-15% clay
	Sand Loam	15-20% clay
	Sand Clay Loam	20-35% clay
	Sand Clay	35-55% clay
	Clay	> 55% clay

Data Analysis

The vegetation data was entered into a database created in TURBOVEG (Hennekens & Schamineé 2001). As a first approximation the data was analysed by applying the Two Way INdicator SPecies ANalysis (TWINSPAN) classification algorithm (Hill 1979a), and refinement of the classification was achieved by Braun-Blanquet procedures (Behr & Bredenkamp 1988, Bredenkamp *et al.* 1989, Fuls *et al.* 1993, Van Staden & Bredenkamp 2006). TWINSPAN, a multivariate statistical program, is a divisive hierarchical classification technique that detects overall patterns of differences in biological data. A phytosociological table was constructed to represent the major communities defined by the TWINSPAN classification.

The resultant phytosociological table was subdivided into four phytosociological tables. The division was arbitrary, with those communities that are closest to each other represented in one table. Each of these tables was again subjected to TWINSPAN. The resultant classification was further refined by using Braun-Blanquet procedures in the MEGATAB computer programme (Hennekens 1996, Hennekens & Schaminée 2001). The groups obtained from this data set were subsequently described and classified. Although all the relevés from dataset 1 and dataset 2 were used for classification purposes, only selected relevés were presented in instances where the large size of classification tables became bulky.

The plant communities were named binomially according to the recommendations of Barkman *et al.* (1986), though a formal syntaxonomy was not applied. The first scientific name is that of a diagnostic plant species within the specific community. The second name is that if a dominant species. In cases where the diagnostic group was made up of inconspicuous forbs, two dominant species were used to name plant communities. Diagnostic and dominant species follow the definitions of Werger (1974). Where relevant, applicable physiognomic terms or an appropriate environmental characteristics were added to the community names. Consequently ecological interpretation of the results followed.

Phase 3 Interpretation of the Van Wyk floristic data set

Plant communities are the products of interaction between two main phenomena (Daubenmire 1968): (i) differences in the environmental tolerances of the various taxa and (ii) the heterogeneity of the environment. A plant community possesses a unique plant species composition, as a result of the composition of its habitat (Bredenkamp *et al.* 2001).

The habitat of a community can be seen as the abiotic platform on which the biotic resides (Figure 5). As environmental variables change over space or time – for instance as the clay content of the soil increases from one end of the site to the other – the plant species composition will also change (Bredenkamp *et al.* 2001). Some species increase in abundance, while others decrease or disappear.

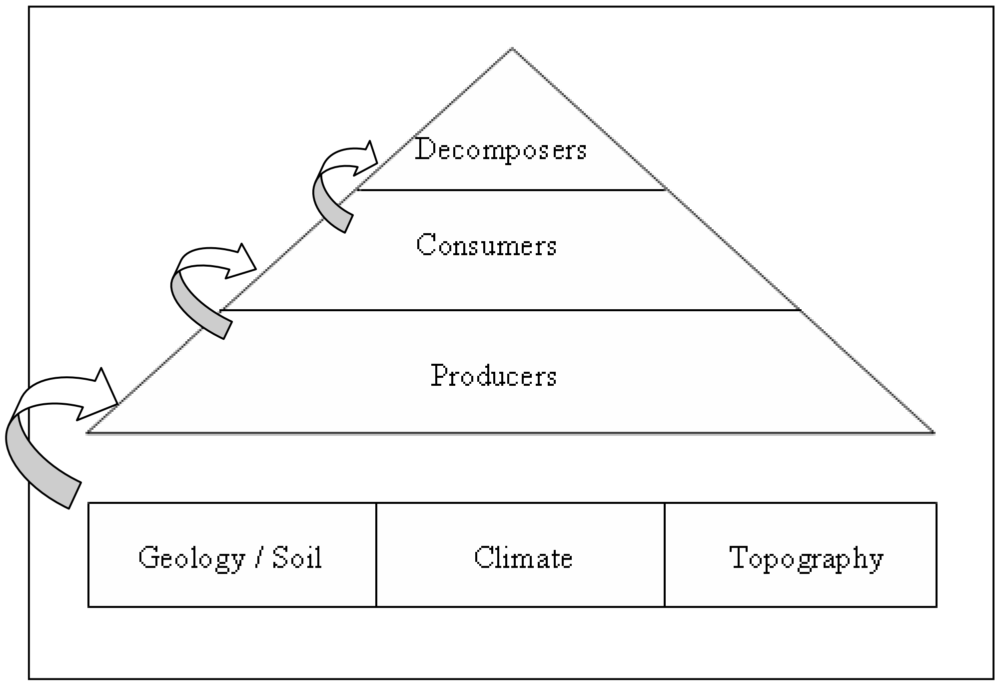


Figure 5 Trophic levels of an ecosystem. The size of the level is related to the biomass of the biota present in a system.

Numerical vegetation analysis is a very useful tool in summarizing the complex relations between species, and between species and their environment as these change over time (Van der Maarel 1996). Multivariate methods of reducing raw vegetation data include:

- Ordination
- Classification

The data collected by Van Wyk was based on species presence/absence and cover-abundance. This first dataset only contain data on the floristic composition of vegetation, without the relevant environmental data accompanying each sample plot. The classification of this dataset, without an ecological interpretation of its interaction with the surrounding abiotic and biotic factors, would be of very little practical or conservation value.

Due to this limitation, it was decided to collect environmental data along with additional floristic data (dataset 2, Phase 2), in order to link ecological meaning to the existing floristic dataset, given that the purpose of vegetation study is an effort to explain the observed patterns of vegetation over space.

Phase 4 Ordination and classification of the "combined dataset" (consisting of the new dataset, containing floristic of the second dataset, as well as the floristic dataset gathered by Van Wyk)

Vegetation is a complex mosaic of continuity and discontinuity, giving rise to separate, distinct plant communities and continuous gradients within and between plant communities (Bredenkamp *et al.* 2001). The difference between the concept of the ordination approach and that of Braun-Blanquet, is clearly one of degree – of emphasis of continuity vs. discontinuity where both are present, of species individuality vs. species groupings, where both are realistic, and of gradient analysis vs. classification where both are possible and relevant (Westhoff & Van der Maarel 1978). In community ecology, species and community patterns are interpreted principally in terms of environmental gradients (Gauch 1982). Because ordination and classification are ordinarily based on floristic data alone (exclusive of environmental data), environmental interpretation is a separate, subsequent step (Gauch 1982). Often, interpretation is by informal comparison of community and environmental patterns, but statistical approaches are also used (Gauch 1982).

In order to make sense of large amounts of vegetation data, classification and ordination can be used as methods for data analyses. These methods can be seen as a means of hypothesis generation as well as techniques for data exploration and data reduction (Kent & Coker 1992). Most quantitative plant ecologists who use classification methods would lean toward the views of Clements (Barbour *et al*. 1987, Kent & Coker 1992) By definition, classification assumes that samples of vegetation composition (species and their abundances) can be grouped into types (Kent & Coker 1992). Others argue that vegetation samples can only be arranged along environmental gradients as continua, and rely on ordination techniques for the description of vegetation (Kent & Coker 1992). This school of thinking was originally proposed by Gleason (Barbour *et al*. 1987, Kent & Coker 1992).

In the table method (classification), associations are presented in a large differentiated table, which manages to preserve most of the original sampling data of species and stands (Barbour *et al.* 1987). Phytosociology is concerned with methods for recognising and defining plant communities (Kent & Coker 1992). 'Phyto' means plant and 'sociology' means assemblages or groupings (of plant species) (Kent & Coker 1992). All methods for recognising and defining plant communities are methods of classification (Kent & Coker 1992). Classification methods attempt to place similar stands together in discrete entities (associations, quadrats or vegetation samples), cleanly separated from all other stands and units (Barbour *et al.* 1987) on the basis of their attributes (floristic composition). The idea of classification is to group together a set of individuals where every individual within each group is more similar to the individuals in that group than to individuals within the other groups (Kent & Coker 1992). The huge amount of information that the phytosociologist deals with must be organized; and this hierarchy is not only necessary, but also invaluable for the understanding and communication of community relationships (Westhoff & Van der Maarel 1978).

The Two Way INdicator SPecies ANalysis (TWINSPAN) described by Hill (1979) was used to classify the combined datasets. Surprisingly, first results showed a distinct separation between relevés of the first dataset and relevés of the second dataset, even though some of them represented similar plant communities. After an in-depth examination of the classification results, it became evident that the division between the temporally separated datasets were derived by the presence/absence of numerous annual species and weak perennial herbaceous species (e.g. biennial species). Since the ecosystems in the southern district of the KNP are event-driven and non-equilibrium systems, it was decided to manipulate the data further by removing these annual and weak perennial plant species from the dataset. The next classification produced more congruent results. The numerical classification of the total dataset consisting of 516 relevés produced 15 uniquely different plant communities.

In contrast, ordination reduces the sampling data to one or two graphs that show different vegetation stands as clusters of sample points in space. The distance between clusters on a graph represents the degree of similarity between relevés, and the graph axes may correspond to gradients of environmental factors (Barbour *et al.* 1987). Ordination was achieved by application of a Detrended Correspondence Analysis (DECORANA) (Hill 1979b), produced with the computer software package PCOrd4.

Phase 5 Interpretation of the classified "combined data set"

During this phase, the uniqueness of vegetation groupings were assessed and evaluated. Distinctly different vegetation units were identified as potential plant communities.

Phase 6 Linking the environmental data of the new data set with the vegetation communities derived from the Van Wyk data set.

Based on the assumption that floristically similar plant communities share similar environmental parameters, the environmental data gathered for the second data set were extrapolated to describe and explain the general ecology and abiotic environment of communities described from the first data set.

Phase 7 Critically comparing and evaluating the derived vegetation communities with the communities described by Coetzee (1983), Gertenbach (1978) and Van Rooyen (1978)

Extensive floristic and environmental comparisons were made between plant communities of the Lowveld described in numerous sources of literature, particularly Coetzee (1983), Gertenbach (1978) and Van Rooyen (1978), since these were the most recent vegetation classification studies completed in the KNP. Other literature sources used to do compare the vegetation communites, were: Van der Schijff (1957), Acocks (1988), Pienaar (1963), Van Wyk (1972), Gertenbach (1978), Bredenkamp (1982), Bredenkamp *et al*. (1991a), Bredenkamp *et al*. (1991b), and Low & Rebelo (1996). Since none of the VEGMAP vegetation units (Mucina *et. al*. 2005) were described at the time of compilation of this thesis, floristic comparisons could not be made in the Description of Plant Communities (pages 41 - 106). Reference is made of the VEGMAP vegetation units (Mucina *et. al*. 2005) as it appears on the map sheets (see page 18). Vegetation structure descriptions were based on Coetzee's (1983) structural classification (Table 3).

Phase 8 Evaluating the use of historical data sets in studies concerning vegetation classification, vegetation dynamics and vegetation management strategies

The use of historical data sets in studies concerning vegetation classification, vegetation dynamics and vegetation management strategies were critically evaluated and discussed philosophically in the Conclusion (see pages 107 – 109).

Phases 7 and 8 are discussed in detail in the Results and Discussion section.

Table 3. Classification of Bushveld by cover regime of three canopy levels. Nouns identify the upper canopy level (cover greater than 1%) and its major cover class (1 - 25 % or 25 - 100%). The adjectives "sparse, moderate, and dense" recognize detailed cover regime of upper canopy level. Elaboration by dependant clauses, using the adjectives and adverbs in parenthesis, describe canopy regime at the remaining height levels (Coetzee 1983).

e.g.: "sparsely scrubby, moderate brushveld, with scattered trees" (upper canopy level at 3 - 5 m covering 5 – 12%, canopy at 1 – 2 m covering 25 – 50% and emergent canopies at 6 m+ covering 0.1 – 1%).

Cover			**Canopy Level**					
Braun-Blanquet class symbol	**% Cover**	**No. of canopy diameters separating canopies**	**Shrub (0.75 m - <2.5 m)**		**Brush (2.5 m - < 5.5 m)**		**Tree (5.5 m +)**	
+	0.1 - 1	8-30	scattered shrub		scattered brush		scattered trees	
1	>1-5	3-8	sparse(ly)		sparse(ly)		sparse	
2a	>5-12	2-3	moderate(ly)	shrubveld (shrubby)	moderate(ly)	brushveld (brushy)	moderate	treeveld
2b	>12-25	1-2	dense(ly)		dense(ly)		dense	
3	>25-50	touching-1	sparse(ly)		sparse(ly)		sparse	
4	>50-75	touching-1	moderate(ly)	scrub(by)	moderate(ly)	thicket(ed)	moderate	bush
5	>75-100	overlapping	dense(ly)		dense(ly)		dense	

RESULTS AND DISCUSSION

Ordination

The distribution of the vegetation communities along the first and second axes of a Detrended Correspondence Analysis (DECORANA), produced with the computer software package PCOrd4, is presented in a scatter diagram (Figure 6). The distribution of vegetation communities along Axis 1 (Eigen value = 0.643) follows a gradient of increasing soil water retention. This is directly correlated with the soil texture, which in turn is related to the particle size of the soils. The size of soil particles is inversely related to the surface area of a given texture class. As particle size decrease, surface area increase. Clay particles provide more surface area per volume than coarse sand (Brewer 1994). The greater the surface area, the greater the soil's potential for holding water (Brady & Weil 1999). Hence soils with a high clay percentage tend to retain hygroscopic water at its surface making the water unavailable for plant use. Other environmental factors associated with Axis one, are: a decrease in rainfall as well as drainage of the soils, and an increase in soil nutrients. The distribution of vegetation communities along Axis 2 (Eigen value = 0.405) follows an increase in moisture availability. The scatter diagram can be divided into four quadrants along the various environmental gradients.

Quadrant A contains relevés from the following communities: *Hyperthelia dissoluta – Terminalia sericea* community on leached soils (1), *Combretum collinum – Terminalia sericea* community on deep sandy soils (2), and the *Themeda triandra – Pterocarpus rotundifolius* community on sand clay loam soils with moderate structure (3). These communities are generally characterized by well-drained, sandy soils of granitic origin. These soils are coarse-grained with a low soil clay fraction and resulting low soil water retention potential. The communities are confined to the western, high rainfall region of the study area. This combination of low soil water retention capabilities within a high rainfall area, results in high water availability for utilization by the vegetation. Additionally, the high rainfall coupled with the coarse grained nature of the soils results in high levels of leaching which in turn has led to the nutrient poor status of the soils.

Quadrant B contains relevés from the following communities: *Combretum zeyheri – Combretum apiculatum* community on deep gravely soils (4), *Grewia bicolor – Combretum apiculatum* community on shallow gravely soils (5), *Sclerocarya birrea – Acacia nigrescens* treeveld community on granite (6), *Sclerocarya birrea – Acacia nigrescens* shrubveld community on basalt (7), *Setaria sphacelata – Themeda triandra* closed grassland community on gabbro (8), *Sporobolus nitens – Acacia grandicornuta* sodic patches (11), and *Acacia tortilis – Acacia nigrescens* community on alluvial floodplains (12). These communities are generally characterized by poorly drained, clayey soils. These soils are fine-grained with a high soil clay fraction and resulting high soil water retention potential. These communities also occur within the relatively low rainfall region in the southern district. This combination of high soil water retention capabilities within a low rainfall area, results in low water availability for utilization by the vegetation. These conditions lead to frequent drought events on a localized scale. The vegetation is generally drought resistant with hardy woody species and many annual herbaceous species. Poor drainage in the areas lead to the accumulation of nutrients in certain areas, particularly the sodic soils associated with *Sporobolus nitens – Acacia grandicornuta* sodic patches.

Quadrant C contains relevés from the following communities: *Croton menyhartii – Acacia welwitschii* community on heavy clays derived from shale (10), *Euclea divinorum – Spirostachys africana* community on alluvial clay drainage lines (13), *Combretum imberbe– Philenoptera violacea* dry riparian woodland (14), and the *Schotia brachypetala – Diospyros mespiliformis* riparian forest (15). These communities are generally associated with azonal landscapes. These include major rivers, tributaries and drainage lines in the southern district. Within this quadrant there is a strong water availability gradient range from high within the *Schotia brachypetala – Diospyros mespiliformis* riparian forest community to low within the *Euclea divinorum – Spirostachys africana* alluvial clay drainage lines community. Water is available throughout the year for the riparian forest vegetation while the water availability for the vegetation of the alluvial clay drainage lines ranges between absolute abundance during the rainy season to periods of extreme physiological water stress during the dry season. These alluvial soils are fine-grained with a high soil clay fraction and resulting high soil water retention potential. The riparian forest community is dominated by hydrophilic vegetation while the alluvial clay drainage lines community contains numerous drought-resistant species. The *Croton menyhartii* – *Acacia welwitschii* community on heavy clays derived from shale are also grouped in this quadrant. The reason for the shared floristic links may be due to the alluvial origin of the sedimentary Shale formations.

Quadrant D contains relevés from the Malelane-Lebombo mountain bushveld community (9). This community is essentially associated with azonal landscapes, which contains highly heterogeneous topography and microhabitats. It is interesting to note that this community shares many species with the rocky outcrops and riverine vegetation within the southern district. This phenomenon has been recorded by several authors Coetzee (1983), Gertenbach (1978), Gertenbach (1983), Bredenkamp & Deutschländer (1995), Du Plessis (2001), Siebert (2001). The similarities in vegetation structure and floristic composition relates to the high water availability within these uniquely different landscapes.

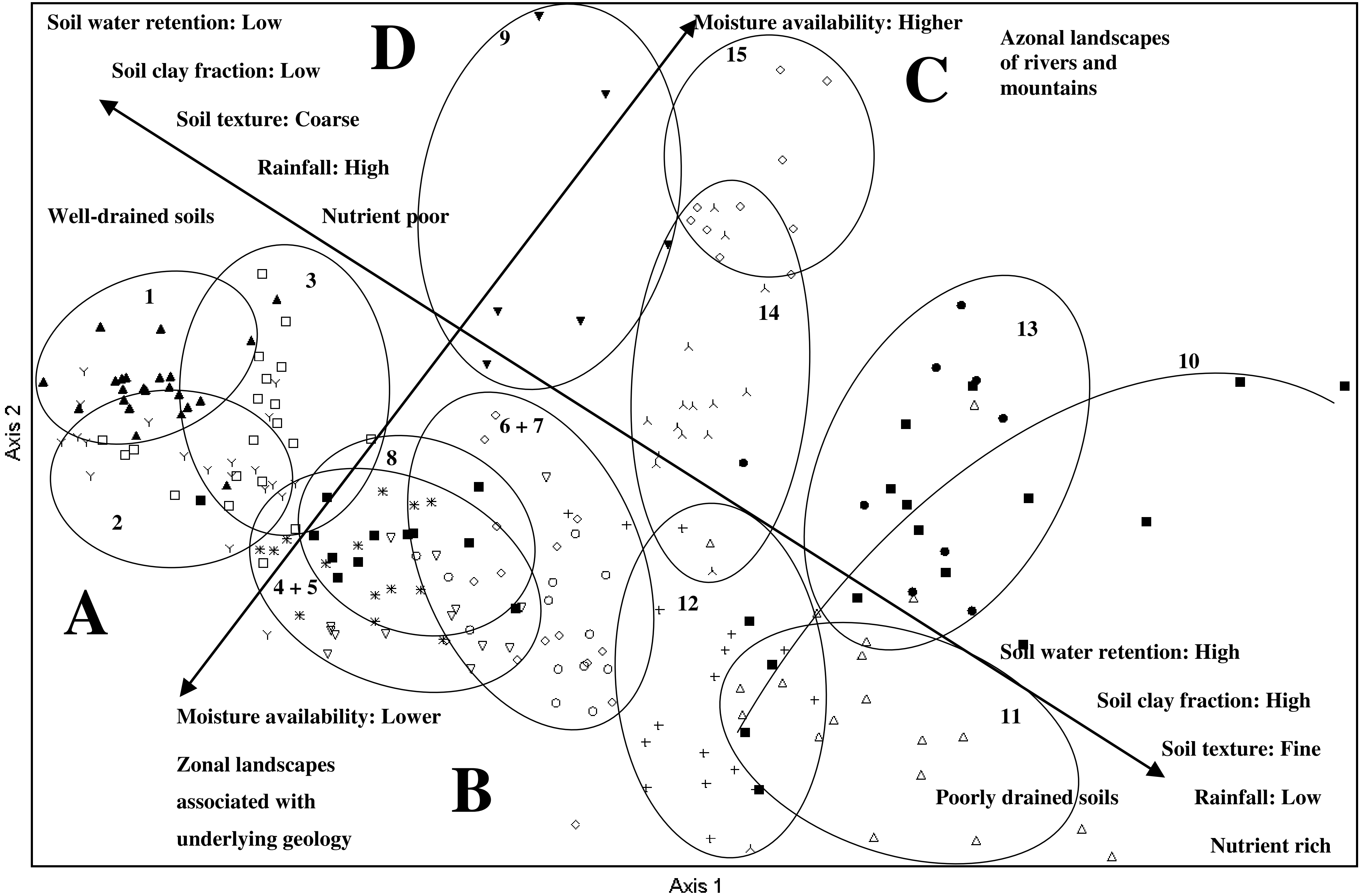


Figure 6 Scatter diagram of Axis 1 and 2 showing the distribution of vegetation communities in the southern district along environmental gradients

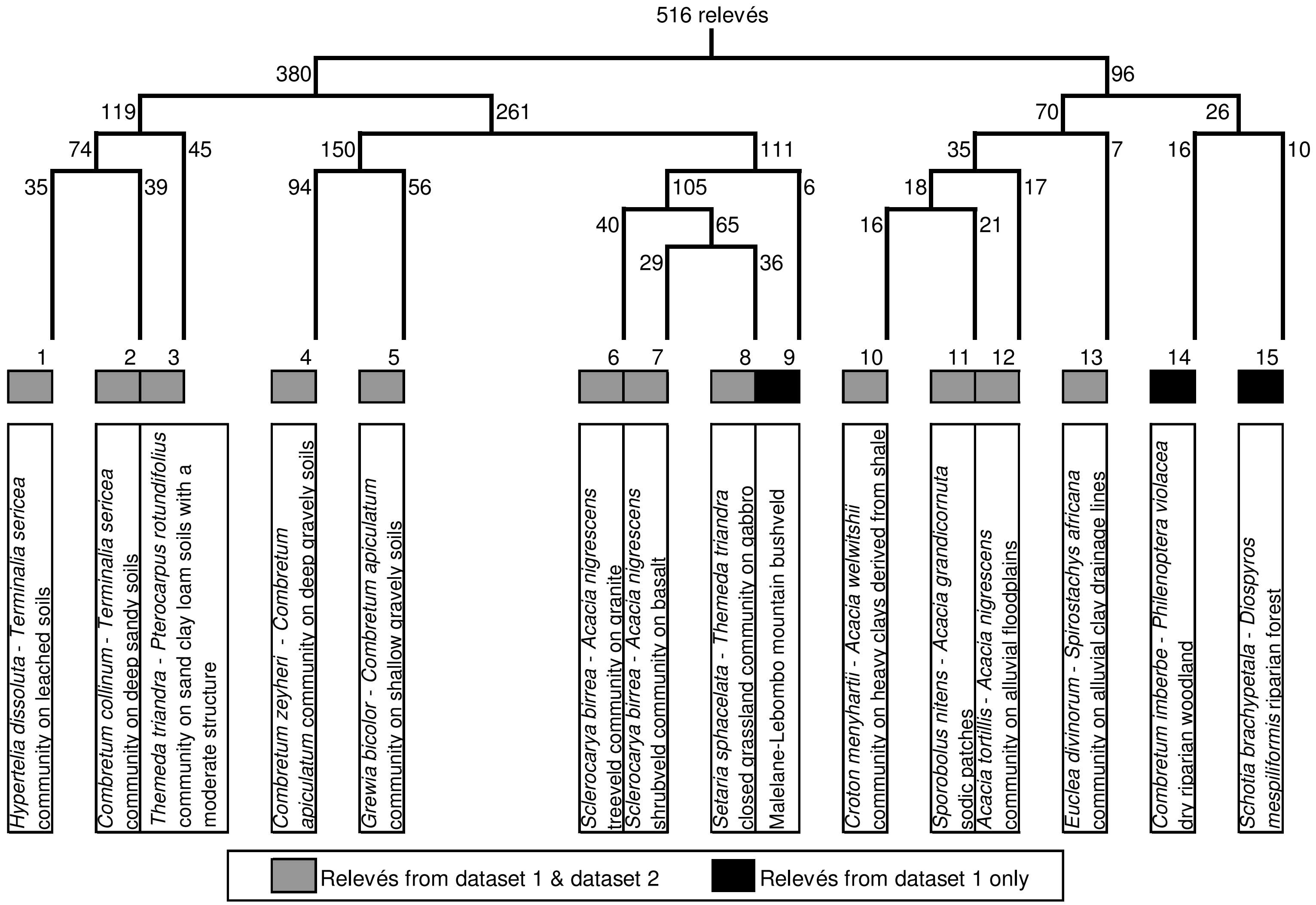


Figure 7 Dendrogram showing TWINSPAN divisions. The numbers indicate the amount of relevés in that specific division

Classification

The numerical classification of the total dataset consisting of 516 relevés produced 15 uniquely different plant communities. The first division created with the multivariate statistical program, TWINSPAN, separated the zonal vegetation from the clay-enriched azonal alluvial vegetation (Figure 7). The second division of the azonal vegetation split the riparian vegetation of perennial rivers from the seasonally wet drainage lines. The second division of the zonal vegetation split the higher rainfall granitic areas from the more arid vegetation. The third division in the arid vegetation separated the vegetation on sand from the vegetation on clay. The classification generally correlates with the plant available soil moisture associated with the various plant communities. In turn, the plant available soil moisture is directly correlated with the clay content and water retention capabilities of soils. These fifteen communities are as follows:

1. *Hyperthelia dissoluta – Terminalia sericea* community on leached soils
2. *Combretum collinum – Terminalia sericea* community on deep sandy soils
3. *Themeda triandra – Pterocarpus rotundifolius* community on sand clay loam soils with a moderate structure
4. *Combretum zeyheri – Combretum apiculatum* community on deep gravely soils
5. *Grewia bicolor – Combretum apiculatum* community on shallow gravely soils
6. *Sclerocarya birrea – Acacia nigrescens* treeveld community on granite
7. *Sclerocarya birrea – Acacia nigrescens* shrubveld community on basalt
8. *Setaria sphacelata – Themeda triandra* closed grassland community on gabbro
9. Malelane–Lebombo mountain bushveld
10. *Croton menyhartii – Acacia welwitschii* community on heavy clays derived from shale
11. *Sporobolus nitens – Acacia grandicornuta* sodic patches
12. *Acacia tortilis – Acacia nigrescens* community on alluvial floodplains
13. *Euclea divinorum – Spirostachys africana* community on alluvial clay drainage lines
14. *Combretum imberbe – Philenoptera violacea* dry riparian woodland
15. *Schotia brachypetala – Diospyros mespiliformis* riparian forest

DESCRIPTION OF PLANT COMMUNITIES

1. *Hyperthelia dissoluta – Terminalia sericea* community on leached soils

Figure 8 *Hyperthelia dissoluta – Terminalia sericea* community on leached soils. (Photo: Synbiosys KNP)

Geomorphology

The *Hyperthelia dissoluta – Terminalia sericea* community on leached soils (Figure 8) is located in the north-western corner of the southern district, near Pretoriuskop. The underlying granite/gneiss is deeply weathered resulting in a sharply undulating landscape with deep sandy to sandy loam soils. Rocky granite outcrops lay scattered throughout this community (Figure 9). Altitudes range from 400 to 650 metres a.s.l.

Climate

Rainfall ranges from 650 to more than 700 mm per year (Gertenbach 1980).

