UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Vegetation ecology of the Soutpansberg and Blouberg Area in the Limpopo Province

by

Theodorus Hendrik Cornelis Mostert

Submitted in partial fulfilment of the requirements
for the degree

Philosophiae Doctor

in the

African Vegetation and Plant Diversity Research Centre
Department of Botany
Faculty of Natural and Agricultural Sciences
University of Pretoria
Pretoria

Supervisor: Prof. Dr. G.J. Bredenkamp

November 2006

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

"Applied ecology is difficult, but not impossible. Action has to be taken, but the problems cannot be solved by off-the-shelf answers. Solutions will require intellectual and empirical depth well beyond what is now available, as well as commitment, money, organization and work. Most significantly, applied ecology requires rethinking the basis of how ecological problems and their solutions are approached. It is almost too late to start, but tomorrow is even later."

(L.B. Slobodkin & D.E. Dykhuizen 1991)

I dedicate this thesis to my Creator for granting me the opportunities to study the splendour of His creation, to my wife for her endless patience, understanding and comradeship as a fellow nature conservationist, my parents for ever becoming less in order for me to become more, and to the people who have guided and moulded me on the journey of scientific discovery.

ABSTRACT

Vegetation ecology of the Soutpansberg and Blouberg Area in the Limpopo Province

by

Theodorus Hendrik Cornelis Mostert

Promoter: Prof. Dr. G.J. Bredenkamp
African Vegetation And Plant Diversity Research Centre
Department of Botany
University of Pretoria

Submitted in partial fulfilment of the requirements
for the degree

Philosophiae Doctor

The fast growing local human population, especially through immigration from countries north of South Africa, is placing the Soutpansberg and Blouberg areas under increasing pressure. The insatiable demand for more arable land within these agriculturally marginal and semi-arid areas is leading to severe degradation of the remaining natural resources. The Soutpansberg–Blouberg region has been recognized as a Centre of Endemism and is regarded as a region of exceptionally high biological diversity. The Soutpansberg Conservancy and the Blouberg Nature Reserve reveal extremely rich diversities of plant communities relative to the sizes of these conservation areas.

The Major Vegetation Types and plant communities of the Soutpansberg Centre of Endemism are described in detail with special reference to the Soutpansberg Conservancy and the Blouberg Nature Reserve. Phytosociological data from 466 sample plots were ordinated using a Detrended Correspondence Analysis

(DECORANA) and classified using Two–way Indicator Species Analysis (TWINSPAN). The resulting classification was further refined with table–sorting procedures based on the Braun–Blanquet floristic–sociological approach of vegetation classification using MEGATAB. Eight Major Vegetation Types were identified and described as *Eragrostis lehmanniana* var. *lehmanniana*–*Sclerocarya birrea* subsp. *caffra* BNR Northern Plains *Bushveld*, *Euclea divinorum*–*Acacia tortilis* BNR Southern Plains Bushveld, *Englerophytum magalismontanum*–*Combretum molle* BNR Mountain Bushveld, *Adansonia digitata*–*Acacia nigrescens* Soutpansberg Arid Northern Bushveld, *Catha* edulis–*Flueggia virosa* Soutpansberg Moist Mountain Thickets, *Diplorhynchus condylocarpon*–*Burkea africana* Soutpansberg Leached Sandveld, *Rhus rigida* var. *rigida*–*Rhus magalismontanum* subsp. *coddii* Soutpansberg Mistbelt Vegetation and *Xymalos monospora*–*Rhus chirendensis* Soutpansberg Forest Vegetation. Plant communities of each of the Major Vegetation Types are described. The primary ecological drivers of the event-driven and the classic climax vegetation types are discussed and management recommendations are made for effective conservation of these last remaining pockets of wilderness. The available data supports the recognition of the region as an important Centre of Plant Endemism and Biological Diversity requiring conservation attention.

Keywords: Soutpansberg Conservancy, Blouberg Nature Reserve, vegetation classification, phytosociology, syntaxonomy, TWINSPAN, ecology, semi-arid event-driven ecosystems, mistbelt vegetation, Afromontane Forest, Centre of Biological Diversity, Limpopo Province.

Table of Contents

LIST OF FIGURES AND TABLES

CHAPTER 1

INTRODUCTION

Phytosociology and Conservation

Humans have transformed almost half of the world's ice-free land surface area into agricultural and urban systems (Chapin *et al.* 2000). These changes in species composition and ecosystem functioning alter the resistance and resilience of ecosystems to environmental change (Reyers 2003). Such alterations also impact on ecosystem services, such as water storage and purification, reduction of radiation and the control of green-house gasses, upon which humans depend for survival (Kunin & Lawton 1996; McCann 2000; Henns & Nath 2003; Barber 2003).

In the past, nature conservation was aimed at the preservation of single species in isolation from humans. Recently, there has been a paradigm shift in conservation towards the more holistic approach of ecosystem conservation (Fairbanks & Grant 2000; Reyers 2003). Holistic knowledge of ecosystem form and function is an indispensable prerequisite the effective conservation and management of the highly valued renewable environmental resources (Wright *et al.* 1998). Conservation efforts have begun to focus on higher levels of the biodiversity hierarchy, e.g. plant communities and vegetation classes (Margules and Pressey 2000; Pressey and Taffs 2001; Wessels *et al.* 2003). In order to conserve ecosystem patterns and processes, even if done only for the self-preservation of man, we need to understand the patterns and processes driving vegetation structure and function (Yeo *et al.* 1998; Turpie *et al.* 2003).

Vegetation is the most noticeable biological component of terrestrial ecosystems (Kent & Coker 1996). The structure and species composition of vegetation reflect the sum of all the abiotic environmental factors within a given environment, thereby acting as a living summary of the surrounding environmental factors (Corney *et al.* 2004). The entire biota of an ecosystem reacts either directly or indirectly to vegetation structure and composition. Vegetation is therefore that crucial link in understanding the interaction between the biotic and abiotic patterns and processes shaping ecosystems (Hudak *et al.* 2004). The physical properties and nature of vegetation renders it a very suitable yardstick by which ecosystems can be described, evaluated and monitored (Salisbury 1926; Cain 1944; Good 1953; Holdridge 1967; McArthur 1972; Box 1981; Stott 1981; Walter 1985; Ellenberg 1988, Mucina 1997; Guisan & Zimmermann 2000; Gillison & Liswanti 2004). The success of terrestrial ecosystem conservation, therefore, depends on understanding the form and function of the plant communities and their environmental drivers as the basic building blocks of the more complex ecosystems (Pienkowski *et al.* 1996).

This need for holistic and long-term approaches towards ecosystem conservation and land-use planning has sparked a renewed international interest in vegetation science phytosociology (Schaminée & Stortelder 1996; Snyman 1998; Wright *et al.* 2001). Tremendous efforts have been made during the last two decades at local, regional and international scale to promote vegetation classification and the standardization of phytosociological databases (Pignatti 1990; Dierscke 1992; Mucina *et al.* 1993; Rodwell *et al.* 1995; Schaminée 1995; Rodwell 1995; Schaminée & Stortelder 1996; Winterbach *et al.* 2000; Du Plessis 2001; Siebert *et al.* 2003). Recent phytosociological syntheses at regional scale include Korotkov *et al.* (1991) in the former Soviet Union, Oberdorfer (1992) and Pott (1992) in Germany, Julve (1993) in France, Grabherr & Mucina (1993) and Mucina *et al.* (1993a,b) in Austria, Rodwell (1990, 1991, 1992, 1995) in Great Britain, Valachovic (1995) in Slovakia, and Schaminée *et al.* (1995a, b) in The Netherlands.

The need for conservation and vegetation studies in the Soutpansberg and Blouberg area

The establishment of conservation areas and biosphere reserves are widely used in order to reduce anthropogenic threats to ecosystem form and function (Margules and Pressey 2000; Fairbanks *et al*. 2001). The Soutpansberg Conservancy (SC) and the Blouberg Nature Reserve (BNR) are examples of such conservation areas. Numerous scientists and conservationists have emphasized the biological importance of the Soutpansberg and Blouberg Mountain Ranges (Van Wyk & Smith 2001; Hahn 2002; Berger *et al*. 2003; Hahn 2006).

The area was not rated by Reyers (2003) as an urgent priority for conservation efforts in South Africa. The relatively few anthropogenic activities seriously threatening the remaining natural systems of the Limpopo Province are given as the main reason for the low urgency listing. However, based on the high levels of biological richness and diversity harboured by this area, it is regarded as a very high long-term priority for conservation (Van Wyk & Smith 2001).

The topographical diversity of the Soutpansberg and Blouberg Mountain Ranges has created suitable conditions for a wide variety of vegetation types, including swamp forests, mistbelt mountain forests, high altitude grasslands, high altitude peatlands and arid savanna bushveld. This phytosociological and topographical complexity has led to an unusually high diversity of ecosystems contained within a geographically relatively small area (Weisser *et al.* 2003). Although the Soutpansberg and Blouberg contain numerous of its own endemic species, they share many near-endemic species with the surrounding centres of endemism (Van Wyk & Smith 2001; Hahn 2002). The mountain range acts as an east-west corridor for the migration of mesic species along the southern slopes and for xeric species along the northern slopes and plains. It also acts as a north-south barrier for the migration of numerous less xeric species (Hahn 2002).

The Soutpansberg–Blouberg region has been recognized as a Centre of Endemism by Van Wyk and Smith (2001). However, little ecological knowledge of the area exists (Anderson 2001; Berger *et al.* 2003). Some floristic surveys conducted by Hahn (1994; 1996; 1997; 1999; 2002), Stirton (1982), Obermeyer *et al.* (1937) and Van Wyk (1984; 1996) indicated that the Soutpansberg Centre of Endemism is exceptionally diverse and species rich for its size (Van Wyk & Smith 2001). The conservation value of this centre lies in its unique ability to house a wide variety of floristic elements from the surrounding floristic regions (Hahn 2002). The region is an outstanding centre of plant diversity, with approximately 2 500–3 000 recorded vascular plant taxa (Hahn 1997). The region boasts with 41% of all plant genera and 68% of all known plant families of the flora of southern Africa. Altogether 595 specific and infra–specific trees and shrubs are known from the Soutpansberg, amounting to one third of all the known tree species in the entire southern Africa region (Hahn 1994; 1997; 2003). This constitutes one of the highest tree counts for a single region in southern Africa (Hahn 1997). The Kruger National Park, which covers an area of two million hectares, contains approximately 380 tree species (Van Wyk 1994), whereas 321 tree species have been recoded by Hahn (2002) in an area of only 2 000 hectares within the SC. Trees and shrubs encompass approximately 24% of the vascular plants of the Soutpansberg and play an important role in the species composition, vegetation structure and relative dominance within the different plant communities.

More than 500 bird species have been recorded throughout the Soutpansberg mountain range, amounting to approximately 56% of the recorded species for the entire southern Africa (Harrison *et al.* 1997; Hockey *et al.* 2005). The Soutpansberg and its surroundings contain some unique reptile habitats, and house seven endemic species (Branch 1988). A total of 46 spider families, 110 genera and 130 species have been recorded in the SC on the single farm Lejuma (<50 km^2), which constitutes 70% of the families, 26% of the genera and 5% of the species recorded for South Africa (Foord *et al.* 2002; 2003). The high biological diversity of the Soutpansberg and Blouberg can possibly be attributed to the fact that the mountain range acts as a refuge in times of environmental flux (Hahn 2003).

In the light of the high diversity recorded for the Blouberg–Soutpansberg expanse, it is proposed that the region be given the status of the Soutpansberg Centre of Biological Diversity (SCBD) in addition to its recognised status as the Soutpansberg Centre of Plant Endemism. There are current efforts to create a biosphere reserve in this area, which will include the SC and BNR (Hahn *in prep.*).

The Soutpansberg Conservancy and the Blouberg Nature Reserve reveal extremely rich diversities of plant communities relative to the sizes of these conservation areas (Van Wyk & Smith 2001). Although Van Rooyen & Bredenkamp (1996) recognised this diversity and unique composition of plant communities within the Soutpansberg–Blouberg complex, the lack of detailed research in the region forced them to lump the area's vegetation under the broad term of Soutpansberg Arid Mountain Bushveld. Acocks (1953) recognised four different Veld Types for the greater surrounding region and described them as Arid Sweet Bushveld, Mixed Bushveld, Sourish Mixed Bushveld and Sour Bushveld. Most of these Veld Types were described as heterogeneous (Acocks 1953), comprising of many sub-communities with different agricultural and production potentials. In addition to the savanna vegetation of the area, Geldenhuys & Murray (1993) and Lubke & McKenzie (1996) described and mapped the patches of Afromontane Forest associated with the region. Van Wyk & Smith (2001) only briefly mention the occurrence of "Fynbos-type" vegetation along the summit of the mountain. They also refer to dense, almost mono–specific stands of Lebombo ironwood (*Androstachys johnsonii*) on the arid northern slopes of the mountain. Due to major gaps in the available vegetation data, no attempt has yet been made to synthesize, classify and to describe the plant communities of this region.

The fast growing local human population, especially through immigration from countries north of South Africa, is placing the Soutpansberg and Blouberg areas under increasing pressure. The insatiable demand for more arable land within these agriculturally marginal and semi-arid areas is leading to severe degradation of the remaining natural resources (Hahn 2002). Ecotourism in the Soutpansberg-Blouberg region have become an important alternative socioeconomic stabiliser within this poverty stricken province. However, the lack of sound ecological information, which is essential for effective management strategies of natural resources, is inhibiting conservation within the Soutpansberg and Blouberg areas. A baseline inventory of ecological data became essential to supply authorities with the necessary information needed to designate areas for the most appropriate forms of land-uses, and to formulate management plans for protection and sustainable use of the region's vegetation as a valuable resource (Kent & Ballard 1988; Bedward *et al.* 1992; Rhoads & Thompson 1992). During a workshop on the environmental, biological and cultural assets of the Soutpansberg (Berger *et al*. 2003) gaps within the existing data and information were identified. The lack of scientifically sound ecological data on the vegetation of the Soutpansberg was identified a one of the key components in urgent need of research. Hence, the motivation for this phytosociological study stemmed from the urgent need to identify and understand the main ecological drivers of vegetation structure and composition within this Centre of Biological Diversity. Phytosociology was therefore used as a basis for the description and ecological interpretation of the observed vegetation patterns.

Aims of the study

The aim of ecological studies on ecosystems is to understand the complex interactions between the various components. In order to reduce the complexity of such a system, one often needs to start by understanding its individual components. However, it is paramount to remember that communities have collective properties, and that the nature of a community is more than just the sum of its constituent species (Begon *et al.* 1996). Oversimplification of the system components leads to overly simplified theoretical explanations with no practical value for projections and predictions within the complexity of ecosystems. The level of complexity at which the researcher studies a particular community is scale dependant.

This study is a first attempt at understanding the complex ecological patterns and processes observed within the vegetation of the SCBD. It is concerned with the phytosociology and synecology of the SC and BNR. Its aim is to identify the different plant communities and to investigate the interrelationships between plant communities and their physical and biological environments. In an attempt to create a holistic image and to explain the macro-ecology of the region, disciplines such as climatology, geology, pedology, physical geography, history and anthropology are drawn upon and integrated. This study provides a first approximation of the vegetation and proposes eight Major Vegetation Types for the study area. It aims to define and describe the characteristics of these Major Vegetation Types within the context of the SC and BNR. This will assist scientists, conservationists and land–use planners when future projects are conducted within the surrounding areas. These plant communities from the SC and BNR will serve as reference sites with which to compare proposed development sites from the surrounding unprotected areas. Sound environmental development is a state of mind (Siebert 2001) and something that can be achieved if basic information, such as this account, is actively drawn upon during conservation planning and the management of natural resources.

CHAPTER 2

STUDY AREA

Location

The BNR (7000 ha) and SC (100 000 ha) are located in the arid northern regions of the Limpopo Province of South Africa (Figure 1). For the purpose of this study, the SC is defined as a section of the Soutpansberg Mountain Range contained by four provincial and national roads. The eastern boudary (E29º55') is the N1 from Makhado in the south to Wyllies Poort in the north. The northern boundary (S 22º52') is the R523 road from Wyllies Poort in the east to Kalkheuwel in the west. The western boundary (E29°15') is the R521 road from Kalkheuwel in the north to Vivo in the south. The southern boundary (S23°12') is the R522 road from Vivo in the west to Makhado in the east. From east to west it spans approximately 70 km and from north to south approximately 25 km at it's widest.

The BNR lies approximately 40 km to the west, situated along the north-eastern section of the Blouberg Mountain.

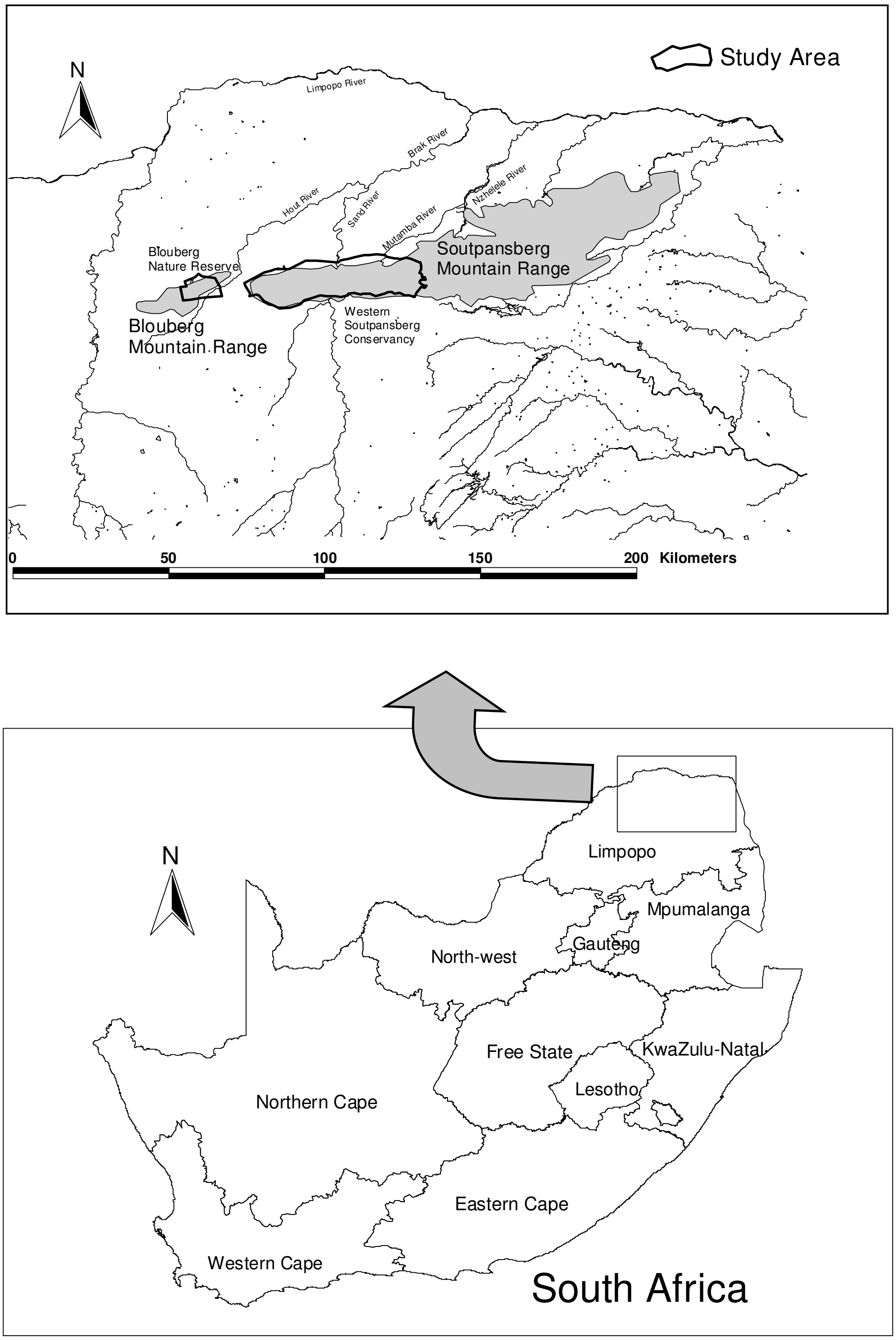


Figure 1. The location of the Blouberg Nature Reserve and Soutpansberg Conservancy within South Africa.

Topography

The SC and BNR are part of the Blouberg–Soutpansberg Mountain Range, with it's ENE–WSW orientation (Figure 2). Although the Blouberg and Soutpansberg belong to the same geological formation they are referred to as separate entities. Successive faulting along the Tshamuvhudzi, Kranspoort, Nakab and Zoutpan strike-faults, followed by the northwards tilting of the area, created these quartzite mountains within the surrounding Limpopo Plain. This gave the Blouberg–Soutpansberg Mountain Range a wedge-shaped appearance with steep southern slopes and moderate northern slopes. The ridges are highest at the western extremity of this range, gradually descending until it finally plunges beneath the Karoo Supergroup along the northern reaches of the Lebombo Mountains near the north-eastern border of the Limpopo Province. The SC's altitude ranges from 750 m above sea level at Waterpoort to 1 748 m at Lejuma. The BNR's altitude ranges from 850 m above sea level in the east to 1 400 m in the west. The highest peak of the Blouberg lies further to the west, reaching 2 051 m above sea level (Bumby 2000). The surrounding plains are approximately 850 m above sea level.

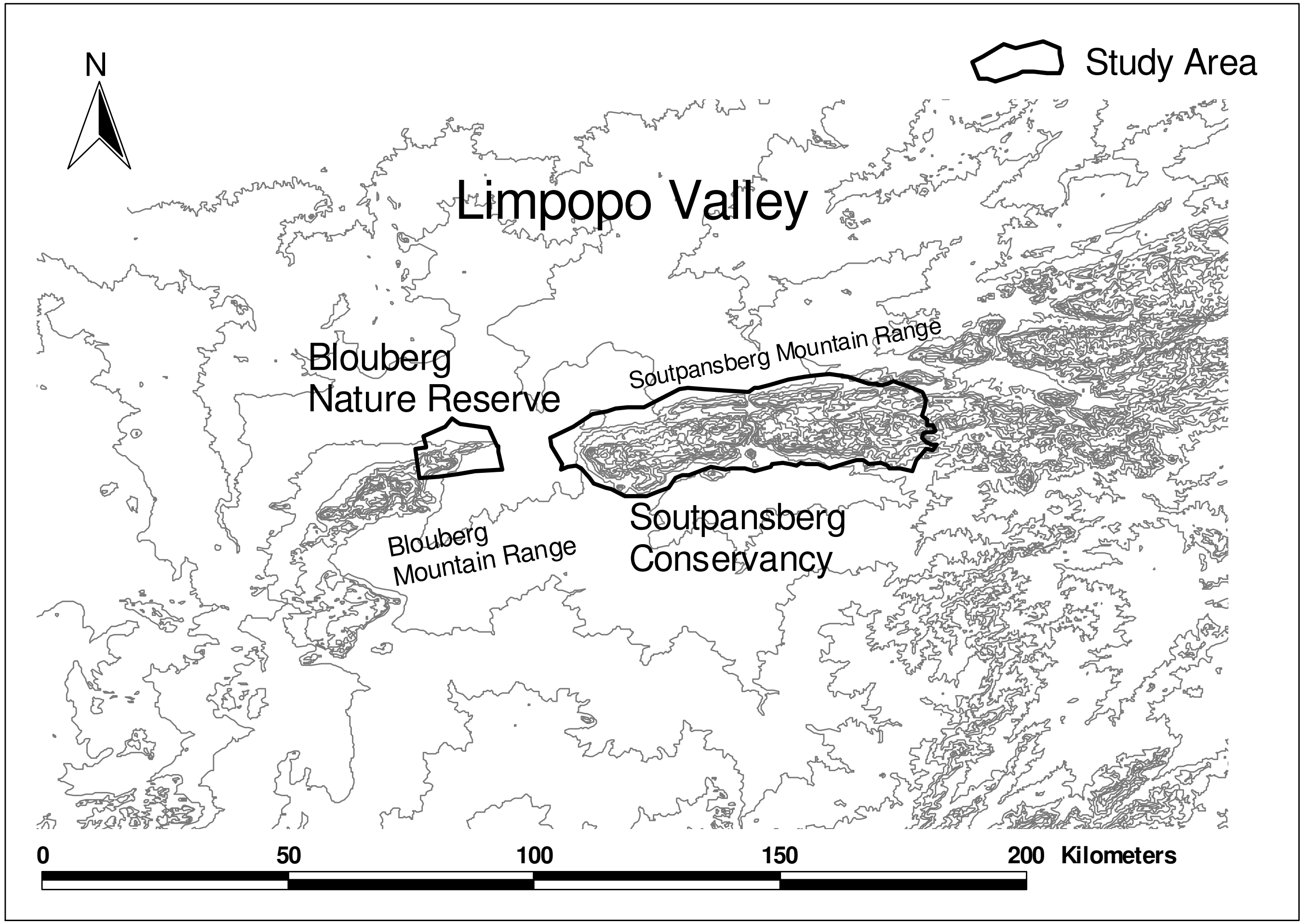


Figure 2 Topography of the Soutpansberg-Blouberg Area

Geology and soils

The Soutpansberg basin was formed approximately 1 800 million years ago as an east-west trending asymmetrical rift along the Palala Shear Belt (Brandl 2002). This belt formed due to a collision between the Kaapvaal craton from the south and the Limpopo Belt from the north (Bumby 2000). Layering of the most prominent geology started with the deposition of basaltic lavas, followed by the settling of various sediments over an extended period of time (Barker 1979). The Soutpansberg rocks initially formed a flat featureless landscape. Approximately 150 millions years ago, the area block-faulted and uniformly tilted to the north (Barker 1979). Numerous north-south extensional faults truncate the Soutpansberg strata. Recent erosion (last 60 million years) formed the landscape as we see it today (Brandl 2003). The pink resistant quartzite was instrumental in shaping the present morphology. The Soutpansberg rocks rest on gneisses of the Limpopo Belt and Bandelierkop Complex. Sedimentary rocks of the Karoo Supergroup cover the Soutpansberg outcrops along its eastern and northern margins. Many diabase dykes and sills occur throughout the Soutpansberg. These dykes are of volcanic origin and often intruded along fault planes (Brandl 2003).

The Soutpansberg Group represents a volcano-sedimentary succession, which is subdivided into seven formations (Brandl 1999). Only the Wyllies Poort and Sibasa Geological Formations are prominently represented within the study area. The geology of the SC and BNR is dominated by pink, erosion resistant quartzite, and sandstone with minor pebble washes of the Wyllies Poort Geological Formation of the Soutpansberg Group. Other less prominent rock types include shale, conglomerate, basalt and diabase intrusions of the Wyllies Poort and Sibasa Geological Formations. The rocks of the study area do not contain large amounts of minerals that are of economic value.

Soils derived from the quartzite and sandstone are generally shallow, gravely, skeletal and well drained, with low nutrient content and acidic characteristics. Soils derived from the basalt and diabase dykes are fine textured, clayey, well weathered and generally deep. These poorly drained soils are prone to erosion along the higher rainfall southern slopes. Soils derived from the Aeolian Kalahari sands are fine-grained deep sands. Large areas along the northern sloped contain no soil, consisting only of the exposed underlying mother material. Peat soils occur along the cooler high lying wetlands of the SC. The deeper soils and saprolite matrix within the mistbelt act as sponge areas, which slowly release water to feed mountain streams over prolonged periods.

Climate

The SC and BNR fall within the summer rainfall zone of southern Africa. A climate diagram (Figure 3) depicts typical rainfall patterns and temperature gradients within the study area.

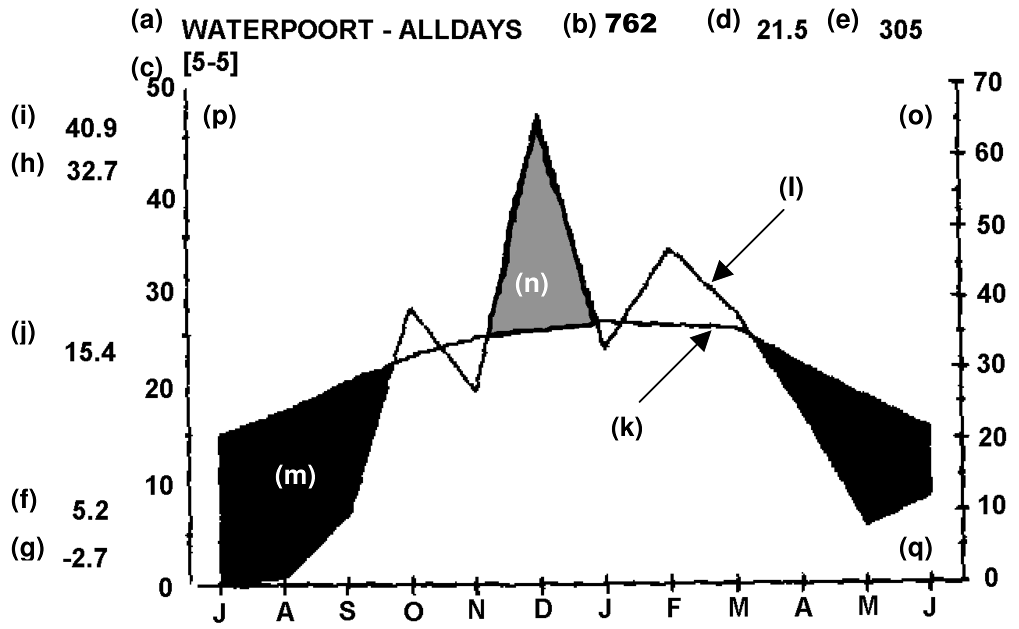
Temperatures vary dramatically according to topography and seasonal conditions. The summer months are warm, with temperatures ranging from 16–40ºC. Winter temperatures are mild, ranging from 12–22ºC. Minimum winter temperatures seldom drop below freezing point.

Due to the east-west orientation of the Soutpansberg, it experiences orographic rainfall. This phenomenon is due to moisture-laden air from the Indian Ocean, driven by the prevailing south-easterly winds onto the southern scarp of the Soutpansberg (Kabanda 2003). The north-south orientated Wolkeberg further blocks the westerly movement of the atmospheric moisture, forcing it into the wedge created by the two mountains in the vicinity of Entabeni. Large amounts of rain are discharged onto these southern slopes of the Soutpansberg and eastern slopes of the Wolkberg. Entabeni receives an annual rainfall of 1 874 mm. Orographic mist along this southern slope may increase annual precipitation to 3 233 mm (Hahn 2002, Olivier *et al.* 2002). This creates a rain-shadow effect along the western slopes of the Wolkberg and the northern slopes of the Soutpansberg. With the SC and BNR located north-west of the Soutpansberg–Wolkberg junction, a double rain-shadow effect is experienced along the northern slopes of the study area. Waterpoort, located north of the Soutpansberg, receives only 367 mm rain annually.

Due to the extreme topographic diversity and altitude changes over short distances within the study area, climate (especially rainfall and mist precipitation) varies dramatically (Kabanda 2003). The amount of orographic rain associated with the southern ridges varies considerably in accordance with the changing landscape. The venturi effect caused by certain narrow gorges when mist is forced through them by orographic, anabatic and catabatic winds can lead to abnormally high localised rainfall (Matthews 1991; Hahn 2002). The areas just below the escarpment crest, where atmospheric moisture can be trapped most effectively against the south-facing escarpment, generally yield the highest precipitation (Matthews 1991).

The diversity of rainfall in the study area can be seen by the long-term average rainfall recorded for three farms, namely Ventersdorp, Hanglip and Schyffontein with annual rainfall of 585 mm, 774 mm and 835 mm respectively (South African Weather Bureau). Apart from the spatial variation in rainfall, the area reveals a high temporal variation in recorded rainfall (Geldenhuys & Murray 1993). Mean annual rainfall for Makhado fluctuated between 571 mm for the period 1965–1971 and 1 027 mm for the period 1979–1988 (South African Weather Bureau). In addition to these rainfall figures, the amount of precipitation as a result of mist can be substantial (Schutte 1971). In the higher lying areas of the KwaZulu-Natal Drakensberg, for example, the orographic fog contribution at 1 800 m altitude is an additional 403 mm per annum, which amounts to one third of the mean annual precipitation (Matthews 1991). As with many mountainous areas, the daily weather of the higher altitude crests and summits of the Soutpansberg is very unpredictable, fluctuating between extremes within a matter of hours.

The higher lying crests and ridges within the mistbelt are exposed to strong winds (Kabanda 2003). During the summer months, these winds carry moisture in from the Indian Ocean, creating a seasonal mistbelt, which gives rise to an abundance of rock- and bark-lichens and bryophytes. The combination of frequent orographic rain and mist during the summer months leaves the available soil drenched and sometimes flooded for extended periods. During the prolonged dry season, the prevailing winds are dry, causing dehydration and desiccation of the soils and vegetation (Hahn 2002). These extreme and fluctuating environmental conditions have led to specialization among the plants and may explain the relatively high level of endemisity within this region (Hahn 2002).



Legend

a Weather station name
b Altitude
c Number of years recorded [temp – rainfall]
d Average annual temp (ºC)
e Average annual rainfall (mm)
f Average daily min (coldest month)
g Lowest temp recorded
h Average daily max (warmest month)
i Highest temp recorded
j Average daily temp fluctuation
k Average monthly temp
l Average monthly precipitation
m Dry season
n Wet season
o Rainfall axis
p Temperature axis
q Time axis (months)

Figure 3. Climate diagram for the Alldays / Waterpoort area.

Soutpansberg Centre of Biological Diversity

The following section is a repetition of some of the information conveyed in the introductory chapter of this manuscript. This duplication of information under the heading of Study Area was deemed appropriate due to the relevance of the statistics on the biological diversity for the area. Its inclusion aims to reemphasize the conservation importance of the Soutpansberg Centre of Biological Diversity.

The Soutpansberg–Blouberg region has been recognized as a Centre of Endemism by Van Wyk and Smith (2001). However, little ecological knowledge of the area exists (Anderson 2001, Berger *et al.* 2003). Some floristic surveys conducted by Hahn (1994; 1996; 1997; 1999; 2002), Stirton (1982), Obermeyer *et al.* (1937) and Van Wyk (1984; 1996) indicated that the Soutpansberg Centre of Endemism is exceptionally diverse and species rich for its size (Van Wyk & Smith 2001). The conservation value of this centre lies in its unique ability to house a wide variety of floristic elements from the surrounding floristic regions (Hahn 2002). The region is an outstanding centre of plant diversity, with approximately 2 500–3 000 recorded vascular plant taxa (Hahn 1997). The region boasts with 41% of all plant genera and 68% of all known plant families of the flora of southern Africa. Altogether 595 specific and infra–specific trees and shrubs are known from the Soutpansberg, amounting to one third of all the known tree species in the entire southern Africa region (Hahn 1994; 1997; 2003). This constitutes one of the highest tree counts in southern Africa (Hahn 1997). The Kruger National Park, which covers an area of two million hectares, contains approximately 380 tree species (Van Wyk 1994), whereas 321 tree species have been recoded by Hahn (2002) in an area of only 2 000 hectares within the SC. Trees and shrubs encompass approximately 24% of the vascular plants of the Soutpansberg and play an important role in the species composition, vegetation structure and relative dominance within the different plant communities.

More than 500 bird species have been recorded throughout the Soutpansberg mountain range, amounting to approximately 56% of the recorded species for the entire southern Africa (Harrison *et al.* 1997; Hockey *et al.* 2005). The Soutpansberg and its surroundings contain some unique reptile habitats, and house seven endemic species (Branch 1988). A total of 46 spider families, 110 genera and 130 species have been recorded in the SC on the single farm Lejuma (<50 km^2), which constitutes 70%

of the families, 26% of the genera and 5% of the species recorded for South Africa (Foord *et al.* 2002; 2003). The high biological diversity of the Soutpansberg and Blouberg can possibly be attributed to the fact that the mountain range acts as a refuge in times of environmental flux (Hahn 2003).

In the light of the high diversity recorded for the Blouberg–Soutpansberg expanse, it is proposed that the region be given the status of the Soutpansberg Centre of Biological Diversity (SCBD) in addition to its recognised status as the Soutpansberg Centre of Plant Endemism. There are current efforts to create a biosphere reserve in this area, which will include the SC and BNR (Hahn *in prep*.).

CHAPTER 3

METHODS

Introduction

Ecological studies of entire ecosystems often have a descriptive nature due to the difficulties of setting up true experimental controls within these complex and multivariate biological systems (Siebert 2001). The first step is usually to search for patterns in community structure and composition. Community ecology is therefore the search for simple ways to describe complex systems.

Conducting science at the community level is difficult due to the enormous size and complexity of the databases compiled. The analytical techniques used are determined by the objectives and scale of the study, and the results are influenced by the variables sampled and the manner in which they were sampled (Jongman *et al.* 1995). The inherent subjectivity associated with gathering descriptive field data contributes to this complexity of ecosystem and community ecology (Begon *et al.* 1996).

The need to develop procedures for describing and comparing communities has dominated the development of community ecology (Begon *et al.* 1996). Quantitative approaches or numerical techniques have been used extensively in plant community ecology (Kent & Coker 1995). Schamineé & Stortelder (1996) emphasized the importance of standardized sampling and data analysis for comparative reasons. According to Werger (1974), the following are important requirements to be fulfilled by any ecological classification method concerning total floristic composition:

1. The method should be scientifically sound.
2. It should fulfil the necessity of classification at an appropriate level or scale.
3. It should be efficient and versatile amongst comparable approaches.

For these reasons, it was decided to use the Braun-Blanquet method (Braun-Blanquet 1932; Werger 1973; Mueller-Dombois & Ellenberg 1974; Whittaker 1978) in order to classify the vegetation of the SC and BNR. The Braun-Blanquet method has been applied successfully by numerous vegetation scientists (Van Der Meulen 1979; Bredenkamp 1987; Brown *et al.* 1996; Witkowski & O'Connor 1996; Siebert *et al.*

2003a). The work presented in this thesis is essentially a scientific description and ecological interpretation of the complex vegetation patterns and its primary environmental drivers of the Soutpansberg Conservancy and the Blouberg Nature Reserve. Emphasis is placed on the deductive use of phytosociology as a tool for ecological application.

Vegetation reflects the complex interaction between the abiotic and biotic environmental drivers of ecosystems. The heterogeneity of ecosystem processes is therefore often expressed by variation in vegetation patterns. In order to understand and manage the processes of southern Africa's rich and diverse ecosystems, it is important to describe and interpret vegetation patterns in an ecologically sensible manner. Plant communities derived from vegetation classification, are often considered to represent the basic ecological units useful for management purposes. These plant communities therefore provide the basic building blocks for the development and implementation of management units and systems. There is a growing interest in applying phytosociological knowledge in nature conservation and natural resource management (Schamineé & Stortelder 1996; Reyers 2003).

Analytical phase

The analytical phases of the vegetation study of the BNR and SC were conducted over the growing seasons of 1988–1989 and 2001–2002 respectively. The field data from the BNR were gathered by H.L. Klopper, while the field data from the SC were collected by T.H.C. Mostert.

The vegetation of the study area was stratified into homogeneous physiographic–physiognomic units, using arial photographs (scale 1: 50 000), as well as maps on the topography, geology, soils and Land Types of the study area. A total of 466 sample plots were placed within each of these stratified units in such a way that habitat was as uniform as possible within each vegetation stand. Homogeneity is difficult to test statistically. It was, therefore, assessed visually and care was taken not to place plots in ecotonal zones. A minimum of 4 plots were place partially random within the subjectively stratified homogeneous vegetation units of the study area. The total number of plots for the study area depended on scale, available time and available resources at the disposal of the fieldworkers.

The sample plot size was set at 400 m^2 in accordance with vegetation studies elsewhere in the semi-arid environments of southern Africa (Siebert 2001). This relatively large plot size was chosen due to the scale of the survey and the heterogeneity of the Soutpansberg Centre of Endemism (Van Wyk & Smith 2001). The cover-abundance for every species present in a sample plot was assessed according to the Braun-Blanquet cover-abundance scale (Werger 1974, Mueller-Dombois & Ellenberg 1974):

- 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

The vegetation structure at each plot was described according to the structural classification system of Edwards (1983). All relevés are stored in the TURBOVEG database (Hennekens 1996a) and managed by the Department of Botany, University of Pretoria. The taxon names of identified species conform to those of Germishuizen & Meyer (2003). Environmental data include soil type, aspect, slope, surface rock cover and disturbance to the soil and vegetation.

Synthetic phase

The data set of 466 relevés, containing 846 infra specific taxa, was entered into a vegetation database created in TURBOVEG (Hennekens & Schamineé 2001). The unpublished phytosociological data, gathered by H.L. Klopper in 1988 from the Blouberg Nature Reserve, were included as representation of some of the variation in the Blouberg vegetation. Data collected by Geldenhuys & Murray (1993) were included as representative for the forests of the Hanglip State Forest.

A first approximation of the main communities was arrived by applying the Two Way INdicator SPecies ANalysis (TWINSPAN) classification algorithm (Hill 1979a) to the floristic data. TWINSPAN is a divisive, hierarchical classification technique that detects overall patterns of differences in biological data. Although the reliability of the TWINSPAN approach has been questioned under certain conditions (Van Groenewoud 1992; Van Der Maarel 1996), it was chosen for its proven combination of effectiveness, robustness, relative objectivity, speed and availability (Gauch & Whittaker 1981; Myklestad & Birks 1993). Due to the relative manageable size of the dataset, no subjective stratification of the data was performed before the numerical classification was done, as is suggested for large datasets (Van Der Maarel *et al.* 1987; Bredenkamp & Bezuidenhout 1995).

A synoptic table was constructed to represent the major groups defined by the TWINSPAN classification (Table 1). Refinement of the synoptic table was done with the Braun-Blanquet procedures according to the steps proposed by Behr & Bredenkamp (1988). These procedures have been used successfully in a number southern African vegetation studies (e.g. Bredenkamp *et al.* 1989; Fuls *et al.* 1993; Siebert *et al.* 2003a; Van Staden & Bredenkamp 2006). The synoptic table contains species in each of the identified Major Vegetation Types on constancy values of 20% ordinal scale (I–V). Only species with a minimum constancy value of 20% (II), in any of the given Major Vegetation Types, were included in the table. All the excluded taxa will be included into tables of subsequent papers that will focus on the composition of individual Major Vegetation Types.

This result was then used to subdivide the data into eight phytosociological tables, each representing on of the Major Vegetation Types of the study area. Each of these was again subjected to TWINSPAN. The resultant classification was further refined by using Braun-Blanquet procedures in the MEGATAB computer programme (Hennekens 1996b; Hennekens & Schaminée 2001). The groups obtained from this data set were subsequently described and classified the various chapters of this thesis. Although all the relevés collected from the SC and BNR were used for classification purposes, only selected relevés were presented in instances where the large size of classification tables became cumbersome.

The ordination algorithm DEtrended CORrespondence ANAlysis (DECORANA)(Hill 1979b) was applied using the computer software package PC-ORD (McCune & Mefford 1999), to determine gradients in vegetation and the relationship between these plant communities and the physical environment. Results are depicted on various scatter diagrams. These ordinations are presented for the Major Vegetation Types, as well as for the plant communities of each of the Major Vegetation Types.

The plant communities were named binomially according to the code of phytosociological nomenclature (Barkman *et al.* 1986). Due to the high turnover of species in the field-layer in these event-driven ecosystems, it was decided to deviate from the traditional rules and customs of community-name giving. Instead of rigidly assigning the first name to the most prominent diagnostic species (Werger 1974), the longevity and persistence of the species within the community was taken into consideration. Preference was given to persistent woody species, with the aim of assigning a name to a community with predictive value even in times of drought. Where applicable, informal alternative plant community names were added, coupled with descriptive physiognomic and environmental postfixes.

The decision was made to focus on the association level for the formal syntaxonomic classification and description of plant communities, based on the groupings and clusters derived from the TWINSPAN classification and the DECORANA ordination. The reason for avoiding the higher levels of the syntaxonomic hierarchy revolves around the incompleteness of the available data set with regard to the Soutpansberg–Blouberg Mountain Range and the surrounding region. Formal classification and identification of syntaxonomic units higher than the association, e.g. alliances, orders and classes, can only be defined and described accurately when using datasets representing most of the variation at the association level, within a naturally defined vegetation unit at regional scale, such as a biome. Classification of unrepresentative and incomplete datasets may lead to oversimplified images of regional vegetation. The classification of biomes and regional vegetation types into formal alliances, orders and classes, using spatially patchy vegetation data, which contains high-level detail on local scale, but which lack representation at a regional scale, may lead to the miss-allocation of hierarchical status and to the duplication of syntaxa (Van Der Meulen 1979). Hierarchical classification is undeniably bound to scale.

Available sources of literature concerning vegetation studies containing plant communities floristically similar to the plant communities described from the study area were used for phytosociological and ecological comparison. These include vegetation studies from:

- Southern African Mopaneveld (Du Plessis 2001; Siebert *et al.* 2003c)
- Sekhukhuneland (Siebert 2001; Siebert *et al.* 2003a, b)
- Lowveld (Van Der Schijff 1957; Bredenkamp 1982, 1986, 1987; Bredenkamp & Theron 1991; Van Rooyen 1978; Coetzee 1983; Gertenbach 1983, 1987; Acocks 1953; Bredenkamp & Theron 1991; Bredenkamp & Deutschlander 1994)
- Northern and Central Bushveld (Louw 1970; Coetzee *et al.* 1976; Scholes 1978; Van Der Meulen 1979; Westfall 1981; Westfall *et al.* 1985; Van Den Berg 1993; Brown *et al.* 1995; Van Rooyen & Bredenkamp 1996a, b, c; Breebaart & Deutchlander 1997; Winterbach 1998; Winterbach *et al.* 2000; Brown 1997; Götze 2002; Smit 2000; Henning 2002; Van Staden 2002; Van Staden & Bredenkamp 2005, 2006)
- Grassland Biome (White 1978b; Bredenkamp 1975; Bredenkamp & Theron 1980; Behr & Bredenkamp 1988; Bredenkamp *et al.* 1989; Bredenkamp & Van Rooyen 1996b; Acocks 1953; Du Preez & Bredenkamp 1991; Fuls *et al* 1993; Burgoyne 1995; Granger & Bredenkamp 1996; Bredenkamp *et al.* 1996)
- Forest Biome (Fanshawe 1969; Moll 1972, 1976; Geldenhuys 1987; Cawe 1990; Geldenhuys & Murray 1993; Louw *et al*. 1994; Lubke *et al*. 1988; Du Preez *et al*. 1991; Lubke & McKenzie 1996; MacDevette 1993; Midgley *et al.* 1995; Shackleton *et al.* 1999; Geldenhuys & Venter 2002; Von Maltitz *et al.* 2003; Van Staden & Bredenkamp 2006)
- Escarpment (Deall *et al.* 1989; Matthews 1991; Matthews *et al.* 1991, 1992a, b, 1993, 1994)
- Southern African wetlands (Le Roux *et al.* 1988; Smuts 1992; Marneweck *et al*. 2001; Venter 2003; Grundling & Grobler 2005)

- Others (Acocks 1953; White 1978a; White 1983; Rutherford & Westfall 1994)

Mapping

Mapping of heterogeneous vegetation in mountainous terrain is extremely challenging and the practical outcome or product is very much scale bound (Raal & Burns 1996; Kovar 2000; Cingolania *et al*. 2004). Due to the scale at which sampling was done and the topographic complexity of the study area, it was decided to restrict mapping resolution to the Major Vegetation Types identified. The smaller patches and finer mosaic patterns formed by Major Vegetation Types along the areas of more extreme morphological complexity was not mapped.

Limitations on fieldwork and data analysis

Due to the destruction caused by the floods of 2000, the Sand River Gorge lost all of its riverine forests and thickets. These vegetation types could therefore not be sampled at the time of data gathering in the summer of 2002–2003.

Some discrepancies between the data of the SC and the BNR required the classification and ordination results to be interpreted with some subjectivity. The homogeneous nature of the BNR vegetation dataset may indicate that some plots were placed incorrectly within heterogeneous transitional vegetation, resulting in mixed relevés.

Data collection of similar plant communities during different growing seasons, especially within the event-driven semi-arid and arid ecosystems of southern Africa, often lead to their separation during classification. These separations are mainly due to changes in the floristic composition of the dynamic herbaceous layer. However, the herbaceous component of event-driven plant communities is regarded as the more variable component of vegetation and is given less priority during the interpretation of results.

Phenological changes over the time of data collection influenced the perceived species abundance and cover, consequently affecting the data of the relevés (Fischer 2000).

The artificial boundaries of the study area place some restrictions on the vegetation data with regard to its representativeness of the regional vegetation. In turn, this had an influence on the hierarchical level of syntaxonomic vegetation classification that could be conducted with confidence.

Chapter 4

Major Vegetation Types of the Soutpansberg Conservancy and the Blouberg Nature Reserve

(Research paper submitted for publication in *Koedoe*)

Major Vegetation Types of the Soutpansberg Conservancy and the Blouberg Nature Reserve

T.H.C. Mostert[1], G.J. Bredenkamp[1], H.L. Klopper[1], C. Verwey[1], R.E. Mostert[2] and N. Hahn[3]

1. African Vegetation and Plant Diversity Research Centre, Department of Botany, University of Pretoria, Pretoria, 0002.
2. South African Biodiversity Institute, Private Bag X101, Pretoria, 0001.
3. Herbarium Soutpansbergensis, P.O. Box 1734, Makhado, 0920.

Abstract

The Major Vegetation Types and plant communities of the Soutpansberg Centre of Endemism are described in detail with special reference to the Soutpansberg Conservancy and the Blouberg Nature Reserve. Phytosociological data from 466 sample plots were ordinated using a Detrended Correspondence Analysis (DECORANA) and classified using Two–way Indicator Species Analysis (TWINSPAN). The resulting classification was further refined with table–sorting procedures based on the Braun–Blanquet floristic–sociological approach of vegetation classification using MEGATAB. Eight Major Vegetation Types were identified and described as Eragrostis lehmanniana *var.* lehmanniana–Sclerocarya birrea *subsp.* caffra *BNR Northern Plains Bushveld,* Euclea divinorum–Acacia tortilis *BNR Southern Plains Bushveld,* Englerophytum magalismontanum–Combretum molle *BNR Mountain Bushveld,* Adansonia digitata–Acacia nigrescens *Soutpansberg Arid Northern Bushveld,* Catha edulis–Flueggia virosa *Soutpansberg Moist Mountain Thickets,* Diplorhynchus condylocarpon–Burkea africana *Soutpansberg Leached Sandveld,* Rhus rigida *var.* rigida–Rhus magalismontanum *subsp.* coddii *Soutpansberg Mistbelt Vegetation and* Xymalos monospora–Rhus chirendensis *Soutpansberg Forest Vegetation.*

Introduction

The Soutpansberg Conservancy (SC) and the Blouberg Nature Reserve (BNR) reveal extremely rich diversities of plant communities relative to the sizes of these conservation areas (Van Wyk & Smith 2001). Although Van Rooyen & Bredenkamp (1996) recognised this diversity and unique composition of plant communities within the Soutpansberg–Blouberg complex, the lack of detailed research in the region forced them to lump the area's vegetation under the broad term of Soutpansberg Arid Mountain Bushveld. Acocks (1953) recognised four different Veld Types for the greater surrounding region and described them as Arid Sweet Bushveld, Mixed Bushveld, Sourish Mixed Bushveld and Sour Bushveld. Most of these Veld Types were described as heterogeneous (Acocks 1953), comprising of many sub-communities with different agricultural and production potentials. In addition to the savanna vegetation of the area, Geldenhuys & Murray (1993) and Lubke & McKenzie (1996) described and mapped the patches of Afromontane Forest associated with the region. Van Wyk & Smith (2001) only briefly mention the occurrence of "Fynbos-type" vegetation along the summit of the mountain. They also refer to dense, almost mono–specific stands of Lebombo ironwood (*Androstachys johnsonii*) on the arid northern slopes of the mountain. Due to major gaps in the available vegetation data, no attempt has yet been made to synthesize, classify and to describe the plant communities of this region.

The study area

Location

The BNR (7000 ha) and SC (100 000 ha) are located in the arid northern regions of the Limpopo Province of South Africa (Fig.1). For the purpose of this study, the SC is defined as a section of the Soutpansberg Mountain Range contained by four provincial and national roads. The eastern boudary (E29°55') is the N1 from Makhado in the south to Wyllies Poort in the north. The northern boundary (S 22°52') is the R523 road from Wyllies Poort in the east to Kalkheuwel in the west. The western boundary (E29°15") is the R521 road from Kalkheuwel in the north to Vivo in the south. The southern boundary (S23°12') is the R522 road from Vivo in the west to Makhado in the east. From east to west it spans approximately 70 km and from north to south approximately 25 km at it's widest. The BNR lies approximately 40 km to the west, situated along the eastern half of the Blouberg Mountain.

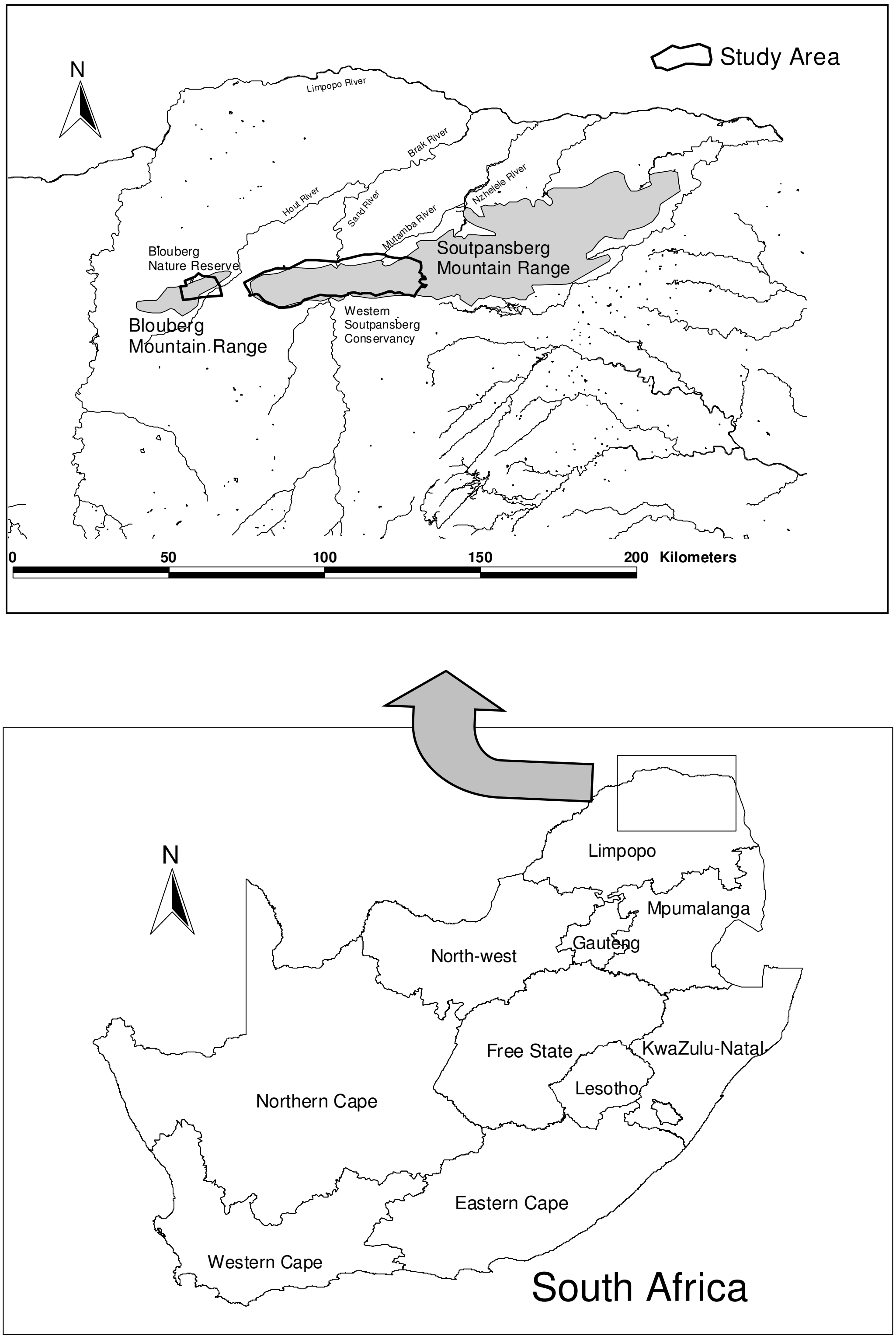


Fig. 1. The location of the Blouberg Nature Reserve and Western Soutpansberg Conservancy within South Africa.

Topography

The SC and BNR are part of the Blouberg–Soutpansberg Mountain Range, with it's ENE–WSW orientation. Although the Blouberg and Soutpansberg belong to the same geological formation they are referred to as separate entities. Successive faulting along the Tshamuvhudzi, Kranspoort, Nakab and Zoutpan strike-faults, followed by the northwards tilting of the area, created these quartzite mountains within the surrounding Limpopo Plain. This gave the Blouberg–Soutpansberg Mountain Range a wedge-shaped appearance with steep southern slopes and moderate northern slopes. The ridges are highest at the western extremity of this range, gradually descending until it finally plunges beneath the Karoo Supergroup along the northern reaches of the Lebombo Mountains near the north-eastern border of the Limpopo Province. The SC's altitude ranges from 750 m above sea level at Waterpoort to 1 748 m at Lejuma. The BNR's altitude ranges from 850 m above sea level in the east to 1 400 m in the west. The highest peak of the Blouberg lies further to the west, reaching 2 051 m above sea level (Bumby 2000). The surrounding plains are approximately 850 m above sea level.

Geology and soils

The geology of the SC and BNR is dominated by pink, erosion resistant quartzite, and sandstone with minor pebble washes of the Wyllies Poort Geological Formation of the Soutpansberg Group. Other less prominent rock types include shale, conglomerate, basalt and diabase intrusions. The rocks of the study area do not contain large amounts of minerals that are of economic value.

Soils derived from the quartzite and sandstone are generally shallow, gravely, skeletal and well drained, with low nutrient content and acidic characteristics. Soils derived from the basalt and diabase dykes are fine textured, clayey, well weathered and generally deep. These poorly drained soils are prone to erosion along the higher rainfall southern slopes. Soils derived from the Aeolian Kalahari sands are fine-grained deep sands. Large areas along the northern sloped contain no soil, consisting only of the exposed underlying mother material. Peat soils occur along the cooler high lying wetlands of the SC. The deeper soils within the mistbelt act as sponge areas, which slowly release water to feed mountain streams over prolonged periods.

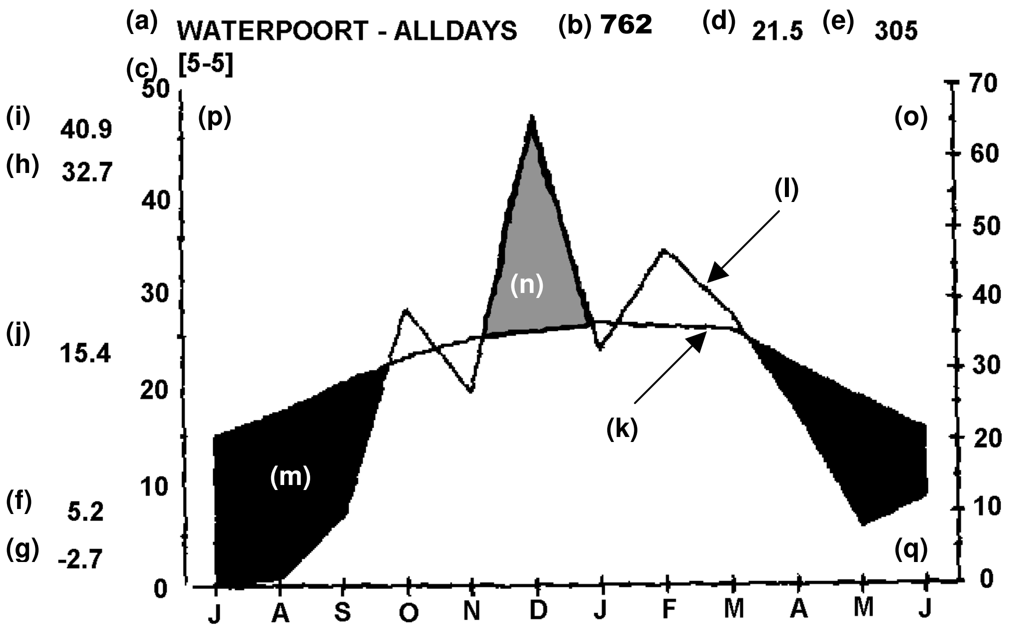
Climate

The SC and BNR fall within the summer rainfall zone of southern Africa. A climate diagram (Fig. 2) depicts typical rainfall patterns and temperature gradients within the study area. Due to the temporal and spatial variability of rainfall for this area, a sample five-year period was chosen for a single area for illustrative purposes only. All other averages mentioned in the text were calculated using long-term data. The South African Weather Bureau (2004) provided the data used to compile this diagram. Due to the east-west orientation of the Soutpansberg, it experiences orographic rainfall. This phenomenon is due to moisture-laden air from the Indian Ocean, driven by the prevailing south-easterly winds into the southern scarp of the Soutpansberg. The north-south orientated Wolkeberg further blocks the westerly movement of the atmospheric moisture, forcing it into the wedge created by the two mountains in the vicinity of Entabeni. Large amounts of rain are discharged onto these southern slopes of the Soutpansberg and eastern slopes of the Wolkberg. Entabeni receives an annual rainfall of 1 874 mm. Orographic mist along this southern slope may increase annual precipitation to 3 233 mm (Hahn 2002, Olivier & Rautenbach 2002). This creates a rain-shadow effect along the western slopes of the Wolkberg and the northern slopes of the Soutpansberg. With the SC and BNR located north-west of the Soutpansberg–Wolkberg junction, a double rain-shadow effect is experienced along the northern slopes of the study area. Waterpoort, located north of the Soutpansberg, receives only 367 mm rain annually.

Due to the extreme topographic diversity and altitude changes over short distances within the study area, climate (especially rainfall and mist precipitation) varies dramatically. The amount of orographic rain associated with the southern ridges varies considerably in accordance to the changing landscape. The venturi effect caused by certain narrow gorges when mist is forced through them by orographic, anabatic and catabatic winds can lead to abnormally high localised rainfall (Matthews 1991; Hahn 2002). The areas just below the escarpment crest, where atmospheric moisture can be trapped most effectively against the south-facing escarpment, generally yield the highest precipitation (Matthews 1991).

The diversity of rainfall in the study area can be seen by the long-term average rainfall recorded for three farms, namely Ventersdorp, Hanglip and Schyffontein with annual rainfall of 585 mm, 774 mm and 835 mm respectively (South African Weather Bureau). Apart from the spatial variation in rainfall, the area reveals a high temporal variation in recorded rainfall (Geldenhuys & Murray 1993). Mean annual rainfall for Makhado fluctuated between 571 mm for the period 1965–1971 and 1 027 mm for the period 1979–1988 (South African Weather Bureau 2004). In addition to these rainfall figures, the amount of precipitation as a result of mist can be substantial (Schutte 1971). In the higher lying areas of the KwaZulu-Natal Drakensberg, for example, the orographic fog contribution at 1 800 m altitude is an additional 403 mm per annum, which amounts to one third of the mean annual precipitation (Matthews 1991). As with many mountainous areas, the daily weather of the higher altitude crests and summits of the Soutpansberg is very unpredictable, fluctuating between extremes within a matter of hours.

The higher lying crests and ridges within the mistbelt are exposed to strong winds. During the summer months, these winds carry moisture in from the Indian Ocean, creating a seasonal mistbelt, which gives rise to an abundance of rock- and bark-lichens and bryophytes. The combination of frequent orographic rain and mist during the summer months leaves the available soil drenched and sometimes flooded for extended periods. During the prolonged dry season, the prevailing winds are dry, causing dehydration and desiccation of the soils and vegetation (Hahn 2002). These extreme and fluctuating environmental conditions have led to specialization among the plants and may explain the relatively high level of endemisity within this vegetation type (Hahn 2002).



Legend

- a Weather station name
- b Altitude
- c Number of years recorded [temp – rainfall]
- d Average annual temp (ºC)
- e Average annual rainfall (mm)
- f Average daily min (coldest month)
- g Lowest temp recorded
- h Average daily max (warmest month)
- i Highest temp recorded
- j Average daily temp fluctuation
- k Average monthly temp
- l Average monthly precipitation
- m Dry season
- n Wet season
- o Rainfall axis
- p Temperature axis
- q Time axis (months)

Fig. 2. Climate diagram for the Alldays / Waterpoort area.

Soutpansberg Centre of Biological Diversity

The Soutpansberg–Blouberg region has been recognized as a Centre of Endemism by Van Wyk and Smith (2001). However, little ecological knowledge of the area exists (Anderson 2001, Berger *et al*. 2003). Some floristic surveys conducted by Hahn (1994; 1996; 1997; 1999; 2002), Stirton (1982), Obermeyer *et al.* (1937) and Van Wyk (1984; 1996) indicated that the Soutpansberg Centre of Endemism is exceptionally diverse and species rich for its size (Van Wyk & Smith 2001). The conservation value of this centre lies in its unique ability to house a wide variety of floristic elements from the surrounding floristic regions (Hahn 2002). The region is an outstanding centre of plant diversity, with approximately 2 500–3 000 recorded vascular plant taxa (Hahn 1997). The region boasts with 41% of all plant genera and 68% of all known plant families of the flora of southern Africa. Altogether 595 specific and infra–specific trees and shrubs are known from the Soutpansberg, amounting to one third of all the known tree species in the entire southern Africa region (Hahn 1994; 1997; 2003). This constitutes one of the highest tree counts in southern Africa (Hahn 1997). The Kruger National Park, which covers an area of two million hectares, contains approximately 380 tree species (Van Wyk 1994), whereas 321 tree species have been recoded by Hahn (2002) in an area of only 2 000 hectares within the SC. Trees and shrubs encompass approximately 24% of the vascular plants of the Soutpansberg and play an important role in the species composition, vegetation structure and relative dominance within the different plant communities.

More than 500 bird species have been recorded throughout the Soutpansberg mountain range, amounting to approximately 56% of the recorded species for the entire southern Africa (Harrison *et al.* 1997; Hockey *et al.* 2005). The Soutpansberg and its surroundings contain some unique reptile habitats, and house seven endemic species (Branch 1988). A total of 46 spider families, 110 genera and 130 species have been recorded in the SC on the single farm Lejuma (<50 km^2), which constitutes 70% of the families, 26% of the genera and 5% of the species recorded for South Africa (Foord *et al.* 2002; 2003). The high biological diversity of the Soutpansberg and Blouberg can possibly be attributed to the fact that the mountain range acts as a refuge in times of environmental flux (Hahn 2003).

In the light of the high diversity recorded for the Blouberg–Soutpansberg expanse, it is proposed that the region be given the status of the Soutpansberg Centre of Biological Diversity (SCBD) in addition to its recognised status as the Soutpansberg Centre of Plant Endemism. There are current efforts to create a biosphere reserve in this area, which will include the SC and BNR (Hahn *in prep*.).

Aims of the study

This study is a first attempt at understanding the complex ecological patterns and processes observed within the SCBD. It is concerned with the phytosociology and synecology of the SC and BNR. Its aim is to identify the different plant communities and to investigate the interrelationships between plant communities and their physical and biological environments. In an attempt to create a holistic image and to explain the macro–ecology of the region, disciplines such as climatology, geology, pedology, physical geography, history and anthropology are drawn upon and integrated. This study provides a first approximation of the vegetation of the study area. It aims to define and describe the characteristics of the Major Vegetation Types and plant communities within the context of the SC and BNR. This will assist scientists, conservationists and land-use planners when future projects are conducted within the surrounding areas. The plant communities from the SC and BNR will serve as reference sites with which to compare proposed development sites from the surrounding unprotected areas. Sound environmental development is a state of mind (Siebert 2001) and something that can be achieved if basic information, such as this account, is actively drawn upon during planning and management of natural resources.

Methods

The vegetation of the study area was stratified into homogeneous physiographic–physiognomic units, using arial photographs (scale 1: 50 000), as well as maps on the topography, geology, soils and Land Types of the study area. A total of 466 sample plots were randomly placed within each of these stratified units. The sample plot size was set at 400 m^2 in accordance with vegetation studies elsewhere in the semi-arid environments of southern Africa (Siebert 2001). The cover-abundance value for every species recorded within each sample plot was assessed according to the Braun-Blanquet cover-abundance scale (Mueller-Dombois & Ellenberg 1974). The taxon names conform to those of Germishuizen & Meyer (2003). Environmental data include soil type, aspect, slope, surface rock cover and disturbance to the soil and vegetation.

The data set, containing 846 specific and infra specific taxa, was entered into a vegetation database created in TURBOVEG (Hennekens & Schamineé 2001). A first approximation of the main communities was arrived at by applying the TWINSPAN classification program (Hill 1979a) to the floristic data, and subsequent refinement of the classification was achieved by applying Braun-Blanquet procedures (Bredenkamp *et al.* 1989; Fuls *et.* al 1993; Kent & Coker 1996; Siebert *et al.* 2003; Van Staden & Bredenkamp 2006).

A synoptic table was constructed to represent the major groups defined by the TWINSPAN classification (Table 1). Refinement of the synoptic table was done with the Braun-Blanquet procedures (Bredenkamp *et al.* 1989, Fuls *et.* al 1993, Van Staden & Bredenkamp 2006). The synoptic table contains species in each of the identified Major Vegetation Types on constancy values of 20% ordinal scale (I–V). Only species with a minimum constancy value of 20% (II), in any of the given Major Vegetation Types, were included in the table. All the excluded taxa will be included into detailed phytosociological tables of subsequent papers that will focus on the individual Major Vegetation Types of the SC and BNR. The ordination algorithm DEtrended CORrespondence ANAlysis (DECORANA)(Hill 1979b) was applied using the computer software package PC-ORD (McCune & Mefford 1999), to determine gradients in vegetation and the relationship between these plant communities and the physical environment.

Results

Eight Major Vegetation Types were identified for the SC and the BNR. These represent the Forest Biome, Grassland Biome, Savanna Biome and some azonal plant communities.

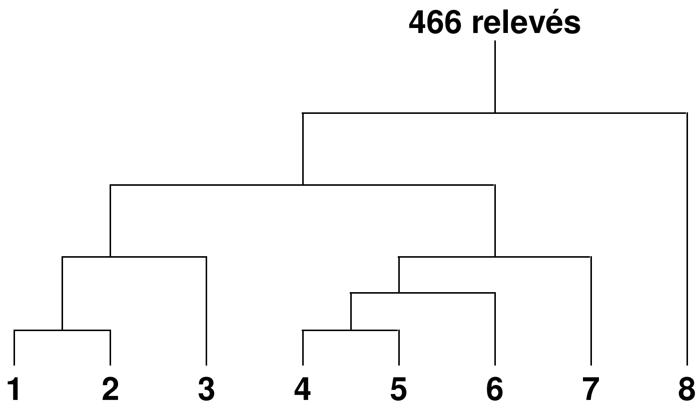
A dendrogram (Fig. 3) of the hierarchical classification was produced with the software package TWINSPAN (Hill 1979b). The first division separated the *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Vegetation form the savanna and grassland Vegetation Types. The second division separated the vegetation of the SC from that of the BNR. A third division split off the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Mistbelt Vegetation from the SC-cluster, and split off the BNR Plains Bushveld from the BNR Mountain Bushveld. Further divisions separated the BNR Northern Plains Bushveld from the BNR Southern Plains Bushveld, while the vegetation of the SC was divided into *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld, *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets, *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld.

The dataset was classified into different plant communities based on diagnostic species. Strong emphasis was placed on long–lived perennial species for the purpose of community description and syntaxonomy. These species were specifically chosen to ensure relatively long–term predictability regarding effective plant community identification by future fieldworkers and managers. Due to the fleeting existence and unpredictable appearance of annual and weak perennial species within communities of arid and semi–arid ecosystems, it was decided to treat such species as the more temporary and fluctuating component within the vegetation of these event–driven systems (Westoby *et al.* 1989).

The floristic composition of the eight Major Vegetation Types is given in a synoptic table (Table 1). These major types are discussed below.

Description of the Major Vegetation Types

The geographical distribution of the Major Vegetation Types of the BNR and SC are displayed in Figures 4 and 5. The smaller patches and finer mosaic patterns formed by Major Vegetation Types along the areas of more extreme morphological complexity was not mapped. The precision with which vegetation units were mapped is therefore scale bound.



Legend:

1 *Eragrostis lehmanniana–Sclerocarya birrea* BNR Northern Plains Bushveld
2 *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld
3 *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld
4 *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld
5 *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets
6 *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld
7 *Rhus rigida–Rhus magalismontanum* Soutpansberg Mistbelt Vegetation
8 *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Vegetation

Fig. 3. A dendrogram showing the hierarchical divisions created with the TWINSPAN (TWo Way INdicator SPecies ANalysis) computer software package (Hill 1979a).

Table 1 Synoptic table of the Major Vegetation Types of the Soutpansberg Conservancy and the Blouberg Nature Reserve

Vegetation type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Number of releves	**98**	**84**	**16**	**65**	**20**	**50**	**33**	**70**
Species Group A								
Diagnostic spp for the *Eragrostis lehmanniana* var. *lehmanniana*–*Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld								
Eragrostis lehmanniana var. *lehmanniana*	V	I	I	I				
Phyllanthus burchellii	IV							
Indigofera species	III	I	I					
Leucas sexdentata	III							
Limeum fenestratum	III							
Erythrophleum africanum	III							
Bulbostylis hispidula ssp. *pyriformis*	III		I	I			I	
Ruellia species	II							
Indigofera rhytidocarpa	II							
Chamaecrista absus	II							
Hermannia grisea	II							
Tragus berteronianus	II							
Tragia minor	II							
Corchorus species	II	I						
Talinum crispatulum	II							
Monechma divaricatum	II							
Dactyloctenium aegyptium	II							
Zornia species	II							
Pogonarthria squarrosa	II							
Blepharis subvolubilis	II			I				
Limeum viscosum	II							
Secamone parvifolia	II	I						
Spirostachys africana	II							
Chamaecrista biensis	II							
Asparagus exuvialis fo. exuvialis	II							
Species Group B								
Diagnostic spp for the *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld								
Lepidagathis scabra	I	V						
Rhinacanthus xerophilus		III						

Melhania prostrata		III		I	I		
Rhus leptodictya	I	II		I	I		
Enteropogon macrostachyus		II					
Combretum imberbe		II			I		
Schotia brachypetala		II		I	I		
Aristida congesta ssp. *barbicollis*		II		I	I		
Corbichonia decumbens		II					

Species Group C

Hibiscus praeteritus	V	IV					
Acanthospermum species	V	II					
Evolvulus alsinoides	IV	II					
Melhania forbesii	IV	II					
Aristida congesta ssp. *congesta*	III	II		I			
Hibiscus calyphyllus	III	V					
Sida ovata	III	II	I				
Blepharis integrifolia	III	II		I			
Lantana rugosa	II	IV	I				
Acacia tortilis ssp. *heteracantha*	II	III		I	I		
Aristida adscensionis	II	III					
Arctotis species	II	II					
Acalypha indica	II	II					
Philenoptera violacea	II	II		I			
Ocimum gratissimum ssp. *gratissimum*	II	II					

Species Group D

Diagnostic spp for the *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld

Loudetia filifolia			IV				
Rhynchosia vendae		I	III				
Trichoneura grandiglumis			III				
Aristida species		I	III				
Combretum zeyheri		I	II				
Elephantorrhiza species			II				
Dalechampia species			II				
Tricliceras schinzii			II				

Species Group E

Cheilanthes involuta		II	III				
Tephrosia purpurea		III	IV				

Species Group F							
Cyperus angolensis	III	III	III				
Commiphora species	IV	II	III				
Grewia flavescens var. *flavescens*	IV	IV	II				
Eragrostis biflora	II	II	II				
Species Group G							
Diagnostic spp for the *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld							
Tribulus terrestris				III			
Grewia hexamita				III			
Commiphora glandulosa				III			
Blepharis diversispina				III			
Adansonia digitata				II			
Grewia flava	I	I		II			
Grewia subspathulata				II			
Cordia monoica				II	I		
Kirkia acuminata	I	I		II			
Maerua parvifolia				II			
Terminalia prunioides	I			II			
Maerua edulis				II	I		
Commiphora tenuipetiolata				II			
Tephrosia macropoda				II			
Solanum lichtensteinii				II	I		
Cassia abbreviata	I			II			
Cleome angustifolia ssp. *petersiana*				II			
Ochna inermis				II		I	
Lannea schweinfurthii	I			II			
Ledebouria apertiflora				II			
Commiphora viminea				II			
Sterculia rogersii		I		II			
Grewia villosa				II			
Chamaecrista mimosoides				II		I	I
Boscia foetida ssp. *rehmanniana*				II			
Sansevieria aethiopica				II			
Heliotropium steudneri	I	I		II	I		
Commiphora africana var. *africana*				II			
Species Group H							
Commiphora mollis	IV	II		IV			
Combretum apiculatum ssp. *apiculatum*	III	III	I	III		I	

Boscia albitrunca var. *albitrunca*	III	II		II				
Grewia bicolor var. *bicolor*	III	III		II	I	I		
Cissus cornifolia	II	II	II	II				
Combretum mossambicense	III			II				
Pristimera longipitiolata	II	I		II	I			

Species Group I

Diagnostic spp for the *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets

Grewia occidentalis var. *occidentalis*					IV			
Dovyalis zeyheri					IV			
Acalypha glabrata				I	IV			
Dombeya rotundifolia var. *rotundifolia*		I			IV		I	
Catha edulis					IV			
Rhus pentheri					III		I	
Carissa edulis					III			
Rhoicissus tridentata ssp. *tridentata*					III		I	
Senna petersiana		I		I	III			
Diospyros lycioides			I		III		I	
Berchemia zeyheri					III			
Dovyalis caffra					II			
Brachiaria deflexa					II			
Capparis tomentosa					II			
Euphorbia ingens	I				II			
Acacia ataxacantha		I			II			I
Euclea undulata				I	II			
Pavetta schumanniana					II		I	
Acacia rehmanniana					II			
Commelina benghalensis					II		I	
Gymnosporia senegalensis					II			
Acokanthera oppositifolia					II			
Mystroxylon aethiopicum ssp. *schlechteri*				I	II			
Rhus pyroides					II			
Bridelia mollis		I	I		II			
Clerodendrum glabrum var. *glabrum*					II			
Ekebergia capensis					II			
Allophylus africanus var. *africanus*					II			
Tarchonanthus camphoratus					II			
Maerua caffra					II			
Coddia rudis					II		I	
Lippia javanica					II		I	
Jasminum multipartitum					II	I	I	

Combretum hereroense	I	I		I	II		
Eragrostis superba					II		I
Panicum deustum		I		I	II		
Acacia caffra					II		
Setaria megaphylla					II		
Christella guenziana					II		
Euclea crispa ssp. *crispa*					II		
Cyperus albostriatus					II		I
Olea europaea ssp. *africana*					II		
Bridelia micrantha					II		
Buddleja saligna					II		
Solanum tettense var. *renschii*				I	II		
Cussonia natalensis					II		
Ficus sycomorus ssp. *sycomorus*					II		
Dicliptera heterostegia				I	II		
Scolopia zeyheri					II		
Canthium inerme					II		
Buddleja salviifolia					II		
Podocarpus falcatus					II		
Pyrenacantha grandiflorus					II		
Aloe greatheadii var. *greatheadii*					II		I
Canthium mundianum					II	I	
Bothriochloa insculpta					II		
Ficus sur					II		I
Sansevieria hyacinthoides				I	II		
Cyperus sphaerospermus					II		I
Bulbostylis burchellii					II		I
Syzygium cordatum					II		
Aloe marlothii ssp. *marlothii*					II		
Barleria gueinzii					II		
Pavetta eylesii					II		
Capparis fascicularis var. *fascicularis*					II		
Acacia gerrardii var. *gerrardii*					II		
Justicia flava	I			I	II		
Species Group J							
Plectroniella armata				II	III	I	
Hibiscus meyeri				III	II		
Peltophorum africanum		I		II	III	I	
Ximenia caffra var. *caffra*				II	II	I	
Gossypium herbaceum ssp. *africanum*				II	II		

Species Group K							
Euclea divinorum		V		II	II		
Flueggia virosa	I	III		II	IV		
Ximenia americana var. *microphylla*		II		II	II		
Heteropogon contortus	I	II		II	II		I
Themeda triandra		II	II	I	III		I
Acacia karroo		II			V		
Gymnosporia buxifolia	I	II		I	III		
Pappea capensis		II	I	I	II		
Acacia nilotica		II		I	II		
Species Group L							
Dichrostachys cinerea ssp. *africana*	IV	IV		IV	III		
Solanum panduriforme	III	IV	II	I	II		
Acacia nigrescens	II	IV		IV	II	I	
Urochloa mosambicensis	III	II			II		
Sclerocarya birrea ssp. *caffra*	IV	II		II	II		
Eragrostis rigidior	III	III		I	II		
Grewia monticola	III	IV		III	II	I	
Ehretia rigida	II	IV		II	III		
Markhamia zanzibarica	IV	I		I	II		
Species Group M							
Diagnostic spp for the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld							
Centropodia glauca						III	
Elephantorrhiza burkei						III	
Diplorhynchus condylocarpon						III	
Ochna pulchra						III	I
Hexalobus monopetalus var. *monopetalus*					I	II	
Grewia retinervis						II	
Ipomoea albivenia						II	
Strychnos pungens						II	
Eragrostis pallens						II	
Ozoroa paniculosa var. *salicina*		I		I		II	
Schizachyrium jeffreysii						II	
Selaginella dregei			I			II	I
Euphorbia aeruginosa						II	
Aloe angelica						II	
Pterocarpus angolensis						II	
Garcinia livingstonei						II	

Eragrostis gummiflua						II	I
Euphorbia zoutpansbergensis						II	
Commiphora marlothii				I		II	
Ficus abutilifolia						II	
Euphorbia cooperi						II	
Cineraria parvifolia						II	
Artabotrys brachypetalus						II	
Portulaca kermesina						II	I
Aristida canescens ssp. *ramosa*						II	
Tephrosia longipes						II	
Aristida diffusa ssp. *burkei*						II	
Indigofera cryptantha var. *cryptantha*						II	
Ficus tettensis						II	
Adenia spinosa						II	
Orthosiphon labiatus					I	II	I
Isoglossa hypoestiflora						II	
Anacampseros subnuda						II	I
Asparagus laricinus						II	
Loudetia flavida						II	
Androstachys johnsonii						II	
Dicoma montana						II	
Species Group N							
Tricalysia junodii var. *kirkii*				II		II	
Euclea natalensis	I			II	II	II	
Species Group O							
Pseudolachnostylis maprouneifolia		I	IV	I		IV	
Burkea africana			III			IV	
Species Group P							
Panicum maximum	V	V	IV	III	IV	II	
Digitaria eriantha	IV	I	IV	I	I	II	I
Ziziphus mucronata	II	III	I	II	V	II	
Strychnos madagascariensis	II	I	IV	II		III	
Enneapogon cenchroides	III	III	II	II		III	I
Waltheria indica	IV	II	II	II		II	
Schmidtia pappophoroides	III	I	II	III		II	
Terminalia sericea	II	I	II	II		III	
Aristida stipitata ssp. *graciliflora*	III			II		II	
Stipagrostis uniplumis var. *uniplumis*	II		I	II		II	

Species Group Q

Diagnostic spp for the *Rhus rigida* var. *rigida*–*Rhus magalismontanum* subsp. *coddii* Soutpansberg Mistbelt Vegetation

Rhus rigida var. *rigida*							IV
Melinis nerviglumis							III
Helichrysum kraussii							III
Brachiaria serrata							III
Cryptolepis cryptolepioides						I	III
Parinari capensis ssp. *capensis*						I	III
Fadogia homblei							III
Coleochloa setifera							III
Setaria sphacelata var. *torta*							III
Rhynchosia monophylla			I				II
Olea capensis ssp. *enervis*							II
Senecio barbertonicus							II
Syzygium legatii							II
Aloe arborescens							II
Rotheca myricoides							II
Euclea linearis							II
Crassula swaziensis			I				II
Khadia borealis							II
Trachypogon spicatus							II
Rhus tumulicola var. *meeuseana*							II
Commelina erecta				I		I	II
Olinia rochetiana							II
Cyperus obtusiflorus var. *obtusiflorus*							II
Combretum moggii							II
Vernonia natalensis							II
Dicoma anomala			I				II
Vangueria soutpansbergensis						I	II
Schistostephium crataegifolium							II
Coptosperma supra-axillare							II
Plectranthus neochilus							II
Gnidia cuneata							II
Elionurus muticus							II
Protea caffra ssp. *caffra*							II
Elephantorrhiza elephantina							II
Tetradenia riparia							II
Wahlenbergia undulata							II
Hypoxis argentea var. *argentea*							II
Eulophia ensata							II
Pteridium aquilinum							II

Kalanchoe sexangularis var. *sexangularis*							II
Sarcostemma viminale				I	I		II
Aristea woodii							II
Apodytes dimidiata ssp. *dimidiata*							II
Anthospermum welwitschii							II
Vernonia oligocephala							II
Protea roupelliae ssp. *roupelliae*							II
Pentanisia prunelloides ssp. *prunelloides*							II
Lopholaena coriifolia							II
Senecio oxyriifolius							II
Coptosperma rhodesiacum							II
Viscum rotundifolium							II
Ekebergia pterophylla							II
Myrsine africana							II
Ipomoea oblongata							II
Helichrysum cerastioides							II
Bulbostylis contexta							II
Hypoxis hemerocallidea							II
Asparagus falcatus						I	II
Species Group R							
Loudetia simplex						III	IV
Xerophyta retinervis						III	II
Corchorus kirkii				I		III	II
Commelina africana var. *lancispatha*				I		II	II
Landolphia kirkii						II	II
Combretum vendae						II	II
Vangueria parvifolia			I			II	II
Myrothamnus flabellifolius						II	II
Species Group S							
Zanthoxylum capense					IV		II
Dioscorea sylvatica					II		II
Heteropyxis natalensis					II		II
Species Group T							
Pellaea calomelanos var. *calomelanos*				II	II	III	II
Species Group U							
Combretum molle			V		IV	II	III
Vitex rehmannii		I	IV		I	III	II

Englerophytum magalismontanum			IV			I	III	
Vangueria infausta ssp. *infausta*	I	I	III		II	II	II	
Rhus magalismontanum ssp. *coddii*			II				IV	
Hyperacanthus amoenus			II		II	II	II	
Mimusops zeyheri			II		II		III	

Species Group V

Diagnostic spp for the *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Vegetation

Xymalos monospora								IV
Zanthoxylum davyi								II
Celtis africana					I			II
Nuxia floribunda							I	II
Rhoicissus tomentosa					I			II
Kiggelaria africana								II
Vepris lanceolata					I			II
Rapanea melanophloeos							I	II
Rothmannia capensis							I	II
Brachylaena discolor		I						II
Ficus craterostoma								II
Combretum kraussii								II
Trichilia dregeana								II
Trimeria grandifolia								II
Drypetes gerrardii								II
Oxyanthus speciosus ssp. *gerrardii*								II

Species Group W

Diospyros whyteana							II	II

Species Group X

Maytenus undata					III		III	II
Rhus chirindensis					II			IV
Cussonia spicata					II		I	II

Species Group Y

Maesa lanceolata		II						II

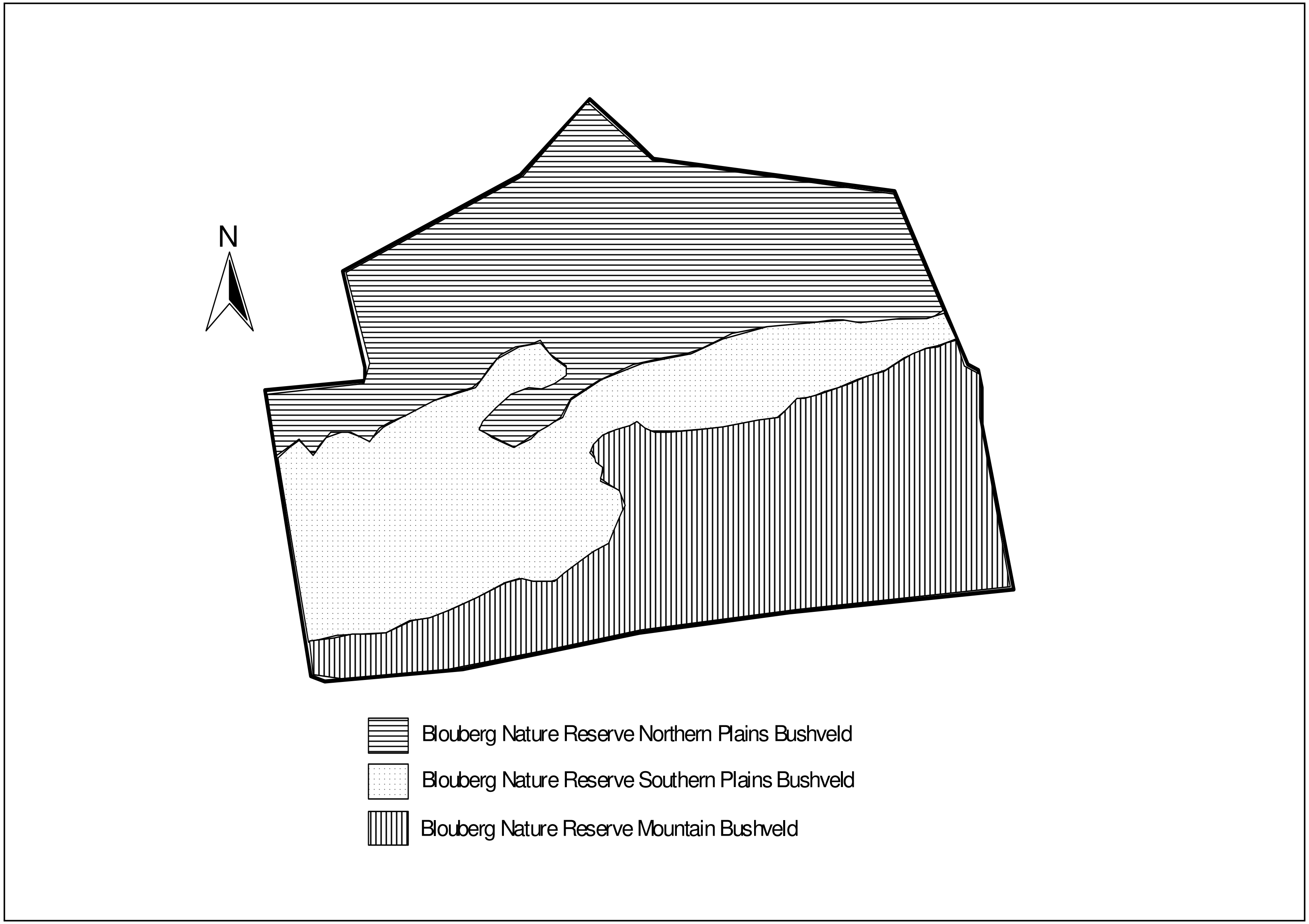


Fig. 4. The Major Vegetation Types of the Blouberg Nature Reserve

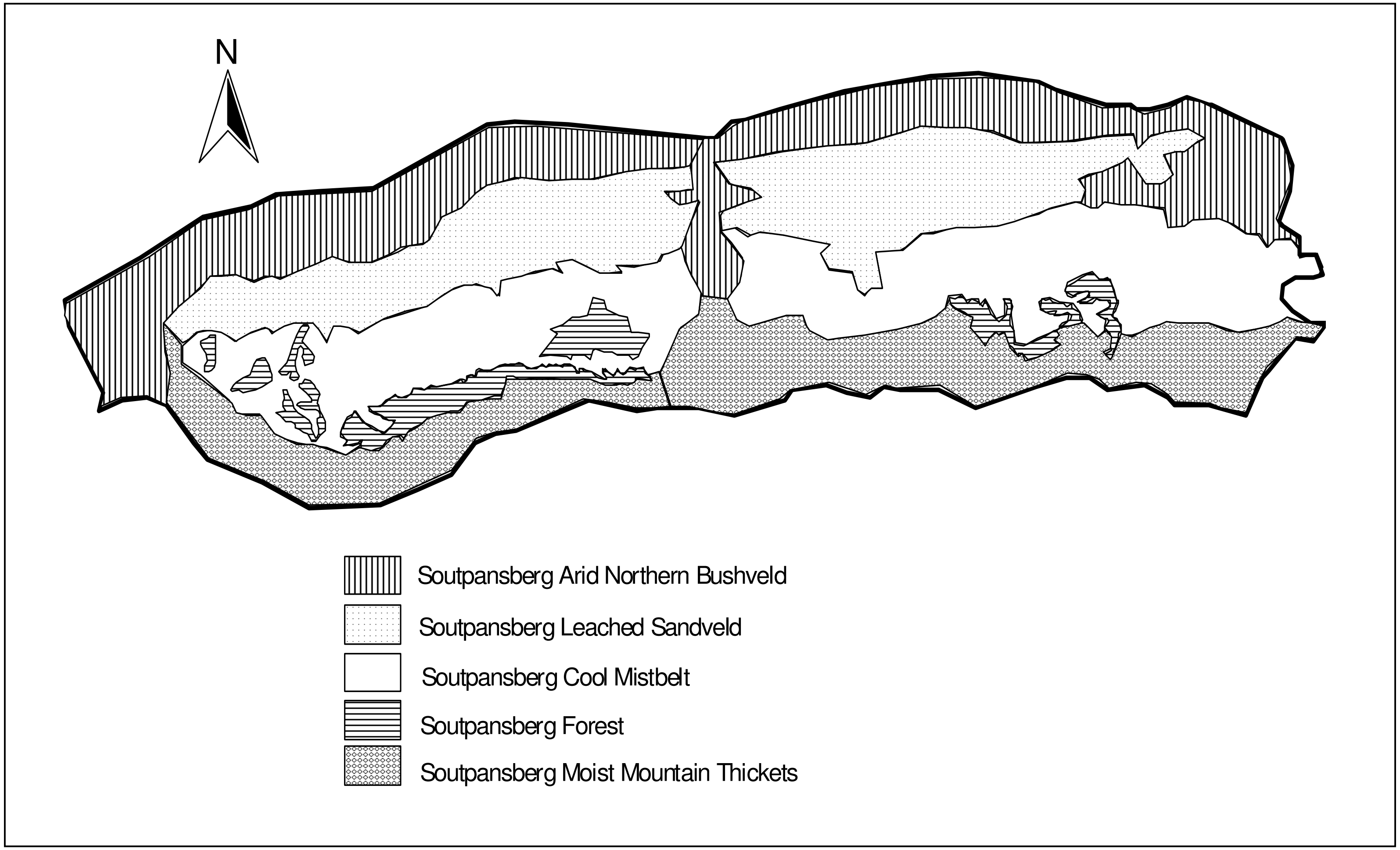


Fig. 5. Major Vegetation Types of the Soutpansberg Conservancy

1. *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type

The *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type occurs on the northern foot slopes and plains of the Blouberg Nature Reserve. The terrain is generally flat with a maximum incline of three degrees. This Major Vegetation Type is associated with the Hutton Soil Form (MacVicar *et al.* 1991) of the Land Type Ae derived from alluvium on sandstone of the Wyllies Poort Geological Formation (Botha 2004a; Patterson & Ross 2004a).

The diagnostic species for this group are presented in species group A (Table 1). This group includes the woody species *Spirostachys africana*. Diagnostic grass species include *Eragrostis lehmanniana* var. *lehmanniana, Tragus berteronianus* and *Dactyloctenium aegyptium, Pogonarthria squarrosa*. This diagnostic group contains numerous herbaceous species such as *Phyllanthus burchellii, Indigofera* species, *Limeum fenestratum, Erythrophleum africanum, Bulbostylis hispidula* subsp. *pyriformis, Ruellia* species, *Indigofera rhytidocarpa, Chamaecrista absus, Hermannia grisea, Tragia minor, Corchorus* species, *Talinum crispatulum, Monechma divaricatum, Zornia* species, *Blepharis subvolubilis, Limeum viscosum, Leucas sexdentata, Secamone parvifolia, Chamaecrista biensis, Asparagus exuvialis* fo. *exuvialis*.

Dominant woody species of this Major Vegetation Type include *Spirostachys africana* (Species Group A), *Commiphora* species, *Grewia flavescens* var. *flavescens* (Species Group F), *Boscia albitrunca* var. *albitrunca*, *Cissus cornifolia*, *Combretum apiculatum* subsp. *apiculatum*, *Combretum mossambicense*, *Commiphora mollis*, *Grewia bicolor* (Species Group H), *Acacia nigrescens*, *Dichrostachys cinerea* subsp. *africana*, *Ehretia rigida*, *Markhamia zanzibarica* and *Sclerocarya birrea* subsp. *caffra* (Species Group L). Dominant grass species include *Eragrostis lehmanniana* var. *lehmanniana* (Species Group A), *Eragrostis rigidior*, *Urochloa mosambicensis* (Species Group L), *Digitaria eriantha*, *Panicum maximum* and *Aristida stipitata* subsp. *graciliflora* (Species Group P). Prominent herbaceous species include *Phyllanthus burchellii* (Species Group A), *Acanthospermum* species, *Arctotis* species, *Aristida congesta* subsp. *congesta*, *Evolvulus alsinoides*, *Hibiscus calyphyllus*, *Hibiscus praeteritus*, *Sida ovata* (Species Group C), *Cyperus angolensis* (Species Group F), *Solanum panduriforme* (Species Group L) and *Waltheria indica* (Species Group P).

The vegetation of the *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type shows some floristic affinities with the *Acacia mellifera–Eragrostis lehmanniana* vegetation class, informally described by Smit (2000) as part of the Eastern Kalahari Tornveld. Shared prominent species within the BNR Northern Plains Bushveld and the *Acacia mellifera–Eragrostis lehmanniana* vegetation class include the grasses *Eragrostis lehmanniana, Pogonarthria squarrosa* and *Schmidtia pappophoroides*. A shared prominent woody species is *Boscia albitrunca*. However, these five species all show wide distribution ranges and exhibit wide ecological tolerance and adaptation within the sandveld areas of southern Africa, and are therefore not exclusive to the Blouberg Arid Mountain Bushveld. This Major Vegetation Type shares some of the drought-resistant woody species with the *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type, such as *Commiphora mollis, Combretum apiculatum, Boscia albitrunca* var. *albitrunca, Grewia bicolor, Combretum mossambicense, Commiphora africana, Dichrostachys cinerea* subsp. *africana* and *Acacia nigrescens*. These species are also commonly found in the *Adansonia*–Mixed Thornveld (14e) (Acocks 1953), the *Adansonia digitata–Colophospermum mopane* Rugged Veld (Gertenbach 1983) and the *Commiphora–Terminalia prunioides* community (Louw 1970).

2. *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type

The *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type is restricted to the plains foot slopes south of the Blouberg within the BNR. The terrain is generally flat with a slope that varies between one to five degrees. It is predominantly associated with the Hutton Soil Form (MacVicar *et al.* 1991), derived from alluvium on sandstone of the Ae Land Type from the Wyllies Poort Geological Formation (Botha 2004a; Patterson & Ross 2004a).

Other Soil Forms associated with this Major Vegetation Type are of less importance. The Oakleaf and Valsrivier Soil Forms (MacVicar *et al*. 1991) are associated with alluvium, sand and calcrete of the Quaternary Deposits of the Ia Landtype (Botha 2004a). The Glenrosa and Mispah Soil Forms (MacVicar *et al*. 1991) of the Fc Landtype (Botha 2004a) are associated with basalt of the Letaba Geological Formation in the Lebombo Group–Karoo Sequence, as well as aphibolite, metapelite of the Malala Drift group. The Mispah, Avalon and Hutton Soil Forms (MacVicar *et al*. 1991) of the Bc Landtype (Botha 2004a) are associated with leucocratic migmatite and gneiss, grey and pink hornblende–biotite gneiss, grey biotite gneiss, minor muscovite–bearing granite, pegmatite and gneiss of the Hout River Gneis Geological Formation, as well as metapelite of the Bandelierskop Complex.

The diagnostic species for this group are presented in species group B (Table 1). The diagnostic woody species characterizing the communities of this Major Vegetation Type are *Combretum imberbe, Rhus leptodictya* and *Schotia brachypetala*. Diagnostic grass species include *Enteropogon macrostachyus* and *Aristida congesta* subsp. *barbicollis*. Diagnostic herbaceous species within this group are *Lepidagathis scabra, Rhinacanthus xerophilus, Melhania prostrata* and *Corbichonia decumbens*.

Dominant woody species of this Major Vegetation Type include *Acacia tortilis* subsp. *heteracantha*, *Lantana rugosa*, *Rhus leptodictya* (Species Group C), *Grewia flavescens* var. *flavescens* (Species Group F), *Combretum apiculatum* subsp. *apiculatum*, *Grewia bicolor var. bicolor* (Species Group H), *Acacia nilotica*, *Euclea divinorum* (Species Group K), *Acacia nigrescens*, *Dichrostachys cinerea* subsp. *africana*, *Ehretia rigida*, *Eragrostis rigidior* (Species Group L), *Ziziphus mucronata* (Species Group P). Dominant grass species include *Enteropogon macrostachyus* (Species Group B), *Aristida congesta* subsp. *congesta*, *Aristida adscensionis* (Species Group C), *Aristida* species (Species Group D), *Eragrostis rigidior*, *Urochloa mosambicensis* (Species Group L), *Enneapogon cenchroides* and *Panicum maximum* (Species Group P). Prominent forbs include *Hibiscus praeteritus*, *Sida ovata*, *Blepharis integrifolia* (Species Group C), *Tephrosia purpurea* (Species Group E), *Cyperus angolensis* (Species Group F) and *Solanum panduriforme* (Species Group L).

The *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type is regarded as a variant of the *Rhus leptodictya–Acacia tortilis* Bushveld of the *Acacietalia rehmannianae–tortilis* of the *Acacienea nilotico–tortilis* of the *Panico maximi–Acacietea tortilis* described by Winterbach (1998) and Winterbach *et al.* (2000) for the north-western savanna of South Africa. Acocks (1953) describe similar vegetation as the Knoppiesdoring Veld (13b) of the Other Turf Thornveld (13). It also compares floristically with the *Acacia tortilis–Panicum maximum–Ziziphus mucronata* major plant community of the Waterberg (Henning 2002). These communities are generally not geographically restricted to a certain part of South Africa, but occur in a patchy distribution where conditions are favourable. Important taxa binding these communities together are *Acacia tortilis* subsp. *heteracantha Rhus leptodictya, Grewia* species, *Acacia nilotica, Euclea divinorum*, *Acacia nigrescens*, *Dichrostachys cinerea* subsp. *africana, Ehretia rigida, Eragrostis rigidior, Ziziphus mucronata, Aristida* species *Eragrostis rigidior, Urochloa mosambicensis* and *Panicum maximum*.

3. *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type

The *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type can be described as the mountain bushveld component of the BNR. This Major Vegetation Type is restricted to the higher lying mountainous terrain of the BNR, ranging from 975–1465 m above sea level. West of the BNR the Blouberg rises to 2051 m above sea level, where more temperate vegetation types occur (Van Jaarsveld & Hardy 1991).

Slope ranges from moderate to very steep with northern, southern and eastern aspects. Soils are generally shallow or skeletal (<100 mm), and associated with Mispah and Glenrosa Soil Forms (MacVicar *et al.* 1991) of the Fa Land Type (Botha 2004a; Patterson & Ross 2004a). The underlying geology is dominated by pink quartzite and minor conglomerate of the Wyllies Poort Geological Formation of the Soutpansberg Group.

The diagnostic species for this group are presented in species group D (Table 1). Diagnostic woody species include *Combretum zeyheri* and an *Elephantorrhiza* species. The diagnostic grass species include *Loudetia filifolia, Trichoneura grandiglumis* and *Aristida* species. Diagnostic herbaceous species include *Rhynchosia vendae,* a *Dalechampia* species and *Tricliceras schinzii*.

Dominant woody species of the *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld include *Combretum zeyheri*, *Elephantorrhiza* species (Species Group D), *Commiphora* species (Species Group F), *Burkea africana*, *Pseudolachnostylis maprouneifolia* (Species Group O), *Strychnos madagascariensis* (Species Group P), *Combretum molle*, *Englerophytum magalismontanum*, *Hyperacanthus amoenus*, *Mimusops zeyheri*, *Rhus magalismontanum* subsp. *coddii*, *Vangueria infausta* subsp. *infausta* and *Vitex rehmannii* (Species Group U). Dominant grass species include *Aristida* species, *Loudetia filifolia*, *Trichoneura grandiglumis* (Species Group D), *Digitaria eriantha*, *Enneapogon cenchroides*, *Panicum maximum* and *Schmidtia pappophoroides* (Species Group P). Prominent herbaceous species include *Rhynchosia vendae* (Species Group D), *Cheilanthes involuta*, *Tephrosia purpurea* (Species Group E), *Cyperus angolensis* (Species Group F) and *Waltheria indica* (Species Group P).

The *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type shares floristic elements with the *Englerophyto magalismontani–Acacietea caffrae* of the Waterberg and Magaliesberg described by Winterbach *et al*. (2000). It shares many of the relatively drought tolerant species associated with the *Rhus rigida var. rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type, lacking some of the more mesic species recorded within the mistbelt of the SC. The central variation of the Bankenveld (Acocks 1953) and the Rocky Highveld Grassland of the Grassland Biome (Bredenkamp & Van Rooyen 1996) share limited floristic and structural elements with the *Rhynchosia vendae–Englerophytum magalismontanum* Blouberg Moist Mountain Bushveld Major Vegetation Type. Although the vegetation structure of the *Diplorhynchus condylocarpon–Englerophytum magalismontanum* Rocky Slope community of the Waterberg Biosphere (Henning 2002) is very similar to that of the Blouberg Moist Mountain Bushveld, the floristic composition differs considerably.

4. *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type

The *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type is confined to the rain–shadow northern ridges of the SC. Due to the wide range of topographic and edaphic conditions found within this Major Vegetation Type, it contains a complex of very diverse plant communities. Despite the diversity of these plant communities, most are adapted to prolonged water–stress conditions and unpredictable rainfall events. These drought events are likely to be the main driving factors behind the vegetation structure and species composition of the various plant communities within this major vegetation type.

This Soutpansberg Arid Northern Bushveld Major Vegetation Type is associated with the Clovelly Soil Form (MacVicar *et al.* 1991) of the Ae, Ag, Ia, Ib, and Fa Land Types derived from sandstone, quartzite and conglomerate of the Wyllies Poort Geological Formation, basalt from the Musekwa Geological Formation, as well as from narrow diabase intrusions or dykes within the Wyllies Poort Geological Formation (Botha 2004b; Patterson & Ross 2004b). The Ia Land Type in particular, is associated with the Aeolian sands (Kalahari sand) covering the Musekwa sediments at the foot of the mountain.

The vegetation structure can generally be described as open woodland (Edwards 1983), with a very sparse field layer. This is especially true during dry cycles, when only the most hardy perennial grass and herbaceous species survive. The woody layer ranges from open along the deeper well-drained sandy soils of the northern plains, to sparse along the shallower clayey foot slopes and around the saltpan.

The diagnostic species for this group are presented in species group G (Table 1). Diagnostic woody species characterizing the communities of this Major Vegetation Type along the northern sandy plains include *Adansonia digitata, Boscia foetida* subsp. *rehmanniana, Commiphora glandulosa, Commiphora tenuipetiolata, Cordia monoica, Blepharis diversispina, Grewia flava, Grewia subspathulata, Grewia villosa* and *Grewia hexamita.* Diagnostic woody species along the basaltic clay foot-slopes are *Kirkia acuminata, Maerua parvifolia, Maerua edulis, Terminalia prunioides, Cassia abbreviata, Sterculia rogersii* and *Commiphora viminea.* Although *Tribulus* *terrestris* was recorded as a relatively strong diagnostic herbaceous species for the group, due to its status as a pioneer annual herbaceous species that dominates disturbed patches, it is not recommended as a reliable indicator species for the Soutpansberg Arid Northern Bushveld. Instead, *Sansevieria aethiopica* and *Ledebouria apertiflora* should be seen as more reliable perennial herbaceous indicator species for this Major Vegetation Type.

Prominent woody species of this Major Vegetation Type include *Grewia hexamita, Commiphora glandulosa, Blepharis diversispina, Adansonia digitata* (Species Group G)*, Commiphora mollis, Combretum apiculatum* (Species Group H), *Hibiscus meyeri* (Species Group M), *Acacia nigrescens, Dichrostachys cinerea* and *Grewia monticola* (Species Group P). Although none of the grass species could be labelled as prominent during the time of the surveys, the most dominant grass species included *Panicum maximum* and *Schmidtia pappophoroides* (Species Group P). Forbs recorded from the poorly developed field layer are *Tephrosia macropoda*, *Solanum lichtensteinii*, *Ledebouria apertiflora*, *Chamaecrista mimosoides*, *Heliotropium steudneri* (Species Group G), *Hibiscus meyeri*, *Gossypium herbaceum* subsp. *africanum* (Species Group J), *Waltheria indica* (Species Group P) and *Pellaea calomelanos* var. *calomelanos* (Species Group T).

The *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type has been described by Acocks (1953) as the *Adansonia*–Mixed Thornveld variant (14e) of the Arid Sweet Bushveld (14). Due to the scale at which these Veld Types were mapped, Acocks' (1953) description includes more variation along the lower laying microphyllous plains between the Blouberg and Soutpansberg Mountain Ranges and less along the foot slopes of these mountains. The *Adansonia*–Mixed Thornveld variant (14e) described by Acocks (1953) is therefore very similar to the associations along the northern sandy plains described here under the Soutpansberg Arid Northern Bushveld Major Vegetation Type.

5. *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets Major Vegetation Type

The *Catha edulis–Flueggia virosa* Moist Mountain Thickets Major Vegetation Type is a mixture of plant communities situated at a variety of different altitudes. They are, however, all associated with soils of a high clay content and relatively moist conditions. Even during dry cycles, the moisture-laden air from the south–east ensures at least some orographic rain and moisture during the summer months. These plant communities are primarily confined to the steep southern slopes where igneous rock in the form of basalt and diabase settled after flowing through the cracks and tears in the upper sedimentary rock layers. However, it also contains plant communities associated with the illuvial clays found in some of the valleys cutting through the mountain ridges.

It is associated with the Shortlands Soil Form (MacVicar *et al.* 1991) derived from basalt and tuff associated with the Fa Land Type of the Sibasa Geological Formation, as well as from narrow diabase intrusions or dykes associated with the Ib Land Type of the Wyllies Poort Geological Formation (Botha 2004b; Patterson & Ross 2004b).

The vegetation structure can be described as low closed thickets (Edwards 1983), with no definite separation between the tree and shrub layers. The woody layer contains a mixture of trees and shrubs ranging from 1.5–4 m in height. A very high percentage canopy cover (>80%) blocks sunlight from reaching the understory to prevent the establishment of a dense field layer.

This Major Vegetation Type is characterised by a high diversity of trees and shrubs. The diagnostic species are presented in species group I (Table 1) and include woody species from relatively moist thickets and wet riverine thickets such as *Catha edulis, Grewia occidentalis, Dovyalis zeyheri, Acalypha glabrata, Dombeya rotundifolia, Rhus pentheri, Carissa edulis, Rhoicissus tridentata* subsp. *tridentata, Senna petersiana, Diospyros lycioides, Berchemia zeyheri, Dovyalis caffra*, *Capparis tomentosa, Euphorbia ingens, Acacia ataxacantha, Euclea undulata, Pavetta schumanniana, Acacia rehmanniana, Gymnosporia senegalensis, Acokanthera oppositifolia, Mystroxylon aethiopicum* subsp. *schlechteri, Rhus pyroides, Bridelia mollis, Clerodendrum glabrum* var. *glabrum, Ekebergia capensis, Allophylus africanus* var. *africanus, Tarchonanthus camphoratus, Maerua caffra, Coddia rudis, Lippia javanica, Jasminum multipartitum, Combretum hereroense, Acacia caffra, Euclea crispa* subsp. *crispa, Olea europaea* subsp. *africana, Bridelia micrantha, Buddleja saligna, Cussonia natalensis, Ficus sycomorus* subsp. *sycomorus, Scolopia* *zeyheri, Canthium inerme, Buddleja salviifolia, Podocarpus falcatus, Pyrenacantha grandiflorus, Canthium mundianum, Ficus sur, Syzygium cordatum, Pavetta eylesii, Capparis fascicularis* var. *fascicularis* and *Acacia gerrardii* var. *gerrardii.* The recorded diagnostic succulent species listed in species group I occur generally wide spread throughout South Africa and include *Aloe greatheadii* var. *greatheadii, Sansevieria hyacinthoides* and *Aloe marlothii* subsp. *marlothii*. Diagnostic grass species recorded from the poorly developed field layer are *Brachiaria deflexa, Eragrostis superba, Panicum deustum, Setaria megaphylla* and *Bothriochloa insculpta.* Diagnostic herbaceous species include *Commelina benghalensis, Christella guenziana, Cyperus albostriatus, Solanum tettense* var. *renschii, Dicliptera heterostegia, Cyperus sphaerospermus, Bulbostylis burchellii, Barleria gueinzii* and *Justicia flava*.

Other prominent woody species include *Flueggia virosa* subsp. v*irosa, Acacia karroo*, *Gymnosporia buxifolia* (Species Group K), *Ehretia rigida* (Species Group L), *Ziziphus mucronata* (Species Group P), *Heteropyxis natalensis*, *Zanthoxylum capense* (Species Group S), *Combretum molle* (Species Group U) and *Maytenus undata* (Species Group X). Only a few shade tolerant grass and herbaceous species are prominent within this Major Vegetation Type such as *Brachiaria deflexa, Panicum deustum, Setaria megaphylla* (Species Group I) and *Panicum maximum* (Species Group P). The shaded conditions also favour fern species such as *Thelypteris gueinziana* (Species Group I) and *Pellaea calomelanos* var. *calomelanos* (Species Group T).

Acocks (1953) considered this Major Vegetation Type one of the many variants of the Sourish Mixed Bushveld (19) and the North–eastern Mountain Sourveld (8). Due to its association with the narrow intrusive basalt, tuff and diabase dykes, it is often difficult to map this Major Vegetation Type when dealing with coarse– or small–scale vegetation studies. The southern-most ridge of the mountain with its large southern basalt slope is one of the few extensive and mapable areas with this Major Vegetation Type.

The strong mixture of temperate and sub-tropical plant species reflects the gradient of plant communities up the southern slopes of the SC. While those communities along the warm and relatively humid footslopes are very tropical, the plant communities of clayey depressions along the cooler higher lying areas tend to contain many temperate species. The lower lying sub-tropical plant communities seem to be unique in their species composition and structure. The higher lying temperate communities compare with the Hillside scrub of the Transitional *Cymbopogon–Themeda* Veld (49) of the Pure Grassveld Types described by Acocks (1953). They share species such as *Acacia karroo, Acacia caffra, Grewia occidentalis, Ehretia rigida, Euclea crispa* subsp. *crispa, Olea europaea* subsp. *africana*, *Buddleja saligna*, *Buddleja salviifolia, Rhus pyroides, Tarchonanthus camphoratus, Diospyros lycioides, Ziziphus mucronata, Dombeya rotundifolia* and *Cussonia* species. These temperate clay communities of the SC also share some floristic links with the riverine woodland *Zizipho mucronatae–Acacietum karroo* described by Brown (1997). According to Du Preez & Bredenkamp (1991), Bezuidenhout *et al*. (1994) and Winterbach (1998), the *Acacia karroo*-dominated vegetation of the southern African grassveld and savanna should be classified as a seperate syntaxonomical class. The high lying clay communities along the southern slopes of the SC may be classified as part of this proposed class.

6. *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type

The *Diplorhynchus condylocarpon–Burkea africana* Leached Sandveld Vegetation Type is confined to the warmer northern slopes of the mountain, as well as some of the more arid southern slopes along the northern most ridges of the mountain range, which falls within the rain-shadow zone of the mountain.

It is associated with the Mispah and Hutton Soil Forms (MacVicar *et al*. 1991) derived from sandstone, quartzite and conglomerate associated with the Ae, Fa, and Ib Land Types of the Wyllies Poort Geological Formation (Botha 2004b; Patterson & Ross 2004b). One plant community in particular is associated with deep regic sands of the Namib Soil Form, which is of an Aeolian origin from the Kalahari (Brandl 2002). It also includes the vegetation associated with the almost bare sheets of exposed rock against the warm northern slopes.

The plant communities of this Major Vegetation Type occur on both very shallow and very deep sands of the relatively dry landscapes of the SC. The shallow soils are situated on steep rocky inclines, while the deep sands are associated with relatively high lying flat plateaus. The combination of the underlying nutrient poor quartzite parent material and the eluviation of silt and clay particles from these well drained sandy soils, have left this system extremely nutrient poor.

With the exception of the plant communities associated with the rock sheets, the Leached Sandveld communities are relatively poor in plant species diversity. The diagnostic species for this group are presented in Species Group M (Table 1). It is characterized by diagnostic woody species such as *Elephantorrhiza burkei, Diplorhynchus condylocarpon, Ochna pulchra, Grewia retinervis* and *Strychnos pungens*. Diagnostic grass species include *Centropodia glauca*, *Eragrostis pallens*, *Schizachyrium jeffreysii*, *Eragrostis gummiflua*, *Aristida canescens* subsp. *ramosa, Aristida diffusa* and *Loudetia flavida*. The herbaceous layer is sparse and species poor and contained some weak indicator species such as *Selaginella dregei, Cineraria parvifolia* and *Tephrosia longipes*.

Prominent woody species include *Pseudolachnostylis maprouneifolia, Burkea africana* (Species Group O), *Strychnos madagascariensis, Terminalia sericea* (Species Group P), *Xerophyta retinervis* (Species Group R) and *Vitex rehmannii* (Species Group U). Locally dominant grass species include *Centropodia glauca, Eragrostis pallens, Schizachyrium jeffreysii, Eragrostis gummiflua, Aristida canescens* subsp. *ramose, Aristida diffusa, Loudetia flavida* (Species Group M), *Stipagrostis uniplumis* var. *uniplumis*, *Enneapogon cenchroides*, *Schmidtia pappophoroides*, *Aristida stipitata* (Species Group P), and *Loudetia simplex* (Species Group R). Some of the locally prominent herbaceous species include *Selaginella dregei*, *Portulaca kermesina*, *Tephrosia longipes*, *Indigofera cryptantha* var. *cryptantha*, *Orthosiphon labiatus*, *Isoglossa hypoestiflora*, *Anacampseros subnuda* (Species Group M), *Waltheria indica* (Species Group P), *Corchorus kirkii*, *Commelina africana*, *Myrothamnus flabellifolius* (Species Group R) and *Pellaea calomelanos* var. *calomelanos* (Species Group T).

Acocks (1953) described the various plant communities of the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Vegetation as variations of the Mixed *Terminalia–Dichapetalum* Veld (18b) of the Mixed Bushveld

(18). The *Burkea africana–Setaria lindenbergiana* Major Community described by Van Staden (2002) and Van Staden & Bredenkamp (2005), the *Barleria bremekampii–Diplorhynchus* Tree Savanna (Coetzee *et al.* 1976), as well as the *Burkea africana–Setaria sphacelata* Undulating Plains, Footslopes, Terraces and Plateaus Community and the *Terminalia sericea–Eragrostis pallens* Deep Sandy Lowlands Community described by Henning (2002) from the Waterberg area share many diagnostic species with the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type of the SC. The coarse vegetation described by Van Den Berg (1993) of the Sour and Mixed Bushveld emphasises the heterogeneity of these Veld Types. The Soutpansberg Leached Sandveld Major Vegetation Type share numerous diagnostic species with the *Terminalio sericeae–Combretetea apiculati* described by Winterbach (1998) and Winterbach *et al.* (2000). More specifically, this Major Vegetation Type shares numerous diagnostic species with the *Burkea africana–Perotis patens* Woodland Alliance described by Van der Meulen (1979).

Due to the nutrient poor nature of this Major Vegetation Type, grazing and browsing fodder production is generally low. Most of the landscape is homogeneous, resulting in low species richness. However, the more rugged landscapes with their higher diversity of micro-habitats are relatively rich in species.

7. *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type

The *Rhus rigida var. rigida–Rhus magalismontanum* subsp. *coddii* Mistbelt Vegetation of the SC is situated above 1200 m above sea level and is confined to the mistbelt region. It is associated with Glenrosa and Mispah Soil Forms (MacVicar *et al.* 1991) derived from sandstone, quartzite and conglomerate associated with the Fa and Ib Land Types of the Wyllies Poort Geological Formation (Botha 2004a; Patterson & Ross 2004a). The Champagne Soil Form (MacVicar *et al.* 1991) was recorded along some of the localized high laying wetlands and peatlands.

This Major Vegetation Type is associated with the rugged landscapes of the upper plateaus and crests of the SC. The soils derived from the underlying sandstone and quartzite are can be described as extremely shallow, coarse sands. The depth of the soil and the extent of rock-cover determine the vegetation structure and species composition within this Major Vegetation Type. During the rainfall season these plant communities are covered in mist on an almost daily basis, contributing towards the abundance of rock- and bark-lichens and bryophytes. The combination of frequent orographic rain and mist during the summer months leaves the available pockets of soil among the rock sheets drenched and sometimes flooded for extended periods. The deeper soils pockets and the half weathered matrix of saprolite within the mistbelt can be regarded as the sponge areas, which slowly release water to feed mountain streams over prolonged periods. During the dry season, the shallow sandy soils rapidly dry out. The local and surrounding topography of the landscape plays a major role in the rate of desiccation of water retention of a specific patch of soil. Extended flooding is often a product of water seepage into an area from the surrounding catchments and sponge areas. In cases where water floods the soil for most of the year, wetlands and peatlands have formed. However, these high lying wetlands and their surrounding catchments are prone to severe periodic droughts. These fluctuating moisture conditions favour those plant species with strategies such as the ephemerals, xerophytes and succulents.

Structurally, the plant communities of the Mistbelt Major Vegetation Type are extremely diverse. It includes peatlands, low open grasslands and islands of short thickets or bush clumps (Edwards 1983). Due to this structural diversity within this Major Vegetation Type, diagnostic species comprise of a mixture of inconspicuous perennials, and do not include any dominant or abundant species. Diagnostic species for this group are presented in species group Q (Table 1). The most important diagnostic woody species include *Rhus rigida* var. *rigida, Helichrysum kraussii, Cryptolepis cryptolepioides* and *Parinari capensis* subsp. c*apensis.* Other, less constant woody indicator species of this Major Vegetation Type include *Olea capensis* subsp. *enervis, Syzygium legatii, Aloe arborescens, Rotheca myricoides, Euclea linearis, Rhus tumulicola* var. *meeuseana, Olinia rochetiana, Combretum moggii, Vangueria soutpansbergensis, Tarenna supra–axillaris, Protea caffra* subsp. *caffra, Elephantorrhiza elephantina, Tetradenia riparia, Apodytes dimidiata* subsp. *dimidiata, Protea roupelliae* subsp. *roupelliae, Lopholaena coriifolia, Coptosperma rhodesiacum, Ekebergia pterophylla* and *Myrsine africana*. Diagnostic grass species include *Melinis nerviglumis, Brachiaria serrata, Setaria sphacelata* var. *torta,* *Trachypogon spicatus* and *Elionurus muticus*. Diagnostic herbaceous species recorded are *Fadogia homblei, Coleochloa setifera, Rhynchosia monophylla, Senecio barbertonicus, Crassula swaziensis, Khadia borealis, Vernonia natalensis, Dicoma anomala, Plectranthus neochilus, Gnidia cuneata, Eulophia ensata, Pteridium aquilinum, Kalanchoe sexangularis, Aristea woodii, Anthospermum welwitsch, Vernonia oligocephala, Pentanisia prunelloides* subsp. *prunelloides, Senecio oxyriifolius, Ipomoea oblongata, Helichrysum cerastioides, Bulbostylis contexta, Hypoxis hemerocallidea* and *Asparagus falcatus*.

Prominent species within this collection of diverse communities include the woody species *Rhus rigida* var. *rigida, Helichrysum kraussii, Cryptolepis cryptolepioides*, *Parinari capensis* subsp. c*apensis* (Species Group Q)*, Mimusops zeyheri, Combretum molle, Englerophytum magalismontanum, Rhus magalismontanum* subsp. *coddii* (Species Group U) and *Maytenus undata* (Species Group X). Locally prominent grass species include *Melinis nerviglumis, Brachiaria serrata, Setaria sphacelata* var. *torta*, *Trachypogon spicatus*, *Elionurus muticus* (Species Group Q) and *Loudetia simplex* (Species Group R). Due to the topographic heterogeneity of this Major Vegetation Type, and the diversity of plant communities it contains, prominent herbaceous species are only locally prominent and may include *Fadogia homblei*, *Coleochloa setifera*, *Rhynchosia monophylla*, *Senecio barbertonicus*, *Crassula swaziensis*, *Khadia borealis*, *Vernonia natalensis*, *Dicoma anomala*, *Plectranthus neochilus*, *Gnidia cuneata*, *Wahlenbergia undulata*, *Hypoxis argentea* var. *argentea*, *Pteridium aquilinum*, *Kalanchoe sexangularis*, *Vernonia oligocephala*, *Pentanisia prunelloides* subsp. *prunelloides*, *Hypoxis hemerocallidea* (Species Group Q) and *Pellaea calomelanos* var. *calomelanos* (Species Group T).

The *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Mistbelt Vegetation Type of the SC is a mosaic of closed bush clumps from the *Englerophyto magalismontani–Acacietea caffrae* in the savannas (Winterbach *et al*. 2000), the patches of high lying low open grasslands from the *Loudetio simplicis–Alloteropsidetea semialatae* in the grasslands (Matthews *et al.* 1994), the *Loudetia simplex–Aristida aequiglumis* Woodlands, Shrublands and Grasslands (Coetzee 1975) and the *Protea caffra–Loudetia simplex* Major Community (Van Staden 2002). The bush clump communities show strong floristic affinities with the *Rhus tumulicola–*

Aloe arborescens mist belt bush clumps (Matthews 1991; Matthews *et al*. 1991) of the North–eastern Mountain Sourveld (Acocks 1953) and the *Landolphia capensis–Crassula argyrophylla* savanna described by Bredenkamp (1975).

Although the grassland patches share structural similarities with the *Diheteropogono amplectentis–Proteetum gaguedi* described by Matthews *et al.* (1994) and the *Protea caffra–Helichrysum setosum* savanna described by Bredenkamp (1975), they show stronger floristic affinities with the grassland patches of the structurally different *Helichrysum kraussii–Englerophytum magalismontanum* bush clump communities described by Matthews (Matthews 1991; Matthews *et al*. 1991).

8. *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Major Vegetation Type

The forests of the SC are confined the southern slopes of the southern most ridges of the mountain. It is associated with the Glenrosa, Mispah and Shortlands Soil Forms (MacVicar *et al.* 1991) derived from basalt, tuff, sandstone, and conglomerate associated with the Fa Landtype of the Sibasa Geological Formation (Botha 2004a; Patterson & Ross 2004a). The soils are generally rich in organic matter and contain relatively high percentages of clay in areas where basalt and tuff form the under lying geological material. Defining the geology and soil formations is often difficult and problematic along this rupture section of the mountain where the upper sedimentary plates have torn and became mixed with volcanic material (Barker 1979, 1983; Bumby 2000). When vegetation is removed, soil erosion becomes a major problem along the steep southern slopes with its relatively shallow soils and high rainfall.

This Major Vegetation Type is dependant on the orographic rain driven onto the southern slopes by a south-easterly wind during summer. The evergreen high forests are confined to the mistbelt of the mountain, which reaches down as far as 1380 m above sea level (Geldenhuys & Murray 1993). Deciduous shrub forest forms a fire resistant ecotone of thickets, which extend to below the mistbelt zone of the southern slopes.

The diagnostic species for this Major Vegetation Type are presented in Species Group V (Table 1). The diagnostic woody species include *Xymalos monospora, Zanthoxylum* *davyi, Celtis africana, Nuxia floribunda, Rhoicissus tomentosa, Kiggelaria africana, Vepris lanceolata, Rapanea melanophloeos, Rothmannia capensis, Brachylaena discolor, Ficus craterostoma, Combretum kraussii, Trichilia dregeana, Trimeria grandifolia, Drypetes gerrardii* and *Oxyanthus speciosus* subsp. *gerrardii*.

Other prominent woody species include *Diospyros whyteana* (Species Group W), *Maytenus undata, Rhus chirindensis, Cussonia spicata* (Species Group X) and *Maesa lanceolata* (Species Group Y).

A recent classification of forest vegetation data by Von Maltitz *et al.* (2003) lumped the forest communities of the Blouberg, Soutpansberg, North Eastern Escarpment, Mariepskop and Barberton regions under the name Northern Mistbelt Forest. These Afrotemperate forests have been described by numerous authors and under various different names; Afromontane forest (Cooper 1985, White 1978), Temperate, Transitional and Scrub Veld Types (Acocks 1953), Uplands Vegetation (Edwards 1967, Moll 1976), Interior Forests (MacDevette *et al.* 1989), Montane *Podocarpus* Forest (Cooper 1985, Edwards 1967, Moll 1976), Highland Sourveld (Acocks 1953), Mist Belt Mixed *Podocarpus* Forest (Cooper 1985, Edwards 1967, Moll 1976) and Natal Mist Belt Ngongoni Veld (45) (Acocks 1953).

The evergreen *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Vegetation, which forms part of the Northern Mistbelt Forests, share some floristic affinities with the Highland Sourveld the Dohne Sourveld (44b) and the Natal Mist Belt 'Ngongoni Veld (45), as well as the Coastal Tropical forest patches associated with the 'Ngongoni Veld (5) (Acocks 1953). Important shared species include the valuable timber species *Podocarpus falcatus, Podocarpus latifolius* and *Ocotea kenyensis*. These species have been exploited for financial gain to such an extent that they are no longer dominant indicator species within all the Soutpansberg forest associations. They now only occur in relatively high abundances where difficult terrain inhibited people from removing these species. This phenomenon of low cover–abundance values of the two *Podocarpus* species within the SC is therefore an artefact of human intervention (McCracken 1986, Obiri *et al.* 2002). The historical prominence of the two *Podocarpus* species therefore justifies the Soutpansberg forests' inclusion into the temperate forest category (Acocks 1953). The

Widdringtonia nodiflora dominated cliff forests along the scarp faces of the southern slopes of the Soutpansberg share some weak floristic and structural affinities with the Highland Sourveld (Acocks 1953) and the *Widdringtonia nodiflora–Podocarpus latifolius* Short Forest of the Waterberg (Van Staden & Bredenkamp 2006).