Soil

The deep soils (Figure 10) are red to yellow-brown in colour and vary from sand to sandy loam with 10 to 15% clay content (Figure 11). The soils are highly leached with Hutton, Clovelly, Fernwood and Cartref as the dominant Soil Forms.

Figure 9 Rocky granite outcrops in the Pretoriuskop region. (Photo: Liesl Mostert)

Figure 10 Deep, sandy soils are found in the *Hyperthelia dissoluta – Terminalia sericea* community on leached soils. (Photo: Theo Mostert)

Figure 11 The sandy loam soils of the *Hyperthelia dissoluta – Terminalia sericea* community on leached soils. (Photo: Liesl Mostert)

Vegetation

Dataset 1: 25 relevés; dataset 2: 14 relevés.

Within the KNP, this unique community occurs only in the southern district. The *Hyperthelia dissoluta – Terminalia sericea* community on leached soils is best represented by the uplands of the Lowveld Sour Bushveld of Pretoriuskop Landscape (1) (Gertenbach 1983). Previous descriptions of the vegetation fall under the following names: The Pretoriuskop long grass savanna woodland and tree savanna (Pienaar 1963); *Terminalia*/sicklebush veld on granite undulations (Van Wyk 1972); Sour Lowveld Bushveld (Low & Rebelo 1998) and Lowveld Sour Bushveld (Acocks 1975).

There is a clear distinction between the grass layer and the tree layer of this community. The structure is moderately shrubby, moderately brushy, moderate to dense treeveld. This broad-leaved open tree savanna is dominated by almost homogeneous stands of *Terminalia sericea*, with tree species averaging four to six meters in height. *Dichrostachys cinerea* occurs as the dominant shrub. The grass layer is dense and often more than a meter in height. Since the field layer is sourveld and unpalatable this community is generally under-utilized by grazing herbivores. The accumulation of large quantities of burning material in the form of a coarse grass layer results in frequent veld fires. Fire plays an important role in the regeneration of this plant community, which sustains large numbers of non-selective bulk grazers, such as buffalo and rhinoceros. The dominant grass species is *Hyperthelia dissoluta*. Termitaria are scattered throughout this community.

Diagnostic species

The diagnostic species for this community can be viewed in species group A (Table 4). The diagnostic woody plants include: *Gymnosporia* cf. *glaucophylla*, *Rhus pyroides*, *Antidesma venosum*, *Rhus transvaalensis*, *Annona senegalensis*, *Senna petersiana*, *Euclea natalensis*, *Piliostigma thonningii*, *Ehretia amoena*, *Albizia versicolor*, *Zanthoxylum capense*, *Trichilia emetica*. The diagnostic grasses include: *Hyperthelia dissoluta*, *Andropogon gayanus*, *Urochloa mosambicensis*, *Schizachyrium sanguineum*. The diagnostic forbs include: *Lippia javanica*, *Hypoxis filiformis*, *Jasminum fluminense*, *Solanum panduriforme*, *Conyza obscura*, *Achyropsis leptostachya*, *Lotononis* species, *Hermannia modesta*, *Phyllanthus parvulus*, *Zornia* species, *Tephrosia longipes*, *Pollichia campestris*, *Aeschynomene micrantha*, *Stylosanthes fruticosa*, *Helichrysum athrixiifolium*, *Coccinia rehmannii*, *Turraea nilotica*, *Alysicarpus vaginalis*, *Tephrosia rhodesica*, *Ocimum gratissimum*, *Cyphostemma simulans*, *Flacourtia indica*, *Abutilon ramosum*, *Crossandra greenstockii*.

Dominant / prominent species

The dominant woody plants are: *Terminalia sericea*, *Strychnos madagascariensis*, *Pterocarpus angolensis*, *Pavetta schumanniana*, *Euclea schimperi*, *Catunaregam spinosa* (Species Group C), *Dichrostachys cinerea*, *Sclerocarya birrea*, *Ziziphus mucronata*, *Ximenia caffra* (Species Group F). The dominant grasses are: *Pogonarthria squarrosa*, *Perotis patens*, *Aristida congesta* subspecies *congesta*, *Trichoneura grandiglumis*, *Loudetia simplex*, *Tricholaena monachne*, *Brachiaria brizantha* (Species Group C), *Panicum maximum*, *Heteropogon contortus*, *Diheteropogon amplectens*, *Digitaria eriantha*, *Setaria sphacelata*, *Melinis repens*, *Elionurus muticus*, *Sporobolus stapfianus* (Species Group F). The dominant forbs are: *Evolvulus alsinoides*, *Vernonia natalensis* (Species Group C). *Lantana rugosa*, *Agathisanthemum bojeri*, *Helichrysum nudifolium*, *Teramnus labialis*, *Xenostegia tridentata* subspecies *angustifolia*, *Chamaecrista mimosoides*, *Melhania didyma*, *Commelina africana*, *Kohautia virgata*, *Tephrosia polystachya*, *Vigna unguiculata*, *Thesium gracilarioides*, *Vernonia oligocephala* (Species Group F).

2. *Combretum collinum – Terminalia sericea* community on deep sandy soils

Figure 12 *Combretum collinum – Terminalia sericea* community on deep sandy soils. (Photo: Synbiosys KNP)

Geomorphology

The *Combretum collinum – Terminalia sericea* community on deep sandy soils (Figure 12) is underlain by granite/gneiss. The altitude varies from 350 to 550 metres a.s.l.

Climate

Rainfall ranges from 600 to 700 mm per year (Gertenbach 1980).

Soil

The deep soils are sandy loam with 10 to 15% clay content (Figure 11). Hutton and Clovelly are the dominant Soil Forms.

Vegetation

Dataset 1: 33 relevés; dataset 2: 2 relevés.

The *Combretum collinum – Terminalia sericea* community on deep sandy soils is best represented by the uplands of the Mixed *Combretum* species/*Terminalia sericea* Woodland Landscape (5) (Gertenbach 1983).

The structure of this broad-leaved community is moderately shrubby to brushy, sparse treeveld. The dominant tree, *Combretum collinum*, may reach heights of up to 7 m. The grass layer is less than a metre high. This community is subjected to light to medium grazing pressure. Although the field layer is generally sour and unpalatable, it provides important winter grazing for migratory grazing herbivores, such as blue wildebeest and zebra. These grass species include: *Pogonarthria squarrosa*, *Perotis patens*, *Aristida congesta* subspecies *congesta*, *Loudetia simplex*, *Tricholaena monachne*, *Trichoneura grandiglumis*, *Schmidtia pappophoroides*, *Brachiaria serrata*, *Heteropogon contortus*, *Diheteropogon amplectens*, *Digitaria eriantha*, and *Setaria sphacelata*.

Diagnostic species

The diagnostic species recorded for this community can be viewed in species group B (Table 4). The diagnostic woody plants include: *Combretum collinum*, *Dalbergia melanoxylon*, *Cassia abbreviata*, *Ormocarpum trichocarpum*. No diagnostic grasses were recorded. The diagnostic forbs include: *Vernonia fastigiata*, *Limeum sulcatum*, *Talinum caffrum*, *Crotalaria burkeana*, *Ipomoea bolusiana*, *Thesium gypsophiloides*.

Dominant / prominent species

The dominant woody plants are: *Terminalia sericea*, *Strychnos madagascariensis*, *Pterocarpus angolensis*, *Pavetta schumanniana* (Species Group C), *Gymnosporia cf. glaucophylla*, *Combretum apiculatum*, *Pterocarpus rotundifolius*, *Combretum zeyheri*, *Acacia exuvialis*, *Lannea discolor* (Species Group E), *Dichrostachys cinerea*, *Sclerocarya birrea*, *Philenoptera violacea*, *Acacia gerrardii*, *Ozoroa insignis*

(Species Group F). The dominant grasses are: *Pogonarthria squarrosa*, *Perotis patens*, *Aristida congesta* subspecies *congesta*, *Trichoneura grandiglumis*, *Loudetia simplex*, *Tricholaena monachne* (Species Group C), *Schmidtia pappophoroides*, *Brachiaria serrata*, *Eustachys paspaloides*, *Brachiaria nigropedata*, *Microchloa caffra* (Species Group E), *Panicum maximum*, *Heteropogon contortus*, *Diheteropogon amplectens*, *Digitaria eriantha*, *Setaria sphacelata*, *Melinis repens*, *Elionurus muticus*, *Eragrostis superba*, *Eragrostis rigidior* (Species Group F). The dominant forbs are: *Evolvulus alsinoides* (Species Group C), *Hibiscus pusillus*, *Chascanum hederaceum*, *Jatropha schlechteri*, *Gladiolus* species, *Indigofera heterantha*, *Indigofera bainesii*, *Chlorophytum galpinii* (Species Group E), *Lantana rugosa*, *Agathisanthemum bojeri*, *Helichrysum nudifolium*, *Teramnus labialis*, *Chamaecrista mimosoides*, *Melhania didyma*, *Ipomoea crassipes*, *Kohautia virgata*, *Sphedamnocarpus pruriens*, *Thesium gracilarioides*, *Xenostegia tridentata* subspecies *angustifolia*, *Acalypha villicaulis*, *Tricliceras schinzii*, *Tephrosia polystachya*, *Vigna unguiculata*, *Raphionacme procumbens*, *Polygala sphenoptera*, *Crabbea hirsuta* (Species Group F).

3. *Themeda triandra – Pterocarpus rotundifolius* community on sand clay loam soils with a moderate structure

Geomorphology

The *Themeda triandra – Pterocarpus rotundifolius* community on sand clay loam soils with a moderate structure is associated with the complex contact zone between the granite and the relatively narrow strip of gabbro - which occurs to the west of the southern district.

Climate

Rainfall ranges from 600 to 700 mm per year (Gertenbach 1980).

Soil

The moderately structured soils range from sand clay loam to sand clay and contain 20 to 35% clay. Shortlands is the dominant Soil Form.

Vegetation

Dataset 1: 44 relevés; dataset 2: 1 relevé.

The *Themeda triandra – Pterocarpus rotundifolius* community is comparable to Coetzee's (1983) *Lannea stuhlmannii – Pterocarpus rotundifolius – Themeda triandra* of the Tropical Semi-arid Doloritic Lowveld. Bredenkamp (1982) described a relatively similar vegetation type, namely *Themeda triandra – Acacia gerrardii* association of the Manyeleti Game Reserve.

The structure is densely shrubby, sparse brushveld with scattered trees. This community forms localized patches dominated by *Pterocarpus rotundifolius*. Elephants and fire play a major role in keeping the *Pterocarpus rotundifolius* in shrub form.

Diagnostic species

The diagnostic species for this community can be viewed in species group D (Table 4). The diagnostic woody plants include: *Pterocarpus rotundifolius*, *Strychnos spinosa*, *Heteropyxis natalensis*, *Sterculia murex*, *Diospyros lycioides*, *Elaeodendron transvaalense*, *Rhus leptodictya*, *Acacia burkei*, *Kirkia wilmsii*, *Acacia robusta*. The diagnostic grasses include: *Themeda triandra*, *Panicum deustum*, *Oropetium capense*, *Setaria incrassata*, *Andropogon schirensis*. The diagnostic forbs include: *Stylochaeton natalensis*, *Tragia dioica*, *Cheilanthes viridis*, *Decorsea galpinii*, *Cheilanthes hastata*, *Urginea epigea*, *Ledebouria* species, *Adenia digitata*, *Chaetacanthus burchellii*, *Blepharis integrifolia*.

Dominant / prominent species

The dominant woody plants are: *Gymnosporia cf. glaucophylla*, *Combretum apiculatum*, *Combretum zeyheri*, *Acacia exuvialis*, *Lannea discolor*, *Commiphora mollis* (Species Group E), *Dichrostachys cinerea*, *Sclerocarya birrea*, *Ziziphus mucronata*, *Dombeya rotundifolia*, *Peltophorum africanum*, *Acacia gerrardii*, *Mundulea sericea*, *Combretum molle*, *Rhoicissus tridentata* (Species Group F). The dominant grasses are: *Schmidtia pappophoroides*, *Eustachys paspaloides*, *Brachiaria nigropedata* (Species Group E), *Panicum maximum*, *Heteropogon contortus*, *Diheteropogon amplectens*, *Digitaria eriantha*, *Setaria sphacelata*, *Melinis repens*, *Elionurus muticus*, *Eragrostis superba* (Species Group F). The dominant forbs are:

Hibiscus pusillus, *Chascanum hederaceum*, *Jatropha schlechteri*, *Thunbergia dregeana*, *Senecio* species (Species Group E), *Lantana rugosa*, *Agathisanthemum bojeri*, *Helichrysum nudifolium*, *Teramnus labialis*, *Chamaecrista mimosoides*, *Melhania didyma*, *Ipomoea crassipes*, *Commelina africana*, *Kohautia virgata*, *Sphedamnocarpus pruriens*, *Thesium gracilarioides*, *Acalypha villicaulis*, *Tricliceras schinzii*, *Vigna unguiculata*, *Raphionacme procumbens*, *Polygala sphenoptera*, *Vernonia oligocephala*, *Crabbea hirsuta*, *Sida dregei*, *Commelina livingstonii*, *Ipomoea obscura* var. *obscura* (Species Group F).

Table 4 Phytosociological table of the southern district of the KNP (part 1)

Association number	**1**																							**2**																				**3**																			
Relevé number									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
									1	1	1	1	1	2	2	2	2	2	2	2	3	3	3			0	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	3	3		1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3
			6	6	7	7	7	7	7	7	7	7	8	0	0	0	1	1	1	1	7	8	8	9	9	1	1	1	2	2	2	2	7	9	7	8	8	9	7	7	9	6	8		2	4	6	6	8	8	8	8	8	1	7	7	8	8	1	6	7	8	8
	5	7	5	6	1	2	3	4	0	2	3	7	5	4	6	7	3	4	5	6	9	1	4	6	7	2	6	8	2	4	5	8	9	6	6	7	8	1	0	6	2	2	8	6	4	3	6	7	0	1	3	6	9	1	1	4	2	5	9	7	3	3	6
Species Group A																																																															
Diagnostic species of the *Hyperthelia dissoluta - Terminalia sericea* community on leached soils																																																															
Hyperthelia dissoluta	+	a	a		a	a	b	1	1	1	1	1		3	a	a	a		a	4	4	a	3					a		+	a										a			1		a			1	1	a								1				
Maytenus senegalensis	+	1		+		+	+						1			1	+	r	+	1	1	1	+					+							1				+		1										a	1							1				
Rhus pyroides		+			+	+	+			1					1	1	+	+	1				+					a																			1				+												
Lippia javanica		+			+	+		+		+					+	1	+		+		+	+																																									
Antidesma venosum		+			+	+	+									1	1	1	1			1	1																1																1								
Rhus transvaalensis					+	+	+	+							1	1		1	1			+																																									
Hypoxis filiformis												a		1	1	1		b	1	a	1	1																													1												
Jasminum fluminense					+	+			+	1					1	1		1	+		+							1																											+								
Annona senegalensis								+	+					a	a		1	a	1	a			1																																		1					
Solanum panduriforme		+			+	+							+	+				1	+	+												+																														
Conyza obscura									r	+				1	+			1	1		1		+																																							
Achyropsis leptostachya									1	1			a	1	1	1	1	1																																													
Senna petersiana										a	+			+	+		1	+	1													1																			+								+				+
Andropogon gayanus										a	1	a		1			1		1																												1																
Lotononis species										+	1						+	+	+	1																	1																										
Urochloa mosambicensis			+							a						+				1			+	+																+																			1		+		
Hermannia modesta									1		1			1						+	+								+																																		
Euclea natalensis			+	+	+	+		+																																																							
Phyllanthus parvulus			+		+	+	+	+																																																							
Zornia species														1			+				1	+	+																																								
Tephrosia longipes	+									+		+					1		+												+							+					+						+														
Pollichia campestris									+	+				1			+																																														
Aeschynomene micrantha										+		r		+			+																				r		+																								
Piliostigma thonningii	+		+				r			1																																																					

Stylosanthes fruticosa	1 1 1 +	+ +	
Ehretia amoena	+ + 1 +	1	+ +
Helichrysum athrixiifolium	+ a 1 +		
Coccinia rehmannii	+ + + +	+	+
Albizia versicolor	3 1 a +		
Turraea nilotica	1 + + +	+	+ +
Alysicarpus vaginalis	+ + +		
Tephrosia rhodesica	+ 1 1		
Ocimum gratissimum	+ + +		a
Cyphostemma simulans	1 + 1	+	+
Zanthoxylum capense	+ + r		+ 1
Trichilia emetica	+ 1 +		
Flacourtia indica	+ + +		
Schizachyrium sanguineum	1 a a		
Abutilon ramosum	+ + +		
Crossandra greenstockii	+ + +		

Species Group B

Diagnostic species of the *Combretum collinum - Terminalia sericea* community on deep sandy soils

Combretum collinum	+ 1 1 a	a a a b a 1 1 b b a a b b a 1 a a 1 a 1	1 1 a 1 1 1
Dalbergia melanoxylon	+ + 1 +	+ a 1 1 + a 1 1 + 1 + +	+ + +
Cassia abbreviata	+ 1 1	1 1 + r + + +	
Vernonia fastigiata	1 1 +	+ + 1 + + + +	+ +
Ormocarpum trichocarpum	+	+ + 1 1 1 +	+ +
Limeum sulcatum		+ + + 1 +	+
Talinum caffrum		+ + + +	+
Crotalaria burkeana		+ + +	1
Ipomoea bolusiana		r + +	
Thesium gypsophiloides		+ a	

Species Group C

Terminalia sericea	b b 3 3 b b b b b 1 b a b 1 1 a a b 1 a a +	1 a 1 1 1 3 a b 1 b a a 1 a 1 1 1 1	1 1 1 1 + 1 +
Pogonarthria squarrosa	+ 1 + 1 + 1 1 1 1 1 + 1 a 1 1 1	+ + 1 1 1 1 1 1 1 1 1 + + + 1	1 1 1 + 1 +
Perotis patens	+ + + + 1 1 1 + 1 + 1 1 1 1 +	1 + + 1 1 + + + + +	1 +
Aristida congesta subsp. *congesta*	+ + 1 1 + + 1 1	+ 1 1 1 + + 1 + + + + + 1 1	1 + + + + + 1 +
Trichoneura grandiglumis	+ + + 1 + 1 1 +	1 + + 1 + 1 + 1 1 + + + +	1 1 + + + +

Evolvulus alsinoides	+ + + + + + + +	+ + + + 1 + + + + + +	1 + + 1
Strychnos madagascariensis	1 + + + 1 + r + 1 +	a + + b 1 + + +	a 1 1 1
Vernonia natalensis	+ + + + + a a + 1 1	+ 1 1 1	
Pterocarpus angolensis	r a 1 1 b r +	b + 1 1 b +	b 1
Loudetia simplex	+ + + 3 a	1 1 3 a b a b	1
Pavetta schumanniana	1 a + + +	+ 1 a + + +	+
Tricholaena monachne	1 1 1 1 +	+ 1 1 + + 1	1 +
Euclea schimperi	1 1 a 1	a + + +	+ 1 +
Catunaregam spinosa	+ + + + + +	+ a	
Brachiaria brizantha	a + a 1	1 +	

Species Group D
Diagnostic species of the *Themeda triandra - Pterocarpus rotundifolius* community on sand clay loam soils with a moderate structure

Pterocarpus rotundifolius		1	a a 1 a a b 1 b 3 a 1 1 a 1 1 a 1 1
Themeda triandra	+ +	+ + 1	1 b 3 3 4 b 1 a 5 1 3 3 b a 4 a 3
Stylochaeton natalensis	1		+ + + + + + + + + +
Tragia dioica	+		1 + + + + + + +
Panicum deustum			a a 1 1 1 1 1
Cheilanthes viridis	1 +	+	+ + + + + a
Decorsea galpinii	1	+	+ 1 1 + +
Cheilanthes hastata		+	+ + + + +
Strychnos spinosa	+ r + 1	1 +	+ + 1 +
Urginea epigea	+	+	+ + 1 +
Ledebouria species			1 + + a
Heteropyxis natalensis	+		b 1 1 1
Adenia digitata		+	+ + + +
Sterculia murex			1 a 1 a
Diospyros lycioides	+ + + a		+ + +
Chaetacanthus burchellii	a 1 a	1 + a	+ + 1
Blepharis integrifolia	r	+	+ + +
Elaeodendron transvaalense	+		+ + r
Oropetium capense			+ + +
Setaria incrassata			+ a
Rhus leptodictya	1	r 1	1 1
Acacia burkei			a b
Andropogon schirensis			1 1

Kirkia wilmsii			1 b
Acacia robusta			1 1
Species Group E			
Maytenus heterophylla	+ 1 1 1 +	+ a 1 a + 1 + 1 1 + + 1 1 1	+ + + 1 + + 1 1 + 1 + + + 1 + + 1
Combretum apiculatum		+ + 1 1 b a 1 1 1	1 b a + a 1 a a + 1 a a 1 1 3 1
Hibiscus pusillus	r + +	+ + + + 1 + + + + + + + +	+ + + + + + + +
Combretum zeyheri	+	1 a 1 1 1 1 1	a a a a 1 1 1 1 1 1 a 1
Schmidtia pappophoroides		1 + b + + a b 1 1 + 1	a a 1 1 1
Brachiaria serrata	+	+ + + + + 1 + 1 1 + 1	+ 1 1 +
Eustachys paspaloides	1 1	1 1 + 1 +	1 1 1 b 1 1 1 1
Brachiaria nigropedata		+ + 1 1 + 1	1 a a 1 a 1 +
Acacia exuvialis		+ 1 1 + 1 + 1	+ 1 1 1 1
Microchloa caffra	+	+ + + + + + + +	+ + + +
Lannea discolor	1 1	+ 1 + 1	+ + + 1 a 1 1
Chascanum hederaceum		1 a a 1 + +	1 1 + +
Commiphora mollis	1	+ 1 +	+ + 1 + + r +
Jatropha schlechteri		1 + + + +	+ + + +
Thunbergia dregeana	+	+ +	+ 1 + + 1 + +
Gladiolus species		+ 1 1 + 1	r a +
Indigofera heterantha	+	+ a a + 1	a a 1
Indigofera bainesii		1 1 + 1 + 1 +	a
Chlorophytum galpinii		+ + + + +	r + 1
Acacia nigrescens	+	b + +	+ + 1 1 1
Senecio species	+ a 1	1	a + a a + +
Indigofera floribunda	+	1 1	+ + + + 1
Oxalis semiloba		1 + + +	+ 1 1
Cucumis hirsutus	+	+ 1 +	1 + +
Ruellia cordata		+ 1	+ + r +
Combretum hereroense		a 1 +	1 1 1
Acacia nilotica	+	1	1 1 + 1
Justicia protracta		+ + +	+ +
Kyllinga alba		1 1 1 +	a
Heliotropium strigosum		+ + +	a +

Species Group F

Species			
Dichrostachys cinerea	+ + 3 a b a a a 1 1 a a 1 1 + b a + 1 a 1 + 1	+ + 1 a 1 a a a a + + a 1 1 1 a a 1 + +	+ + + 1 1 1 1 + 1 1 1 1 + + 1 +
Panicum maximum	+ + + a + 1 + b b 1 b b 4 a 1 a a a 3 1 b	+ b 3 b 4 1 3 3 b 1 a 1 b a 3	+ 4 1 b b 1 a 1 a a a a 1 + 1 a 1 1
Sclerocarya birrea	1 + + + + + 1 1 1 b b a 1 1 1 1 a a a 1 1 1 b	+ 1 + 1 + 3 1 1 1 + + 1 a 1	+ 1 + + a 1 + + + 1 + r
Lantana rugosa	1 1 + 1 1 1 1 1 1 1 1 + +	+ 1 1 1 1 + + + 1 + + 1 + + +	+ 1 1 1 1 1 1 1 + 1 + 1 1 + + 1
Heteropogon contortus	a + + + + 1 a 1 1 1 1 1 1	1 + a 1 a + b 1 1 1 + 1 1 1 a 1 1	b 1 1 1 1 1 1 1 a 1 a
Diheteropogon amplectens	+ + + 1 1 1 1 1 1 1 1 a b 1 1	a 1 a a 1 1 a a a + 1	1 1 a 1 a 1 1 1 + 1 + a 1 1 1
Digitaria eriantha	+ 1 1 + 1 a 1 1	+ + a + 1 + + b a a 1 1 a 1 1 + b 1	1 a 1 a 1 1 1 1 a 1 1 b 1
Setaria sphacelata	+ + + + + 1 1 1 1 b 3 3 a a b	a b b a 4 a 1 b 3 3 b 3 a 1 b	3 + r a a b b a a
Agathisanthemum bojeri	+ + + + + 1 + 1 1 a a a a 1 a 1 1 1 1	+ 1 a + 1 1 1 a 1 1 + 1	+ 1 1 a 1 1 1
Helichrysum nudifolium	1 1 1 1 1 1 1 1 1 1 1 1 1 +	+ + 1 1 + + + + 1 +	+ + + 1 + 1 1 1 + + + + +
Teramnus labialis	+ + + + a 1 1 + + +	+ + + 1 1 1 1 + + + +	1 + + + + + +
Melinis repens	+ + 1 1 + + 1 + + 1 + + +	+ + 1 + 1 + +	1 + 1 1 1 + 1 1
Chamaecrista mimosoides	+ + + r + +	1 + 1 + 1 + 1 + + + + 1 + 1 +	+ 1 + + + + +
Elionurus muticus	3 + b b 1 1 a + + 1 a 1	a 1 a a a + + b	a b a 1 a + a
Melhania didyma	1 1 1 1 1 + +	+ + 1 1 1 + + 1 +	+ 1 + 1 + +
Ipomoea crassipes	1 + 1	+ + + 1 1 1 r 1	1 1 + 1 1 1 1 1 + 1 +
Eragrostis superba	+ 1 +	+ + 1 1 1 1 1 + + + +	1 1 1 + + + +
Commelina africana	+ + + 1 1 + + + +	+ + +	+ 1 1 1 1 + + + +
Ziziphus mucronata	+ + 1 1 + +	+ 1 1	+ + + + + + 1 + 1 1 + 1
Dombeya rotundifolia	+ + + a 1	a + 1 1	+ 1 a 1 + a 1 1 + 1 1 +
Peltophorum africanum	+ + + + 1 1 +	a 1 1 1	1 + + a + + a 1 + +
Kohautia virgata	1 + 1 1 1 a 1 + +	1 + 1 + 1 1 1	1 + + 1
Sphedamnocarpus pruriens	+ + 1 +	+ + 1 + + +	+ 1 1 1 + + + + +
Lonchocarpus capassa	+ + + + + 1 +	+ + 1 + 1 1 +	1 + + + +
Thesium gracilarioides	1 a 1 1 +	1 a + + + + +	1 1 1 1 + a
Xenostegia tridentata subsp. angustifolia	+ + 1 1 1 1 + + + + +	+ + + + + +	+
Eragrostis rigidior	+ + + 1	b a 1 + 1 1 1 1 1 1 +	1 1 +
Acalypha villicaulis	+ 1 1 1	1 1 + + 1 + 1 +	+ 1 1 1 1
Acacia gerrardii	r 1 +	+ 1 + 1 1 1 +	1 + + 1 1 1 1
Tricliceras schinzii	+ + r r	+ + + + r r +	+ + + + +
Tephrosia polystachya	+ + 1 1 + + +	+ + + a a +	+ 1 +
Vigna unguiculata	1 1 1 r +	+ + + + 1	+ + + + 1
Raphionacme procumbens	+ + +	+ + + + 1 +	r + 1 1 + +
Polygala sphenoptera	1 1 1 + +	1 + 1 a +	1 1 + + +
Vernonia oligocephala	1 1 1 a 1 1	1 +	+ + a + + +

Rhoicissus tridentata			+	+						+			1		1		+	1					
Mundulea sericea								+		1				1								+	
Crabbea hirsuta									+	+							+						
Ozoroa insignis				+								1										+	
Ximenia caffra		+	+					+				+		+							+		
Aristida congesta subsp. barbicollis				+						+				1		+				+			1
Combretum molle	+		+	b								1											
Sporobolus stapfianus															+	1	1	+			+		a
Sida dregei															+			+					
Commelina livingstonii													+		+								
Ipomoea obscura var. *obscura*															+		1		1				
Mariscus rehmannianus									+					1	+			+	+				
Diospyros mespiliformis		+					+			+				+		1							
Kanahia laniflora									r		+												
Solanum incanum			+	+					+						+								
Grewia monticola			+	+					1														
Ochna natalitia					+								a									1	
Rhynchosia totta									r								+	+					
Seddera suffruticosa									+							r				r			
Fimbristylis species									1												+	+	
Sporobolus sanguineus											a				1		1						
Cymbopogon excavatus	+										a						+						
Commelina ecklonia																+							
Abrus precatorius																	+	1	1				

Rhoicissus tridentata					1															+
Mundulea sericea							1	1												1
Crabbea hirsuta			+		+					1	1					+				
Ozoroa insignis			+			+	+				+		+	+						
Ximenia caffra													1				+			
Aristida congesta subsp. barbicollis	+									1										
Combretum molle			+			+									1					
Sporobolus stapfianus														1			+			
Sida dregei										+						+				
Commelina livingstonii				+										1	+			+		
Ipomoea obscura var. *obscura*					+				+					+						
Mariscus rehmannianus													+				+	+	+	
Diospyros mespiliformis			r		+											1				
Kanahia laniflora					+							+	r		+					+
Solanum incanum	+										+									
Grewia monticola					1						+					+				
Ochna natalitia																+				
Rhynchosia totta				+						1										
Seddera suffruticosa				+		+			+											
Fimbristylis species							+											+		
Sporobolus sanguineus									+				a							
Cymbopogon excavatus																				+
Commelina ecklonia			+	+									+							
Abrus precatorius																				

Rhoicissus tridentata				+			1			1				a				+	
Mundulea sericea			1	1									+	1		1			1
Crabbea hirsuta	+	+				+	+					+							
Ozoroa insignis					1					+				1					
Ximenia caffra						+				+						1			1
Aristida congesta subsp. barbicollis			1	1													+	+	
Combretum molle			1	1		1	+				1								
Sporobolus stapfianus								1					+	1					
Sida dregei		+	+	+			+				+		+		+				
Commelina livingstonii									a				+	+		+	+		
Ipomoea obscura var. *obscura*				+		+				+	+							+	
Mariscus rehmannianus																	+	+	
Diospyros mespiliformis											1		+						
Kanahia laniflora								+						+					
Solanum incanum			+	+										+					
Grewia monticola									+			1							
Ochna natalitia								+			+					+			1
Rhynchosia totta									+	+								+	
Seddera suffruticosa				+		r													
Fimbristylis species		1															1		
Sporobolus sanguineus								a											
Cymbopogon excavatus				1					1										
Commelina ecklonia	1				+														
Abrus precatorius			+								+								

4. *Combretum zeyheri – Combretum apiculatum* community on deep gravely soils

Figure 13 *Combretum zeyheri – Combretum apiculatum* community on deep gravelly soils. (Photo: Synbiosys KNP)

Geomorphology

The *Combretum zeyheri – Combretum apiculatum* community on deep gravely soils (Figure 13) is mainly underlain by granite/gneiss. The granite/gneiss is deeply weathered - resulting in an undulating landscape. Additionally, some of the sample points occur on the rhyolitic Lebombo Mountains. Altitudes range from nearly 200 to 500 metres a.s.l.