Ordination

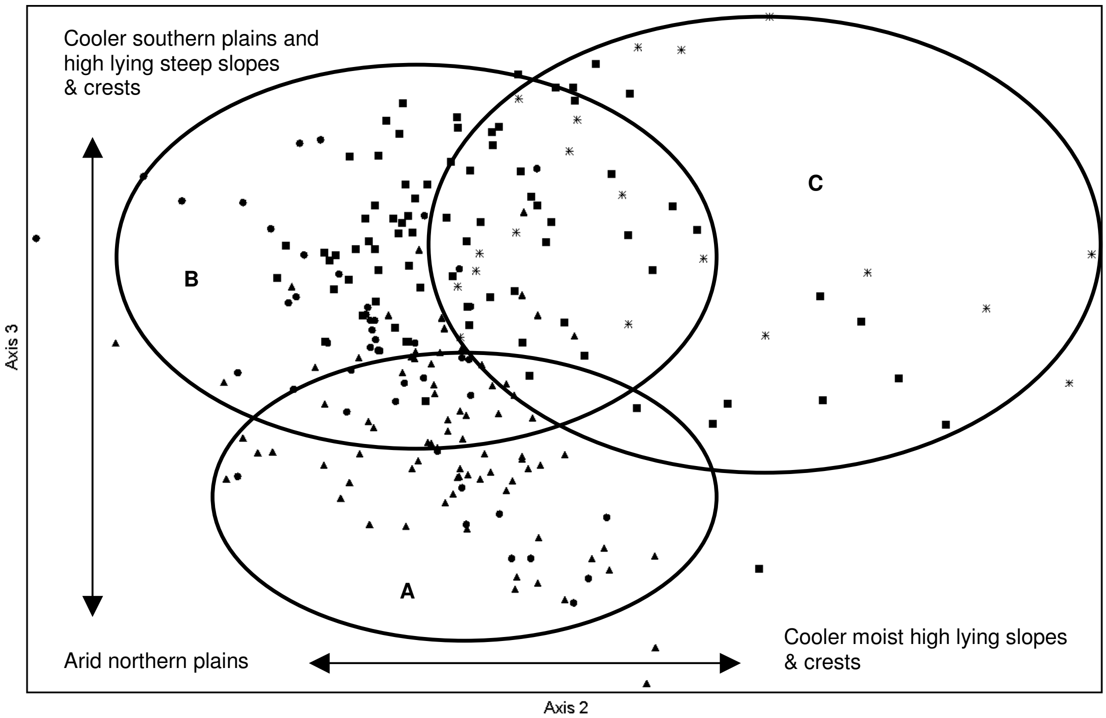
The rich diversity of plant communities within the SC and BNR is closely associated with the topographic and geologic diversity of these areas. The variation in topography and geology of the landscape contributes to variation in localised climatic conditions, seasonal precipitation, predictability of precipitation, processes and tempos of weathering, degrees of nutrient leaching from the soil, accumulation tempo of organic matter in the soil and plant available moisture in the soil. An ordination of the available vegetation data on these two areas revealed distinct groupings of relevés, which in turn represent different Major Vegetation Types and plant communities. In order to display and interpret these vegetation groupings in an ecologically meaningful manner, it was decided to separate the two distinct clusters representing the SC and the BNR.

Vegetation of the Blouberg Nature Reserve

The scatter diagram (Fig. 7) displays the distribution of relevés along the second and third ordination axes. The vegetation units are represented as groups and their distribution on the scatter diagram corresponds with certain physical environmental conditions. The lack of any distinct groupings with some relative distance between groupings reflects the floristic similarities among the plant communities of the BNR. However, numerous environmental gradients could be correlated with the distribution of the plant communities and individual relevés along the x– and y–axes.

The second axis (eigen value = 0.583), orientated along the x–axis, represents gradients in soil depth, soil moisture, surface rock cover, altitude, slope, plant–available moisture and soil texture. Those plant communities along the left side of the diagram represent the dry flat areas with relatively deep fine–grained soils. These include the *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld and the *Euclea divinorum*–Acacia tortilis BNR Southern Plains Bushveld. Those plant communities along the right side of the diagram represent the wetter steep, rocky slopes with relatively shallow coarse sandy soils. These are mostly represented by the *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld.

The third axis (eigen value = 0.392), orientated along the y–axis, represents gradients in plant–available moisture, soil depth and slope. Those plant communities along the top of the diagram represent the wetter steep, rocky slopes with relatively shallow coarse sandy soils, represented by the *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld. Those plant communities along the bottom of the diagram represent the dry flat areas with relatively deep fine–grained soils, represented by the *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld and the *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld.



Deep ←	Soil depth	→ Shallow
Low ←	Soil moisture	→ High
Low ←	Surface rock cover	→ High
Low ←	Altitude	→ High
Flat ←	Slope	→ Steep
Arid ←	Plant–available moisture	→ Moist
Fine sands ←	Soil texture	→ Coarse

Legend:
A: *Eragrostis lehmanniana–Sclerocarya birrea* BNR Northern Plains Bushveld
B: *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld
C: *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld

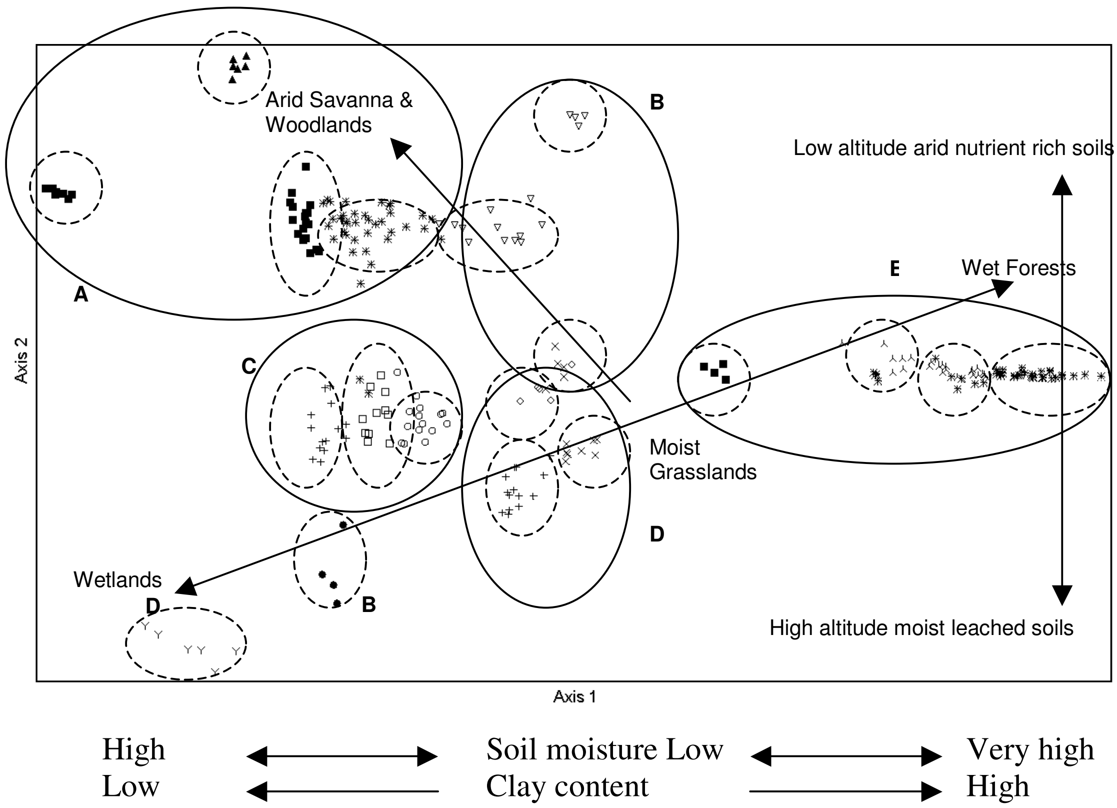
Fig. 6. Relative positions of relevés along the second and third axes of the ordination of the vegetation data from the Blouberg Nature Reserve (DECORANA, Hill 1979b).

Vegetation of the Soutpansberg Conservancy

The scatter diagram (Fig. 8) displays the distribution of relevés along the first and second ordination axes. The vegetation units are represented as groups and their distribution on the scatter diagram corresponds with certain physical environmental conditions. The very distinct groupings of relevés within the virtual space of the scatter–plot are a good indication of the unique nature of each of the different plant communities it represents. These pronounced ordination clusters re–enforce those groupings created by the numerical classification done on the available vegetation data of the SC. Numerous environmental gradients could be correlated with the distribution of the plant communities and individual relevés along the x– and y–axes. The different associations described in Chapters 6, 7, 8 and 9 are indicated with broken lines and different symbols.

The first axis (eigen value = 0.950), orientated along the x–axis, represents gradients in plant–available soil moisture and soil clay content. Those plant communities along the left side of the diagram represent the arid areas with relatively sandy soils. These include the *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld and *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld. Those plant communities along the right side of the diagram represent the relatively moist areas with soils with a higher clay content. These include the *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets and the *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Vegetation.

The second axis (eigen value = 0.641), orientated along the y–axis, represents gradients in plant–available moisture, soil mineral content and altitude. Those plant communities along the top of the diagram represent the lower lying mineral rich arid areas of the SC. These include the *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld and *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets. Those plant communities along the bottom of the diagram represent the moist high altitude Major Vegetation Types on the leached soils of the SC. This includes the. *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Mistbelt Vegetation.



Legend:

A: *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld
B: *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets
C: *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld
D: *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Mistbelt Vegetation
E: *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Vegetation

Fig. 7. Relative positions of relevés along the first and second axis of the ordination of the vegetation data from the Soutpansberg Conservancy (DECORANA, Hill 1979b).

Conclusion

The results of both the ordination and the classification indicate a considerable difference between the vegetation types of the Blouberg Nature Reserve and the Soutpansberg Conservancy (Fig. 6 & 7; Table 1). Species Group F is restricted to the BNR showing the relationship among the BNR plant communities and indicates that it has unique vegetation. Although individual Major Vegetation Types of the SC are exceptionally unique (with many diagnostic species e.g. Species Groups G, I, M, Q and V), no species groups emphasize the coherence of the vegetation of the SC. On the contrary, Species Groups H, K, L, O, P, U and Y indicate the relationship of SC plant communities with some BNR communities.

This array of heterogeneous vegetation types and plant communities all fall within an estimated area of only 108 000 hectares (1 080 km^2). The conservation of such a biological hotspot should be a provincial, national and international priority (Walker 1989; Wessels *et al.* 2003; UNESCO 2002). The Soutpansberg Conservancy and the Blouberg Nature Reserve represent numerous Major Vegetation Types of the SCBD, and form the core of present conservation efforts. These nature reserves should act as benchmark sites for the monitoring of the impact of development on the surrounding unprotected areas.

The observed diversity in vegetation patterns is the result of the region's high spatial variation (topography, geology, pedology, extreme localised climate patterns) as well as the region's high temporal variability (irregular climatic cycles, periodic stochastic events) (Gibson *et al.* 2004). In addition to the environmental factors influencing the observed vegetation and floristic patterns, certain regions of the study area have been altered through intense anthropogenic activities over prolonged periods of time. The stochasticity with which humans have impacted on this environment has led to even higher levels of spatial and temporal variation in habitat heterogeneity. Numerous stone tools and artefacts indicate that humans have occupied the region on a periodic basis since the Early Stone Age (Coles & Higgs 1975). More recent times have seen cultures and civilisations such as the Khoisan (Eloff 1979), the people of Mapungubwe (Huffman 1996), the Vhenda people (Nemudzivhadi 1985), and European settlers utilizing the region for hunting, livestock farming and the cultivation of crops (Voigt & Plug 1984).

It is important to identify and to understand the major ecological processes driving this particular ecosystem in order to conserve and manage it effectively (Wessels *et al* 2003). The major vegetation patterns seen among the plant communities of the SC and BNR are largely related to the availability of soil-moisture and the rate of environmental desiccation (Bond *et al.* 2003). The underlying geology and soils, as well as altitude seem to play only secondary roles in the community composition of these event–driven systems (Krebs 2001). Soil moisture availability within the study area is governed mainly by four environmental factors: (1) the amount of precipitation of atmospheric moisture, (2) the rate of water loss through evaporation (3) the soil's ability to capture and keep moisture within reachable depth of the plant roots, (4) as well as the available soil water capacity (Kramer 1969; Scott & Le Maitre 1998). White (1995) defines the available soil water capacity as the amount of water in a soil that is available for plant growth. The upper limit is set by the soil's field capacity (water-saturated soil), while the lower limit is set by the volumetric water content value at which plants lose turgor and wilt, or the permanent wilting point.

The SC and BNR are surrounded by many poverty stricken informal settlements of rural Venda. These people rely on the savanna and forest plant communities to supply grazing, fuel wood, timber and agricultural produce. Approximately 58% of the province's land area is used for grazing, and 22% used for agriculture (Hoffman & Ashwell 2000). The Limpopo Province contributes considerably to the formal economy through its ecotourism, livestock, mining, timber and export fruit and vegetable industries (Adams *et al.* 2000). Sadly though, this culturally, historically and naturally rich and diverse province of South Africa is a poverty stricken region (Shackleton & Shackleton 2000). The province's rural communities are often in a struggle for survival against the frequent and severe droughts. This has led to a culture where "if it does not pay, it does not stay" (Goudie 2000). In addition, the ever-expanding population of South Africa is making increasing demands on the natural resources of the Limpopo region. This will inevitably lead to the expansion of agriculture and industry into marginal and ecologically sensitive areas. In order for the government to plan development, management and conservation sensibly, we need the necessary ecological knowledge of the area. Without this baseline information and insight on the region's driving ecological processes and patterns, the much-needed development of the Limpopo's infrastructure and the utilization of its natural resources will be unsustainable, with only limited short-term benefits for a few selected individuals.

Acknowledgements

We thank the National Research Foundation for funding this project. Thank you to all the landowners within the SC and management of the BNR for access to gather field data. Thank you to Goro Lodge, Lajuma Mountain Retreat, Medike Mountain Reserve, and the Soutpansberg Herbarium for accommodation during fieldwork.

References

ACOCKS, J.P.H. 1953. Veld types of South Africa. *Memoirs of the Botanical Survey of South Africa* 28: 1–192. (3rd edition with updated names and illustrations published in 1988 as *Memoirs of the Botanical Survey of South Africa* 57: 1–146).

ADAMS, M., B. COUSINS and S. MANONA 2000. Land tenure and economic development in rural South Africa constraints and opportunities Pp. 111–128. *In*: COUSINS, B. (ed.). *At the Crossroads Land and Agrarian Reform in South Africa into the 21st Century, School of Government*, University of the Western Cape, Cape Town.

ANDERSON, J.M. (ed.) 2001. Towards Gondwana Alive, Vol.1 (Assoc. eds. BERGER, L., M. DE WIT, L.P. FATTI, E. HOLM, B. RUBIDGE, G. SMITH, F. THACKERAY and B. VAN WYK) Gondwana Alive Society, Pretoria.

BARKER, O.B. 1979. A contribution to the geology of the Soutpansberg Group, Waterberg Supergroup, northern Transvaal. MSc thesis, University of the Witwatersrand, Johannesburg.

BARKER, O.B. 1983. A proposed geotectonic model for the Soutpansberg Group within the Limpopo Mobile Belt, southern Africa. *In*: VAN BILJON, W.J. and J.H. LEGG (eds.). The Limpopo Belt. *Geological Society of South Africa* 8: 181–190.

BERGER, K., E. CRAFFORD, I. GAIGER, M.J. GAIGER, N. HAHN and I. MACDONALD. 2003. *A first synthesis of the environmental, biological and cultural assets of the Soutpansberg*. Leach Printers & Signs, Makhado.

BEZUIDENHOUT, H., G.J. BREDENKAMP and G.K. THERON 1994. Phytosociological classes of the western Transvaal grassland, South Africa. *Koedoe* 37: 1–18.

BOND, W.J., G.F. MIDGLEY and F.I. WOODWARD 2003. What controls South African vegetation – climate or fire? *South African Journal of Botany* 69: 79–91.

BOTHA, M.J. 2004a. Land types of the map 2228 Alldays. *In*: MACVICAR, C.N. (ed.). *Memmoirs on the Agricultural Natural Resources of South Africa*. Department of Agriculture and Water Supply, www.arc.agric.za/institutes/iscw/main/maps/htm

BOTHA, M.J. 2004b. Land types of the map 2328 Pietersburg. *In*: MACVICAR, C.N. (ed.). *Memmoirs on the Agricultural Natural Resources of South Africa*. Department of Agriculture and Water Supply, www.arc.agric.za/institutes/iscw/main/maps/htm

BRANCH, W.R. 1988. South African Red Data Book - Reptiles and amphibians. *South African National Scientific Programmes Report* 151.

BRANDL, G. 2002. The Geology of the Alldays Area. Explanation, Sheet 2228 Alldays, Council for Geoscience South Africa, Pretoria.

BREDENKAMP, G.J. 1975. 'n Plantsosiologiese studie van die Suikerbosrand-natuurreservaat. MSc thesis, University of Pretoria, Pretoria.

BREDENKAMP, G.J., A.F. JOUBERT and H. BEZUIDENHOUT. 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. and N. VAN ROOYEN 1996. 34. Rocky Highveld Grassland. P 39. *In*: LOW, A.B. & A.G. REBELO (eds.). *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affaire and Tourism, Pretoria.

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, Pretoria.

BUMBY, A.J. 2000. The geology of the Blouberg Formation, Waterberg and Soutpansberg Groups in the area of Blouberg Mountain, Northern Province, South Africa. PhD thesis, University of Pretoria, Pretoria.

COETZEE, B.J. 1975. A phytosociological classification of the Rustenburg Nature Reserve. *Bothalia* 11: 561–580.

COETZEE, B.J., F. VAN DER MEULEN, S. ZWANZIGER, P. GONSALVES and P.J. WEISSER 1976. A phytosociological classification of the Nylsvlei Nature Reserve. *Bothalia* 12: 137–160.

COLES, J.M. and E.S. HIGGS 1975. *The archaeology of early man*. Peregrine Books, Great Britain.

COOPER, K. H. 1985. The conservation status of indigenous forests in Transvaal, Natal and O.F.S., South Africa. Wildlife Society of South Africa, Durban.

DU PREEZ, P.J. and G.J. BREDENKAMP 1991. Vegetation classes of the southern and eastern Orange Free State (Republic of South Africa) and the highlands of Lesotho. *Navorsinge van die Nasionale Meuseum Bloemfontein* 7: 477–526.

EDWARDS, D. 1967. A plant ecological survey of the Tugela river basin. *Botanical Survey of South Africa Memoir* 36. Town and Regional Planning Commission, Pietermaritzburg.

ELOFF, J.F. 1979. III *Die kulture van Greefswald – 'n argeologiese studie van die Ystertydperkkulture op die plaas Greefswald*. UP Printers, University of Pretoria, Pretoria.

FOORD, S.H., A.S. DIPPENAAR–SCHOEMAN and M. VAN DER MERWE 2002. A checklist of the spider fauna of the Western Soutpansberg, South Africa (Arachnida: Araneae). *Koedoe* 45(1): 35–43.

FOORD, S.H. and A.S. DIPPENAAR–SCHOEMAN 2003. Spiders (Araneae). Pp. 45–50. *In*: BERGER, K., J.E. CRAFFORT, I. GAIGER, M.J., GAIGER, N. HAHN and I. MACDONALD, (eds.). *A first synthesis of the environmental, biological and cultural assets of the Soutpansberg*. Leach Printers & Signs, Makhadu.

FULS, E.R., G.J. BREDENKAMP, N. VAN ROOYEN and 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.

GELDENHUYS, C.J. and B. MURRAY 1993. Floristic and structural composition of Hanglip forest in the Soutpansberg, Northern Transvaal. *South African Forestry Journal* 165: 9–20.

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

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

GIBSON, L.A., B.A. WILSON and J.G. ABERTON 2004. Landscape characteristics associated with species richness and occurrence of small native mammals inhabiting a coastal heathland: a spatial modelling approach. *Biological Conservation* 120: 75–89.

GOUDIE, A. 2000. *The human impact on the natural environment*. Blackwell Publishers, Oxford.

HAHN, N. 1994. *Tree list of the Soutpansberg*. Fantique Publishers, Pretoria.

HAHN, N. 1996. Rubiaceae. A new species of *Vangueria* from the Soutpansberg. *Bothalia* 27(1): 45–48.

HAHN, N. 1997. Rare and endangered flora of Tshikondeni. In house manuscript of the Tshikondeni Mining Company (Pty) Ltd.

HAHN, N. 1999. Rubiaceae. A new species of *Pavetta* from the Soutpansberg, South Africa. *Bothalia* 29(1): 107–109.

HAHN, N. 2002. Endemic flora of the Soutpansberg. MSc thesis, University of Natal, Pietermaritzburg.

HAHN, N. 2003. Endemic flora. *In*: BERGER, K., E. CRAFFORD, I. GAIGER, M.J. GAIGER, N. HAHN and I. MACDONALD (eds.). *A first synthesis of the environmental, biological and cultural assets of the Soutpansberg*. Leach Printers & Signs, Makhado.

HAHN, N. *in prep*. Endemism and biogeography. PhD thesis, University of Pretoria, Pretoria.

HARRISON, J.A., D.G. ALLAN, L.G. UNDERHILL, M. HERREMANS, A.J TREE, V. PARKER and C.J. BROWN 1997. *The atlas of southern African birds*. Avian Demography Unit, Bird Life South Africa.

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

HENNING, B.J. 2000. The relevance of ecosystems to ecotourism in the Waterberg Biosphere Reserve. PhD thesis, University of Pretoria, Pretoria.

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, New York.

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

HOCKEY, P.A.R., W.R.J. DEAN and P.G. RYAN 2005. *Roberts – Birds of Southern Africa*, (7th edition). The Trustees of the John Voelcker Bird Book Fund, Cape Town.

HOFFMAN, T. and A. ASHWELL 2000. *Land degradation: Northern Province fact sheet*. Salty Print.

HUFFMAN, T. N. 1996. Archaeological evidence for climatic change during the last 2000 years in southern Africa. *Quaternary International* 33: 55–60.

KENT, M. & P. COKER 1996. *Vegetation description and analysis: a practical approach*. John Wiley & Sons Ltd., Sussex, England.

KRAMER, P.J. 1969. *Plant & soil water relationships: a modern synthesis.* McGraw–Hill, United States of America.

KREBS, C.J. 2001. *Ecology: the Experimental Analysis of Distribution and Abundance* (5th edition). Benjamin Cummings, San Francisco.

LOUW, A.J. 1970. Mopane veld noord van die Soutpansberg. DSc thesis, University of Pretoria, Pretoria.

LUBKE, R.A. and B. MACKENZIE 1996. Afromontane Forest. *In*: LOW, A.B. & A.G. REBELO (eds.) *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affaire and Tourism, Pretoria, p 12.

MACDEVETTE, D.R., D.K. MAC DEVETTE, I.G. GORDON and R.I.C. BARTHOLOMEW 1989. Floristics of the Natal indigenus forests of southern Africa. *Occasional Report* 45. Foundation for Research and Development, Pretoria.

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

MATTHEWS, W.S. 1991. Phytosociology of the North–eastern Mountain Sourveld. MSc thesis, University of Pretoria, Pretoria.

MATTHEWS, W.S., G.J. BREDENKAMP and N. VAN ROOYEN. 1991. The grassland-associated vegetation of the Black Reef Quartzite and associated large rocky outcrops in the north-eastern mountain sourveld of the Transvaal Escarpment. *South African Journal of Botany* 57: 143–150.

MATTHEWS, W.S., G.J. BREDENKAMP and N. VAN ROOYEN. 1994. The phytosociology and syntaxonomy of relatively low-altitude areas in the North-eastern Mountain Sourveld, in the eastern Transvaal escarpment region. *Koedoe* 37(2): 73–87.

MCCRACKEN, D.P. 1986. The indigenous forests of colonial Natal and Zululand. *Natalia* 16: 19–38.

MACDEVETTE, D. R. 1993. The woody vegetation of the Zululand coastal dunes. Pp. 633–637. *In*: VAN DER SEJDE (ed.). *South African forestry handbook / Suid-Afrikaanse bosbouhandboek.* Southern African Institute of Forestry, Pretoria.

MOLL, E.J. 1976. *The vegetation of the Three Rivers region, Natal*. Natal Town and Regional Planning Reports 33. Town and Regional Planning Commission, Pietermaritzburg.

MUELLER-DOMBOIS, D. and H. ELLENBERG. 1974. Aims and methods of vegetation ecology. Wiley, New York.

NEMUDZIVHADI, M. 1985. *Lini na Zwini, Thangela ya ndavhuko ya Histori ya Venda*. Thohoyandou Press.

OBERMEYER, A.A., H.G. SCHWEICKERDT and I.C. VERDOORN 1937. An enumeration of the plants collected in the northern Transvaal. *Bothalia* 3(2): 223–258.

OBIRI, J.A.F. 2002 Resource quantification, use and sustainable management of coastal forests in the Eastern Cape Province. PhD thesis. University of Natal, Pietermaritzburg.

OBIRI, J., M. LAWES and M. MUKOLWE 2002. The dynamics and sustainable use of high–value tree species of the coastal Pondoland forests of the Eastern Cape Province, South Africa. *Forest Ecology and Management* 199: 131–148.

OLIVIER, J. and C.J. RAUTENBACH 2002. The implementation of fog water collection systems in South Africa. *Atmospheric Research* 64(4): 227–239.

PATTERSON, D.G. and P.G. ROSS 2004a. Land types of the map 2228 Alldays. *In*: MACVICAR, C.N. (ed.). *Memmoirs on the Agricultural Natural Resources of South Africa.* Department of Agriculture and Water Supply, www.arc.agric.za/institutes/iscw/main/maps/htm

PATTERSON, D.G. & P.G. ROSS 2004b. Land types of the map 2328 Pietersburg. *In*: MACVICAR, C.N. (ed.). *Memmoirs on the Agricultural Natural Resources* *of South Africa*. Department of Agriculture and Water Supply, www.arc.agric.za/institutes/iscw/main/maps/htm

SCHUTTE, J.M. 1971. Die onttrekking van water uit die newellaag en lae wolke by Mriepskop. S.A. Department of Water Affairs, Division Hydrological Research, Technical note 20: 1–21.

SCOTT, D.F. and D.C. LE MAITRE 1998. *The interaction between vegetation and groundwater: research priorities for South Africa*. Water Research Commission WRC Report; no. 730/1/98, Pretoria.

SHACKLETON, C.M and S.E. SHACKLETON 2000. Direct use values of secondary resources harvested from communal savannas in the Bushbuckridge Lowveld, South Africa. *Journal of Tropical Forest Products* 6: 28–47.

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

SIEBERT, F., G.J. BREDENKAMP and S.J. SIEBERT. 2003. A comparison of Mopane vegetation in South Africa, Namibia and Zimbabwe. *Bothalia* 33(1): 121–134.

SMIT, J.H.L. 2000. Phytosociology and veld management of the eastern Kalahari Thornveld. MSc thesis, University of Pretoria, Pretoria.

SOUTH AFRICAN WEATHER BURO 2004. South African Weather Service, http://www.weathersa.co.za

STIRTON, C.H. 1982. A new species of *Rhynchosia* from Venda. *Bothalia* 14(1): 76–77.

UNESCO 2002. *Convention concerning the protection of the world cultural and natural heritages*. UNESCO World Heritage Centre, France http://www.unesco.org

VAN DEN BERG, H.M. 1993. Die identifisering en kartering van veldekotope in die noordwes-Transvaalse suur- en gemengde-bosveld. MSc thesis, University of Pretoria, Pretoria.

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

VAN JAARSVELD, E. and D. HARDY 1991. The Blouberg botanical expedition, with specific reference to the succulent vegetation. *Aloe* 28(3): 78–83.

VAN ROOYEN, N. and G.J. BREDENKAMP. 1996. 17. Sweet Bushveld. P. 21. *In*: LOW, A.B. & A.G. REBELO (eds.). *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affaire and Tourism, Pretoria.

VAN STADEN, P.J. 2002. An ecological study of the plant communities of Marakele National Park. MSc thesis, University of Pretoria, Pretoria.

VAN STADEN, P.J. and BREDENKAMP G.J. 2005. Major plant communities of the Marakele National Park. *Koedoe* 48(2): 59–70.

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

VAN WYK, A.E. 1984. A new species of *Combretum* from Venda and taxonomic notes on the section *Angustimarginata* (Combretaceae). *South African Journal of Botany* 3(2): 125–1345.

VAN WYK, P. 1994. *Field guide to the trees of the Kruger National Park* Struik Publishers, Cape Town.

VAN WYK, A.E. 1996. Biodiversity of the Maputaland Centre. *The biodiversity of African plants*. Umdaus Press, Pretoria.

VAN WYK, A.E. and G.F. SMITH 2001. *Regions of floristic endemism in southern Africa*. Umdaus Press, Pretoria.

VOIGT, E.A. and I. PLUG 1984. Happy Rest: the earliest Iron Age Fauna from the Soutpansberg. *South African Journal of Science* 80: 22–227.

VON MALTITZ, G.P., L. MUCINA, C. GELDENHUYS, M. LAWES, H. EELEY, H. ADIE, D. VINK, G. FLEMING and T. VOSTER 2003. Classification system for South African Indigenous Forests: an objective classification for the Department of Water Affairs and Forestry. Environmentek report ENV–P–C 2003–017 CSIR, Pretoria.

WALKER, B. 1989. Diversity and stability in ecosystem conservation. *In*: WESTERN, D. and M. PEARL (eds.). *Conservation for the twenty–first century*. Oxford University Press, New York.

WESTOBY, M., B. WALKER and I. NOY-MEIR 1989. Opportunistic management for rangelands not at equilibrium. *Journal of Rangeland Management* 42(4): 266–274.

WESSELS, K.J., B. REYERS, A.S. VAN JAARSVELD and M.C. RUTHERFORD 2003. Identification of potential conflict areas between land transformation and biodiversity conservation in north-eastern South Africa. *Agriculture, Ecosystems and Environment* 95: 157–178.

WHITE, F. 1978. The Afromontane Region. Pp. 463–513. *In*: WERGER, M.J.A. (ed.). *Biogeography and ecology of southern Africa*. Junk, The Hage.

WHITE, R.E. 1995. *Introduction to the principles and practices of soil science.* Second edition, Blackwell Sciences (Ltd), Oxford.

WINTERBACH, R. 1998. A phytosociological synthesis of *Acacia tortilis* communities in the north–western savanna of South Africa. MSc thesis, University of Pretoria, Pretoria.

WINTERBACH, R., G.J. BREDENKAMP, M.S. DEUTSCHLANDER and L. MUCINA 2000. Preliminary syntaxonomic scheme of vegetation classes for the Central Bushveld of South Africa. Pp. 123–127. *In*: WHYTE, P.S., L. MUCINA, J.S. LEPS and E. VAN DER MAAREL (eds.). Proceedings IAVS Symposium, Opulus Press, Upsala.

CHAPTER 5

PLANT COMMUNITIES OF THE BLOUBERG NATURE RESERVE

Introduction

In an overview of the vegetation of the Soutpansberg Conservancy and the Blouberg Nature Reserve (Chapter 4), three Major Vegetation Types were identified within the BNR, namely the *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld, the *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld and the *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld. The classification of these three Major Vegetation Types is addressed in this chapter.

Only a few vegetation studies have been done on savannas of the Blouberg, which includes a B.Sc. Honours project by Scholes (1978) and a management report written by Klopper (1988) for the BNR. The unpublished format of these studies makes them inaccessible to the scientific community, reducing their value as research projects. Klopper did however collect valuable field data on the vegetation of the BNR, which includes the north-eastern lower lying sections of the Blouberg Mountain Range. However, Klopper failed to complete the synthetic phase of this phytosociological study, leaving the data unprocessed and ecologically un-interpreted. It was decided to analyze this valuable set of detailed field data in order to propose a first phytosociological approximation of the BNR vegetation.

The vegetation of the BNR is relatively homogeneous compared to the vegetation of the higher lying western sections of the Blouberg and the topographically diverse Soutpansberg Conservancy. Nevertheless, Van Rooyen & Bredenkamp (1996) and Van Wyk & Smith (2001) regarded the vegetation of this area as unique and of very high conservation value. Due to a lack of sound phytosociological data or detailed vegetation descriptions of the Blouberg, Van Rooyen & Bredenkamp (1996) were forced to lump the area's vegetation under the broad term of Soutpansberg Arid Mountain Bushveld. Acocks (1953) recognised four different Veld Types for the surrounding region and described them as Arid Sweet Bushveld, Mixed Bushveld, Sourish Mixed Bushveld and Sour Bushveld. Most of these Veld Types were described as heterogeneous (Acocks 1953), comprising of many sub–communities with varying agricultural and production potentials. In addition to the savanna vegetation of the area, patches of Afromontane Forest (Lubke & McKenzie 1996) and high altitude grasslands (Van Jaarsveld & Hardy 1991) occur within the Blouberg, west of the BNR. These grasslands along the summits and crests of the Blouberg contain numerous Fynbos floristic elements (Wyk & Smith 2001). Due to major gaps in the available vegetation data, no attempt has yet been made to synthesize, classify and to describe the plant communities of this region.

Vegetation classification

An analysis of the BNR vegetation data resulted in the identification of three Major Vegetation Types (Table 1, Chapter 4) and eight plant communities (Table 2, 3 and 4). A dendrogram (Fig. 4) of the hierarchical classification was produced using the software package TWINSPAN (Hill 1979a). A Detrended Correspondence Analysis ordination with the software package DECORANA (Hill 1979b) produced some weak clustering of relevés, representing the Major Vegetation Types of the BNR. Some trends in environmental gradients were correlated with the strongest ordination axes. No distinct clusters representing any of the individual plant communities of the BNR was observed.

Due to the artificial boundaries of the relatively small BNR, the plant communities described from the BNR do not represent the total diversity in vegetation of the entire Blouberg Mountain Range. Werger (1974), Coetzee (1983), and Du Plessis (2001) warned against the premature syntaxonomic classification and formal description of vegetation from localised studies that may not be representative of the full diversity in vegetation from the surrounding landscapes. Such classifications may lead to the lumping of syntaxa that may otherwise belong to separate hierarchical divisions. For this reason, it was decided not to attach formal syntaxonomical names to the plant communities described for the BNR.

Strong emphasis was placed on long-lived perennial species for the purpose of community description. These species were specifically chosen to ensure relatively long-term predictability regarding effective plant community identification by future fieldworkers and managers. Due to the fleeting existence and unpredictable appearance of annual and weak perennial species within communities of arid and semi-arid ecosystems, it was decided to treat such species as the more temporary and fluctuating component within the vegetation of these event-driven systems (Westoby *et al.* 1989a, b). The informal classification of the vegetation of the BNR is as follows:

1. *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type
   1.1 *Spirostachys africana–Sclerocarya birrea* subsp. *caffra* community
   1.2 *Solanum panduriforme–Sclerocarya birrea* subsp. *caffra* community
   1.3 *Terminalia prunioides–Sclerocarya birrea* subsp. *caffra* community

2. *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type
   2.1 *Acacia nilotica–Acacia tortilis* community
   2.2 *Combretum apiculatum–Acacia tortilis* community
   2.3 *Rhus leptodictya–Acacia tortilis* community

3. *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type
   3.1 *Pseudolachnostylis maprouneifolia–Combretum molle* community
   3.2 *Hyperacanthus amoenus–Combretum molle* community

Table 2 Phytosociological table of the plant communities of the *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type

Community no.	**1**									
Relevè number	485	486	479	480	482	483	484	490	491	492
Diagnostic species of the *Spirostachys africana–Sclerocarya birrea* subsp. *caffra* community										
Species Group A										
Hibiscus calvphvllus	1	b	b	1	b	b		1	b	3
Spirostachys africana		1	b	b	b	3	b	b	1	
Dactyloctenium aegyptium	b		1	1		1	4	1	1	
Arctotis species	3	1		b	1		b		4	3
Eragrostis biflora			1	1	b		4	1	3	
Triumfetta pentandra				1	1	1	b	1	1	
Phyllanthus pinnatus	3				5	b		3		
Euphorbia crotonoides	1			b				1		b
Secamone parvifolia			1	1	1	b				
Grewia flava		3	1	3	3					
Ochna inermis			b		1	b		1		
Spermacoce senensis				1			1	1	1	
Corchorus species	1	1	1				1			
Chamaecrista biensis				b	1		1	1		
Euclea natalensis			1	b	1					
Combretum hereroense		b	1			1				
Lepidagathis scariosa		1			b		1			
Barleria elegans					1			1	1	
Gardenia volkensii				b			1		b	
Gymnosporia buxifolia			1			1				
Diagnostic species of the *Solanum panduriforme–Sclerocarya birrea* subsp. *caffra* community										
Species Group B										
Solanum panduriforme		b								
Portulaca pilosa										
Justicia flava		1								1
Abutilon guineense									3	
Euclea divinorum										
Acalypha indica	b	1								1
Euphorbia ingens										
Kirkia acuminata										
Albizia anthelmintica										
Crotalaria laburnifolia										
Albizia harveyi										

Community no.	**2**																	
Relevè number	450	472	477	448	464	442	443	444	447	451	452	453	463	441	449	461	440	437
Diagnostic species of the *Spirostachys africana–Sclerocarya birrea* subsp. *caffra* community																		
Species Group A																		
Hibiscus calvphvllus	1		1			1	1											
Spirostachys africana																		
Dactyloctenium aegyptium				b					1						b			
Arctotis species		1	b		1			1					1					
Eragrostis biflora														1	b			
Triumfetta pentandra																		
Phyllanthus pinnatus			3															
Euphorbia crotonoides																		
Secamone parvifolia								1										
Grewia flava																		
Ochna inermis																		
Spermacoce senensis							1											
Corchorus species						1						1	1				1	
Chamaecrista biensis		1																
Euclea natalensis					1													
Combretum hereroense																		
Lepidagathis scariosa			1															
Barleria elegans																		
Gardenia volkensii													1					
Gymnosporia buxifolia																		
Diagnostic species of the *Solanum panduriforme–Sclerocarya birrea* subsp. *caffra* community																		
Species Group B																		
Solanum panduriforme		1	1		b	1	1		1		1	1		b	1	1		1
Portulaca pilosa		1				1			1		1	1			1			1
Justicia flava					1			1			1	1				1		
Abutilon guineense				1					1			1			1	1		
Euclea divinorum				1						b	b					1		
Acalypha indica		1	4	1	1													
Euphorbia ingens							4		1		1	1						
Kirkia acuminata		b	1															
Albizia anthelmintica										b								
Crotalaria laburnifolia												1			b			
Albizia harveyi											b				1			

Community no.	**3**							
Relevè number	413	406	412	407	414	415	416	430
Diagnostic species of the *Spirostachys africana–Sclerocarya birrea* subsp. *caffra* community								
Species Group A								
Hibiscus calvphvllus				1		1	1	
Spirostachys africana								
Dactyloctenium aegyptium								
Arctotis species						1	1	
Eragrostis biflora						b		
Triumfetta pentandra								
Phyllanthus pinnatus								
Euphorbia crotonoides								
Secamone parvifolia					1	1		
Grewia flava	4							
Ochna inermis								
Spermacoce senensis								
Corchorus species				1	1			
Chamaecrista biensis			1	r	1			1
Euclea natalensis								
Combretum hereroense								
Lepidagathis scariosa								
Barleria elegans								
Gardenia volkensii								
Gymnosporia buxifolia								
Diagnostic species of the *Solanum panduriforme–Sclerocarya birrea* subsp. *caffra* community								
Species Group B								
Solanum panduriforme	1	1			1			
Portulaca pilosa								
Justicia flava								
Abutilon guineense								
Euclea divinorum								
Acalypha indica		1				1		
Euphorbia ingens								
Kirkia acuminata								1
Albizia anthelmintica								
Crotalaria laburnifolia								
Albizia harveyi								

Species Group C

Digitaria eriantha	1 3b b b 3 3b	b b b 1b b 3b b b 4b 3 3 1 3 1	3 5
Phyllanthus burchellii	1 1 1 1 1 1 1 1 1	1 1b 1 1 1 1 1 1 1 1 1 1	
Melhania forbesii	4b 1 1 1 1	1 1 1b b b 3 3 1 1 1 1b 1	1 1
Combretum mossambicense	b 3b 4 3 1 1 1	b b b 1b 1b 1b b b	b 1
Sida ovata	b 1 3 1 b	1 b 1 1b b 1 1 1b 3b b b	b 1
Erythrophleum africanum	1 1 1 1 1	1 1 1 1 1 1 1 1 1	
Cissus cornifolia	b 1 b b	1 1 1b 1b b b	1
Hermannia grisea	b b 3b 3	3b 1 b 1	
Tragus berteronianus	1b b 1 1 b 1	1 1 1 1 1	
Ehretia rigida	b b	1 1b 1b b b b	b
Indigofera rhytidocarpa	1 1 1 1 1	1 1 1 1 1 1	
Ziziphus mucronata	1	b b b 1 b b 1 1	
Philenoptera violacea	b b 4 4	b 3 b 1 1	
Pristimera longipitiolata	1 3b 1b 3	b b	1
Talinum tenuissimum	1 1	1 1 1 1 1 1	1
Vangueria infausta	1 1b b	b 1b 1	
Terminalia sericea	b b 3	b 3 1b	
Zornia species	1 1 1	1 1 1 1	1
Asparagus exuvialis	b b 1	b 1 1 1	1
Monechma divaricatum	5 b b	1 1 1 1	1b

Diagnostic species of the *Terminalia prunioides–Sclerocarya birrea* subsp. *caffra* community

Species Group D

Melhania rehmannii		1	b 1b b 1b
Limeum viscosum		1 1 1	1 1 1 1 1 1
Ocimum gratissimum	1	1 1	1 1 1 1 1
Hermannia glanduligera			1 1 1 1 1
Lannea schweinfurthii		3 3	1 b 3 3
Blepharis subvolubilis	1	b 3 1	b 1 1 3
Terminalia prunioides			1 b b
Commiphora schimperi			b 1b
Phyllanthus species	1		1 1
Combretum species		1	1 1
Hirpicium species		1 1	1
Alyssum species		1 1 1 1	1

Species Group E

Cyperus angolensis	1	1 1 1 1 1 1 1 1 1 1 1 1	1 1b b b 1 1
Aristida congesta	1	1b b b b b b 1 1b 3	1 1b 1 1 1 3
Urochloa mosambicensis	1 1 3	1b b 3 b b b b 1 1b 3	5b b 4b
Eragrostis rigidior	b 1	1 1b 1 b b b 1 3b b	3 b 3b
Grewia bicolor var. *bicolor*	b 1 3	b b 3b 1b b 3b	3 b 3b b
Lantana rugosa	1	1 1 1 1 1 1 b	1 1 1 1
Pogonarthria squarrosa	1	b 1 1 b 1 1	1 1 3
Ruellia species	1	1 1 b	1 1 1

Species Group F

Eragrostis lehmanniana	4 3 3 4 3 3 3b b	3b 1b 5 5b 3 3 3 3 3b 4 3b 4 3	1 5b b 5 1
Hibiscus praeteritus	1 1b 1 1 1b 1 b	1 1 1 1b 1 1b 1 1 1 1b 1 1b 1	1 1 1 3 1 1
Panicum maximum	5b 3 4 3 5 3b 1 3	3 5 4 5 3 3 5 5 4 5 4 5 3 5 5	5b 1 3 5 4
Acanthospermum species	b 3 3b b 3 4 1b b	1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1b 1
Tephrosia purpurea	1 1b 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

Evolvulus alsinoides	1 1b 1 1 1 b	1 1 1 1 1 1 1 1 1 1 1b 1 1 1	1 1b1
Dichrostachys cinerea	b b 1 3b 4 b	b 3 3 1 1 b 1 b b 1 3 3 1	b 1 1 1 3
Commiphora species	1 1 1 1 1 1b 1 1	1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1
Waltheria indica	b b b 3b 1 3	1b 3 1 1 1b 3 3b 1 1b 1	b 1 1b
Commiphora mollis	b b 1 3 1b b 1	1 3b 1 b 3 1 3b b b b	1b 4b3
Grewia flavescens	b 1 3b b 3	1 3b 1 3 3 3b b b b 4	1 1b b 1 3 3
Markhamia zanzibarica	b b b b	b 3 3 3b 1 1 3 1 b b 1	b b b b 1
Sclerocarya birrea	1 3 5 b	b b 3b 4 5 1 1b 3 5b 5 1	4 1 1 b
Leucas sexdentata	1b 1 1	1 1 1 1 1 1 1 1 1 1 r	1 1 1 1b 1
Combretum apiculatum	b b 3 b	1 3b 1 3b b 1 3 5 1 1	1b 1 4
Boscia albitrunca	r r 1 1b b b 1	1 1 r b b 1 1 r 1	b b 1 1
Bulbostylis hispidula	1 1b b b 1 1	1b 1 1 1 1 1 1 1b 1	b 3 4 3
Enneapogon cenchroides	b b 1 1b b 1 1 1	1 1 b 1 1b	b 1b b 1b
Indigofera species	1b 1 1 1 1	1 1 1 1 1 1 1 1 1 1	1 1 1 1
Limeum fenestratum	1 1 3b 1 1b b	1 1 1 1 1 1	1 1 1 1 1 1
Aristida stipitata	b b 1 3b	b 3 b 1 1 b 1 1 b 1b	b 1
Schmidtia pappophoroides	1 1b	4b 1 1 3b b 1b b	3 3 1
Grewia monticola	3 1 b 3	b 1 b b 1 3 b	1b 1 1b b
Acacia nigrescens	5b b 4	b 4 1 3 1 1 3 1	b b
Commiphora africana	1b b 1 1	1 1 1 1b 1	1 1 1
Chamaecrista absus	1 b	1 1 1 1 1 1b 1 1	1
Stipagrostis uniplumis	b b b 1	3 b b b b 3	1 b
Blepharis integrifolia	1 1 1	1 1 1 1 1 1 1 1	1
Aristida adscensionis	b 1b	b 1 b 1 1	b 1
Acacia tortilis	b 3	3 1 1 1 3 b	3 1
Tragia minor	1 1 3	b 1 1 b b	5 1
Strychnos madagascariensis	1 b	1b b 1 b	1 3
Cassia abbreviata	3	1 b 4	
Bidens biternata	1	1 1	

Table 3 Phytosociological table of the plant communities of the *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type

Community no.	**1**																										**2**															**3**							
Relevè number	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6	6	5	5	6	6	6	6	6	5	6	6	5	5	5	5	5	5	4	4
	1	2	3	3	2	5	5	5	6	6	6	6	3	5	5	5	5	5	5	4	4	4	4	4	3	4	1	1	1	1	2	3	4	0	0	0	1	1	4	0	1	8	8	8	8	8	8	3	3
	8	7	0	4	4	6	7	8	0	8	6	7	2	0	1	2	3	4	5	2	4	7	8	9	9	3	7	6	8	9	0	6	5	7	8	9	2	1	6	6	5	2	3	4	5	6	8	1	3
Diagnostic species of the *Acacia nilotica–Acacia tortilis* community																																																	
Species Group A																																																	
Eragrostis rigidior	b	3	3	b	1		b		b	b	b	1	b	b	4	4		4	3	3		3	3	b			b			1			b			b										1	5		
Evolvulus alsinoides	1	1	1	1	1		1			1		1	1			1		1		b		1	1				1			1	1				1														
Melhania forbesii	b	3		b			1		b	b		1	1		b	1	1	b					1	1								1				1							1						
Acacia nilotica			3	b			b		5			3	b	1		3	b	b	b	3			b																								2		
Aristida congesta ssp. *congesta*	b	3	1						b		b		b			b		b	1	3	b	b	b									1	1																
Urochloa mosambicensis	3	3	3						b	b	1			b	3	3	1	3		1							b		1																				
Acacia karroo		3	b	b			b	b	b					b			b			b	b			3								3					b												
Blepharis integrifolia			1	1					1				1		b			1		1	1		1	1	1								1		1				1										
Sida ovata		1	1	1						b					1	1	1		1	1				1								1																	
Combretum imberbe				3						b			b		1				1	1	b		b	b								4		b										2					
Ximenia americana var. *microphylla*					2	1					b	b		b		1			b					b			1											1											
Abutilon austro-afric			1	1									1			1	1	1						1																									
Schotia brachypetala			1		1						1			5			1						b	b									b										2						2
Grewia flava		b												1			3	b			b		b										b																

Diagnostic species of the *Combretum apiculatum–Acacia tortilis* community

Species Group B

Species			
Combretum apiculatum ssp. *apiculatum*	5 b 4 1 2	3 1 3 2 b b b 3 b 3 3 1	r
Aristida species		2 2 1 1 1 1 2	
Ocimum gratissimum ssp. *gratissimum*	1 1 1 1 1	1 1 1 1 1 1	
Heteropogon contortus	b 1 b b	3 3 b 1 5 3	
Cheilanthes involuta	1 1	1 1 1 1 1 1	
Acalypha indica	1 1 1 1	1 1 1 1 1 1	
Ormocarpum trichocarpum	b 1	1 b b 1 1	
Rhynchosia vendae	1 2	1 1 1 1 1	
Albizia harveyi		2 2 2 5	
Berkheya mackenii		1 2 1 1	
Cymbopogon pospischilii	1 1	b 3 1 b	
Pristimera longipitiolata		1 2 1 1	
Markhamia zanzibarica	2	3 2 2 2 2	
Themeda triandra	b 1 b	b b 1 b	
Pappea capensis	1	2 1 b 1	r 1 2
Ozoroa paniculosa var. *salicina*		b 1 1	
Psiadia punctulata	1	3 1 1	
Commiphora pyracanthoides		2 2	
Berchemia zeyheri	2 b	b b	
Pseudolachnostylis maprouneifolia		1 2	

Species Group C

Species			
Acacia nigrescens	3 b 5 2 1 1 4 3 1 4 b 1 5 3 b 4 2 1	b 1 2 2 3 3 3 3 4 b 4 r 3 2 1	5 2
Hibiscus praeteritus	1 1 1 1 1 1 1 1 1 1 1 1 1 b 1 1 b 1 1 2 1	1 1 1 2 1 b 1 1 1 1	
Lantana rugosa	1 b b b 2 1 1 b 1 1 b 1 1 1 1 1 1 1 1 3 2	1 1 1 1 1 1 1 1	1 1
Enneapogon cenchroides	b b b 3 1 1 1 1 b b 1 b 5 b 2	1 3 2 b 1 5 b 3 b 1 2 2	1
Tephrosia purpurea	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
Solanum panduriforme	b 1 1 1 1 b 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1	1 1
Rhinacanthus xerophilus	1 1 1 1 1 1 1 1 1 1 b 1 1 1 1	1 1 1 1 1 1 1 1	

Boscia albitrunca var. *albitrunca*	b b 1 b r 1 1 1 b b 1 1	b 1 1 2 1 1 1 1 1	
Cyperus angolensis	1 1 1 1 1 1 1 1 1 b 1 1 1	1 1 1 1 1 1 1 1	
Maesa lanceolata	1 1 1 1 1 1 1 1 1 1 1 1 1	b 1 1 1 1 r	
Aristida adscensionis	b b 1 1 b 1 b 1	1 1 1 1 b 1 b b 1 b 2	
Melhania prostrata	1 1 1 1 1 1 3 1 b 1 1	1 1 1 1 1 1	
Enteropogon macrostachyus	b 2 1 1 4 b 2 5	2 1 b 5 b 5 2 4	1
Corbichonia decumbens	1 b 1 1 1 1 1 1 1 1 1	1 1 1 1	
Acanthospermum species	1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1
Commiphora mollis	3 1 b b 5 5	5 2 2 2 5 3 2	
Eragrostis biflora	1 1 b 1 1	1 1 1 1 1 1 1 1	
Waltheria indica	1 3 1 b 1 1 1 2 1	1 1 1	3
Aristida congesta ssp. *barbicollis*	b b b b	1 1 b b 1	
Vernonia fastigiata	1 1 1 1 1 1	1 1 1	
Commiphora species	1 1 1 1 1 1	1 1 1	
Kirkia acuminata	5 b 1 4	2 b 3 3 2	
Combretum zeyheri	1 b b 2	b 1 b 1	
Strychnos madagascariensis	2 2	b b 3	
Indigofera species	1 1 1	b 1	

Diagnostic species of the *Rhus leptodictya–Acacia tortilis* community

Species Group D

Acacia ataxacantha			2 4 2 2 1 5 2
Senna petersiana			2 2 1 1

Species Group E

Panicum maximum	5 4 5 5 5 5 5 5 5 5 5 5 5 5 3 5 4 3 b 5 3 4	3 5 5 4 5 5 5 4 5 5 4 2	5 5 5 5 5 5 5
Hibiscus calyphyllus	1 b b 1 2 1 b b b 1 1 1 1 1 1 1 b 1 1 b 1 b 1 1	b 1 1 1 b 1 1 1 1 1 1	1 1 1 1
Lepidagathis scariosa	b 1 1 b 1 1 1 1 1 1 1 1 1 1 1 1 1 b 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1	1 1 1 1
Grewia monticola	b 3 b b 2 b b 1 b b b b 1 b 3 b 1 3 1 b b 1	b 3 1 2 2 b 1 1 2 2	2 2 2 1 1
Dichrostachys cinerea ssp. *africana*	3 3 1 3 1 b 3 3 b 3 3 b b b 3 b 3 3 b b 1 b	1 b b b b 1 1	2 1 3 5 5 1 2
Grewia flavescens var. *flavescens*	3 3 2 b 1 b 1 3 b 1 b b b b b 3 3	1 3 3 2 3 b b 2 2	4 2 3 5 2 2 4
Ehretia rigida	1 b 1 1 b b 1 b 1 b b b 3 1 b 1 b b 4 1	b 1 1 1 1	2 1 2 1 1

Euclea divinorum	1 b 1 1 b 3 b b 3 b 1 b 4 b 3 b 1 b 3	3 1 1 3 1	2 2 2 1 2
Ziziphus mucronata ssp. mucronata	1 b 1 3 b 1 b b b 4 3 b b 3	2 2 1 1 b b 2	4 1 1 1 2
Acacia tortilis ssp. *heteracantha*	b 3 5 5 3 5 b 3 1 b 5 3 b 4 3	b 3	3 3 1 2 1
Grewia bicolor	b b b 3 3 b b 3 b b b 2 2	3 2 1 3 2	2 2 2
Flueggea virosa ssp. *virosa*	1 b b 3 1 b 1 1 1 b	1 b 1 1 2	2 1 1 2
Rhus leptodictya	1 1 b b b b	b 1 1	2 2 2 2 3 2 2 2
Arctotis species	1 1 1 b 1 1 2	1 1 2 1 1 1 1	1 1 1
Cissus cornifolia	b 2 b b	1 2 1 1 1 1	2 r 2 1 1 1
Philenoptera violacea	r 1 b b r 1 1 1 b 2		3 2 1 3 5 4
Gymnosporia buxifolia	1 4 3 1 1 b 1 1	b b 1 3	2 2 2 1
Sclerocarya birrea ssp. *caffra*	1 b	1 b 1 1	2 2 2 2
Digitaria eriantha	b b 1 1	b	1 2
Dombeya rotundifolia var. *rotundifolia*	b b	4 b	1 2

Table 4 Phytosociological table of the plant communities of the *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type

Relevè number	540	541	605	598	610	614	595	597	599	600	622	623	625	624	627	628
Community no.					**1**								**2**			
Diagnostic species of the *Pseudolachnostylis maprouneifolia–Combretum molle* community																
Species Group A																
Strychnos madagascariensis	3	2	2	2	1	1	2	2	2	2						
Pseudolachnostylis maprouneifolia	1	2	3		2	2	2	2	2	2			2			
Cyperus angolensis	1		1	1	2	1	1	1	1	1						
Cheilanthes involuta	1		1	1	1	1	1		1	1						
Schmidtia pappophoroides	2		2	1			3		3	3						
Trichoneura grandiglumis			1	1	1		1	1	1		1	1				
Elephantorrhiza species	2		2		1	1		2			2					
Burkea africana				2	2		2	2	2			3	4			
Enneapogon cenchroides	1				1			1	1	1						
Waltheria indica		1	1				1		1	2						
Solanum panduriforme	1	1				1	1	1								
Combretum apiculatum ssp. *apiculatum*	3	2								3						
Sida ovata								1	1	1						
Eragrostis lehmanniana var. *lehmanniana*			1	1				2								
Terminalia sericea							4	2	2							1
Eragrostis biflora			1		1					1						
Bulbostylis hispidula ssp. *pyriformis*				1			1			1						
Acacia sieberiana var. *woodii*	3	2														
Andropogon chinensis	2	2														
Boophane disticha					1				1							
Brachiaria nigropedata				1				1								
Felicia clavipilosa					2		1									
Selaginella dregei								2	3							
Stipagrostis uniplumis var. *uniplumis*							5	2								
Lannea discolor				2			2									
Leonotis ocymifolia				1						1	1					
Vangueria parvifolium			2													
Dyschoriste transvaalensis							2									
Diagnostic species of the *Hyperacanthus amoenus–Combretum molle* community																
Species Group B																
Hyperacanthus amoenus											1		1	2	2	3
Mimusops zeyheri											2			2	2	2
Diospyros lycioides											2		1	1		
Themeda triandra					2						1	2				1
Tricliceras schinzii										2	1	2	1			

Crassula swaziensis											1			1		
Leucadadendron spissifolium ssp. *spissifolium*						1								1		1
Rhus magalismontanum ssp*. coddii*								1			4	3				
Cotyledon barbeyi											1			1		
Cryptolepis cryptolepioides											2	1				
Dichapetalum cymosum											2	2				
Dicoma anomala											1	1				
Cyperus species											1	1				
Olinia emarginata											2			2		
Perotis patens					2						1			1		
Rhynchosia monophylla											1	1				
Ficus abutilifolia												1				
Olea capensis ssp*. enervis*											1					
Species Group C																
Combretum molle	1	2	2	2	2	1	2	2	3		1		2		2	3
Panicum maximum	5	5	5	1		5	4	2		2			4	1	5	5
Vitex rehmannii	2	1	1		1	1		1	2		2		1		2	1
Digitaria eriantha	1	1	2	2			2	1	1	2	1	1		1		
Tephrosia purpurea	1	1	1	2	1		2	1	2	1	1	1				
Englerophytum magalismontanum	1	1	1	1		1					2	1	2	3	2	
Loudetia filifolia			2	4	5		2	2	1	2	2	3	2			
Commiphora species	1			1	1		1				1	1	1	1		
Aristida species				3	2		3	3	3	1	1	3				
Vangueria infausta			2		1	2	1				2	2		1		
Rhynchosia vendae			1	1			1	1	1		1		1			
Dalechampia species			1		1	1					1	1				1
Combretum zeyheri	2	2			2								2		3	
Cissus cornifolia			1	1		3							1		2	
Grewia flavescens var*. flavescens*			2			2				2						2
Pappea capensis			r			2										2
Bridelia mollis			2			2									2	
Ziziphus mucronata ssp*. mucronata*			2			2									2	
Lantana rugosa						1								1	1	
Psiadia punctulata						1										1
Indigofera species				1							1					

Community description

1. *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type

The *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type is associated with the northern foot slopes and plains of the Blouberg Nature Reserve. The generally flat landscape has a maximum incline of three degrees. Prominent Soil Forms associated with this Major Vegetation Type are the Hutton Soil Form (MacVicar *et al.* 1991) of the Land Type Ae derived from alluvium on sandstone of the Wyllies Poort Geological Formation (Botha 2004a; Patterson & Ross 2004a).

The diagnostic species for this group are presented in species group A (Table 1, Chapter 4). This group includes the woody species *Spirostachys africana* and *Erythrophleum africanum*. Diagnostic grass species include *Eragrostis lehmanniana* var. *lehmanniana, Tragus berteronianus* and *Dactyloctenium aegyptium, Pogonarthria squarrosa*. This diagnostic group contains numerous herbaceous species such as *Phyllanthus burchellii, Indigofera* species, *Limeum fenestratum, Bulbostylis hispidula* subsp. *pyriformis, Ruellia* species, *Indigofera rhytidocarpa, Chamaecrista absus, Hermannia grisea, Tragia minor, Corchorus* species, *Talinum crispatulum, Monechma divaricatum, Zornia* species, *Blepharis subvolubilis, Limeum viscosum, Leucas sexdentata, Secamone parvifolia, Chamaecrista biensis, Asparagus exuvialis* fo. *exuvialis.*

Dominant woody species of this Major Vegetation Type include *Spirostachys africana* (Species Group A), *Commiphora* species, *Grewia flavescens* var. *flavescens* (Species Group F), *Boscia albitrunca* var. *albitrunca*, *Cissus cornifolia*, *Combretum apiculatum* subsp. *apiculatum*, *Combretum mossambicense*, *Commiphora mollis*, *Grewia bicolor* (Species Group H), *Acacia nigrescens*, *Dichrostachys cinerea* subsp. *africana*, *Ehretia rigida*, *Markhamia zanzibarica* and *Sclerocarya birrea* subsp. *caffra* (Species Group L). Dominant grass species include *Eragrostis lehmanniana* var. *lehmanniana* (Species Group A), *Eragrostis rigidior*, *Urochloa mosambicensis* (Species Group L), *Digitaria eriantha*, *Panicum maximum* and *Aristida stipitata* subsp. *graciliflora* (Species Group P). Prominent herbaceous species include

Phyllanthus burchellii (Species Group A), *Acanthospermum* species, *Arctotis* species, *Aristida congesta* subsp. *congesta*, *Evolvulus alsinoides*, *Hibiscus calyphyllus*, *Hibiscus praeteritus*, *Sida ovata* (Species Group C), *Cyperus angolensis* (Species Group F), *Solanum panduriforme* (Species Group L) and *Waltheria indica* (Species Group P).

The *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type shows some floristic affinities with the *Acacia mellifera–Eragrostis lehmanniana* vegetation class, informally described by Smit (2000) as part of the Eastern Kalahari Tornveld. Prominent species shared by the BNR Northern Plains Bushveld and the *Acacia mellifera–Eragrostis lehmanniana* vegetation class include the grasses *Eragrostis lehmanniana, Pogonarthria squarrosa* and *Schmidtia pappophoroides*. A prominent woody species shared is *Boscia albitrunca*. However, these five species all show wide distribution ranges and exhibit wide ecological tolerance and adaptation within the sandveld areas of southern Africa, and are therefore not exclusive to the BNR Northern Plains Bushveld. This Major Vegetation Type shares some of the drought-resistant woody species with the *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type, such as *Commiphora mollis, Combretum apiculatum, Boscia albitrunca* var. *albitrunca, Grewia bicolor, Combretum mossambicense, Commiphora africana, Dichrostachys cinerea* subsp. *africana* and *Acacia nigrescens*. These species are also commonly found in the *Adansonia*–Mixed Thornveld (14e) (Acocks 1953), the *Adansonia digitata–Colophospermum mopane* Rugged Veld (Gertenbach 1983) and the *Commiphora–Terminalia prunioides* community (Louw 1970).

Plant communities of the *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type are presented in Table 2. This Major Vegetation Type is relatively homogeneous and plant communities share most of their dominant and prominent species. Diagnostic species groups of the various communities are generally weak, consisting mainly of short-lived herbaceous and grass species.

A Detrended Correspondence Analysis ordination by DECORANA (Hill 1979b) produced no distinct clustering of relevés within the *Eragrostis lehmanniana* var.

lehmanniana–Sclerocarya birrea subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type (Figure 7, Chapter 4). This lack of groupings further emphasizes the homogeneous nature of the vegetation of the BNR Northern Plains. No trends in environmental gradients could be inferred from the relevés associated with the three different plant communities identified from the TWINSPAN (Hill 1979a) classification. For this reason, these three plant communities are only described floristically, without detailed ecological interpretation of their potential environmental driving factors. A possible explanation for the observed homogeneity in the vegetation data gathered by H.L. Klopper may be that some sample plots were placed incorrectly within heterogeneous transitional vegetation, resulting in mixed relevés. Such mixed relevés prevent the formation of distinct clusters during ordination and complicate statistical separation during numeric classification (Kent & Coker 1995).

1.1 *Spirostachys africana–Sclerocarya birrea* subsp. *caffra* community

The diagnostic species for the *Spirostachys africana–Sclerocarya birrea* subsp. *caffra* community are presented in species group A (Table 2). Diagnostic woody species include *Spirostachys africana*, *Grewia flava*, *Ochna inermis*, *Euclea natalensis*, *Combretum hereroense*, *Gardenia volkensii* subsp. *volkensii* and *Gymnosporia buxifolia*. Diagnostic grass species include *Dactyloctenium aegyptium* and *Eragrostis biflora*. Diagnostic herbaceous species include *Hibiscus calyphyllus*, *Arctotis* species, *Triumfetta pentandra*, *Phyllanthus pinnatus*, *Secamone parvifolia*, *Spermacoce senensis*, *Corchorus* species, *Chamaecrista biensis*, *Lepidagathis scariosa* and *Barleria elegans*. A diagnostic succulent species recorded is *Euphorbia crotonoides*.

Dominant woody species recorded for the *Spirostachys africana–Sclerocarya birrea* subsp. *caffra* community include *Spirostachys africana* (Species Group A), *Combretum mossambicense*, *Pristimera longipitiolata*, *Vangueria infausta* subsp. *infausta* (Species Group C), *Dichrostachys cinerea* subsp. *africana*, *Commiphora* species, *Commiphora mollis*, *Grewia flavescens* v. *flavescens*, *Markhamia zanzibarica*, *Sclerocarya birrea* subsp. *caffra*, *Combretum apiculatum* subsp. *apiculatum* and *Boscia albitrunca* var. *albitrunca* (Species Group F). Dominant grass species include *Dactyloctenium aegyptium*, *Eragrostis biflora* (Species Group A), *Digitaria eriantha*, *Tragus berteronianus* (Species Group C), *Eragrostis lehmanniana* var. *lehmanniana*, *Panicum maximum*, *Enneapogon cenchroides* and *Aristida stipitata* subsp. *graciliflora* (Species Group F). Prominent herbaceous species include *Hibiscus calyphyllus*, *Arctotis* species, *Triumfetta pentandra* (Species Group A), *Phyllanthus burchellii*, *Melhania forbesii*, *Sida ovata*, *Hermannia grisea* (Species Group C), *Hibiscus praeteritus*, *Acanthospermum* species, *Tephrosia purpurea*, *Evolvulus alsinoides*, *Waltheria indica*, *Leucas sexdentata*, *Bulbostylis hispidula* subsp. *pyriformis*, *Indigofera* species and *Limeum fenestratum* (Species Group F).

1.2 *Solanum panduriforme–Sclerocarya birrea* subsp. *caffra* community

The diagnostic species for the *Solanum panduriforme–Sclerocarya birrea* subsp. *caffra* community are presented in species group B (Table 2). The diagnostic woody species *Euclea divinorum* was recorded. Diagnostic herbaceous species include *Solanum panduriforme*, *Portulaca pilosa*, *Justicia flava*, *Abutilon guineense* and *Acalypha indica*. The diagnostic succulent species *Euphorbia ingens* was recorded.

Dominant woody species recorded for the *Solanum panduriforme–Sclerocarya birrea* subsp. *caffra* community include *Combretum mossambicense*, *Ziziphus mucronata* subsp. *mucronata* (Species Group C), *Grewia bicolor* var. *bicolor* (Species Group E), *Dichrostachys cinerea* subsp. *africana*, *Commiphora* species, *Commiphora mollis*, *Grewia flavescens* var. *flavescens*, *Markhamia zanzibarica*, *Sclerocarya birrea* subsp. *caffra*, *Combretum apiculatum* subsp. *apiculatum*, *Boscia albitrunca* var. *albitrunca*, *Grewia monticola* and *Acacia nigrescens* (Species Group F). Dominant grass species include *Digitaria eriantha* (Species Group C), *Aristida congesta* subsp. *congesta*, *Urochloa mosambicensis*, *Eragrostis rigidior* (Species Group E), *Eragrostis lehmanniana* var. *lehmanniana*, *Panicum maximum*, *Aristida stipitata* subsp. *graciliflora* and *Schmidtia pappophoroides* (Species Group F). Prominent herbaceous species include *Solanum panduriforme* (Species Group B), *Phyllanthus burchellii*, *Melhania forbesii*, *Sida ovata* (Species Group C), *Cyperus angolensis* (Species Group E), *Hibiscus praeteritus*, *Acanthospermum* species, *Tephrosia purpurea*, *Evolvulus alsinoides*, *Waltheria indica*, *Leucas sexdentata* and *Bulbostylis hispidula* subsp. *pyriformis* (Species Group F).

1.3 *Terminalia prunioides–Sclerocarya birrea subsp. caffra* community

The diagnostic species for the *Terminalia prunioides–Sclerocarya birrea* subsp. *caffra* community are presented in species group D (Table 2). Diagnostic woody species include *Lannea schweinfurthii* var. *stuhlmannii*, *Terminalia prunioides*, *Commiphora schimperi* and *Combretum* species. Prominent herbaceous species include *Melhania rehmannii*, *Limeum viscosum*, *Ocimum gratissimum* subsp. *gratissimum*, *Hermannia glanduligera*, *Blepharis subvolubilis*, *Phyllanthus* species, *Hirpicium* species and *Alyssum* species.

Dominant woody species recorded for the *Terminalia prunioides–Sclerocarya birrea* subsp. *caffra* community include *Lannea schweinfurthii* var. *stuhlmannii*, *Terminalia prunioides*, *Commiphora schimperi* (Species Group D), *Grewia bicolor* var. *bicolor* (Species Group E), *Dichrostachys cinerea* subsp. *africana*, *Commiphora mollis*, *Grewia flavescens* var. *flavescens* and *Markhamia zanzibarica* (Species Group F). Dominant grass species include *Aristida congesta* subsp. *congesta*, *Urochloa mosambicensis*, *Eragrostis rigidior* (Species Group E), *Eragrostis lehmanniana* var. *lehmanniana*, *Enneapogon cenchroides* and *Grewia monticola* (Species Group F). Dominant herbaceous species include *Melhania rehmannii*, *Limeum viscosum*, *Ocimum gratissimum* subsp. *gratissimum*, *Hermannia glanduligera*, *Blepharis subvolubilis* (Species Group D), *Cyperus angolensis* (Species Group E), *Hibiscus praeteritus*, *Acanthospermum* species, *Tephrosia purpurea*, *Evolvulus alsinoides*, *Waltheria indica* and *Limeum fenestratum* (Species Group F).

2. *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type

The *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type is located along the plains and foot slopes south of the Blouberg within the BNR. The generally flat is predominantly associated with the Hutton Soil Form (MacVicar *et al.* 1991), derived from alluvium on sandstone of the Ae Land Type from the Wyllies Poort Geological Formation (Botha 2004a; Patterson & Ross 2004a). Other Soil Forms associated with this Major Vegetation Type are of less importance.

The diagnostic species for this group are presented in species group B (Table 1, Chapter 4). The diagnostic woody species characterizing the communities of this Major Vegetation Type are *Combretum imberbe, Rhus leptodictya* and *Schotia brachypetala*. Diagnostic grass species include *Enteropogon macrostachyus* and *Aristida congesta* subsp. *barbicollis*. Diagnostic herbaceous species within this group are *Lepidagathis scabra, Rhinacanthus xerophilus, Melhania prostrata* and *Corbichonia decumbens*.

Dominant woody species of this Major Vegetation Type include *Acacia tortilis* subsp. *heteracantha*, *Lantana rugosa*, *Rhus leptodictya* (Species Group C), *Grewia flavescens* var. *flavescens* (Species Group F), *Combretum apiculatum* subsp. *apiculatum*, *Grewia bicolor* var. *bicolor* (Species Group H), *Acacia nilotica*, *Euclea divinorum* (Species Group K), *Acacia nigrescens*, *Dichrostachys cinerea* subsp. *africana*, *Ehretia rigida*, *Eragrostis rigidior* (Species Group L), *Ziziphus mucronata* (Species Group P). Dominant grass species include *Enteropogon macrostachyus* (Species Group B), *Aristida congesta* subsp. *congesta*, *Aristida adscensionis* (Species Group C), *Aristida* species (Species Group D), *Eragrostis rigidior*, *Urochloa mosambicensis* (Species Group L), *Enneapogon cenchroides* and *Panicum maximum* (Species Group P). Prominent forbs include *Hibiscus praeteritus*, *Sida ovata*, *Blepharis integrifolia* (Species Group C), *Tephrosia purpurea* (Species Group E), *Cyperus angolensis* (Species Group F) and *Solanum panduriforme* (Species Group L).

The *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type may be regarded as a partof the *Rhus leptodictya–Acacia tortilis* Bushveld of the *Acacietalia rehmannianae–tortilis* of the *Acacienea nilotico–tortilis* of the *Panico maximi–Acacietea tortilis* described by Winterbach (1998) and Winterbach *et al.* (2000) for the north-western savanna of South Africa. Acocks (1953) describe similar vegetation as the Knoppiesdoring Veld (13b) of the Other Turf Thornveld (13). It also compares floristically with the *Acacia tortilis–Panicum maximum–Ziziphus mucronata* major plant community of the Waterberg (Henning 2002). These communities are generally not geographically restricted to a certain part of South Africa, but occur in a patchy distribution where conditions are favourable. Important taxa shared among these communities are *Acacia tortilis* subsp. *heteracantha, Rhus leptodictya, Grewia* species, *Acacia nilotica, Euclea divinorum*, *Acacia nigrescens*, *Dichrostachys cinerea* subsp. *africana, Ehretia rigida, Eragrostis rigidior, Ziziphus mucronata, Aristida* species *Eragrostis rigidior, Urochloa mosambicensis* and *Panicum maximum.*

Plant communities of the *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type are presented in Table 3. This Major Vegetation Type is relatively homogeneous and plant communities share most of their dominant and prominent species. Diagnostic species groups of the various communities are generally based on differentiating species from the field layer. In years of drought the field layer may become very sparse. In the relative absence of the field layer, the homogeneous woody layer of these three plant communities will cause them to flow into one another, becoming one plant community. The diagnostic species groups recorded for these three plant communities are therefore not very robust, but in dynamic flux with ecosystem driving events such as droughts. Such dynamic diagnostic species groups provide relatively poor predictive value in terms of the identification of plant communities in times of low rainfall. Depending on the state of the field layer at the time of data gathering, these communities may be viewed as either distinctly unique communities, with distinctly different grazing capacities, or may be viewed as one homogeneous landscape, with very little variation in browsing potential.

A Detrended Correspondence Analysis ordination by DECORANA (Hill 1979b) produced no distinct clustering of relevés within the *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type (Figure 7, Chapter 4). This lack of groupings further emphasizes the homogeneous nature of the vegetation of the BNR Northern Plains. No trends in environmental gradients could be inferred from the relevés associated with the three different plant communities identified from the TWINSPAN (Hill 1979a) classification. For this reason, these three plant communities are only described floristically, without detailed ecological interpretation of their potential environmental driving factors.

2.1 *Acacia nilotica–Acacia tortilis* community

The diagnostic species for the *Acacia nilotica–Acacia tortilis* community are presented in species group A (Table 3). Diagnostic woody species include *Acacia* *nilotica*, *Acacia karroo*, *Combretum imberbe*, *Ximenia americana* var. *microphylla*, *Schotia brachypetala* and *Grewia flava*. Diagnostic grass species include *Eragrostis rigidior*, *Aristida congesta* subsp. *congesta* and *Urochloa mosambicensis*. Diagnostic herbaceous species include *Evolvulus alsinoides*, *Melhania forbesii*, *Blepharis integrifolia*, *Sida ovata* and *Abutilon austro-africanum*.

Dominant woody species recorded for the *Acacia nilotica–Acacia tortilis* community include *Acacia nilotica*, Acacia *karroo* (Species Group A), *Acacia nigrescens*, *Lantana rugosa* (Species Group C), *Grewia monticola*, *Dichrostachys cinerea* subsp. *africana*, *Grewia flavescens* var. *flavescens*, *Ehretia rigida*, *Euclea divinorum*, *Ziziphus mucronata* subsp. *mucronata*, *Acacia tortilis* subsp. *heteracantha* and *Grewia bicolor* (Species Group E). Dominant grass species recorded include *Eragrostis rigidior*, *Aristida congesta* subsp. *congesta*, *Urochloa mosambicensis* (Species Group A), *Enneapogon cenchroides* (Species Group C), *Panicum maximum* (Species Group E). Dominant herbaceous species recorded include *Evolvulus alsinoides*, *Melhania forbesii* (Species Group A), *Hibiscus praeteritus* (Species Group C), *Hibiscus calyphyllus* and *Lepidagathis scariosa* (Species Group E).

2.2 *Combretum apiculatum–Acacia tortilis* community

The diagnostic species for the *Combretum apiculatum–Acacia tortilis* community are presented in species group B (Table 3). Diagnostic woody species include *Combretum apiculatum* subsp. *apiculatum*, *Ormocarpum trichocarpum*, *Albizia harveyi* and *Pristimera* longipitiolata. Diagnostic grass species include *Aristida* species, *Heteropogon contortus*, *Cymbopogon pospischilii*, *Themeda triandra*. Diagnostic herbaceous species include *Ocimum gratissimum* subsp. *gratissimum*, *Cheilanthes involuta*, *Acalypha indica*, *Rhynchosia vendae*, *Berkheya mackenii* and *Psiadia punctulata*.

Dominant woody species recorded for the *Combretum apiculatum–Acacia tortilis* community include *Combretum apiculatum* subsp. *apiculatum* (Species Group B), *Acacia nigrescens*, *Lantana rugosa*, *Boscia albitrunca* var. *albitrunca*, *Commiphora mollis* (Species Group C), *Grewia monticola*, *Dichrostachys cinerea* subsp. *africana*, *Grewia flavescens* var. *flavescens* (Species Group E). Dominant grass species include *Aristida* species, *Heteropogon contortus* (Species Group B), *Enneapogon* *cenchroides*, *Aristida adscensionis*, *Enteropogon macrostachyus* (Species Group C), *Panicum maximum* (Species Group E). Dominant herbaceous species include *Ocimum gratissimum* subsp. *gratissimum* (Species Group B), *Hibiscus praeteritus*, *Tephrosia purpurea* (Species Group C), *Hibiscus calyphyllus* and *Lepidagathis scariosa* (Species Group E).

2.3 *Rhus leptodictya–Acacia tortilis* community

This plant community seems to represent some isolated azonal tall thickets along very sheltered southern slopes of the BNR. The diagnostic species for the *Rhus leptodictya–Acacia tortilis* community are presented in species group D (Table 3). Diagnostic woody species include *Acacia ataxacantha* and *Senna petersiana*. None of the other species recorded are regarded as diagnostic for this community.

Dominant woody species recorded for the *Rhus leptodictya–Acacia tortilis* community include *Acacia ataxacantha*, *Senna petersiana* (Species Group D), *Grewia monticola*, *Dichrostachys cinerea* subsp. *africana*, *Grewia flavescens* var. *flavescens*, *Acacia tortilis* subsp. *heteracantha*, *Rhus leptodictya*, *Cissus cornifolia* and *Philenoptera violacea* (Species Group E). The grass species *Panicum maximum* was recorded as a prominent species.

3. *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type

The *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type is restricted to the higher lying mountainous terrain of the BNR, ranging from 975–1465 m above sea level. It encorporates the lower lying north-eastern parts of the Blouberg. West of the BNR the Blouberg rises to 2051 m above sea level, where more temperate vegetation types occur (Van Jaarsveld & Hardy 1991).

Slope ranges from moderate to very steep with northern, southern and eastern aspects. Soils are generally shallow or skeletal (<100 mm), and associated with Mispah and Glenrosa Soil Forms (MacVicar *et al.* 1991) of the Fa Land Type (Botha 2004a; Patterson & Ross 2004a). The underlying geology is dominated by pink quartzite and minor conglomerate of the Wyllies Poort Geological Formation of the Soutpansberg Group.

The diagnostic species for this group are presented in species group D (Table 1, Chapter 4). Diagnostic woody species include *Combretum zeyheri* and an *Elephantorrhiza* species. The diagnostic grass species include *Loudetia filifolia, Trichoneura grandiglumis* and *Aristida* species. Diagnostic herbaceous species include *Rhynchosia vendae,* a *Dalechampia* species and *Tricliceras schinzii*.

Dominant woody species of the *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld include *Combretum zeyheri*, *Elephantorrhiza* species (Species Group D), *Commiphora* species (Species Group F), *Burkea africana*, *Pseudolachnostylis maprouneifolia* (Species Group O), *Strychnos madagascariensis* (Species Group P), *Combretum molle*, *Englerophytum magalismontanum*, *Hyperacanthus amoenus*, *Mimusops zeyheri*, *Rhus magalismontanum* subsp. *coddii*, *Vangueria infausta* subsp. *infausta* and *Vitex rehmannii* (Species Group U). Dominant grass species include *Aristida* species, *Loudetia filifolia*, *Trichoneura grandiglumis* (Species Group D), *Digitaria eriantha*, *Enneapogon cenchroides*, *Panicum maximum* and *Schmidtia pappophoroides* (Species Group P). Prominent herbaceous species include *Rhynchosia vendae* (Species Group D), *Cheilanthes involuta*, *Tephrosia purpurea* (Species Group E), *Cyperus angolensis* (Species Group F) and *Waltheria indica* (Species Group P).

The *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type shares floristic elements with the *Englerophyto magalismontani–Acacietea caffrae* of the Waterberg and Magaliesberg described by Winterbach *et al.* (2000). It shares many of the relatively drought tolerant species associated with the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type, lacking some of the more mesic species recorded within the mistbelt of the SC. The central variation of the Bankenveld (Acocks 1953) and the Rocky Highveld Grassland of the Grassland Biome (Bredenkamp & Van Rooyen 1996) share limited floristic and structural elements with the *Rhynchosia vendae–Englerophytum magalismontanum* Blouberg Moist Mountain Bushveld Major Vegetation Type. Although the vegetation structure of the *Diplorhynchus condylocarpon–Englerophytum magalismontanum* Rocky Slope community of the Waterberg Biosphere (Henning 2002) is very similar to that of the BNR Mountain Bushveld, the floristic composition differs considerably.

The plant communities of the *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type are presented in Table 4. This Major Vegetation Type can be divided into two relatively distinct plant communities based on the diagnostic and dominant species presented in Table 4. However, a Detrended Correspondence Analysis ordination by DECORANA (Hill 1979b) produced no distinct clustering of relevés within the *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type (Figure 7, Chapter 4).

3.1 *Pseudolachnostylis maprouneifolia–Combretum molle* community

The diagnostic species recorded for the *Pseudolachnostylis maprouneifolia–Combretum molle* community are presented in species group A (Table 4). Diagnostic woody species include *Strychnos madagascariensis*, *Pseudolachnostylis maprouneifolia*, *Elephantorrhiza* species and *Burkea africana*. Diagnostic grass species recorded include *Schmidtia pappophoroides*, *Trichoneura grandiglumis* and *Enneapogon cenchroides*. Diagnostic species herbaceous include *Cyperus angolensis*, *Cheilanthes involuta* and *Waltheria indica*.

Dominant woody species recorded within the *Pseudolachnostylis maprouneifolia–Combretum molle* community include *Strychnos madagascariensis*, *Pseudolachnostylis maprouneifolia*, *Elephantorrhiza* species, *Burkea africana*, *Terminalia sericea* (Species Group A), *Combretum molle*, *Vitex rehmannii*, *Englerophytum magalismontanum*, *Commiphora* species, *Vangueria infausta* (Species Group C). Dominant grass species include *Schmidtia pappophoroides*, *Trichoneura grandiglumis*, *Enneapogon cenchroides* (Species Group A), *Panicum maximum*, *Digitaria eriantha*, *Loudetia filifolia*, *Aristida* species (Species Group C). Prominent herbaceous species include *Cyperus angolensis*, *Cheilanthes involuta*, *Waltheria indica* (Species Group A), *Tephrosia purpurea* and *Rhynchosia vendae* (Species Group C).

The *Pseudolachnostylis maprouneifolia–Combretum molle* community share numerous species with the *Burkeo africanae–Pseudolachnostylietum maprouneifoliae* and the *Terminalio sericea–Burkeetum africanae* of the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type described in Chapter 8. These plant communities are associated with highly leached sandy soils. Soil depth varies from very deep to very shallow. The *Pseudolachnostylis maprouneifolia–Combretum molle* community of the BNR seems to represent the transition between the gentle slopes and shallow soils of the *Burkeo africanae–Pseudolachnostylietum maprouneifoliae* and the deep sandy terraces of the *Terminalio sericea–Burkeetum africanae* of the SC. Despite these similarities, a Detrended Correspondence Analysis ordination and a hierarchical classification of the BNR and SC floristic data sets, revealed distinct separation between the sandveld communities of the SC and the *Pseudolachnostylis maprouneifolia–Combretum molle* community of the BNR.

3.2 *Hyperacanthus amoenus–Combretum molle* community

The diagnostic species recorded for the *Hyperacanthus amoenus–Combretum molle* community are presented in species group B (Table 4). Diagnostic woody species include *Hyperacanthus amoenus*, *Mimusops zeyheri*, *Diospyros lycioides*, *Olinia emarginata* and *Rhus magalismontanum* subsp. *coddii*. Diagnostic grass species include *Themeda triandra* and *Perotis patens*. Diagnostic herbaceous species include *Tricliceras schinzii*, *Crassula swaziensis*, *Leucadadendron spissifolium* subsp. *spissifolium*, *Cotyledon barbeyi*, *Cryptolepis cryptolepioides*, *Dichapetalum cymosum*, *Dicoma anomala*, *Cyperus* species and *Rhynchosia monophylla*.

Dominant woody species recorded within the *Hyperacanthus amoenus–Combretum molle* community include *Hyperacanthus amoenus*, *Mimusops zeyheri*, *Diospyros lycioides*, *Rhus magalismontanum* subsp. *coddii* (Species Group B), *Combretum molle*, *Vitex rehmannii*, *Englerophytum magalismontanum* and *Commiphora* species (Species Group C). Dominant grass species include *Panicum maximum* and *Loudetia filifolia* (Species Group C). Prominent herbaceous species include *Cotyledon barbeyi* and *Cryptolepis cryptolepioides* (Species Group B).

The *Hyperacanthus amoenus–Combretum molle* community share some of the relatively drought tolerant species associated with the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type, lacking some of the more mesic species recorded within the mistbelt of the SC. The lack of a regular mistbelt along the relatively low altitude of the *Hyperacanthus amoenus–Combretum molle* community may well be the reason for this phenomenon. Some of the relatively drought resistant species associated with the *Burkeo africanae–Pseudolachnostylietum maprouneifoliae* of the SC Sandveld are also shared by the *Hyperacanthus amoenus–Combretum molle* community of the BNR. These species may be associated with localised patches and micro-habitats of deeper sandy soils almong the generally rocky slopes and skeletal soils of the *Hyperacanthus amoenus–Combretum molle* community.

Conclusion

The vegetation of the BNR contains some unique species complexes within each of the three distinctly different Major Vegetation Types identified. Despite the unique species composition of these Major Vegetation Types, the share some of the more general and prominent species recorded from the SC. The *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type and the *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type share numerous arid savanna species with the *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type. The *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type share sandveld species with the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type, and share some of the more temperate species with the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type. The species complexes of the BNR generally contain more drought-tolerant species than those of the SC. This emphasises the relatively drier conditions prevailing within the BNR as a result of the lack of orographic rain and mist at these altitudes of the Blouberg.

Vegetation within each of these Major Vegetation Types is relatively homogeneous. Some variations were identified and described as communities. Due to the lack of prominent diagnostic species groups of within the vegetation classification tables and the lack of distinct relevé clusters within the ordination scatter plot, the hierarchical syntaxonomic status of the described plant communities are likely to be very low. It is proposed that the described BNR plant communities be regarded as variations or sub-associations.

CHAPTER 6

SOUTPANSBERG ARID NORTHERN BUSHVELD COMMUNITIES

Introduction

In an overview of the vegetation of the Soutpansberg Conservancy and the Blouberg Nature Reserve (Chapter 4), the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld was identified as a Major Vegetation Type. The classification of this Major Vegetation Type is addressed in this chapter.

Only a few isolated detailed phytosociological studies have been done on the arid savannas of the Limpopo Province, which includes Breebaart & Deutchlander (1997), Siebert (2001), Du Plessis (2001), Henning (2002) and Götze (2002). B.Sc. Honores students from the University of Pretoria have done a number of smaller studies throughout the province as part of their practical training and to develop management plans for privatised game reserves and game ranches. These studies however, focussed on management planning and ended in reports rather than journals. The level of detail included in these studies varies and were often determined by scale and intensity of management practiced by landowners. The arid systems of the Limpopo Province, and for that matter most of the southern African savannas (Du Plessis 2001), have only been sampled in localised patches, such as areas of high conservation value and or high economic value. Therefore, the vegetation of many areas remains to be investigated and described in order to complete the puzzle of patchy vegetation studies throughout the province. One such a puzzle piece is the arid northern bushveld of the Soutpansberg mountain range.

Acocks (1953) mapped the vegetation of this area as Mixed Bushveld (18) on the plain directly north of the Soutpansberg mountain, Sourish Mixed Bushveld (19) along the northern foot slopes and Sour Bushveld (20) south of the northern most ridges. He described these Veld Types as “a Deadalian maze of variations and transitions”. Despite Acocks’ valuable efforts, and due to the scale of his map, he failed to identify and describe most of the plant communities discussed in this chapter, and urged that more work had to be done to unravel these complex vegetation patterns. Although not mapped as such, the *Adansonia*–Mixed Thornveld he described under the heading of Arid Sweet Bushveld may be regarded as a coarse description for the vegetation of the northern plains of the Soutpansberg Conservancy. Van Rooyen & Bredenkamp (1998) also recognised the uniqueness of this region's vegetation. However, without the necessary data, they too had to lump these communities under the broad term of Soutpansberg Arid Mountain Bushveld.

Vegetation classification

The analysis of the vegetation data resulted in the identification of eight plant communities, classified into eight associations (Table 5). The plant communities of the *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld (within the SC) are classified as follows:

Adansonia digitata–Acacia nigrescens Soutpansberg Arid Northern Bushveld Major Vegetation Type.
Classified under the *Commiphoro mollis–Colophospermetea mopani* described by Winterbach *et al*. (2000)

1. *Commiphoro tenuipetiolatae–Adansonietum digitatae*
2. *Ledebourio ovatifoliae–Commiphoretum mollii*
3. *Phyllantho reticulati–Acacietum nigrescentis*
4. *Tinneo rhodesianae–Combretetum apiculati*
5. *Dichrostachyo cinereae–Spirostachyetum africani*
6. *Themedo triandrae–Pterocarpetum rotundifolii*
7. *Cypero albostriati–Syzygietum cordatum*
8. *Sesamothamno lugardii–Catophractetum alexandri*

Table 5 Phytosociological table of the plant communities of the *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type

Association no.	1																			2										3							4												5				6			7				8					
Relev 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
	8	8	8	8	9	9	9	9	9	9	9	9	9	9	0	0	0	0	5	3	3	4	4	4	4	6	0	0	1	5	5	5	6	6	6	6	3	4	4	4	4	5	0	0	0	0	3	4	7	7	8	8	6	7	7	4	4	4	4	4	4	4	4	4	4
	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	0	7	8	1	2	3	4	1	5	6	0	7	8	9	0	2	3	4	2	5	6	7	8	6	4	7	8	9	1	0	8	9	0	1	9	0	1	6	7	8	9	0	1	2	3	4	5
Species Group A																																																																	
Diagnostic species of the *Commiphoro tenuipetiolatae–Adansonietum digitatae*																																																																	
Tephrosia macropoda	+	+	+	+	+	+	+		+	+	+	+	+	+	+		+	+	+																																													
Sclerocarya birrea ssp. caffra	a	b	a		+		+	+	+	+	+	+	a	1	a	a	a	1		+	+					+						+										+					1	+								r									
Commiphora tenuipetiolata	+			1	1	+	+	+	+	+	+	+	1	1	1		+							+	+							+														+																			
Ledebouria apertiflora	+	+	+	+	+	+		+		+	+	+			+	+			+			+			+																																								
Aristida stipitata ssp. graciliflora			+	+		+			+	1	1	1	+	+	+		a	1						+																											+							+							+
Tricholaena monachne	+	+	1		+		+		+		+		+		+		+	+																																															
Hermannia boraginiflora	+			+	+		+	+	+	+	+			+	+	+																																																	
Blepharis subvolubilis		+	+	+			+	+	+			+	+	+				+	+											+																																			
Dicerocaryum eriocarpum				+			+	+	+	+	+		+		+		+	+								+																																							
Chamaecrista mimosoides	+			+		+		+		+		+		+			+	+					+									+												+							+										+				
Albizia anthelmintica		+		+	1	1	+					+		+			+		a																																														
Barleria species			+			+	+	+	+																																																								
Phyllanthus maderaspatensis				+	+	+							+	+	+	+	+																																																
Indigofera adenoides	+	+	+			+	+		+			+	+																																																				
Sansevieria hyacinthoides	+			+	+			+							+	+		+				+												+				+																										+	
Corchorus trilocularis	+		+		+			+				+				+																																																	
Schotia brachypetala	r			+		+	+									+			+																																					+									
Agathisanthemum bojeri			+	+						+				+	+	+																																																
Asparagus asparagoides		+		+						+							+		+																																														
Acacia nilotica ssp. kraussiana				+	r	r							+						1						+																						1	1																	
Commelina africana		a	1							+																			+				+																											+					
Maytenus senegalensis	+	+	+							+											r																																												
Solanum kwebense		+		+						+									+					+				+																																					
Eragrostis pseudosclerantha										1	1	+																																																					

Species	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8
Acacia erioloba	+ + +						r	
Acacia burkei	+ + +							
Ehretia obtusifolia	+ + +			+			+	+
Polygala hottentotta	+ + +							
Ochna natalitia	+ + +			+				
Euclea natalensis	+ + +			+				
Tephrosia longipes	+ + +	+			+			
Eragrostis pallens	+ + +						+	
Species Group B								
Diagnostic species of the *Ledebourio ovatifoliae–Commiphoretum mollii*								
Ledebouria ovatifolia		+ + + + + + + +	+					
Asparagus cooperi		+ + + + + +		+				
Barleria elegans		+ + + + +	+	+				
Dalbergia nitidula	r	+ + + + + +	+	+				
Ocimum canum		+ + + + +	+					
Asparagus racemosus		+ + + + + +		+				
Abutilon angulatum var. angulatum		+ + + + + +	+					
Stapelia gigantea		+ + + +	+					
Euclea undulata	r	+ + + + +		r +				
Lantana rugosa	+	+ + +				+		
Pyrostria hystrix		+ + + +	r					
Aloe globuligemma		+ + + +			+			
Rhigozum obovatum		+ + +		+				
Pseudolachnostylis maprouneifolia	r	r + +		+ +		+		
Toddaliopsis bremekampii		r + +						
Species Group C								
Adansonia digitata	1 1 1 a + 1 1 1 1 + 1 1 1 1 1 1	1 1 1 + 1 1 1 1 + +						
Blepharis diversispina	+ 1 + 1 + + + + + + + + + + + + 1 + + +	+ + + + + +	+	+				
Terminalia prunioides	a 1 b a 1 a + + + +	+ + 1 + + 1 1 + + +						
Ximenia americana var. microphylla	+ + + + + + + +	+ + + + + + + +	+	+ +			+	+
Combretum mossambicense	+ + + + + + + + + + + +	+ + + + + + +	+					
Gossypium herbaceum ssp. africanu	+ + + + + + + +	+ + + + + + +		+ +				
Commiphora viminea	+ + + + + + + + + +	+ + + + +						

Waltheria indica	+	+	+							+	+	+						+		+	+						+	+	+														+		+				+									+					+		

Species Group D

Diagnostic species of the *Phyllantho reticulati–Acacietum nigrescentis*

Phyllanthus reticulatus																r					+									+	1	a	a	a	+	+																					+		+							
Setaria nigrirostris																														1	1	+	a	+	a	+																														
Ruspolia hypocrateriformis																														+	+	1	+	+	1	1																														
Asparagus setaceus																														+			+	+	+	+						+		+																					
Wrightia natalensis																														+	+	+		+	+																														
Rhynchosia nervosa																															+	+	+	+	+																														
Acalypha glabrata																														+	+	+			1	+											1																		
Melhania prostrata																+																+	+	+	+	+														+																
Brachylaena discolor																														1	+			+	+	+																														
Canthium mundianum																														+		+	+	+																															
Pouzolzia mixta																																+		+	+	+						+																							
Barleria obtusa																															+		+		+	+													+													+				
Ruspolia hypocrateriformis var. *australis*																																		1	a	1																														
Clerodendrum makanjanum																																		+	+	+																														
Loeseneriella crenata																														+			+			+																														
Combretum molle																											r					+	r						r																											
Vangueria infausta ssp. *infausta*		+					+																			+								+	+																														
Bridelia cathartica																															+				+					+																									
Barleria rotundifolia											r																					+	+							+		+																						
Ficus ingens var. *ingens*																						+					+			+				r																									+						
Ruttya ovata																																+		+	+																														
Aristida congesta ssp. *congesta*				+							+										+									+		r							r			+							+														+		
Maytenus tenuispina																														+			+									+											+												
Ptaeroxylon obliquum																														+			+																															
Croton gratissimus																															a		+																															
Phyllanthus pinnatus													r																					+		+																														

Species Group E

Sterculia rogersii	+		+																	+	+	+	+	+	+		+	+			+	+		+	+	+																														
Cissus cornifolia																			+	+	+		+	+	+				+	+	+		+	+	+	+								+																					
Albizia brevifolia																					+	+		+	+		+		+	+		+		1	a	b																														

Entandrophragma caudatum		+ + + + +	+ 1 + 1 +					
Markhamia zanzibarica		+ + + +	+ + + + +					
Lannea schweinfurthii var. stuhlmannii	r	+ + 1 1 + + +	+ + + +	+			+	
Tricalysia junodii var. kirkii		+ + r + + + 1 +	+ + + +	+				
Commiphora marlothii		+ 1 + + 1 +	+ + + +					
Gyrocarpus americanus ssp. africanus		+ 1 + 1 +	+ + + +					
Species Group F								
Pristimera longipitiolata	+ + + +	+ + + + + +	+ + 1 + + +	+ +	r		+	
Grewia subspathulata	+ + + 1 1 1 +	1 1 + 1 1 + + + +	+ 1 1 + + +					+
Grewia bicolor	+ + + + 1 1 1 1 1 1 + +	1 a + + + +	+ 1 + + + +					
Flueggea virosa ssp. virosa	+ +	+ + + + + + +	a a b 1 a + a	+ +				
Panicum deustum	+ +	+ +	+ + + +		+		+	
Asparagus exuvialis fo. exuvialis	+ + + + +		+ +					
Species Group G								
Diagnostic species of the *Tinneo rhodesianae–Combretetum apiculati*								
Tinnea rhodesiana			+ +	+ 1 a 1 a 1 + + + +				
Steganotaeni araliacea			+ +	r + + 1 + + +				
Barleria ovata			+	+ + 1 + + +				
Asparagus bechuanicus			+	+ + + + +				
Crabbea velutina			+	+ + + + +				
Psiadia punctulata	+ +		+	+ + 1 +	+	1		
Elephantorrhiza burkei				r + + +				
Aloe marlothii ssp. marlothii				+ 1 1	+			
Euphorbia ingens	r	+		+ 1 1				
Asparagus africanus			+	+ + +				
Asparagus suaveolens				+ + +				
Combretum imberbe	+			+ + +	r			
Diospyros villosa var. parvifolia				+ + +			+	
Kalanchoe paniculata				+ + +				
Species Group H								
Blepharis integrifolia			+ + +	+ + + + +				
Cardiospermum halicacabum			+ + +	+ + + + + +				

Species								
Species Group I								
Combretum apiculatum ssp. apiculatu	+ + r	+ 1 + + + b a b	+ + + + + +	1 a a a b + a b a b		+		
Kirkia acuminata		+ 1 + + 1 a +	1 a a b b	+ + a a a 1 + +	+ +			
Ochna inermis		r r + + + + +	+ + 1 + 1	+ + + +				
Pellaea calomelanos var. calomelanos		+ + + + +	+ + +	+ + + + +		+		
Solanum panduriforme	r	+ + + + + +		+ + 1			+	
Cassia abbreviata	+ +	+ + + + + +	+ + + + +	+ r + +				
Species Group J								
Maerua parvifolia	+ + + + + +	+ + + + + + +	+ +	+ + + + + +				
Acacia nigrescens	a b a a a 1 1 1 1 a a a a 1 1 a a a	+ 3 b a 1 1 a + 1 a	3 a a b a	1 + +			+	
Species Group K								
Diagnostic species of the *Dichrostachyo cinereae–Spirostachyetum africani*								
Spirostachys africana	r r r				1 a + 1			
Aristida congesta ssp. barbicollis	+	+ +		1	1 +		+	+
Rhoicissus revoilii		+ +		+	+ +			
Hyperacanthus amoenus	+				+ +			
Panicum coloratum var. coloratum		+			+ 1			+
Berchemia zeyheri			+		+ +	+		
Euclea schimperi var. schimperi	r			+	+ +		+	
Species Group L								
Heteropogon contortus	+	+	+	+ + a + + + +	+ +	+		+
Brachylaena huillensis		+	a 1 1 +	+	+ + +			
Pappea capensis	+		+ r	+ + + +	+ + +	+		
Albizia harveyi			r 1	+ + + + +	1 + 1 1			
Species Group M								
Maerua edulis	+ +	+ + + + + +	+ + + + +	+ +	+ + +	+		
Ziziphus mucronata ssp. mucronata	r +	+ 1 + + + +	+ + + +	+ + +	+ +	+		
Species Group N								
Grewia flavescens	+ + + + + + + + + 1 1 + 1 1 + a +	+ 1 + 1 + + + + +	1 + a 1 1 a	+ + 1 1 1 a + + 1 +	+ +	+	+	+

Panicum maximum	+ + + + + + + +	+ + + + + + + +	+	+ + + + + a a a	a a 1 1	+	
Commiphora glandulosa	+ a a a 1 1 + 1 1 1 + + 1	+ + + + + + +		+ + + + +	+ + +		
Boscia albitrunca var. albitrunca	+ + + + + + + +	+ + + + + +	+ + + +	+	1 + 1 1		
Grewia villosa	+ + +	+		+ + + + r + +	+ + +		+
Balanites maughamii	+ + + + +			+	+ + +		+
Euclea divinorum	+ + + +	+ + +		+ + +	+ + +		

Species Group O
Diagnostic species of the *Themedo triandrae–Pterocarpetum rotundifolii*

Themeda triandra	r	+	+	+		b 3 b	
Pterocarpus rotundifolius ssp. rotundifolius	+		+	1 +		a + 1	
Bolusanthus speciosus					r	1 + +	
Rhynchosia komatiensis				+		+ + +	
Acacia caffra						+ + +	
Indigofera hilaris						+ + +	
Gymnosporia buxifolia	+ +	+		+		+ + +	
Lannea discolor				+		+ +	
Dombeya rotundifolia var. rotundifolia				+ +		+ +	
Cleome gynandra			+			+ +	
Rhynchosia venulosa				+		+ +	
Acacia gerrardii var. gerrardii	+			1 1		+ +	

Species Group P

Combretum hereroense				+ + r +	+ + +	+ +	

Species Group Q

Enneapogon cenchroides	r	+ + + + a +		+ a b a a b b +	+ + 1 +	+ a 1	

Species Group R

Grewia monticola	+ + + +	+ r + + 1 a + +	1	+ 1 1 1 1 + + a a 1 1	1 + 1 1	1 + +	
Commiphora mollis	b b b 1 1 1 1 1 1 1 b 1 a a 1 + b 1	b a a b a 3 + + + +	a	+ + 1 + + + + +	1 1 1 +	+ +	+
Ximenia caffra var. caffra	+ + + + + + + + +	+ + +		+ + + + +		+ +	+
Cleome angustifolia ssp. petersiana	+ + + + + + + + + + +	+		+	r	+ +	
Ozoroa paniculosa var. salicina	+ + + r		+	+ + +		1 1 +	+

Species								
Species Group S								
Diagnostic species of the *Cypero albostriati–Syzygietum cordatum*								
Cyperus albostriatus							3 4 4 3	
Syzygium cordatum							3 a b 3	
Hyphaene petersiana	+ +						1 a a a	
Cynodon dactylon	+	+			+		a a b 1	+
Acacia robusta ssp. clavigera	+			+			a + a +	
Thelypteris madagascariensis							+ 1 + a	
Senna petersiana	+			+			1 1 + +	
Persicaria serrulata							+ + + +	
Fimbristylis complanata							+ + + +	
Pycreus polystachyos							+ + + +	
Andropogon eucomus							+ + + +	
Fuirena pubescens							+ + + +	
Garcinia livingstonei	+ +						a b 1	
Albizia versicolor	+						+ 3 +	
Mystroxylon aethiopicum ssp. schlecl	+ +	+		+	+		a + b	
Bridelia mollis		+ +					+ a +	
Artabotrys brachypetalus	+					r	1 + +	
Ficus sycomorus							+ b	
Xanthocercis zambesiaca	+						b +	
Urochloa mosambicensis	+ +	+					+ +	
Cyperus distans							+ +	
Wahlenbergia grandiflora							+ +	
Cyperus solidus							+ +	
Hypericum lalandii							+ +	
Vernonia centaureoides							+ +	
Species Group T								
Philenoptera violacea	+	r		+ + +	+ +		1 1 + +	
Species Group U								
Grewia hexamita	+ + + + + + + + + + + + + 1	+ + + + 1 + + +	+ +				1 + 1 +	
Dichrostachys cinerea ssp. africana	+ + + + + + + + + + + +	+ + + + + + +	+ 1 + + +	+ + + + + + + + + a 1	a 1 a a		+ + +	
Plectroniella armata	a a 1 + + + + + + + + + +	+ +	+ +	1 + +		+	+ +	

Terminalia sericea	+ + + 1 1 1 + + + + +	+		r			+ +	+
Strychnos madagascariensis	+ + + + + 1 a 1	+ + + +		+ +			+ + +	
Peltophorum africanum	+ + + 1 +	+ +		+ + + 1		+	+ + +	
Euclea natalensis ssp. angustifolia	+ + + + + + +						+ +	
Rhus leptodictya	r + +			+	r		+ +	
Bulbostylis hispidula	+ + + +						+ +	
Acacia welwitschii ssp. delagoensis	+ r r	+ 1	r				+ +	
Species Group V								
Diagnostic species of the *Sesamothamno lugardii–Catophractetum alexandri*								
Catophractes alexandri								1 a a a 1 1
Commiphora pyracanthoides	+ +							1 a a a + a
Acacia nebrownii								1 1 1 1 + 1
Sesamothamnus lugardii								1 1 + 1 1 +
Ipomoea adenioides								1 1 1 1 +
Salvadora australis								+ 1 + + +
Acacia senegal var. rostrata								+ 1 + + +
Dicoma species								+ + + + +
Balanites pedicellaris								+ + + + +
Kyphocarpa angustifolia	r							+ + + +
Euphorbia guerichiana								+ + + +
Kleinia longiflora								+ + + +
Solanum coccineum								+ + + +
Becium angustifolium								+ + + +
Hibiscus calyphyllus	+							+ + + +
Rhigozum zambesiacum	1 +	+ +		r +				+ + + +
Sporobolus ioclados		+		1 +				+ + + +
Vernonia capensis								+ + + +
Acacia mellifera ssp. detinens								1 + +
Aptosimum lineare								+ + +
Lycium species								+ + +
Blepharis aspera								+ + +
Becium obovatum								+ + +
Barleria wilmsiana								+ + +
Tribulus zeyheri ssp. zeyheri								+ + +

Boscia foetida ssp. *filipes*	+							+ + +
Odyssea paucinervis								+ + +
Becium filamentosum								+ + +
Aristida meridionalis		+	+					+ + +
Commelina erecta	+	+	+	+			+	+ +
Evolvulus alsinoides		+	+					+ +
Aloe littoralis	+ +	+						+ +
Pterodiscus species								+ +
Kalanchoe brachyloba								+ +
Adenia repanda								+ +
Species Group W								
Melinis repens ssp. repens	+ +	+		+ +	+		+	+ +
Cenchrus ciliaris	r	+		+ + +	+			a 1
Species Group X								
Justicia flava			+ + + + + +	+ + + +				+ + +
Species Group Y								
Sarcostemma viminale	+ +	+ + + + +	+					+ +
Species Group Z								
Schmidtia pappophoroides	a a a + 1 + + 1 1 + 1 + 1 + + a a + +	+	+	+ +	+			+ a a + 1 1
Grewia flava	1 1 1 a a 1 + + + 1 1 1 + 1 1 + 1 +	+ +	a				+ +	+ +
Stipagrostis uniplumis var. uniplumis	b b b + 1 + 1 + 1 a a + + a a 1	+					+	+ +
Commiphora africana	a + + + + + 1 + + + + 1 +		+ +	+ + + + r +				1 a + 1 +
Heliotropium steudneri	+ + + + + + + + + +			+ + + +	+			+ + + + +
Boscia foetida ssp. rehmanniana	+ + + 1 + 1 1 + 1							1 1 + + 1
Ehretia rigida	+ + + + + + + 1		+	+ +	1 + 1 a			+ + +
Dicliptera heterostegia	+ + + + + + +		+ +					+ +
Sansevieria aethiopica	+ + + + + + + +	+						+ + + +
Commiphora schimperi	1 + 1 1 + 1		r	+				1 + +
Tribulus terrestris	+ + + + + + + + + + + + + + + + + + +	+ + + + + + +		+ +	r			+ + +
Cordia monoica	+ + + + + + + + + + + + +	+ + + + + + +		+				+ +
Acacia tortilis ssp. heteracantha	+ + + + + + r + + + + b	+ + + +		1 1			+	+ + +

Hibiscus meyeri	+	+	+	+	+	+										+				+	+	+	+	+	+	+			+	+	+	+		+	+									+			+														+		1	+	+	+
Eragrostis lehmanniana var. lehman.			+			+						+	+				1	1				+	+	+			+	+	+																			+							+					+	+		+	+
Solanum incanum	+	+	+																+	+	+							+																+	+		+	+	+				+			+				+		+		+	

Community description

***Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type**

The *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type is classified under the *Commiphoro mollis–Colophospermetea mopani* described by Winterbach *et al*. (2000). This class name was suggested by Winterbach *et al.* (2000), but the class was not formally described. Although not a single *Colophospermum mopane* tree was recorded within this vegetation type during field surveys, numerous diagnostic species characterising this class and the *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld are shared. In a syntaxonomic synthesis of *Colophospermum mopane* vegetation in southern Africa, Du Plessis (2001) also described this phenomenon, whereby the dominant species forming part of the name description of a higher-level community within the hierarchical classification, is absent from lower level communities. Based on the complex of diagnostic species shared by *Colophospermum mopane* vegetation and the *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type, these two vegetation units are synecologically linked.

Numerous authors have described different aspects of the Soutpansberg Arid Northern Bushveld Major Vegetation Type, such as the *Adansonia*–Mixed Thornveld (14e) of the Arid Sweet Bushveld (Acocks 1953), the Soutpansberg Arid Mountain Bushveld (11) savanna vegetation type (Bredenkamp & Van Rooyen 1996), the Sweet Bushveld (17) savanna vegetation type (Van Rooyen & Bredenkamp 1996), the Mixed Bushveld (18) savanna vegetation type (Van Rooyen & Bredenkamp 1996), the *Colophospermum mopane–Commiphora glandulosa–Seddera capensis* open tree savanna in the northern most section of the Kruger National Park (Van Rooyen 1978, Van Rooyen *et al.* 1981), the *Commiphora–Terminalia prunioides* community of the Limpopo Plains (Louw 1970) and the *Ptycholobium contortum–Colophospermum mopane* Vegetation Type (Du Plessis 2001).

Environmental data

The *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type is confined to the rain-shadow northern ridges of the SC.

Although its plant communities are associated with a variety of topographic and edaphic conditions, most are adapted to prolonged water-stress conditions and unpredictable rainfall events. This vegetation type includes of a variety of arid ecosystems. With the exception of some isolated swamps dotted along the northern plains, all these communities are water-limited. Water-stress within these systems is brought about by both a lack of precipitation, as well as by the unavailability of soil water within the soils of high clay content. The small pore sizes among clay particles create strong adhesive forces between clay particles and the available water molecules, which inhibit the water from being taken up by hair-roots.

The northern foot-slopes have high rock cover values, while the lower laying sandy plains have basically no surface rocks. Clay content of the soil varies from less than five percent to more than 55%. The structure of the vegetation can mainly be classified as short open woodland (Edwards 1983). The associated terrain includes flat sandy plains and gentle clayey foot-slopes (1–5°). The exception to this predominantly flat terrain, are the steep and clayey foot-slopes within the deep Sand River Gorge.

This major vegetation type is associated with the Namib Soil Form (McVicar *et al.* 1991) of Land Types Ae, Ag, Ia, Ib, and Fa derived from sandstone, quartzite and conglomerate of the Wyllies Poort Geological Formation, basalt from the Musekwa Geological Formation, as well as from narrow diabase intrusions or dykes within the Wyllies Poort Geological Formation (Botha 2004a; Patterson & Ross 2004a).

Altitude ranges from approximately 746 m to 1060 m above sea level. The average annual rainfall is 382 mm (South African Weather Bureau), varying between 330 mm on the farm Omloop to 435 mm on the farm Sandow. Rainfall events are irregular and localised north of the mountain range.

The *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type, like much of southern Africa's arid and semi-arid areas, is considered to function as event-driven and non-equilibrium ecosystems (Schultze & McGee 1978; Werger & Coetzee 1978; Coetzee 1983; Westoby 1979; De Angelis &

Waterhouse 1987; Westoby *et al.* 1989; Mentis *et al.* 1989; Laycock 1991; Behnke & Scoones 1993; Dodd 1994; Bredenkamp & Brown *in prep.*). The dynamics of these ecosystems are controlled by external control mechanisms (abiotic factors), which are not subject to feedback control from within the ecosystem (Ellis & Swift 1988). Climatic factors, such as the irregular and unpredictable droughts are often the main driving force of arid and semi-arid ecosystems (Noy-Meir 1982; Wiens 1984; Bredenkamp & Brown *in prep.*).

Diagnostic taxa

The diagnostic species for this group are presented in species group G (Table 1, Chapter 4). Diagnostic perennial woody species characterizing the communities of this vegetation type include *Adansonia digitata, Commiphora glandulosa, Blepharis diversispina, Grewia flava, Grewia subspathulata, Grewia hexamita, Boscia albitrunca* var. *albitrunca, Boscia foetida* subsp. *rehmanniana* and *Commiphora tenuipetiolata, Kirkia acuminata, Maerua parvifolia, Maerua edulis, Terminalia prunioides, Cassia abbreviata, Sterculia rogersii, Sansevieria aethiopica* and *Commiphora viminea. Tribulus terrestris* is a relatively strong diagnostic herbaceous species for the group, but due to its status as a widely distributed annual herb, it is not seen as a reliable indicator species for the Soutpansberg Arid Bushveld.

Dominant / prominent taxa

Dominant woody species of this vegetation type include *Adansonia digitata, Blepharis diversispina, Boscia foetida* subsp. *rehmanniana, Cassia abbreviata, Commiphora glandulosa, Commiphora tenuipetiolata, Cordia monoica, Grewia flava, Grewia hexamita, Grewia subspathulata, Kirkia acuminata, Sterculia rogersii, Terminalia prunioides* (Species Group G), *Commiphora mollis, Combretum apiculatum* subsp. *apiculatum* (Species Group H), *Hibiscus meyeri* (Species Group J), *Acacia nigrescens, Dichrostachys cinerea* subsp. *africana* and *Grewia monticola* (Species Group L). Prominent grass species include *Schmidtia pappophoroides, Stipagrostis uniplumis* var. *uniplumis* and *Panicum maximum* Species Group P). The general prominence of the herbaceous pioneer species *Tribulus terrestris* is an indication of frequent disturbances to the field layer.

1. *Commiphoro tenuipetiolatae–Adansonietum digitatae* ass. nov., hoc loco.

Nomenclatural type: Relevé 96 (holotypus)

Alternative name: *Commiphora tenuipetiolata–Adansonia digitata* Short Open Woodland of the Soutpansberg Arid Northern Sandveld / Plains

Environmental data

The vegetation of this association can be described as short open woodland (Edwards 1983) with large baobab trees breaking the monotone vegetation structure of the landscape. It is found exclusively north of the northern most ridges of the mountain, where aeolian (Kalahari) sands have covered the Musekwa sediments at the foot of the mountain. The habitat is flat and marks the beginning of the vast arid Limpopo plain north of the mountain. It is mostly confined to the Ia Land Type, with the Ae Land Type playing a minor role (Botha 2004a). The Hutton Soil Form (McVicar *et al.* 1991) is the dominant soil type. Surface rock-cover for this association is low.

Diagnostic taxa

This association is characterised by species group A (Table 5). Diagnostic woody species include *Sclerocarya birrea* subsp. *caffra, Commiphora tenuipetiolata, Blepharis subvolubilis* and *Albizia anthelmintica*, with a fair number of *Schotia brachypetala* associated with termitaria.

The herb layer is sparse with only a few hardy species, which includes diagnostic species such as *Tephrosia macropoda, Ledebouria apertiflora, Hermannia boraginiflora, Dicerocaryum eriocarpum, Chamaecrista mimosoides, Phyllanthus maderaspatensis, Indigofera adenoides, Sansevieria hyacinthoides* and *Agathisanthemum bojeri*.

Recorded diagnostic grass species included *Aristida stipitata* subsp. *graciliflora* and *Tricholaena monachne*.

Dominant / prominent taxa

Dominant and prominent woody species include *Commiphora tenuipetiolata*, *Sclerocarya birrea* subsp. *caffra* (Species Group A), *Adansonia digitata, Blepharis diversispina, Combretum mossambicense, Commiphora viminea, Terminalia* *prunioides, Ximenia americana* var. *microphylla* (Species Group C), *Grewia bicolor* (Species Group F), *Acacia nigrescens* (Species Group J), *Commiphora glandulosa, Grewia flavescens* (Species Group N), *Commiphora mollis, Ximenia caffra* var. *caffra* (Species Group R), *Dichrostachys cinerea, Grewia hexamita, Plectroniella armata, Terminalia sericea* (Species Group U), *Acacia tortilis* subsp. *heteracantha, Boscia foetida* subsp. *rehmanniana, Commiphora africana, Cordia monoica* and *Grewia flava* (Species Group Z).

Due to the drought experienced at the time of the field survey, the field layer was sparse, with only the most drought resistant perennial species visible and available for collection and identification. None of the recorded forbs could be described as dominant. However, prominent forb species include *Blepharis subvolubilis*, *Chamaecrista mimosoides, Dicerocaryum eriocarpum*, *Hermannia boraginiflora, Ledebouria apertiflora, Tephrosia macropoda* (Species Group A), *Cleome angustifolia* subsp. *petersiana* (Species Group R), *Heliotropium steudneri, Sansevieria aethiopica* and *Tribulus terrestris* (Species Group Z).

Dominant grass species are *Aristida stipitata* subsp. *graciliflora* (Species Group A), *Schmidtia pappophoroides* and *Stipagrostis uniplumis* var. *uniplumis* (Species Group Z).

Some aspects of the *Commiphoro tenuipetiolatae–Adansonietum digitatae* have also been described by Acocks (1953) as the *Adansonia*–Mixed Thornveld (14e) of the Arid Sweet Bushveld, and by Van Rooyen & Bredenkamp (1996) as the Sweet Bushveld (17) savanna vegetation type of South Africa. This SC association also shares some floristic elements with the *Colophospermum mopane–Commiphora glandulosa–Seddera capensis* open tree savanna in the northern most section of the Kruger National Park (Van Rooyen 1978;Van Rooyen *et al.* 1981). In these plant communities *Adansonia digitata* and a variety of *Commiphora* species contribute greatly to the characteristic vegetation structure of open tree savanna. Gertenbach (1983) described this vegetation unit of the Kruger National Park as the *Adansonia digitata–Colophospermum mopane* Rugged Veld. However, the *Commiphoro tenuipetiolatae–Adansonietum digitatae* on the sandy plains of the SC is not associated with the rugged basalt koppies and slopes, as are the *Colophospermum* *mopane–Commiphora glandulosa–Seddera capensis* open tree savanna of the northern KNP. Louw (1970) described similar vegetation north of the Soutpansberg as the *Commiphora–Terminalia prunioides* community. However, the *Commiphora–Terminalia prunioides* community and the *Colophospermum mopane–Commiphora glandulosa–Seddera capensis* open tree savanna of the northern Kruger National Park contain *Colophospermum mopane* as a strong floristic component, which does not occur within the *Commiphoro tenuipetiolatae–Adansonietum digitatae* of the SC. Floristic affinities between the above mentioned plant communities are therefore based on the complex of diagnostic species shared. The *Ptycholobium contortum–Colophospermum mopane* Vegetation Type described by Du Plessis (2001) lumps the *Commiphoro tenuipetiolatae–Adansonietum digitatae* as part of the Limpopo River Valley Mopane-veld north of the Soutpansberg. Straub (2002) described similar vegetation along the Limpopo River Valley as *Terminalia prunioides–Colophospermum mopane* woodland. These variations of the Mopane-veld are associated with arid areas of low and unpredictable annual rainfall (Du Plessis 2001). They are characterised by floristic elements of typically drier habitas, such as *Boscia* species, *Commiphora* species, *Terminalia prunioides* and *Adansonia digitata*.

2. *Ledebourio ovatifoliae–Commiphoretum mollii* ass. nov., hoc loco.

Nomenclatural type: Relevé 44 (holotypus)

Alternative name: *Ledebouria ovatifolia–Commiphora mollis* Short Bushland on the arid clayey northern foot-slopes of the Soutpansberg

Environmental data

The vegetation structure of the *Ledebourio ovatifoliae–Commiphoretum mollii* association can be described as Short Bushland (Edwards 1983) on arid clayey northern foot-slopes and northern entrance of the Sand River Gorge of the Soutpansberg. The landscape is very arid with very little available soil moisture for uptake by plant roots. At times of drought, the field layer dies back dramatically, leaving the soil surface bare and exposed. During such times only the most drought resistant species remain visible, making identification and notation of the total floristic composition impossible. As this vegetation represents a non-equilibrium, event-driven system, this state is often found, and is considered as normal for this vegetation. This has prompted the study to focus on dominant drought resistant perennial species as a means for association description and community identification.

This plant community is restricted to the diabase intrusions within the Wyllies Poort Geological Formation on the northern foot-slopes of the mountain, and in particular the northern entrance of the Sand River Gorge. The slope of the landscape varies from 5–15°. It is associated with the Fa Land Type and its Glenrosa and Mispah Soil Forms (Botha 2004; Patterson & Ross 2004). The soil clay content is high and exceeds 55% in some places. Surface rock cover varies between 25–50%.

Diagnostic taxa

This association is characterised by species group B (Table 5). Diagnostic woody species include *Dalbergia nitidula, Euclea undulata, Rhigozum obovatum* and *Pyrostria hystrix*.

Forbs and succulents recorded and presented in this group are *Ledebouria ovatifolia, Asparagus cooperi, Barleria elegans, Ocimum canum, Asparagus racemosus, Abutilon angulatum* var. *angulatum, Stapelia gigantea, Lantana rugosa* and *Aloe globuligemma*.

Dominant / prominent taxa

The dominant woody species are all very drought resistant, and include *Adansonia digitata* (Species Group C), *Terminalia prunioides* (Species Group C), *Commiphora marlothii* (Species Group E), *Gyrocarpus americanus* subsp. *africanus* (Species Group E), *Lannea schweinfurthii* var. *stuhlmannii* (Species Group E), *Grewia subspathulata* (Species Group F), *Combretum apiculatum* subsp. *apiculatum* (Species Group I), *Kirkia acuminata* (Species Group I), *Acacia nigrescens* (Species Group J), *Maerua edulis* (Species Group M), *Grewia flavescens* (Species Group N) and *Commiphora mollis* (Species Group R).

The field layer is poorly developed. This is especially true for times of below-average rainfall. None of the species recorded within the field layer could be described as prominent at the time of data gathering.

The *Ledebourio ovatifoliae–Commiphoretum mollii* shares numerous floristic links with the *Adansonia*–Mixed Thornveld (14e) of the Arid Sweet Bushveld (Acocks 1953), the *Commiphora–Terminalia prunioides* community (Louw 1970), the *Colophospermum mopane–Commiphora glandulosa–Seddera capensis* open tree savanna in the northern most section of the Kruger National Park (Van Rooyen 1978,Van Rooyen *et al.* 1981), the *Boscio albitruncae–Terminalietum prunioidis* (Coetzee 1983), the *Adansonia digitata–Colophospermum mopane* Rugged Veld Landscape (Gertenbach 1983), the Sweet Bushveld (17) savanna vegetation type of South Africa (Rooyen & Bredenkamp 1996) and the *Ptycholobium contortum–Colophospermum mopane* Vegetation Type (Du Plessis 2001). The soils of the above mentioned plant communities might generally be described as extremely arid, shallow, stony soils with a very high clay fraction. Drought resistant woody species dominate the vegetation structure and composition. The field layer is poorly developed and unstable due to the unpredictability of rainfall events and the frequent severe droughts within the area. They are all dominated by with a poorly developed and unstable field layer. The most prominent diagnostic species shared among these communities are *Terminalia prunioides, Adansonia digitata, Boscia albitrunca* var. *albitrunca, Boscia foetida* subsp. *rehmanniana*, numerous *Commiphora* species, *Sterculia rogersii*, numerous *Grewia* species, *Acacia nigrescens* and *Combretum apiculatum.*

Ledebourio ovatifoliae–Commiphoretum mollii of the northern clayey foot-slopes of the Soutpansberg and *Commiphoro tenuipetiolatae–Adansonietum digitatae* of the sandy plains north of the Soutpansberg share strong floristic links through Species Group C (Tabel 5). Based on strong group of diagnostic species presented in Species Group C, a new vegetation order and a new alliance are proposed, namely:

Terminalio prunioidis–Adansoniatalia digitatae order nov., hoc loco

Terminalio prunioidis–Adansonion digitatae all. nov., hoc loco.

Nomenclatural type: *Commiphoro tenuipetiolatae–Adansonietum digitatae*

The diagnostic species for these syntaxa are presented in species group C and include the woody species *Adansonia digitata, Blepharis diversispina, Terminalia prunioides,* *Ximenia americana var. microphylla, Combretum mossambicense, Gossypium herbaceum* subsp. *africanum* and *Commiphora viminea*.

Numerous authors described such communities dominated by *Terminalia prunioides, Adansonia digitata, Boscia albitrunca* var. *albitrunca, Boscia foetida* subsp. *rehmanniana*, numerous *Commiphora* species, *Sterculia rogersii*, numerous *Grewia* species, *Acacia nigrescens* and *Combretum apiculatum* (Acocks 1953; Louw 1970; Van Rooyen 1978; Rooyen *et al.* 1981; Gertenbach 1983; Rooyen & Bredenkamp 1996b; Du Plessis 2001; Straub 2002). These communities occur predominantly on shallow clayey soils along rocky outcrops, ridges and steep slopes of gorges and rivers, which are associated with igneous and intrusive rock formations in semi-arid and arid areas. One of the driving factors seem to be frequent and prolonged water-stressed conditions for vegetation, intensified by high water retention capabilities of certain soil types (Schultze & McGee 1978; Werger & Coetzee 1978; Coetzee 1983; Du Plessis 2001; Bredenkamp & Brown *in prep*).

3. *Phyllantho reticulati–Acacietum nigrescentis* ass. nov., hoc loco.

Nomenclatural type: Relevé 63 (holotypus)

Alternative name: *Phyllanthus reticulatus–Acacia nigrescens* Low-lying Short Bushland at the southern ends of North-south-running gorges

Environmental data

The *Phyllantho reticulati–Acacietum nigrescentis* is located at low altitude (800–900 m above sea level) at the southern ends of the north-south openings in the east-west running ridges of the Soutpansberg. The vegetation of these gorges, especially that of the Sand River Gorge, show a strong gradient of declining soil moisture availability from south to north. The varying topography and miscellaneous soil types, lead to a very heterogeneous vegetation structure and composition. The shrub and tree layers are well developed and can be regarded as a Short Bushland (Edwards 1983). The field layer is generally poorly developed. This association is located within the Ib349, Ib362, Fa535 and Fa641 Land Types and associated with Glenrosa and Mispah Soil Forms (Botha 2004a; Patterson & Ross 2004a). Soil clay content is approximately 35–55%. This plant community is restricted to the diabase intrusions within the sandstone and conglomerate of the Wyllies Poort Formation, as well as diabase intrusions within the basalt, tuff, sandstone and conglomerate of the Sibasa Formation. Surface rock cover varies between 15–40%.

Due to this association's position within the topography of the mountain's southern slopes, it may receive higher precipitation on a very localised scale, especially along the southern extremities of the Sand River Gorge. As moisture-laden air is pushed from the south against the sharp raising scarp of the Soutpansberg, it is forced through these ravines and gorges. The venturi-effect and the rapid cooling of the air lead to the formation of thick mist and fine rain at very localised patches (Matthews 1991; Matthews *et al.*1991).

Diagnostic taxa

This association is characterised by species group D (Table 5). The diagnostic woody species of this association include *Phyllanthus reticulatus, Ruspolia hypocrateriformis, Wrightia natalensis, Acalypha glabrata, Brachylaena discolor, Canthium mundianum, Pouzolzia mixta, Ruspolia hypocrateriformis* var. *australis, Clerodendrum makanjanum* and *Loeseneriella crenata.*

The grass layer is sparse, with the grass *Setaria nigrirostris* as the most prominent diagnostic grass species.

Diagnostic forbs include *Asparagus setaceus, Rhynchosia nervosa, Melhania prostrata* and *Barleria obtusa.*

Dominant / prominent taxa

A variety of woody species are prominent within this heterogeneous plant community and include *Ruspolia hypocrateriformis* var. *australis*, *Phyllanthus reticulatus* (Species Group D), *Sterculia rogersii*, *Albizia brevifolia*, *Entandrophragma caudatum*, *Markhamia zanzibarica* (Species Group E), *Pristimera longipitiolata*, *Grewia subspathulata*, *Grewia bicolor*, *Flueggea virosa* subsp. *virosa* (Species Group F), *Combretum apiculatum* subsp. *apiculatum, Kirkia acuminata, Ochna inermis, Cassia abbreviata* (Species Group I), *Acacia nigrescens* (Species Group J), *Brachylaena huillensis* (Species Group L), *Grewia flavescens* (Species Group N), *Dichrostachys cinerea* (Species Group U) and *Hibiscus meyeri* (Species Group Z).

Dominant herbaceous species within the field layer include *Justicia flava* (Species Group X) and *Cissus cornifolia* (Species Group E).