Climate

Rainfall ranges from 600 to 650 mm per year (Gertenbach 1980).

Soil

The crests of the undulating granites have coarse textured soils (Figure 14), which are sandy loam soils and contain 10 to 15% clay. The soils are of the Hutton and Glenrosa Soil Forms.

Figure 14 Sandy loam soils of the *Combretum zeyheri – Combretum apiculatum* community on deep gravelly soils. (Photo: Liesl Mostert)

Vegetation

Dataset 1: 68 relevés; dataset 2: 26 relevés.

The *Combretum zeyheri – Combretum apiculatum* community on deep gravelly soils is best represented by the uplands of the Mixed *Combretum* species / *Terminalia sericea* Woodland Landscape (5) (Gertenbach 1983); and is comparable to Coetzee's (1983) *Combretum zeyheri – Pterocarpus rotundifolius – Terminalia sericea* – dominated treeveld and brushveld of the Tropical Semi-arid Granitic Lowveld. Previous descriptions of the vegetation fall under the following names: *Combretum apiculatum – C. zeyheri* association (Van der Schijff 1957), Mixed *Combretum* Savanna Woodland (Pienaar 1963), Red bush-willow veld on Granite undulations

(Van Wyk 1972), Mixed Lowveld Bushveld (Low & Rebelo 1998) and Lowveld (Acocks 1975).

The structure of this broad-leaved community is densely shrubby to brushy, sparse treeveld. The dominant shrubs are *Combretum apiculatum* and *C. zeyheri*. These tall shrubs may reach 5 m in height. The grass layer is generally unpalatable with grass species such as *Eragrostis rigidior*, *Heteropogon contortus*, *Melinis repens*, *Digitaria eriantha*, *Aristida congesta*, *Schmidtia pappophoroides* and *Tricholaena monachne* present. This community is subjected to light to medium grazing pressure and provide essential winter grazing for the migrating herbivore species. Termitaria are scattered throughout this community.

Diagnostic species

The diagnostic species for this community can be viewed in species group A (Table 5). The diagnostic woody plants include: *Combretum zeyheri*, *Pterocarpus rotundifolius*, *Strychnos madagascariensis*, *Grewia flava*, *Mundulea sericea*, *Terminalia sericea*, *Combretum collinum*. Even though *P. rotundifolius* appears as a diagnostic species for this community in this table, this species should be seen as a weak diagnostic species compared to its absolute dominance in the *Themeda triandra–Pterocarpus rotundifolius* community. No diagnostic grasses were recorded. The diagnostic forbs include: *Commelina erecta*, *Chamaecrista mimosoides*, *Tephrosia* species, *Ocimum americanum* var. *americanum*.

Dominant / prominent species

The dominant woody plants are: *Combretum apiculatum* (Species Group F), *Dalbergia melanoxylon* (Species Group J), *Acacia exuvialis*, *Grewia monticola* (Species Group M), *Dichrostachys cinerea*, *Sclerocarya birrea*, *Ziziphus mucronata*, *Philenoptera violacea*, *Peltophorum africanum* (Species Group P). The dominant grasses are: *Tricholaena monachne*, *Trichoneura grandiglumis*, *Perotis patens* (Species Group C), *Schmidtia pappophoroides*, *Melinis repens* (Species Group F), *Enneapogon cenchroides*, *Aristida congesta* subspecies *congesta* (Species Group J), *Panicum maximum*, *Digitaria eriantha*, *Heteropogon contortus*, *Eragrostis rigidior*, *Pogonarthria squarrosa* (Species Group P). The dominant forbs are: *Melhania prostrata*, *Rhynchosia totta*, *Ceratotheca triloba*, *Stylochaeton natalensis*, *Cissus* *cornifolia* (Species Group C), *Sphedamnocarpus pruriens* (Species Group F), *Hibiscus micranthus* (Species Group J), *Evolvulus alsinoides* (Species Group M), *Lantana rugosa*, *Solanum panduriforme*, *Commelina africana*, *Ipomoea crassipes*, *Agathisanthemum bojeri* (Species Group P).

5. *Grewia bicolor – Combretum apiculatum* community on shallow gravely soils

Figure 15 *Grewia bicolor – Combretum apiculatum* community on shallow gravely soils. (Photo: Liesl Mostert)

Geomorphology

The majority of the sample points of the *Grewia bicolor – Combretum apiculatum* community on shallow gravely soils (Figure 15) are limited to granite/gneiss, with the exception occurring on the rhyolitic Lebombo Mountains. This community is mainly associated with the convex slopes of the granitic uplands with altitudes ranging from 200 to nearly 400 metres a.s.l.

Climate

The rainfall ranges between 600 and 650 mm per year (Gertenbach 1980).

Soil

The coarse textured, gravely soils (Figure 16) are well-drained, shallow and stony with 15 to 20% clay content. These shallow soils are of the Mispah and Glenrosa Soil Forms.

Figure 16 The loamy sand soils of the *Grewia bicolor – Combretum apiculatum* community on shallow gravelly soils are coarse textured. (Photo: Liesl Mostert)

Vegetation

Dataset 1: 46 relevés; dataset 2: 10 relevés.

The *Grewia bicolor – Combretum apiculatum* community on shallow gravely soils is best represented by the uplands of the Thickets of the Sabie and Crocodile Rivers Landscape (4) (Gertenbach 1983); and is comparable to Coetzee's (1983) *Combretum apiculatum* dominated treeveld and brushveld of the Tropical Semi-arid Granitic Lowveld. The field layer is comparable to some of the other rugged KNP Landscapes described by Gertenbach (1983). These rugged Landscapes are arid, with low water retention capabilities and little potential for biomass production. This can be ascribed to the relatively low rainfall enhanced by shallow soils and steep slopes, which increase drainage (Gertenbach 1983).

The structure of the *Grewia bicolor – Combretum apiculatum* community on shallow gravely soils is moderately to densely brushy treeveld where the shrub and tree layers cannot be distinguished from each other. The dominant shrubs are *Combretum apiculatum*, *Grewia bicolor* and *Acacia exuvialis*. This community is prone to regular water shortage, as can be seen in the long-lived drought-resistant species, which dominate the woody layer, and the annual species that make up most of the field layer. It should be emphasised that this community is a typical savanna community: the grass layer is extremely dynamic, whereas the tree and shrub layers are relatively static. This community's field layer is extremely susceptible to change in available moisture. Dynamic and unstable field layers are typical of event-driven systems (Bredenkamp *et al. in prep*, Westoby 1979, DeAngelis & Waterhouse 1987, Westoby *et al.* 1989, Mentis *et al.* 1989, Laycock 1991). This community is subjected to low grazing pressure due to its low biomass production and the generally unpalatability of the sour field layer. *Microchloa caffra*, *Tricholaena monachne*, *Perotis patens*, *Melinis repens*, *Enneapogon cenchroides*, *Digitaria eriantha*, *Aristida congesta* and *Trichoneura grandiglumis* are some of the wiry grass species frequently found in this community. Termitaria are scattered throughout this community.

Diagnostic species

The diagnostic species for this community can be viewed in species group B (Table 5). There is a clear distinction between relevés of the first dataset and relevés of the second dataset. This separation can be explained by looking closely at the species. Notice that mostly herbs occur in the second dataset. This is probably due to seasonal differences (i.e. a wet season vs. a dry season). In event-driven systems, when little rain is received, the herbaceous layer is negatively affected. The diagnostic species of this community are weak species with low cover abundance values. The diagnostic woody plants include: *Dyschoriste rogersii*. The diagnostic grasses include: *Microchloa caffra*, *Cymbopogon plurinodis*, *Sporobolus fimbriatus*, *Oropetium capense*. The diagnostic forbs include: *Cyperus rupestris*, *Hermannia modesta*, *Mariscus rehmannianus*, *Mariscus dregeanus*, *Commelina livingstonii*, *Corchorus asplenifolius*, *Chamaesyce neopolycnemoides*, *Aptosimum lineare*, *Leucas neuflizeana*.

Dominant / prominent species

The dominant woody plants are: *Combretum apiculatum* (Species Group F), *Grewia hexamita* (Species Group I), *Grewia bicolor, Acacia exuvialis* (Species Group M), *Dichrostachys cinerea*, *Acacia nigrescens*, *Grewia flavescens* (Species Group P). The following grasses can be regarded as prominent grass species: *Schmidtia pappophoroides*, *Melinis repens* (Species Group F), *Enneapogon cenchroides*, *Aristida congesta* subspecies *congesta* (Species Group J), *Panicum maximum*, *Digitaria eriantha*, *Aristida congesta* subspecies *barbicollis*, *Pogonarthria squarrosa* (Species Group P). Other grass species include: *Tricholaena monachne*, *Trichoneura grandiglumis*, *Perotis patens* (Species Group C), *Chloris virgata* (Species Group I), *Eragrostis superba* (Species Group M), *Eragrostis rigidior* (Species Group P). The following forbs are present, however, they are not regarded as dominant species: *Melhania prostrata*, *Rhynchosia totta*, *Ceratotheca triloba*, *Stylochaeton natalensis*, *Cissus cornifolia* (Species Group C), *Lippia javanica*, *Cyperus angolensis* (Species Group E), *Hermbstaedtia odorata* (Species Group F), *Ruellia patula* (Species Group I), *Hibiscus micranthus* (Species Group J), *Abutilon austro-africanum*, *Evolvulus alsinoides*, *Heliotropium strigosum* (Species Group M), *Lantana rugosa, Solanum panduriforme*, *Commelina africana*, *Justicia flava*, *Tephrosia polystachya*, *Agathisanthemum bojeri*, *Tragia dioica*, *Melhania didyma*, *Kohautia virgata*, *Indigofera floribunda*, *Acalypha indica*, *Thunbergia dregeana*, *Polygala sphenoptera*, *Blepharis integrifolia* (Species Group P).

6. *Sclerocarya birrea – Acacia nigrescens* treeveld community on granite

Figure 17 *Sclerocarya birrea – Acacia nigrescens* treeveld community on granite. (Photo: Synbiosys KNP)

The floristic composition of communities 6 and 7 are similar in the sense that the dominant species in these two communities are the same. However, structurally there is a huge difference between these two communities. The *Sclerocarya birrea – Acacia nigrescens* treeveld community on granite (Figure 17) is made up of tall trees and a fairly dense grass layer. Shrubs play an inferior role. While, the *Sclerocarya birrea – Acacia nigrescens* shrubveld community on basalt (Figure 19) can be described as a dense grass-dominated savanna, where the majority of trees are dwarfed and struggle to get out of the firetrap.

Geomorphology

The underlying material of the *Sclerocarya birrea – Acacia nigrescens* treeveld community on granite (Figure 17) is moderately weathered granite/gneiss resulting in an undulating landscape. Altitudes range from 250 to 400 metres a.s.l.

Climate

Rainfall ranges from 600 to 650 mm per year (Gertenbach 1980).

Soil

These non-duplex bottomland soils (Figure 18) with sandy clay loam contain 20 to 35% clay. The soils predominantly consist of the Sterkspruit and Valsrivier Soil Forms.

Figure 18 The sandy clay loam soils of the *Sclerocarya birrea – Acacia nigrescens* treeveld community on granite. (Photo: Liesl Mostert)

Vegetation

Dataset 1: 18 relevés; dataset 2: 10 relevés.

The *Sclerocarya birrea – Acacia nigrescens* treeveld community on granite is best represented by the bottomlands of the Mixed *Combretum* species / *Terminalia sericea* Woodland Landscape (5) (Gertenbach 1983), more specifically the *Acacia gerrardii* / *Acacia nigrescens* / *Combretum apiculatum*–sub–association (Gertenbach 1987); and is comparable to Coetzee's (1983) *Pterocarpus rotundifolius – Combretum hereroense – Peltophorum africanum – Bolusanthus speciosus – Maytenus* *heterophylla – Acacia nigrescens – A. gerrardii – Sclerocarya caffra* – dominated brushveld and treeveld of the Tropical Semi-arid Granitic Lowveld.

This community has well-defined strata within the vegetation: a clear distinction exists between the tree, shrub and field layer. The structure of this community may be described as moderately shrubby, moderately brushy, moderate treeveld. The dominant trees, namely *Acacia nigrescens* and *Sclerocarya birrea*, reach heights of 10 m and 8 m respectively. Dominant shrubs are *Grewia* species, *Combretum hereroense* and *Euclea divinorum*. The field layer consists of a mosaic of locally dominant grass patches, particularly *Themeda triandra*, *Heteropogon contortus*, *Eragrostis rigidior* and *Panicum maximum*. Grazing pressure in this community is moderate to high. This community undergoes physiological stress from lack of water for large periods of the year due to the high water-retention capabilities of the clayey soils. The high clay content of the soil is a result of the accumulation of fine soil particles leached from the crests of the surrounding landscape into the bottomlands.

Diagnostic species

The diagnostic species for this community can be viewed in Species Group D (Table 5). The diagnostic woody plants include: *Abutilon fruticosum*. The diagnostic grasses include: *Sporobolus nitens*. The diagnostic forbs include: *Seddera suffruticosa*, *Geigeria ornativa*, *Achyropsis leptostachya*, *Corbichonia decumbens*.

Dominant / prominent species

The dominant woody plants are: *Grewia hexamita* (Species Group I), *Grewia bicolor* (Species Group J), *Acacia gerrardii* (Species Group L), *Combretum hereroense*, *Flueggea virosa*, *Euclea divinorum* (Species Group O), *Dichrostachys cinerea*, *Acacia nigrescens*, *Sclerocarya birrea*, *Ziziphus mucronata*, *Grewia flavescens*, *Gymnosporia senegalensis*, *Peltophorum africanum*, *Diospyros mespiliformis*, *Acacia nilotica* (Species Group P). Despite the relatively high cover abundance value in localized patches, *Combretum apiculatum* (Species Group F) occurs generally as a sparse shrub with low cover-abundance values and cannot be seen as a prominent species in this community. The dominant grasses are: *Schmidtia pappophoroides, Melinis repens* (Species Group F), *Bothriochloa insculpta* (Species Group H), *Aristida congesta* subspecies *congesta* (Species Group J), *Panicum coloratum*

(Species Group L), *Eragrostis superba* (Species Group M), *Themeda triandra* (Species Group O), *Panicum maximum*, *Digitaria eriantha*, *Aristida congesta* subspecies *barbicollis*, *Heteropogon contortus*, *Urochloa mosambicensis*, *Eragrostis rigidior* (Species Group P). Herbaceous species within the field layer of this community are generally inconspicuous compared to the prominent grass layer. The following forbs are present: *Lippia javanica*, *Cyperus angolensis* (Species Group E), *Hermbstaedtia odorata, Sphedamnocarpus pruriens, Chascanum hederaceum* (Species Group F), *Becium filamentosum* (Species Group H), *Hibiscus micranthus* (Species Group J), *Abutilon austro-africanum*, (Species Group M), *Ocimum gratissimum* (Species Group O), *Lantana rugosa*, *Solanum panduriforme*, *Commelina africana*, *Ipomoea crassipes*, *Justicia flava*, *Tephrosia polystachya*, *Tragia dioica*, *Melhania didyma*, *Hibiscus pusillus*, *Indigofera floribunda*, *Acalypha indica*, *Ipomoea obscura* var. *obscura*, *Thunbergia dregeana* (Species Group P)

7. *Sclerocarya birrea – Acacia nigrescens* shrubveld community on basalt

Figure 19 *Sclerocarya birrea – Acacia nigrescens* shrubveld community on basalt (Photo Liesl Mostert)

Geomorphology

Basalt is the underlying material in this community. Altitudes range from 200 to 250 metres a.s.l.

Climate

Rainfall ranges from 600 to 650 mm per year (Gertenbach 1980).

Soil

The soils associated with the *Sclerocarya birrea – Acacia nigrescens* shrubveld community on basalt (Figure 19) are red, black or brown and clayey with more than 55% clay content (Figure 20). The dominant soil Forms are: Shortlands, Swartland, Mayo, Milkwood and Glenrosa.

Figure 20 The clay soils of the *Sclerocarya birrea – Acacia nigrescens* shrubveld community on basalt. (Photo: Liesl Mostert)

Vegetation

Dataset 1: 17 relevés; dataset 2: 6 relevés.

The *Sclerocarya birrea – Acacia nigrescens* shrubveld community on basalt is best represented by the *Sclerocarya birrea / Acacia nigrescens* savanna Landscape (17)

(Gertenbach 1983); and is comparable to Coetzee's (1983) *Sclerocarya caffra – Acacia nigrescens – Themeda triandra – Bothriochloa radicans* dominated treeveld of the Non-Vertic Tropical Semi-arid Basaltic Lowveld. Previous descriptions of the vegetation fall under the following names: Open Knobthorn-Marula-bushveld (Codd 1951), typical *Acacia nigrescens – Sclerocarya caffra* association (Van der Schijff 1957), *Acacia nigrescens – Sclerocarya birrea* tree savanna (Pienaar 1963), Knobthorn / marula veld (Van Wyk 1972), and *Acacia nigrescens – Sclerocarya birrea* moderate tree savanna (Gertenbach 1987).

The vegetation of this community can be described as a grass-dominated savanna, with a dense field layer. The structure ranges from sparse shrubveld to dense thicket, as conditions change. The vegetation of this habitat may also be regarded as a relatively stable pyrophylous climax community (Pienaar 1963). This community is completely dominated by the grass layer where trees are dwarfed and struggle to get out of the firetrap. *Sclerocarya birrea*, *Philenoptera violacea* and *Grewia villosa* usually occur as dwarfed shrubs and hardly ever escape the firetrap, whereas *Acacia nigrescens* occasionally escapes the firetrap. The structure may change quite drastically as grazing pressure increases, as can be seen in the dense impenetrable thickets of *Dichrostachys cinerea* on historically trampled and overgrazed areas (Coetzee 1983). The field layer consists of a mosaic of grass patches dominated by single species. Hence the dominant grass species are very localized. What makes this community unique is the absolute dominance of widely distributed species, particularly species such as *Urochloa mosambicensis*, which has cover abundance values of up to 50 percent per sample plot. The grazing is inherently sweet veld, but has become progressively infested by the unpalatable *Bothriochloa insculpta*, which is now dominant over large parts of this community (Pienaar 1963).

This community bears testimony to the complex interaction of plant available moisture, plant available nutrients, fire, herbivory and rainfall (Skarpe 1992, Bredenkamp *et al. in prep*) shaping southern African savannas.

Diagnostic species

The diagnostic species for this community can be viewed in Species Group G (Table 5). The diagnostic woody plants include: *Rhus gerrardii*, *Gossypium herbaceum*. The diagnostic grasses include: *Cenchrus ciliaris*. The diagnostic forbs include: *Barleria spinulosa*, *Asystasia subbiflora*, *Gomphrena celosioides*.

Dominant / prominent species

The dominant woody plants are: *Grewia villosa* (Species Group H), *Grewia hexamita* (Species Group I), *Grewia bicolor* (Species Group J), *Combretum hereroense*, *Bolusanthus speciosus*, *Combretum imberbe*, *Flueggea virosa* (Species Group O), *Dichrostachys cinerea*, *Acacia nigrescens*, *Sclerocarya birrea*, *Philenoptera violacea*, *Gymnosporia senegalensis*, *Ehretia rigida* (Species Group P). The locally dominant grasses are: *Bothriochloa insculpta* (Species Group H), *Chloris virgata* (Species Group I), *Enneapogon cenchroides* (Species Group J), *Eragrostis superba* (Species Group M), *Themeda triandra* (Species Group O), *Panicum maximum*, *Digitaria eriantha*, *Aristida congesta* subspecies *barbicollis*, *Urochloa mosambicensis* (Species Group P). The dominant forbs are: *Sida rhombifolia* (Species Group L), *Heliotropium strigosum* (Species Group M), *Lantana rugosa*, *Solanum panduriforme*, *Ipomoea crassipes*, *Justicia flava*, *Tephrosia polystachya*, *Tragia dioica*, *Ipomoea obscura* var. *obscura* (Species Group P).

8. *Setaria sphacelata – Themeda triandra* closed grassland community on gabbro

Figure 21 *Setaria sphacelata – Themeda triandra* closed grassland community on gabbro. (Photo: Liesl Mostert)

Geomorphology

Gabbro is the underlying material of the *Setaria sphacelata – Themeda triandra* closed grassland community on gabbro (Figure 21). The gabbro intrusions are generally higher in altitude than the surrounding granite. Altitudes range from 350 to 550 metres a.s.l.

Climate

Rainfall ranges from 600 to 700 mm per year (Gertenbach 1980).

Soil

The soils that develop from gabbro are usually dark in colour and clayey (Figure 22). These soils have a clay content that is greater than 55%. Some of these clay soils have strong swell and shrink properties - the soils swell when wetted and shrink with cracking when dried (MacVicar *et al*. 1991). The clay soils of this community predominantly consist of the Mayo, Bonheim and Arcadia Soil Forms.

Figure 22 The clay soils of the *Setaria sphacelata – Themeda triandra* closed grassland community on gabbro. (Photo: Liesl Mostert)

Vegetation

Dataset 1: 6 relevés; dataset 2: 9 relevés.

The *Setaria sphacelata – Themeda triandra* closed grassland community on gabbro is best represented by the Thornveld on Gabbro Landscape (19) (Gertenbach 1983); and is comparable to Coetzee's (1983) *Acacia nigrescens* – various species – *Themeda triandra* – dominated shrubby, brushy, treeveld of the Tropical Semi-arid Doloritic Lowveld. Bredenkamp (1982) described a relatively similar vegetation type, namely *Themeda triandra – Setaria woodii* association on wet vertic soils of the Gabbro geological formation of the Manyeleti Game Reserve. The gabbro intrusions occur in narrow strips throughout the park, however, the rainfall in the southern district is generally higher than the rest of the park, hence the community on gabbro is somewhat different to those described by Gertenbach (1978), Gertenbach (1987), Coetzee (1983) and Bredenkamp (1982).

This open savanna has a dense grass cover. Trees are usually absent, scattered or present as a sparse layer. Overall, the majority of the dwarfed trees are caught in the firetrap and reduced to coppicing shrubs (Higgins *et al*. 2000). Another reason for the dwarfed trees relates to the root-pruning effect of the expanding and shrinking vertic soils. This community is subjected to light to heavy grazing and is particularly important for game that prefers open plains. Gertenbach (1978) described similar grass dominated savannas associated with the gabbro intrusions of the central district. The communities in the central district as well as the southern district have a high production of palatable grazing and have the potential to support large numbers of grazers.

Diagnostic species

The diagnostic species for this community can be viewed in Species Group K (Table 5). There are no diagnostic woody plants in this community. The diagnostic grasses include: *Setaria sphacelata*. The diagnostic forbs include: *Rhynchosia minima*, *Vernonia oligocephala*, *Litogyne gariepina*.

Dominant / prominent species

The woody plants are: *Acacia gerrardii* (Species Group L), *Combretum hereroense*, *Euclea divinorum* (Species Group O), *Dichrostachys cinerea*, *Acacia nigrescens*, *Sclerocarya birrea*, *Ziziphus mucronata*, *Gymnosporia senegalensis*, *Ormocarpum trichocarpum*, *Gymnosporia cf. glaucophylla* (Species Group P). The dominant grasses are: *Eragrostis superba* (Species Group M), *Themeda triandra* (Species Group O), *Panicum maximum*, *Digitaria eriantha*, *Heteropogon contortus*, *Urochloa mosambicensis* (Species Group P). The dominant forbs are: *Abutilon austro-africanum*, *Evolvulus alsinoides* (Species Group M), *Lantana rugosa*, *Tephrosia polystachya*, *Agathisanthemum bojeri*, *Hibiscus pusillus*, *Kohautia virgata* (Species Group P).

9. Malelane–Lebombo mountain bushveld

Figure 23 Lebombo mountain vegetation. (Photo: Synbiosys KNP)

Geomorphology

The geomorphological description is taken from Gertenbach (1983): In the south-western corner of the southern district, granite and rock formations of the Swaziland System form the underlying material of this community, and on the eastern side of the southern district the geological formation is rhyolite and granophyre of the Lebombo Group (Figure 23). Altitudes range from 350 to 800 metres a.s.l. in the southwestern corner (Malelane mountain complex) and 250 to 360 metres a.s.l. on the eastern side of the southern district (Lebombo Mountain).

Climate

Rainfall ranges from 600 to 700 mm per year (Gertenbach 1980).

Soil

The soils associated with this community are shallow and rocky and can be described as lithosols. The dominant Soil Forms are Mispah and Glenrosa.