The most dominant grass recorded is *Setaria nigrirostris* (Species Group D).

The *Phyllantho reticulati–Acacietum nigrescentis*, as well as the *Commiphoro tenuipetiolatae–Adansonietum digitatae* and *Ledebourio ovatifoliae–Commiphoretum mollii*, contain *Acacia nigrescens* as a prominent species. Based on the prominence of *Acacia nigrescens* and the general vegetation structure of these associations, some similarities can be seen with the *Acacia nigrescens* dominated vegetation types of the southern Kruger National Park and the neighbouring reserves to its west (Acocks 1953; Bredenkamp 1981, 1987, 1991; Coetzee 1983; Gertenbach 1983, 1987). The *Acacia nigrescens* dominated plant communities of the Kruger National Park are currently viewed as part of the *Panico maximi–Acacietea tortilis* of the Central Bushveld (Winterbach 1998; Winterbach *et al.* 2000). However, based on the diagnostic species of the *Acacia nigrescens* dominated associations within the SC, these associations show stronger floristic links with the *Commiphoro mollis–Colophospermetea mopani* (Winterbach 1998; Winterbach *et al.* 2000; Du Plessis 2001). Due to the lack of syntaxonomic work over larger geographical ranges within southern Africa, the correct syntaxonomic position of these three *Acacia nigrescens* dominated associations within the SC is not yet clear. Further more, depending on whether emphasis is placed on the more persistent woody layer, or whether emphasis is placed on the more dynamic event-driven field layer, the syntaxonomic position of these *Acacia nigrescens* dominated communities may change. More vegetation studies pertaining the role of the herbaceous layer within the event-driven ecosystems of the southern African savannas with regard to syntaxonomy are sorely needed.

The *Phyllantho reticulati–Acacietum nigrescentis* shares very limited floristic links with the *Colophospermum mopane–Acacia nigrescens* Savanna Landscape of the northern Kruger National Park (Gertenbach 1983). The topographic diversity and strong moisture gradients associated with the *Phyllantho reticulati–Acacietum nigrescentis* of the SC contribute towards the high species richness within the woody layer, compared to the relatively low species richness in woody species associated with the topographically simple north-western Kruger National Park (Gertenbach 1983). However, the herbaceous layer of the *Colophospermum mopane–Acacia nigrescens* Savanna Landscape has a higher species richness than the *Phyllantho reticulati–Acacietum nigrescentis* with its weakly developed field layer.

4. *Tinneo rhodesianae–Combretetum apiculati* ass. nov., hoc loco.

Nomenclatural type: Relevé 48 (holotypus)

Alternative name: *Tinnea rhodesiana–Combretum apiculatum* Short Bushland on semi-arid clayey slopes

Environmental data

The structure of the *Tinneo rhodesianae–Combretetum apiculati* can be categorized as Short Bushland (Edwards 1983). This association is restricted to the rain-shadow northern slopes north of the southern-most ridge of the mountain, but excludes the arid northern slopes of the northern-most ridge of the mountain. It is associated with the clayey soils derived from the basaltic rock of the Musekwa Formation, and fall within the Fa641 and Ae310 Land Types (Botha 2004a). The shallow soils are gravely and littered with talus rock fragments from the broken up quartzite formations at higher altitude. The top layer of soil is often mixed with sand washed down from higher lying quartzite, resulting in soil clay content of 20–35%. The dominant Soil Forms are Glenrosa and Mispah

Diagnostic taxa

This association is characterised by the diagnostic species presented in species group G (Table 5). Some of the woody species in this group include *Tinnea rhodesiana, Steganotaenia araliacea, Aloe marlothii* subsp. *marlothii* and *Euphorbia ingens*. Diagnostic species from the field layer include *Barleria ovata, Asparagus bechuanicus* and *Crabbea velutina*.

Dominant / prominent taxa

Prominent woody species within this association included *Tinnea rhodesiana, Steganotaenia araliacea* (Species Group G), *Combretum apiculatum* subsp. *apiculatum, Kirkia acuminata* (Species Group I), *Maerua parvifolia* (Species Group J) *Commiphora glandulosa, Grewia flavescens*, *Grewia villosa* (Species Group N), *Grewia monticola, Commiphora mollis* (Species Group R) and *Dichrostachys cinerea* (Species Group U).

Due to the dense canopy cover provided by the trees and shrubs, the field layer of this association is poorly developed. The field layer is generally sparse with some patchy stands of grass cover. These stands are either dominated by *Enneapogon cenchroides* (Species Group Q), or by a mixture of *Heteropogon contortus* (Species Group L) and *Panicum maximum* (Species Group N).

Within the context of the Soutpansberg the floristic analyses resulted in this plant community being placed under the Soutpansberg Arid Northern Bushveld Major Vegetation Type. However, the *Tinneo rhodesianae–Combretetum apiculati* shares many of the diagnostic and dominant species of the *Terminalio sericeae–Combretetea apiculati* described by Winterbach *et al.* (2000) as part of the Central Bushveld savanna classes. It is therefore proposed that the *Tinneo rhodesianae–Combretetum apiculati* rather be classified as part of the *Terminalio sericeae–Combretetea apiculati*. However, this vegetation class is complex, sharing many floristic elements with the *Englerophyto magalismontani–Acacietum caffrae* (Winterbach 1988; Winterbach *et al.* 2000). Due to the topographic and geological diversity associated with these two vegetation classes, plant community turnover on a spatial scale is rapid. This results in mosaic vegetation patterns along the ever-changing environmental gradients. More phytosociological and syntaxonomical studies are needed in order to define the status and syntaxonomic positions of the mountain Bushveld and *Combretum apiculatum*-dominated plant communities of southern Africa.

The *Tinneo rhodesianae–Combretetum apiculati* shows some weak floristic links with the *Enneapogono scoparii–Acacietum leiorachis* described by Siebert (2001) and Siebert *et al.* (2003) as part of the Open Mountain Bushveld of Sekhukhuneland Centre of Endemism. It also shares some floristic links with the *Kirkia acuminata–Colophospermum mopane* woodland community located within the Limpopo River Valley (Straub 2002).

5. *Dichrostachyo cinereae–Spirostachyetum africani* ass. nov., hoc loco.

Nomenclatural type: Relevé 178 (holotypus)

Alternative name: *Dichrostachys cinerea–Spirostachys africana* Low Thickets on heavy clay soil

Environmental data

The structure of this plant community can be described as a Low Thicket (Edwards 1983). It is associated with very fine clayey alluvial soils in narrow valley bottoms. All of these valley bottoms are also associated with diabase dykes within the Ae310 Land Type of the surrounding quartzitic Wyllies Poort Geological Formation. Soil clay content exceeds 55%, and surface rock cover is negligibly low. Due to the amount of sand washed into and mixed with the clay, the soil cannot be described as vertic. The Mayo Soil Form is dominant within this section of the landscape. The species of this association are prone to water stress due to the clay particles' ability to withhold the available soil moisture from being taken up by the plant roots through its strong adhesive forces with the water. Due to the very palatable grazing and browsing produced by this association during the wet season, the vegetation is over-utilized and trampled by herbivore species. The veld is severely degraded and shows all the signs of bush encroachment and thickening.

Diagnostic taxa

This association is characterised by the diagnostic species presented in species group K (Table 5). The only strong indicator species within this group is *Spirostachys africana*. The field layer is weakly developed with only a few uncharacteristic annual species present.

Dominant / prominent taxa

The woody layer dominates this association and consists of drought resistant species such as *Spirostachys africana* (Species Group K), *Albizia harveyi* (Species Group L), *Maerua edulis* (Species Group M), *Balanites maughamii, Boscia albitrunca* var. *albitrunca, Euclea divinorum* (Species Group N), *Combretum hereroense* (Species Group P), *Commiphora mollis, Grewia monticola* (Species Group R), *Dichrostachys cinerea* (Species Group U) and *Ehretia rigida* (Species Group Z).

The grass *Panicum maximum* (Species Group N) was the most dominant species within the field layer. Due to the relatively high palatability of the field layer on these nutrient-rich clayey soils, compared to their relatively unpalatable surroundings within the SC, the *Dichrostachyo cinereae–Spirostachyetum africani* is regularly over-utilized by grazers and browsers. This over-utilisation gives the woody layer the competitive advantage above the field layer, resulting in the thickening of the woody stratum, which in turn results in even more favourable conditions for a woodland dominated vegetation (Bredenkamp 1986).

The *Dichrostachys–Acacia* Veld (14g) (Acocks 1953), the *Spirostachys africana–Sporobolus ioclados* woodland on granite plant community (Van Der Meulen 1979), the *Acacia tortilis–Spirostachys africana* Savanna community (Bredenkamp & Van Vuuren 1977), the bottomlands of the Thickets of the Sabie and Crocodile Rivers landscape (Gertenbach 1983) and the *Euclea divinorum–Acacia welwitschii* plant community (Gertenbach 1987) share some floristic links with the *Dichrostachyo cinereae–Spirostachyetum africani* of the SC. Due to the over-utilised and bush-encroached nature of the *Dichrostachyo cinereae–Spirostachyetum africani*, the woody layer is dominated by the pioneering woody species *Dichrostachys cinerea.* The *Dichrostachyo cinereae–Spirostachyetum africani* of the SC should be classified under the *Spirostacho africanae–Acacion tortilis*, as part of the *Sporobolo nitentis–Acaciatalia tortilis* within the *Acacienea nilotico–tortilis* subclass of the *Panico maximi–Acacietea tortilis* described by Winterbach *et al.* (2000).

6. *Themedo triandrae–Pterocarpetum rotundifolii* ass. nov., hoc loco.

Nomenclatural type: Relevé 170 (holotypus)

Alternative name: *Themeda triandra–Pterocarpus rotundifolius* Short Closed Grassland on steep basaltic slopes

Environmental data

The *Themedo triandrae–Pterocarpetum rotundifolii* can be described structurally as either a Short Closed Grassland, or as a Low Sparse Woodland (Edwards 1983), depending on the number of trees within the community. It is very restricted within the range of the study area and is associated with a steep section of basalt of the Sibasa Formation of the Soutpansberg Group on one of the inner or middle ridges of the mountain. The shallow soil has a clay content of 20–35%, surface rock cover of 10–25% and the terrain has an incline of 20–30°. Though Botha (2004a) classified the area as the Fa641 Land Type of the Wyllies Poort Geological Formation, this basaltic island of the Sibasa Formation is atypical to its surroundings. It is associated with the Mayo Soil Form.

Diagnostic taxa

This association is characterised by the diagnostic species presented in species group O (Table 5). Due to the poorly developed woody layer, none of the woody species in species group O can be described as dominant. These woody species include *Acacia caffra, Acacia gerrardii* var. *gerrardii, Bolusanthus speciosus, Dombeya rotundifolia* var. *rotundifolia, Gymnosporia buxifolia, Lannea discolor* and *Pterocarpus rotundifolius* subsp. *rotundifolius.*

Diagnostic species within the field layer include the grass species *Themeda triandra* and the herbaceous species *Cleome gynandra, Indigofera hilaris, Rhynchosia komatiensis* and *Rhynchosia venulosa*.

Dominant / prominent taxa

Although none of the trees or shrubs is dominant, the few prominent but scattered woody species include *Bolusanthus speciosus, Pterocarpus rotundifolius* subsp. *rotundifolius* (Species Group O)*, Ozoroa paniculosa* var. *salicina* (Species Group R).

The field layer is dominated by the grasses *Themeda triandra* (Species Group O) and *Enneapogon cenchroides* (Species Group Q).

Dominant herbaceous species include *Rhynchosia komatiensis*, *Indigofera hilaris*, *Cleome gynandra*, *Rhynchosia venulosa* (Species Group O) and *Cleome angustifolia* subsp. *petersiana* (Species Group R).

The *Themedo triandrae–Pterocarpetum rotundifolii* shares some limited floristic links with the *Themeda triandra–Acacia gerrardii* association (Bredenkamp 1982), the *Sclerocarya caffra–Acacia nigrescens–Bothriochloa radicans–Themeda triandra–*

Digitaria eriantha brushveld (Coetzee 1983) and the *Themedo triandrae–Acacietum gerrardii* (Coetzee 1983) of the Mpumalange Lowveld. The soil properties of both these plant communities are typically derived from dolerite and basalt rock, which weather to heavy poorly drained clayey soils. The limited rainfall associated with these plant communities and the high water retention capabilities of the clay soils create extremely arid growing conditions for the plant species involved (Werger & Coetzee 1978; Coetzee 1983; Westoby 1979; Westoby *et al.* 1989; Mentis *et al.* 1989; Behnke & Scoones 1993; Bredenkamp & Brown *in prep.*). The vegetation structure is typically a dense grass sward with scattered dwarf shrubs.

7. *Cypero albostriati–Syzygietum cordatum* ass. nov., hoc loco.

Nomenclatural type: Relevé 146 (holotypus)

Alternative name: *Cyperus albostriatus–Syzygium cordatum* Sandveld Swamp Forest

Environmental data

Isolated swamps are dotted along fault scarps on the northern boundaries of resistant Soutpansberg Group quartzites (Scott 1982). At these localities, underground water filter to the surface to form “seepage-springs”. The springs are situated within the Ia151 Land Type (Botha 2004), which is associated with deep undifferentiated deposits of scree and sand from the Quaternary System. These isolated swamps differ markedly from its surroundings and may be regarded as an azonal community. The vegetation structure varies according to the level of submergence. Along the open water edge, a thick fringe of sedges and water-tolerant grass species grow. The interspersed islands and tongues of higher ground and peat house a Tall Forest vegetation structure (Edwards 1983) and have been described as swamp forest (Scott 1982).

Diagnostic taxa

The *Cypero albostriati–Syzygietum cordatum* are characterised by the diagnostic species presented in species group S (Table 5). The diagnostic woody species include *Syzygium cordatum, Hyphaene petersiana, Acacia robusta* subsp. *robusta, Senna petersiana, Garcinia livingstonei, Albizia versicolor, Mystroxylon aethiopicum* subsp. *schlechteri, Bridelia mollis, Artabotrys brachypetalus, Ficus sycomorus, Xanthocercis zambesiaca* and *Hypericum lalandii*.

Diagnostic grass species are *Cynodon dactylon, Andropogon eucomus* and *Urochloa mosambicensis*.

Diagnostic sedges, forbs and ferns of this group are *Cyperus albostriatus, Thelypteris madagascariensis, Persicaria serrulata, Fimbristylis complanata, Pycreus polystachyos, Fuirena pubescens, Cyperus distans, Wahlenbergia grandiflora, Cyperus solidus*, *Vernonia centaureoides*.

Dominant / prominent taxa

Dominant tree and shrub species of this association are *Syzygium cordatum, Hyphaene petersiana*, *Acacia robusta* subsp. *clavigera, Garcinia livingstonei*, *Senna petersiana, Albizia versicolor, Mystroxylon aethiopicum* subsp. *schlechteri, Bridelia mollis, Artabotrys brachypetalus, Ficus sycomorus, Xanthocercis zambesiaca* (Species Group S), *Philenoptera violacea* (Species Group T) and *Grewia hexamita* (Species Group U).

The grasses *Andropogon eucomus* (Species Group S) and *Cynodon dactylon* (Species Group S) were recorded as the most dominant grasses.

The four most dominant sedges and ferns are *Cyperus albostriatus*, *Fimbristylis complanata*, *Fuirena pubescens*, *Pycreus polystachyos* and *Thelypteris madagascariensis* (Species Group S).

The *Cypero albostriati–Syzygietum cordatum* shares strong floristic links with the *Acacia albida–Ficus sycomorus* River / Fountain Forests of the northern Kruger National Park (Van Rooyen 1978, Van Rooyen *et al.* 1981). These plant communities are driven and maintained by the perennial flooded conditions of sandy soils. Tall hydrophilic tree species dominate the woody vegetation, while sedges and water tolerant grass species dominate the inundated forest fringes.

The *Syzygyium cordatum–Stenoclaena tenuifolia* swamp forest, the *Ficus trichopoda–Nephrolepis biserrata* swamp forest and the *Barrintonia acemosa–Bridelia micrantha* swamp forests of the Mfabeni peat swamps in St. Lucia (Venter 2003), show limited floristic links with the woody component of the *Cypero albostriati–Syzygietum cordatum* of the SC. The extent of the Mfabeni peat swamps are far greater than the isolated swamps of the SC, and are therefore generally richer in swamp species.

The swamp forests of the Natal Coastal Plain Peatland Eco-Region (Marneweck *et al.* 2001; Grundling & Grobler 2005) share very limited floristic links with the *Cypero albostriati–Syzygietum cordatum* of the SC. These highly endangered Maputaland peat swamp forests are situated within the high-rainfall belt of the Mozambican coastal plain and are driven by very different ecological processes compared to the swamps of the SC.

The Closed Riverine Woodlands and the *Phoenix reclinata–Syzygium* spp. on Termitaria of the Okavango Delta in Botswana (Biggs 1979) share only limited floristic links with the *Cypero albostriati–Syzygietum cordatum* of the SC. These plant communities all occur along the slightly elevated sandy soils within the surrounding inundated plains. The dominant trees are hydrophilic and very typical for many of southern Africa's low lying riverine forests and woodlands.

8. *Sesamothamno lugardii–Catophractetum alexandri* ass. nov., hoc loco.

Nomenclatural type: Relevé 145 (holotypus)

Alternative name: *Sesamothamnus lugardii–Catophractes alexandri* Tall Sparse Shrubland on the Soutpansberg Saltpan

Environmental data

The vegetation of the *Sesamothamno lugardii–Catophractetum alexandri* is a Tall, Sparse Shrubland (Edward 1983) associated with the natural vegetation on the periphery of the saltpan at the north-western end of the Soutpansberg mountain range. The saltpan and its surroundings are part of a unique ecosystem within the surrounding landscape. The terrain is concave and is enriched with sodium chloride. This source of table salt has been mined since the end of the 19^{th} century and is still mined for commercial benefit today. Salt is produced at two sites from the dry saltpan on Zoutpan 459 MS, where brines are pumped from a number of boreholes penetrating the underlying Karoo strata. The salt content of the brines is derived from the basal Karoo shales (Madzaringwe Formation) by groundwater action. The long history of disturbance, over-utilization and overgrazing around the saltpan has left the vegetation in degrade state. The sodium-enriched vegetation attracts numerous grazers and browsers. The more common Soutpansberg savanna species show stunted growth forms within this association. An interesting assembly of halophytic plant species are associated with vegetation on the pan's periphery namely: *Heliotopium curassavicum, Suaeda fructicosa* and *Odyssea paucinervis*.

This association is associated with the Clovelly Soil Form (McVicar *et al.* 1991) of Land Type Ae305 derived from sand of the Quaternary System (Botha 2004a). The soil drains freely and has a depth of >600mm.

Diagnostic taxa

This association is characterised by the diagnostic species of species group V (Table 5). Woody species in this group include *Catophractes alexandri, Commiphora pyracanthoides, Acacia nebrownii, Sesamothamnus lugardii, Salvadora australis, Acacia senegal* var. *rostrata, Balanites pedicellaris, Rhigozum zambesiacum, Acacia mellifera* subsp. *detinens, Boscia foetida* subsp. *filipes* and a *Lycium* species.

Succulents include *Euphorbia guerichiana, Aloe littoralis, Pterodiscus* species and *Kalanchoe brachyloba*.

The grasslayer is heavily over-utilised. Some of the diagnostic grasses are *Sporobolus ioclados, Odyssea paucinervis* and *Aristida meridionalis.*

Diagnostic herbaceous species include the forbs *Ipomoea adenioides, Dicoma* species, *Kyphocarpa angustifolia, Kleinia longiflora, Solanum coccineum, Becium angustifolium, Vernonia capensis, Hibiscus calyphyllus, Aptosimum lineare, Becium obovatum, Barleria wilmsiana, Tribulus zeyheri* subsp. *zeyheri, Becium filamentosum, Evolvulus alsinoides* and *Adenia repanda.*

Dominant / prominent taxa

Dominant woody species include the drought resistant *Acacia mellifera* subsp. *detinens, Acacia nebrownii, Acacia senegal* var. *rostrata, Aloe littoralis, Balanites pedicellaris, Boscia foetida* subsp. *filipes, Catophractes alexandri, Commiphora* *pyracanthoides, Lycium* species, *Rhigozum zambesiacum*, *Salvadora australis* (Species Group V), *Commiphora africana* and *Boscia foetida* subsp. *rehmanniana* (Species Group Z).

Succulents include *Euphorbia guerichiana*, *Kalanchoe brachyloba*, *Pterodiscus* species and *Sesamothamnus lugardii* (Species Group V).

Dominant grasses include *Eragrostis lehmanniana* var. *lehmanniana* and *Schmidtia pappophoroides* (Species Group Z).

Herbaceous species are dominated by *Heliotropium steudneri*, *Hibiscus meyeri* and *Sansevieria aethiopica* (Species Group Z).

The *Sesamothamno lugardii–Catophractetum alexandri* shows some weak floristic links with the *Salvadora australis–Colophospermum mopane* main woodland community (Straub 2002) of the Limpopo River Valley and the *Salvadora angustifolia* Floodplains landscape (Gertenbach 1983) of the Kruger National Park. These vegetation units are associated with sodium rich soils. However, the processes of sodium accumulation within the soils of these plant communities differ radically. The *Salvadora australis–Colophospermum mopane* main woodland community (Straub 2002) of the Limpopo River Valley and the *Salvadora angustifolia* Floodplains landscape (Gertenbach 1983) of the Kruger National Park are both driven by flooding events of the nearby river systems, while the *Sesamothamno lugardii–Catophractetum alexandri* of the SC is not affected by any river system. The mechanism by which the salt of the Soutpansberg saltpan accumulated is still unclear, but may have been the result of oceanic influence (Hahn 2002).

The *Sesamothamno lugardii–Catophractetum alexandri* shares floristic elements with the *Eragrostis viscosa–Colophospermum mopane* major plant community of the semi-arid Mopaneveld (Du Plessis 2001) as part of the Etosha National Park (Le Roux *et al.* 1988). Both these vegetation units are prone to severe droughts and event-driven by nature (Du Plessis 2001). While the *Sesamothamno lugardii–Catophractetum alexandri* soils are sodium-rich, the soils of the *Eragrostis viscosa–Colophospermum mopane* major plant community are calcareous (Du Plessis 2001; Hahn 2002).

Drought resistant species such as *Catophractes alexandri*, numerous *Commiphora, Acacia* and *Boscia* species dominate the vegetation. *Colophospermum mopane,* which is the dominant species within the *Eragrostis viscosa–Colophospermum mopane* major plant community of the Etosha National Park, does not occur within the *Sesamothamno lugardii–Catophractetum alexandri* of the SC.

Ordination

On a broad and coarse scale, the Soutpansberg Arid Northern Bushveld Major Vegetation Type can be described as an open woodland system, with a relatively sparse distribution of woody species. The field layer is most often only of a temporary nature, dominated by annual species during times of abundant rainfall, which tends to disappear altogether during times of drought. This woodland dominated arid landscape is mostly confined to the north of the mountain range and include the northern plains and northern foot-slopes. Although the different associations forming this vegetation type are varied in vegetation structure and floristic composition, most of them share the ability to tolerate drought conditions and unpredictable rainfall events. A combination of soil moisture availability and soil texture plays a major role in the species composition of these communities.

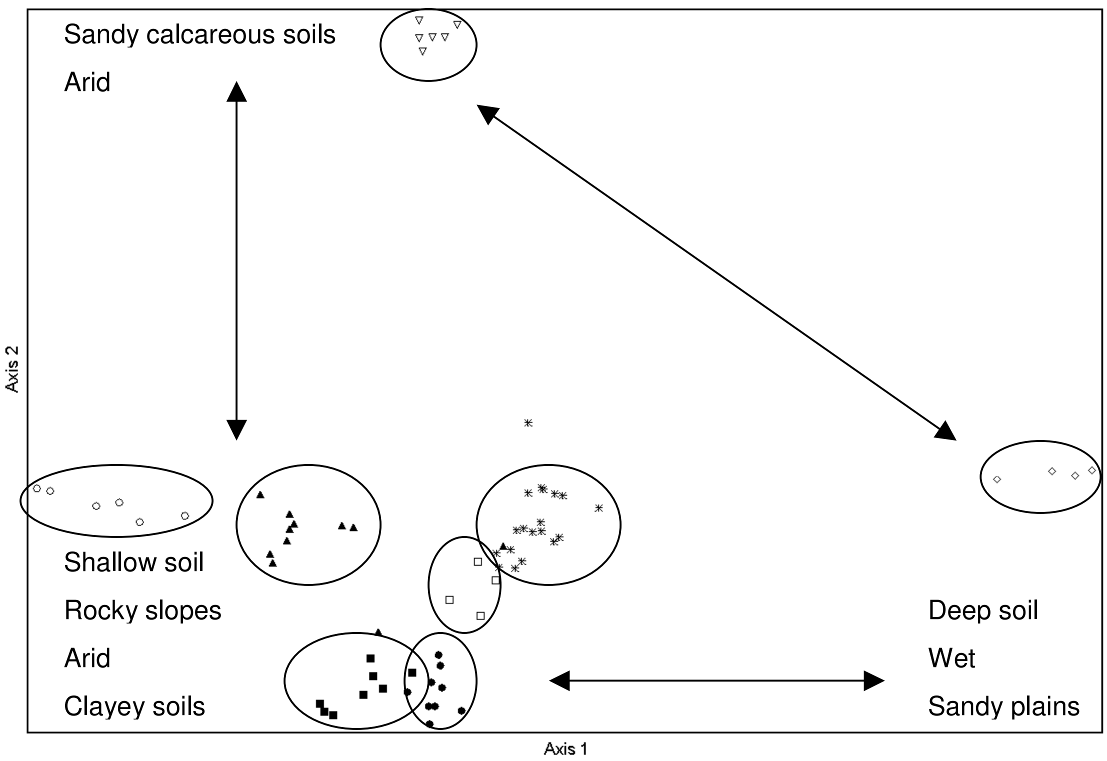
The scatter diagram displays the distribution of relevés along the first and second ordination axes (Figure 9). The vegetation units are represented as groups and their distribution on the scatter diagram corresponds with certain physical environmental gradients. The soil texture, soil depth, incline, surface rock cover and consequently soil moisture availability, determines a gradient that is depicted by the first axis (eigen value = 0.782).

Those associations on the left of the diagram are associated with rocky and clayey slopes along the northern ridges and northern slopes within the rain-shadow of the Soutpansberg Mountain Range. These systems are very arid and highly event-driven due to unpredictable low rainfall and the high water retention capabilities of the shallow clayey soils. The rocky slopes lead to high runoff and weak infiltration of the available rainwater. The clay soils further impede water infiltration due to its poor drainage properties. Soil depth also contributes to this gradient of available soil moisture revealed by the x-axis. The shallow soils associated with the communities to the left pose restrictions on the potential amount of water that can be stored within the given volume of soil. Although clay soil has a greater potential field capacity to store water, the percentage of water available for uptake by roots are lower than the percentage available from sandy soil (White 1995). This is mainly due to stronger adhesive forces between water and the smaller clay particles than the larger sand particles. The distribution of associations along the x-axis is also correlated with a declining surface rock cover from left to right along the axis. Surface rock cover and rockiness within the soil matrix have result in many complex interactions with the biota of a given area. It may increase rainwater runoff. It reduces available soil surface and subsequently increases the amount of rainwater per unit surface area. It provides shelter from desiccating elements such as wind and direct radiation. It provides protection against harsh grazing pressures under certain circumstances. Rocks in the soil matrix may hamper root penetration or may increase competition for the available soil and its available nutrients. The various ways, in which rockiness and surface rock cover may influence the associated vegetation, are numerous. This makes accurate ecological interpretation of the observed distribution of communities along the gradient of increasing surface rock cover extremely complex.

The soil clay fraction seems to reduce while the sand fraction increases to the right of the scatter plot. At the extreme right of the scatter plot, conditions are dramatically different from those associated with the plant communities along the left. This swamp forest community is associated with permanent wetness and flooded conditions. The soils are deep and sandy along this relatively flat plain. The swamp forest vegetation of the SC is less driven by drought events, and is more representative of the conventional equilibrium models (Tainton & Hardy 1999). This relatively stable state is maintained by the constant and predictable source of water from the underlying seepage-springs.

The second ordination axis (eigen value = 0.565) is displayed along the y-axis of the scatter plot. Like with the first ordination axis, the soil texture, soil depth, incline, surface rock cover and consequently soil moisture availability, determines a gradient that is depicted by the second axis. In addition, the soils of the association situated at the top pf the scatter plot, is enriched with sodium. The cluster of plant communities at the bottom left is associated with rocky and clayey slopes along the northern ridges and northern slopes within the rain-shadow of the Soutpansberg Mountain Range. These systems are very arid due to unpredictable low rainfall and the high water retention capabilities of the shallow clayey soils. These systems are highly event-driven. The plant community at the top is associated with the saltpan of the Soutpansberg. The soils are deep fine-grained sands, with some evidence of a calcareous layer relatively deep below the surface. The terrain is relatively flat, which results in little runoff and good infiltration of available rainfall. Surface rock cover is low.

The large relative distances between some of the groupings suggest that these vegetation units do not belong to the same syntaxonomic classes. However, the commonly shared species separate them from the rest of the BNR and SC vegetation, grouping them together.



X-Axis

High	←	Soil clay fraction →	Low
Low	←	Soil moisture →	High
High	←	Surface rock cover →	Low
Steep northern foot-slopes		Incline →	Flat plains

Y-Axis

Sodium enriched soils — Top = Saltpans of the Soutpansberg

Soil clay fraction — Top = Low — Bottom = High

Legend

Star:	*Commiphoro tenuipetiolatae–Adansonietum digitatae*
Diamond:	*Cypero albostriati–Syzygietum cordatum*
Circle filled:	*Ledebourio ovatifoliae–Commiphoretum mollii*
Circle – empty:	*Themedo triandrae–Pterocarpetum rotundifolii*
Triangle – filled:	*Tinneo rhodesianae–Combretetum apiculati*
Triangle – empty:	*Sesamothamno lugardii–Catophractetum alexandri*
Square – filled:	*Phyllantho reticulati–Acacietum nigrescentis*
Square – empty:	*Dichrostachyo cinereae–Spirostachyetum africani*

Figure 9 Relative positions of all the relevés along the first and second axis of the ordination of the *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type

CHAPTER 7

SOUTPANSBERG MOIST MOUNTAIN THICKETS

Introduction

In an overview of the vegetation of the Soutpansberg Conservancy and the Blouberg Nature Reserve (Chapter 4), the *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets were identified as a Major Vegetation Type. The detailed classification of this Major Vegetation Type is addressed in this chapter.

Detailed phytosociological studies have been conducted by numerous authors within the thicket vegetation of the Waterberg (Westfall *et al.* 1985; Henning 2002;Van Staden & Bredenkamp 2006), the Springbok Flats (Winterbach *et al.* 2000) and the north-western Bushveld (Van der Meulen 1979) of South Africa. These moist vegetation types along the high rainfall escarpments of the Limpopo and Mpumalanga Provinces have only been sampled in localised patches, such as areas of high conservation value and or high economic value (Du Plessis 2001). No efforts have yet been made to describe and classify the thickets of the SC.

Acocks (1953) considered the Soutpansberg Moist Mountain Thickets Major Vegetation Type as one of the many variants of the Sourish Mixed Bushveld (19) and the North–eastern Mountain Sourveld (8), but mapped the geographical area as Sour Bushveld (20). This Veld Type of Acocks is however, an oversimplification of the variety of distinct plant communities within this very heterogeneous landscape. Van Rooyen & Bredenkamp (1998) recognised the uniqueness of this region's vegetation. However, without the necessary data, they too had to lump these communities under the broad term of Soutpansberg Arid Mountain Bushveld. Due to its association with the narrow intrusive basalt, tuff and diabase dykes, it is often difficult to map this Major Vegetation Type when dealing with coarse- or small-scale vegetation studies. The southern most ridge of the mountain with its large southern basalt slope is one of the few extensive and mapable areas with this Major Vegetation Type.

In order to place the Soutpansberg thicket syntaxonomically correct, it becomes necessary to compare and classify representative relevés from thickets found throughout southern Africa. Coetzee (1983) and Everard (1987) warned against the premature syntaxonomic classification of the vegetation of under-sampled regions or biomes. A syntaxonomic classification based on relevés from a single region, will only lead to artificial lumping of unrelated vegetation units. This will result in a syntaxonomic hierarchy with only very local significance and relevance, without representing the variation and relation to thickets of the entire sub-region (Coetzee 1983).

This thesis focuses on the lower syntaxonomic unit of association, avoiding classification into higher syntaxonomic units. This precaution was taken in order to avoid lumping the communities of clearly different classes into similar orders or alliances. This often happens when diverse vegetation types from geographically small or artificially delineated areas are classified as a single data set (Werger 1974; Coetzee 1983; Everard 1987; Du Plessis 2001).

The communities of the thickets, especially those of the *Acacietea karroo* (Du Preez 1991; Du Preez & Bredenkamp 1991) cause a great deal of confusion with regard to their syntaxonomic position. The cause of this confusion may be because these communities are often azonal or in a state of transition after some form of disturbance (Trollope 1974; Rossow 1983; Müller 1986; Bezuidenhout & Bredenkamp 1989; Bredenkamp *et al.* 1989; Kooij *et al.* 1990; Kooij *et al.* 1991; Du Preez & Bredenkamp 1991). There is no formal “Thicket Biome” recognised in the scientific literature (Lubke 1996). However, Everard (1987) classified and described this functional vegetation type as transitional between the Forest, Savanna and Grassland Biomes. Due to his low intensity of sampling, he refrained from identifying associations and alliances, keeping to the higher syntaxonomic units of orders and classes. This is of course not correct, as higher syntaxonomic units can only be formally classified if the lower units are known and typified. Everard (1987) states that more data are required before the variation within some of the thickets of the eastern Cape can be classified formally.

According to Du Preez & Bredenkamp (1991), Bezuidenhout *et al*. (1994) and Winterbach (1998), the *Acacia karroo*-dominated vegetation of the southern African grassveld, savanna and thickets should be classified as a separate syntaxonomical class. The high lying communities on clay along the southern slopes of the SC may be classified as part of this proposed class. The lower lying sub-tropical communities may belong to a different vegetation class, which includes all the subtropical transitional thickets. A holistic approach towards the syntaxonomic classification of southern African thickets is strongly recommended.

Vegetation classification

The analysis of the vegetation data resulted in the identification of four plant communities, classified into four syntaxonomic associations (Table 6). The plant communities of the *Catha edulis–Flueggia virosa* Soutpansberg Soutpansberg Moist Mountain Thickets Major Vegetation Type are classified as follows:

1. *Euphorbio ingentis–Cathetum edulis*

   Classified under the *Acacietalia rehmanniana–tortilis* (Winterbach 1998; Winterbach *et al.* 2000).

2. *Bridelio micranthae–Carissetum edulis*

   Classified under the newly proposed *Diospyrodetea mespiliformis* of the Lowveld rivers (Mostert *et al. in prep*).

3. *Cussonio natalensis–Acacietum karroo*

   Classified under the *Acacietea karroo* (Du Preez & Bredenkamp 1991)

4. *Olea europapaeae–Buddlejetum salviifoliae*

   Classified under the *Panico maximi–Acacietea tortilis* described by Winterbach *et al*. (2000).

Table 6 Phytosociological table of the plant communities of the *Catha edulis*–*Flueggia virosa* Soutpansberg Moist Mountain Thickets Major Vegetation Type

Community number	1								2					3			4			
Association number	33	34	35	36	39	53	54	55	151	152	153	154	155	65	66	67	49	50	51	52
Diagnostic species of the *Euphorbio ingentis–Cathetum edulis*																				
Species Group A																				
Euphorbia ingens	1	+	1	1	+	+	+	+												
Ximenia americana var. *microphylla*	+	+		+	1	+	+	+												
Gymnosporia senegalensis	+	+	+	+	1	+	+													
Acacia rehmanniana	+	1	+	+	+		+	+												
Sclerocarya birrea ssp. *caffra*		+	+	+	+	+	+													
Tarchonanthus camphoratus			+	+	+	+	+	+												
Dioscorea sylvatica	+	+	+	+			+	+				+								
Cussonia spicata	+	+			+	+	+	+	+											
Grewia flavescens			1	1		+	+	+					+							
Acacia caffra	+	1				+	+	+												
Jasminum multipartitum		+		+	+	+	+													
Aloe greatheadii var. *greatheadii*	+		+			+	+	+												
Eragrostis superba		+		+	+	+		+												
Maerua cafra	+	+				+	+	+									+			
Mystroxylon aethiopicum ssp. *schlechteri*		+	+	1		r	+				+									
Combretum hereroense	+		+	+			+	+												
Hibiscus meyeri		+	+	+			+	+												
Gossypium herbaceum ssp. *africanum*	+	+	+		+															
Euclea divinorum			+	+		+		+	+											
Acacia nilotica ssp. *kraussiana*				+	+		+	+												
Solanum panduriforme				+		+	+	+		+										
Bothriochloa insculpta	1			+		+	+				+									
Acacia gerrardii var. *gerrardii*			1	1	+	+														
Aloe marlothii ssp. *marlothii*				+	1	+		+												
Euclea undulata var. *undulata*	+	+	+	+							+	+								
Barleria gueinzii		+		+			+	+												
Ximenia caffra var. caffra	+		+		+		+													
Heteropogon contortus	1	1		+	+															
Grewia monticola				+	1			+				+								

Gymnosporia tenuispina	+	+			1											
Heliotropium steudneri				+		+	+									
Cordia monoica			+	+		+										
Acacia tortilis ssp. *heteracantha*				+	+											
Solanum lichtensteinii		+						+								
Balanites maughamii ssp. *maughamii*			r			+										
Combretum imberbe			+				+									
Pristimera longipitiolata			+	+									+			
Pouzolzia mixta	+				+											
Barleria elegans		+		+												
Schotia brachypetala						+	+									
Alternanthera pungens				+			+									
Pavonia senegalensis		+				+										
Cephalaria pungens				+				+				+				
Acacia davyi						+	+									
Pterolobium stellatum							+	+								
Opuntia ficus-indica		+		+												
Vepris lanceolata						+		+								
Calodendrum capense						+		+								
Digitaria eriantha			+				+									
Sarcostemma viminale	+			+												
Vitex rehmannii						r	+				+					
Brachylaena huillensis	+				+				1							
Grewia bicolor	+	+														
Lannea discolor						+	+									

Diagnostic species of the *Bridelio micranthae–Carissetum edulis*

Species Group B

Setaria megaphylla									a	1	a	a	1			
Bridelia micrantha									a	1	a	+	1			
Ekebergia capensis								+	+	1	1	1	1			
Christella guenziana									+	+	1	r	1			
Ficus sur									1	+	1	1	+			
Cyperus albostriatus									+	+	+	+	+			
Syzygium cordatum										1	a	a	a			
Rhus chirindensis									1	1		+	+			
Ficus sycomorus ssp. *sycomorus*										1	1	1	+			
Pyrenacantha grandiflora									+	1		+	+			
Panicum deustum			+							+	1	+	1		+	
Markhamia zanzibarica									1	+	+		+			+
Podocarpus falcatus										+	1	+	+			

Bulbostylis burchellii						+			+	+	+	+				
Cyperus sphaerospermus										+	+	+	+			
Pavetta eylesii										1		+	+			r
Acacia robusta ssp. *clavigera*										+		1	+			
Trema orientalis									1		+		+			
Diospyros villosa var. *parvifolia*						+		+	1		+	+				
Ziziphus rivularis											+	+	+			
Adenia digitata											+	+	+			
Verbena bonariensis					+				+		+	+				
Cyperus sexangularis									+		+		+			
Vernonia glabra									+	+			+			
Euclea natalensis ssp. *natalensis*	+									+	+	+		+		
Pycreus polystachyos									+		+		+			
Rhoicissus tomentosa									+	+	+					
Ficus burkei										+		+	+			
Ischaemum fasciculatum											1	1				
Euclea schimperi var. *schimperi*					+				1				+			
Celtis africana									1			+				
Hermannia depressa						+					+	+				
Rhus rehmanniana var. *glabrata*									+		+					
Persicaria attenuata									+			+				
Dietes grandiflora										+			+			
Dovyalis rhamnoides										+			+			
Ficus ingens var. *ingens*									1				+			
Asparagus virgatus										+		+				
Equisetum ramosissimum										+		+				
Fuirena pubescens											+	+				
Cyperus distans										+		+				
Ptaeroxylon obliquum										+			+			
Cyperus solidus										+			+			
Tecoma capensis					+				+			+				
Erythrina lysistemon					+						+	+				
Flacourtia indica									+				+			
Hexalobus monopetalus var. *monopetalus*											+	+				
Barleria ovata									+			+				
Species Group C																
Flueggea virosa ssp. *virosa*	a	1	1	+	1	+	+	+	+	+	1	1	1			
Rhus pentheri	a	a	+	1	a	1	1	1	a		+		+			+
Carissa edulis	1	+		+	+	1	1	1	a	+	a	+	1			
Dichrostachys cinerea ssp. *africana*	+	a	1	a	1	+	+		r	r	+					

Peltophorum africanum	1	+	1	+	+	+	+	+		+	+		+			
Senna petersiana	+		+	+		+		+	1	1	+	+	+			
Berchemia zeyheri	1	1		+	1	+	+			+	+	+		+		
Brachiaria deflexa		+	1	1	1		+		a		+		+			
Plectroniella armata		+	+	+	+	r	+			+	+		+			
Dovyalis caffra	+	+	+	+		+				+	+	+				
Capparis tomentosa	+		+	+	+		+	+	+			+				
Heteropyxis natalensis	1	1			+	+	+	r	a				+			
Commelina benghalensis				+			+		+	+	+	+	+			
Urochloa mosambicensis	+							+	+	+	+	+				
Rhus pyroides			+	+						+	+	+			+	
Rhus leptodictya	+				+	+		+		+			+	+		
Coddia rudis	+	+				+	+				+		+			
Bridelia mollis					+	+	+	+	+			+				
Pappea capensis	+	+			+		+				+		+			
Pellaea calomelanos var. *calomelanos*	+				+	+		+	+			+				
Mimusops zeyheri	+					+			+		+					
Sansevieria hyacinthoides		+				+				+		+				
Justicia flava				+			+			+	+					

Diagnostic species of the *Cussonio natalensis–Acacietum karroo*

Species Group D

Solanum tettense var. *renschii*						+				+				1	+	+
Cussonia natalensis						+								+	+	+
Eragrostis rigidior													+	+	+	+
Dicliptera heterostegia						+								+	+	+
Psiadia punctulata														+	+	
Scadoxus puniceus														+		+

Species Group E

Acacia ataxacantha							+		1	1		1	1	+	1	+

Species Group F

Panicum maximum	b	a	b	a	a	+	+	+	+		+	+	1	+	+	+
Acalypha glabrata	+	+	1	+	+	+	+		1	+		+	+	+	+	
Dovyalis zeyheri	+		+	+	1		+	+	1	1	1	1	1	+		+
Ehretia rigida	+	+	1	1	1					+			+	+	+	+
Vangueria infausta ssp. *infausta*						+	+				+		+	+	+	+
Lippia javanica							+	+					+	1	+	+
Capparis fascicularis var. *fascicularis*	+					+	+							+	+	

Diagnostic species of the *Olea europaeae–Buddlejetum salviifoliae*

Species Group G																				
Olea europaea ssp. *africana*						+											b	a	b	b
Buddleja salviifolia																	1	a	a	a
Buddleja saligna									r								a	a	1	a
Euclea crispa ssp. *crispa*														+			1	a	1	1
Allophylus africanus var. *africanus*						+	+										+	1	+	+
Canthium inerme																	+	+	+	+
Scolopia zeyheri																	+	+	+	+
Pavetta gardeniifolia																	+	+	+	
Species Group H																				
Acokanthera oppositifolia														+	+	+	+	+	+	+
Hyperacanthus amoenus							+							+	+	+	+	+		+
Clerodendrum glabrum var. *glabrum*														+	+	+	+		+	+
Species Group I																				
Diospyros lycioides ssp. *sericea*	+										+		+				+		+	+
Species Group J																				
Ziziphus mucronata ssp. *mucronata*	+	+	+	+	+	+	+	+	+	+	1	+	+	+	+		+	+	+	
Acacia karroo	+	+		+	+	r	r		+	+	+		+	a	a	b	+	+	+	+
Zanthoxylum capense	+		+			+	+	+	1		+	+		+			+	+	+	+
Grewia occidentalis var. *occidentalis*	+	+			+	+	+	+	+	1		+	+				+	+	+	+
Gymnosporia buxifolia	+	+				+	+	+			+			+		+	+	+	+	+
Themeda triandra	b	a	+	1	+						+	+	+				a	a	a	1
Dombeya rotundifolia var. *rotundifolia*	1	1	+	+	1	+	+	+	+	+								1	1	1
Combretum molle	+	+		+	+	1	1	1			+		+	+				+	+	+
Catha edulis	a	a	1	1	1	1	+	1									+	1	a	1
Rhoicissus tridentata ssp. *tridentata*	+	+				+							+	+	+	+	1	1	a	a
Maytenus undata	+				+	+			+					+	+	+	1		1	1
Pavetta schumanniana						+	+	+									+	+	1	1
Canthium mundianum							+	+										+	+	+

Community description

***Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets Major Vegetation Type**

The *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thicket Major Vegetation Type is a mixture of plant communities situated at a variety of different altitudes. The distribution of temperate and sub-tropical plant species reflects the gradient of plant communities up the southern slopes of the SC. While those communities along the warm and relatively humid foot slopes are quite tropical, the plant communities of clayey depressions along the cooler higher lying areas tend to contain many temperate species. The lower lying sub-tropical plant communities seem to be unique in their species composition and structure. The higher lying temperate communities compare with the Hillside scrub of the Transitional *Cymbopogon–Themeda* Veld (49) of the Pure Grassveld Types described by Acocks (1953). They share species such as *Acacia karroo, Acacia caffra, Grewia occidentalis, Ehretia rigida, Euclea crispa* subsp. *crispa, Olea europaea* subsp. *africana*, *Buddleja saligna*, *Buddleja salviifolia, Rhus pyroides, Tarchonanthus camphoratus, Diospyros lycioides, Ziziphus mucronata, Dombeya rotundifolia* and *Cussonia* species. These temperate clay communities of the SC also share some floristic links with the riverine woodland *Zizipho mucronatae–Acacietum karroo* described by Brown *et al*. (1998).

Environmental data

The *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thicket Major Vegetation Type is associated with soils of high clay content and relatively moist conditions along the southern slopes of the SC. Even during dry cycles, the moisture-laden air from the south–east ensures at least some orographic rain and mist during the summer months. The eutrophic clayey soils of this Major vegetation Type are derived from igneous basalt and diabase, as well as illuvial clays found in some of the valleys cutting through the mountain ridges. It is associated with the Shortlands Soil Form (MacVicar *et al.* 1991) of the Fa and Ib Land Types derived from basalt, tuff and narrow diabase intrusions or dykes of the Sibasa and Wyllies Poort Geological Formations. The fine-textured clayey soils have high water retention capabilities and tend to release less water to the vegetation than the surrounding sandy soils. High water run-off and poor drainage capabilities result in high potential for soil erosion if vegetation is removed. The high crown cover of the woody layer and poorly developed field layer further enhance run-off and more soil erosion.

The vegetation structure can be described as low closed thickets (Edwards 1983), with no definite separation between the tree and shrub layers. The woody layer contains a mixture of trees and shrubs ranging from 1.5–4 m in height. A very high percentage canopy cover (>80%) blocks enough sunlight from reaching the understory to prevent the establishment of a dense field layer.

Diagnostic taxa

The *Catha edulis–Flueggia virosa* Moist Mountain Thicket Major Vegetation Type is characterised by a high diversity of trees and shrubs. Diagnostic species from the diverse associations within this Major Vegetation Type are presented in species group I (Table 1, Chapter 4) and include woody species such as *Grewia occidentalis* var. *occidentalis, Dovyalis zeyheri, Acalypha glabrata, Dombeya rotundifolia, Catha edulis, Rhus pentheri, Carissa edulis, Rhoicissus tridentata* subsp. *tridentate, Senna petersiana, Diospyros lycioides, Berchemia zeyheri, Dovyalis caffra, Heteropyxis natalensis, Capparis tomentosa, Acacia ataxacantha, Euclea undulata, Pavetta schumanniana, Acacia rehmanniana, Gymnosporia senegalensis, Acokanthera oppositifolia, Mystroxylon aethiopicum* subsp. *schlechteri, Rhus pyroides, Bridelia mollis, Clerodendrum glabrum* var. *glabrum, Ekebergia capensis, Allophylus africanus* var. *africanus, Tarchonanthus camphoratus, Maerua caffra, Coddia rudis, Lippia javanica, Jasminum multipartitum, Combretum hereroense, Acacia caffra, Euclea crispa* subsp. *crispa, Olea europaea* subsp. *africana, Bridelia micrantha, Buddleja saligna, Cussonia natalensis, Ficus sycomorus* subsp. *sycomorus, Scolopia zeyheri, Canthium inerme, Buddleja salviifolia, Podocarpus falcatus, Canthium mundianum, Ficus sur, Syzygium cordatum, Pavetta eylesii, Capparis fascicularis* var. *fascicularis* and *Acacia gerrardii* var. *gerrardii*.

Diagnostic succulent species include *Euphorbia ingens, Aloe greatheadii* var. *greatheadii, Sansevieria hyacinthoides* and *Aloe marlothii* subsp. *marlothii*.

The only diagnostic grass species within the field layer of this Major Vegetation Type are *Brachiaria deflexa, Eragrostis superba, Panicum deustum, Setaria megaphylla* and *Bothriochloa insculpta*.

Diagnostic forbs recorded include *Commelina benghalensis*, *Christella guenziana*, *Cyperus albostriatus*, *Solanum tettense* var. *renschii*, *Dicliptera heterostegia*, *Cyperus sphaerospermus*, *Bulbostylis burchellii*, *Barleria gueinzii*, *Pyrenacantha grandiflorus* and *Justicia flava.*

Dominant / prominent taxa

Dominant woody species of this Major Vegetation Type include *Grewia occidentalis* var. *occidentalis*, *Dovyalis zeyheri*, *Acalypha glabrata*, *Dombeya rotundifolia*, *Catha edulis*, *Rhus pentheri*, *Carissa edulis*, *Rhoicissus tridentata* subsp. *tridentata*, *Senna petersiana*, *Diospyros lycioides* subsp. *sericea*, *Berchemia zeyheri* (Species Group I), *Plectroniella armata*, *Peltophorum africanum* (Species Group J), *Flueggia virosa*, *Acacia karroo*, *Gymnosporia buxifolia*, *Themeda triandra* (Species Group K), *Dichrostachys cinerea* subsp. *africana*, *Ehretia rigida* (Species Group L), *Ziziphus mucronata* (Species Group P), *Zanthoxylum capense* (Species Group S), *Combretum molle* (Species Group U) and *Maytenus undata* (Species Group X).

Only a few shade tolerant grass and herbaceous species with generally low cover-abundance values were recorded within this Major Vegetation Type. Grass species include *Brachiaria deflexa, Panicum deustum, Setaria megaphylla* (Species Group I) and *Panicum maximum* (Species Group P).

The shaded conditions also favour fern species such as *Thelypteris gueinziana* (Species Group I) and *Pellaea calomelanos* var. *calomelanos* (Species Group T).

1. *Euphorbio ingentis–Cathetum edulis* ass. nov., hoc loco.

Nomenclatural type: Relevé 33 (holotypus)

Classified under the *Acacietalia rehmanniana–tortilis* (Winterbach 1998; Winterbach *et al.* 2000).

Alternative name: *Euphorbia ingens–Catha edulis* Low Thicket on southern slopes of the SC.

Environmental data

Most of the woody species are in the form of short trees or tall shrubs ranging from 1.5–4 m in height. The woody layer is well developed with a crown cover of 65–85%, resulting in a low closed thicket vegetation structure (Edwards 1983). No definite separation in the woody strata can be detected. The field layer is poorly developed under the dense shade of the tree and shrub layer. This association is situated along the warm and relatively humid sub-tropical southern foot-slopes of the SC. It is associated with the Shortlands Soil Form (MacVicar *et al*. 1991) of the Fa Land Type derived from basalt and tuff of the Sibasa Geological Formation (Botha 2004b; Patterson & Ross 2004b). The soil is fine-textured, clayey, relatively deep and rich in nutrients. Water penetration and drainage is poor, resulting high potential for soil erosion along these high rainfall steep (15–30º) southern slopes of the Soutpansberg. Surface rock cover is generally below 5%.

Diagnostic taxa

This association is characterised by the diagnostic species of species group A (Table 6). Woody species in this group include *Ximenia americana* var. *microphylla, Gymnosporia senegalensis, Acacia rehmanniana, Sclerocarya birrea* subsp. *caffra, Tarchonanthus camphoratus, Cussonia spicata, Grewia flavescens, Acacia caffra, Jasminum multipartitum, Maerua cafra, Mystroxylon aethiopicum* subsp. *schlechteri, Combretum hereroense, Euclea divinorum, Acacia nilotica* subsp. *kraussiana, Acacia gerrardii* var. *gerrardii, Euclea undulata* var. *undulata, Ximenia caffra* var. *caffra, Grewia monticola, Gymnosporia tenuispina* and *Cordia monoica.*

Diagnostic succulent species include *Euphorbia ingens, Aloe greatheadii* var. *greatheadii* and *Aloe marlothii* subsp. *marlothii.*

Some of the diagnostic grass species include *Eragrostis superba, Bothriochloa insculpta* and *Heteropogon contortus.*

The diagnostic herbaceous species representing this Major Vegetation Type include *Dioscorea sylvatica, Hibiscus meyeri, Gossypium herbaceum* subsp. *africanum, Solanum panduriforme* and *Barleria gueinzii*.

Dominant / prominent taxa

The woody layer is a rich mixture of species and includes dominant species such as *Ximenia americana* var. *microphylla*, *Gymnosporia senegalensis*, *Acacia rehmanniana*, *Sclerocarya birrea* subsp. *caffra*, *Tarchonanthus camphoratus*, *Cussonia spicata*, *Grewia flavescens*, *Acacia caffra*, *Mystroxylon aethiopicum* subsp. *schlechteri*, *Combretum hereroense*, *Euclea divinorum*, *Acacia nilotica* subsp. *kraussiana*, *Acacia gerrardii* var. *gerrardii*, *Euclea undulata* var. *undulata*, *Ximenia caffra* var. *caffra* (Species Group A), *Rhus pentheri*, *Flueggea virosa* subsp. *virosa*, *Carissa edulis*, *Dichrostachys cinerea*, *Peltophorum africanum*, *Senna petersiana*, *Berchemia zeyheri*, *Plectroniella armata*, *Dovyalis caffra*, *Capparis tomentosa*, *Heteropyxis natalensis*, *Rhus leptodictya*, *Coddia rudis*, *Bridelia mollis*, *Pappea capensis* (Species Group C), *Acalypha glabrata*, *Dovyalis zeyheri*, *Ehretia rigida* (Species Group F), *Ziziphus mucronata* subsp. *mucronata*, *Acacia karroo*, *Zanthoxylum capense*, *Grewia occidentalis* var. *occidentalis*, *Gymnosporia buxifolia*, *Dombeya rotundifolia* var. *rotundifolia*, *Combretum molle* and *Catha edulis* (Species Group J).

Prominent succulent species include *Euphorbia ingens*, *Aloe greatheadii* var. *greatheadii* and *Aloe marlothii* subsp. *marlothii* (Species Group A).

The dense crown cover provided by the woody layer inhibits the development of a strong field layer. Some of the more frequent grass species recorded include *Bothriochloa insculpta*, *Eragrostis superba* (Species Group A), *Brachiaria deflexa* (Species Group C), *Panicum maximum* (Species Group F) and *Themeda triandra* (Species Group J).

Prominent herbaceous species include *Dioscorea sylvatica*, *Jasminum multipartitum*, *Hibiscus meyeri*, *Gossypium herbaceum* subsp. *africanum*, *Barleria gueinzii*, *Heliotropium steudneri* (Species Group A) and *Pellaea calomelanos* var. *calomelanos* (Species Group C). *Dioscorea sylvatica* is considered rare and threatened due to overexploitation (Von Maltitz *et al*. 2003).

The *Euphorbio ingentis–Cathetum edulis* along the warm and relatively humid sub-tropical southern foot-slopes of the SC compare floristically with numerous plant communities throughout the grassveld and savanna of South Africa. These include the Low Altitude Bushveld (6a) of the Zululand Thornveld (6) (Acocks 1953), Norite Black Turfveld (13b) of the Other Turf Thornveld (13) (Acocks 1953), *Rhus leptodictya–Acacia tortilis* Bushveld of the *Acacietalia rehmanniana–tortilis* (Winterbach 1998; Winterbach *et al.* 2000), *Dombeya rotundifolia–Panicum maximum* Sweet Rocky Community of the Waterberg area (Henning 2002), the *Pappea capensis–Acacia tortilis* community of the Nylsvlei Nature Reserve (Coetzee *et al.* 1976), the *Rhus leptodictya–Mimusops zeyheri* Termitatium Thickets of Marakele Nature Reserve (Van Staden 2002) and the woodlands on diabase dykes of the *Acacia tortilis–Carissa bispinosa* Woodland Alliance of the *Acacia tortilis–Panicum maximum* Woodland Order of the western Transvaal Bushveld (Van der Meulen 1979). These plant communities are associated with eutrophic, clayey mesic soils derived from unsaturated igneous parent material (Acocks 1953; Van der Meulen 1979; Winterbach *et al.* 2000). Typical species shared by these plant communities include *Acacia caffra*, *Acacia karroo*, *Acacia nilotica*, *Acacia tortilis*, *Rhus leptodictya*, *Rhus pyroides*, *Ziziphus mucronata*, *Ehretia rigida*, *Dichrostachys cinerea* subsp. *africana*, *Euclea crispa*, *Euclea undulata*, *Gymnosporia buxifolia*, *Dombeya rotundifolia* var. *rotundifolia*, *Pappea capensis*, *Ximenia americana* var. *microphylla*, *Aloe marlothii* subsp. *marlothii* and *Panicum maximum*.

2. *Bridelio micranthae–Carissetum edulis* ass. nov., hoc loco.

Nomenclatural type: Relevé 151 (holotypus)

Classified under the newly proposed *Diospyrodetea mespiliformis* of the Lowveld rivers (Mostert *et al. in prep*).

Alternative name: *Bridelia micrantha–Carissa edulis* Tall Riverine Thicket

The *Bridelio micranthae–Carissetum edulis* include the azonal riverine forests and thickets of the SC. Unfortunately, the Sand River Gorge lost all of its riverine forests and thickets due to the destruction caused by the floods of 2000. These vegetation types could therefore not be sampled at the time of data gathering in the summer of 2002–2003. The riverine communities of the Sand River Gorge within the SC would have been part of the *Bridelio micranthae–Carissetum edulis* described here.

Environmental data

The moist conditions along the well-sheltered gorges give rise to lush growth of lianas, ferns, sedges and other hydrophilic herbaceous species. The woody layer is rich in species and includes many typical Lowveld riverine forest species. The closed canopy cover value of the riverine thickets produces dense shade on ground level, inhibiting development of a dense grass layer. According to the structural classification of Edwards (1983) the vegetation may be regarded as short thickets and tall forests. However, this classification is not very descriptive for the diversity within the gallery forests of the rivers and ravines of the Lowveld. The soils are mostly deep, alluvial and rich in organic matter.

Diagnostic taxa

The Riverine Thickets of the SC is characterised by the diagnostic species presented in species group B (Table 6). The woody layer is rich in species and includes many typical Lowveld riverine forest species such as *Bridelia micrantha, Ekebergia capensis, Ficus sur, Syzygium cordatum, Rhus chirindensis, Ficus sycomorus* subsp. *sycomorus, Pyrenacantha grandiflora, Markhamia zanzibarica, Podocarpus falcatus, Pavetta eylesii, Acacia robusta* subsp. *clavigera, Trema orientalis, Diospyros villosa var. parvifolia, Ziziphus rivularis, Euclea natalensis* subsp. *natalensis, Rhoicissus tomentosa, Ficus burkei, Euclea schimperi* var. *schimperi, Celtis africana, Rhus rehmanniana* var. *glabrata, Dovyalis rhamnoides, Ficus ingens* var. *ingens, Ptaeroxylon obliquum, Tecoma capensis, Erythrina lysistemon, Flacourtia indica* and *Hexalobus monopetalus* var. *monopetalus*.

The high canopy cover value of the riverine thickets produces dense shade on the ground, inhibiting development of a dense grass layer. Diagnostic grass species include *Setaria megaphylla, Panicum deustum* and *Ischaemum fasciculatum*.

The moist conditions along the sheltered gorges and ravines give rise to lush growth of lianas, ferns, sedges and other hydrophilic herbaceous species. Diagnostic sedges include *Cyperus albostriatus, Bulbostylis burchellii, Cyperus sphaerospermus, Cyperus sexangularis, Fuirena pubescens, Cyperus distans, Cyperus solidus* and *Pycreus polystachyos*. The fern *Christella guenziana* and fern-ally *Equisetum* *ramosissimum* were recorded as diagnostic species. Diagnostic herbaceous species include *Adenia digitata, Verbena bonariensis, Vernonia glabra, Hermannia depressa, Persicaria attenuata, Dietes grandiflora, Asparagus virgatus* and *Barleria ovata*.

Dominant / prominent taxa

Dominant trees along the rivers

Bridelia micrantha, *Ekebergia capensis*, *Ficus sur*, *Syzygium cordatum*, *Rhus chirindensis*, *Ficus sycomorus* subsp. *sycomorus*, *Pyrenacantha grandiflora*, *Markhamia zanzibarica*, *Podocarpus falcatus*, *Pavetta eylesii*, *Acacia robusta* subsp. *clavigera*, *Trema orientalis*, *Diospyros villosa* var. *parvifolia*, *Ziziphus rivularis*, *Euclea natalensis* subsp. *natalensis*, *Rhoicissus tomentosa*, *Ficus burkei* (Species Group B), *Flueggea virosa* subsp. *virosa*, *Rhus pentheri*, *Carissa edulis*, *Peltophorum africanum*, *Senna petersiana*, *Berchemia zeyheri*, *Brachiaria deflexa*, *Plectroniella armata*, *Dovyalis caffra*, *Rhus pyroides* (Species Group C), *Acacia ataxacantha*, *Acalypha glabrata*, *Dovyalis zeyheri* (Species Group E), *Ziziphus mucronata* subsp. *mucronata*, *Acacia karroo*, *Zanthoxylum capense* and *Grewia occidentalis* var. *occidentalis* (Species Group J).

The grass layer is dominated by shade tolerant species, which include *Setaria megaphylla*, *Panicum deustum*, *Ischaemum fasciculatum* (Species Group B), *Brachiaria deflexa*, *Urochloa mosambicensis* (Species Group C), *Panicum maximum* (Species Group F) and *Themeda triandra* (Species Group J).

Prominent sedges include *Cyperus albostriatus, Bulbostylis burchellii, Cyperus sphaerospermus, Cyperus sexangularis, Fuirena pubescens, Cyperus distans, Cyperus solidus* and *Pycreus polystachyos* (Species Group B). Prominent ferns and fern allies include *Christella guenziana*, *Equisetum ramosissimum* (Species Group B) and *Pellaea calomelanos* var. *calomelanos* (Species Group C). Prominent herbaceous species include shade tolerant species such as *Adenia digitata*, *Verbena bonariensis*, *Vernonia glabra*, *Hermannia depressa*, *Persicaria attenuata*, *Dietes grandiflora*, *Asparagus virgatus*, *Barleria ovata* (Species Group B), *Commelina benghalensis*, *Sansevieria hyacinthoides* and *Justicia flava* (Species Group C).

Some weak floristic links with the *Mimusops zeyheri–Pappea capensis* Ravine Woodland and the *Ziziphus mucronata–Acacia karroo* Riverine Woodland of the Borakalalo Nature Reserve (Brown *et al.* 1995, 1997). The *Combretum erythrophyllum–Celtis africana* Forest Alliance described by Van der Meulen (1979), contain numerous species shared with the *Bridelio micranthae–Carissetum edulis* of the SC and many of the gallery forests of South Africa (Louw 1951; Edwards 1967; Werger 1973; Werger & Coetzee 1977; Coetzee 1983; Van Staden & Bredenkamp 2006). However, the riverine forests of the SC are rich in species, especially trees of a tropical nature (Mostert *et al. in prep*.). The riverine thickets and forests of the SC also share numerous species with the Sandveld Swamp Forest of the Soutpansberg Arid Northern Bushveld (Chapter 6). It may be argued that these two associations belong to the same syntaxonomic alliance or order, despite major differences in their primary ecological drivers. As can be seen from the vegetation damage caused by the 2000 floods in the Sand River Gorge, the riverine communities are prone to frequent mechanical disturbance and destruction. The swamp communities, however, are less frequently disturbed at such dramatic scales.

3. *Cussonio natalensis–Acacietum karroo* ass. nov., hoc loco.

Nomenclatural type: Relevé 65 (holotypus)

Classified under the *Acacietea karroo* (Du Preez & Bredenkamp 1991)

Alternative name: *Cussonia natalensis–Acacia karroo* Low Thickets along the southern slopes of the Soutpansberg.

Environmental data

The *Cussonio natalensis–Acacietum karroo* is situated below the lower reaches of the mistbelt along the southern slopes of the SC. The vegetation structure can be described as low thickets (Edwards 1983). It is associated with the Shortlands Soil Form (MacVicar *et al*. 1991) of the Fa and Ib Land Types derived from basalt and tuff of the Sibasa Geological Formation (Botha 2004b; Patterson & Ross 2004b). The soil is fine-textured, clayey, relatively deep and rich in nutrients. Water penetration and drainage is poor, resulting high potentials for soil erosion along these high rainfall southern slopes of the Soutpansberg. These highly eroded basalts create localised narrow plateaus, with which the *Cussonio natalensis–Acacietum karroo* is associated. Surface rock cover generally ranges from 5–15%.

Diagnostic taxa

This association is characterised by the diagnostic species of species group D (Table 6). The only diagnostic woody species recorded for this association is *Cussonia natalensis*. The only diagnostic grass species to be recorded was *Eragrostis rigidior*. Diagnostic herbaceous species include *Solanum tettense* var. *renschii*, *Dicliptera heterostegia*, *Psiadia punctulata* and *Scadoxus puniceus*.

Dominant / prominent taxa

The dominant species recorded for this association are strongly associated with heavy clays and include the woody species *Cussonia natalensis* (Species Group D), *Acacia ataxacantha* Species Group E), *Panicum maximum*, *Acalypha glabrata*, *Dovyalis zeyheri*, *Ehretia rigida*, *Vangueria infausta* subsp. *infausta*, *Lippia javanica*, *Capparis fascicularis* var. *fascicularis* (Species Group F), *Acokanthera oppositifolia*, *Hyperacanthus amoenus*, *Clerodendrum glabrum* var. *glabrum* (Species Group H), *Ziziphus mucronata* subsp. *mucronata*, *Acacia karroo*, *Gymnosporia buxifolia*, *Rhoicissus tridentata* subsp. *tridentata* and *Maytenus undata* (Species Group J). The field layer is not very well developed.

The most dominant grass species include *Eragrostis rigidior* (Species Group D) and *Panicum maximum* (Species Group F).

A few prominent forbs include *Solanum tettense* var. *renschii*, *Dicliptera heterostegia*, *Psiadia punctulata* and *Scadoxus puniceus* (Species Group D).

There are many signs of historical overgrazing and crop cultivation along these eutrophic plateaus. These localised patches of arable land and sweet palatable grazing and browsing fodder within the surrounding sea of nutrient poor shallow quartzitic sandy soils, have been heavily utilised for as long as people and their livestock have occupied the Soutpansberg region. Heavy seasonal grazing pressures from herbivore game species may also form part of the natural system. However, the more recent settlement of people at these altitudes on a year round basis, has lead to severe over-utilisation and degradation of these isolated patches. The *Cussonio natalensis*–

Acacietum karroo may therefore very well be a pioneer sere or even a plagioclimax of what was once a grass dominated plant community (Bredenkamp *et al. in press*).

The *Cussonio natalensis–Acacietum karroo* compares to the species poor azonal *Panicum maximum–Acacia karroo* Veld (14f) of the Arid Sweet Bushveld (14) described by Acocks (1953). Du Preez & Bredenkamp (1991) classified similar riparian thicket communities of the southern and eastern Free State as the *Acacietea karroo*. Winterbach (1998) classified the similarly *Acacia karroo* dominated communities of the north-western savanna of South Africa into the *Rhus penteri–Acacia karroo* Microphyllous Forest of the *Crabbea hirsuta–Acacia rehmanniana* bushveld communities of the *Acacietalia rehmannianae–tortilis* of the *Panico maximi–Acacietea tortilis*. However, according to Du Preez & Bredenkamp (1991), Bezuidenhout *et al*. (1994) and Winterbach *et al*. (2000), the *Acacia karroo*-dominated vegetation of the southern African grassveld and savanna should be classified as a separate syntaxonomical class. The *Cussonio natalensis–Acacietum karroo* should therefore be classified as part of this *Acacia karroo*-dominated syntaxonomic class of *Acacietea karroo* (Du Preez & Bredenkamp 1991).

4. *Olea europapeae–Buddlejetum salviifoliae* ass. nov., hoc loco.

Nomenclatural type: Relevé 49 (holotypus)

Classified under the *Panico maximi–Acacietea tortilis* described by Winterbach *et al.* (2000).

Alternative name: *Olea europapea* subsp. *africana–Buddleja salviifolia* low thickets along the sheltered, high lying southern clay slopes of the Soutpansberg mistbelt

Environmental data

The *Olea europapeae–Buddlejetum salviifoliae* is situated within the lower reaches of the mistbelt along some of the more sheltered southern slopes of the SC. Annual precipitation is relatively high with relatively low desiccation of the surrounding environment, as can be inferred from the abundance of rock and bark lichens. The vegetation structure can be described as low thickets (Edwards 1983), with a well-developed woody layer and a poorly developed field layer. It is associated with the Shortlands Soil Form (MacVicar *et al.* 1991) of the Fa and Ib Land Types derived from basalt and tuff of the Sibasa Geological Formation (Botha 2004b; Patterson &

Ross 2004b). The soil is fine-textured, clayey, relatively deep and rich in nutrients. Water penetration and drainage is poor, resulting high potentials for soil erosion along these high rainfall southern slopes of the Soutpansberg. The A horizon is often totally eroded away, exposing the top of the well-structured B horizon at the surface. Slope ranges from 2–7º, and surface rock cover generally ranges from 10–25%.

Diagnostic taxa

This association is characterised by the diagnostic species of species group G (Table 6). The species in this group include *Olea europaea* subsp. *africana*, *Buddleja salviifolia*, *Buddleja saligna*, *Euclea crispa* subsp. *crispa*, *Allophylus africanus* var. *africanus*, *Canthium inerme*, *Scolopia zeyheri* and *Pavetta gardeniifolia*.

No diagnostic grass or herbaceous species were recorded during the fieldwork phase.

Dominant / prominent taxa

Olea europaea subsp. *africana*, *Buddleja salviifolia*, *Buddleja saligna*, *Euclea crispa* subsp. *crispa*, *Allophylus africanus* var. *africanus*, *Canthium inerme*, *Scolopia zeyheri*, *Pavetta gardeniifolia* (Species Group G), *Acokanthera oppositifolia*, *Hyperacanthus amoenus*, *Clerodendrum glabrum* var. *glabrum* (Species Group H), *Diospyros lycioides* subsp. *sericea* (Species Group I), *Ziziphus mucronata* subsp. *mucronata*, *Acacia karroo*, *Zanthoxylum capense*, *Grewia occidentalis* var. *occidentalis*, *Gymnosporia buxifolia*, *Dombeya rotundifolia* var. *rotundifolia*, *Combretum molle*, *Catha edulis*, *Rhoicissus tridentata* subsp. *tridentata*, *Maytenus undata*, *Pavetta schumanniana* and *Canthium mundianum* (Species Group J).

Themeda triandra (Species Group J) was recorded as the only prominent grass species for this association. No prominent herbaceous species were recorded.

The *Olea europaeae–Buddlejetum salviifoliae* share numerous species with the *Celtis africana–Osyris lanceolata* Kloof Forests (Westfall 1981, 1985), the *Podocarpus latifolius–Diospyros whyteana* Kloof Community (Henning 2002), and the *Olea europaea* subsp. *africana–Diospyros whyteana* Major Comunity (Van Staden 2002; Van Staden & Bredenkamp 2006) of the Waterberg Mountain Range, the *Rhus* *leptodictya–Olea europaea* subsp. *africana* Bushveld of the *Rhus leptodictya–Acacia tortilis* Bushveld (Winterbach 1998) as part of the Springbok Flats, as well as the *Myrica serrata–Olea europaea* subsp. *africana* Hygrophilous Scrub of the *Leucosidea sericea–Buddleja salviifolia* Moist Shrubland of the southern and eastern Free State (Du Preez 1991; Du Preez & Bredenkamp 1991). Winterbach *et al.* (2002) classified the communities of the Springbok Flats into the *Acacienea nilotico–tortilis* of the *Panico maximi–Acacietea tortilis*, while Du Preez & Bredenkamp (1991) classified the communities of the Korannaberg into the *Rhoo burchellii–Buddlejion salignae* of the *Rhoetum erosae* described by Werger (1980). Typical species shared among these communities include *Olea europaea* subsp. *africana, Buddleja salviifolia, Euclea crispa* subsp. *crispa, Canthium inerme, Acokanthera oppositifolia, Grewia occidentalis* var. *occidentalis, Rhoicissus tridentata* subsp. *tridentata* and *Maytenus undata*. In view of its close floristic relationships with the savanna vegetation of the Waterberg area, it is proposed that the *Olea europaeae–Buddlejetum salviifoliae* of the SC be classified under the *Panico maximi–Acacietea tortilis* described by Winterbach *et al*. (2000). However, the syntaxonomic relationship between the *Rhoo burchellii–Buddlejion salignae* of the Free State (Du Preez & Bredenkamp 1991) and the *Olea europaea* subsp. *africana* dominated communities of the *Panico maximi–Acacietea tortilis* of the Limpopo Province is confusing, vague and seems to be an artificial separation of similar syntaxa. Earlier phytosociologists such as Werger (1974), warned against compiling a formal syntaxonomy too early, before adequate data over larger areas were available. It is recommended that the thicket biome of South Africa be reclassified syntaxonomically as an integrated unit, and not as separate geographical entities.

Ordination

The Soutpansberg Moist Mountain Thickets Major Vegetation Type is represented by a relatively diverse group of plant communities form diverse ecosystems. However, the vegetation structures the four described associations can all be regarded as thickets. These associations share numerous species, further strengthening their phytosociological grouping as a unit (Figure 9, Chapter 4). The woody layer is generally rich in species, while the filed layer is poorly developed due to a lack of sunlight. Soils are clayey, eutrophic and relatively deep with relatively low surface rock cover. These thickets are confined to relatively moist areas, such as the southern slopes of the Soutpansberg and sheltered ravines. This Major Vegetation Type is relatively stable and less event-driven than those associations located along the northern ridges of the Soutpansberg. This may be due to the relatively high and predictable precipitation along the southern slopes and ravines of the SC.

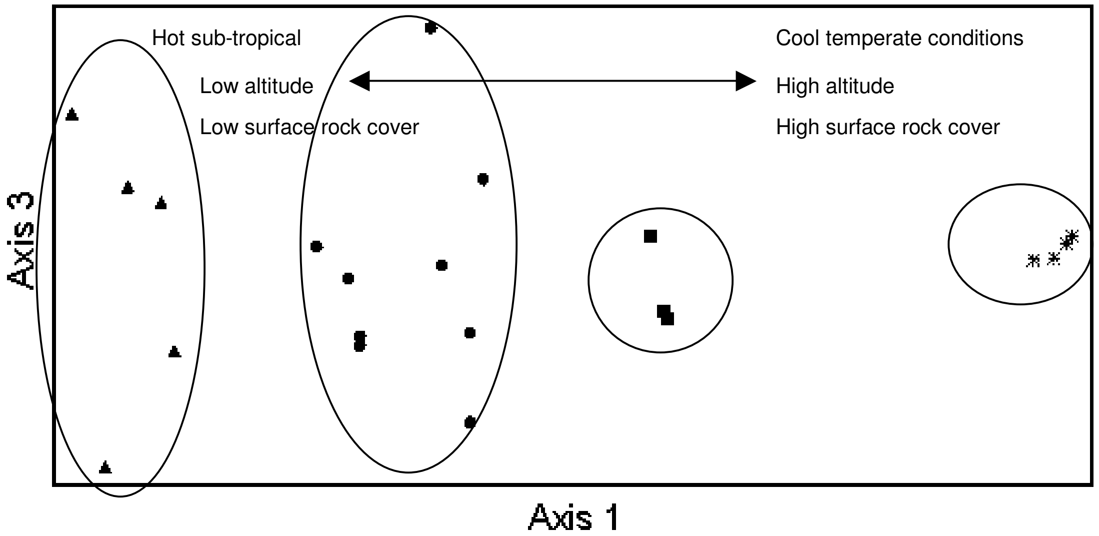
The scatter diagram displays the distribution of relevés along the first and third ordination axes (Figure 10). The vegetation units are represented as groups and their distribution on the scatter diagram corresponds with certain physical environmental gradients. The first ordination axis (eigen value = 0.745) is represented by the x-axis and the third ordination axis (eigen value = 0.288) is represented by the y-axis. Some environmental gradients that may contribute to the observed separation of associations along the x- and y-axes include altitude, temperature, precipitation, soil moisture availability, slope, soil depth, soil texture, water drainage and air-moisture in the form of orographic mist and fog.

The right side of the x-axis represents the more temperate *Olea europapeae–Buddlejetum salviifoliae,* situated within the lower reaches of the mistbelt along some of the more sheltered southern slopes of the SC. Annual precipitation is relatively high due to moisture provided by seasonal orographic rain and mist. The soil is fine-textured, clayey, relatively deep and rich in nutrients. Slope ranges from 2–7º, and surface rock cover generally ranges from 10–25%. Water penetration and drainage is poor, resulting in the erosion of the thin A horizon to expose the under laying B horizon.

The middle of the scatter plot along the x-axis represents the more sub-tropical thickets of the southern foot slopes and terraces of the SC. These associations include the *Euphorbio ingentis–Cathetum edulis* and the *Cussonio natalensis–Acacietum karroo*. It falls below the mistbelt of the SC, and conditions are generally hot, humid and sub-tropical due to its low altitude. Water penetration is generally poor due to a sparse filed layer, moderate slopes and fine-textured soils.

The left side of the x-axis represents the highly sheltered ravines and gorges of the SC. Although precipitation may be less than for those associations to the right of the scatter plot, the accumulation of run-off water within this low laying landscape creates wet and moist conditions. The thickets and low forests of these sheltered drainage lines are dense, with very high canopy cover. The high canopy cover and sheltered position reduces desiccation of the surrounding environment. The undergrowth is generally lush with numerous ferns, orchids and lianas. The soils are rich in organic matter, mixed with rich alluvial silt, clay and sand imported from higher laying areas.

No significant environmental trends could be ascribed to the weak patterns of relevé distribution along the y-axis.



Legend

Triangle: *Bridelio micranthae–Carissetum edulis*
Circle: *Euphorbio ingentis–Cathetum edulis*
Square: *Cussonio natalensis–Acacietum karroo*
Star: *Olea europaeae–Buddlejetum salviifoliae*

Figure 10 Relative positions of all the relevés along the first and third axes of the ordination of the *Catha edulis–Flueggia virosa* Soutpansberg Soutpansberg Moist Mountain Thickets Major Vegetation Type

Discussion

The communities associated with the *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets Major Vegetation Type contain numerous species indicating various degrees of disturbance in recent times. Du Preez (1991) and Du Preez & Bredenkamp (1991) found similar trends of encroachment and bush thickening within the *Acacia karroo* Riparian Thicket Vegetation Class (*Acacietea karroo*) of the southern and eastern Orange Free State grasslands. Very little is known about post-disturbance dynamics and recovery of subtropical transitional thicket communities (Everard 1987). Cowling (1984) considers subtropical transitional thicket to be stable but with low resilience. Thicket communities are vulnerable to overstocking and are slow to recover after disturbances (Aucamp & Barnard 1980). The nature of disturbances of the *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets associations include seasonal flooding, bush clearing and wood collection, over grazing, tilling and general disturbance due to human and livestock settlement.

CHAPTER 8

SOUTPANSBERG LEACHED SANDVELD COMMUNITIES

Introduction

In an overview of the vegetation of the Soutpansberg Conservancy and the Blouberg Nature Reserve (Chapter 4), the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld was identified as a Major Vegetation Type. The classification of this Major Vegetation Type is addressed in this chapter.

A number of detailed phytociciological studies have been conducted within the leached sandveld communities of the Limpopo Province by Coetzee (1976), Van Der Meulen (1979), Westfall (1981), Westfall *et al.* (1985), Van Den Berg (1993), Winterbach (1998), Henning (2002), Van Staden (2002) and Van Staden & Bredenkamp (2005). These studies were all focussed on small geographical areas concerned with meeting localised conservation and localised vegetation-mapping demands. The arid ecosystems of the Limpopo Province, and for that matter most of the southern African savannas (Du Plessis 2001), have only been sampled in localised patches, such as areas of high conservation value and or high economic value. Large gaps still remain to be filled in order to create a holistic image of the phytosociology of the southern African leached sandveld.

Acocks (1953) mapped the vegetation of this area as Sour Bushveld (20). This Vegetation Type of Acocks is however, an oversimplification of the variety of distinct plant communities within this very heterogeneous landscape. Van Rooyen and Bredenkamp (1998) recognised the uniqueness of this region’s vegetation. However, without the necessary data, they too had to lump these communities under the broad term of Soutpansberg Arid Mountain Bushveld. Despite being unique, the communities associated with this sandveld type are generally species poor. The communities associated with the bare rock sheets are the exception to the recorded low species richness.

Vegetation classification

The analysis of the vegetation data resulted in the identification of four plant communities, classified into four syntaxonomic associations (Table 7). The plant communities of the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type are classified as follows:

1. *Myrothamno flabellifolii–Hexalobetum monopetali*

   Classified under the proposed *Selaginelletea dregei* described by Mostert *et al.* (*in prep*)

2. *Burkeo africanae–Pseudolachnostylietum maprouneifoliae*

   Classified under the *Burkea africana–Perotis patens* Woodland Alliance of the *Combretum molle–Diheteropogon amplectens* Woodland Order (Van Der Meulen 1979), under the *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000)

3. *Terminalio sericea–Burkeetum africanae*

   Classified under the *Burkea africana–Perotis patens* Woodland Alliance of the *Combretum molle–Diheteropogon amplectens* Woodland Order (Van Der Meulen 1979), under the *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000)

4. *Androstachyetum* (Coetzee 1983)

   Classified under the proposed *Crotonetea gratissimi* described by Mostert *et al.* (*in prep*)

Table 7 Phytosociological table of the plant communities of the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type

Association no.	**1**															**2**														**3**														**4**						
Releve number	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	6	6	6	6	1	1	2	2	2	2	1	1	2	2	2	2	2	2	2	5	5	5	5	7			1	1	1	1	1	1	1	1	2	2	2	3							
	5	6	9	3	4	0	1	2	3	7	8	0	1	2	5	8	9	1	2	3	5	6	7	8	6	7	8	9	2	8	9	0	1	2	3	4	5	6	7	0	4	9	0	1	2	3	4	5	6	7
Diagnostic species of the *Myrothamno flabellifolii–Hexalobetum monopetali*																																																		
Species Group A																																																		
Hexalobus monopetalus var. *monopetalus*	+	+	+	+	1	1	1	+	a	+	a	+	1	1	+	r	r						r				+																							
Myrothamnus flabellifolius	+	+	1	+	+		+	+	+	+	+	+	+	+	+										+			+																						
Selaginella dregei	+	+	+	+	+	r		r	r	+	+		+	+	+																																			
Hyperacanthus amoenus	+	+	+	+	+	+	+			+	+	+	+	+																																				
Ipomoea albivenia	+	+	+	+	+			+		+	+	+	+	+	1						+			r																										
Euphorbia zoutpansbergensis	+		+	r	+		+	r				+	+		+																																			
Aloe angelica	+	1		+	+		+	+	+	1	+		+	+	+																																			
Euphorbia aeruginosa	+	+	+	+	+				+	+	+	+	+	+	+																																			
Euphorbia cooperi var. *cooperi*	+	+	+	+	+	+	+			+	+	+	+	+																																				
Garcinia livingstonei	+	+	+	+	+	r		r		+			+	+	+							+																												
Combretum vendae	+		+		+	a	a	1	1			+	+	+	+																																			
Commiphora marlothii			+	+	+	r				+	+	+	+	+	+						+		r																											
Orthosiphon labiatus		+			+	+	+	+		+	+	+	+		+																																			
Anacampseros subnuda	+	+	+	+		+				+	r		+	+	+																																			
Portulaca kermesina	+	+	+	+	+	r	+	r						+	+																												+							
Artabotrys brachypetalus		+	+			+	+	+	+	+		+	1	+		+																																		

Ficus tettensis		+	+	+	+			r			+	+	+	+	+																
Isoglossa hypoestiflora		+	+	+	+	+	+			+	+				+											+					
Ficus abutilifolia			+		+	+	+		r			+	+	+	+				r			+									
Dicoma montana		+	+	+		+		+	+		+	+	+																		
Asparagus laricinus	+	+		+	+	+				+		+			+	+				+											
Ficus ingens var. *ingens*		+						+	+	+	+		+	+	+																
Indigofera cryptantha var. *cryptantha*				+		+	+	+	+		+		+	+				+				+									
Aloe chabaudii var. *chabaudii*		+		+				+	+	+			+	+	+																
Ochna inermis			+		+		+	+	+	+		+								+		+									
Jasminum multipartitum					+	+	+		+	+		+	+																		
Justicia montis-salinarum	+		+	+		+		+	+					+																	
Indigofera schimperi	+		+			+	+		+	+	+																		+		
Barleria rotundifolia	+		+			+	+	+					+	+																	
Psydrax livida			+	+	+	+					+			+					+				+								
Corchorus asplenifolius	+				+		+		+		+		+																		
Psydrax locuples			+	+	+	+					+		+				+							+							
Avonia rhodesica	+		+	+	+	+	+																								
Ziziphus mucronata ssp. *mucronata*		r	+			+					+	+		+					r				r				+	+			
Eragrostis trichophora		+			+	+					+		+						+						+						+
Vangueria soutpansbergensis	+				+	+	+						+																		
Cyperus rupestris		+			+				+		+			+																	
Canthium mundianum		+			+	+						+			+																
Pavonia dentata			+					+	+		+	+							+												
Convolvulus sagittatus	+	+								+	+		+																		
Ceratotheca triloba	+		+							+	+				+																
Euphorbia griseola ssp. *griseola*			+							+	+		+	+																	
Sida cordifolia								+	+	+			+												+		+			+	
Justicia anagalloides		+		+	+				+																						
Justicia odora				+								+	+	+						+	+										

Ceropegia species	+ + + + +			
Asparagus exuvialis for. *exuvialis*	+ + + +			
Albizia brevifolia	+ + +	r		
Euclea natalensis ssp. *angustifolia*	+ + +	+		
Ficus glumosa	+ + +	+		
Oldenlandia herbacea	+ + +			
Isoglossa grantii	+ + +	+		
Panicum schinzii	+ + +			
Euphorbia confinalis	+ + +			
Cleome macrophylla	+ + +			
Vepris reflexa	+ + +			
Kalanchoe sexangularis	+ + +			

Diagnostic species of the *Burkeo africanae–Pseudolachnostylietum maprouneifoliae*

Species Group B

Tricalysia junodii var. *kirkii*	+	+ + 1 1 + + 1 + 1 + +		
Grewia bicolor		+ + + + 1 + + +		
Mundulea sericea		+ + + 1 1 1 + +		
Lannea discolor	+	+ + 1 + + +	1	
Corchorus confusus		+ + + +		
Toddaliopsis bremekampii	+	+ 1 + +		
Combretum apiculatum ssp. *apiculatum*	r	+ a 1 a	+	
Melinis nerviglumis		+ + +	+	
Ectadiopsis oblongifolia	+ +	+ + +		
Indigofera hilaris		+ + +	+	
Grewia flavescens	+	+ r +	+ +	r

Species Group C				
Enneapogon cenchroides	1 1 1 + + 1 a 1 a + 1 + + + +	b b b a a b 3 b 3 b b 3 a a		r
Centropodia glauca	1 a + 1 1 3 a a + a a 1 1 1	a b a a 3 1 a b b b 3 3 b	1	
Pseudolachnostylis maprouneifolia	+ r 1 r + a 1 a 1 1 1 + 1 +	a a a a b 1 1 1 + a a a 1	+ + + 1 + + +	r
Diplorhynchus condylocarpon	+ + + 1 1 a 1 + 1 1 1 1 +	+ b a 1 + + + a 1 1 +		
Loudetia simplex	+ + 1 + 1 r r + + + 1 1 +	+ 1 1 + a 1 + + + + + + +	+ +	+ +
Elephantorrhiza burkei	+ + + + + + + + 1 + + + +	+ + a 1 1 1 1 1 + +	a + +	
Pellaea calomelanos var. *calomelanos*	+ + + + + + + + + + +	+ + + + + + + + + + +		+
Xerophyta retinervis	+ + + + + + + + + +	+ + + + 1 1 + + + +	+	
Vangueria parvifolium	+ + + + + + + +	1 1 1 a 1 1 + 1 1 + +		
Combretum molle	+ + +	+ 1 a + a + 1 1 1 1 1 1	+	
Landolphia kirkii	+ + + + + + +	+ + + + + + + + +		
Aristida stipitata ssp. *graciliflora*	+ + 1 1 +	+ + a a b + + + + +	a a	
Corchorus kirkii	+ + + + r + + + + + +	1 + + + + + + +	+ +	
Loudetia flavida	+ + + + + + +	+ + +		
Vangueria infausta ssp. *infausta*	+ + + + + + +	+ + +		
Adenia spinosa	+ + + + + + +	+ + +		
Commelina africana	+ + +	+ + +	+ +	
Diagnostic species of the *Terminalio sericea–Burkeetum africanae*				
Species Group D				
Eragrostis pallens			1 a a 1 a a b b 1 a a 1 b +	
Eragrostis gummiflua			+ + + 1 a 1 1 1 1 1 + +	
Grewia retinervis	+ + +	+ r	+ + + + + + + + + + + 1	
Schmidtia pappophoroides	+ +	+ +	+ + a b a a b a a + +	r
Stipagrostis uniplumis var. *uniplumis*		+ +	+ a b a 1 a b a + + +	
Digitaria eriantha			+ + + + 1 a a + + a 3	
Schizachyrium jeffreysi		+ +	1 1 1 + + + + + 1 a 1	

Pterocarpus angolensis		+ +	1 + + + 1 1 1 + 1 +	
Euclea natalensis ssp. *natalensis*	r		+ + + + + + + + + +	
Aristida canescens ssp. *ramosa*	+		1 1 1 1 1 + + 1 1	
Urginea altissima			+ + + + + + + + +	
Aristida diffusa ssp. *burkei*			+ + + 1 1 + + a + +	
Cineraria parvifolia			+ + + + + + + + +	
Parinari capensis ssp. *capensis*			+ + + a 1 a 1 + 1	
Tephrosia longipes		+ +	+ + + + + + + +	
Peltophorum africanum	+		+ + 1 1 1 1 + +	
Setaria sphacelata var. *sphacelata*	+		+ + + + + +	
Suregada africana			+ + + + + +	
Dichapetalum cymosum			+ + + + + + +	
Salacia rehmannii			+ + + + + + +	
Strychnos pungens	+ + + + +	r +	+ + + + + + +	
Conostomium zoutpansbergense		r	+ + + + +	
Elaeodendron transvaalense			+ + + +	
Raphionacme procumbens			+ + + +	
Pterocarpus rotundifolius ssp. *rotundifolius*		1	a a a +	
Grewia monticola	+ +	r +	+ + r +	
Bulbostylis hispidula			+ + + +	
Cyperus albostriatus			+ + + +	
Rhus leptodictya			+ + +	
Agathisanthemum bojeri			+ + +	
Phylica burchellii			+ + +	
Chamaecrista mimosoides	+ +	+	+ + +	
Pygmaeothamnus zeyheri var. *zeyheri*			+ 1 1	
Elephantorrhiza elephantina		b	+ + +	
Rhus pentheri			r + r	

Species				
Species Group E				
Burkea africana	+ + + + +	1 b b a a 1 + + 1 + 1 + +	1 1 1 a b 3 3 a 3 a b b a b	
Vitex rehmannii	+ + +	+ + + + a + + + + +	+ + + + + + + + + + +	
Terminalia sericea		1 + + + + r r +	a a a a b a a a a 1 1 b 1 b	
Ochna pulchra	+	b a 1 1 + +	a 1 a a b a a a a a b 1 a a	
Ozoroa paniculosa var. *salicina*		+ + + + + + + 1	+ + + + 1 r	
Ximenia caffra var. *caffra*		r + +	+ + r r	
Waltheria indica	+ +	+ + + + +	+ + + + 1	
Species Group F				
Strychnos madagascariensis	+ + + + + + + +	1 + 1 + + + +	+ 1 + + + + + +	
Diagnostic species of the *Androstachyetum*				
Species Group G				
Androstachys johnsonii				4 4 4 4 5 5 5
Brachylaena huillensis	+ +			+ + 1 + 1 + +
Asparagus falcatus		+ +		+ + + +
Sansevieria pearsonii				+ + + +
Croton pseudopulchellus	+			+ + + +
Panicum coloratum var. *coloratum*	+ +			r + r
Croton gratissimus	+			+ + +
Obetia tenax				+ +
Species Group H				
Panicum maximum	+	+	+ + + + +	+ + + +

Community description

***Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type**

Acocks (1953) referred to parts of the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type as the Terminalia Veld (18b1) and the Burkea Veld (18b4) of the Mixed Bushveld (18) and the Sour Bushveld (20). Van Rooyen & Bredenkamp (1996) described similar leached sandveld communities for the Waterberg Mountain Range as the Waterberg Moist Mountain Bushveld as part of the savanna biome. Westfall (1981) and Westfall *et al.* (1985) described numerous plant communities from the Waterberg area, which share many floristic elements with the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type of the SC. Some of the leached sandveld plant communities of the Nylsvlei Nature Reserve (Coetzee *et al*. 1979) within the Springbok Flats of the Limpopo Province show strong floristic affinities with those leached sandveld communities described for the SC.

The *Burkea africana–Setaria lindenbergiana* Major Community described by Van Staden (2002) and Van Staden & Bredenkamp (2005) as well as the *Burkea africana–Setaria sphacelata* Undulating Plains, Footslopes, Terraces and Plateaus Community and the *Terminalia sericea–Eragrostis pallens* Deep Sandy Lowlands Community described by Henning (2002) of the Waterberg area share many diagnostic species with the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type of the SC. The coarse vegetation described by Van Den Berg (1993) of the Sour and Mixed Bushveld emphasises the heterogeneity of these Veld Types.

The *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type shares numerous diagnostic species with the *Terminalio sericeae–Combretetea apiculati* described by Winterbach (1998) and Winterbach *et al*. (2000). More specifically, this Major Vegetation Type share numerous diagnostic species with the *Burkea africana–Perotis patens* Woodland Alliance described by Van der Meulen (1979). These species include *Agathisanthemum bojeri, Aristida diffusa, Aristida stipitata, Burkea africana, Bulbostylis hispidula, Chamaecrista* *mimosoides, Combretum molle, Convolvulus sagittatus, Croton gratissimus, Digitaria eriantha, Diplorhynchus condylocarpon, Elephantorrhiza elephantina, Eragrostis gummiflua, Euclea natalensis, Grewia flavescens, Grewia monticola, Hexalobus monopetalus, Lannea discolor, Loudetia simplex, Melinis nerviglumis, Mundulea sericea, Ochna pulchra, Oldenlandia herbacea, Ozoroa paniculosa, Panicum maximum, Pellaea calomelanos, Pseudolachnostylis maprouneifolia, Pterocarpus rotundifolius, Rhus leptodictya, Schizachyrium* spp., *Schmidtia pappophoroides, Selaginella dregei, Setaria sphacelata, Strychnos pungens, Tephrosia longipes, Terminalia sericia, Vangueria infausta, Vangueria parvifolium, Vitex rehmannii, Waltheria indica* and *Xerophyta retinervis.* The large number of diagnostic and prominent species shared among these vegetation units, suggests that at least some of the associations of the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type may be classified syntaxonomically under the *Burkea africana–Perotis patens* Woodland Alliance within the *Combretum molle–Diheteropogon amplectens* Woodland Order (Van der Meulen 1979) of the proposed *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al*. 2000).

It is interesting to note that *Combretum apiculatum* does not occur within the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type as a dominant or diagnostic species. However, based on the complex of diagnostic species shared by *Terminalio sericeae–Combretetea apiculati* and the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type, these two vegetation units are syntaxonomically regarded as belonging to the same vegetation class. In a syntaxonomic synthesis of the southern African Mopaneveld, Du Plessis (2001) also described this phenomenon, whereby *Colophospermum mopane* is absent from some of the associations belonging to the *Commiphoro mollis–Colophospermetea mopani*. Based on the complex of diagnostic species shared by the Mopaneveld associations, they are syntaxonomically linked (Du Plessis 2001).

The *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type also shares numerous prominent species with the *Englerophyto magalismontani–Acacietea caffrae* (Mountain Bushveld Class) (Winterbach 1998; Winterbach *et al*. 2000). This syntaxonomic class, however, is poorly understood and contains enormous variation in vegetation types and plant communities (Winterbach *et al*. 2000; Henning 2002). The distinction between the *Terminalio sericeae–Combretetea apiculati* and *Englerophyto magalismontani–Acacietea caffrae* in the veld is often unclear (Winterbach *et al*. 2000), resulting in an overlap of lower level communities (associations and alliances) within the syntaxonomic hierarchy. The *Englerophyto magalismontani–Acacietea caffrae* may very well be a complex of several separate and unique vegetation classes. Much more researched is needed in order to understand the relative syntaxonomical position and status of the very diverse and complex *Englerophyto magalismontani–Acacietea caffrae.*

The *Androstachyetum* of the SC seems to be an azonal community of the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type. It shares very few diagnostic and dominant species of the Soutpansberg Leached Sandveld communities. It is regarded to be part of the proposed Koppies and Outcrops syntaxonomic class described from the Kruger National Park (Mostert *et al. in prep*.).

Environmental data

Due to the varying topography of the landscape of the Leached Sandveld Major Vegetation Type, it comprises of four distinctly different plant communities, which vary dramatically in both floristic composition and vegetation structure.

The Leached Sandveld Vegetation Type is confined to the warmer northern slopes of the mountain, as well as some of the more arid southern slopes falling within the mountain's rain-shadow on the northern ridges. It is associated with the Mispah and Hutton Soil Forms (MacVicar *et al*. 1991) of Land Types Ae, Fa and Ib derived from sandstone, quartzite and conglomerate of the Wyllies Poort Geological Formation (Botha 2004a, b; Patterson & Ross 2004a, b). The *Terminalio sericea–Burkeetum africanae* in particular is associated with deep regic sands of the Namib Soil Form, which is of an aeolian origin from the Kalahari (Brandl 2002). It also includes the vegetation associated with the almost bare sheets of exposed rock against the warm northern slopes.

This vegetation type is associated with well-drained sandy soils of the relatively dry landscapes of the SC. Its plant communities occur on both very shallow and very deep sands. The shallow soils are situated on steep inclines, while the deep sands are associated with valley bottoms or higher lying sandy plateaus. Nutrients are leached out of these systems and deposited either into lower-laying systems down the catena, or transported deeper underground. The combination of soils derived from nutrient-poor parent materials and the observed leaching effect has left these communities extremely nutrient-poor and unproductive (Coetzee *et al.* 1976; Van Der Meulen 1979; Westfall 1981; Westfall *et al.* 1985).

Altitude ranges from approximately 855 m to 1590 m above sea level. The average annual rainfall is 383 mm (South African Weather Bureau), varying between 356 mm at Waterpoort to 410 mm on the farm Albert. Rainfall events are irregular and localised north of the mountain range (South African Weather Bureau).

Diagnostic taxa

The diagnostic species for *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type are presented in species group M (Table 1, Chapter 4). Diagnostic trees and shrubs characterizing the communities of this major vegetation type include *Diplorhynchus condylocarpon, Elephantorrhiza burkei, Ochna pulchra, Hexalobus monopetalus* var. *monopetalus, Grewia retinervis, Strychnos pungens, Ozoroa paniculosa* var. *salicina, Pterocarpus angolensis, Garcinia livingstonei, Commiphora marlothii, Ficus abutilifolia, Artabotrys brachypetalus, Ficus tettensis* and *Orthosiphon labiatus.*

Diagnostic succulent species include *Aloe angelica, Anacampseros subnuda, Euphorbia cooperi, Euphorbia zoutpansbergensis* and *Portulaca kermesina.*

Some of the diagnostic grass species include *Centropodia glauca, Eragrostis pallens, Schizachyrium jeffreysii, Eragrostis gummiflua, Aristida canescens* subsp. *ramosa, Aristida diffusa* and *Loudetia flavida.*

The diagnostic forbs and field-layer succulents representing this Major Vegetation Type are *Ipomoea albivenia, Selaginella dregii, Euphorbia aeruginosa, Cineraria* *parvifolia, Tephrosia longipes, Indigofera cryptantha* var. *cryptantha, Adenia spinosa, Isoglossa hypoestiflora* and *Asparagus laricinus.*

Dominant / prominent taxa

Different woody species are dominant in the different associations of this vegetation type. The most prominent of the species that are found in the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type include *Androstachys johnsonii*, *Diplorhynchus condylocarpon, Elephantorrhiza burkei*, *Garcinia livingstonei, Hexalobus monopetalus* var. *monopetalus, Ochna pulchra, Pterocarpus angolensis* (Species Group M)*, Tricalysia junodii* var. *kirkii* (Species Group N)*, Burkea africana, Pseudolachnostylis maprouneifolia* (Species Group O)*, Terminalia sericea* (Species Group P)*, Parinari capensis* subsp. *capensis* (Species Group Q), *Combretum vendae, Vangueria parvifolium* (Species Group R)*, Combretum molle, Vitex rehmannii* and *Hyperacanthus amoenus* (Species Group U).

Prominent succulent species include *Aloe angelica, Anacampseros subnuda, Euphorbia cooperi* var. *cooperi, Euphorbia zoutpansbergensis* and *Portulaca kermesina* (Species Group M).

As with the woody species, the different associations revealed different dominant grass species. Some of the grass species that dominate in the different landscapes of this vegetation type are *Aristida canescens* subsp. *ramosa*, *Centropodia glauca, Eragrostis gummiflua, Eragrostis pallens, Schizachyrium jeffreysii* (Species Group M)*, Stipagrostis uniplumis* var. *uniplumis, Digitaria eriantha, Enneapogon cenchroides, Schmidtia pappophoroides* (Species Group P) and *Loudetia simplex* (Species Group R).

The most prominent forbs within the field-layer include *Dicoma montana, Ipomoea albivenia* (Species Group M) and *Myrothamnus flabellifolius* (Species Group R).

1. *Myrothamno flabellifolii–Hexalobetum monopetali* ass. nov., hoc loco.

Nomenclatural type: Relevé 124 (holotypus)

Classified under the proposed *Selaginelletea dregei* described by Mostert *et al.* (*in prep*)

Alternative name: *Myrothamnus flabellifolius–Hexalobus monopetalus* var. *monopetalus* rock-sheet community

The *Myrothamno flabellifolii–Hexalobetum monopetali* can be regarded as an azonal plant community, which occupies the extensive rock sheets of the warmer northern slopes of the Soutpansberg. Due to the greater diversity in microhabitats structure among the rock sheets, boulders and crevices, this association contains higher plant species richness than the surrounding Leached Sandveld. The habitat associated with the *Myrothamno flabellifolii–Hexalobetum monopetali* can be described as a mosaic of distinctly different microhabitats. Depending on the specific level of syntaxonomic interpretation, the vegetation of these micro-habitats or micro-ecosystems may be regarded as uniquely different associations. The vegetation associated with these rock sheets exhibit high levels of spatial diversity, varying with the ever-changing micro-topography. This landscape is diverse and shows very little repetition. Temporal flooding of shallow soils is often followed by prolonged periods of severe desiccation. This results in an increased temporal variation in the form of successional colonisation and competition within the herb layer of a given micro-system over relatively short periods of time. For this reason, the focus was placed on strong perennial species during community description, while the herbaceous layer was handled as the more dynamic and fluctuating component of this ecosystem. For the purpose of this report, it is therefore considered as a single association that needs further study.

The *Myrothamnus flabellifolius–Hexalobus monopetalus* var. *monopetalus* Rock-sheet community is relatively rich in species endemic to the Soutpansberg. They include species such as *Aloe angelica, Combretum vendea, Ceratotheca saxicola, Duvalia procumbens, Encephlartos hirsutus, Euphorbia aeriginosa, E. rowlandii, E. zoutpnsbergensis, Pavetta tshikondeni, Orbianthus conjuntus, Stapelia clavicorona, Blepharis* sp. nov., *Tylophora codii* and *Vangueria soutpansbergensis* (Hahn 2002).

The near-endemic species *Sansiveria halii* is shared with Zimbabwe, while *Strophantus lutiolus* is shared with Maputaland (Hahn 2002).

Environmental data

The vegetation of the *Myrothamno flabellifolii–Hexalobetum monopetali* is synonymous with the north facing bare rock sheets of the SC. These rock sheets are exposed to extreme solar radiation and desiccation. The slope is a gentle 15° and the bare rock sheets comprise up to 90% of the exposed surface. The vegetation is locally discontinuous and mostly restricted to the available soil patches. Soil is limited to depressions, cracks and crevices in the bare rock sheets where soil and vegetation particles are trapped and accumulate. Soil depth varies dramatically between patches. Some of these soil patches are underlain by impermeable rock and become waterlogged in the wet season, while they are prone to severe desiccation during the prolonged dry season. The soils of this heterogeneous association mostly belong to the Mispah Soil Form (MacVicar et al. 1991) and are associated with the Fa641 Land Type. The underlying geology is sandstone and quartzite of the Wyllies Poort Geological Formation (Botha 2004a, b; Patterson & Ross 2004a, b).

Vegetation may vary from individual plants to desiccation-resistant bush-clumps containing numerous species. These islands of vegetation within a landscape of predominantly bare rock sheets are often unique in structure and species composition. The vegetation structure of the *Myrothamno flabellifolii–Hexalobetum monopetali* association can generally be described as Low Sparse Woodland (Edwards 1983).

Diagnostic taxa

This association is characterises by the diagnostic species presented in species group A (Table 7). The most prominent diagnostic tree and shrub species include *Hexalobus monopetalus* var. *monopetalus*, *Hyperacanthus amoenus, Euphorbia zoutpansbergensis, Aloe angelica, Aloe chabaudii* var. *chabaudii, Euphorbia cooperi* var. *cooperi, Garcinia livingstonei, Combretum vendae, Commiphora marlothii, Artabotrys brachypetalus, Ficus tettensis, Ficus abutilifolia, Ficus ingens* var. *ingens, Ochna inermis, Psydrax livida, Psydrax locuples, Ziziphus mucronata* subsp.

mucronata, Vangueria soutpansbergensis, Canthium mundianum, Ficus glumosa, Ceratotheca triloba and *Euphorbia confinalis.*

Eragrostis trichophora and *Panicum schinzii* were the only diagnostic grass species recorded for this association at the time when the fieldwork was conducted.

The field layer is characterised by hardy desiccation-resistant species that are capable of enduring extreme environmental fluctuations. They include *Myrothamnus flabellifolius, Selaginella dregei, Ipomoea albivenia, Euphorbia aeruginosa, Orthosiphon labiatus, Anacampseros subnuda, Portulaca kermesina, Isoglossa hypoestiflora, Dicoma montana, Asparagus laricinus, Indigofera cryptantha* var. *cryptantha, Jasminum multipartitum, Justicia montis-salinarum, Indigofera schimperi, Barleria rotundifolia, Corchorus asplenifolius, Avonia rhodesica, Cyperus rupestris, Pavonia dentata, Convolvulus sagittatus, Euphorbia griseola* subsp. *griseola, Sida cordifolia, Justicia anagalloides* and *Justicia odora*.

Dominant / prominent taxa

Prominent trees and shrubs include *Aloe angelica* (Species Group A), *Combretum vendae* (Species Group A), *Euphorbia cooperi* var. *cooperi* (Species Group A), *Euphorbia zoutpansbergensis* (Species Group A), *Garcinia livingstonei* (Species Group A), *Hexalobus monopetalus* var. *monopetalus* (Species Group A), *Hyperacanthus amoenus* (Species Group A), *Diplorhynchus condylocarpon* (Species Group C), *Elephantorrhiza burkei* (Species Group C) and *Pseudolachnostylis maprouneifolia* (Species Group C).

The most prominent grass species include *Centropodia glauca* (Species Group C), *Enneapogon cenchroides* (Species Group C), and *Loudetia simplex* (Species Group C).

Hardy perennials that are resistant to environmental extremes dominate the field layer. They include *Ipomoea albivenia* (Species Group A), *Myrothamnus flabellifolius* (Species Group A), *Pellaea calomelanos* var. *calomelanos* (Species Group C) and *Xerophyta retinervis* (Species Group C).

The large number of diagnostic species suggests that this community is unique and may present an azonal vegetation class on its own, probably with several associations. The *Myrothamno flabellifolii–Hexalobetum monopetali* is currently classified under the *Selaginellaetea dregei* of the rock sheet communities proposed by Mostert *et al.* (*in prep*). Precious little phytosociological studies have been done on the rock sheet communities of the southern African savannas (Du Preez & Bredenkamp 1991). The *Myrothamno flabellifolii–Hexalobetum monopetali* share some of the more prominent plant species within the *Munduleo sericeae–Euphorbietum cooperi* and *Crassulo sarcocaulis–Aristidietum transvaalensis* of the Sekhukhuneland rock outcrop vegetation (Siebert *et al.* 2003). These associations contain numerous succulent and drought-resistant species, which are highly specialized in their ability to withstand desiccation.

2. *Burkeo africanae–Pseudolachnostylietum maprouneifoliae* ass. nov., hoc loco.

Nomenclatural type: Relevé 19 (holotypus)

Classified under the *Burkea africana–Perotis patens* Woodland Alliance of the *Combretum molle–Diheteropogon amplectens* Woodland Order (Van Der Meulen 1979), under the *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000)

Alternative name: *Burkea africana–Pseudolachnostylis maprouneifolia* Low Bushland on shallow sandy soils against moderate slopes

Environmental data

The structure of the *Burkeo africanae–Pseudolachnostylietum maprouneifoliae* can be described as Low Bushland (Edwards 1983), dominated by short trees and shrubs (2–5 m), with a relatively dense grass sward. The woody species are somewhat stunted when compared to similar species in other associations. These communities are generally associated with the gentle northern upper slopes of the mountain's northern most ridges. These slopes are covered by shallow sandy soils of the Mispah Soil Form (MacVicar et al. 1991) and are associated with the Fa641 Land Type. The underlying geology is sandstone, quartzite and conglomerate of the Wyllies Poort Geological Formation (Botha 2004a, b; Patterson & Ross 2004a, b). These shallow sandy soils drain well, are leached and relatively nutrient poor, with a clay-content of less than 10%. Surface rock cover is generally high and ranges between 40 and 70%. The slopes are gentle at 15° and tend to be concave. The generally dense field layer results in very little soil erosion.

Diagnostic taxa

This association is characterises by the diagnostic species presented in species group B (Table 7). The diagnostic woody species are generally weak and include *Tricalysia junodii* var. *kirkii, Grewia bicolor, Mundulea sericea* and *Lannea discolor*.

Only one grass species *Melinis nerviglumis* is included in this group of diagnostic species and cannot be regarded as a very constant character species for the association.

Diagnostic forbs are relatively woody and include *Ectadiopsis oblongifolia, Corchorus confusus* and *Indigofera hilaris*.

Dominant / prominent taxa

Prominent woody species include *Diplorhynchus condylocarpon* (Species Group C), *Combretum molle* (Species Group C), *Pseudolachnostylis maprouneifolia* (Species Group C), *Vangueria parvifolium* (Species Group C), *Xerophyta retinervis* (Species Group C), *Burkea africana* (Species Group E), *Elephantorrhiza burkei* (Species Group F), and *Vitex rehmannii* (Species Group F).

The grass sward is dense and is dominated by *Aristida stipitata* subsp. *graciliflora* (Species Group C), *Centropodia glauca* (Species Group C), *Enneapogon cenchroides* (Species Group C) and *Loudetia simplex* (Species Group C).

Due to the dense grass layer, forbs are not very prominent and are more or less confined to bare patches between rocks. Some of the more prominent and common species include *Corchorus kirkii* (Species Group C), *Landolphia kirkii* (Species Group C) and *Pellaea calomelanos* var. *calomelanos* (Species Group C).

Numerous authors have described rocky leached sandveld communities very similar to the *Burkeo africanae–Pseudolachnostylietum maprouneifoliae* of the SC. These include the *Burkea africana–Diplorhynchus condylocarpon* variation of the *Burkea africana–Setaria lindenbergiana* Low Thicket of the *Burkea africana–Setaria lindenbergiana* Major Community of the Waterberg (Van Staden 2002; Van Staden & Bredenkamp 2005), the *Burkea africana–Setaria sphacelata* Undulating Plains, Footslopes, Terraces and Plateaus of the Waterberg (Henning 2002), the *Combretum molle–Euclea crispa* closed woodland (Westfall 1981; Westfall *et al.* 1985), the *Combretum molle–Aristida diffusa–Vitex rehmannii* variation of the *Combretum molle–Aristida diffusa* open woodland (Westfall 1981), the *Combretum molle–Landolphia capensis* closed woodland (Westfall 1981; Westfall *et al.* 1985), and the *Barleria bremekampii–Diplorhynchus* Tree Savanna (Coetzee *et al.* 1979) of the Nylsvlei Nature Reserve. The *Barleria bremekampii–Diplorhynchus* Tree Savanna (Coetzee *et al.* 1976) and the *Combretum molle–Aristida diffusa–Vitex rehmannii* variation (Westfall 1981) should be regarded as synonyms of the *Burkeo africanae–Pseudolachnostylietum maprouneifoliae* of the SC. In the context of the syntaxonomic classification done by Van der Meulen (1979), the above mentioned associations and communities should all be regarded as part of the *Burkea africana–Perotis patens* Woodland Alliance on warmer rocky slopes and deeper sands within the *Combretum molle–Diheteropogon amplectens* Woodland Order, under the *Terminalio sericeae–Combretetea apiculati* described by Winterbach *et al*. (2000).

3. *Terminalio sericea–Burkeetum africanae* ass. nov., hoc loco.

Nomenclatural type: Relevé 12 (holotypus)

Classified under the *Burkea africana–Perotis patens* Woodland Alliance of the *Combretum molle–Diheteropogon amplectens* Woodland Order (Van Der Meulen 1979), under the *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al*. 2000)

Alternative name: *Terminalia sericia–Burkea africana* Leached Deep Sandveld

Acocks (1953) described this association as “*Terminalia* Veld Propper (1)” under the Mixed *Terminalia–Dichapetalum* Veld (18b) of the Mixed Bushveld (18).

Environmental data

Structurally, the *Terminalio sericea–Burkeetum africanae* can be described as Short Closed Woodland (Edwards 1983). The tree layer is very dominant, with scantly distributed shrubs and a field layer dominated by grass species. Species diversity within this community is very low. It is associated with deep regic sands of an aeolian origin from the Kalahari (Brandl 2002). The soil is classified as the Namib Soil Form. Although these wind borne sands are not indicated on the Land Type maps (Botha 2004a & b; Patterson & Ross 2004a & b), they are represented on the 1:250 000 Alldays geological map (Brandl 2002). These patches of fine-grained sands occur in some valley bottoms and terraces where the sand was deposited over many years. Clay content of the soil is less than 10% and nutrient poor. Drainage is very good and the soils are leached. Within these sands, surface nutrients leach deep into the sand and are transported out of reach of the vegetation on the surface.

Diagnostic taxa

This association is characterised by the diagnostic species presented in species group D (Table 7). The diagnostic woody species include *Pterocarpus angolensis, Euclea natalensis* subsp. *natalensis, Parinari capensis* subsp. *capensis, Peltophorum africanum, Suregada africana, Dichapetalum cymosum, Salacia rehmannii, Elaeodendron transvaalense, Pterocarpus rotundifolius* subsp. *rotundifolius, Grewia monticola, Rhus leptodictya, Pygmaeothamnus zeyheri* var. *zeyheri* and *Elephantorrhiza elephantina.*

Some of the diagnostic grass species characterising this association include *Eragrostis pallens, Eragrostis gummiflua, Schmidtia pappophoroides, Stipagrostis uniplumis* var. *uniplumis, Digitaria eriantha, Schizachyrium jeffreysi, Aristida canescens* subsp. *ramosa, Aristida diffusa, Setaria sphacelata* var. *sphacelata* and *Aristida diffusa* subsp. *burkei.*

The field layer is generally poor in herb species, with diagnostic species such as *Urginea altissima, Cineraria parvifolia, Tephrosia longipes, Conostomium zoutpansbergense, Raphionacme procumbens, Bulbostylis hispidula, Cyperus albostriatus, Agathisanthemum bojeri, Phylica burchellii* and *Chamaecrista mimosoides*.

Dominant / prominent taxa

Prominent woody species include *Euclea natalensis* subsp. *natalensis* (Species Group D), *Grewia retinervis* (Species Group D), *Parinari capensis* subsp. *capensis* (Species Group D), *Peltophorum africanum* (Species Group D), *Pterocarpus angolensis* (Species Group D), *Burkea africana* (Species Group E), *Ochna pulchra* (Species Group E), *Terminalia sericea* (Species Group E), *Vitex rehmannii* (Species Group E) and *Strychnos madagascariensis* (Species Group F).

Most of the prominent grasses within the *Terminalio sericea–Burkeetum africanae* include *Aristida diffusa* subsp. *burkei* (Species Group D), *Aristida canescens* subsp. *ramosa* (Species Group D), *Digitaria eriantha* (Species Group D), *Eragrostis gummiflua* (Species Group D), *Eragrostis pallens* (Species Group D), *Schizachyrium jeffreysi* (Species Group D), *Schmidtia pappophoroides* (Species Group D), *Setaria sphacelata* var. *sphacelata* (Species Group D) and *Stipagrostis uniplumis* var. *uniplumis* (Species Group D).

The most dominant herbaceous species are relatively inconspicuous with species such as *Cineraria parvifolia* (Species Group D) and *Tephrosia longipes* (Species Group D). The geophyte *Urginea altissima* (Species Group D) is relatively common in this association.

Numerous authors have described the plant communities associated with the deeper leached sandy soils of the Waterberg and its surrounding areas. Many of these communities closely resemble the *Burkeo africanae–Pseudolachnostylietum maprouneifoliae* of the SC based on diagnostic and dominant species. Some of these include the *Ochna pulchra–Terminalia sericea* Woodland Association on rock outcrop and deeper sand (Van der Meulen 1979), the *Combretum molle–Terminalia sericea* closed woodland (Westfall 1981), the *Combretum molle–Aristida diffusa–Strychnos madagascariensis* variation of the *Combretum molle–Aristida diffusa* open woodland (Westfall 1981), the *Burkea africana–Setaria lindenbergiana* Major Community (Van Staden 2002; Van Staden & Bredenkamp 2005), and the *Terminalia sericea–Eragrostis pallens* Deep Sandy Lowlands Community (Henning 2002). Based on their common floristic and environmental components, they should all be regarded syntaxonomically as part of the *Burkea africana–Perotis patens* Woodland

Alliance on warmer rocky slopes and deeper sands within the *Combretum molle–Diheteropogon amplectens* Woodland Order described by Van Der Meulen (1979), under the *Terminalio sericeae–Combretetea apiculati* described by Winterbach *et al.* (2000).

The leached sands of the *Burkeo africanae–Pseudolachnostylietum maprouneifoliae* and *Terminalio sericea–Burkeetum africanae* are relatively species poor and no Soutpansberg endemic or near-endemic species are known to be associated specifically with them.

4. *Androstachyetum* (Coetzee 1983)

Classified as a sub-community of the *Androstachyetum* desribed by Coetzee (1983).

Nomenclatural type: Relevé 8 of Table 9 in Coetzee 1983

Alternative name: Western Soutpansberg *Androstachys johnsonii* Low Closed Woodland on steep talus slopes

Little is known about the autecology of *Androstachys johnsonii* within the Soutpanberg and Lebombo mountain ranges (Coetzee 1983; Van Rooyen 1978; Van Rooyen *et al.* 1981). Coetzee (1983) provides a speculative description of the environmental factors that he considers being the driving elements behind the structure and composition of this community. Many of the environmental conditions described by Coetzee (1983) are also similar to those experienced by the *Androstachys johnsonii* communities of the western Soutpansberg. Dense fog and mist seems to be one of the driving factors within this relatively arid ecosystem. Some in-depth autecological research on *Androstachys johnsonii* is needed in order to understand and interpret the nature and habits of these communities. The *Androstachys johnsonii* communities of the Western Soutpansberg constitute the western most distribution of *Androstachys johnsonii* and these communities within southern Africa.

The *Androstachys johnsonii* Low Closed Woodland on the steep talus slopes of the SC share floristic elements with the *Androstachys johnsonii* woodlands of the Maputaland Centre of Endemism (Hahn 2002). Floristically similar *Androstachys* *johnsonii* woodlands occur on the Mozambican costal plains (Hahn 2002). However, these woodlands are structurally taller and are associated with deep sandy substrates. Soutpansberg endemic species associated with the *Androstachys johnsonii* woodlands are *Orbianthus conjuntus* and *Duvalia procumbens*.

Due to the slow growing nature of *Androstachys johnsonii* within the western Soutpansberg, the wood produced is crooked and twisted, and does not have the same economic potential as the strait poles produced by the *Androstachys johnsonii* woodlands of the Mozambican costal plains (Hahn 2002). The threat and pressure from over-exploitation for construction material should therefore be less than currently experienced in the Maputaland Centre of Endemism. However, the limited distribution of these *Androstachys johnsonii* woodlands within the western Soutpansberg makes these populations vulnerable and wood harvesting and cutting should not be considered. The *Androstachyetum* of the SC should be protected and conserved as part of the western-most populations of *Androstachys johnsonii* woodlands. The exploitation of such a limited and slow growing natural resource is not sustainable within the confines SC.

Environmental data

The vegetation structure of the *Androstachyetum* of the SC can be described as low closed woodland (Edwards 1983). Van Rooyen (1978) described a similar community type in the north of the Kruger National Park as a dry forest. With canopy cover of this community around 75%, the decision of classifying it as closed woodland or as a forest becomes arguable. However, due to a lack of clearly defined strata within this vegetation type, the category of woodland was used in this study.

The *Androstachyetum* of the SC is associated with steep slopes and scarps on some of the southern aspects within the rain-shadow northern ridges of the mountain. These are arid environments with very low water retention capabilities. The steep southern slopes are covered with quartzite talus, which are often several meters thick. The underlying geology is diabase, overlain by this layer of quartzite talus. The underlying diabase weathers to clayey soils. The soils are litholitic, comprising of quarzite boulders overlying clayey soils. This creates a complex soil matrix for the plants involved. Plants without long taproots, such as those from the field layer, do not have access to the underlying clayey soils. It is unknown whether the *Androstachys johnsonii* trees utilise these underlying clayey soils, or whether they are restricted to the upper layers of quartzitic talus and sand. The soils underlying the talus are deep litholitic soils. The scarps are the rugged quartzite edges of the shear-levels of the Limpopo Fault. The associated landscape contains almost no soil.

The *Androstachyetum* of the SC falls within the Ib and Fa Land Types (Botha 2004a, b; Patterson & Ross 2004a, b), which is associated with the sandstone, quartzite and conglomerate of the Wyllies Poort Geological Formation. The soil is predominantly of the Mispah Form, and is prone to prolonged drought conditions. It receives a small fraction of the orographic mist that spills over the southern most ridges in order to reach these more central and northern ridges. This summer mist and fog may contribute to the plant-available moisture within this ecosystem. Whether *Androstachys johnsonii* can capture moisture in the form of mist is unknown. Further east along the Soutpansberg Mountain Range, these *Androstachys johnsonii* communities also occur along the arid northern slopes where mist and fog only occur extremely rarely.

Diagnostic taxa

This association is characterised by species group G (Table 7). Diagnostic woody species include *Androstachys johnsonii, Brachylaena huillensis* and *Obetia tenax* in the tree layer, and *Croton pseudopulchellus* and *Croton gratissimus* in the shrub layer.

A weak diagnostic grass species is *Panicum coloratum* var. *coloratum*.

The group includes only two weak diagnostic herbaceous species namely *Asparagus falcatus* and the xerophytic *Sansevieria pearsonii*.

Dominant / prominent taxa

The composition of the woody layer is completely dominated by *Androstachys johnsonii* (Species Group G), forming almost mono-specific stands. The field layer is almost non-existent and no other species can be considered as prominent.

The *Androstachyetum* of the SC is an evergreen azonal community associated with the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type within the SC. Although it has been grouped as part of the Leached Sandveld Major Vegetation Type based on communal floristics, it shares very few dominant species with the Soutpansberg Leached Sandveld communities.

The *Androstachys johnsonii–Croton pseudopulchelus* Dry Forest of the northern Kruger National Park (Van Rooyen 1978) is a relatively similar plant community at the eastern extreme of the Soutpansberg. Although the *Androstachys johnsonii–Croton pseudopulchelus* Dry Forest communities are more species rich than the *Androstachyetum* of the SC, they are considered to be sub-communities of the same association.

Coetzee (1983) first described the *Androstachyetum* from the Rhyolite formations where the Olifants River Gorge cuts through the Lebombo Mountain Range in the Kruger National Park. The *Androstachys johnsonii* dominated scrubby thicketed bush of steep talus slopes with deep litholitic soil variant (Coetzee 1983) of this association bare very close resemblance to the *Androstachys johnsonii* community described for the quartzite talus slopes of the SC. The *Androstachyetum* is regarded to be part of the proposed *Crotonetea gratissimi* described from the Kruger National Park (Mostert *et al. in prep*.).

The *Croton gratissimus–Setaria lindenbergiana* Woodland Association on isolated rocky koppies in the Bushveld Basin, which forms part of the *Burkea africana–Perotis patens* Alliance of the *Combretum molle–Diheteropogon amplectens* Woodland Order described by Van Der Meulen (1979) as part of the *Terminalio sericeae–Combretetea apiculati* described by Winterbach *et al*. (2000), share some of the diagnostic floristic elements of the *Androstachyetum* of the SC. However, it is proposed that the *Croton gratissimus–Setaria lindenbergiana* Woodland Association on isolated rocky koppies in the Bushveld Basin be removed from the *Terminalio sericeae–Combretetea apiculati* into the newly proposed *Crotonetalia* of the *Crotonetea gratissimi* (Mostert *et al. in prep*.)

Ordination

The Soutpansberg Leached Sandveld Major Vegetation Type contains a relatively diverse group of plant communities. These differences are very clear when vegetation structure and floristic composition are compared between some of the different communities. The communities are generally poor in species, with only a few species dominating in each association. The vegetation of this semi-arid Major Vegetation Type is dominated and characterised by its woody layer and contain numerous succulent species. The field layer is most often only of a temporary nature, dominated by annual species during times of abundant rainfall. These species become inconspicuous during the dry season and disappear during times of drought.

The scatter diagram displays the distribution of relevés along the second and third ordination axes (Figure 11). The vegetation units are represented as groups and their distribution on the scatter diagram corresponds with certain physical environmental gradients. The second ordination axis (eigen value = 0.760) is represented by the x-axis and the third ordination axis (eigen value = 0.674) is represented by the y-axis. Some environmental gradients that may contribute to the observed separation of associations along the x- and y-axes include surface rock cover, slope, soil depth, soil texture, soil moisture availability, aspect and air-moisture in the form of mist and fog.

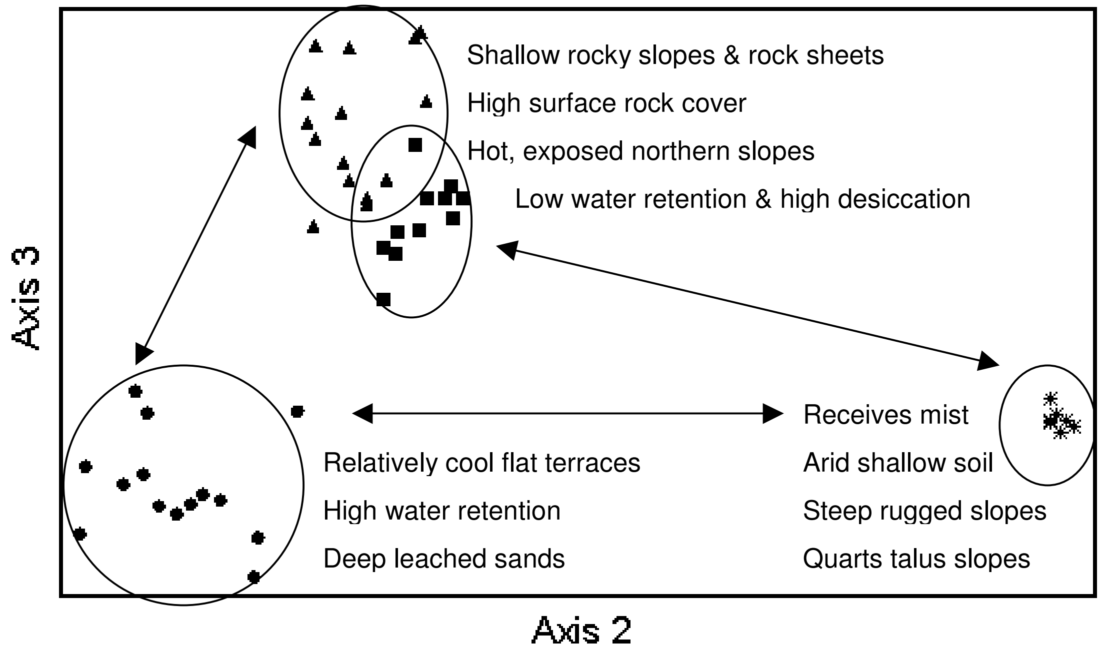
The extreme right side of the x-axis represents steep slopes on the southern aspects and crests, covered with quartzite talus. These are arid environments with very low water retention capabilities. The soils are litholitic, comprising of quarzite boulders overlying clayey soils. This creates a complex soil matrix for the plants involved. Plants without long taproots, such as those from the field layer, do not have access to the underlying clayey soils. It is unknown whether the *Androstachys johnsonii* trees utilise these underlying clayey soils, or whether they are restricted to the upper layers of quartzitic talus and sand.