Vegetation

Dataset 1: 6 relevés; dataset 2: 0 relevés.

This community is represented by the Malelane Mountain Bushveld Landscape (2) and the Lebombo South Landscape (29) (Gertenbach 1983); Van Wyk (1972) described the vegetation as Mixed montane vegetation and Mixed Red bush-willow veld respectively.

This is an azonal community associated with sheltered ravines and slopes of the Lebombo Mountain and the mountainous areas in the Malelane region. The vegetation is very heterogeneous due to the complex topography. This forms a complex mosaic of microclimates and plant communities, which are associated with a wide variety of plants communities dominated by woody species. Many of these woody species are shared with the rocky outcrops as well as riverine areas in the KNP. These phenomenons, where species are shared between rocky outcrops and riverine areas, have been described by several authors (Van der Schijff 1957, Van Wyk 1972, Bredenkamp 1982, Coetzee 1983, Gertenbach 1983, Bredenkamp & Deutschländer 1995, Du Plessis 2001).

Prominent species

Due to the heterogeny and complexity of this cluster of plant communities, no distinction was made between diagnostic and dominant species. The prominent species for this community can be viewed in Species Group N (Table 5). The woody plants include: *Ochna natalitia*, *Euclea schimperi*, *Zanthoxylum capense*, *Elaeodendron transvaalense*, *Olea europaea* subspecies *africana*, *Rhoicissus tridentata*, *Hippobromus pauciflorus*, *Gymnosporia tenuispina*, *Mystroxylon aethiopica*, *Dovyalis caffra*, *Spirostachys africana*, *Asparagus minutiflorus*, *Rhus pyroides*, *Pappea capensis*, *Heteropyxis natalensis*, *Asparagus buchananii*, *Maerua juncea*, *Maytenus undata*, *Schotia capitata*, *Rhus pentheri*, *Schotia brachypetala*, *Pterocarpus angolensis*, *Rhus leptodictya*, *Trichilia emetica*, *Teclea pilosa*, *Senecio pleistocephalus*, *Erythrina humeana*, *Acokanthera oppositifolia*, *Vitex* species, *Englerophytum magalismontanum*, *Cussonia spicata*, *Trema orientalis*, *Sterculia murex*, *Galactia tenuiflora*, *Adenia hastata*, *Euphorbia ingens*, *Croton sylvaticus*, *Dalbergia armata*, *Kraussia* species, *Acacia ataxacantha*, *Flacourtia indica*, *Ficus abutilifolia*, *Commiphora neglecta*, *Schrebera alata*, *Bauhinia galpinii*, *Senna* *petersiana*, *Commiphora* species, *Phyllanthus reticulatus*, *Combretum microphyllum*, *Sideroxylon inerme*, *Terminalia phanerophlebia*, *Acalypha villicaulis*, *Acacia robusta* (Species Group N), *Combretum hereroense*, *Bolusanthus speciosus*, *Combretum imberbe*, *Flueggea virosa*, *Euclea divinorum* (Species Group O), *Dichrostachys cinerea*, *Acacia nigrescens*, *Sclerocarya birrea*, *Ziziphus mucronata*, *Philenoptera violacea*, *Grewia flavescens*, *Gymnosporia senegalensis*, *Peltophorum africanum*, *Ormocarpum trichocarpum*, *Gymnosporia* cf. *glaucophylla*, *Diospyros mespiliformis*, *Ehretia rigida*, *Polygala sphenoptera*, *Acacia nilotica*, *Dombeya rotundifolia* (Species Group P).

The grasses include: *Panicum deustum*, *Elionurus muticus*, *Setaria* species, *Eragrostis heteromera*, *Andropogon gayanus*, *Setaria megaphylla*, *Phragmites australis* (Species Group N), *Themeda triandra* (Species Group O), *Panicum maximum*, *Digitaria eriantha*, *Aristida congesta* subspecies *barbicollis*, *Heteropogon contortus*, *Urochloa mosambicensis*, *Eragrostis rigidior*, *Pogonarthria squarrosa* (Species Group P).

The forbs include: *Rhynchosia caribaea*, *Sarcostemma viminale*, *Cyphostemma simulans*, *Orthosiphon suffrutescens*, *Sansevieria hyacinthoides*, *Drimiopsis maxima*, *Plectranthus tetensis*, *Helichrysum athrixiifolium*, *Barleria elegans*, *Cotyledon barbeyi*, *Jasminum fluminense*, *Oxalis semiloba*, *Gladiolus* species, *Crassula vaginata*, *Schoenoxiphium sparteum*, *Indigofera swaziensis*, *Cyperus* species, *Cryptolepis obtusa*, *Abrus precatorius*, *Hibiscus lunarifolius*, *Gnidia capitata*, *Senecio* species, *Dioscorea cotinifolia*, *Barleria obtusa*, *Decorsea galpinii*, *Cheilanthes hastata*, *Kalanchoe* species, *Crassula expansa*, *Kedrostis foetidissima*, *Hibiscus* species, *Priva cordifolia*, *Dolichos trilobus* (Species Group N), *Ocimum gratissimum* (Species Group O), *Lantana rugosa*, *Solanum panduriforme*, *Commelina africana*, *Ipomoea crassipes*, *Justicia flava*, *Tephrosia polystachya*, *Agathisanthemum bojeri*, *Tragia dioica*, *Melhania didyma*, *Hibiscus pusillus*, *Kohautia virgata*, *Indigofera floribunda*, *Acalypha indica*, *Ipomoea obscura* var. *obscura*, *Thunbergia dregeana*, *Solanum incanum*, *Ledebouria* species, *Blepharis integrifolia* (Species Group P).

Table 5 Phytosociological table of the southern district of the KNP (part 2)

Association number	4													
Relevé number											1	1	1	1
									1	1	2	2	3	3
		1	2	2	3	3	3	5	2	2	3	9	1	2
	2	6	0	5	3	5	6	5	4	5	3	0	8	0
Species Group A														
Diagnostic species of the *Combretum zeyheri - Combretum apiculatum* community on deep gravely soils														
Combretum zeyheri	1	1	a	+	+	1	1	a	1	a	1	1	a	a
Pterocarpus rotundifolius	+	+		+	+			r		+	1	1	1	1
Commelina erecta	+	+	+	+	+	+	+			+				
Chamaecrista mimosoides	+							+	+	+		+	+	+
Strychnos madagascariensis		+	+					+	+	+				
Grewia flava	+		+			a	1							
Tephrosia species	+	+	+			+								
Ocimum americanum	+			+		+	+							
Mundulea sericea				+	+								1	
Combretum collinum			+					+						
Terminalia sericea	1	a	+					1	a	1				1
Species Group B														
Diagnostic species of the *Grewia bicolor - Combretum apiculatum* communtiy on shallow gravely soils														
Cyperus rupestris														
Hermannia modesta												+		
Mariscus rehmannianus												+	+	
Microchloa caffra												+		+
Mariscus dregeanus														
Commelina livingstonii											1			1
Cymbopogon plurinodis														
Corchorus asplenifolius				+										
Sporobolus fimbriatus				+			1							
Chamaesyce neopolycnemoides														
Dyschoriste rogersii														
Aptosimum lineare		+												
Oropetium capense														
Leucas neuflizeana														

Association number	5													
Relevé number								1	1	1	1	1	1	1
					1	1	1	0	3	3	3	3	3	3
	4	8	9	9	0	0	2	5	0	2	3	3	4	5
	1	9	0	5	1	5	0	9	4	4	1	4	2	7
Species Group A														
Diagnostic species of the *Combretum zeyheri - Combretum apiculatum* community on deep gravely soils														
Combretum zeyheri	+								+					
Pterocarpus rotundifolius														
Commelina erecta						+				+				
Chamaecrista mimosoides														
Strychnos madagascariensis	+													
Grewia flava	+													
Tephrosia species														
Ocimum americanum														
Mundulea sericea							+							
Combretum collinum				+										
Terminalia sericea					r									
Species Group B														
Diagnostic species of the *Grewia bicolor - Combretum apiculatum* communtiy on shallow gravely soils														
Cyperus rupestris								1	+	+		+		1
Hermannia modesta									+	1		+	+	+
Mariscus rehmannianus									+	+	1	+		1
Microchloa caffra									+	+		+		1
Mariscus dregeanus									+	+	+		+	
Commelina livingstonii								1		+	+		+	
Cymbopogon plurinodis	+									+	1	+		
Corchorus asplenifolius									+	+			+	+
Sporobolus fimbriatus	+									1	1			
Chamaesyce neopolycnemoides									+	+		+		
Dyschoriste rogersii											1	a		a
Aptosimum lineare									+	+		+		
Oropetium capense								1	+					+
Leucas neuflizeana								1			+	+		

Association number	6														
Relevé number								1	1	1	1	1	1	1	1
						1	1	1	1	1	2	3	3	3	3
	6	8	9	9	9	0	0	5	5	7	2	3	4	5	5
	2	6	1	2	8	3	4	2	6	1	7	9	0	3	6
Species Group A															
Diagnostic species of the *Combretum zeyheri - Combretum apiculatum* community on deep gravely soils															
Combretum zeyheri													1		
Pterocarpus rotundifolius	a														
Commelina erecta							+								
Chamaecrista mimosoides															
Strychnos madagascariensis										1					
Grewia flava															
Tephrosia species															
Ocimum americanum															
Mundulea sericea									1						
Combretum collinum															
Terminalia sericea						r				+		1			
Species Group B															
Diagnostic species of the *Grewia bicolor - Combretum apiculatum* communtiy on shallow gravely soils															
Cyperus rupestris															
Hermannia modesta								+						+	
Mariscus rehmannianus														+	
Microchloa caffra															+
Mariscus dregeanus												+			
Commelina livingstonii											+	+			
Cymbopogon plurinodis	+														
Corchorus asplenifolius												+			+
Sporobolus fimbriatus															
Chamaesyce neopolycnemoides															
Dyschoriste rogersii															
Aptosimum lineare															
Oropetium capense															+
Leucas neuflizeana												+			

Association number	7												
Relevé number				1	1	1	1	1	1	1	1	1	1
				0	0	1	1	1	1	1	2	2	3
	2	3	3	2	8	0	0	0	1	1	4	9	4
	9	8	9	6	2	1	2	4	1	5	5	8	6
Species Group A													
Diagnostic species of the *Combretum zeyheri - Combretum apiculatum* community on deep gravely soils													
Combretum zeyheri													
Pterocarpus rotundifolius				1	a								
Commelina erecta	+		+										+
Chamaecrista mimosoides							1	1	+	+			
Strychnos madagascariensis													
Grewia flava		+											
Tephrosia species													
Ocimum americanum	+	+											
Mundulea sericea													
Combretum collinum													
Terminalia sericea													
Species Group B													
Diagnostic species of the *Grewia bicolor - Combretum apiculatum* communtiy on shallow gravely soils													
Cyperus rupestris													
Hermannia modesta													
Mariscus rehmannianus													
Microchloa caffra													
Mariscus dregeanus													
Commelina livingstonii								+					
Cymbopogon plurinodis					1								
Corchorus asplenifolius													
Sporobolus fimbriatus													
Chamaesyce neopolycnemoides													
Dyschoriste rogersii													
Aptosimum lineare													
Oropetium capense													
Leucas neuflizeana													

Association number	8											
Relevé number							1	1	1	1	1	1
							0	0	0	2	2	2
		1	7	7	8	8	1	7	7	0	7	8
	8	1	5	6	0	3	0	1	5	0	5	1
Species Group A												
Diagnostic species of the *Combretum zeyheri - Combretum apiculatum* community on deep gravely soils												
Combretum zeyheri					+	+						
Pterocarpus rotundifolius			+				1					
Commelina erecta												
Chamaecrista mimosoides							1		1		a	
Strychnos madagascariensis												
Grewia flava	+											
Tephrosia species	+											
Ocimum americanum		+										
Mundulea sericea												
Combretum collinum									1			
Terminalia sericea											+	1
Species Group B												
Diagnostic species of the *Grewia bicolor - Combretum apiculatum* communtiy on shallow gravely soils												
Cyperus rupestris											+	
Hermannia modesta												
Mariscus rehmannianus										+		
Microchloa caffra												
Mariscus dregeanus												
Commelina livingstonii										1		
Cymbopogon plurinodis			+	+								
Corchorus asplenifolius												+
Sporobolus fimbriatus												
Chamaesyce neopolycnemoides												
Dyschoriste rogersii												
Aptosimum lineare												
Oropetium capense								+			+	+
Leucas neuflizeana												

Association number	9					
Relevé number	1	1	1	1	1	1
	1	2	2	3	3	3
	9	6	8	7	7	8
	8	2	7	1	8	5
Species Group A						
Diagnostic species of the *Combretum zeyheri - Combretum apiculatum* community on deep gravely soils						
Combretum zeyheri						
Pterocarpus rotundifolius						
Commelina erecta					1	
Chamaecrista mimosoides						
Strychnos madagascariensis	1					
Grewia flava						
Tephrosia species						
Ocimum americanum						
Mundulea sericea						
Combretum collinum						
Terminalia sericea	+	1				
Species Group B						
Diagnostic species of the *Grewia bicolor - Combretum apiculatum* communtiy on shallow gravely soils						
Cyperus rupestris						
Hermannia modesta						
Mariscus rehmannianus	+					+
Microchloa caffra						+
Mariscus dregeanus	+					
Commelina livingstonii						
Cymbopogon plurinodis						
Corchorus asplenifolius						
Sporobolus fimbriatus						
Chamaesyce neopolycnemoides						
Dyschoriste rogersii						
Aptosimum lineare						
Oropetium capense					+	+
Leucas neuflizeana						

Species Group C

Tricholaena monachne		+	+	+	+	+	+		+	+	1	1	+	+	+	+	+	+	1	+		a	1	+	1	1		+												1													1																				
Trichoneura grandiglumis				+		+			+	+			+			+						1	+	+	+	1	+																																														
Perotis patens		+		+				+	+	+					+				+				+	+	+																																																	
Melhania prostrata	+		+	+				+							+	+		+	+		+								+			+		+																																								
Rhynchosia totta			+						+			+	+							+			+	+	+	+															+		+																									+						
Ceratotheca triloba									+	+		+					+			+	+							+								+																											+										
Stylochaeton natalensis					+	+							+	+								+	+		+											+		+																																		+		
Lannea schweinfurthii					+					+			b											+		1																a																				+											
Cissus cornifolia			+	+	+	+	+	+		+		+		+	+		+	+	+	+	+			+	+			+	+					+										+										+	+																		

Species Group D
Diagnostic species of the *Sclerocarya birrea - Acacia nigrescens* treeveld community on granite

Abutilon fruticosum															+					+									+	+	+		+		+														1	+																								
Sporobolus nitens																														1	+								1			+	+											1				+																	+
Seddera suffruticosa											+														+			+								+			+		+	+	+											+	+																		
Geigeria ornativa																											+	+								+			+	+			+																					1								
Achyropsis leptostachya																																						1			+	+																															
Corbichonia decumbens																									+														+		+	+																															

Species Group E

Lippia javanica	+					+											+				+						+	+	+			+		+								+	+		+										1														+						
Clerodendrum ternatum													+											+	+	a											r	a			a	+								1																		a						
Cyperus angolensis																							1	1				+												+	+	+													+																			+

Species Group F

Combretum apiculatum	a	a	a	+	a	b	b	a	a	a	a	b	a	+	b	3	3	3	3	a	a	b	b	1	a	1	1	a	+						1	a	a																				+				+	+												
Schmidtia pappophoroides				+		+		a	+	+		a	1	a			+	+	+				a	1	1	1	a	b	+	+	+		+	+					a	1	1		1																									+	+					
Melinis repens	a	a		+		+	+		+	+	a	+	+	1	+	+			r			1		1		1							r			1	1				1	+	+																					1									
Commiphora schimperi	+	+		+			+	+							+				+	+									+				+	+	+									+																														
Hermbstaedtia odorata			+																				+		+	1										+				+		+													+																		
Sphedamnocarpus pruriens			+	+						+			+	+					+					1										+			+	+																																+		
Chascanum hederaceum			+										+														+													+	1		+				1																												

Species	1	2	3	4	5	6
Species Group G						
Diagnostic species of the Sclerocarya birrea - Acacia nigrescens shrubveld community on basalt						
Cenchrus ciliaris				a + b b		
Barleria spinulosa			+	+ + + +		
Rhus gerrardii			1 +	a 1 1 +		
Gossypium herbaceum			1	1 1 1 +	1	
Asystasia subbiflora	+	+ +	+	+ + + +		
Gomphrena celosioides			+	+ + +	+	
Species Group H						
Bothriochloa insculpta	1		b + + b 1 b	1 + a b + a a	1 +	
Grewia villosa		+ 1	+ + + 1	1 a + 1		
Acacia tortilis	+	1	+ 1 1	+ 1 1 +		
Becium filamentosum		+	a 1 + 1	+ 1 1		
Achyranthes aspera	+	+	+ + 1 +	1 1 1		1 +
Species Group I						
Grewia hexamita		+ + + 1 1 + 1 1	+ 1 + + + 1 1 1 + + 1	1 + 1 1 +		
Chloris virgata		+ +	+ + +	+ + + + + 1 + 1		
Ruellia patula		+ 1 +	1 1	+ 1 1	+	
Species Group J						
Grewia bicolor	1 +	+ + + a a 1 a + + 1 a	+ 1 a 1 + a 1 a 1 1 a	+ 1 1 a 1 1 a	+	1 1
Enneapogon cenchroides	+ + + 1 a	a + a + + 1 1 + + + 1 +	+ + + 1 a 1	1 1 1 1 a		
Hibiscus micranthus	+ + + + 1	+ + + + 1 + + + + + +	+ + 1 1 + 1	+ + +		+
Dalbergia melanoxylon	+ + + + r + + +	r 1	+ + 1 +	+ + 1	+	+
Leucas glabrata	+ +	+	+ 1 +	+ + a		+
Aristida congesta subsp. *congesta*	+ + + + + + 1 + +	+ + 1 1 +	+ + +	1 +		
Talinum caffrum	+ + +	+	+ +	+ +		+
Species Group K						
Diagnostic species of the *Setaria sphacelata - Themeda triandra* closed grassland community on gabbro						
Setaria sphacelata	+		1	+ +	3 + + + + b 1 b b b a 1	
Rhynchosia minima	+	+			+ + + +	
Vernonia oligocephala		+ +			+ + + 1	1
Polygala hottentotta					+ +	
Digitaria argyrograpta				1	+ a	
Litogyne gariepina	+		+	+	+ a a 1 +	1

Species						
Species Group L						
Acacia gerrardii	1	+	+ + + 1 1 +	+ + 1 1 1	+ + 1 a 3 b + 1	
Panicum coloratum	+		+ + + 1 1	1 a	+ 1	
Sida rhombifolia		+	+ + +	1 + 1 + +	+ +	
Species Group M						
Eragrostis superba	+ + b + +	+ + 1 + + 1 +	+ + + + + + 1 1 1 + 1 + 1	1 1 1 1 1 1 +	+ + + 1 1 1 +	+
Acacia exuvialis	+ + + + 1 a + + 1 1 1	a + a 1 + a 1 + 1 1 1	+ 1 1 + 1 + 1	+	+ r + 1 +	1
Abutilon austro-africanum	1	+ + + + +	+ + + + + 1 1 + + + +	+ + 1 +	+ + 1 +	+
Evolvulus alsinoides	+ + + + + +	+ + + + + +	+ + +	+ +	+ + + +	
Grewia monticola	+ + + 1 + +	+ + +	+ 1 a	+ a a	+ + + +	
Ehretia amoena	+ + +		+ + +	+ + + +	+ + + +	+
Albizia harveyi	+ + +	+	+ +	a 1 +	+ a a	
Heliotropium strigosum	+ +	+ 1 + +	+ +	+ 1 1 + + +	+ +	
Species Group N						
Diagnostic species of the Malelane - Lebombo mountain bushveld						
Ochna natalitia			+			1 + 1 1 + +
Panicum deustum			a		r	1 + a 1 1 1
Euclea schimperi		+	1 + +	+	1	1 1 a 1 1 +
Zanthoxylum capense		+	+			+ r + + +
Rhoicissus tridentata	+		+ +		+	1 + + + +
Elaeodendron transvaalense	+	+	+ + +		+	+ + a a 1
Rhynchosia caribaea		+	+ 1 + +	1	+ +	1 + 1 + +
Olea europaea						1 a 1 a
Hippobromus pauciflorus						a 1 + +
Maytenus tenuispina			+			1 1 1 a
Cassine aethiopica					1	a a 1 1
Sarcostemma viminale					+	1 + + +
Cyphostemma simulans			+	1		+ + + +
Orthosiphon suffrutescens			+			+ a 1 1
Dovyalis caffra			+			1 1 +
Spirostachys africana			a	1		a 1 1
Asparagus minutiflorus			+ +			+ + +
Rhus pyroides			a			a 1 1
Pappea capensis	+		+			+ + 1
Heteropyxis natalensis						1 + 1
Sansevieria hyacinthoides			+		1	+ + +
Elionurus muticus			1		+	1 a +

Asparagus buchananii				+	1 +	1 + +
Setaria species	+		1	+ +		b a a
Pavetta catophylla				+		+ + +
Maerua juncea			+			+ +
Drimiopsis maxima	+					+ +
Plectranthus tetensis						+ 1
Maytenus undata						1 +
Helichrysum athrixiifolium						+ 1
Schotia capitata						1 1
Rhus pentheri					+	+ +
Schotia brachypetala					1	1 1
Barleria elegans			1		a	1 1
Cotyledon barbeyi					+	+ +
Jasminum fluminense		+	+ +		1	1 1
Oxalis semiloba					+ +	+ 1
Eragrostis heteromera					a	1 a
Coddia rudis			+			+ 1
Hoslundia opposita						+ +
Hippocratea crenata				1		+ +
Aloe komatiensis				+		+ +
Putterlickia pyracantha			+			+ +
Bridelia cathartica						a +
Acacia burkei		+	a			1 +
Andropogon gayanus						+
Pterocarpus angolensis						a
Rhus leptodictya						+
Gladiolus species						+
Trichilia emetica						1
Teclea pilosa						+
Crassula vaginata						+
Senecio pleistocephalus						+
Schoenoxiphium sparteum						+
Heteropogon species						+
Erythrina humeana						+
Acokanthera oppositifolia						+
Vitex species						+
Englerophytum magalismontanum						1
Cussonia spicata						+
Trema orientalis						1
Setaria megaphylla						+

Phragmites australis						+
Sterculia murex						1
Indigofera swaziensis						+
Galactia tenuiflora						a
Cyperus species						a
Cryptolepis obtusa						+
Adenia hastata						+
Euphorbia ingens						1
Croton sylvaticus						1
Dalbergia armata						1
Kraussia species						+
Acacia ataxacantha						+
Flacourtia indica						1
Abrus precatorius						1
Hibiscus lunarifolius		1				a
Gnidia capitata		+				1
Senecio species						+
Ficus abutilifolia						+
Commiphora neglecta						+
Schrebera alata						a
Dioscorea cotinifolia						+
Bauhinia galpinii						a
Barleria obtusa		+				+
Decorsea galpinii		1				+
Senna petersiana	+					1
Cheilanthes hastata						+
Commiphora species	+	+				+
Phyllanthus reticulatus			+			+
Combretum microphyllum			1			1
Kalanchoe species			+			+
Crassula expansa			+			+
Kedrostis foetidissima						+
Sideroxylon inerme			1			1
Hibiscus species						+
Priva cordifolia						+
Terminalia phanerophlebia		1	a			+
Acalypha villicaulis	+					+
Dolichos trilobus	1	+				+
Acacia robusta			1			3

Species						
Species Group O						
Themeda triandra	1 + + +	+ 1	b 1 a + + + b a b a + a 1 3	a 3 4 b a b 3 a 3 a a a b	+ 1 + + a 3 3 + 3 a b 3	1 + 1 a b
Combretum hereroense	1	+	+ a + a a + a a 1 a + a	+ a 1 + + 1	1 + 1 1 a 1 1 a 1	1 1 1
Bolusanthus speciosus			+ +	1 1 1 1 1	+ + +	1 1 1
Combretum imberbe			+ 1 a 1	1 1 1	+ r 1 + 1	1 +
Ocimum gratissimum		+	1 1 + + +	1 a	+ +	a + +
Flueggea virosa	+	+	+ 1 + + 1	+ + + + + + + 1 1	+ 1	1 + + +
Euclea divinorum	+ +		+ + 1 + + + + 1	+ 1 a	r + 1 1 1	1 1 a
Species Group P						
Panicum maximum	a 1 a + 1 1 1 + 1 a a 3 3	1 + + + + + a a a b a 4 a	+ 1 + + + a + a 3 a a b b 3	+ 1 a b 3 b 3 a a 3 a a b	+ 1 + a a a 1 1	a 1 1 1 a
Dichrostachys cinerea	+ + + + + 1 + + + 1 1 1 1	+ + + + + + + + a a 1 1	+ + 1 + a + + 1 1 1 a +	a a + 1 1 1 1 1 b a +	+ + + 1 + a + 1 a	1 + +
Digitaria eriantha	+ + + + + b a a a	+ + + a a a a 1 b a	1 + + + 1 a a a b 1 a a	+ + 1 1 a a 1 3 1 b 1	a + + + + a b a a a a	a 1 1 +
Acacia nigrescens	+ + + + 1	1 + + + 1 + + 1 1	a a a a a 1 1 b 1 1 + + 1 a b	a + a b b a a b a 1 b a a	1 + a 1 1 1 a 1 1	+ 1
Sclerocarya birrea	+ 1 1 + + + 1 + + 1 + 1 +	1 + + + + 1 + a	1 + + + a a 1 1 1	+ + + 1 b 1 + 1 + 1 + 1	+ + + + + + r + +	1 + +
Aristida congesta subsp. *barbicollis*	+ + + 1 1	1 a a 1 + + 1 + 1 b + 1	+ a + + 1 + + 1 a 1 1 1	a 1 1 1 1 1 a 1 +	+ 1 1 + +	+ + + +
Heteropogon contortus	+ + 1 a + + a a + 1 1	+ + + 1	+ + 1 + + 1 a b a a 1 + a	+ +	+ + + + a + a 1 a	1 1 1 1
Urochloa mosambicensis	+ + 1 +	+ 1 1	+ + + + + + 1 1 1 1 +	a a + a b 3 a 3 a a a a 1	1 + 1 + 1 1 + 1	1 1 +
Lantana rugosa	+ + + + + + 1 + +	+ + + + 1 + +	+ 1 1 1 + 1 1 +	+ + 1 1 a 1 1	+ + + 1 1 1 1	1 + 1
Ziziphus mucronata	+ + + + + 1 + 1	+ + 1 + 1 1	+ + + 1 + 1 + a 1 a 1 1	+ + + 1 1 +	+ + + 1 1 1	1 1
Eragrostis rigidior	+ a + 1 1 b + + + 1	+ + + + 1	+ + 1 + a + 1 1 + 1	+	+ 1 1 1 1	+ + 1
Pogonarthria squarrosa	+ 1 1 + 1 + + 1 1 + a	1 + + + + 1 + a 1 a a	+ + + +		+ 1 1 + +	+ 1
Solanum panduriforme	+ + + + + +	+ + 1 + 1	+ + 1 1 + +	+ + + a 1 1 a 1 1	+ + +	+ + +
Lonchocarpus capassa	+ + + + + + + + 1 +	r + r 1 1 a	r + a	+ r + 1 3 1 +	+ + + +	1
Grewia flavescens	+ + + +	+ + 1 + + 1	1 + 1 + 1 + 1 1 1 + +	+ a a +	+	+ 1 + +
Commelina africana	+ + + 1 + +	+ + + 1 + 1 +	+ 1 + + +	+ + + +	+	1 a + +
Maytenus senegalensis	+ + +		+ + 1 1 1 b +	+ + 1 + + a	+ + 1 1 1 1	a 1 1 1
Peltophorum africanum	+ + + 1 1 1	+ + + +	+ 1 + r + 1 + +		+ + 1 +	1 1 1
Ipomoea crassipes	1 + 1 +	+ + +	1 1 + +	1 + 1 1 + + 1	1 + +	1 + + 1
Justicia flava	+ + + +	+ + 1 1 + +	1 1 a + + + +	+ 1 1 1 +	+	a +
Ormocarpum trichocarpum	+ + +	+	+ + + +	+ 1 + + +	+ 1 a + 1 +	1 + +
Tephrosia polystachya	+ +	1 1 + +	+ + 1 + +	1 1 + + 1	1 + + 1 1	1 +
Agathisanthemum bojeri	+ + + + + + 1 1 + 1	1 + + 1	+		+ a + 1 +	a + 1
Tragia dioica	1 + +	1 + + +	+ 1 + +	+ + + + +	+ + +	+ + +
Melhania didyma	1 1	1 + + + + +	a 1 + 1 + +	1 +	1	1 + + +
Maytenus heterophylla	1 1	+	+ + + +	+ 1 + 1	+ + 1 1 +	+ 1 1
Hibiscus pusillus	1 +		+ + + + +	+ + +	+ + + + +	+ + +
Kohautia virgata	+ + a +	+ + + +	1 +	+	+ + a +	1 a +
Indigofera floribunda	+ 1 +	1 + + +	+ + 1 +	+ 1	+ 1 +	+
Acalypha indica	1	+ + + + 1 1 +	1 1 + +	+ + 1	+	+

Ipomoea obscura var. *obscura*					+																			+	+												+			+	+		+			+	+	1	+						+									1	1			+					+
Diospyros mespiliformis				+		r																+		1											1	1	1		1					r		+	+										+											1	1	b		+	
Ehretia rigida											+		+										+			+											+					+	+				+		+	+				+	+									a								+
Thunbergia dregeana												+										+		+		a									+	1	+		+	+	1											1															1		+		+	
Polygala sphenoptera	+		+								+		+										1		+	+															+																					+			+	+					+	+
Acacia nilotica				+																						1			+	+			+				b																			+									1			a			1		1
Solanum incanum	+	+							+													+									+	+					+																							+					+		+	+					
Ledebouria species												+											+		+		+											+																								+			+	+	+		+		+	
Blepharis integrifolia										+	+										+	+	+															+	+			+																							+	+				+		
Dombeya rotundifolia																	+														+					+																							+	+					+		1	1				

10. *Croton menyhartii – Acacia welwitschii* community on heavy clays derived from shale

Figure 24 *Croton menyhartii – Acacia welwitschii* community on heavy clays derived from shale. (Photo: Synbiosys KNP)

Geomorphology

The Karoo sediments occur as a wedge between the granite in the west, and the basalt in the east, and extend from north to south throughout the Park. Karoo sediments consist of Cave Sandstone, Red Beds and Ecca-shales. This *Croton menyhartii – Acacia welwitschii* community on heavy clays derived from shale (Figure 24) occurs on the Ecca-shales. The area is concave, low lying and reasonably flat. Altitudes range from nearly 200 to 250 metres a.s.l.