The *Androstachys johnsonii* closed woodland association is very unique and is depicted by the x-axis as floristically “far removed” from the other three associations of this major vegetation type. This unique structural and floristic composition may be due to a very complex interaction between the plant species and the environmental factors involved. As mentioned by Coetzee (1983), *Androstachys johnsonii* alters and influences its local environment through its unique physiology. It may even have allelopathic effects on the surrounding vegetation, which may very well override the more obvious and measurable environmental effects acting upon it. The environmental gradients observed and measured for the current study within the Soutpansberg Leached Sandveld Major Vegetation Type seems to be insufficient for explaining the ecology of this unique plant community. Little is known about *Androstachys johnsonii* and its interaction with its immediate environment. Autecological research is needed to understand this ecologically and economically important species.

The rocky nature and steep inclines of the landscapes decreases toward the left of the x-axis. The plant communities along the middle of the x-axis are associated with moderate inclines along the northern aspects of the Soutpansberg. Surface rock cover is generally high within the *Burkeo africanae–Pseudolachnostylietum maprouneifoliae*, with some extensive rock sheets associated with the *Myrothamno flabellifolii–Hexalobetum monopetali*. The soils comprise of coarse textured sands, which are shallow and skeletal in places. The soil's water retention capabilities are generally low and water runoff against these slopes is high. Soils are well drained and leached.

The extreme left of the x-axis represents the *Terminalio sericea–Burkeetum africanae*, which is associated with deep, fine-grained, sandy soils with high water retention capabilities. Soils are well drained and leached. The terrain is relatively flat and includes relatively cool high lying sandy terraces along the northern ridges of the Soutpansberg. The surface rock cover is low.

The spatial distribution of communities along the y-axis tends to echo some of the possible environmental gradients responsible for variation in recorded floristic composition. Some of these environmental factors may include soil depth, slope, sand texture, surface rock cover, soil moisture holding capacity and soil moisture availability to plant roots. The bottom of the y-axis represents progressively finer grained sands, deeper soils, flatter slopes, less surface rock cover, higher soil moisture storage capacity and higher soil moisture availability. The top parts of the y-axis represent progressively higher values of surface rock cover, coarser grained sands, shallower soils, hotter conditions along the northern slopes of the Soutpansberg, higher water runoff from the moderate inclines and lower water retention capabilities for the shallow and skeletal soils.



Legend

Triangle: *Myrothamno flabellifolii–Hexalobetum monopetali*
Square: *Burkeo africanae–Pseudolachnostylietum maprouneifoliae*
Circle: *Terminalio sericea–Burkeetum africanae*
Star: *Androstachyetum*

Figure 11 Relative positions of all the relevés along the second and third axes of the ordination of the *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type

CHAPTER 9

SOUTPANSBERG MISTBELT COMMUNITIES

Introduction

In an overview of the vegetation of the Soutpansberg Conservancy and the Blouberg Nature Reserve (Chapter 4), the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt was identified as a Major Vegetation Type. The classification of this Major Vegetation Type is addressed in this chapter.

The mistbelt vegetation of the northern and eastern mountainous regions of South Africa has been studied and described by various authors (Acocks 1953; Moll 1972; White 1983; Lubke *et al.* 1988; Matthews *et al.* 1992b; Geldenhuys & Murray 1993; Von Maltitz *et al.* 2003). Detailed studies of the mistbelt vegetation of the north-eastern escarpment region were done by Matthews *et al.* (1991; 1992a; 1992b; 1993; 1994). These studies encompassed the Wolkberg Centre of Endemism (Van Wyk & Smith 2001). As the centre's Afrikaans name refers, this mountain's summit is often covered in clouds and mist, resulting in a variety of mistbelt vegetation types of the subtropical eastern escarpment (Fabricius 1988). Only a few of the above mentioned studies included the vegetation of the Soutpansberg. Most of these involve coarse scaled descriptions of regional vegetation types. Geldenhuys & Murray (1993) gave a detailed phytosociological description of the small and isolated Hanglip State Forest within the western Soutpansberg. In a later synthesis and reclassification of the existing forest data, Von Maltitz *et al.* (2003) lumped the forests of the Soutpanberg and north-eastern escarpment under the "Northern Mistbelt Forests". These studies, however, focussed on the forests alone and did not include any of the other plant communities situated within the mistbelt of the Soutpansberg. Acocks (1953) gave a very broad and general description of the extensive higher rainfall regions of the Soutpansberg. He lumped the plant communities of this very diverse and heterogeneous landscape under the broad categories of (8) North-eastern Mountain Sourveld and (20) Sour Bushveld. His description of the veldtypes aimed at identifying vegetation units of similar agricultural production potential, and therefore lacks the detail aimed for in the study presented in this thesis. White (1978a; 1978b;

1983) included the entire Soutpansberg region in the more inclusive Drakensberg Regional Mountain System of the Afromontane Region. The Afromontane Region was recognised as an important Centre of Plant Diversity in Africa (Site Af67), and called the Drakensberg Afromontane Regional System (Davies *et al.* 1994).

Except for the localised Hanglip State Forest vegetation study (Geldenhuys & Murray 1993), no attempt has been made to describe the different mistbelt plant communities of the Soutpansberg. This chapter is a first attempt to identify and describe the western Soutpansberg mistbelt plant communities at the syntaxonomic level of the association.

Vegetation classification

The analysis of the vegetation data resulted in the identification of a number of very diverse (structurally and floristically) plant communities within the mistbelt of the western Soutpansberg. It was decided to group and discuss these plant communities in a single chapter based on their geographical proximity along the landscape and affinity for the relatively moist and cool climatic conditions of the high lying mistbelt along the southern ridges of the Soutpansberg. Based on the hierarchical classification generated by the computer software package TWINSPAN (Hill 1979a) (Chapter 4), the plant communities were grouped into two major vegetation types:

- *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type
- *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Major Vegetation Type

By using Braun-Blanquet procedures (Mueller-Dombois & Ellenberg 1974) to further refine the phytosociological tables in MEGATAB (Hennekens & Schaminée 2001), four associations were described within the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type (Table 8):

1. *Viteco rehmannii–Syzygietum legatti*
2. *Heteropyxo natalensis–Combretetum mollis*
3. *Proteo caffrae–Setarietum sphacelatae*

4. *Cypero albostriati–Pennisetetum glaucocladii*

The first division created by the statistical computer software package TWINSPAN (Hill 1979) separated the wetlands and peatlands (*Cypero albostriati–Pennisetetum glaucocladii*) from the remaining floristic data. The second division separated the high altitude grasslands (*Proteo caffrae–Setarietum sphacelatae*) from the thickets and bush clumps. A last division split the thickets and bush clumps into the predominantly north-facing (*Heteropyxo natalensis–Combretetum mollis*) and predominantly south-facing (*Viteco rehmannii–Syzygietum legatti*) plant communities.

Table 8 Phytosociological table of the plant communities of the *Rhus rigida* var. *rigida*–*Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type

Association no.	**1**								**2**					**3**														**4**					
Relevé number	78	79	80	81	82	83	84	85	164	165	166	167	168	126	127	128	129	130	131	132	133	134	135	136	137	138	139	72	73	74	75	76	77
Diagnostic species of the *Viteco rehmannii–Syzygietum legatti*																																	
Species Group A																																	
Syzygium legatii	a	a	a	a	b	a	1	a				+									+	+		+									
Olea capensis ssp. *enervis*	a	a	1	a	a	a	1	a	+		+				+		+							+									
Vitex rehmannii	a	a	1	1	a	1	a	1																									
Euclea linearis	1	+	1	1	+	1	1	1									+	+			+			+									
Kalanchoe sexangularis	+	+	+	1	+	1	1	1																									
Lopholaena festiva	+	+	+	+	+	+	+	+																									
Xerophyta retinervis	+	+	+	+	+	+	+	+																									
Aloe arborescens	+	+	+	+	+	+	+	+	+		+						+		+					+									
Crassula swaziensis	+	+	+	+	+	+	+	+	+												+	+		+									
Senecio barbertonicus	+	+	+	+	+	+	+	+	+						+						+			+									
Khadia borealis	+	+	+	+	+	+	+	+										+			+				r								
Combretum moggii	+	+	+	+		+	+	+									+				+			+									
Apodytes dimidiata ssp. *dimidiata*	1	+	1	1	+		1	1					+																				
Vangueria parvifolium	+	+	1	+	+	+		+				+																					
Vangueria soutpansbergensis	+	+	+	+	+	+	+						+														+						
Viscum rotundifolium	+	+		+	+	+	+	+																									
Diospyros whyteana	+	+		1		1	1	1									+				+												
Rhoicissus revoilii	1	1	1	+	+	+																											
Mystacidium braybonae	+		+	+		+	+	+																									
Aloe sessiliflora	+	+		+		+	+	+																									
Psychotria capensis ssp. *capensis*	+	+	+	+		+																											
Sericanthe andongensis andongensis		+	+	+		+	+					+																					
Ekebergia pterophylla		+		+		+	+	+											+					+									
Maytenus acuminata var. *acuminata*	+	+		+		+		+				+																					
Tetradenia riparia	+	+		+			+	+					+		+												+						
Chionanthus battiscombei	+	+		+	+			+																									
Cyperus denudatus	+		+	+	+			+			+																						
Enneapogon cenchroides	+	+	+		+			+			+																						
Commelina benghalensis		+	+		+		+	+					+																				
Selaginella dregei	+	+			+	+		+																									
Anthospermum welwitschii				+	+	+	+	+			+					+						+											
Tarenna zimbabwensis	+	+			+			+				+			+									+									
Cotyledon barbeyi	+	+	+		+																												
Avonia rhodesica	+		+	+			+																										
Anacampseros subnuda		+		+	+			+																									
Nuxia floribunda	r		+	r		r																											

Rothmannia capensis	+			+	+		+																				
Rapanea melanophloeos				+		+	+	+															+					
Portulaca kermesina		+	+		+		+																				
Schefflera umbellifera				+		+		+			+																	
Cyanotis speciosa	+						+	+					+													+		
Tricalysia junodii var. *kirkii*				+				+																				
Euphorbia zoutpansbergensis	+				r																							
Polygala hottentotta				+			+																					
Isoglossa grantii			+	+																								
Ursinia nana	+					+													+					+				
Eragrostis chloromelas		+	+																		+							
Podocarpus latifolius				r		+																						
Rhus chirindensis				+			+																					
Robsonodendron eucleiform				+		+																						
Diagnostic species of the *Heteropyxo natalensis–Combretetum mollis*																												
Species Group B																												
Heteropyxis natalensis									a	+	b	a	a															
Rhus pentheri									1	r	+	1	a															
Coddia rudis									1	+	1	1	+															
Orthosiphon labiatus									+	1	+	+	+															
Lagynias dryadum									+	+		+	+															+
Erythrina lysistemon									+	+		+	+															
Dombeya rotundifolia var. *rotundifolia*									+	+		+																
Pavetta schumanniana									+	+			+															
Rhoicissus tridentata ssp. *tridentata*										+	+	+																
Tecoma capensis									+	+	+		+															
Ficus sur									+	+			+															
Flacourtia indica									+	+		+																
Oncoba spinosa									+	+			+															
Felicia muricata									+			+	+				+	+										
Senecio venosus									+	+	+					+												
Rhus lucida				+			+			+	+		+															
Tetradenia brevispicata									+	+			+												+			+
Pseudognaphalium luteo-album						+				+			+				+											
Cussonia natalensis									+		+																	
Carissa edulis									+			+																
Acacia caffra									+		+																	
Lantana rugosa									+		+																	
Acacia ataxacantha										+			+															
Vepris lanceolata									+		+																	
Species Group C																												
Englerophytum magalismontanum	a	a	1	a	1	a	a	a	+	a	+	+		1	+		+		+			+		1				
Maytenus undata	+	+	+	1	1	1	1	1	+	r	1	1	1	+								+		+				
Combretum molle	+	+	+	+	+	+	+	+	1	1	+	+	1	+					+									
Hyperacanthus amoenus	+	+	+	+	+	+	+	+	+	r	+	+	+															
Rotheca myricoides	+	+	+	+	+	+		+	+	r	+	+	+															
Combretum vendae	+		+	+	+	+	+	+	+		+	+																
Commelina erecta	+		+	+	+		+		+			+	+				+											+
Tarenna supra-axillaris			+	+	+		+	+		1	+		+															+
Olinia rochetiana	1	1	+	+	+	+	+	+			+		+															

Senecio oxyriifolius	+		+	+	+	+		+		+		+																					
Dioscorea sylvatica	+		+	+		+	+	+	+				+																				
Plectranthus neochilus			+	+	+	+			+		+	+	+				+																
Myrothamnus flabellifolius	r	r		r					a	+	+	+	+																				
Sarcostemma viminale	+			+	+		+		+	+		+	+																				
Cyperus rupestris	+	+	+					+			+	+																					
Zanthoxylum capense	+			+	+			+	+			+		+																			

Diagnostic species of the *Proteo caffrae–Setarietum sphacelatae*

Species Group D

Setaria sphacelata var. *torta*														+	a	1	3	b	b	3	1	a	4	1	3	3	b							
Trachypogon spicatus														+	+	+	+	+	+		+	+			+	+	+							
Protea caffra ssp. *caffra*														+	+		+	1	+	1		+		+			+							
Elionurus muticus														+	+		+	+	+		+	+			+		+							
Dicoma anomala														+	+	+	+		+	+	+	+		+										
Schistostephium crataegifolium																+	+	+	+	+		+	+		+	+								
Elephantorrhiza elephantina														+	+		+		+		+	+			+		+							
Protea roupelliae ssp. *roupelliae*															+			+	+	1	+	+		+			+							
Wahlenbergia undulata														+	+		+	+			+	+	+		+									
Vernonia oligocephala														+	+	+				+	+	+				+	+							
Hypoxis argentea var. *argentea*														+	+	+	+				+				+	+	+							
Eulophia ensata														+			+	+	+	+	+	+					+							
Hypoxis hemerocallidea														+	+		+	+	+			+			+									
Bulbostylis contexta														+		+			+	+	+					+	+							
Gnidia cuneata			+												+	+					+	+	+	+			+			+				
Cyperus obtusiflorus var. *obtusiflorus*					+						+			+		+			+	+			+			+	+			1				
Aristea woodii	+														+	+	+					+			+		+			+				
Bulbostylis burchellii															+			+	+	+				+	+									
Ipomoea oblongata						+									+	+	+	+	+				+											
Scabiosa columbaria														+			+					+			+	+	+							
Andropogon chinensis																1	+	+	+		+													
Eragrostis gummiflua														+							+	+			+		+	+						
Vernonia capensis															+		+			+				+			+							
Themeda triandra																		1		1		+	1		+									
Wahlenbergia grandiflora																+				+	+				+	+								
Senecio purpureus												+				+		+	+			+												
Heteropogon contortus															+					+			+				+							
Chamaecrista mimosoide															+				+	+			+											
Senecio speciosus					+										+									+	+	+						+		
Senecio inornatus		+												+							+		+		+						+			
Senecio coronatus			+								+							+				+				+							+	
Faurea saligna														+			+								+									
Gerbera jamesonii														+					+		+													
Thunbergia atriplicifolia																			+						+		+							
Eragrostis acraea																	+			+							+							
Anthospermum hispidulum																	+		+	+														
Schrebera alata															+									+			+							
Schizachyrium sanguineum															+	+	+																	
Lapeirousia sandersonii															+				+					+										
Senecio gerrardii										+				+						+				+										
Brachiaria nigropedata															+										+		+							
Eragrostis superba															+				+							1								

Species				
Dicoma montana			+ + +	
Ochna pulchra			+ + +	
Conostomium zoutpansbergense			+ + +	
Pygmaeothamnus zeyheri var. *zeyheri*			+ + +	
Salacia rehmannii			+ + +	
Dichapetalum cymosum			+ + +	
Digitaria eriantha			+ + + +	
Species Group E				
Vangueria infausta ssp. *infausta*	+	+ 1 + + 1	+ + +	
Aloe greatheadii var. *greatheadii*		+ + +	+ + +	
Lippia javanica		+ r +	+ + +	
Polygala uncinata		+ + +	+ + +	
Rhynchosia monophylla		+ +	+ + + + + + + + + + +	
Rhus tumulicola var. *meeuseana* forma *pumila*		+ +	+ + + + + + + + +	
Helichrysum cerastioides		+ +	+ + + + +	
Sporobolus fimbriatus		+ +	+ + +	
Jasminum multipartitum		+ +	+ + +	
Diospyros lycioides ssp. *sericea*		+	+ + + +	
Species Group F				
Rhus rigida var. *rigida*	1 1 1 1 + + + +	+ + +	+ + + + + + + + + + +	
Loudetia simplex	+ + + + + + + +	+ 1 1 +	a 1 1 1 1 a + a 1 + 1 1 a	
Rhus magalismontana ssp. *coddii*	a 1 a 1 a 1 1 1	+ +	+ + 1 + + + + + + + +	
Helichrysum kraussii	+ + + r 1 +		a + a + + 1 + 1 1 1 + +	+
Brachiaria serrata	+ + + + + + +		1 + + + 1 1 1 + + +	
Parinari capensis ssp. *capensis*	+ +		1 + 1 + + + 1 + + + + + +	
Mimusops zeyheri	+ 1 + + + 1 1 1	+ 1 +	+ + +	
Melinis nerviglumis	+ + + + + + + +	+ + + +	a + + + + +	
Pellaea calomelanos var. *calomelanos*	+ + + + +	+ + +	+ + + + +	
Ectadiopsis oblongifolia	+ + +	+ + + +	+ + + + + + + + +	
Landolphia kirkii	+ +	+ + +	+ + + +	
Corchorus kirkii	+ + +	+ + + + +	+ + +	
Commelina africana	+ +	+ +	+ + +	
Coleochloa setifera	+ + + + + + + +		+ + + + + +	
Asparagus falcatus	+ + + + + + +		+ + + +	
Pentanisia prunelloides ssp. *prunelloides*	+ + + + +		+ + +	
Myrsine africana	+ + +	+	+ + +	
Diagnostic species of the *Cypero albostriati–Pennisetetum glaucocladii*				
Species Group G				
Cyperus albostriatus				b 3 b 4 4 b
Thelypteris confluens				3 b b a 3 a
Pennisetum glaucocladum				3 b b b b 3
Cyperus sphaerospermus				+ a 1 b +
Pteridium aquilinum		+	r +	1 1 + + 1
Bulbostylis hispidula				1 + + + +
Pycreus polystachyos				+ + + + +
Psoralea pinnata				+ + + + +
Cyperus solidus				a a a a
Alloteropsis semialata			+	+ + + +

Persicaria decipiens																	a	1			a	a
Gunnera perpensa																			1		1	1
Drimia robusta																					+	+
Kniphofia species																				+		+
Schoenoplectus brachyceras																		+			+	
Dissotis canescens																		+				+
Chironia purpurascens																	+	+				
Chironia palustris																	+					+
Andropogon eucomus																	+			+		
Species Group H																						
Fadogia homblei				+	1	+		+	1	+	+	+	+	+	+	+			+		+	
Vernonia natalensis				+		+	+		+	+	+				+		+			+		

Seventy forest vegetation relevés were classified, using the statistical computer software package TWINSPAN (Hill 1979a). The Braun-Blanquet procedures (Werger 1974; Mueller-Dombois & Ellenberg 1974) were used to further refine the phytosociological tables in MEGATAB (Hennekens & Schaminée 2001), resulting in four associations within the *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Major Vegetation Type (Table 9):

1. *Acacio ataxacanthae–Rhoetum chirindensis*
2. *Rapaneo melanophloei–Rhoetum chirindensis*
3. *Ocoteo kenyensis–Xymaloetum monosporae*
4. *Diospyro whyteanae–Widdringtonietum nodiflorae*

The first division, created by the statistical computer software package TWINSPAN (Hill 1979a), isolated the *Widdringtonia nudiflora* dominated cliff forests from the rest of the forest communities. A further division led to the separation of regrowth and mature forest. Regrowth forest was further divided into early regrowth and advanced regrowth forest.

This very diverse group of plant communities have been group together based on the classification by the multivariate algorithm within TWINSPAN (Hill 1979a). This grouping may have been dramatically different if this data set included floristic data from a broader geographical range, e.g. including Afrotemperate regions from the eastern Soutpansberg, the upper Blouberg summits and the adjacent Wolkberg–Drakensberg range. It may be that some of the associations within the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type belong to different classes within the syntaxonomical hierarchy of southern Africa’s vegetation. However, many species are shared between the four described associations, rendering them more alike to one another than to the associations of the other major vegetation types of the Blouberg and Soutpansberg Conservancy. More intense sampling of the topographically diverse mistbelt landscape of the Soutpansberg will certainly lead to an increased number of associations. More phytosociological work is sorely needed within this landscape.

As with the rest of the major vegetation types described within this thesis, the decision was made not to describe any new alliances, orders and classes at this point in time. The classification of vegetation data representative of a small geographical range into higher order groupings, without understanding its floristic association and position within the vegetation of the relevant associated vegetation, is premature and unproductive (Werger 1974). Such classified units are artificial and without any predictive value. The formal syntaxonomic description of alliances, orders and classes should be based on a classification of ecologically related plant communities, and should not be dictated by geographical or artificial boundaries of nature reserves or countries. The associations described in this thesis were assigned to existing vegetation classes from the literature where deemed appropriate.

Community description

Rhus rigida var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type

The *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type consists of somewhat artificial conglomerate of associations, which may belong different syntaxanomic vegetation classes. Syntaxanomic affiliations will be discussed under the headings of the various associations.

Environmental data

The *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type is confined to the higher lying crests and plateaus situated above 1 200 m above sea level and include the highest peak of the Soutpansberg mountain range, Lajuma (1748 m above sea level). The landscape is rugged and forever changing, resulting in a high richness of habitat types within very limited spatial confines. It is associated with Glenrosa and Mispah Soil Forms (McVicar *et al.* 1991) of Land Types Fa641 and Ib362 derived from sandstone, quartzite and conglomerate of the Wyllies Poort Geological Formation (Botha 2004a). The Champagne Soil Form is found along the localized high lying wetlands.

The soils derived from the underlying sandstone and quartzites are extremely shallow and made up of coarse sands. Along the rugged and broken hillsides, these coarse sandy soils drain quickly, leading to leached and acidic soil conditions. However, the impermeable rock beds along the relatively flat plateaus often prevent water from draining away, leading to temporary flooded conditions of the shallow soils. The depth of the soil and the extent of rock-cover determine the vegetation structure and species composition within this vegetation type.

The higher lying crests and ridges within the mistbelt are exposed to strong winds. During the summer months, these winds carry moisture in from the Indian Ocean, covering the vegetation in mist on an almost daily basis, giving rise to an abundance of rock- and bark-lichens and bryophytes. The combination of frequent orographic rain and mist during the summer months leaves the available soil drenched and sometimes flooded for extended periods. During the prolonged dry season, the prevailing winds are dry, causing dehydration and desiccation of the soils and vegetation (Hahn 2002). These extreme and fluctuating environmental conditions have led to specialization among the plants and may explain the relatively high level of endemisity within this vegetation type (Hahn 2002). The deeper soils within the mistbelt can be regarded as sponge areas, which slowly release water to feed mountain streams over prolonged periods.

The amount of orographic rain associated with the southern ridges varies considerably in accordance to the changing landscape. The venturi effect caused by certain narrow gorges when mist is forced through them by orographic, anabatic and catabatic winds can lead to abnormally high and localised rainfall (Matthews 1991; Hahn 2002). The areas just below the escarpment crest, where atmospheric moisture can be trapped most effectively against the south-facing escarpment, generally yield the highest precipitation (Matthews 1991). Long-term average rainfall measured on the farm Ventersdorp (altitude 1370 m) for the period of 20 years (1934–1954) is 585 mm per annum (South African Weather Bureau). The recorded long-term average rainfall on the farm Hanglip (altitude 1719 m) for the period of 90 years (1913–2003) is 774 mm per annum (South African Weather Bureau). Long-term average rainfall measured on the farm Schyffontein (altitude 1370 m) for the period of 22 years (1964–1986) is 835 mm per annum (South African Weather Bureau). Apart from the spatial variation in rainfall, the area reveals a high temporal variation in recorded rainfall (Geldenhuys & Murray 1993). Mean annual rainfall fluctuated between 571 mm for the period 1965 to 1971 and 1 027 mm for the period 1979–1988 (South African Weather Bureau). Additionally to these rainfall figures, the amount of precipitation as a result of mist can be substantial (Schutte 1971). In the higher lying areas of the KwaZulu-Natal Drakensberg the orographic fog contribution at 1 800 m altitude is an additional 403 mm per annum, which amounts to one third of the mean annual precipitation (Matthews 1991). As with many mountainous areas, the daily weather of the higher altitude crests and summits of the Soutpansberg is very unpredictable, fluctuating between extremes within a matter of hours.

Structurally, the plant communities of the Mistbelt Major Vegetation Type are extremely diverse. It includes wetlands, low open grasslands and bush clumps of short thickets (Edwards 1983).

Diagnostic taxa

The diagnostic species for this group are presented in Species Group V (Table 1, Chapter 4). Due to the structural and floristic diversity within the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type, diagnostic species may be locally dominant, but very few have high constancy throughout the entire major vegetation type.

The diagnostic woody species include mainly dwarfed or stunted trees and shrubs, such as *Rhus rigida* var. *rigida, Ectadiopsis oblongifolia* and *Parinari capensis* subsp. *capensis, Olea capensis* subsp. *enervis, Syzygium legatii, Rotheca myricoides, Euclea linearis, Rhus tumulicola* var. *meeuseana, Olinia rochetiana, Combretum moggii, Vangueria soutpansbergensis, Tarenna supra-axillaris, Protea caffra* subsp. *caffra, Elephantorrhiza elephantina, Tetradenia riparia, Apodytes dimidiata* subsp. *dimidiata, Protea roupelliae* subsp. *roupelliae, Lopholaena coriifolia, Tarenna zimbabwensis, Ekebergia pterophylla* and *Myrsine africana.*

Diagnostic herbaceous species include *Fadogia homblei, Helichrysum kraussii, Rhynchosia monophylla, Commelina erecta, Vernonia natalensis, Dicoma anomala, Gnidia cuneata, Wahlenbergia undulata, Hypoxis argentea* var. *argentea, Eulophia ensata, Aristea woodii, Vernonia oligocephala, Pentanisia prunelloides* subsp. *prunelloides, Anthospermum welwitschii, Ipomoea oblongata, Schistostephium* *crataegifolium* and *Asparagus falcatus*, as well as the succulent herbaceous species *Senecio barbertonicus, Aloe arborescens, Crassula swaziensis, Khadia borealis, Plectranthus neochilus, Kalanchoe sexangularis, Sarcostemma viminale, Senecio oxyriifolius,* the fern species *Pteridium aquilinum,* and the parasitic species *Viscum rotundifolium* on woody plants.

Diagnostic grass species include *Melinis nerviglumis, Brachiaria serrata, Setaria sphacelata* var. *torta, Trachypogon spicatus* and *Elionurus muticus*.

Diagnostic sedge species include *Coleochloa setifera, Cyperus obtusiflorus* var. *obtusiflorus* and *Bulbostylis contexta*.

Dominant / prominent taxa

The most prominent grass species within this collection of diverse communities is *Loudetia simplex* (Species Group F).

Dominant woody species include *Combretum molle* (Species Group C), *Rhus magalismontanum* subsp. *coddii* (Species Group F), *Englerophytum magalismontanum* (Species Group F), *Mimusops zeyheri* (Species Group F), and *Maytenus undata* (Species Group F).

1. *Viteco rehmannii–Syzygietum legatti* ass. nov., hoc loco.

Nomenclatural type: Relevé 78 (holotypus)

Alternative name: *Vitex rehmannii–Syzygium legatti* Mistbelt Low Thickets and Bush Clumps

This association should be classified as part of the *Englerophyto magalismontani–Acacietea caffrae* Savanna Class described by Winterbach *et al.* (2000).

Environmental data

The vegetation structure of the *Viteco rehmannii–Syzygietum legatti* can be described as Low Thicket (Edwards 1983) or short bush clumps (Matthews 1991). The topography is one of rugged quartzite mountain slopes and terraces. Soils are sandy, coarse, shallow and leached by the relatively high precipitation from orographic summer rain. Soil clay content is below 10%. Among the rock fragments, plates and boulders are patches of deeper soil where these bush clumps and thickets proliferate. Surface rock cover varies between 20–60%. The Land Types associated with this community, Fa, Ab and Ib, are derived from the sandstone and conglomerate of the Wyllies Poort Formation (Botha 2004b). Soils are mostly of the Mispah Soil Form (McVicar *et al.* 1991). Altitude ranges between 1 400 and 1 700 m. This mistbelt association is situated high on the southern slopes of the southern ridges of the western Soutpansberg, which are frequently dampened by orographic mist during the summer months.

Diagnostic taxa

This association is characterised by the diagnostic species represented by Species Group A (Table 8). The most prominent diagnostic woody species include *Syzygium legatii, Olea capensis* subsp. *enervis, Vitex rehmannii, Euclea linearis, Kalanchoe sexangularis, Lopholaena festiva, Xerophyta retinervis, Aloe arborescens, Crassula swaziensis, Senecio barbertonicus, Khadia borealis, Combretum moggii, Apodytes dimidiata* subsp. *dimidiata, Vangueria parvifolium, Vangueria soutpansbergensis, Viscum rotundifolium, Diospyros whyteana, Rhoicissus revoilii, Aloe sessiliflora, Psychotria capensis* subsp. *capensis, Sericanthe andongensis* var. *andongensis, Ekebergia pterophylla, Maytenus acuminata* var. *acuminata, Tetradenia riparia* and *Chionanthus battiscombei*.

The grass layer is generally poorly developed, with *Enneapogon cenchroides* as the only weak diagnostic species for this group.

Diagnostic herbaceous species include *Mystacidium braybonae, Commelina benghalensis, Selaginella dregei* and *Anthospermum welwitschii,* as well as the succulent species *Kalanchoe sexangularis*, the sedge *Cyperus denudatus* and the parasitic species on woody plants *Viscum rotundifolium.*

Dominant / prominent taxa

Many of the dominant woody species are also diagnostic species and include *Syzygium legatii* (Species Group A)*, Olea capensis* subsp. *enervis* (Species Group A), *Englerophytum magalismontanum* (Species Group C), *Rhus magalismontana* subsp. *coddii* (Species Group F), *Rhus rigida* var. *rigida* (Species Group F), *Euclea linearis* (Species Group A), *Vitex rehmannii* (Species Group A), *Apodytes dimidiata* subsp. *dimidiate* (Species Group A), *Diospyros whyteana* (Species Group A), *Xerophyta retinervis* (Species Group A), *Combretum molle* (Species Group A), *Hyperacanthus amoenus* (Species Group C) and *Olinia rochetiana* (Species Group C).

Prominent grass species within the weak grass layer include *Loudetia simplex* (Species Group F), *Brachiaria serrata* (Species Group F) and *Melinis nerviglumis* (Species Group F).

Dominant herbaceous species include *Mystacidium braybonae* (Species Group A), *Helichrysum kraussii* (Species Group F), *Asparagus falcatus* (Species Group F), as well as the succulent species *Kalanchoe sexangularis* (Species Group A), *Senecio oxyriifolius* (Species Group C), *Crassula swaziensis* (Species Group F), *Senecio barbertonicus* (Species Group F), *Khadia borealis* (Species Group F) and the sedge species *Coleochloa setifera* (Species Group F) and the parasitic species on woody plants *Viscum rotundifolium* (Species Group A). A strong presence of lichens and bryophytes were noted within this association during the time of vegetation sampling.

The larger bush clumps within this association contain many forest tree species. It may therefore seem to be an early successional stage of forest community. However, the size of the available soil pockets and the generally shallow nature of the soil will prevent it from turning into forest. The *Viteco rehmannii–Syzygietum legatti* and the *Heteropyxo natalensis–Combretetum mollis* of the SC mistbelt share numerous species (Species Group C). Both these associations share their most dominant species with the *Combretum molle–Coleochloa setifera* open woodland and the *Combretum molle–Heteropogon contortus–Rhus dentata* closed woodland variation of the *Combretum molle–Heteropogon contortus* closed and open woodlands described by Westfall (1981, 1985) of the Waterberg Mountain Range. It is therefore suggested that these associations and communities be classified into a single syntaxon of higher hierarchical status, such as an alliance or an order.

The *Diplorhynchus condylocarpon–Englerophytum magalismontanum* Rocky Slope Community of the Waterberg Biosphere (Henning 2002) share some limited floristic elements with the *Viteco rehmannii–Syzygietum legatti*. Although they share a very similar landscape, the *Diplorhynchus condylocarpon–Enlerophytum magalismontanum* Rocky Slope Community of the Waterberg contain more xeric species, while the *Viteco rehmannii–Syzygietum legatti* of the Soutpansberg mistbelt contains more mesic species.

2. *Heteropyxo natalensis–Combretetum mollis* ass. nov., hoc loco.

Nomenclatural type: Relevé 164 (holotypus)

Alternative name: *Heteropyxis natalensis–Combretum molle* Mistbelt Low Thicket and Bush Clumps

Classified under the *Englerophyto magalismontani–Acacietea caffrae* Savanna Class described by Winterbach *et al.* (2000).

Environmental data

The vegetation structure of the *Heteropyxo natalensis–Combretetum mollis* can be described as Low Thicket (Edwards 1983) or short bush clumps (Matthews 1991). It is situated between 1 400 and 1 600 m above sea level and falls within the confines of the mistbelt. This plant community occurs in close proximity of the *Viteco rehmannii–Syzygietum legatti*. The *Heteropyxo natalensis–Combretetum mollis*, however, occupies the warmer and drier northern aspects with its gentle slopes. It shares the same Land Types as the *Viteco rehmannii–Syzygietum legatti* namely Fa, Ab and Ib, derived from the sandstone and conglomerate of the Wyllies Poort Formation (Botha 2004b). Soils are mostly of the Mispah Soil Form (McVicar *et al.* 1991). Soil clay content is below 10%. Surface rock cover varies between 20–60%.

Diagnostic taxa

This association is characterised by the diagnostic species represented in Species Group B (Table 8). Most prominent diagnostic woody species include *Heteropyxis natalensis, Rhus pentheri, Coddia rudis, Orthosiphon labiatus, Lagynias dryadum, Erythrina lysistemon, Dombeya rotundifolia* var. *rotundifolia, Pavetta schumanniana, Rhoicissus tridentata* subsp. *tridentata* and *Tecoma capensis*.

No diagnostic grass species were recorded.

Only a few weak diagnostic herbaceous species were recorded for this association namely *Felicia muricata, Senecio venosus, Pseudognaphalium luteo-album* and *Lantana rugosa*.

Dominant / prominent taxa

Prominent trees and shrubs include *Heteropyxis natalensis* (Species Group B), *Englerophytum magalismontanum* (Species Group C), *Maytenus undata* (Species Group C), *Rhus pentheri* (Species Group B), *Coddia rudis* (Species Group B), *Orthosiphon labiatus* (Species Group B), *Combretum molle* (Species Group C), *Hyperacanthus amoenus* (Species Group C), *Rotheca myricoides* (Species Group C) and *Vangueria infausta* subsp. *infausta* (Species Group E).

A weak grass layer is dominated by *Loudetia simplex* (Species Group F) and *Melinis nerviglumis* (Species Group F).

Dominant herbaceous species include *Myrothamnus flabellifolius* (Species Group C), *Ectadiopsis oblongifolia* (Species Group F) and *Corchorus kirkii* (Species Group F).

The *Heteropyxo natalensis–Combretetum mollis* and the *Viteco rehmannii–Syzygietum legatti* of the SC mistbelt share numerous species (Species Group C). As mentioned previously, both these associations share their most dominant species with the *Combretum molle–Coleochloa setifera* open woodland and the *Combretum molle–Heteropogon contortus–Rhus dentata* closed woodland variation of the *Combretum molle–Heteropogon contortus* closed and open woodlands described by Westfall (1981, 1985) of the Waterberg Mountain Range. It is therefore suggested that these associations and communities be classified into a single syntaxon of higher hierarchical status, such as an alliance or an order. The *Burkea africana–Englerophytum magalismontanum* variation of the of the *Burkea africana–Setaria lindenbergiana* Low Thicket of the *Burkea africana–Setaria lindenbergiana* Major Community (Van Staden 2002; Van Staden & Bredenkamp 2006) share some limited floristic elements of the *Heteropyxo natalensis–Combretetum mollis* of the SC.

3. *Proteo caffrae–Setarietum sphacelatae* ass. nov., hoc loco.

Nomenclatural type: Relevé 127 (holotypus)

Alternative name: *Protea caffra–Setaria sphacelata* var *torta* High Altitude Low Closed Grassland

This association should be classified as part of the *Loudetio simplicis–Alloteropsidetea semialatae* Grassland Class described by Matthews *et al.* (1994).

Environmental data

The vegetation structure of the *Proteo caffrae–Setarietum sphacelatae* can be classified as Low Closed Grassland (Edwards 1983). Some authors have referred to these high lying grasslands as "Fynbos" (Van Wyk & Smith 2001) due to the high incidence of Fynbos floristic elements within this plant community. However, this association is dominated by grass species and share structural similarities with the *Diheteropogono amplectentis–Proteetum gaguedi* described by Matthews (1994) as part of the relatively low altitude grasslands of the North-eastern Mountain Sourveld of the Limpopo and Mpumalanga escarpment. It should therefore, be regarded as part of the Afromontane grasslands of the Afro-alpine Phytochorion (White 1978) and part of the North-eastern Mountain Grassland of the Grassland Biome (Deall *et al.* 1989; Matthews *et al.* 1992b; 1993; Burgoyne 1995; Bredenkamp *et al.* 1996). Numerous other *Protea*-dominated grassland communities have been described by Acocks (1953) from the Bankenveld, Coetzee (1974, 1975) from the Magaliesberg area, Bredenkamp and Theron (1978) from the Suikerbosrand, Behr and Bredenkamp (1988) from the Witwatersrand, Hattingh (1991) from the hills of the Voortrekker Monument in Pretoria, Bezuidenhout *et al.* (1994) from the Gatsrand area in North-West Province, Coetzee *et at.* (1995), Bredenkamp and Brown (1998a; 1998b) from the natural areas of the Western Metropolitan Local Council, Grobler *et at.* (2002), from various natural open spaces in Gauteng, and Bredenkamp and Van Rooyen (1996b) from the rocky hills and ridges in the Witwatersrand, Magaliesberg, Suikerbosrand, Gatsrand and Vredefort Dome areas.

The shallow coarse-grained sandy soils of this association are highly leached and dominated by the Glenrosa Soil Form (McVicar *et al.* 1991). Soil clay content is below 10%. Water drainage is good. It is associated with the Fa, Ab and Ib Land Types derived from the sandstone and conglomerate of the Wyllies Poort Formation (Botha 2004b). The landscape is a mosaic of grassland patches and rocky quartzite outcrops within a heterogeneous rugged terrain. The low closed grassland (Edwards 1983) patches cover the flat and undulating areas where shallow sandy soils have accumulated to sustain a dense grass layer. These low grasslands with their shallow soils are prone to soil erosion and very sensitive to overgrazing and trampling. The rocky outcrops cover between 10 and 45% of the surface area. Fynbos associated floristic elements tend to increase as surface rock cover increases, while the percentage of relative grass cover decreases. The vegetation is predominantly situated at high altitudes (1 500–1 748 m) high against the southern slopes of the southern most ridges of the mountain and exposed to strong winds. The woody vegetation is generally dwarfed and low growing.

Diagnostic taxa

This association is characterised by the diagnostic species represented in Species Group D (Table 8). The most prominent diagnostic woody species include *Protea caffra* subsp. *caffra, Elephantorrhiza elephantina, Protea roupelliae* subsp. *roupelliae, Faurea saligna, Rhus rigida* var. *rigida, Rhus magalismontana* subsp. *coddii*, *Parinari capensis* subsp. *capensis, Schistostephium crataegifolium* and *Ectadiopsis oblongifolia*.

Diagnostic grass species are *Setaria sphacelata* var. *torta, Trachypogon spicatus, Elionurus muticus* and *Andropogon chinensis*.

The herbaceous layer is relatively rich in species and contains diagnostic species such as *Dicoma anomala, Wahlenbergia undulata, Vernonia oligocephala, Hypoxis argentea* var. *argentea, Eulophia ensata, Hypoxis hemerocallidea, Gnidia cuneata, Aristea woodii, Ipomoea oblongata, Scabiosa columbaria* and *Vernonia capensis*, as well as sedge species *Bulbostylis contexta, Bulbostylis burchellii* and *Cyperus obtusiflorus* var. *obtusiflorus*.

Dominant / prominent taxa

The woody layer is sparse with isolated and often prominent individuals of *Protea caffra* subsp. *caffra* (Species Group D), *Elephantorrhiza elephantina* (Species Group D), *Protea roupelliae* subsp. *roupelliae* (Species Group D), *Schistostephium crataegifolium* (Species Group D) and *Faurea saligna* (Species Group D).

Dominant grass species include *Setaria sphacelata* var. *torta* (Species Group D), *Trachypogon spicatus* (Species Group D), *Elionurus muticus* (Species Group D), *Andropogon chinensis* (Species Group D), *Loudetia simplex* (Species Group F) and *Brachiaria serrata* (Species Group F).

The rich herbaceous layer is dominated by species such as *Dicoma anomala* (Species Group D), *Wahlenbergia undulata* (Species Group D), *Vernonia oligocephala* (Species Group D), *Hypoxis argentea* var. *argentea* (Species Group D), *Eulophia ensata* (Species Group D), *Hypoxis hemerocallidea* (Species Group D), *Helichrysum kraussii* (Species Group F) and *Fadogia homblei* (Species Group H).

Combretum molle–Agyrolobium transvaalense open woodland community described by Westfall (1981, 1985) of the Waterberg Mountain Range share some floristic and structural properties with the *Proteo caffrae–Setarietum sphacelatae* of the SC. However, the *Combretum molle–Agyrolobium transvaalense* open woodland community is associated with higher soil nutrient status and is dominated by *Themeda triandra*. Both of these are regarded as grasslands, and not as woodlands. *Proteo caffrae–Setarietum sphacelatae* of the SC also share some species with the *Combretum molle–Heteropogon contortus–Chaetacanthus costatus* open woodland variation of the *Combretum molle–Heteropogon contortus* closed and open woodlands described by Westfall (1981, 1985) of the Waterberg Mountain Range. However, the *Combretum molle–Heteropogon contortus–Chaetacanthus costatus* open woodland variation contains more woody species and is regarded as woodland and not a grassland. The *Combretum molle–Protea caffra* open woodland described by Westfall (1981) and Westfall *et al.* (1985) of the Waterberg Mountain Range share limited florist links (but few structural links) with the *Proteo caffrae–Setarietum sphacelatae*. Some limited floristic links exist between the *Andropogon* *appendiculatus–Eragrostis pallens* grassland of the Waterberg Mountain Range (Westfall 1981; Westfall *et al.* 1985) and the *Proteo caffrae–Setarietum sphacelatae*.

Strong floristic links exist between the *Protea roupellia–Helichrysum nudifolium* sparse woodland and the *Trachypogon spicatus–Eragrostis racemosa* grassland of the Waterberg (Westfall 1981; Westfall *et al.* 1985) and the *Proteo caffrae–Setarietum sphacelatae* of the SC. However, the *Trachypogon spicatus–Eragrostis racemosa* grassland of the Waterberg is more comparable to the lower altitude high rainfall grassland patches further to the east within the Soutpansberg. These communities are generally rich in herbaceous species, and are often referred to as types of "fynbos" (Van Wyk & Smith 2001). However, based on the dominance of grass species within these plant communities, they are regarded as grassland containing limited fynbos floristic elements.

The *Protea caffra–Loudetia simplex* Major Community of the Marakele National Park (Van Staden 2002) compares to the communities described by Westfall (1981) and Westfall *et al.* (1985) for the Waterberg Mountain Range, and share some species with the *Proteo caffrae–Setarietum sphacelatae*.

The system is quite stable and fairly predictable without much change caused by normal droughts or grazing. However, if overgrazed or disturbed to such an extent that degradation proceeds beyond a threshold, then recovery is very slow, due to reduced nutrient cycling and decreased nutrient availability, and the vegetation may change to another domain of attraction (Bredenkamp *et al. in press*), which will be different from the original climax vegetation, representing a plagioclimax. A change back to the original domain of attraction is unlikely if not impossible in the short and medium term (Bredenkamp *et al. in press*). Due to the quartzitic derived shallow nutrient poor soils these systems are sensitive and intolerant to frequent impacts such as heavy grazing, ploughing, trampling.

4. *Cypero albostriati–Pennisetetum glaucocladii* ass. nov., hoc loco.

Nomenclatural type: Relevé 75 (holotypus)

Alternative name: *Cyperus albostriatus–Pennisetum glaucocladum* High Altitude Wetlands and Peatlands

The *Cypero albostriati–Pennisetetum glaucocladii* association falls within the Limpopo Plain and Central Highland Peatland Eco-regions described by Marneweck *et al.* (2001).

The *Cypero albostriati–Pennisetetum glaucocladii* wetlands can be described as azonal plant communities, whose distribution is governed by the occurrence of permanent wet patches. Within the high altitude areas of the Soutpansberg, these wetlands are very localised and limited to small areas. Some of the high altitude wetlands sampled revealed characteristics of peat wetlands and bogs. As a broad estimate, a soil may be considered a peat soil if it has more than 20–35% organic matter on a dry weight basis (Mitsch and Gosselink 1986). This is by no means a strict definition and there is still considerable debate among wetland scientists as to what actually defines a peat soil (Smuts 1992). Peatlands are some of the most rare wetland types in South Africa and only 1 % of the peatlands of the world occur in Africa and South America (Marneweck *et al.* 2001; Grundling & Grobler 2005).

At least three internationally recognised peatlands occur within the SC, namely the Bluegumspoort Peatland, the Lajuma East Peatland and the Lajuma West Peatland (Marneweck *et al.* 2001). They form part of the Limpopo Plain and the Central Highlands Peatland Eco-regions described by Marneweck *et al.* (2001). Wetlands and peatlands are protected in accordance with the Conservation of Agricultural Resources Act (Act 43 of 1983). The National Water Act, 36 of 1998 further states that it is a criminal offence to mine peatlands or to divert, impede or alter the course or characteristics of water flow within wetlands without the proper authorisation (Winstanley 2001). These wetlands are of great ecological and economical value and should be conserved for their biodiversity, ecosystem functioning and the irreplaceable ecological services they provide to the humans depending on them (Costana *et al.* 1997).

Even though the six wetlands sampled within the SC differed considerably with regard to vegetation structure, it was decided to bind them into a single association based on their floristic similarities and their ecological functionality as wetlands. This phenomenon of great structural and floristic differences between different individual wetland stands were also observed by Cilliers *et al.* (1998), Marneweck *et al.* (2001), Myburg & Bredenkamp (2004) and Grundling & Grobler (2005) However, more work is needed in order to understand and conserve the variety of different wetlands and peatlands within the western Soutpansberg effectively.

Environmental data

The topography of the six high altitude wetlands sampled varies considerably. Some are long and narrow, following the sharp bottomlands of small and isolated valleys. Others are polygons of low-lying depressions within isolated "amphitheatres". The topography of a wetland affects the potential water depth, speed of water flow and the drainage of the wetland. Due to the strong rainfall gradients experienced within the Soutpansberg, the geographical position of the wetland will influence the potential amount of rain it receives. Likewise, the size of the wetland's catchment area will affect the potential amount of water it may receive. In turn, these factors affect the structure and composition of the vegetation of a given wetland. With so much variation in local topography, catchment area size and local precipitation, the dynamics of the different wetlands and peatlands vary accordingly.

In general, the vegetation structure can be described as medium to tall closed grass-and-sedge wetlands, with a very high biomass production. Similarly structured vegetation has been described for the bogs and mires of Lesotho (Granger & Bredenkamp 1996; Marneweck *et al.* 2001). The high biomass production at the relatively cool temperatures of these high altitudes, together with seasonally waterlogged conditions have led to the build-up of organic matter within the available soil. Under these cold anaerobic conditions, organic decomposition is often very slow, which leads to the build-up of organic matter in the soil (Marneweck *et al*. 2001). Over prolonged periods this process may lead to the formation of peatlands. Some of the wetlands sampled reveal localised accumulation of fine-grained peat, and can therefore considered as peatlands. Elsewhere, the dominant soil form within these wetlands may be classified as the Champagne Soil Form (McVicar *et al.* 1991).

Although the surface rock cover within the wetlands is below 1 %, continuous quartzite banks often demarcate the edges of the wetlands.

It occurs in a variety of Land Types, such as Fa, Ab and Ib (Botha 2004a). All of these Land Types are associated with sandstone and conglomerate of the Wyllies Poort Formation. Soils from the surrounding slopes are shallow and comprise mainly of coarse sands, which drain well and are highly leached. Water from the small catchments of these isolated plateaus drain into the lower lying depressions to form these wetlands. The underlying water-impermeable rock prevents water from draining away vertically. This leads to either stagnant waterlogged conditions, in the case where the wetland has no outlet, or slow horizontal draining to lower ground, in the case where the wetland has an outlet.

Diagnostic taxa

The diagnostic species for this group are presented in Species Group G (Table 8). The most prominent diagnostic grass species characterising this association are *Pennisetum glaucocladum, Alloteropsis semialata* and *Andropogon eucomus*.

Diagnostic sedges include *Cyperus albostriatus, Cyperus sphaerospermus, Bulbostylis hispidula, Pycreus polystachyos* and *Cyperus solidus*.

Two locally prominent ferns were recorded as diagnostic species namely *Thelypteris confluens* and *Pteridium aquilinum*.

Some of the diagnostic herbaceous species include *Persicaria decipiens, Gunnera perpensa, Drimia robusta, Kniphofia* species, *Schoenoplectus brachyceras, Dissotis canescens, Chironia purpurascens, Psoralea pinnata* and *Chironia palustris.*

Dominant / prominent taxa

The grass species *Pennisetum glaucocladum* (Species Group G) dominates the peripheral drier zone of this association.

Fern species *Thelypteris confluens* (Species Group G) and *Pteridium aquilinum* (Species Group G) dominate the moist zone.

Members of the Cyperaceae family *Cyperus albostriatus, Cyperus sphaerospermus, Bulbostylis hispidula, Pycreus polystachyos* and *Cyperus solidus* dominate the permanently wet core area. The only herbaceous species worth mentioning as potentially dominant is *Persicaria decipiens* (Species Group G), which is confined to the wetter core area.

Due to the scale at which sampling have been done, the wetlands of the SC have been described as a single association. However, the various zones of wetness within theses wetlands should be described and delineated as unique variations, sub-associations or even separate associations. Each of these zones has a distinctly different floristic composition and ecological functioning (Marneweck *et al.* 2001). More work is needed with regard to these different zones within the wetlands of the SC.

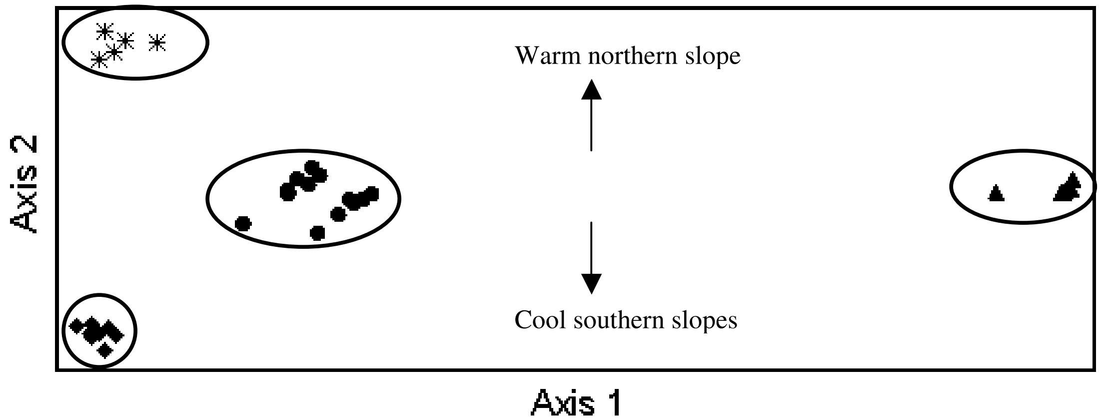
Ordination

The *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type represents those associations restricted to the mistbelt zone of the SC. Although one can describe these associations as structurally and floristically diverse, they all share an affinity and dependence on the moisture laden-air, fog-drip and orographic rain associated with the mistbelt. These sources of moisture are predictable and create relatively moist conditions within the context of the SC. The mistbelt associations rely on and are primarily driven by this relative abundance of plant-available moisture. High percentage atmospheric moisture during the warm and often dry summer months further reduces transpiration and water-loss during critically dry periods of the growing season.

The scatter diagram (Figure 12) displays the distribution of relevés along the first and second ordination axes. The vegetation units are represented as groups and their distribution on the scatter diagram corresponds with certain physical environmental conditions. The first axis (eigen value = 0.957), orientated along the x-axis, represents soil depth, percentage surface rock cover, soil texture, clay percentage and soil moisture content. Those associations along the left of the diagram represent bush clump vegetation with shallow soils, relatively little organic soil matter, high percentages surface rock cover, relatively low soil moisture values and low soil clay fractions. The cluster of relevés on the right represents a wetland association with deep peat soils with a high percentage of organic soil matter, low percentages surface rock cover, permanently flooded conditions and high soil clay fractions.

The second axis (eigen value = 0.455), orientated along the y-axis, represents aspect and solar radiation. The relevés closer to the x/y-intercept represent the plant communities situated on southern aspects, while the relevés further from the x/y-intercept represent the plant communities situated along the northern aspects. Due to the inclination if the sun during winter in the southern hemisphere, and the inclination of the under lying rock plates, the northern aspects receive much more perpendicular radiation than the southern aspects. The southern slopes are steeper, causing the sun's rays to reach this aspect at a shallow angle, dispersing the intensity and amount of radiation experienced by the vegetation. The southern aspects can therefore be regarded as cooler than the northern aspects of the mountain.

It is clear from the distinct groupings in the above ordination scatter plot that there are distinct differences between these four associations. According to the classification done on the mistbelt vegetation data, each of these associations contain a large number of unique diagnostic species. These distinct separations among the mistbelt associations of the SC strengthen the notion that these associations may belong to different syntaxonomic classes.



Shallow	←	Soil depth	→	Deep
Low	←	Soil moisture	→	High
High	←	Surface rock cover	→	Low
Low	←	Clay content	→	High
Low	←	Organic fraction	→	High

Legend

Star: *Heteropyxo natalensis–Combretetum mollis*
Diamond: *Viteco rehmannii–Syzygietum legatti*
Circle: *Proteo caffrae–Setarietum sphacelatae*
Triangle: *Cypero albostriati–Pennisetetum glaucocladii*

Figure 12. Relative positions of all the relevés along the first and second axis of the ordination of the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type

Forests of the Soutpansberg Conservancy

South Africa's temperate inland forests are highly valued and extensively utilised for their hardwood species and general biodiversity. Afromontane, or rather Afrotemperate Forest is considered as an extremely vulnerable vegetation type (Cawe 1990; Lawes *et al.* 2000; Seydack 2000; Obiri 2002) and is protected under the National Forests Act (Act No 84 of 1998). Unfortunately, most of the western Soutpansberg's forest patches were converted to commercial plantations of exotic timber species before legislation came into effect (Geldenhuys & Murray 1993). Selective logging of the eighteenth and nineteenth century have also had long-term impacts on forest species composition (Obiri 2002).

A number of attempts have been made to create a comprehensive classification for South Africa's remaining forest types (White 1978a; Geldenhuys 1987; Geldenhuys 1992; Shackleton *et al.* 1999; Von Maltitz *et al.* 2003). The recent classification by Von Maltitz *et al.* (2003) lumped the forest communities of the Blouberg, Soutpansberg, North Eastern Escarpment, Mariepskop and Barberton regions under the name "Northern Mistbelt Forest". These Afrotemperate forests have been described by numerous authors and under various different names; Afromontane forest (Cooper 1985, White 1978), Temperate, Transitional and Scrub Veld Types (Acocks 1953), Uplands Vegetation (Edwards 1967; Moll 1976), Interior Forests (MacDevette *et al*. 1989), Montane *Podocarpus* Forest (Cooper 1985; Edwards 1967; Moll 1976), Highland Sourveld (Acocks 1953), Mist Belt Mixed *Podocarpus* Forest (Cooper 1985; Edwards 1967; Moll 1976) and Natal Mist Belt Ngongoni Veld (Acocks 1953).

The Afrotemporate Forest vegetation type has a highly fragmented distribution pattern and ranges from Knysna in the south to the Soutpansberg in the north (Whyte 1978; Van Wyk & Smith 2001). These forests are generally confined to the mountainous regions of the Drakensberg (*sensu latu)* along sheltered pockets (relatively frost- and snow-free) of the escarpment (Acocks 1953). It is associated with areas of high plant-available water (Rutherford and Westfall 1986), which in tern is a function of amount of precipitation, seasonality of precipitation, evapotranspiration, soil structure and availability of groundwater (Von Maltitz *et al.* 2003).

Forest should be seen as dynamic ecosystems that owe their persistence and resilience to fundamentally different processes of plant regeneration ecology (Bond & Midgley 2001). While late succession species have seeds that can germinate and establish under a mature forest canopy, early succession species establish in larger forest gaps or at the forest fringe (Midgley *et al.* 1995; Brokaw & Busing 2000). Depending on the type and frequency of disturbance within a forest, a dynamic equilibrium between early and late successional species can fluctuate between extremes (Denslow 1987). Due to this dynamic nature of especially forest edges, the associated communities tend to shift in space over time as ecological events and disturbances alter the forest margin. Even though these communities associated with the forest margin may be seen as ecotonal and spatially temporal, they play such an important role in the integrity and stability of the core forest areas, that they should be considered as functional and structural vegetation entities in their own right. The current patterns of distribution and composition of forest species are the result of many factors, such as historical events, dispersal pathways, management, successional stage, dispersal mechanisms, habitat requirements, establishment requirements, biotic interactions and disturbance events and regimes (Von Maltitz *et al.* 2003).

All the forest communities of the Soutpansberg have not yet been described and classified. Geldenhuys & Murray (1993) provided a comprehensive description of one of the larger remaining forest patches within the western Soutpansberg, the Hanglip State Forest. This data, together with some newly collected data from further west within the SC, were classified in order to create a more comprehensive image of the forest communities of the SC. Some measures had to be taken to enhance compatibility of the old and new data, which are discussed in detail under the heading "Methods". The aim of this classification is to provide conservation agencies with a yardstick by which forests types can be identified, evaluated, managed, protected and monitored. Without a scientifically based classification, conservation authorities will not be able to report meaningfully on the state of the forest resources, nor set and adapt conservation priorities (Von Maltitz *et al.* 2003). It is vital to understand the floristic characteristics and ecology of these remaining pockets of forest within the SC in order to affectively conserve, protect and manage them.

Until the work of Von Maltitz *et al.* (2003), there has been no attempt to co-ordinate an objective classification system for all forests in South Africa (Shackleton *et al.* 1999). However valuable their classification, it did not produce a formal syntaxonomic hierarchy of the southern African forests. Due to the geographical restriction of the data used in the classification of the Soutpansberg forests, vegetation could only be described up to the association level. This is also true for some previous formal syntaxonomic descriptions of forest vegetation (Matthews *et al.* 1992a; Van Staden & Bredenkamp 2006).

Xymalos monospora–Rhus chirendensis **Western Soutpansberg Forest Major Vegetation Type**

Environmental data

The *Xymalos monospora–Rhus chirendensis* Western Soutpansberg Forest Major Vegetation Type is confined the southern slopes of the southern most ridges of the mountain. The higher lying quartz escarpment forms part of the Wyllies Poort Geological Formation, while the lower lying igneous rock forms part of the Sibasa Geological Formation (Brandl 2002). Dominant soil forms include the Glenrosa, Mispah and Shortlands Soil Forms (McVicar *et al.* 1991) of Landtype Fa535 derived from basalt, tuff, sandstone, and conglomerate of the Sibasa Geological Formation (Von dem Bussche 1984; Botha 2004a; Patterson & Ross 2004a), as well as the Glenrosa and Mispah Soil Forms (McVicar *et al.* 1991) of Landtype Ib349 derived from sandstone and conglomerate of the Wyllies Poort Formation (Botha 2004a; Patterson & Ross 2004a). According to Louw *et al*. (1994) the soils derived from the igneous rock are highly weathered, fertile red ferrallitic soils with a high clay fraction. The A-horizon is often a complex mixture of quartzitic sand from the higher lying Wyllies Poort Formation and clay from the local Sibasa Formation, as well as high quantities of organic matter from the forest vegetation. Defining the geology and soil formations is often difficult and problematic along this ruptured section of the mountain where the upper sedimentary plates have torn and mixed with volcanic material (Barker 1979, 1983; Bumby 2000, Bumby *et al.* 2001). When vegetation is removed, soil erosion becomes a major problem along the steep slopes with its relatively shallow soils and high rainfall.

As with the other Afrotemperate Forest types, the *Xymalos monospora–Rhus chirendensis* Western Soutpansberg Forest Major Vegetation Type is dependant on the orographic rain and mist driven onto the southern slopes by a south-easterly wind during summer. Rainfall varies dramatically with regard to topographical positioning of individual forest patches. Variability in annual precipitation is further complicated by cyclical dry and wet periods of which we understand precious little of. Von Maltitz *et al.* (2003) estimated the average annual rainfall at approximately 1500 mm. Temperatures range from below 0 °C in winter to above 30 °C in summer and increases from higher altitudes to the foothills (South African Weather Bureau).

The evergreen high forests are confined to the mistbelt of the mountain, which reaches down as far as 1380 m above sea level (Geldenhuys & Murray 1993). Deciduous shrub forest forms a fire resistant ecotone of thickets, which extend to below the mistbelt zone of the southern slopes. Within the Soutpansberg mistbelt plants often rely on 'fog drip' for moisture (Cawe 1994).

Geldenhuys and Venter (2002) identified the Soutpansberg forests as relatively high in species richness, recording 195 trees, 79 shrubs, 34 lianes, 21 vines, 43 ferns, 13 graminoids, 9 geophytes, 20 epiphytes, 32 herbs and 4 other growth forms. The vegetation structure of the *Xymalos monospora–Rhus chirendensis* Western Soutpansberg Forest Major Vegetation Type can be described as closed high forest (Edwards 1983).

Diagnostic taxa

The diagnostic species for the *Xymalos monospora–Rhus chirendensis* Western Soutpansberg Forest Major Vegetation Type are presented in Species Group V (Table 1, Chapter 4). They include the woody species *Xymalos monospora, Zanthoxylum davyi, Celtis africana, Nuxia floribunda, Rhoicissus tomentosa, Kiggelaria africana, Vepris lanceolata, Rapanea melanophloeos, Rothmannia capensis, Brachylaena discolor, Ficus craterostoma, Combretum kraussii, Trichilia dregeana, Trimeria grandifolia, Drypetes gerrardii* and *Oxyanthus speciosus* subsp. *gerrardii*.

Dominant / prominent taxa

Prominent species within this major vegetation type include the woody species *Xymalos monospora*, *Celtis africana, Nuxia floribunda, Rhoicissus tomentosa, Vepris lanceolata, Rapanea melanophloeos, Rothmannia capensis* (Species Group V), *Diospyros whyteana* (Species Group W), *Rhus chirindensis* and *Cussonia spicata* (Species Group X).