Climate

Rainfall ranges from 600 to 650 mm per year (Gertenbach 1980).

Soil

The soils that develop from the shales are rich in sodium. The brown duplex soils (Figure 25) are very shallow – less than 30 cm – with loam over prismatic calcareous clay (Venter 1990). Furthermore, these sodic duplex soils are poorly drained and are highly sensitive to erosion (Venter 1990). The soils of this community contain more than 55% clay. The dominant type of soil is the Sterkspruit and Escourt Soil Forms.

Figure 25 *Croton menyhartii – Acacia welwitschii* community on heavy clays derived from shale (Photo: Liesl Mostert)

Vegetation

Dataset 1: 11 relevés; dataset 2: 8 relevés.

The *Croton menyhartii – Acacia welwitschii* community on heavy clays derived from shale is best represented by the *Acacia welwitschii* Thickets on Karoo Sediments Landscape (13) (Gertenbach 1983); and is comparable to Coetzee's (1983) *Acacia welwitschii* – dominated treeveld of the Tropical Semi-arid Karoo Sediment Lowveld. Previous descriptions of the vegetation fall under the following names: Delagoa Thorn Thickets (Van Wyk 1972), and dense thornbush thickets (Pienaar 1963).

The structure is a continuum of densely shrubby, densely brushy, dense treeveld forming impenetrable thickets. Shrub and tree layers are often difficult to distinguish from each other. The dominant tree, *Acacia welwitschii*, may range from low shrubs to trees that reach heights of 10 m. *Spirostachys africana* and *Albizia petersiana* are commonly found among the trees. Dominant shrubs include: *Croton menyhartii*, *Euclea divinorum* and *Boscia mossambicensis*. Grasses are sparse due to a number of factors: (i) the dense canopy cover of the woody layer; (ii) the occurring grass species are highly palatable and therefore prone to over-utilization and trampling; and (iii) physiological drought due to the high water-retention capabilities of the underlying clay. The dense canopy cover favours shade-tolerant grasses, such as: *Panicum coloratum*, *Panicum deustum*, *Panicum maximum* and *Enteropogon monostachyus*. Palatable grasses include: *Sporobolus nitens*, *Urochloa mosambicensis* and numerous *Panicum* species.

Diagnostic species

The diagnostic species for this community can be viewed in Species Group A (Table 6). The diagnostic woody plants include: *Acacia welwitschii*, *Albizia petersiana*, *Kalanchoe paniculata*, *Croton menyharthii*, *Ximenia americana*, *Kalanchoe lanceolata*. The diagnostic grasses include: *Eragrostis superba*. The diagnostic forbs include: *Asparagus falcatus*, *Sida dregei*, *Gomphrena celosioides*.

Dominant / prominent species

The dominant woody plants are: *Solanum coccineum*, *Capparis tomentosa*, *Boscia mossambicensis* (Species Group C), *Flueggea virosa*, *Ehretia amoena* (Species Group F), *Dichrostachys cinerea*, *Euclea divinorum*, *Spirostachys africana*, *Grewia flavescens*, *Pappea capensis*, *Schotia capitata* (Species Group I). The dominant grasses are: *Urochloa mosambicensis*, *Chloris virgata*, *Eragrostis rigidior*, *Panicum coloratum* (Species Group F), *Panicum maximum*, *Sporobolus nitens*, *Aristida congesta* subspecies *barbicollis*, *Enteropogon monostachyus* (Species Group I). The dominant forbs are: *Justicia protracta*, *Stylochaeton natalensis* (Species Group C), *Becium filamentosum* (Species Group F), *Justicia flava*, *Solanum panduriforme*, *Achyranthes aspera*, *Abutilon austro-africanum*, *Ruellia patula*, *Blepharis integrifolia*, *Barleria elegans*, *Lantana rugosa*, *Achyropsis leptostachya*, *Cyphia angustifolia*, *Abutilon ramosum* (Species Group I).

11. *Sporobolus nitens – Acacia grandicornuta* sodic patches

Figure 26 *Sporobolus nitens – Acacia grandicornuta* sodic patches. (Photo: Synbiosys KNP)

Geomorphology

The granites, between the Sabie and Crocodile rivers, are well dissected by many drainage lines. Along the banks of these two rivers, level to gently sloping bottomlands with sodic duplex soils occurs. The *Sporobolus nitens – Acacia grandicornuta* sodic patches (Figure 26) occur in these bottomlands. Altitudes range from 250 to 350 metres a.s.l.

Climate

Rainfall ranges from 550 to 650 mm per year (Gertenbach 1980).

Soil

The clay soils contain more than 55% (Figure 27) and are usually shallow - where it is deeper, it is often saturated with sodium. Sterkspruit, Estcourt and Valsriver Soil Forms occur in these bottomlands.

Figure 27 *Sporobolus nitens – Acacia grandicornuta* sodic patches (Photo: Liesl Mostert)

Vegetation

Dataset 1: 11 relevés; dataset 2: 10 relevés.

The *Sporobolus nitens – Acacia grandicornuta* sodic patches is best represented by the brackish bottomlands of the Thickets of the Sabie and Crocodile Rivers Landscape (4) (Gertenbach 1983); and is comparable to Coetzee's (1983) "*Acacia grandicornuta* – dominated brushveld and treeveld" of the Tropical Arid Granitic Lowveld of the Sabie River Valley. However, this and the following three communities could not be mapped by the above-mentioned authors due to patchy distribution of the complex mosaic of communities within the granitic landscape.

The structure is sparsely to moderately shrubby, moderate to dense treeveld. The dominant tree, *Acacia grandicornuta*, reaching heights of 7 m, occurs in almost monotypic stands in places. The field layer is sparse to absent, particularly the grass component, due to the high palatability of both the field layer and the available browse fodder with resulting high grazing pressure and trampling. Preferred browsing species include: *Acacia grandicornuta*, *Acacia nigrescens*, *Acacia tortilis*, *Acacia nilotica*, *Acacia senegal*, *Ziziphus mucronata*, *Boscia foetida*, *Capparis tomentosa*. The sedentary behaviour of Impala close to rivers causes eutrification and a proliferation of pioneer herbaceous species. The alien invasive plant, *Opuntia stricta*, also presents itself in this community.

Diagnostic species

The following species were recorded as diagnostic species for this community and are presented in Table 6 (Species Group B). The diagnostic woody plants include: *Dyschoriste rogersii*, *Terminalia prunioides*, *Boscia foetida*, *Acacia senegal*, *Pavetta catophylla*, *Zanthoxylum humile*, *Cordia monoica*. The diagnostic grasses include: *Trichoneura grandiglumis*, *Tricholaena monachne*. The diagnostic forbs include: *Ocimum americanum*, *Indigofera schimperi*, *Sansevieria hyacinthoides*, *Kohautia virgata*, *Ipomoea obscura* var. *obscura*, *Commelina livingstonii*, *Asparagus buchananii*, *Melhania didyma*, *Senecio linifolius*, *Fimbristylis* species, *Indigofera floribunda*. The problem plant in this community, *Opuntia stricta*, is also presented in the diagnostic group.

Dominant / prominent species

The dominant woody plants are: *Capparis tomentosa*, *Boscia mossambicensis* (Species Group C), *Grewia villosa*, *Maerua parvifolia* (Species Group E), *Acacia tortilis*, *Ormocarpum trichocarpum*, *Acacia exuvialis* (Species Group F), *Acacia nilotica* (Species Group H), *Dichrostachys cinerea*, *Grewia bicolor*, *Euclea divinorum*, *Ziziphus mucronata*, *Acacia grandicornuta*, *Spirostachys africana*, *Grewia hexamita*, *Pappea capensis*, *Acalypha indica* (Species Group I). The dominant grass species occuring in the community is: *Sporobolus nitens* (Species Group I). Other grasses include: *Sporobolus fimbriatus* (Species Group E), *Urochloa mosambicensis*, *Chloris virgata*, *Digitaria eriantha*, *Eragrostis rigidior*, *Panicum coloratum* (Species Group F), *Panicum maximum*, *Aristida congesta* subspecies *barbicollis*, *Enteropogon monostachyus*, *Aristida congesta* subspecies *congesta* (Species Group I). The dominant forbs are: *Solanum coccineum*, *Justicia protracta* (Species Group C), *Hibiscus micranthus*, *Leucas glabrata* (Species Group E), *Abutilon fruticosum*, *Leucas neuflizeana*, (Species Group F), *Geigeria ornativa*, *Mariscus rehmannianus*, *Portulaca kermesina*, *Selaginella dregei* (Species Group H), *Justicia flava*, *Solanum panduriforme*, *Achyranthes aspera*, *Abutilon austro-africanum*, *Ruellia patula*, *Blepharis integrifolia*, *Lantana rugosa*, *Cyphia angustifolia*, *Achyropsis leptostachya*, *Evolvulus alsinoides*, *Abutilon ramosum*, *Tragia dioica*, *Alternanthera pungens* (Species Group I).

12. *Acacia tortilis – Acacia nigrescens* community on alluvial floodplains

Figure 28 *Acacia tortilis – Acacia nigrescens* community on alluvial floodplains. (Photo: Liesl Mostert)

Geomorphology

The *Acacia tortilis – Acacia nigrescens* community on alluvial floodplains (Figure 28) is found within the bottomlands and floodplains of the southern district, and is largely restricted to basalt and granite/gneiss. Altitudes range from 200 to 350 metres a.s.l.

Climate

Rainfall ranges from 550 to 650 mm per year (Gertenbach 1980).

Soil

The soils in these floodplains or bottomlands range from alluvial soils that are deep sandy-clay sandy soils to duplex soils with 35 to 55% clay content (Figure 29).

Figure 29 The soils of the *Acacia tortilis – Acacia nigrescens* community on alluvial floodplains are alluvial in origin. (Photo: Liesl Mostert)

Vegetation

Dataset 1: 7 relevés; dataset 2: 10 relevés.

The *Acacia tortilis – Acacia nigrescens* community on alluvial floodplains is best represented by the bottomlands of the Thickets of the Sabie and Crocodile Rivers Landscape (4) (Gertenbach 1983). Gertenbach's (1987) *Acacia nigrescens – Acacia tortillis* open shrub savanna is very similar to this *Acacia tortilis – Acacia nigrescens* community and shares numerous dominant species. These communities are not characterized by truly diagnostic species, but rather by the high cover abundance values of its dominant species.

This open savanna is sparsely to moderately brushy, sparse shrubveld with scattered trees. The dominant trees, namely *Acacia nigrescens* and *Acacia tortillis* may also occur as shrubs in this community. The relevés on granite are azonal and associated with clay-enriched floodplains that occur behind the levees of channels and larger rivers such as the N'waswitshaka and Sabie rivers. The relevés on basalt are zonal and directly correlated with the geology and also associated with bottomlands. This community can be considered quite dry with periods of extreme physiological water stress, except when flooding events occur. Trampling plays a role in these heavily grazed floodplains and bottomlands. *Acacia tortilis* occurs throughout the park, but is concentrated near rivers and experience occasional overgrazing. The grass species present depends largely on the intensity of overgrazing. In instances of high grazing, many annual grass species are present in this community.

Diagnostic species

The diagnostic species for this community can be viewed in Table 6 (Species Group D). The diagnostic woody plants include: *Grewia monticola*, *Dalbergia melanoxylon*, *Rhus gueinzii*. The diagnostic grasses include: *Themeda triandra*, *Bothriochloa insculpta*, *Cenchrus ciliaris*, *Enneapogon cenchroides*. The diagnostic forbs include: *Heliotropium strigosum*, *Heliotropium steudneri*.

Dominant / prominent species

The dominant woody plants are: *Grewia villosa*, *Maerua parvifolia* (Species Group E), *Acacia tortilis*, *Flueggea virosa*, *Ehretia amoena* (Species Group F), *Dichrostachys cinerea*, *Grewia bicolor*, *Euclea divinorum*, *Ziziphus mucronata*, *Spirostachys africana*, *Acacia nigrescens*, *Grewia hexamita*, *Grewia flavescens*, *Ehretia rigida* (Species Group I). The dominant grasses are: *Urochloa mosambicensis*, *Chloris virgata*, *Digitaria eriantha*, *Panicum coloratum* (Species Group F), *Panicum maximum*, *Aristida congesta* subspecies *barbicollis* (Species Group I). The dominant forbs are: *Hibiscus micranthus*, *Cissus cornifolia*, *Leucas glabrata* (Species Group E), *Abutilon fruticosum*, *Leucas neuflizeana*, *Melhania forbesii* (Species Group F), *Tephrosia polystachya*, *Sida rhombifolia* (Species Group H), *Justicia flava*, *Solanum panduriforme*, *Achyranthes aspera*, *Abutilon austro-africanum*, *Ruellia patula*, *Lantana rugosa*, *Achyropsis leptostachya* (Species Group I).

13. *Euclea divinorum – Spirostachys africana* community on alluvial clay drainage lines

Figure 30 *Euclea divinorum – Spirostachys africana* community on alluvial clay drainage lines. (Photo: Synbiosys KNP)

Geomorphology

The *Euclea divinorum – Spirostachys africana* community on alluvial clay drainage lines (Figure 30) is not limited to any specific geology, since the underlying material is alluvial in origin.

Climate

Rainfall ranges from 550 to 650 mm per year (Gertenbach 1980).

Soil

The clay soils in these drainage lines are typically alluvial soils with 35 to 55% clay content (Figure 31).

Figure 31 The clay soils of the *Euclea divinorum – Spirostachys africana* community on alluvial clay drainage lines. (Photo: Liesl Mostert)

Vegetation

Dataset 1: 7 relevés; dataset 2: 2 relevés.

This community is represented by the bottomlands of the Thickets of the Sabie and Crocodile Rivers Landscape (4) (Gertenbach 1983).

The structure is sparsely to moderately shrubby with moderate to dense treeveld and bush. The dominant tree, *Spirostachys africana*, occurs in dense stands in the drainage lines. Although relevés collected by Mostert are generally species poor and lack the diagnostic species recorded by Van Wyk, these relevés were grouped based on the very high cover abundance values and dominance of *Spirostachys africana* and *Euclea divinorum*.

Diagnostic species

The diagnostic species for this community can be viewed in Table 6 (Species Group G). The diagnostic woody plants include: *Mystroxylon aethiopicum* subspecies *aethiopicum*, *Diospyros mespiliformis*, *Euclea schimperi*. The diagnostic grasses include: *Oropetium capense*. The diagnostic forbs include: *Cotyledon barbeyi*, *Plectranthus tetensis*, *Chlorophytum galpinii*, *Hypoestes aristata*.

Dominant species

The dominant woody plants are: *Grewia bicolor*, *Euclea divinorum*, *Ziziphus mucronata*, *Acacia grandicornuta*, *Spirostachys africana*, *Acacia nigrescens*, *Grewia flavescens*, *Pappea capensis*, *Gymnosporia tenuispina*, *Schotia capitata*, *Rhus gerrardii*, *Elaeodendron transvaalense* (Species Group I). The dominant grasses are: *Panicum maximum*, *Sporobolus nitens*, *Aristida congesta* subspecies *barbicollis*, *Enteropogon monostachyus* (Species Group I). The dominant forbs are: *Acalypha indica* (Species Group I) *Mariscus rehmannianus*, *Portulaca kermesina*, *Selaginella dregei*, *Cyperus rupestris* (Species Group H), *Justicia flava*, *Solanum panduriforme*, *Achyranthes aspera*, *Abutilon austro-africanum*, *Ruellia patula*, *Blepharis integrifolia*, *Barleria elegans*, *Lantana rugosa*, *Cyphia angustifolia*, *Achyropsis leptostachya*, *Evolvulus alsinoides*, *Abutilon ramosum*, *Tragia dioica*, *Alternanthera pungens*, *Asparagus plumosus* (Species Group I).

Table 6 Phytosociological table of the southern district of the KNP (part 3)

Association number	**10**																**11**																			**12**																	**13**								
Relevé number									1	1	1	1	1	1	1	1									1	1	1	1	1	1	1	1	1	1	1											1	1	1	1	1	1	1			1	1	1	1	1	1	1
			1	1	1	1	1	1	0	1	1	2	3	1	1	1									0	0	0	0	0	0	2	2	2	3	3							1	1	1	1	0	0	1	1	1	2	3			0	0	0	0	0	3	3
	3	3	0	0	0	1	1	1	5	2	2	5	1	0	1	4	4	4	4	4	4	5	6	8	0	0	0	3	5	5	3	4	5	2	3		2	2	2	4	4	1	1	1	1	6	8	1	2	4	5	3	4	6	1	2	4	8	9	3	7
	0	7	8	7	9	4	5	6	4	1	5	2	2	9	0	9	0	5	6	7	8	8	0	7	0	1	6	9	0	3	8	0	8	3	6	1	2	6	7	4	9	0	1	2	9	3	0	2	9	1	3	8	3	1	5	0	4	5	8	0	0
Species Group A																																																													
Diagnostic species of the *Croton menyhartii - Acacia welwitshii* community on heavy clays derived from shale																																																													
Acacia welwitschii	a	3	a	a	a	+	4	b	3	3	a	b	a	b	b	3																			1			1	a					+																	
Croton menyharthii	a		3	4			+	+						b		+																							1																						
Albizia petersiana					1	b		a			3			+	1																													+																	
Asparagus falcatus			+	+	+			+						1		1					+											+																+											+			
Kalanchoe paniculata				+	+	+	+	+																																																					
Ximenia americana		+					+	+																													+																								
Kalanchoe lanceolata									+	1					1																				+																										
Sida dregei									+				+		1																																														
Eragrostis superba									1		1		+																																			1	1														+
Gomphrena celosioides								+		1			+												+										+																	+					+				
Species Group B																																																													
Diagnostic species of the *Sporobolus nitens - Acacia grandicornuta* sodic patches																																																													
Ocimum americanum									+																+		1			1	1	1		+	+												+								+					+	
Dyschoriste rogersii																												+	1	a	b	1	1	a														1												1		
Terminalia prunioides																		1		+	+	+								b				+						1																					
Boscia foetida				+												+		+	+	+	+	+									+									+																	+		+		
Indigofera schimperi																									+	+					1		1		1																r									+	
Acacia senegal											1		1								+			+	+		1						1																							1					
Opuntia stricta																			+	+		+	+																															+							
Trichoneura grandiglumis									+																				1	+				+	+																										
Sansevieria hyacinthoides																		+		+									1		+																+														
Kohautia virgata																											1				+			+	1																				+						+
Ipomoea obscura var. *obscura*																									+	1			+	+																													+		
Commelina livingstonii											+														+	+	+							+																					+						
Asparagus buchananii									+						1														+	1				+	+																										+
Pavetta catophylla									+			+																+	1		+				+												+									+					
Zanthoxylum humile			+																	+						+				+										+																					
Melhania didyma																												+	1						+																										

Cordia monoica		+ + +		
Senecio linifolius		+ + a		+
Fimbristylis species		+ 1 +	+	1
Indigofera floribunda	+ +	+ 1 +	+ +	+
Tricholaena monachne	1	+ +		+

Species Group C

Solanum coccineum	1 1 + 1	+ + 1 1 + +		+ +
Capparis tomentosa	+ + + +	+ + 1 + +		+ 1
Boscia mossambicensis	+ + + + + 1 1	+ a		
Justicia protracta	1 1 a + a	+ + b		+ 1
Stylochaeton natalensis	+ + + 1	+ + +		+

Species Group D
Diagnostic species of the *Acacia tortilis - Acacia nigrescens* community on alluvial floodplains

Themeda triandra	+ 1		a + + a + + 3 a 3	
Grewia monticola			+ + + + + a 1	
Bothriochloa insculpta		1 1	1 b + b b 1 1	1
Dalbergia melanoxylon			+ a + +	
Cenchrus ciliaris			a a r 1	
Enneapogon cenchroides	+		+ 1 1 a	
Rhus gueinzii	+ +	+	+ + + +	+
Heliotropium strigosum		+	1 + +	
Heliotropium steudneri	+	+	+ + +	

Species Group E

Grewia villosa		+ + + + +	+ + + + + + + 1 1 1	
Maerua parvifolia	+ +	+ 1 + 1 + +	+ + + + + + +	
Hibiscus micranthus	+ +	+ + + + 1	+ + + + + 1 1	
Cissus cornifolia		+ + +	+ + + +	
Leucas glabrata	+	1 1 + +	+ 1 1	
Cymbopogon plurinodis		+ 1	+ + 1	+
Balanites maughamii		r + +	+ +	
Lannea schweinfurthii		+ 1 +	1 1	
Sporobolus fimbriatus		1 1 1	1 +	

Species Group F				
Urochloa mosambicensis	a b a + + 1 a a 1	+ + 1 a + + 1	a + + b 1 + a a b a a 1	+ 1
Chloris virgata	+ + + + 1 + 1	+ a a a + + a + +	+ + + b 1 1 1 1 + +	+ +
Acacia tortilis	1 1	+ a a 1 + 1 1 a 1	+ + + 1 b r + + 1 + + a 1 1	1 1
Digitaria eriantha	+ 1 a	1 + + 1 a	+ + + + + 1 a a 1 a	+ 1
Abutilon fruticosum	+ + +	+ + + + + + +	+ + + +	+ +
Leucas neuflizeana	+ a +	1 1 + a 1 a	1 1 a +	+
Ormocarpum trichocarpum	+ + + +	1 a 1 + +	+ 1 a	+
Flueggea virosa	+ + + +		+ + + + 1 1 1 +	+
Ehretia amoena	+ + 1		+ + + + + + +	
Eragrostis rigidior	a a 1 1	+ 1	1 + +	
Panicum coloratum	+ + a +	1 +	a 1 a	a 1
Acacia exuvialis	+ +	+ r + +	+ +	
Becium filamentosum	1 + +	+ 1 +	a +	
Melhania forbesii	+ +	1	+ + + 1	
Maytenus senegalensis	+ + 1 +		+ + +	
Panicum deustum	+ + +		+ 1 +	+ + +
Cucumis africanus	+ 1		+ 1 +	
Species Group G				
Diagnostic species of the *Euclea divinorum - Spirostachys africana* communtiy on alluvial clay drainage lines				
Cassine aethiopica			+ +	a + 1 + 1 +
Oropetium capense		+ +		1 1 1 a +
Euclea schimperi				+ + + 1
Diospyros mespiliformis	+ +		+	+ + 1
Cotyledon barbeyi	+ 1			1 + a
Plectranthus tetensis	a			1 1
Chlorophytum galpinii				+ +
Hypoestes aristata				1 1
Species Group H				
Combretum hereroense		+ + 1 1	+ + 1 + +	+ + 1
Geigeria ornativa	a	1 1 + 1 1 1 1	+ a	1 a
Acacia nilotica		+ a + a b 1 1	+ a 1	1
Mariscus rehmannianus		+ + + + 1 + +	+	+ + +
Tephrosia polystachya	+	+ 1 +	1 1 a 1	+
Portulaca kermesina	+	+ 1 + +		+ + + +
Sida rhombifolia	+	+ +	a 1 +	1 +
Selaginella dregei		+ + + + 1 a + +		a a
Cyperus rupestris		+ +		+ + +

Species Group I

Panicum maximum	a + + + a b 4 3 b 3 b 4	1 + + + 1 a a a 1 + 1 1 1 3 1	b 1 1 a + + + + a b b a 3 b 3	1 1 1 1 a
Dichrostachys cinerea	+ b a + r 1 a + 1 + 1	+ + a + + + + 1 a a a + 1 + 1	1 3 b a + 1 a b 1 1 1 + 1 + a	+ 1 + 1 1
Grewia bicolor	+ 1 1	+ 1 + 1 + + + 1 1 b a a 1 + + +	+ + 1 + 1 + + + + 1 a 1 + 1	+ 1 a + +
Justicia flava	+ + + + + a a 1 1 + 1	1 + 1 + + + a a + 1	+ + + + + + 1 1 1 1 +	+ + 1 1 1 1
Euclea divinorum	+ + a 1 + + + + 3 1 1 1 1 1 b	b + 1 + 1 1 1	a 1 1 1 + 1 1	1 3 a a 3 b a 1 a
Sporobolus nitens	+ 1 1 + 1 a 1 1 +	b + + + a a 1 1 a 1 a a a + 1	+ 1 1 1 1	1 b 1 a 1 1 1 +
Solanum panduriforme	+ + + + a a +	+ + + + + a 1 + 1 a 1 1 a + +	+ + + + + + + a 1 1	+ 1 1 +
Ziziphus mucronata	+ + 1 1 +	+ + + + 1 b a a 1 1	+ + + + 1 + + + a 1 1 + a	+ + 1 + +
Acacia grandicornuta	+ 1 a + 1	1 4 3 a a a 3 b a b b b 1 1	1 + 1 a 1	+ a a 3 b b
Spirostachys africana	+ a 1 + + b b b	1 3 + 1 b b 1 a a	+ + + b a	4 3 b 3 b b + a
Achyranthes aspera	+ + + 1 a 1 1 1 a	a + a 1 1 a a 1 1	+ + 1 1 1 1	a a 1 a 1 +
Acacia nigrescens	+ 1 1 1	+ + 3 a +	a + + + a 1 1 b + b b + a b a a	1 + 1 1 1
Abutilon austro-africanum	+ 1 1 1 1 1 +	+ + 1 1 1 1 a 1 1	+ + 1 1 1 +	+ + 1 1 1 + +
Ruellia patula	1 1 1 a a 1 1 1	a 1 + + 1 1 a 1 + 1	1 + 1 1	1 1 1 + 1 +
Grewia hexamita	1 + +	+ + + + 1 1 + 1 1 + +	+ + + + + + 1 1 +	+ + + +
Grewia flavescens	+ + 1 + + +	r + a 1 + + 1	+ + + + + 1 1 + + +	+ 1 + +
Blepharis integrifolia	+ + + + 1 1	+ 1 + + + + 1 +	+ + + +	+ + 1 a 1 + +
Aristida congesta subsp. *barbicollis*	a + 1 1	a + + a 1 a a 1 1 a	+ + 1 a + +	a 1 1
Barleria elegans	+ + + 1 a 1 a + a 1	+ a 1 1	+ + +	+ 1 a 1 1
Lantana rugosa	1 + 1 1	+ + + + 1 + +	+ + 1 1 1 1 1	1 + +
Enteropogon monostachyus	a 1 1 1 1 a a 1	1 1 1 1 + +	a	a 3 3 b 4 b
Ehretia rigida	1 + + +	+ + + +	+ + + + 1 + + 1 +	+ + +
Pappea capensis	+ + 1 + +	+ + 1 + + 1	+	+ + a 1 b 1 1 +
Cyphia angustifolia	+ 1 1 + + 1	1 + 1 + + 1 a a	+	1 + 1 + +
Achyropsis leptostachya	+ a 1 a a	+ + + 1 +	+ + + 1 +	1 + a +
Evolvulus alsinoides	+ 1 +	+ + 1 + + + + +	+ +	+ + + +
Maytenus tenuispina	+ + + 1 1	+ 1 + 1 + 1	1	1 1 1 1
Acalypha indica	1 1	+ + 1 1 1 +	1 +	a 1 1 +
Abutilon ramosum	+ a + 1 +	1 + a a + +		+ + +
Tragia dioica	+ +	1 + + + + +	+	+ + +
Alternanthera pungens	+ + +	+ 1 1 1	1	1 + +
Aristida congesta subsp. *congesta*	1	+ + + 1 1	1 +	1 1
Schotia capitata	+ + +	+		+ + + 1 + +
Rhus gerrardii	1 1 + +		1	+ + a + 1
Commelina africana	+ 1	+ +	+ a	1 + a
Asparagus plumosus	+ + +	+		+ 1 + + +
Elaeodendron transvaalense	+ 1 a	1 1		+ 1 1 1
Seddera suffruticosa	+ + +		+ + +	1 +

14. *Combretum imberbe – Philenoptera violacea* dry riparian woodland

Geomorphology

The *Combretum imberbe – Philenoptera violacea* dry riparian woodland is not limited to any specific geology, since the underlying material is alluvial in origin.

Climate

Rainfall ranges from 550 to 650 mm per year (Gertenbach 1980).

Soil

The dominant soil is the Sterkspruit Soil Form.

Vegetation

Dataset 1: 16 relevés; dataset 2: 0 relevés.

This plant community shares numerous species with the *Acacia tortilis–Combretum imberbe* Riparian Woodland and the *Ochna natalitia–Diospyros mespiliformis* Woodland of the Sabie River system described by Bredenkamp *et al*. (1991a). Bredenkamp *et al*. described these plant communities as part of the larger *Acacia robusta–Longocarpus capassa* Riparian woodlands of the Sabie River. The *Combretum imberbe– Philenoptera violacea* Dry Riparian Woodland plant community also compares well with the *Lonchocarpus capassa–Trichilia emetica* Riparian Woodland of the Crocodile River described by Bredenkamp *et al*. (1991b).

These communities are associated with the upper and relatively dry zone of the riverbanks and the seasonal flood plains on all types of geology. They constitute the dry woodland component of the riparian vegetation and contain virtually no aquatic vegetation.

Diagnostic species

The following species were recorded as diagnostic species for this community and are presented in Table 7 (Species Group A). The diagnostic woody plants include: *Combretum imberbe, Lippia javanica, Acacia tortilis, Grewia bicolor, Sclerocarya birrea* subspecies *caffra, Strychnos spinosa, Grewia villosa, Acacia xanthophloea, Dalbergia melanoxylon, Loeseneriella crenata, Trichilia emetica*. The diagnostic grasses include: *Urochloa mosambicensis, Sporobolus fimbriatus, Cenchrus ciliaris,* *Sporobolus africanus, Eragrostis superba, Bothriochloa insculpta, Chloris virgata, Bothriochloa radicans, Themeda triandra*. The diagnostic forbs include: *Solanum panduriforme, Tragia dioica, Melhania forbesii, Abutilon austro-africanum, Cucumis africanus, Becium filamentosum, Sida rhombifolia, Leucas glabrata, Erica* species, *Ocimum gratissimum, Commelina africana, Lantana rugosa, Tephrosia polystachya, Hibiscus micranthus, Alternanthera pungens, Solanum coccineum, Leucas neuflizeana, Justicia protracta, Wedelia* species, *Rhynchosia minima, Abutilon fruticosum, Ocimum americanum, Ruellia patula, Senna occidentalis*.

Dominant / prominent species

The dominant woody plants are: *Combretum imberbe, Lippia javanica, Acacia tortilis* (Species Group A), *Diospyros mespiliformis, Euclea schimperi, Grewia flavescens, Flueggea virosa, Gymnosporia senegalensis, Dichrostachys cinerea, Philenoptera violacea, Acalypha indica, Ziziphus mucronata, Euclea divinorum, Rhus gerrardii, Ehretia rigida, Combretum hereroense, Grewia hexamita, Acacia robusta, Phyllanthus reticulatus, Acacia nigrescens, Spirostachys africana, Grewia monticola, Pavetta catophylla, Breonadia salicina, Berchemia discolor, Ficus sycomorus, Dovyalis caffra, Kigelia africana, Xanthocercis zambesiaca, Nuxia oppositifolia, Salix mucronata* (Species Group C).. The dominant grasses are: *Urochloa mosambicensis* (Species Group A), *Panicum maximum* (Species Group C). The dominant forbs are: *Solanum panduriforme, Tragia dioica, Melhania forbesii* (Species Group A), *Thunbergia dregeana, Achyranthes aspera, Barleria elegans, Justicia flava, Abutilon ramosum, Jasminum fluminense, Hypoestes aristata, Sida dregei* (Species Group C).

15. *Schotia brachypetala – Diospyros mespiliformis* riparian forest

Geomorphology

The *Schotia brachypetala – Diospyros mespiliformis* riparian forest is mostly associated with the granite/gneiss and Karoo sedimentary rock sections of the Sabie and Crocodile rivers.

Climate

Rainfall ranges from 550 to 650 mm per year (Gertenbach 1980).

Soil

The dominant soil is the Sterkspruit Soil Form.

Vegetation

Dataset 1: 9 relevés; dataset 2: 0 relevés.

The *Schotia brachypetala–Diospyros mespiliformis* riparian forest plant community shares numerous species with the *Ochna natalitia–Diospyros mespiliformis* Woodland of the Sabie River system (Bredenkamp *et al*. 1991a), as well as the *Kraussia floribunda–Trichilia emetica* Moist Riparian Forest and Woodland and the *Acacia tortilis– Trichilia emetica* of the Crocodile River system (Bredenkamp *et al*. 1991b). These communities represent the broad zone of wet riparian forest, mostly associated with the granite and Karoo sedimentary rock sections of the Sabie and Crocodile rivers.

Diagnostic species

The following species were recorded as diagnostic species for this community and are presented in Table 7 (Species Group B). The diagnostic woody plants include: *Schotia brachypetala, Rhoicissus tridentata, Mystroxylon aethiopica, Gymnosporia tenuispina, Pappea capensis, Manilkara mochisia, Ochna natalitia, Elaeodendron transvaalense, Kraussia* species, *Teramnus labialis, Combretum apiculatum, Rhus pyroides, Dombeya rotundifolia, Priva cordifolia, Syzygium cordatum, Flacourtia indica*. The diagnostic grasses include: *Panicum deustum*. The diagnostic forbs include: *Cyphostemma simulans, Rhynchosia caribaea, Cheilanthes viridis, Asparagus minutiflorus, Stylochiton natalensis*.

Dominant / prominent species

The dominant woody plants are: *Schotia brachypetala, Rhoicissus tridentata, Mystroxylon aethiopica, Gymnosporia tenuispina, Pappea capensis, Manilkara mochisia* (Species Group B), *Diospyros mespiliformis, Euclea schimperi, Grewia flavescens, Flueggea virosa, Gymnosporia senegalensis, Dichrostachys cinerea,* Philenoptera violacea, *Acalypha indica, Ziziphus mucronata, Euclea divinorum, Rhus gerrardii, Ehretia rigida, Combretum hereroense, Grewia hexamita, Acacia robusta, Phyllanthus reticulatus, Acacia nigrescens, Spirostachys africana, Grewia monticola,* *Pavetta catophylla, Breonadia salicina, Berchemia discolor, Ficus sycomorus, Dovyalis caffra, Kigelia africana, Xanthocercis zambesiaca, Nuxia oppositifolia, Salix mucronata* (Species Group C). The dominant grasses are: *Panicum deustum* (Species Group B), *Panicum maximum* (Species Group C). The dominant forbs are: *Cyphostemma simulans, Rhynchosia caribaea, Cheilanthes viridis, Asparagus minutiflorus, Stylochiton natalensis* (Species Group B), *Thunbergia dregeana, Achyranthes aspera, Barleria elegans, Justicia flava, Abutilon ramosum, Jasminum fluminense, Hypoestes aristata* (Species Group C).

Table 7 Phytosociological table of the southern district of the KNP (part 4) - plant communities of the riverine thickets and forests

Association number	**14**																**15**									
Relevé number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	0	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	0	0	0	0	1	1	2	2	2	3
	5	0	2	3	4	4	5	3	4	4	5	5	5	6	1	4	4	6	8	9	6	7	1	4	8	5
	5	3	8	3	5	6	3	9	2	6	0	1	6	0	1	3	6	9	6	5	2	4	7	4	9	0
Species Group A																										
Diagnostic species of the *Combretum imberbe - Philenoptera violacea* dry riparian woodland																										
Urochloa mosambicensis	1	a	a	1	3	1	a	1	1	a	1	1	+	+		1										
Combretum imberbe	b	+				3		1	a	b	a		1	1	b											1
Lippia javanica			1	1		1	1	a		a	1			+		1										
Solanum panduriforme			1			+	1		1	1	1		1		1	+		1					+			
Tragia dioica	+	+	+			+				1	1				+	+		+				+				
Melhania forbesii			a						a	a	1		1	+		+										
Acacia tortilis			1	1	a									a	1	1										
Sporobolus fimbriatus			1	1						1	a				a	+										
Abutilon austro-africanum			+			+			+	+		+	+						+							
Cucumis africanus			1	1	1	+									+	+		1					+			
Becium filamentosum			1	+						1	1			+												
Sida rhombifolia					+			1	+	+						+								1		
Leucas glabrata	+	+	1			+									1				+							
Grewia bicolor									1	1		+	1	a			1								+	
Sclerocarya birrea subsp. *caffra*					1	1				1					1											
Cenchrus ciliaris						1			r	1			+													
Erica species				+				1	+					+												
Ocimum gratissimum				a					1			1	1									1				
Commelina africana				+		a							+		+				+							
Sporobolus africanus							a	+	+			+												+		
Dalbergia melanoxylon			1			1				a		+					1					a				
Lantana rugosa	+			1		1							+						1						+	
Strychnos spinosa			a				1				1															
Tephrosia polystachya	+	+					+																			
Hibiscus micranthus			1			1					+															
Eragrostis superba										1		+			+											
Grewia villosa			1							1		1														
Bothriochloa insculpta	1			3					+																	
Alternanthera pungens									a		+	+														
Solanum coccineum			1	1				+																		
Leucas neuflizeana			+								+		1													
Chloris virgata		+							1					+												
Justicia protracta									+	+			1													
Acacia xanthophloea				3			+								1											
Bothriochloa radicans							1			1					+											
Wedelia species										1	1		+													
Rhynchosia minima							+			r			+													
Loeseneriella crenata							+		1				+													1
Abutilon fruticosum				+	1											+					+					
Ocimum americanum			a				1									+							1			
Ruellia patula		+		1											1						+					
Senna occidentalis							1		r			+												r		
Themeda triandra	a									a						1			1				1			
Trichilia emetica								+			a															

	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
Species Group B																										
Diagnostic species of the *Schotia brachypetala* - *Diospyros mespiliformis* riparian forest																										
Schotia brachypetala						1											3	1	3	b		3	a		b	4
Rhoicissus tridentata																	+	1	+		1	a	1		1	+
Mystroxylon aethiopica																	1	a	1	1		+	a		1	
Panicum deustum								3			1								+			a	1	1	1	
Gymnosporia tenuispina									+				+					1	+			+	a		1	
Pappea capensis	+												+				+	+	1			+			+	
Cyphostemma simulans	+																		+	+		1	1			
Manilkara mochisia													+					+	1		1			1		
Ochna natalitia																	1					+	r	+		
Elaeodendron transvaalense																					a	+	a			+
Rhynchosia caribaea	1		+										+			+	+					1			1	+
Cheilanthes viridis														+									1		+	+
Kraussia species								+									a			1				b		
Teramnus labialis																					+	+	1			
Asparagus minutiflorus																		+		1			1			
Stylochiton natalensis																					+	+	+			
Combretum apiculatum																	1	1							+	
Rhus pyroides																				1		+	+			
Dombeya rotundifolia																	1			+	+					
Priva cordifolia																							+		+	+
Syzygium cordatum																	1							1		
Flacourtia indica																				+				+		
Species Group C																										
Panicum maximum	a	3	3	1	3	4	a	a	3	3	4	3	4	4	4	4	a	4	4	4	a	b	3	1	1	3
Diospyros mespiliformis	+	+	1		1	1		+	1	1	b	b	+	+	+		3	4	+	a	b	b	1	1	b	1
Euclea schimperi	1	+	1		+	+	1	r	+		1		+				a	1	1	+	r	1	a	1	+	1
Grewia flavescens	a		1			+	1	1	1	a	+	1	+	1			1	1		+	+	+	1	1		
Flueggea virosa		+		1	+	1	1	1		1	+	+	+	+		1				+		+	+		+	+
Thunbergia dregeana	1			1	+	+		+	a		+			+	+	a		1	+	1		1	a			+
Gymnosporia senegalensis	a	+		a	1	1	1	1	1			1		a		1		a				1	1	+	1	
Achyranthes aspera	1	+		1	a	1		1				a			+	1	1	a	a		1				+	+
Dichrostachys cinerea			a			+	1	+	a	a	1	1	1	a	1	+				+		1	1	1		
Barleria elegans	1				+	a				1	1		+	+			1	1	1		1		1		1	1
Philenoptera violacea	1	1		1	1	1		1		1	+	+		1	+	1	a					1			+	
Acalypha indica	1		1			+			1	1	1	+	1	+		a		1			+				1	+
Ziziphus mucronata					a	1			1		+		+					1	+	1		+	+	+	+	
Euclea divinorum	a	1		1	+				1				+					1	a	+	1	a	1			
Rhus gerrardii	a			1		+							+	+			1	1	+	1	+			+		
Ehretia rigida	+		+		+	+			+	1		+	+					+	+			a			+	
Justicia flava	+			a			1		1	1			+	1	+	+		+	a			b				
Abutilon ramosum				+	+	+		1	a		a	a		a	+		+	a		+						
Combretum hereroense	1	1				+			1			1	1			1		a		1		1			1	
Grewia hexamita	1		+			1		+	1			+	+	1				1			+					+
Acacia robusta			1				b			1	1		1		1		3						1	+	+	
Phyllanthus reticulatus							a	+	+	+		+			+		1	+				+		1		
Acacia nigrescens	1	1				a					a		b	1				+	a						1	1
Jasminum fluminense	+					+	1			+								+		1		a		1	+	
Spirostachys africana						a				1		b	a				3		3	+	a					1
Grewia monticola			1							1	+	1								+	+	+	+			
Pavetta catophylla									+		+		+	+								+	+	+		1
Breonadia salicina							1		1		1	1					1			1				a		1
Hypoestes aristata								1			1	+		a			b			1	1		+			
Sida dregei	+											+		+		+			+	1		+			+	
Berchemia discolor								1	b			+								b		+	b		+	
Maerua parvifolia						+							+			+	+								+	+

Asparagus plumosus						+			+				+								+				+	+
Ficus sycomorus								1				a			1		1			1				1		
Dovyalis caffra													1			+				+						1
Kigelia africana			3					1									b			a						
Xanthocercis zambesiaca											a	1														+
Nuxia oppositifolia								1				1												1		
Salix mucronata							a					1												1		

CONCLUSION

The main aim of this study was to breathe new life into historical data. This aim was successfully accomplished. However, this was only achieved due to expert knowledge of the vegetation of the study area as well as an in depth knowledge of the strengths and weaknesses of the Braun-Blanquet survey technique. The "old" and "new" datasets had to be evaluated critically with regard to variations found between the two. The reasons for these discrepancies was investigated and assessed before conclusions could be made with regard to the description of plant communities.

The initial TWINSPAN classification of the combined dataset resulted in a distinct separation between relevés of the "old" dataset and relevés of the "new" dataset, even though some of them clearly represented similar plant communities. Numerical classifications of floristic datasets are strongly influenced by the presence/absence of species. After an in-depth examination of the classification results, it became evident that the division between the temporally separated datasets was derived due to the presence/absence of numerous annual and weak perennial herbaceous species (e.g. biennial species). The recorded differences in the herbaceous species composition were mainly due to differences in rainfall in the study area over the two different surveying periods. Mean annual rainfall recorded during collection of the "old" dataset was 656 mm, whereas mean annual rainfall recorded during collection of the "new" dataset was 462 mm. These differences had profound impacts on the species composition and cover abundance values of the field layer. Annual and certain weak perennial species have the ability to respond quickly to variation in rainfall or cyclic drought events.

In arid regions, annual herbaceous species are considered of less importance than woody or perennial plants for vegetation descriptions. The reasoning behind this is found in the fact that the woody layer is considered the more stable component of the ecosystem, and the herbaceous layer is considered the more dynamic component of the ecosystem. Therefore, the decision was made to place emphasis on persistent woody species and to minimise the role of annual herbaceous species. These subjective decisions on the importance of individual species required expert knowledge of the ecosystem and the way in which species react to water availability.

In a subsequent phase of the study all annual species were removed from the combined dataset before re-classification took place. This classification resulted in vegetation units that contain relevés from both the "new" and "old" datasets. Once this process of merging the old and new datasets was successfully completed, the process of ecological interpretation of the combined dataset could commence. The resultant 15 plant communities could be interpreted ecologically within the abiotic and biotic environments. The most important environmental driving factors were identified, described and evaluated for the various plant communities. The aim of reviving old floristic data by augmentation with new floristic data was therefore successfully achieved. Important issues were highlighted and re-emphasised with regard to phytosociology in semi-arid savannas. The following valuable lessons were identified:

- Expert knowledge of an ecosystem is required in order to compare old and new floristic datasets of a given area.
- The Braun-Blanquet method, with its focus on total floristic composition, is an invaluable tool for descriptive vegetation studies.
- The subjective nature of the Braun-Blanquet method complicates detailed comparisons between floristic datasets, making the more absolute quantitative methods more suitable for these purposes.
- Successful interpretation and comparison of floristic datasets compiled with the Braun-Blanquet method can be achieved successfully if used within the context of the strengths and weaknesses of this method.
- The herbaceous layer within semi-arid event-driven systems is highly dynamic and complicates comparison of study areas over time.

Additional observations highlighted during this study:

- The importance of the safe storage of data.
- The importance of accurate and detailed environmental data for the ecological interpretation of vegetation data.
- The importance of prompt analyses and interpretation of data.
- The importance of scale at which sampling and interpretation is done respectively.

- The importance of conducting vegetation research in the optimal season.
- The importance of community level vegetation studies, as opposed to landscape level vegetation studies:
- The value of annual monitoring of the herbaceous layer based on total floristic composition in order to determine cyclic changes due to rainfall, herbivory and fire.
- The value of long-term monitoring projects to determine changes in species composition and cover abundance values of woody species.

Challenges encountered during project:

- The inability of TWINSPAN to assign higher importance to selected species.
- The amount of interpretation and expert knowledge required to conduct comparative vegetation research when dealing with descriptive methods.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

ACKNOWLEDGEMENTS

Thanks to Prof. George Bredenkamp for his advice and valuable guidance.

The Kruger National Park staff assisted in various ways in this project, I would specifically like to thank the following for valuable information, as well as their time and friendly assistance:

- Dr. Holger C. Eckhardt
- Dr. Freek Venter
- Nick Zambatis
- Sandra MacFadyen

Thanks to Theo Mostert and Franci Siebert who provided invaluable insight into the interpretation of the data.

Thank you for the use of photographic material, which was taken by John Janssen of Alterra Research (University of Wageningen) for the SynBioSys Kruger Project.

REFERENCES

ACOCKS, J.P.H. 1988. Veld Types of South Africa (3rd Ed.). *Memoirs of the Botanical Survey of South Africa* 57: 1–146.

BARBOUR, M.G., BURK, J.H., & PITTS W.D. 1987. *Terrestrial Plant Ecology*. (2nd Ed.). Benjamin/Cummings, California.

BARKMAN, JJ. MORAVEC, J. & RAUSCHERT, S. 1986. Code of phytosociological nomenclature. *Vegetatio* 32: 131–185.

BEHR, C.M. & BREDENKAMP, G.J. 1988. A phytosociological classification of the Witwatersrand National Botanical Garden. *South African Journal of Botany* 54: 525–533.

BELSKY, A.J. 1994. Influences of trees on savanna productivity: tests of shade, nutrients, and tree-grass competition. *Ecology* 75(4): 922–932.

BRADY, N.C. & WEIL, R.R. 1999. *The Nature and Properties of Soils.* (12th Ed.). Prentice Hall, New Jersey.

BREDENKAMP, G.J. 1982. *'n Plantekologise studie van die Manyeleti-wildtuin*. D.Sc. verhandeling. Universiteit van Pretoria, Pretoria.

BREDENKAMP, G.J. & BROWN, L.R. 2001. Vegetation – a reliable tool for environmental planning. *Urban Green File* Nov/Dec: 38–39.

BREDENKAMP, G.J. & BROWN, L.R. 2006. Vegetation type and dynamics in African savannas. Bericht der Reinh.-Tüxen-Gesellschaft. Rintelner Symposium VIII. 18, 69–82. Hannover.

BREDENKAMP, G.J. & DEUTSCHLÄNDER, M.S. 1995. New azonal syntaxa from the hills and river banks of the Manyeleti Game Reserve, Northern Transvaal Province, South Africa. *Koedoe* 38 (1): 41–58.

BREDENKAMP, G.J., JOUBERT, A.F. & BEZUIDENHOUT, H. 1989. A reconnaissance survey of the vegetation of the plains in the Potchefstroom-Fochville-Parys Area. *South African Journal of Botany* 55: 199–206.

BREDENKAMP, G.J., BROWN, L.R., GROBLER, C. & CUSTERS, M. 2001. Vegetation – more than just a species list!. *International Association for Impact Assessment South Africa (IAIASA) Newsletter* Nov: 4.

BREDENKAMP, G.J., BROWN, L.R., SIEBERT, F. *in prep*. Gradients between equilibrium and nonequilibrium dynamics in southern African savannas.

BREDENKAMP, G.J., VAN ROOYEN, N. & THERON, G.K. 1991a. A survey of the riparian vegetation of the Sabie River in the Kruger National Park. Vegetation report by Ecotrust Environmental Consultants, University of Pretoria, Pretoria.

BREDENKAMP, G.J., VAN ROOYEN, N. & THERON, G.K. 1991b. A survey of the vegetation of the Crocodile River in the Kruger National Park. Vegetation report by Ecotrust Environmental Consultants, University of Pretoria, Pretoria.

BREWER, R. 1994. *The Science of Ecology* (2nd Ed.). Saunders College Publishing, Philidelphia.

BROWN, L.R. 1997. *A Plant Ecological Study and Wildlife Management Plan of the Borakalalo Nature Reserve, North-West Province*. PhD thesis, University of Pretoria.

CODD, L.E.W. 1951. Bome en struike van die Nasionale Kruger-Wildtuin. *Plantkundige Opname Pamflet* no. 26: 1–192.

COETZEE, B.J., 1983. *Phytosociology, Vegetation Structure and Landscapes of the Central District, Kruger National Park, South Africa*. Dissertationes Botanicae 69: 1–456.

COETZEE, B.J., ENGELBRECHT, A.H., JOUBERT, S.C.J. & RETIEF, P.F. 1979. Elephant impact on *Sclerocarya caffra* trees in *Acacia nigrescens* Tropical Plains Thornveld of the Kruger National Park, South Africa. *Koedoe* 22: 39–60.

COETZEE, B.J., GERTENBACH, W.P.D. & NEL, P.J. 1977. Korttermyn plantegroeistruktuurveranderings op basalt in die Sentrale Distrik, Nasionale Krugerwiltuin. *Koedoe* 20: 53–65.

CUMMING, D.H.M. 1982. The Influence of Large Herbivores on Savanna Structure in Africa. Pp 217–245. *In:* HUNTLEY, B.J. & WALKER, B.H. (Eds.). *Ecology of Tropical Savannas*. Springer-Verlag, Berlin.

DAUBENMIRE, R. 1968. *Plant Communities: A Textbook of Plant Synecology.* Haper & Row, New York.

DEANGELIS, D.L. & WATERHOUSE, J.C. 1987. Equilibrium and nonequilibrium concepts in ecological models. *Ecological Monographs* 57(1): 1–21.

DENNIS, N.J. & SCHOLES, R.J. 1995. *The Kruger National Park: Wonders of an African Eden.* New Holland, London.

DU PLESSIS, F. 2001. *A Phytosociological synthesis of Mopaneveld.* MSc thesis, University of Pretoria, Pretoria.

FERTILIZER SOCIETY OF SOUTH AFRICA. 1974. *Manual of soil analysis methods Standardised methods used by laboratories of member companies of the FSSA* (3rd Ed.). FSSA Publication no. 37. Fertilizer Society of South Africa, Pretoria.

FULS, E.R., G.J. BREDENKAMP, N. VAN ROOYEN & G.K. THERON 1993. The physical environment and major plant communities of the Heilbron-Lindley-Warden-Villiers area, northern Orange Free State. *South African Journal of Botany* 59: 345–359.

GAUCH, H.G. 1982. *Multivariate analysis in community ecology*. Cambridge University Press, Cambridge

GERMISHUIZEN, G. & N.L. MEYER (Eds.) 2003. Plants of southern Africa: an annotated checklist. *Strelitzia* 14:1–1231.

GERTENBACH, W.P.D. 1978. *Plantgemeenskappe van die Gabbro-kompleks in die noordweste van die Sentrale Distrik van die Nasionale Krugerwildtuin*. MSc. thesis. Potchefstroomse Universiteit vir Christelike Hoër Onderwys.

GERTENBACH, W.P.D. 1980. Rainfall patterns in the Kruger National Park. *Koedoe* 23: 35–43.

GERTENBACH, W.P.D. 1987. *'n Ekologiese studie van die suidelikste Mopanieveld in die nasionale Krugerwildtuin*. D.Sc. thesis. University of Pretoria.

GERTENBACH, W.P.D., 1983. Landscapes of the Kruger National Park. *Koedoe* 26: 9–121.

GIVEN, D.R. 1994. *Principles and Practice of Plant Conservation*. Chapman & Hall, London.

GOVENDER, N. TROLLOPE, W.S.W. & VAN WILGEN, B.W. 2006. The effect of fire, season, fire frequency, rainfall and management on fire intensity in savanna vegetation in South Africa. *Journal of Applied Ecology* 43: 748–758.

GUY, P.R. 1981. Changes in the biomass and productivity of woodlands in the Sengwa Wildlife Research Area, Zimbabwe. *Journal of Applied Ecology* 18:507–519.

HARMSE, H.J. VON M. & VAN WYK, P. 1972. Verkenningsgrondkaart van die Suidelike Distrik van die Nasionale Kruger Wildtuin. Unpublished map. Univiversity of Potchefstroom for CHE, Potchefstroom.

HARMSE, H.J. VON M., VAN WYK, P. & GERTENBACH, W.P.D. 1974. Verkenningsgrondkaart van die noordelike gedeelte van die Krugerwildtuin. Unpublished map. University of Potchefstroom for CHE, Potchefstroom.

HENNEKENS, S. 1996. *TURBOVEG: Software package for input, processing, and presentation of phyosociological data. User's guide*. IBN-DLO. University of Lancaster.

HENNEKENS, S.M. & J.H.J. SCHAMINEE. 2001. Turboveg, a comprehensive database management system for vegetation data. *Journal of Vegetation Science* 12: 589–591.

HIGGINS, S.I., BOND, W.J. & TROLLOPE, W.S.W. 2000. Fire, resprouting and variability: a recipe for grass-tree coexistence in savanna. *Journal of Ecology* 88: 213–229.

HILL, M.O., 1979a. TWINSPAN - a FORTRAN Program for arranging multivariate data in an ordered two way table by classification of individuals and attributes. Cornell University Ithaca, New York.

HILL, M.O. 1979b. DECORANA - a FORTRAN program for detrended correspondence analysis and reciprocal averaging. Cornell University Ithaca, New York.

HUNTLEY, B.J. 1982. Southern African Savannas. Pp 101–119. *In:* HUNTLEY, B.J. & WALKER B.H. (Eds.). *Ecology of Tropical Savannas*. Springer-Verlag, Berlin.

JACANA EDUCATION. 1995. *Nasionale Krugerwildtuin: Wildtuin Ervaring* (2nd Ed.). Jacana, Johannesburg.

KENT, M. & COKER, P. 1992. *Vegetation Description and Analysis: A Practical Approach*. John Wiley & Sons, Chichester.

KNOOP, W.T. & WALKER, B.H. 1985. Interactions of woody and herbaceous vegetation in a southern African savanna. *Journal of Ecology* 73: 235–253.

KRAAIJ, T. & WARD, D. 2006. Effects of rain, nitrogen, fire and grazing on tree recruitment and early survival in bush-encroached savanna, South Africa. *Plant Ecology* 186(2): 235–246.

LAWS, R.M., PARKER, I.S.C. & JOHNSTONE, R.C.B. 1975. *Elephants and their Habitats*. Claredon Press, Oxford.

LAYCOCK, W.A. 1991. Stable states and thresholds of range condition on North American rangelands: A viewpoint. *Journal of Range Management* 44(5): 427–433.

LOW, A.B. & REBELO, A.G. 1996. *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs & Tourism, Pretoria.

LUDWIG, F., DE KROON, H., PRINS, H.H.T. & BERENDSE, F. 2001. Effects of nutrients and shade on tree-grass interactions in an East African savanna. *Journal of Vegetation Science* 12: 579–588.

MACVICAR, C.N., BENNIE, A.T.P. & DE VILLIERS, J.M. 1991. *Soil classification: A taxonomic system for South Africa*. Department of Agricultural Development, Pretoria.

MEDINA, E. 1987. Requirements, conservation and cycles of nutrients in the herbaceous layer. Pp39–65. *In:* WALKER, B.H. (Ed.). *Determinants of tropical savannas*. ICSU Press. Miami.

MENTIS, M.T., GROSSMAN, D., HARDY, M.B. O'CONNOR, T.G. & O'REAGAIN, P.J. 1989. Paradigm shifts in South African range science, management and administration. *South African Journal of Science* 85: 684–687.

MUCINA, L. RUTHERFORD, M.C. & POWRIE, L.W. (eds) 2005. Vegetation Map of South Africa, Lesotho and Swaziland, 1:1,000,000 scale sheet maps, South African National Biodiversity Institute, Pretoria. ISBN 1-919976-22-1.

OWEN-SMITH, R.N. 1988. *Megaherbivores: The influence of very large body size on ecology*. Cambridge University Press, Cambridge.

PIENAAR, U DE V. 1963. The large mammals of the Kruger National Park – their distribution and present-day status. *Koedoe* 6:1–37.

SANKARAN, M., HANAN, N.P., SCHOLES, R.J., RATNAM, J., AUGUSTINE, D.J., CADE, B.S., GIGNOUX, J., HIGGINS, S.I., LE ROUX, X., LUDWIG, F., ARDO, J., BANYIKWA, F., BRONN, A., BUCINI, G., CAYLOR, K.K., COUGHENOUR, M.B., DIOUF, A., EKAYA, W., FERAL, C.J., FEBRUARY, E.C., FROST, P.G.H., HIERNAUX, P., HRABAR, H., METZGER, K.L., PRINS, H.H.T., RINGROSE, S., SEA, W., TEWS, J., WORDEN, J., & ZAMBATIS, N. 2005. Determinants of woody cover in African savannas. *Nature* 438(8): 846–849.

SCHOLES, R.J. 1997. Savanna. Pp 258–277. *In:* COWLING, R.M., RICHARDSON, D.M., & PIERCE, S.M. (Eds.). *Vegetation of Southern Africa*. Cambridge University Press, Cambridge.

SCHOLES, R.J., BOND, W.J. & ECKHARDT, H.C. 2003. Vegetation Dynamics in the Kruger Ecosystem. Pp 242–262. *In:* DU TOIT, J.T., ROGERS, K.H. & BIGGS, H.C. (Eds). *The Kruger Experience: Ecology and Management of Savanna Heterogeneity*. Island Press, Washington.

SCHOLES, R.J. & WALKER, B.H. 1993. *An African Savanna: Synthesis of the Nylsvley Study*. Cambridge University Press, Cambridge.

SCHUTTE, I.C. 1974. 'n Geologiese verkenningsopname van die Noord-Sentrale gedeelte van die Nasionale Krugerwildtuin. Pretoria: Geological Survey.

SCHUTTE, I.C. 1982. Eerste verslag oor die geologie van die Suid-Sentrale gebied, Nasionale Krugerwildtuin, Pretoria: Geological Survey.

SIEBERT, S.J. 2001. *Vegetation on the ultramafic soils of the Sekhukhuneland Centre of Endemism*. Ph.D thesis, University of Pretoria, Pretoria.

SKARPE, C. 1992. Dynamics of savanna ecosystems. *Journal of Vegetation Science* 3: 293–300.

STUART-HILL, G.C. & TAINTON, N.M. 1989. The competitive interaction between *Acacia karroo* and the herbaceous layer and how this is influenced by defoliation. *Journal of Applied Ecology* 26: 285–298.

SWART, L.P.J. & MARTENS J.C. 1994. Guidelines to veld burning in mixed and sweetveld and sourveld areas of the Eastern Cape. *Döhne Information System (DIS): Information Bulletin July*: 1–7.

TAINTON, N.M. & WALKER, B.H. 1993. Grasslands of Southern Africa. Pp265–290. *In:* COUPLAND, R.T. (Ed.). *Ecosystems of the world (vol. 8B) Eastern Hemisphere and résumé*. Elsevier, Amsterdam.

TROLLOPE, W.S.W. 1990. Veld management with specific reference to game ranching in the grassland and savanna areas of South Africa. *Koedoe* 33(2): 77–86.

TROLLOPE, W.S.W. 1993. Fire regime of the Kruger National Park for the period 1980–1992. *Koedoe* 36(2): 45–52.

TROLLOPE, W.S.W., TROLLOPE, L.A., BIGGS, H.C., PIENAAR, D. & POTGIETER, A..L.F. 1998. Long-term changes in the woody vegetation of the Kruger National Park, with special reference to the effects of elephants and fire. *Koedoe* 41(2): 103 112.

VAN DER MAAREL, E. 1996. Vegetation dynamics and dynamic vegetation science. *Acta Bot. Neerl.* 45(4): 421–442.

VAN DER MEULEN, F. 1979. *Plant sociology of the western Transvaal Bushveld, South Africa. A syntaxonomical and synecological study*. Dissertationes Botanicae 49: 1–192.

VAN DER SCHIJFF, H.P. 1957. *'n Ekologiese Studie van die Flora van die Nasionale Krugerwildtuin*. Deel 1. D.Sc thesis. Potchefstroomse Universiteit vir Christelike Hoër Onderwys.

VAN OUDTSHOORN, F. 1999. *Guide to grasses of southern Africa*. Briza, Pretoria.

VAN ROOYEN, N., 1978. *'n Ekologiese studie van die plantegemeenskappe van die Punda Milia-Pafuri-Wambiyagebied in die Nasionale Kruger Wildtuin.* M.Sc. thesis, University of Pretoria.

VAN STADEN, P.J. & G.J. BREDENKAMP 2006. A floristic analysis of forest and thicket vegetation of the Marakele National Park. *Koedoe* 49(1): 15–31.

VAN WILGEN, B.W., BIGGS, H.C., O'REGAN, S.P. & MARÈ, N. 2000. A fire history of the savanna ecosystems in the Kruger National Park, South Africa, between 1941 and 1996. *South African Journal of Science* April 96: 167–178.

VAN WILGEN, B.W. & SCHOLES, R.J. 1997. The vegetation and fire regimes of southern hemisphere Africa. Pp 27–46. *In:* VAN WILGEN, B.W., ANDREAE, M.O., GOLDAMMER, J.G., & LINDESAY, J.A. (Eds.). *Fire in Southern African Savannas: Ecological and Atmospheric Perspectives*. Witwatersrand University Press, Johannesburg.

VAN WYK, P. 1972. *Trees of the Kruger National Park.* Volume I and II. Cape Town: Purnell.

VENTER, F.J. 1981. *Grondtipes van die Swenispruit-Opvanggebied.* M.Sc. thesis. University of Potchefstroom for CHE, Potchefstroom.

VENTER, F.J. 1990. *A classification of Land for management planning in the Kruger Naional Park*. Ph.D. thesis. University of South Africa.

WEBBER, N.W. 1979. *The effects of fire on Soil-Plant Ecological relationships in the southern part of the Kruger National Park. A study in soil geography.* M.Sc. thesis. UNISA, Pretoria.

WERGER, M.J.A. 1974. On concepts and techniques applied in the Zürich-Montpellier method of vegetation survey. *Bothalia* 11(3): 309–323.

WESTHOFF, V. & VAN DER MAAREL, E. 1978. The Braun-Blanquet Approach. Pp. 287–399. *In:* WHITTAKER, R.H. (Ed.). *Classification of Plant Communities*. Dr W Junk, The Hague.

WESTOBY, M. 1979. Elements of a theory of vegetation dynamics in arid rangelands. *Israel Journal of Botany* 28: 169–194.

WESTOBY, M., WALKER, B. & NOY-MEIR, I. 1989. Range management on the basis of a model which does not seek to establish equilibrium. *Journal of Arid Environments* 17: 235–239.

WHITE, R.E. 1995. *Introduction to the Principles and Practice of Soil Science (*2nd Ed.). Blackwell Science, Oxford.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

APPENDICES

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

APPENDIX A

FIELD FORM:

Dr. Holger Eckhardt, Scientific Services (013) 735 4000 Liesl Joubert

KNP – Suidelike deel Perseelno.________ Datum:________

Veldtoestand:______________________

Notas: ____________________________

____

____

Topografie

GPS – lesing: O:_______________ H:_______________

S:_______________ WPT:_______________

Helling:____________________________ Aspek:_____________

Geologie / Landskap: A B C D E F G I

Rots: % bedekking:_________________ grootte:____________

Grond:____

Hoogte: boomlaag: __ struiklaag: __ graslaag: __

Bedekking: boomlaag: __ struiklaag: __ graslaag:__ Totaal:__

Grasse		**Kruide**		**Bome**	
Spesienaam	BW	Spesienaam	BW	Spesienaam	BW

APPENDIX B

PLANT SPECIES CHECKLIST

This is a plant species checklist of plants surveyed in the southern district of the Kruger National Park during phytosociological studies by the late Piet Van Wyk in the 1970's and Liesl Mostert in 2002 and 2003. This list contains 850 species represented by 108 families. Plant names follow Germishuizen & Meyer (2003).

Pteridophyta

EQUISETACEAE

Equisetum ramosissimum Desf.

MARSILEACEAE

Marsilea macrocarpa C.Presl

PTERIDACEAE

Cheilanthes hastata (L.f.) Kunze

Cheilanthes viridis (Forssk.) Sw.

SELAGINELLACEAE

Selaginella dregei (C.Presl) Hieron.

Dicotyledons

ACANTHACEAE

Asystasia gangetica (L.) T.Anderson subsp. *micrantha* (Nees) Ensermu

Asystasia subbiflora C.B.Clarke

Barleria affinis C.B.Clarke

Barleria delagoensis Oberm.

Barleria elegans S.Moore ex C.B.Clarke

Barleria holubii C.B.Clarke

Barleria obtusa Nees

Barleria oxyphylla Lindau

Barleria species

Barleria spinulosa Klotzsch

Blepharis integrifolia (L.f.) E.Mey. ex Schinz

Blepharis maderaspatensis (L.) Roth

Blepharis subvolubilis C.B.Clarke

Chaetacanthus burchellii Nees

Chaetacanthus costatus Nees

Crabbea angustifolia Nees

Crabbea hirsuta Harv.

Crabbea species

Crabbea velutina S.Moore

Crossandra fruticulosa Lindau

Crossandra greenstockii S.Moore

Dyschoriste rogersii S.Moore

Hypoestes aristata (Vahl) Sol. ex Roem. & Schult. var. *alba* K.Balkwill

Justicia anagalloides (Nees) T.Anderson

Justicia betonica L.

Justicia flava (Vahl) Vahl

Justicia petiolaris (Nees) T.Anderson

Justicia protracta (Nees) T.Anderson

Justicia species

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

Monechma debile (Forssk.) Nees

Monechma divaricatum (Nees) C.B.Clarke

Ruellia cordata Thunb.

Ruellia malacophylla C.B.Clarke

Ruellia patula Jacq.

Thunbergia atriplicifolia E.Mey. ex Nees

Thunbergia dregeana Nees

Thunbergia neglecta Sond.

AMARANTHACEAE

Achyranthes aspera L.

Achyropsis leptostachya (E.Mey. ex Meisn.) Baker & C.B.Clarke

Aerva leucura Moq.

Alternanthera pungens Kunth

Amaranthus thunbergii Moq.

Cyathula lanceolata Schinz

Gomphrena celosioides Mart.

Hermbstaedtia odorata (Burch.) T.Cooke var. *odorata*

Hermbstaedtia species

Kyphocarpa angustifolia (Moq.) Lopr.

Pupalia lappacea (L.) A.Juss. var. *lappacea*

ANACARDIACEAE

Lannea discolor (Sond.) Engl.

Lannea edulis (Sond.) Engl. var. *edulis*

Lannea schweinfurthii (Engl.) Engl. var. *stuhlmannii* (Engl.) Kokwaro

Lannea species

Ozoroa engleri R.& A.Fern.

Ozoroa insignis Delile subsp. *reticulata* (Baker f.) J.B.Gillett

Ozoroa species

Ozoroa sphaerocarpa R.& A.Fern.

Rhus gerrardii (Harv. ex Engl.) Diels

Rhus gueinzii Sond.

Rhus leptodictya Diels

Rhus pentheri Zahlbr.

Rhus pyroides Burch.

Rhus transvaalensis Engl.

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

ANNONACEAE

Annona senegalensis Pers. subsp. *senegalensis*

APIACEAE

Centella asiatica (L.) Urb.

APOCYNACEAE

Acokanthera oppositifolia (Lam.) Codd

Adenium multiflorum Klotzsch

Adenium swazicum Stapf

Asclepias albens (E.Mey.) Schltr.

Asclepias eminens (Harv.) Schltr.

Aspidoglossum interruptum (E.Mey.) Bullock

Carissa bispinosa (L.) Desf. ex Brenan

Carissa tetramera (Sacleux) Stapf

Ceropegia carnosa E.Mey.

Ceropegia crassifolia Schltr. var. crassifolia

Cryptolepis obtusa N.E.Br.

Cynanchum gerrardii (Harv.) Liede

Cynanchum schistoglossum Schltr.

Fockea angustifolia K.Schum.

Gomphocarpus fruticosus (L.) Aiton f.

Gomphocarpus tomentosus Burch. subsp. *tomentosus*

Kanahia laniflora (Forssk.) R.Br.

Orbea miscella (N.E.Br.) Meve

Pachycarpus concolor E.Mey.

Pergularia daemia (Forssk.) Chiov.

Raphionacme flanaganii Schltr.

Raphionacme procumbens Schltr.

Raphionacme velutina Schltr.

Sarcostemma viminale (L.) R.Br. subsp. *viminale*

Secamone parvifolia (Oliv.) Bullock

Xysmalobium asperum N.E.Br.

ARALIACEAE

Cussonia spicata Thunb.

ASTERACEAE

Acanthospermum australe (Loefl.) Kuntze

Acanthospermum hispidum DC.

Ageratum conyzoides L.

Aspilia mossambicensis (Oliv.) Wild

Aspilia natalensis (Sond.) Wild

Aspilia pluriseta Schweinf. subsp. *pluriseta*

Athanasia sertulifera DC.

Athrixia phylicoides DC.

Bidens bipinnata L.

Bidens pilosa L.

Calostephane divaricata Benth.

Conyza obscura DC.

Dicoma tomentosa Cass.

Emilia transvaalensis (Bolus) C.Jeffrey

Geigeria burkei Harv.

Geigeria ornativa O.Hoffm.

Geigeria species

Gerbera jamesonii Bolus ex Adlam

Gnaphalium species

Helichrysum allioides Less.

Helichrysum athrixiifolium (Kuntze) Moeser

Helichrysum nudifolium (L.) Less.

Helichrysum species

Laggera crispata (Vahl) Hepper & J.R.I.Wood

Litogyne gariepina (DC.) Anderb.

Macledium zeyheri (Sond.) S.Ortíz subsp. *zeyheri*

Nidorella resedifolia DC. subsp. *resedifolia*

Pegolettia senegalensis Cass.

Pseudoconyza viscosa (Mill.) D'Arcy

Pseudognaphalium luteo-album (L.) Hilliard & B.L.Burtt

Pseudognaphalium undulatum (L.) Hilliard & B.L.Burtt

Schkuhria pinnata (Lam.) Cabrera

Senecio erubescens Aiton var. *dichotomus* DC.

Senecio linifolius L.

Senecio pleistocephalus S.Moore

Senecio species

Sonchus oleraceus L.

Tagetes minuta L.

Vellereophyton species

Vernonia fastigiata Oliv. & Hiern

Vernonia glabra (Steetz) Vatke var. *laxa* (Steetz) Brenan

Vernonia natalensis Sch.Bip. ex Walp.

Vernonia oligocephala (DC.) Sch.Bip. ex Walp.

Vernonia poskeana Vatke & Hildebr.

Vernonia species

Wedelia species

Xanthium species

Zinnia peruviana (L.) L.

BALANITACEAE

Balanites maughamii Sprague subsp. *maughamii*

Balanites pedicellaris Mildbr. & Schltr. subsp. *pedicellaris*

BIGNONIACEAE

Kigelia africana (Lam.) Benth.

Rhigozum zambesiacum Baker

Tecoma capensis (Thunb.) Lindl.

BORAGINACEAE

Cordia grandicalyx Oberm.

Cordia monoica Roxb.

Ehretia amoena Klotzsch

Ehretia rigida (Thunb.) Druce subsp. *nervifolia* Retief & A.E.van Wyk

Heliotropium ciliatum Kaplan

Heliotropium steudneri Vatke

Heliotropium strigosum Willd.

BRASSICACEAE

Lepidium africanum (Burm.f.) DC. subsp. *africanum*

BUDDLEJACEAE

Nuxia oppositifolia (Hochst.) Benth.

BURSERACEAE

Commiphora africana (A.Rich.) Engl. var. *africana*

Commiphora glandulosa Schinz

Commiphora mollis (Oliv.) Engl.

Commiphora neglecta I.Verd.

Commiphora schimperi (O.Berg) Engl.

Commiphora species

CACTACEAE

Opuntia stricta Haw.

CAMPANULACEAE

Wahlenbergia denticulata (Burch.) A.DC.

Wahlenbergia undulata (L.f.) A.DC.

CAPPARACEAE

Boscia albitrunca (Burch.) Gilg & Gilg-Ben.

Boscia foetida Schinz subsp. *rehmanniana* (Pestal.) Toelken

Boscia mossambicensis Klotzsch

Capparis brassii DC.

Capparis tomentosa Lam.

Cleome angustifolia Forssk. subsp. *petersiana* (Klotzsch ex Sond.) Kers

Cleome maculata (Sond.) Szyszyl.

Cleome monophylla L.

Maerua angolensis DC.

Maerua juncea Pax subsp. *crustata* (Wild) Wild

Maerua parvifolia Pax

CARYOPHYLLACEAE

Corrigiola litoralis L. subsp. *litoralis* var. *litoralis*

Pollichia campestris Aiton

CELASTRACEAE

Elaeodendron transvaalense (Burtt Davy) R.H.Archer

Gymnosporia c.f. *glaucophylla* M.Jordaan

Gymnosporia senegalensis (Lam.) Loes.

Gymnosporia tenuispina (Sond.) Szyszyl.

Hippocratea species

Loeseneriella crenata (Klotzsch) N.Hallé

Maytenus undata (Thunb.) Blakelock

Mystroxylon aethiopicum (Thunb.) Loes. subsp. *schlechteri* (Loes.) R.H.Archer

Pristimera longipetiolata (Oliv.) N.Hallé

Putterlickia pyracantha (L.) Szyszyl.

CELTIDACEAE

Trema orientalis (L.) Blume

CHENOPODIACEAE

Chenopodium album L.

CHRYSOBALANACEAE

Parinari curatellifolia Planch. ex Benth.

CLUSIACEAE

Garcinia livingstonei T.Anderson

COMBRETACEAE

Combretum apiculatum Sond. subsp. *apiculatum*

Combretum collinum Fresen. subsp. *suluense* (Engl. & Diels) Okafor

Combretum erythrophyllum (Burch.) Sond.

Combretum hereroense Schinz

Combretum imberbe Wawra

Combretum microphyllum Klotzsch

Combretum molle R.Br. ex G.Don

Combretum mossambicense (Klotzsch) Engl.

Combretum zeyheri Sond.

Terminalia phanerophlebia Engl. & Diels

Terminalia prunioides M.A.Lawson

Terminalia sericea Burch. ex DC.

CONVOLVULACEAE

Convolvulus farinosus L.

Evolvulus alsinoides (L.) L.

Ipomoea albivenia (Lindl.) Sweet

Ipomoea bolusiana Schinz

Ipomoea coptica (L.) Roth ex Roem. & Schult.

Ipomoea crassipes Hook.

Ipomoea eriocarpa R.Br.

Ipomoea hochstetteri House

Ipomoea lapathifolia Hallier f.

Ipomoea magnusiana Schinz

Ipomoea obscura (L.) Ker Gawl. var. *obscura*

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

Ipomoea species

Jacquemontia tamnifolia (L.) Griseb.

Merremia palmata Hallier f.

Seddera capensis (E.Mey. ex Choisy) Hallier f.

Seddera suffruticosa (Schinz) Hallier f.

Xenostegia tridentata (L.) D.F.Austin & Staples subsp. *angustifolia* (Jacq.) Lejoly & Lisowski

CRASSULACEAE

Cotyledon barbeyi Schweinf. ex Baker

Cotyledon species

Crassula expansa Dryand.

Crassula hirsuta Schönland & Baker f.

Crassula species

Crassula vaginata Eckl. & Zeyh.

Kalanchoe lanceolata (Forssk.) Pers.

Kalanchoe paniculata Harv.

Kalanchoe species

CUCURBITACEAE

Acanthosicyos naudinianus (Sond.) C.Jeffrey

Citrullus lanatus (Thunb.) Matsum. & Nakai

Coccinia adoensis (A.Rich.) Cogn.

Coccinia rehmannii Cogn.

Corallocarpus bainesii (Hook.f.) A.Meeuse

Ctenolepis cerasiformis (Stocks) Hook.f.

Cucumis africanus L.f.

Cucumis hirsutus Sond.

Cucumis metuliferus E.Mey. ex Naudin

Cucumis species

Cucumis zeyheri Sond.

Kedrostis foetidissima (Jacq.) Cogn.

Momordica balsamina L.

Momordica boivinii Baill.

Momordica cardiospermoides Klotzsch

Mukia maderaspatana (L.) M.Roem.

Trochomeria macrocarpa (Sond.) Hook.f. subsp. *macrocarpa*

Zehneria scabra (L.f.) Sond. subsp. *scabra*

DIPSACACEAE

Scabiosa columbaria L.

EBENACEAE

Diospyros lycioides Desf.

Diospyros mespiliformis Hochst. ex A.DC.

Euclea crispa (Thunb.) Gürke subsp. *crispa*

Euclea divinorum Hiern

Euclea natalensis A.DC.

Euclea schimperi (A.DC.) Dandy

Euclea undulata Thunb.

ERICACEAE

Erica species

ERYTHROXYLACEAE

Erythroxylum delagoense Schinz

EUPHORBIACEAE

Acalypha indica L.

Acalypha punctata Meisn.

Acalypha segetalis Müll.Arg.

Acalypha villicaulis Hochst.

Antidesma venosum E.Mey. ex Tul.

Bridelia cathartica G.Bertol. subsp. *melanthesoides* (Baill.) J.Léonard var. *melanthesoides* forma *melanthesoides*

Croton gratissimus Burch.

Croton megalobotrys Müll.Arg.

Croton menyharthii Pax

Croton sylvaticus Hochst.

Dalechampia galpinii Pax

Euphorbia confinalis R.A.Dyer subsp. *confinalis*

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

Euphorbia hirta L.

Euphorbia ingens E.Mey. ex Boiss.

Euphorbia neopolycnemoides Pax & K.Hoffm.

Euphorbia prostrata Aiton

Euphorbia species

Euphorbia tirucalli L.

Flueggea virosa (Roxb. ex Willd.) Voigt subsp. virosa

Jatropha schlechteri Pax subsp. *schlechteri*

Jatropha variifolia Pax

Phyllanthus asperulatus Hutch.

Phyllanthus incurvus Thunb.

Phyllanthus maderaspatensis L.

Phyllanthus nummulariifolius Poir. var. *nummulariifolius*

Phyllanthus parvulus Sond.

Phyllanthus pentandrus Schumach. & Thonn.

Phyllanthus reticulatus Poir. var. *reticulatus*

Spirostachys africana Sond.

Tragia dioica Sond.

FABACEAE

Abrus precatorius L. subsp. *africanus* Verdc.

Acacia ataxacantha DC.

Acacia burkei Benth.

Acacia caffra (Thunb.) Willd.

Acacia erubescens Welw. ex Oliv.

Acacia exuvialis I.Verd.

Acacia gerrardii Benth. subsp. *gerrardii* var. *gerrardii*

Acacia grandicornuta Gerstner

Acacia hebeclada DC. subsp. *hebeclada*

Acacia karroo Hayne

Acacia nigrescens Oliv.

Acacia nilotica (L.) Willd. ex Delile subsp. *kraussiana* (Benth.) Brenan

Acacia robusta Burch. subsp. *clavigera* (E.Mey.) Brenan

Acacia schweinfurthii Brenan & Exell var. *schweinfurthii*

Acacia senegal (L.) Willd.

Acacia swazica Burtt Davy

Acacia tortilis (Forssk.) Hayne subsp. *heteracantha* (Burch.) Brenan

Acacia welwitschii Oliv. subsp. *delagoensis* (Harms) J.H.Ross & Brenan

Acacia xanthophloea Benth.

Aeschynomene micrantha DC.

Albizia forbesii Benth.

Albizia harveyi E.Fourn.

Albizia petersiana (Bolle) Oliv. subsp. *evansii* (Burtt Davy) Brenan

Albizia versicolor Welw. ex Oliv.

Alysicarpus rugosus (Willd.) DC. subsp. *rugosus*

Alysicarpus vaginalis (L.) DC. var. *vaginalis*

Argyrolobium transvaalense Schinz

Bauhinia galpinii N.E.Br.

Bolusanthus speciosus (Bolus) Harms

Canavalia virosa (Roxb.) Wight & Arn.

Cassia abbreviata Oliv. subsp. *beareana* (Holmes) Brenan

Cassia species

Chamaecrista comosa E.Mey. var. *capricornia* (Steyaert) Lock

Chamaecrista mimosoides (L.) Greene

Crotalaria burkeana Benth.

Crotalaria lanceolata E.Mey. subsp. *lanceolata*

Crotalaria monteiroi Taub. ex Baker f.

Crotalaria pallida Aiton var. *pallida*

Crotalaria schinzii Baker f.

Crotalaria sphaerocarpa Perr. ex DC. subsp. *sphaerocarpa*

Crotalaria virgulata Klotzsch subsp. *grantiana* (Harv.) Polhill

Dalbergia armata E.Mey.

Dalbergia melanoxylon Guill. & Perr.

Dalbergia species

Decorsea galpinii (Burtt Davy) Verdc.

Desmodium barbatum (L.) Benth. var. *dimorphum* (Welw. ex Baker) B.G.Schub.

Desmodium gangeticum (L.) DC.

Desmodium species

Dichrostachys cinerea (L.) Wight & Arn.

Dolichos trilobus L. subsp. *transvaalicus* Verdc.

Elephantorrhiza elephantina (Burch.) Skeels

Erythrina humeana Spreng.

Erythrina latissima E.Mey.

Galactia tenuiflora (Willd.) Wight & Arn. var. *villosa* (Wight & Arn.) Benth.

Indigofera arrecta Hochst. ex A.Rich.

Indigofera astragalina DC.

Indigofera bainesii Baker

Indigofera baumiana Harms

Indigofera capillaris Thunb.

Indigofera comosa N.E.Br.

Indigofera filipes Benth. ex Harv.

Indigofera floribunda N.E.Br.

Indigofera heterantha Wall. ex Brandis

Indigofera laxeracemosa Baker f.

Indigofera rehmannii Baker f.

Indigofera rhytidocarpa Benth. ex Harv. subsp. *rhytidocarpa*

Indigofera sanguinea N.E.Br.

Indigofera schimperi Jaub. & Spach var. *schimperi*

Indigofera species

Indigofera swaziensis Bolus

Indigofera vicioides Jaub. & Spach

Lotononis carinata (E.Mey.) Benth.

Lotononis species

Macrotyloma axillare (E.Mey.) Verdc. var. *axillare*

Macrotyloma maranguense (Taub.) Verdc.

Mundulea sericea (Willd.) A.Chev.

Neorautanenia amboensis Schinz

Ormocarpum trichocarpum (Taub.) Engl.

Pearsonia uniflora (Kensit) Polhill

Peltophorum africanum Sond.

Philenoptera violacea (Klotzsch) Schrire

Piliostigma thonningii (Schumach.) Milne-Redh.

Pterocarpus angolensis DC.

Pterocarpus rotundifolius (Sond.) Druce subsp. *rotundifolius*

Ptycholobium plicatum (Oliv.) Harms subsp. *plicatum*

Rhynchosia caribaea (Jacq.) DC.

Rhynchosia densiflora (Roth) DC. subsp. *chrysadenia* (Taub.) Verdc.

Rhynchosia komatiensis Harms

Rhynchosia minima (L.) DC.

Rhynchosia species

Rhynchosia totta (Thunb.) DC. var. *totta*

Schotia brachypetala Sond.

Schotia capitata Bolle

Senna hirsuta (L.) H.S.Irwin & Barneby

Senna italica Mill. subsp. *arachoides* (Burch.) Lock

Senna occidentalis (L.) Link

Senna petersiana (Bolle) Lock

Sesbania sesban (L.) Merr. subsp. *sesban* var. *nubica* Chiov.

Stylosanthes fruticosa (Retz.) Alston

Tephrosia burchellii Burtt Davy

Tephrosia capensis (Jacq.) Pers.

Tephrosia elongata E.Mey.

Tephrosia longipes Meisn. subsp. *longipes* var. *longipes*

Tephrosia polystachya E.Mey.

Tephrosia reptans Baker var. *reptans*

Tephrosia rhodesica Baker f.

Tephrosia species

Teramnus labialis (L.f.) Spreng. subsp. *labialis*

Tylosema fassoglensis (Schweinf.) Torre & Hillc.

Vigna luteola (Jacq.) Benth. var. *luteola*

Vigna species

Vigna unguiculata (L.) Walp.

Xanthocercis zambesiaca (Baker) Dumaz-le-Grand

Zornia capensis Pers. subsp. *capensis*

Zornia species

FLACOURTIACEAE

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

Flacourtia indica (Burm.f.) Merr.

GENTIANACEAE

Chironia palustris Burch.

Enicostema axillare (Lam.) A.Raynal subsp. *axillare*

Enicostema species

Sebaea grandis (E.Mey.) Steud.

Sebaea species

GERANIACEAE

Monsonia burkeana Planch. ex Harv.

Monsonia glauca R.Knuth

GESNERIACEAE

Streptocarpus polyanthus Hook.

HETEROPYXIDACEAE

Heteropyxis natalensis Harv.

KIRKIACEAE

Kirkia wilmsii Engl.

LAMIACEAE

Becium filamentosum (Forssk.) Chiov.

Clerodendrum ternatum Schinz

Endostemon tereticaulis (Poir.) M.Ashby

Hemizygia bracteosa (Benth.) Briq.

Hoslundia opposita Vahl

Leonotis leonurus (L.) R.Br.

Leonotis nepetifolia (L.) R.Br.

Leonotis ocymifolia (Burm.f.) Iwarsson

Leucas glabrata (Vahl) Sm. var. *glabrata*

Leucas neuflizeana Courbon

Ocimum americanum L. var. *americanum*

Ocimum gratissimum L. subsp. *gratissimum* var. *gratissimum*

Ocimum species

Orthosiphon suffrutescens (Thonn.) J.K.Morton

Plectranthus tetensis (Baker) Agnew

Rotheca hirsuta (Hochst.) R.Fern.

Rotheca myricoides (Hochst.) Steane & Mabb.

Tetradenia riparia (Hochst.) Codd

Vitex species

LOBELIACEAE

Cyphia angustifolia C.Presl ex Eckl. & Zeyh.

Lobelia erinus L.

Lobelia flaccida (C.Presl) A.DC.

Monopsis decipiens (Sond.) Thulin

LYTHRACEAE

Galpinia transvaalica N.E.Br.

MALPIGHIACEAE

Sphedamnocarpus pruriens (A.Juss.) Szyszyl. subsp. *pruriens*

Triaspis hypericoides (DC.) Burch.

MALVACEAE

Abutilon austro-africanum Hochr.

Abutilon englerianum Ulbr.

Abutilon fruticosum Guill. & Perr.

Abutilon grandiflorum G.Don

Abutilon guineense (Schumach.) Baker f. & Exell

Abutilon ramosum (Cav.) Guill. & Perr.

Abutilon sonneratianum (Cav.) Sweet

Abutilon species

Anisodontea fruticosa (P.J.Bergius) Bates

Cienfuegosia gerrardii (Harv.) Hochr.

Cienfuegosia hildebrandtii Garcke

Gossypium herbaceum L. subsp. *africanum* (Watt) Vollesen

Gossypium species

Hibiscus aethiopicus L.

Hibiscus calyphyllus Cav.

Hibiscus cannabinus L.

Hibiscus engleri K.Schum.

Hibiscus lunarifolius Willd.

Hibiscus micranthus L.f. var. *micranthus*

Hibiscus palmatus Forssk.

Hib*iscus pusillus* Thunb.

Hibiscus schinzii Gürke

Hibiscus sidiformis Baill.

Hibiscus species

Hibiscus trionum L.

Malvastrum coromandelianum (L.) Garcke

Pavonia burchellii (DC.) R.A.Dyer

Pavonia transvaalensis (Ulbr.) A.Meeuse

Sida chrysantha Ulbr.

Sida cordifolia L.

Sida dregei Burtt Davy

Sida rhombifolia L. subsp. *rhombifolia*

MELIACEAE

Trichilia emetica Vahl subsp. *emetica*

Turraea nilotica Kotschy & Peyr.

Turraea obtusifolia Hochst.

MENISPERMACEAE

Cocculus hirsutus (L.) Diels

MESEMBRYANTHEMACEAE

Lithops species

MOLLUGINACEAE

Corbichonia decumbens (Forssk.) Exell

Limeum fenestratum (Fenzl) Heimerl var. *fenestratum*

Limeum sulcatum (Klotzsch) Hutch.

Limeum viscosum (J.Gay) Fenzl

Mollugo nudicaulis Lam.

Pharnaceum elongatum (DC.) Adamson

MORACEAE

Ficus abutilifolia (Miq.) Miq.

Ficus glumosa Delile

Ficus sycomorus L. subsp. *sycomorus*

MYRTACEAE

Eucalyptus species

Syzygium cordatum Hochst. ex C.Krauss

Syzygium guineense (Willd.) DC.

NYCTAGINACEAE

Boerhavia coccinea Mill. var. *coccinea*

OCHNACEAE

Ochna natalitia (Meisn.) Walp.

Ochna pretoriensis E.Phillips

OLACACEAE

Olax dissitiflora Oliv.

Ximenia americana L. var. *microphylla* Welw. ex Oliv.

Ximenia caffra Sond.

OLEACEAE

Jasminum fluminense Vell. subsp. *fluminense*

Jasminum multipartitum Hochst.

Olea europaea L. subsp. *africana* (Mill.) P.S.Green

Schrebera alata (Hochst.) Welw.

OROBANCHACEAE

Alectra orobanchoides Benth.

Alectra vogelii Benth.

Buchnera longespicata Schinz

Cycnium adonense E.Mey. ex Benth.

Striga asiatica (L.) Kuntze

Striga elegans Benth.

Striga forbesii Benth.

Striga gesnerioides (Willd.) Vatke

OXALIDACEAE

Oxalis depressa Eckl. & Zeyh.

Oxalis semiloba Sond. subsp. *semiloba*

Oxalis species

PASSIFLORACEAE

Adenia digitata (Harv.) Engl.

Adenia hastata (Harv.) Schinz

PEDALIACEAE

Ceratotheca triloba (Bernh.) Hook.f.

Dicerocaryum eriocarpum (Decne.) Abels

Harpagophytum procumbens (Burch.) DC. ex Meisn.

Pterodiscus aurantiacus Welw.

Sesamum alatum Thonn.

PLUMBAGINACEAE

Plumbago zeylanica L.

POLYGALACEAE

Polygala amatymbica Eckl. & Zeyh.

Polygala hottentotta C.Presl

Polygala producta N.E.Br.

Polygala rehmannii Chodat

Polygala species

Polygala sphenoptera Fresen. var. *sphenoptera*

Polygala spicata Chodat

POLYGONACEAE

Oxygonum dregeanum Meisn.

Oxygonum sinuatum (Hochst. & Steud. ex Meisn.) Dammer

Oxygonum species

PORTULACACEAE

Portulaca kermesina N.E.Br.

Portulaca oleracea L.

Portulaca quadrifida L.

Talinum caffrum (Thunb.) Eckl. & Zeyh.

PROTEACEAE

Faurea saligna Harv.

Protea species

RANUNCULACEAE

Clematis brachiata Thunb.

Clematis oweniae Harv.

RHAMNACEAE

Berchemia discolor (Klotzsch) Hemsl.

Berchemia zeyheri (Sond.) Grubov

Ziziphus mucronata Willd. subsp. *mucronata*

Ziziphus rivularis Codd

RUBIACEAE

Agathisanthemum bojeri Klotzsch subsp. *bojeri*

Breonadia salicina (Vahl) Hepper & J.R.I.Wood

Canthium inerme (L.f.) Kuntze

Catunaregam spinosa (Thunb.) Tirveng. subsp. *spinosa*

Coddia rudis (E.Mey. ex Harv.) Verdc.

Gardenia volkensii K.Schum. subsp. *volkensii* var. *volkensii*

Hyperacanthus amoenus (Sims) Bridson

Kohautia amatymbica Eckl. & Zeyh.

Kohautia cynanchica DC.

Kohautia virgata (Willd.) Bremek.

Kraussia species

Oldenlandia corymbosa L. var. *caespitosa* (Benth.) Verdc.

Oldenlandia tenella (Hochst.) Kuntze

Pachystigma latifolium Sond.

Pavetta catophylla K.Schum.

Pavetta gracilifolia Bremek.

Pavetta schumanniana F.Hoffm. ex K.Schum.

Psydrax obovata (Eckl. & Zeyh.) Bridson subsp. *obovata*

Pyrostria hystrix (Bremek.) Bridson

Rubia cordifolia L. subsp. *conotricha* (Gand.) Verdc.

Spermacoce natalensis Hochst.

Spermacoce senensis (Klotzsch) Hiern

Tricalysia junodii (Schinz) Brenan var. *junodii*

Vangueria infausta Burch. subsp. *infausta*

RUTACEAE

Ptaeroxylon obliquum (Thunb.) Radlk.

Teclea pilosa (Engl.) I.Verd.

Zanthoxylum capense (Thunb.) Harv.

Zanthoxylum humile (E.A.Bruce) P.G.Waterman

SALICACEAE

Salix mucronata Thunb. subsp. *woodii* (Seemen) Immelman

SANTALACEAE

Thesium gracilarioides A.W.Hill

Thesium gypsophiloides A.W.Hill

Thesium species

Thesium triflorum Thunb. ex L.f.

SAPINDACEAE

Allophylus decipiens (Sond.) Radlk.

Cardiospermum corindum L.

Cardiospermum halicacabum L.

Hippobromus pauciflorus (L.f.) Radlk.

Pappea capensis Eckl. & Zeyh.

SAPOTACEAE

Englerophytum magalismontanum (Sond.) T.D.Penn.

Manilkara mochisia (Baker) Dubard

Sideroxylon inerme L. subsp. *inerme*

SCROPHULARIACEAE

Aptosimum lineare Marloth & Engl. var. *lineare*

Jamesbrittenia micrantha (Klotzsch) Hilliard

Sutera species

SOLANACEAE

Solanum americanum Mill.

Solanum incanum L.

Solanum panduriforme E.Mey. ex Dunal

Solanum tomentosum L. var. *coccineum* (Jacq.) Willd.

STERCULIACEAE

Dombeya rotundifolia (Hochst.) Planch.

Hermannia boraginiflora Hook.

Hermannia depressa N.E.Br.

Hermannia modesta (Ehrenb.) Mast.

Hermannia species

Melhania didyma Eckl. & Zeyh.

Melhania forbesii Planch. ex Mast.

Melhania prostrata DC.

Melhania species

Sterculia murex Hemsl.

Waltheria indica L.

STRYCHNACEAE

Strychnos madagascariensis Poir.

Strychnos pungens Soler.

Strychnos spinosa Lam.

THYMELAEACEAE

Gnidia capitata L.f.

TILIACEAE

Corchorus asplenifolius Burch.

Corchorus confusus Wild

Corchorus longipedunculatus Mast.

Corchorus trilocularis L.

Grewia bicolor Juss. var. bicolor

Grewia caffra Meisn.

Grewia flava DC.

Grewia flavescens Juss.

Grewia hexamita Burret

Grewia monticola Sond.

Grewia occidentalis L. var. *occidentalis*

Grewia villosa Willd. var. *villosa*

TURNERACEAE

Tricliceras laceratum (Oberm.) Oberm.

Tricliceras schinzii (Urb.) R.Fern. subsp. *schinzii* var. *juttae* (Dinter & Urb.) R.Fern.

URTICACEAE

Pouzolzia mixta Solms

VAHLIACEAE

Vahlia capensis (L.f.) Thunb.

VERBENACEAE

Chascanum hederaceum (Sond.) Moldenke

Chascanum pinnatifidum (L.f.) E.Mey.

Lantana camara L.

Lantana rugosa Thunb.

Lippia javanica (Burm.f.) Spreng.

Lippia species

Lippia wilmsii H.Pearson

Priva cordifolia (L.f.) Druce

Priva meyeri Jaub. & Spach var. *meyeri*

Verbena bonariensis L.

VIOLACEAE

Hybanthus enneaspermus (L.) F.Muell. var. *enneaspermus*

VITACEAE

Cissus cornifolia (Baker) Planch.

Cissus quadrangularis L. var. *quadrangularis*

Cissus rotundifolia (Forssk.) Vahl

Cyphostemma congestum (Baker) Desc. ex Wild & R.B.Drumm.

Cyphostemma humile (N.E.Br.) Desc. ex Wild & R.B.Drumm. subsp. *dolichopus* (C.A.Sm.) Wild & R.B.Drumm.

Cyphostemma puberulum (C.A.Sm.) Wild & R.B.Drumm.

Cyphostemma simulans (C.A.Sm.) Wild & R.B.Drumm.

Cyphostemma subciliatum (Baker) Desc. ex Wild & R.B.Drumm.

Cyphostemma woodii (Gilg & M.Brandt) Desc.

Rhoicissus digitata (L.f.) Gilg & M.Brandt

Rhoicissus species

Rhoicissus tridentata (L.f.) Wild & R.B.Drumm. subsp. *cuneifolia* (Eckl. & Zeyh.) Urton

ZYGOPHYLLACEAE

Tribulus terrestris L.

Monocotyledons

ALLIACEAE

Nothoscordum borbonicum Kunth

AMARYLLIDACEAE

Ammocharis coranica (Ker Gawl.) Herb.

Ammocharis species

Boophone disticha (L.f.) Herb.

Crinum species

Haemanthus species

Scadoxus puniceus (L.) Friis & Nordal

ANTHERICACEAE

Chlorophytum galpinii (Baker) Kativu var. *galpinii*

Chlorophytum recurvifolium (Baker) C.Archer & Kativu

ARACEAE

Gonatopus boivinii (Decne.) Engl.

Stylochaeton natalensis Schott

ARECACEAE

Phoenix reclinata Jacq.

ASPARAGACEAE

Asparagus aethiopicus L.

Asparagus buchananii Baker

Asparagus cooperi Baker

Asparagus falcatus L.

Asparagus minutiflorus (Kunth) Baker

Asparagus plumosus Baker

Asparagus species

Asparagus virgatus Baker

Protasparagus species

ASPHODELACEAE

Aloe cryptopoda Baker

Aloe marlothii A.Berger subsp. *marlothii*

Aloe spicata L.f.

Aloe zebrina Baker

Trachyandra saltii (Baker) Oberm.

COLCHICACEAE

Camptorrhiza strumosa (Baker) Oberm.

Gloriosa superba L.

COMMELINACEAE

Commelina africana L.

Commelina benghalensis L.

Commelina eckloniana Kunth

Commelina erecta L.

Commelina livingstonii C.B.Clarke

Commelina species

Murdannia simplex (Vahl) Brenan

CYPERACEAE

Alinula paradoxa (Cherm.) Goetgh. & Vorster

Bulbostylis hispidula (Vahl) R.W.Haines

Bulbostylis humilis (Kunth) C.B.Clarke

Courtoisina cyperoides (Roxb.) Soják

Cyperus albostriatus Schrad.

Cyperus angolensis Boeck.

Cyperus compressus L.

Cyperus distans L.f.

Cyperus elephantinus (C.B.Clarke) Kük.

Cyperus indecorus Kunth var. *decurvatus* (C.B.Clarke) Kük.

Cyperus obtusiflorus Vahl

Cyperus rupestris Kunth

Cyperus schinzii Boeck.

Cyperus sexangularis Nees

Cyperus species

Fimbristylis species

Fuirena pubescens (Poir.) Kunth

Kyllinga alba Nees

Mariscus dregeanus Kunth

Pycreus macranthus (Boeck.) C.B.Clarke

Pycreus macrostachyos (Lam.) J.Raynal

Pycreus pumilus (L.) Domin

Schoenoxiphium sparteum (Wahlenb.) C.B.Clarke

DIOSCOREACEAE

Dioscorea cotinifolia Kunth

Dioscorea sylvatica (Kunth) Eckl.

DRACAENACEAE

Sansevieria hyacinthoides (L.) Druce

HYACINTHACEAE

Albuca abyssinica Jacq.

Albuca aurea Jacq.

Dipcadi rigidifolium Baker

Drimia altissima (L.f.) Ker Gawl.

Ledebouria species

Ornithogalum species

Resnova humifusa (Baker) U.& D.Müll.-Doblies

Urginea species

HYDROCHARITACEAE

Lagarosiphon species

HYPOXIDACEAE

Hypoxis filiformis Baker

Hypoxis hemerocallidea Fisch. & Avé-Lall.

Hypoxis rigidula Baker

IRIDACEAE

Gladiolus ferrugineus Goldblatt & J.C.Manning

Gladiolus liliaceus Houtt.

Gladiolus species

Lapeirousia gracilis Vaupel

Radinosiphon leptostachya (Baker) N.E.Br.

POACEAE

Andropogon chinensis (Nees) Merr.

Andropogon gayanus Kunth var. polycladus (Hack.) Clayton

Andropogon schirensis Hochst. ex A.Rich.

Aristida adscensionis L.

Aristida bipartita (Nees) Trin. & Rupr.

Aristida canescens Henrard subsp. *canescens*

Aristida congesta Roem. & Schult. subsp. *barbicollis* (Trin. & Rupr.) De Winter

Aristida congesta Roem. & Schult. subsp. *congesta*

Aristida diffusa Trin. subsp. *burkei* (Stapf) Melderis

Aristida mollissima Pilg. subsp. *argentea* (Schweick.) Melderis

Bewsia biflora (Hack.) Gooss.

Bothriochloa bladhii (Retz.) S.T.Blake

Bothriochloa insculpta (Hochst. ex A.Rich.) A.Camus

Bothriochloa radicans (Lehm.) A.Camus

Brachiaria brizantha (A.Rich.) Stapf

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

Brachiaria dictyoneura (Fig. & De Not.) Stapf

Brachiaria eruciformis (Sm.) Griseb.

Brachiaria nigropedata (Ficalho & Hiern) Stapf

Brachiaria serrata (Thunb.) Stapf

Brachiaria species

Brachiaria xantholeuca (Schinz) Stapf

Cenchrus ciliaris L.

Chloris gayana Kunth

Chloris mossambicensis K.Schum.

Chloris roxburghiana Schult.

Chloris species

Chloris virgata Sw.

Cymbopogon excavatus (Hochst.) Stapf ex Burtt Davy

Cymbopogon nardus (L.) Rendle

Cymbopogon pospischilii (K.Schum.) C.E.Hubb.

Cynodon dactylon (L.) Pers.

Cynodon species

Dactyloctenium aegyptium (L.) Willd.

Dactyloctenium geminatum Hack.

Digitaria argyrograpta (Nees) Stapf

Digitaria debilis (Desf.) Willd.

Digitaria eriantha Steud.

Digitaria longiflora (Retz.) Pers.

Digitaria monodactyla (Nees) Stapf

Diheteropogon amplectens (Nees) Clayton

Echinochloa pyramidalis (Lam.) Hitchc. & Chase

Eleusine coracana (L.) Gaertn. subsp. *africana* (Kenn.-O'Byrne) Hilu & de Wet

Elionurus muticus (Spreng.) Kunth

Enneapogon cenchroides (Licht. ex Roem. & Schult.) C.E.Hubb.

Enneapogon scoparius Stapf

Enteropogon macrostachyus (Hochst. ex A.Rich.) Munro ex Benth.

Enteropogon monostachyus (Vahl) K.Schum. subsp. *africanus* Clayton

Eragrostis aethiopica Chiov.

Eragrostis aspera (Jacq.) Nees

Eragrostis barbinodis Hack.

Eragrostis biflora Hack. ex Schinz

Eragrostis chloromelas Steud.

Eragrostis cilianensis (All.) Vignolo ex Janch.

Eragrostis cylindriflora Hochst.

Eragrostis glandulosipedata De Winter

Eragrostis gummiflua Nees

Eragrostis heteromera Stapf

Eragrostis hierniana Rendle

Eragrostis inamoena K.Schum.

Eragrostis lappula Nees

Eragrostis lehmanniana Nees var. *lehmanniana*

Eragrostis micrantha Hack.

Eragrostis minor Host

Eragrostis pallens Hack.

Eragrostis racemosa (Thunb.) Steud.

Eragrostis rigidior Pilg.

Eragrostis species

Eragrostis superba Peyr.

Eragrostis trichophora Coss. & Durieu

Eriochloa stapfiana Clayton

Eustachys paspaloides (Vahl) Lanza & Mattei

Fingerhuthia africana Lehm.

Hemarthria altissima (Poir.) Stapf & C.E.Hubb.

Heteropogon contortus (L.) Roem. & Schult.

Heteropogon species

Hyparrhenia filipendula (Hochst.) Stapf

Hyparrhenia hirta (L.) Stapf

Hyparrhenia tamba (Steud.) Stapf

Hyperthelia dissoluta (Nees ex Steud.) Clayton

Ischaemum afrum (J.F.Gmel.) Dandy

Leptochloa eleusine (Nees) Cope & N.Snow

Loudetia flavida (Stapf) C.E.Hubb.

Loudetia simplex (Nees) C.E.Hubb.

Melinis nerviglumis (Franch.) Zizka

Melinis repens (Willd.) Zizka subsp. *repens*

Microchloa caffra Nees

Oropetium capense Stapf

Panicum coloratum L. var. *coloratum*

Panicum deustum Thunb.

Panicum infestum Peters

Panicum maximum Jacq.

Panicum natalense Hochst.

Panicum species

Paspalum scrobiculatum L.

Perotis patens Gand.

Phragmites australis (Cav.) Steud.

Pogonarthria squarrosa (Roem. & Schult.) Pilg.

Rottboellia cochinchinensis (Lour.) Clayton

Sacciolepis curvata (L.) Chase

Schizachyrium sanguineum (Retz.) Alston

Schmidtia pappophoroides Steud.

Setaria incrassata (Hochst.) Hack.

Setaria megaphylla (Steud.) T.Durand & Schinz

Setaria sagittifolia (A.Rich.) Walp.

Setaria species

Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss

Sorghum versicolor Andersson

Sporobolus africanus (Poir.) Robyns & Tournay

Sporobolus consimilis Fresen.

Sporobolus fimbriatus (Trin.) Nees

Sporobolus nitens Stent

Sporobolus panicoides A.Rich.

Sporobolus pectinatus Hack.

Sporobolus pyramidalis P.Beauv.

Sporobolus sanguineus Rendle

Sporobolus stapfianus Gand.

Themeda triandra Forssk.

Trachypogon spicatus (L.f.) Kuntze

Tragus berteronianus Schult.

Tricholaena monachne (Trin.) Stapf & C.E.Hubb.

Trichoneura grandiglumis (Nees) Ekman

Urelytrum agropyroides (Hack.) Hack.

Urochloa brachyura (Hack.) Stapf

Urochloa mosambicensis (Hack.) Dandy

Urochloa oligotricha (Fig. & De Not.) Henrard

POTAMOGETONACEAE

Potamogeton thunbergii Cham. & Schltdl.

RESTIONACEAE

Anthochortus species

VELLOZIACEAE

Xerophyta retinervis Baker