Table 9 Phytosociological table of the plant communities of the *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Major Vegetation Type

Association number	1											2														3																																				4			
Variant number																										3.1								3.2																				3.3												
Releve number	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	210	211	212	213	214	215	216	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	111	112	113	114	68	69	70	71
Species Group A																																																																		
Diagnostic species of the *Acacio ataxacanthae–Rhoetum chirindensis*																																																																		
Acacia ataxacantha	4	2	2	2	2	3	3	3	1	1	1	1																																																						
Acacia sieberiana		1			1	2																																																												
Erythrina lysistemon	1									1		1																																																						
Species Group B																																																																		
Rhus chirindensis	1	3	4	2	2	2	2	2	2	3	3	2	2	4	4	4	4	3	3	2	2	1	3	3	3	2	3	2								1							1	1	1						1	2							1			2				
Brachylaena discolor	1	2	1					2	2	3		1		1		1		3		4	1		1			1	2				1							1																												
Vepris lanceolata				1	2	2	3			2	3	2	2	1		2	1	1	2			2		2							1				2	1																													
Halleria lucida			2									1	1	3				2			2	2																																												
Curtisia dentata		1									1					1			1		1	2																																												
Pittosporum viridiflorum					2		1	1											2	2																																														
Species Group C																																																																		
Diagnostic species of the *Ocoteo kenyensis–Xymaloetum monosporae*																																																																		
Xymalos monospora					1				2		2		3	2		1								1		3	5		3	3	3	3	2	3	2	3	3	3	3	3	2	3	4	3	3	3	3	2	2	2	2	3	2	3	4	2	3	2	1	2	3	2				
Rhoicissus tomentosa					1																						2	1	1		2	1	1	2	1	2			2	1	1				3		1	1	1					1							1					
Chionanthus foveolatus																						2							1		1	1	1																					2	2					1						

Species Group D
Diagnostic species of the *Olea capens* ssp. *macrocarpa* variant

Drypetes gerrardii		2	1 2 2 2 1 2	2 2	2 1
Olea capens ssp. *macrocarp*		1	2 2 1 1 1 1	1 2	1

Species Group E
Diagnostic species of the *Rothmannia capensis* variant

Rothmannia capensis				2 2 3 3 2 2 2 1 2 3 1 1 1 1 2 1 2 1	1
Oxyanthus speciosus ssp *gerardii*			1 1	1 2 1 1 3 1 2 2 2 1 1	1 1
Calodendrum capense	1	1	1	1 1 1 1	
Trichilia emetica			1	1 1 1 1	1

Species Group F
Diagnostic species of the *Ocotea kenyensis* variant

Ocotea kenyensis				1 1 1	1 2 2 1 2 2 1 2 3
Podocarpus falcatus					1 3 1
Podocarpus latifolius					1 4 1

Species Group G

Celtis africana	1 1 2	2 1 1	1 2 1 1 1 1	1 2 2 1 1	3 2 1 2 2 1 1
Nuxia floribunda	2 1 3 3	3 3 2 2 2 1 1 2 2 1	1 1	2 1 4 3 2	1 1
Cussonia spicata	1 2 2 2 2 2 2 3	3 3 1 1 1 2 1 2	2 2	2 1 2 1 1	
Zanthoxylum davyi	1	2 1 1 1 1 1 2	1 1 1 1	2 1 1 1 2 1 1 2	1 1 1
Maesa lanceolata	1 2 2 1	1 1 2 2 2 3 2	1	1 1 1	2 3 1
Kiggelaria africana	1 2 1 2	1 2	1 2 1 1 2	1 1 2 1	1 1
Maytenus undata	3 4 1 1 1	2	2 3 2	2 1 2 1 1 1 2 1	
Trichilia dregeana	1 3	1 1 1 2 1 1	1	1 1 1 2	1 1 1 1
Rapanea melanophloeos	1 1 1	2 2 3 2 4 4 3 4	1	1 1 1	
Ficus crateostoma		1 1	1 1	2 1 1 1 1 2	1 1 1 3
Combretum kraussii	1 1	2 1 3 1 1 1		1 1	1 1
Timeria grandifolia	2 1	1 1 1 1	1	1	1 1
Prunus africana	1 1 2	2	1 2 1	1	
Ochna holstii	1 1			1 1 2	2 1 1
Cassipourea geradii	1	2		1 1	2 1 1
Rhus leptodictya	1 1 1		2 1		

Clausena anisata		1 2	1			
Vepris reflexa		2	1			

Species Group H
Diagnostic species of the *Diospyro whyteanae–Widdringtonietum nodiflorae*

Widdringtoni nodiflora						3 3 2 2
Myrsine africana						2 2 1 2
Rhoicissus revoilii						2 1 2 1
Clutia pulchella v. pulchella						1 1 2 1
Rumoha adiantiformis						1 1 1 1
Kalanchoe crundallii						1 1 1

Species Group I

Diospyros whyteana	1 1	1 2 1 2 1	1	2 3 1 2	4 2 2 2	2 2 2

1. *Acacio ataxacanthae–Rhoetum chirindensis* ass. nov., hoc loco.

Nomenclatural type: Relevé 182 (holotypus)

Alternative name: *Acacia ataxacantha–Rhus chirindensis* early regrowth forest (Geldenhuys & Murray 1993)

The *Acacio ataxacanthae–Rhoetum chirindensis* shows some floristic similarities with the *Acacio ataxacanthae–Celtidetum africanae* described by Matthews *et al.* (1992a). Their syntaxonomic relationships are currently not clear.

Environmental data

Early regrowth forest occurs mainly along the forest margin where disturbances have driven the vegetation back to early successional stages. These disturbances can either be historical, such as the removal of timber from the one mature forest patches, or may recent or regular, such as fire damage to the forest margin. Disturbance regimes are the main driving forces behind the establishment and maintenance of these early regrowth forest patches. Other environmental factors, such as geology and soil type, play only minor parts in the dynamic nature of the early regrowth forests. Due to the dynamic nature of this vegetation type, it is not geographically restricted or stagnant and will disappear as the forest is given the opportunity to recover to mature forest. The vegetation structure can be described as short to tall forest (Edwards 1983).

Diagnostic taxa

The diagnostic species for the *Acacio ataxacanthae–Rhoetum chirindensis* are presented in Species Group A (Table 9). They include the woody species *Acacia ataxacantha, Acacia sieberiana* and *Erythrina lysistemon*.

Dominant / prominent taxa

Acacia ataxacantha (Species Group A) and *Vepris lanceolata* (Species Group C) regenerate profusely in the early regrowth forests. Other prominent woody species include *Rhus chirindensis* (Species Group C), *Brachylaena discolor* (Species Group C), and *Cussonia spicata* (Species Group H). Where light manages to penetrate to the forest floor through forest canopy openings, the grass species *Oplismenus hirtellus* occurs. These patches are dependent on disturbance events, such as a fallen canopy tree, and are only of a temporary nature within this vegetation type.

2. *Rapaneo melanophloei–Rhoetum chirindensis* ass. nov., hoc loco.

Nomenclatural type: Relevé 199 (holotypus)

Alternative name: *Rapanea melanophloes–Rhus chirindensis* advanced regrowth forest (Geldenhuys & Murray 1993)

Environmental data

Advanced regrowth forest generally occurs away from the forest margin, and is located between early regrowth forest and mature forest. Just as with the early regrowth forests, the advanced regrowth forests are dynamic in their structure and species composition. Again, disturbance regimes are the main driving forces behind its establishment, with other environmental factors of less importance regarding its dynamic nature. The vegetation structure can be described as high forest (Edwards 1983).

Diagnostic taxa

The diagnostic species for the *Rapaneo melanophloei–Rhoetum chirindensis* are presented in Species Group B (Table 9). According to the plots sampled, this association only contains a single diagnostic woody species *Rapanea melanophloes*. *Rapanea melanophloes* regenerate abundantly in advanced regrowth forests, but is relatively absent from the early regrowth forests. The *Rapaneo melanophloei–Rhoetum chirindensis* is characterised more redily by the absence of those species presented in Species Groups A, C, D, E, F and H. Since this plant community occupies the transitional state of succession between pioneer stages and mature forest, it shares species with both the *Acacio ataxacanthae–Rhoetum chirindensis* (early regrowth forest) and the *Ocoteo kenyensis–Xymaloetum monosporae* (mature forest). Tree species shared with the early regrowth forest include *Brachylaena discolour, Vepris lanceolata, Halleria lucida, Curtisia dentata*, *Pittosporum viridiflorum* and *Rhus chirindensis*. However, individuals of these trees are much larger within the advanced regrowth forests, and fewer individuals of a specific species contribute to the estimated cover value. *Zanthoxylum davyi* (Species Group H) is more or less restricted to the advanced regrowth forest and mature forest.

Dominant / prominent taxa

These communities have higher species richness then those of the more mature forest communities. This is typical for areas of intermediate disturbance regimes or for early successional stages where competition for the available resources and niches are still fierce, with no domination by any single species yet. Prominent or dominant tree species within the advanced regrowth forests include *Rhus chirindensis* (Species Group C), *Brachylaena discolor* (Species Group C), *Vepris lanceolata* (Species Group C), *Maesa lanceolata* (Species Group C), *Halleria lucida* (Species Group C), *Maesa lanceolata* (Species Group D), *Nuxia floribunda* (Species Group H), *Cussonia spicata* (Species Group H) and *Zanthoxylum davyi* (Species Group H). Again, those trees shared with the early regrowth forest are much larger within the advanced regrowth forests, and fewer individuals of a specific species contribute to the estimated cover value.

3. *Ocoteo kenyensis–Xymaloetum monosporae* ass. nov., hoc loco.

Nomenclatural type: Relevé 113 (holotypus)

Alternative name: *Ocotea kenyensis–Xymalos monospora* mature forest

Environmental data

Dominant soil forms include the Glenrosa, Mispah and Shortlands Soil Forms (McVicar *et al.* 1991) of Landtype Fa derived from basalt, tuff, sandstone, and conglomerate of the Sibasa Geological Formation (Von dem Bussche 1984; Botha 2004a; Patterson & Ross 2004a). However, A-horizon is often a complex mixture of quartzitic sand washed in from the higher lying Wyllies Poort Formation and clay from the local Sibasa Formation, as well as high quantities of organic matter from the forest vegetation. These nutrient rich soils, with their high organic matter content and high plant available moisture content, are very productive. Unfortunately, these favourable conditions have been exploited by commercial forestry, which converted large areas of indigenous high forest to exotic plantations of Pine and Eucalyptus trees. The remaining patches of natural forest can be described as high forest (Edwards 1983).

Diagnostic taxa

Diagnostic tree species of the *Ocoteo kenyensis–Xymaloetum monosporae* (mature forest) are presented in Species Group C, D, E and F (Table 9), and include *Xymalos monospora, Rhoicissus tomentosa, Chionanthus foveolatus* (Species Group C), *Drypetes gerrardii, Olea capens* subsp. *macrocarpa* (Species Group D), *Trichilia emetica, Rothmannia capensis, Oxyanthus speciosus* subsp. *gerardii, Calodendrum capense* (Species Group E), *Ocotea kenyensis, Podocarpus falcatus* and *Podocarpus latifolius* (Species Group F).

Dominant / prominent taxa

Prominent tree species of the mature forest include *Xymalos monospora, Rhoicissus tomentosa* (Species Group C), *Drypetes gerrardii, Olea capens* subsp. *macrocarpa* (Species Group D), *Rothmannia capensis, Oxyanthus speciosus* subsp. *gerardii* (Species Group E), *Ocotea kenyensis, Podocarpus falcatus, Podocarpus latifolius* (Species Group F) and *Celtis africana* (Species Group G).

Some localised patches of mature forest contained *Rhus chirendensis* as a common species. However, the individuals in the mature forest are considerably larger then those in the regrowth forests. This indicates an advanced stage of recovery after a disturbance (Geldenhuys & Murray 1993). These plots may therefore have been placed in non-homogeneous vegetation units.

Three variations within the *Ocoteo kenyensis–Xymaloetum monosporae* (mature forest) were identified based on the classification (Table 9). These include 3.1 *Olea capens* subsp. *macrocarpa* dominated stands, 3.2 *Rothmannia capensis* dominated stands and 3.3 *Ocotea kenyensis* dominated stands. However, the environmental variables recorded for these three variations showed no obvious differences. These variations could therefore not be interpreted ecologically. This may indicate that the variation in floristics noted is due to different successional stages of the vegetation, or that the environmental data gathered did not reflect the true driving factors of the vegetation. More fieldwork may shed some light on this issue.

The *Ocoteo kenyensis–Xymaloetum monosporae* shares very limited floristic links with the *Celtis africana–Erythrina lysistemon* kloof forest described by Westfall

(1981, 1985) of the Waterberg Mountain Range and the *Clauseno–Podocarpus latiflii* of the *Podocarpetalia latifolii* described by Du Preez *et al.* (1991) for the eastern Free State. The *Podocarpus latifolius–Rothmannia capensis* Tall Forest (Van Staden 2002; Van Staden & Bredenkamp 2006) resembles the *Rothmannia capensis* dominated stands of the *Ocoteo kenyensis–Xymaloetum monosporae*. The *Olea europaea–Calpurnea aurea* Tall Closed Woodland (Van Staden 2002; Van Staden & Bredenkamp 2006) share a few species with the *Olea capens* subsp. *macrocarpa* dominated stands.

4. *Diospyro whyteanae–Widdringtonietum nodiflorae* ass. nov., hoc loco.

Nomenclatural type: Relevé 68 (holotypus)

Alternative name: *Diospyros whyteana–Widdringtonia nudiflora* quartzite cliff forest

Very few studies of cliff vegetation have been done in southern Africa. Because they are so difficult to reach and so little is known about their associated species, vegetation scientists often choose to ignore them. The cliff forests of South Africa are no exceptions. The *Diospyro whyteanae–Widdringtonietum nodiflorae* is therefore a first attempt to describe a cliff forest community formally and syntaxonomically.

Environmental data

The *Diospyro whyteanae–Widdringtonietum nodiflorae* is situated against the steep south facing cliffs and narrow ledges of the southern most ridges of the Soutpansberg. These high lying sandstone and quartzite scarps form part of the Wyllies Poort Geological Formation (Botha 2004a; Patterson & Ross 2004a). As warm moisture laden air rises from the southern plains, it cools down, drenching the cliffs in thick mist and fine orographic rain on a frequent basis during the summer months. These moist conditions are conducive to the growth of many bryophytes and lichens. Over thousands of years, these wet sponges have trapped enough dust particles to form skeletal soils along the narrow ledges and cracks of the cliffs. It is these skeletal soils that maintain the cliff forest recorded in this study. Some of the soil pockets contain thick layers of highly weathered organic material, which aid in the absorption and retention of atmospheric moisture. Throughout most of the rainy season these sponge-like soils are saturated with moisture, slowly releasing water through gravity. It is plain to see how sensitive and vulnerable the soils of this system are to potential disturbances. The vegetation structure can be described as short forest (Edwards 1983).

Diagnostic taxa

The diagnostic specie of the *Diospyro whyteanae–Widdringtonietum nodiflorae* are presented in Species Group I (Table 9). They include the woody species *Widdringtoni nodiflora, Myrsine africana, Rhoicissus revoilii* and *Clutia pulchella* var. *pulchella*.

Diagnostic herbaceous species include the fern species *Rumoha adiantiformis* and the succulent herbaceous species *Kalanchoe crundallii*.

Dominant / prominent taxa

This association is entirely dominated by the tree species *Widdringtoni nodiflora* (Species Group I). Other dominant woody species include *Myrsine africana* (Species Group I), *Rhoicissus revoilii* (Species Group I) and *Diospyros whyteana* (Species Group J).

The most dominant fern species is *Rumoha adiantiformis* (Species Group I), while *Kalanchoe crundallii* (Species Group I) could be considered the most prominent herbaceous species.

The *Widdringtonia nodiflora–Podocarpus latifolius* Short Forest of the Marakele National Park (Van Staden 2002; Van Staden & Bredenkamp 2006) share some species with the *Diospyro whyteanae–Widdringtonietum nodiflorae*. However, this community of Marakele is much richer in species, containing a species complex are abscent from the *Diospyro whyteanae–Widdringtonietum nodiflorae* of the SC. While the *Widdringtonia nodiflora–Podocarpus latifolius* Short Forest is associated with deep moist kloofs and ravines, the *Diospyro whyteanae–Widdringtonietum nodiflorae* is associated with exposed steep cliffs. Both these communities are however, seasonally drenched in moisture. The differences in species composition and ecosystem functioning between these two communities suggest that they differ enough to be concidered seperate associations. The *Diospyro whyteanae–Widdringtonietum nodiflorae* shares some very limited floristic affinities with the

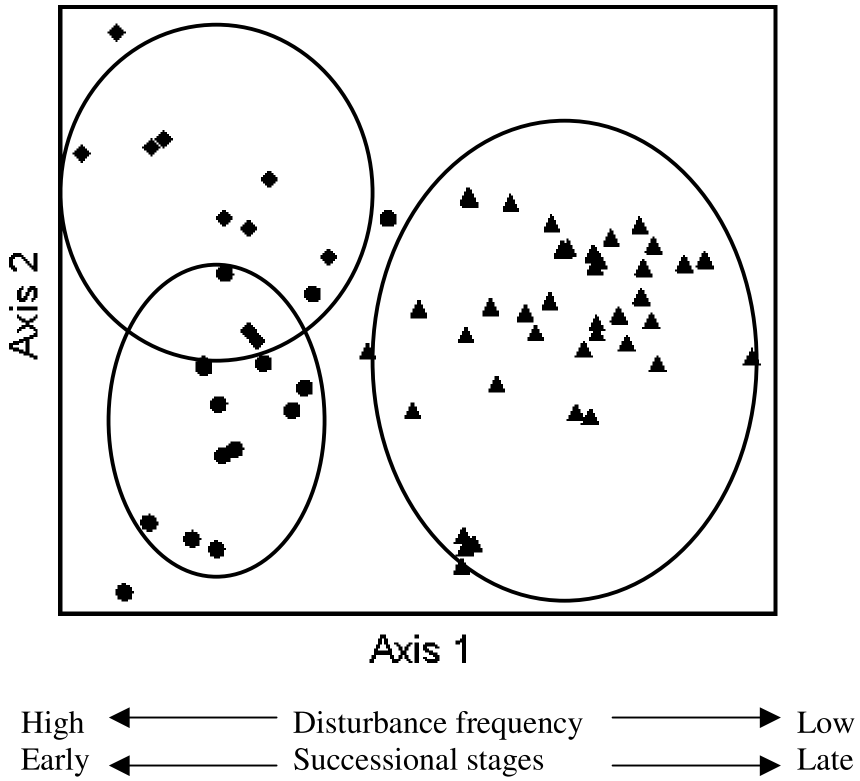
Trachypogon spicatus–Eragrostis racemosa grassland described by Westfall (1981, 1985) for the Waterberg Mountain Range.

Ordination

The forests of the SC can firstly be categorised as sheltered high forests and exposed cliff forests. These two types are structurally and floristically very different. Both the classification and ordination done on the vegetation dataset showed this to be the case. For this reason, vegetation data from the relatively sheltered high forest were subsequently ordened separately. This created some distance between the relevés in the scatter plot, enhancing the ability to detect and identify groupings.

The scatter diagram (Figure 13) displays the distribution of relevés along the first and second ordination axes. The vegetation units are represented as groups and their distribution on the scatter diagram corresponds with certain physical environmental conditions. The first axis (eigen value = 0.859), orientated along the x-axis, represents the degree of succession in which a particular vegetation sample plot was at the time of recording. This was taken as an indication of the frequency and / or degree of disturbance the vegetation has been submitted to in the relatively recent past (>100 years). Those associations along the left of the diagram represent forest vegetation that is still in the early stages of succession after some disturbance events in the past. These associations include the *Acacio ataxacanthae–Rhoetum chirindensis* early regrowth forest and the *Rapaneo melanophloei–Rhoetum chirindensis* advanced regrowth forest. The relevés further to the right in the scatter plot represent vegetation sample plots associated with forest patches that are in late successional stages, which have reached a climax state. These relevés represent the *Ocoteo kenyensis–Xymaloetum monosporae* mature forest. Due to a number of reasons, these forest patches have escaped the disturbances of high intensity timber mining, or sufficient time have passed for their recovery after the last major disturbance event.

The second axis (eigen value = 0.565), orientated along the y-axis, does not reflect the succession gradient seen along the x-axis. None of the recorded environmental variables could be linked to the distribution gradient displayed by the relevés along y-axis.



Legend

Diamond: *Acacio ataxacanthae–Rhoetum chirindensis* ass.
Early regrowth forest

Circle: *Rapaneo melanophloei–Rhoetum chirindensis* ass.
Advanced regrowth forest

Triangle: *Ocoteo kenyensis–Xymaloetum monosporae* ass.
Mature forest

Figure 13. Relative positions of all the relevés along the first and second ordination axes of the of the *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Major Vegetation Type

SYNTAXONOMIC SUMMARY

To assist in giving a clear concise account of the syntaxa identified within the eight Major Vegetation Types of the Soutpansberg Conservancy and the Blouberg Nature Reserve, the following summary is presented (communities of the BNR were not formally named):

4. *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type
   4.1 *Spirostachys africana–Sclerocarya birrea* subsp. *caffra* community
   4.2 *Solanum panduriforme–Sclerocarya birrea* subsp. *caffra* community
   4.3 *Terminalia prunioides–Sclerocarya birrea* subsp. *caffra* community

5. *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type
   5.1 *Acacia nilotica–Acacia tortilis* community
   5.2 *Combretum apiculatum–Acacia tortilis* community
   5.3 *Rhus leptodictya–Acacia tortilis* community

6. *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type
   6.1 *Pseudolachnostylis maprouneifolia–Combretum molle* community
   6.2 *Hyperacanthus amoenus–Combretum molle* community

7. *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type
   7.1 *Commiphoro tenuipetiolatae–Adansonietum digitatae*
   7.2 *Ledebourio ovatifoliae–Commiphoretum mollii*
   7.3 *Phyllantho reticulati–Acacietum nigrescentis*
   7.4 *Tinneo rhodesianae–Combretetum apiculati*
   7.5 *Dichrostachyo cinereae–Spirostachyetum africani*
   7.6 *Themedo triandrae–Pterocarpetum rotundifolii*
   7.7 *Cypero albostriati–Syzygietum cordatum*

7.8 *Sesamothamno lugardii–Catophractetum alexandri*

8. *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets Major Vegetation Type
   8.1 *Euphorbio ingentis–Cathetum edulis*
   8.2 *Bridelio micranthae–Carissetum edulis*
   8.3 *Cussonio natalensis–Acacietum karroo*
   8.4 *Olea europaeoe–Buddlejetum salviifoliae*

9. *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type
   9.1 *Myrothamno flabellifolii–Hexalobetum monopetali*
   9.2 *Burkeo africanae–Pseudolachnostylietum maprouneifoliae*
   9.3 *Terminalio sericea–Burkeetum africanae*
   9.4 *Androstachyetum*

10. *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type
   10.1 *Viteco rehmannii–Syzygietum legatti*
   10.2 *Heteropyxo natalensis–Combretetum mollis*
   10.3 *Proteo caffrae–Setarietum sphacelatae*
   10.4 *Cypero albostriati–Pennisetetum glaucocladii*

11. *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Major Vegetation Type
   11.1 *Acacio ataxacanthae–Rhoetum chirindensis*
   11.2 *Rapaneo melanophloei–Rhoetum chirindensis*
   11.3 *Ocoteo kenyensis–Xymaloetum monosporae*
   11.4 *Diospyro whyteanae–Widdringtonietum nodiflorae*

CONCLUSION

The results also revealed a high diversity of unique and distinct plant communities within this relatively small geographical area. The observed diversity in vegetation patterns is the result of the region's high spatial variation (topography, geology, pedology, extreme localised climate patterns) as well as the region's high temporal variability (irregular climatic cycles, periodic stochastic events) (Gibson *et al.* 2004). In addition to the environmental factors influencing the observed vegetation and floristic patterns, certain regions of the study area have been altered through intense anthropogenic activities over prolonged periods of time (Moleele & Mainah 2003). The stochasticity with which humans have impacted on this environment has led to even higher levels of spatial and temporal variation in habitat heterogeneity. Numerous stone tools and artefacts indicate that humans have occupied the region on a periodic basis since the Early Stone Age (Coles & Higgs 1975). More recent times have seen cultures and civilisations such as the Khoisan (Eloff 1979), the people of Mapungubwe (Huffman 1996), the Vhenda people (Nemudzivhadi 1985), and European settlers utilizing the region for hunting, livestock farming and the cultivation of crops (Voigt & Plug 1984).

The major vegetation patterns seen among the plant communities of the SC and BNR are primarily related to the availability of soil–moisture and the rate of environmental desiccation. Within the region, the underlying geology and soils, as well as temperature along altitude gradients seem to play only secondary roles in the vegetation structure and species composition of these ecosystems. Soil moisture availability for plants within the study area is governed mainly by four environmental factors: 1) the amount of precipitation of atmospheric moisture, 2) the rate of water loss through evaporation 3) the soil's ability to capture and keep moisture within reachable depth of the plant roots, 4) as well as the available soil water capacity (Kramer 1969; Scott & Le Maitre 1998). White (1995) defines the available soil water capacity as the amount of water in a soil that is available for plant growth. The upper limit is set by the soil's field capacity (water-saturated soil), while the lower limit is set by the volumetric water content value at which plants lose turgor and wilt, referred to as the permanent wilting point.

The study area, especially the SC, can be divided into areas of predictable and regular precipitation, and areas of highly unpredictable and localised rainfall events. The southern slopes of the Soutpansberg receive regular seasonal orographic rain and mist. This predictability and relative abundance of water has led to ecosystems of relative stability that are close to equilibrium (Tainton & Hardy 1999). Classical succession models can be used to describe the ecology of these systems (Ellis & Swift 1988). However, these southern slopes of the Soutpansberg represent only a small fraction of the total surface area of the SC and BNR.

Rainfall within most of the study area, especially the semi-arid and arid components, is spatially and temporally highly irregular. The amount of precipitation and atmospheric moisture, or the apparent lack thereof, seems to overshadow all of the other factors regulating plant available moisture. The area is also prone to prolonged and severe droughts. This unpredictability of rainfall has therefore led to event-driven ecosystems that are non-equilibrial in its nature, constantly occurring in a state of transition in reaction to the most recent event (Westoby 1979; De Angelis & Waterhouse 1987; Westoby *et al.* 1989; Mentis *et al.* 1989; Laycock 1991; Behnke & Scoones 1993; Dodd 1994; Bredenkamp & Brown *in prep.*). Events, as well as the reaction of the vegetation on these events, are unpredictable. The dynamics of these ecosystems are not dependent on biotic factors, such as the density of grazing animals, but rather on abiotic factors, often events of drought (Noy-Meir 1975; Wiens 1984). The low rainfall governs the establishment and maintenance of vegetation. The field layer practically disappears during dry periods, leaving the soil surface bare and exposed to severe desiccation (Bredenkamp & Brown *in prep.*). However, in the event of rainfall, the herbaceous layer responds very quickly. The soil texture and clay content have secondary and localised influences on the vegetation through water infiltration, water retention, the degree of nutrient leaching and the duration of moisture availability to the plants (White 1995). Biomass production is generally low and fire plays a minor role within these systems, especially the sweet-veld areas where grazing pressures are higher and biomass accumulation is low. The dynamics of these semi-arid and arid ecosystems are totally dependant on rainfall and the intensities and duration of drought periods, and are therefore considered to be event-driven, non-equilibrium systems.

Conservation and Management recommendations

The Soutpansberg Concervancy and the Blouberg Nature Reserve are surrounded by many poverty stricken informal settlements of rural Venda. These people rely on the savanna, forest and wetland plant communities to supply grazing, firewood, timber, thatching material and agricultural produce. Approximately 58% of the province's land area is used for grazing, and 22% used for agriculture (Hoffman & Ashwell 2000). The Limpopo Province contributes considerably to the formal economy through its ecotourism, livestock, mining, timber and export fruit and vegetable industries (Adams *et al.* 2000). Sadly though, this culturally, historically and naturally rich and diverse province of South Africa is a poverty stricken region (Shackleton & Shackleton 2000). The province's rural communities are often in a struggle for survival against the frequent and severe droughts. This has led to a culture where "if it does not pay, it does not stay" (Goudie 2000). In addition, the ever–expanding population of South Africa is making increasing demands on the natural resources of the Limpopo region, especially refugees from the northern and eastern southern African countries. This will inevitably lead to the expansion of agriculture and industry into agriculturally marginal and ecologically sensitive areas. In order for the government to plan development, management and conservation sensibly, we need sound ecological knowledge of the area. Without this baseline information and insight on the region's driving ecological processes and patterns, the much–needed development of the Limpopo Province's infrastructure and the utilization of its natural resources will be unsustainable, with only limited short–term benefits for a few selected individuals.

With regard to the ecotourism industry, the vegetation of the SC and BNR can be divided into mainly two land-use types. The first is the broad-leaved sour veld of the higher lying mountainous regions. This include vegetation along steep slopes, rugged rocky terrain, leached sandy soils along high lying terraces, mistbelt forests, short grasslands along the high lying crests and summits, and high altitude wetlands. These plant communities encompass most of the SC (>80%), and approximately a third of the BNR. Due to the low palatability and nutritional value of this vegetation, commercial game ranching for tourism and hunting should be avoided within these mountainous areas. The vegetation of these sour-veld communities is generally sensitive to intense herbivory and trampling. The associated soils are prone to erosion. Where bulk grazers, such as zebra, wildebeest, eland and white rhinoceros, have been introduced to the high altitude grasslands, destruction of the natural vegetation and soil erosion followed within very short periods of time, leading to severe habitat degradation. The once floristically rich grasslands with its numerous Fynbos floristic elements have been reduced to species poor and badly trampled anthropogenic systems. The ability to produce palatable fodder for grazers and browsers has been degraded to such an extent that current game populations have to be fed year-round in order to survive. Meanwhile the trampling and over utilisation continues to inflict irreversible damage to these unique systems.

However, what these landscapes lack in large mammal carrying capacity, they make up for in spectacular scenery and ecosystem diversity. Tourism aimed at scenic landscapes, floristic and ecosystem diversity and solitude are highly recommended. Hiking trails, birding and botanical tours have huge potential as ecotourism possibilities.

The second land-use type is the semi-arid and arid sweet bushveld. These plant communities are restricted to the relatively flat plains below the foot-slopes of the SC and BNR. Most of these communities showed a relatively high potential for the production of palatable grazing and browsing fodder. Commercial game ranching for tourism and hunting should be restricted to this vegetation type.

However, care will have to be taken when calculating appropriate herbivore stocking rates (Pulina *et al.* 2004). These are event-driven systems, frequently affected by severe droughts. Long-term average rainfall figures should be used with extreme caution (Liversidge & Berry 2002). The accurate estimation of grazing and browsing capacities will depend on factors such as the previous season's rainfall, together with the resulting fodder production and consumption thereof, as well as projections for the expected rainfall for the coming growing season. These factors should merely be used as guidelines to estimate conservative stocking rates, and should not be used in set recipes for the absolute calculation of stocking rates. The plant communities of the Soutpansberg-Blouberg area are not very forgiving towards over ambitious game and livestock farmers (Moleele & Mainah 2003). The penalties for overstocking are severe and are usually paid with the starvation of the animals involved. The key to successful wildlife and livestock farming within these event-driven ecosystems is adaptive management (Liversidge & Berry 2002; Moleele & Mainah 2003).

The need for a holistic focus on vegetation classification

It is important to identify and to understand the primary ecological processes driving different ecosystems in order to conserve and manage southern Africa's last remaining pockets of wilderness effectively (Wessels *et al.* 2003). Without a deeper understanding of ecosystem functioning, all of our conservation efforts will simply revert to futile attempts to preserve single species or to freeze-frame southern Africa's dynamic and ever-changing event-driven ecosystems.

In southern African savannas a number of phytosociological studies have focussed on the relationships between plant communities within the various proposed savanna vegetation classes (Winterbach 1998; Du Plessis 2001). However, little has been done to describe the ecological and floristic relationships between the syntaxonomic classes of the savannas (Winterbach *et al.* 2000). With the lack of experience in formal syntaxonomy in South Africa, it often happened that floristically similar relevés were assigned to different syntaxonomical classes because they were classified in isolation of one another as localised studies.

Du Plessis (2001) found this to be the case during a synopsis of the southern African Mopaneveld. This is why earlier phytosociologists, e.g. Werger (1974) warned against compiling a formal syntaxonomy too early, before adequate data over larger areas were available. Detailed local classifications could lead to a proliferation and duplication of community types under different names (Coetzee 1983), creating false and overcomplicated images of the vegetation patterns. Mueller-Dombois & Ellenberg (1974) consider it useful to maintain an unsystematic status for abstract communities in all cases where the emphasis is on intensive local vegetation studies. They add that a hierarchical scheme becomes very desirable where the emphasis lies on developing a vegetation synopsis at a more extensive geographical scale. This useful approach was re-emphasized by Coetzee (1983) and could reserve the rank of association for its original practical purpose in southern Africa (Barkman 1988).

The solution for this problem is to classify all the existing relevés within a given biome as an integrated unit. Unfortunately, the classification of such large datasets is fraught with its own set of complicated problems that tend to discourage vegetation scientists from doing so (Du Plessis 2001). The two-step vegetation classification method proposed by Van Der Maarel *et al*. (1987) and the three-step method proposed by Bredenkamp & Bezuidenhout (1995), as well as the advent of powerful numerical data processing computer software (Westhoff 1979; Schamineé & Stortelder 1996; Tichý 2002, 2005) have enabled phytosociologists to classify such large datasets.

Phytosociology should aim at holistic classification (Schamineé & Stortelder 1996; Winterbach 1998; Winterbach *et al.* 2000; Du Plessis 2001). While it is extremely useful for conservation and management to describe the lower ranking syntaxa at local spatial scale, it is often difficult to explain ecosystem functioning holistically within geographically small areas in the savannas of southern Africa. When emphasis is placed on complete integration of vegetation knowledge of the southern African savanna biome, complexity is dispersed, resulting in a simplified view of the same ecosystem (Du Plessis 2000).

In the light of these arguments for holistic vegetation studies, a schematic diagram is presented to depict the complex interrelationships between the numerous proposed zonal vegetation classes of the savannas associated with the central bushveld and Lowveld areas of South Africa (Figure 14). This is merely a simple two-dimensional representation of a very complex multi-dimensional distribution and overlap of vegetation in virtual space.

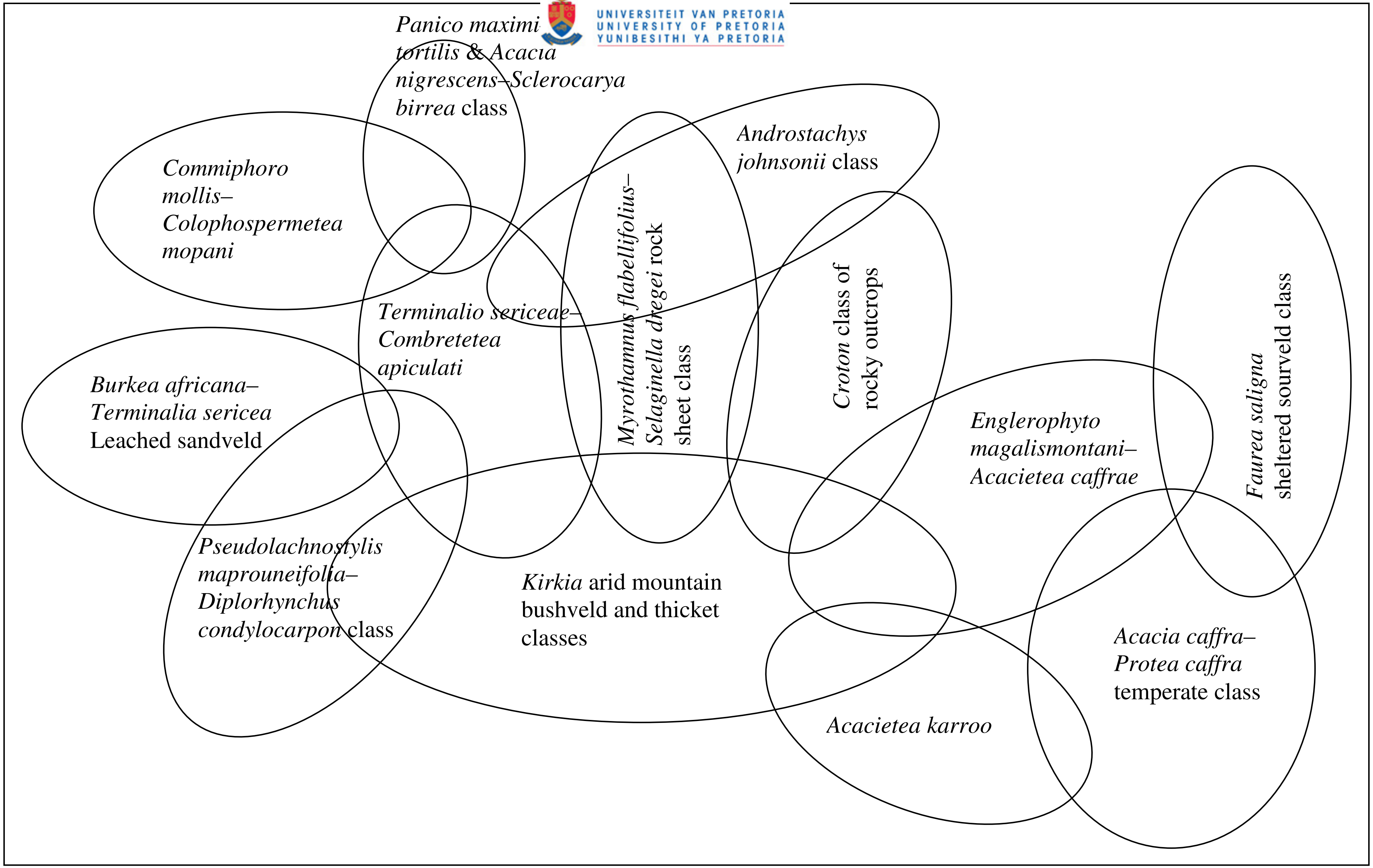


Figure 14. A schematic representation of the interconnected floristic relationships between some of the proposed zonal vegetation classes of the savannas associated with the central, northern and Lowveld bushveld areas of South Africa.

It is suggested that the following classes could exist in the central, northern and arid Lowveld bushveld of southern Africa. Though some of these classes were previously suggested by different authors, some are suggested here for the first time. These suggested classes have, however, not yet been described formally. A total of 14 vegetation classes are presented, which include:

1. *Panico maximi–Acacietea tortilis* (Winterbach *et al.* 2000)
2. *Acacia nigrescens–Sclerocarya birrea* class of the arid northern and Lowveld bushveld (suggested)
3. *Commiphoro mollis–Colophospermetea mopani* (Winterbach *et al.* 2000; Siebert *et al*. 2003b)
4. *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000)
5. *Burkea africana–Terminalia sericea* leached sandveld class (suggested)
6. *Pseudolachnostylis maprouneifolia–Diplorhynchus condylocarpon* class (suggested)
7. *Kirkia* arid mountain bushveld and thicket classes (suggested)
8. *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep*)
9. *Androstachys johnsonii* class (suggested)
10. *Croton* class of rocky outcrops (Mostert *et al*. *in prep*)
11. *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000)
12. *Acacietea karroo* (Du Preez & Bredenkamp 1991)
13. *Acacia caffra–Protea caffra* class of temperate areas (suggested)
14. *Faurea saligna* class of sheltered sourveld areas (suggested)

1. *Panico maximi–Acacietea tortilis* (Winterbach *et al.* 2000)

The *Panico maximi–Acacietea tortilis* of the Transvaal Plateau Basin (Winterbach 1998; Winterbach *et al.* 2000) is associated with dark coloured heavy clayey soils. This class shares floristic links with the *Commiphoro mollis–Colophospermetea mopani* of arid and semi-arid regions (Winterbach 1998; Winterbach *et al.* 2000; Du Plessis 2001; Siebert *et al.* 2003b), the *Terminalio sericeae–Combretetea apiculati* (Winterbach 1998; Winterbach *et al.* 2000), and the *Acacia nigrescens–Sclerocarya birrea* class of the arid northern and Lowveld bushveld. It usually occurs as extensive homogeneous vegetation units, such as those described from the central bushveld.

2. *Acacia nigrescens–Sclerocarya birrea* class of the arid northern and Lowveld bushveld (suggested)

The *Acacia nigrescens–Sclerocarya birrea* class of the semi-arid and sub-tropical Lowveld and northern bushveld areas is associated with eutrophic soils, ranging from heavy clayey soils to nutrient rich un-leached sands of arid areas. These classes share floristic links with the *Commiphoro mollis–Colophospermetea mopani* of arid and semi-arid regions (Winterbach 1998; Winterbach *et al.* 2000; Du Plessis 2001; Siebert *et al.* 2003b), the *Terminalio sericeae–Combretetea apiculati* (Winterbach 1998; Winterbach *et al.* 2000), and the *Panico maximi–Acacietea tortilis* of the central bushveld (Winterbach *et al.* 2000). They may either occur as extensive homogeneous vegetation units, such as those described from the basaltic plains of the Lowveld and the arid sandy plains of the northern bushveld, or may occur as a mosaic of patches occupying the clayey bottomlands of the undulating granitic landscape of the Lowveld.

3. *Commiphoro mollis–Colophospermetea mopani* (Winterbach *et al.* 2000; Siebert *et al*. 2003b)

The *Commiphoro mollis–Colophospermetea mopani* (Winterbach 1998; Winterbach *et al.* 2000; Du Plessis 2001; Siebert *et al.* 2003b) is restricted to the semi-arid and arid frost-free regions of southern Africa, covering extensive tracts of land. Due to its homogeneous nature, this class and its communities are generally easy to delineate geographically.

4. *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000)

Winterbach (1998) and Winterbach *et al.* (2000) proposed a *Terminalio sericeae–Combretetea apiculati* from the central and north-western South African savannas. However, this class has proven to be extremely complex, with communities from the rugged basaltic Lowveld, the undulating granitic Lowveld and the morphologically and geologically complex arid mountain bushveld areas. Although communities are often easily described, their syntaxonomic positions are unclear. Numerous species are shared with the *Commiphoro mollis–Colophospermetea mopani* of arid and semi-arid regions (Winterbach 1998; Winterbach *et al.* 2000; Du Plessis 2001; Siebert *et al.* 2003b), the *Acacia nigrescens–Sclerocarya birrea* class of the arid northern and Lowveld bushveld, the *Panico maximi–Acacietea tortilis* of the central bushveld

(Winterbach 1998; Winterbach *et al.* 2000), and the *Kirkia* arid mountain bushveld and thicket classes of various low lying mountainous regions. This vegetation class generally occurs as mosaic patches, occupying the gravely uplands of the undulating landscape of the Lowveld, or as relatively small units along suitable habitat within topographically complex mountainous areas. Species composition and vegetation structure are constantly changing along the ever-changing topography of the landscape, making the geographic delineation of these small pockets of vegetation impractical at regional scale.

5. *Burkea africana–Terminalia sericea* leached sandveld class (suggested)

Communities of the *Burkea africana–Terminalia sericea* leached sandveld class have been described by a number of authors (Coetzee 1976; Van Der Meulen 1979; Winterbach 1998; Henning 2002; Van Staden 2002). It is associated with deep nutrient poor leached sandy soils and shares strong floristic links with the *Pseudolachnostylis maprouneifolia–Diplorhynchus condylocarpon* class. Some limited floristic overlap occurs with the *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000) where soils become shallower and coarser. The leached sandveld class communities generally form relatively large homogeneous vegetation units that can be delineated geographically at regional scale.

6. *Pseudolachnostylis maprouneifolia–Diplorhynchus condylocarpon* class (suggested)

Communities of the *Pseudolachnostylis maprouneifolia–Diplorhynchus condylocarpon* class have been described by a number of authors (Coetzee 1976; Van Der Meulen 1979; Winterbach 1998; Henning 2002; Van Staden 2002). It is associated with shallow coarse nutrient poor leached sandy soils and shares numerous floristic links with the suggested *Burkea africana–Terminalia sericea* leached sandveld class, the *Terminalio sericeae–Combretetea apiculati* and the suggested *Kirkia* arid mountain bushveld and thicket classes. Its association with the topographically diverse mountainous landscapes cause communities to occupy relatively small areas as mosaics with other classes, making the regional delineation of this class difficult.

7. *Kirkia* arid mountain bushveld and thicket classes (suggested)

The *Kirkia* arid mountain bushveld and thicket classes are highly diverse, occupying the geomorphically diverse landscapes associated with mountains. The syntaxonomic statuses and positions of the various potential classes are poorly understood and are in need of much research. Numerous floristic links are shared with the suggested *Pseudolachnostylis maprouneifolia–Diplorhynchus condylocarpon* class, *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000), *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep*), *Croton* class of rocky outcrops (Mostert *et al. in prep*), *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000) and the *Acacietea karroo* (Du Preez & Bredenkamp 1991).

8. *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep.*)

The proposed *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep.*) are associated with the vegetation of highly exposed rock sheets. This vegetation relies on skeletal soil within the cracks, fissures and depressions of the rock sheets. Plant species are often dwarfed and highly specialised due to the harsh growing conditions. Many endemic species are associated with the more isolated rocky environments of the southern African savannas (Siebert *et al.* 2003c). This vegetation class share floristic links with the suggested *Kirkia* arid mountain bushveld and thicket classes, *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000), the suggested *Androstachys johnsonii* class and the *Croton* class of rocky outcrops (Mostert *et al. in prep.*).

9. *Androstachys johnsonii* class (suggested)

Coetzee (1983) and Van Rooyen *et al.* (1981) described some communities of the *Androstachys johnsonii* class associated with rocky environments. However, little is known about the phytosociology of the *Androstachys* woodlands associated with the sandy plains of Mozambique. More research is needed for a more comprehensive picture of this class. Existing vegetation descriptions indicate floristic links with the *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000), *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep*), and the *Croton* class of rocky outcrops (Mostert *et al. in prep*).

10. *Croton* class of rocky outcrops (Mostert *et al. in prep*)

The proposed *Croton* class of rocky outcrops (Mostert *et al. in prep.*) is associated with the relatively sheltered environments among the boulders and large rocks of rocky outcrops and rugged geological shear zones. Its distribution is widespread, ranging from the sheltered gorges and escarpment of the Highveld, to the granitic outcrops of the Lowveld. This vegetation class share floristic links with the *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep*), the suggested *Androstachys johnsonii* class, the *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000) and the suggested *Kirkia* arid mountain bushveld and thicket classes.

11. *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000)

The *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000) is restricted to the more temperate and cooler high lying slopes of mountainous areas. The terrain is generally rugged and topographically diverse with a wide variety of micro-habitats. It shares floristic links with the *Croton* class of rocky outcrops (Mostert *et al. in prep*), the suggested *Faurea saligna* class of sheltered sourveld areas, the suggested *Acacia caffra–Protea caffra* temperate class, *Acacietea karroo* (Du Preez & Bredenkamp 1991) and the suggested *Kirkia* arid mountain bushveld and thicket classes. Its association with the topographically diverse mountainous landscapes cause communities to occupy relatively small areas as mosaics with other classes, making the regional delineation of this class difficult.

12. *Acacietea karroo* (Du Preez & Bredenkamp 1991)

The *Acacietea karroo* of temperate areas have been described by Du Preez & Bredenkamp (1991) primarily as an azonal component of the grassland biome of South Africa. However, Acocks (1953) also described communities associated with this class along the floodplains of numerous prominent rivers of the Highveld and central plateau bushveld. It is a complex vegetation class with uncertain syntaxonomic status, sharing floristic links with the suggested *Kirkia* arid mountain bushveld and thicket classes, the suggested *Acacia caffra–Protea caffra* class of temperate areas and *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000).

13. *Acacia caffra–Protea caffra* class of temperate areas (suggested)

The *Acacia caffra–Protea caffra* class of temperate areas is associated with the transitional zone between the primary grasslands and the savanna biome of southern Africa. Du Preez & Bredenkamp (1991) described some components of this proposed class. Acocks (1953) described this vegetation as Bankenveld, while Bredenkamp & Van Rooyen (1996) described it as Rocky Highveld Grassland. Despite the relatively cool and frost prone landscapes, the rocky nature of these areas create suitable habitat for the establishment of a sparse woody layer within a sour grassveld. This class shares floristic links with other temperate savanna classes such as the *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000), *Acacietea karroo* (Du Preez & Bredenkamp 1991) and the suggested *Faurea saligna* sheltered sourveld class.

14. *Faurea saligna* class of sheltered sourveld areas (suggested)

The proposed *Faurea saligna* class of sheltered sourveld areas is associated with cool kloof areas of relatively high rainfall that are relatively frost-free conditions. Soils are relatively well developed along these moderately steep grassy slopes. It shares floristic links with the *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000) and the suggested *Acacia caffra–Protea caffra* temperate savanna class. Its association with moderate to steep slopes cause communities to occupy relatively small areas as mosaic patches with communities from other classes, making the regional delineation of this class difficult.

During a visit to the Nylsvlei Nature Reserve in the Limpopo Province, the late Professor Victor Westhoff, pioneer in conservation and vegetation science, was asked to define the concept of a syntaxon, with particular reference to the association within the very complex southern African savannas. His reply was simple yet eloquent: "Associations (or syntaxa) are useful stepping stones in the swamp of (vegetative) variation" (Bredenkamp, G.J. *pers. com.*).

Until we have a reasonably complete dataset, representing all the major variations within the southern African savannas, we will have to accept those syntaxonomically "grey" areas where relevés may belong to two or more vegetation classes at the same time. In the meanwhile, vegetation scientists should keep on describing and classifying those “useful stepping stones”, avoiding the premature description and classification of formal syntaxa based on those relevés representing the “swamp of variation”.

Acknowledgements

Thanks are due to the following institutions and persons for their valuable contributions in the preparation of this thesis:

- Prof. George Bredenkamp for guidance and mentorship;
- Liesl Mostert for her encouragement and assistance with the vegetation classification;
- Norbert Hahn for providing invaluable knowledge on the floristics of the study area and his guidance during the fieldwork phase;
- Prof. Braam van Wyk for assistance with species identification;
- The South African Weather Bureau and the Institute for Soil, Water and Climate for supplying rainfall and temperature data for the study area;
- All the landowners within the SC and management of the BNR for access to the study area;
- Goro Lodge, Lajuma Mountain Retreat, Medike Mountain Reserve, and the Soutpansberg Herbarium for accommodation during fieldwork;
- The National Research Foundation for funding this project.

REFERENCES

Acocks, J.P.H. 1953. Veld types of South Africa. *Memoirs of the Botanical Survey of South Africa* 28: 1–192. (3rd edition with updated names and illustrations published in 1988 as *Memoirs of the Botanical Survey of South Africa* 57: 1–146).

Adams, M., Cousins, B. and Manona, S. 2000 Land tenure and economic development in rural South Africa constraints and opportunities Pp. 111–128. *In*: B. Cousins, (ed.). *At the Crossroads Land and Agrarian Reform in South Africa into the 21st Century, School of Government*, University of the Western Cape, Cape Town.

Al-Eisawi, D. 2003. Effect of biodiversity conservation on arid ecosystems with special emphasis on Bahrain. *Journal of Arid Environments* 54: 81–90.

Anderson, J.M. (ed.) 2001. Towards Gondwana Alive, Vol.1 (Assoc. eds.). Berger, L., De Wit, M., Fatti, L.P., Holm, E., Rubidge, B., Smith, G., Thackeray, F. and Van Wyk, B. Gondwana Alive Society, Pretoria.

Aucamp, A.J. and Barnard, H.H. 1980. Die ontplooing van die veekundepotensiaal van die droë gras – bosgemeenskappe in die Oos-Kaap. *Proceedings of the Grassland Society of southern Africa* 15: 137-140.

Barber, B. 2003. Production, consumption and the world summit on sustainable development. *Environment, Development and Sustainability* 5(1): 63–93.

Barker, O.B. 1979. A contribution to the geology of the Soutpansberg Group, Waterbergberg Supergroup, northern Transvaal. MSc thesis, University of the Witwatersrand, Johannesburg.

Barker, O.B. 1983. A proposed geotectonic model for the Soutpansberg Group within the Limpopo Mobile Belt, southern Africa. Pp. 10. *In*: W.J. van Biljon and J.H. Legg (eds.). The Limpopo Belt. *Geological Society of South Africa* 8: 181–190.

Barkman, J.J. 1988. The association concept in the Braun-Blanquet School of Phytocoenology. Biologisch Station Wijster, *Meded* 370: 1–13.

Barkman, J.J., Moravec, J. and Rauschert, S. 1986. Code of phytosociological nomenclature. *Vegetatio* 67: 145–195.

Bedward, M., Pressey, R.L. and Keith, D.A. 1992. A new approach for selecting fully representative reserve networks: addressing efficiency, reserve design and land suitability with an iterative analysis. *Biological Conservation* 62: 115–125.

Begon, M., Harper, J.L. and Townsend, C.R. 1996. Ecology. Blackwell Science, Oxford

Behnke, R.H. and Scoones, I. 1993. Rethinking range ecology: implications for rangeland management in Africa. Pp. 1–30. *In*: Behnke, R.H., Scoones, I. and Kerven, C. (eds.). *Range ecology at disequilibrium.* Overseas Development Institute, London.

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

Berger, K., Craffort, J.E., Gaiger, I., Gaiger, M.J., Hahn, N. and MacDonald, I. 2003. *A first synthesis of the environmental, biological and cultural assets of the Soutpansberg*. Leach Printers and Signs, Makhadu.

Bezuidenhout, H. and Bredenkamp, G.J. 1990. A reconnaissance survey of the vegetation of the dolomite region in the Potchefstroom–Ventersdorp–Randfontein area, South Africa. *Phytocoenologia* 18(2,3): 387-403.

Bezuidenhout, H., Bredenkamp, G.J. and Theron, G.K. 1994. Syntaxonomy of the vegetation of the Fb land type in the western Transvaal grassland, South Africa. *South African Journal of Botany* 60: 72-80.

Bezuidenhout, H. Bredenkamp, G.J. and Theron, G.K. 1994. Phytosociological classes of the western Transvaal grassland, South Africa. *Koedoe* 37: 1–18.

Biggs, R.C. 1979. The ecology of Chief's Island and the adjacent floodplains of the Okavango Delta. MSc thesis, University of Pretoria, Pretoria.

Bond, W. J., and Midgley, J. J. 2001. Ecology of sprouting in woody plants: the persistence niche. *Trends in Ecology and Evolution* 16: 45–51.

Bond, W.J., Midgley, G.F. and Woodward, F.I. 2003. What controls South African vegetation – climate or fire? *South African Journal of Botany* 69: 79–91.

Botha, M.J. 2004a. Land types of the map 2228 Alldays. *In*: MacVicar, C.N. (ed.). *Memmoirs on the Agricultural Natural Resources of South Africa*. Department of Agriculture and Water Supply, www.arc.agric.za/institutes/iscw/main/maps/htm

Botha, M.J. 2004b. Land types of the map 2328 Pietersburg. *In*: MacVicar, C.N. (ed.). *Memmoirs on the Agricultural Natural Resources of South Africa*. Department of Agriculture and Water Supply, www.arc.agric.za/institutes/iscw/main/maps/htm

Box, E.O., 1996. Plant functional types and climate at the global scale. *Journal of Vegetation Science* 7: 309–320.

Branch, W.R. 1988. South African Red Data Book – Reptiles and amphibians. *South African National Scientific Programmes Report* 151.

Brandl, G. 2002. The Geology of the Alldays Area. Explanation, Sheet 2228 Alldays, Council for Geoscience South Africa, Pretoria, 71pp.

Brandl, G. 2003. Geology. Pp. 7–9. *In*: Berger, K., Craffort, J.E., Gaiger, I., Gaiger, M.J., Hahn, N. and MacDonald, I. (eds.). *A first synthesis of the environmental, biological and cultural assets of the Soutpansberg*. Leach Printers and Signs, Makhadu.

Bredenkamp, G.J. 1975. 'n Plantsosiologiese studie van die Suikerbosrand-natuurreservaat. MSc thesis, University of Pretoria, Pretoria.

Bredenkamp, G.J. 1982. 'n Plantekologiese studie van die Manyeleti–wildtuin. DSc thesis, University of Pretoria, Pretoria.

Bredenkamp, G.J. 1986. Ecological profiles of potential bush encroacher species in the Manyeleti Game Reserve. *South African Journal of Botany* 52(1): 53–59.

Bredenkamp, G.J. 1987. An overview of the major plant communities of the Manyeleti Game Reserve, Gazankulu, South Africa. *Coenoses* 2(1): 29–38.

Bredenkamp, G.J. and Bezuidenhout, H. 1995. A proposed procedure for the analysis of large phytosociological data sets in the classification of South African grasslands. *Koedoe* 38(1): 33–39.

Bredenkamp, G.J. and Brown, L.R. 1998a. A vegetation assessment of the open spaces in the Western Metropolitan local Council area. Ekotrust cc pp 1–54

Bredenkamp, G.J. and Brown, L.R. 1998b. A vegetation Assessment of open spaces in the northern areas of the Northern Metropolitan Local Council. Ekotrust cc, 1–60

Bredenkamp, G.J. and Brown, L.R. *in prep.* Vegetation type and dynamics: African savannas Gradients.

Bredenkamp, G.J. and Brown, L.R. *in prep*. A reappraisal of Acocks' Bankenveld: origin and diversity of vegetation types.

Bredenkamp, G.J. and Deutschlander, M.S. 1994. The *Themedo triandrae–Setarietum incrassatae,* a new association from gabbro in the Manyeleti Game Reserve, Gazankulu, South Africa. *Koedoe* 37(2): 43–57.

Bredenkamp, G.J. and Theron, G.K. 1980. A synecological account of the Suikerbosrand Nature Reserve Part II: The phytosociology of the Ventersdorp geological system. *Bothalia* 13: 199–216

Bredenkamp, G.J. and Theron, G.K. 1980. A synecological account of the Suikerbosrand Nature Reserve Part II: The phytosociology of the Ventersdorp geological system. *Bothalia* 13: 199–216.

Bredenkamp, G.J. and Theron, G.K. 1991. The *Eucleo divinori–Acacietum nigricentis*, a new association from the calcareous bottomland clays of the Manyeleti Game Reserve, Eastern Transvaal Lowveld, Gazankulu, South Africa. *Vegetatio* 93: 119–130.

Bredenkamp, G.J. and Van Rooyen, N. 1996. 34. Rocky Highveld Grassland. P. 39. *In*: Low, A.B. and Rebelo, A.G. (eds.). *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affaire and Tourism, Pretoria.

Bredenkamp, G.J. and Van Vuuren, D.R.J. 1977. The plant communities below Turfloop Dam, Lebowa. University of the North.

Bredenkamp, G.J., Brown, L.R. and Pfab, M. *in press*. Conservation value of the Egoli Granite Grassland, an endemic grassland in Gauteng, South Africa. *Koedoe* in press.

Bredenkamp, G.J., Granger, E. and Van Rooyen, N. 1996. 43. North–eastern Mountain Grassland. P. 49. *In*: Low, A.B. and Rebelo, A.G. (eds.). *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

Bredenkamp, G.J., Joubert, A.F. and 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.

Breebaart, L. and Deutchlander, M. 1997. The vegetation types and management units of the Goedverwacht farm in the mixed bushveld of the Northern Province, South Africa. *Koedoe* 40: 19–33.

Brokaw, N., and Busing, R.T. 2000. Niche versus chance and tree diversity in forest gaps. *Trends in Ecology and Evolution* 15:183–188.

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, Pretoria.

Brown, L.R., Bredenkamp, G.J. and Van Rooyen, N. 1995a. The phytosociology of the western section of the Borakalalo Nature Reserve. *Koedoe* 38(2): 49–64.

Brown, L.R., Bredenkamp, G.J. and Van Rooyen, N. 1995b. Phytosociological synthesis of the vegetation of the Borakalalo Nature Reserve, North-west Province. *South African Journal of Botany* 63(5): 242–253.

Bumby, A.J. 2000. The geology of the Blouberg Formation, Waterberg and Soutpansberg Groups in the area of Blouberg Mountain, Northern Province, South Africa. PhD thesis, University of Pretoria, Pretoria.

Bumby, A.J., Eriksson, P.G., Van Der Merwe, R. and Maier, W. 2001. The stratigraphic relationship between the Waterberg Group and the Soutpansberg Group, Northern Province, South Africa: Evidence from the Blouberg area. *South African Journal of Geology* 104: 205–216.

Burgoyne, P.M. 1995. Phytosociology of the north–eastern Transvaal high mountain grasslands. MSc thesis, University of Pretoria, Pretoria.

Cain, S.A. 1944. *Foundations of Plant Geography*. Harpers and Brothers, New York, London.

Cawe, S. G. 1994. Rainfall and vegetation patterns in Transkei and environs. *South African Journal of Science* 90: 79–85.

Cawe, S.G. 1990. A classification of the Coastal Forests of Transkei and an assessment of their timber potential. University Press, University of Transkei, Umtata.

Chapin, F.S., Zavaleta, E.S., Eviner, V.T., Naylor, R.L., Vitousek, P.M., Reynolds, H.L., Hooper, D.U., Lavorel, S., Sala, O.E., Hobbie, S.E., Mack, M.C. and Diaz, S. 2000. Review article: consequences of changing biodiversity. *Nature* 405: 234–242.

Cilliers, S.S., Schoeman, L.L. and Bredenkamp, G.J. 1998. Wetland plant communities in the Potchefstroom Municipal area, North-west, South Africa. *Bothalia* 28(2): 231–229.

Cingolania, A.M., Renisona, D., Marcelo, B., Zaka, R. and Cabidoa, M.R. 2004. Mapping vegetation in a heterogeneous mountain rangeland using landsat data: an alternative method to define and classify land-cover units. *Remote Sensing of Environment* 92: 84–97.

Coetzee, B.J. 1974. A phytosociological classification of the vegetation of the Jack Scott Nature Reserve. *Bothalia* 11: 329–347.

Coetzee, B.J. 1975. A phytosocological classification of the Rustenburg Nature Reserve. *Bothalia* 11: 561–580.

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., Van Der Meulen, F., Zwanziger, S., Gonsalves, P. and Weisser, P.J. 1976. A phytosociological classification of the Nylsvlei Nature Reserve. *Bothalia* 12: 137–160.

Coetzee, J.P., Bredenkamp, G.J. and Van Rooyen, N. 1995. Plant communities of the Sub-humid Cool Temperate Mountain Bushveld in the Pretoria Witbank Heidelberg area. *South African Journal of Botany* 61: 114–122.

Coles, J.M. and Higgs, E.S. 1975. *The archaeology of early man*. Peregrine Books, Great Britain.

Cooper, K. H. 1985. *The conservation status of indigenous forests in Transvaal, Natal and O.F.S., South Africa*. Wildlife Society of South Africa, Durban.

Corney, P.M., Le Duc, M.G., Smart, S.M., Kirkby, K.J., Bunce, R.G.H. and Marrs, R.H. 2004. The effect of landscape-scale environmental drivers on the vegetation composition of the British woodlands. *Biological Conservation* 120: 491–505.

Costana, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Rasin, R.G., Sutton, P. and Van Den Belt, M. 1997. The value of the world's ecosystem services and natural capital. *Economics* 25: 3–15.

Darkoh, M.B.K. 2003. Regional perspectives on agriculture and biodiversity in the drylands of Africa. *Journal of Arid Environments* 54: 261–279.

Davies, S.D., Heywood, V.H. and Hamilton, A.C. (eds.) 1994. *Centres of plant diversity. A guide and strategy for their conservation*. Volume 1: Europe, Africa, South West Asia and the Middle East. IUCN Publications Unit, Cambridge, U.K.

De Angelis, D.L. and Waterhouse, J.C. 1987. Equilibrium and non–equilibrium concepts in ecological models. *Ecological Monographs* 57(1): 1–21.

Deall, G.B., Theron, G.K. and Westfall, R.H. 1989. The vegetation ecology of the Eastern Transvaal escarpment in the Sabie area: Floristic classification. *Bothalia* 19: 69–89.

Denslow, J. S. 1987. Tropical rainforest gaps and tree species diversity. *Annual Review of Ecology and Systematics* 18:431–451.

Dodd, J.L. 1994. Desertification and degradation in Sub–Saharan Africa. *Bioscience* 44:(1): 28–34.

Du Plessis, F. 2001. A Phytosociological synthesis of Mopaneveld. MSc thesis, University of Pretoria, Pretoria.

Du Preez. P.J. 1991. A syntaxonomical and synecological study of the vegetation of the southern and eastern Orange Free State and related areas with special reference to Korannaberg. PhD thesis, University of the Orange Free State, Bloemfontein.

Du Preez, P.J. and Bredenkamp, G.J. 1991. Vegetation classes of the southern and eastern Orange Free State (Republic of South Africa) and the highlands of Lesotho. *Navorsinge van die Nasionale Meuseum Bloemfontein* 7: 477–526.

Du Preez, P.J., Bredenkamp, G.J. and Venter, H.J.T. 1991. The syntaxonomy and synecology of the forests in the eastern Orange Free State, South Africa. I. The *Podocarpetalia latifolii*. *South African Journal of Botany* 57(4): 198–206.

Edwards, D. 1967. A plant ecological survey of the Tugela river basin. *Botanical Survey of South Africa Memoir* 36. Town and Regional Planning Commission, Pietermaritzburg.

Edwards, D. 1983. A broad–scale structural classification of vegetation for practical purposes. *Bothalia* 14: 705–712.

Ellenberg, H., 1953. Physiologisches und o¨kologisches Verhalten derselben Pflanzenarten. Ber. *Dtsch. Bot. Ges.* 65: 351–362.

Ellis, J.E. and Swift, D.M. 1988. Stability of African pastoral ecosystems: Alternate paradigms and implications for development. *Journal of Range Management* 41(6): 450–459.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Eloff, J.F. 1979. Die kulture van Greefswald. 'n Argeologiese studie van die Ystertydperkkulture op die plaas Greefswald Deel III. Department of Archaeology, University of Pretoria, Pretoria.

Everard, D.A. 1987. A classification of the subtropical transitional thicket in the eastern Cape, based on syntaxonomic and structural attributes. *South African Journal of Botany* 53: 329–340.

Fabricius, A.F. 1988. Klimageographie–Sudafrika Moqambique, Swaziland, Republik Sudafrika). Africa–Kartenwerke S5, Beiheft S5. Deutche Forschungs-gemeinschaft, Bomm–Bad Godesberg.

Fairbanks, D.H.K. and Grant, A.B. 2000. Identifying regional landscapes for conservation planning: a case study from KwaZulu-Natal, South Africa. *Landscape and Urban Planning* 50: 237–257.

Fairbanks, D.H.K., Reyers, B. and Van Jaarsveld, A.S. 2001. Species and environment representation: selecting reserves for the retention of avian diversity in KwaZulu-Natal, South Africa. *Biological Conservation* 98: 365–379.

Fanshawe, D.B. 1969. The vegetation of Zambia. *Forest Research Bulletin* 7: 1–67.

Fischer, H.S. 2000. Multivariate analysis of phenological data. *Phytocoenologia* 30: 477–480.

Foord, S.H. and Dippenaar–Schoeman, A.S. 2003. Spiders (Araneae). Pp. 45–50. *In*: Berger, K., Craffort, J.E., Gaiger, I., Gaiger, M.J., Hahn, N. and MacDonald, I. (eds.). *A first synthesis of the environmental, biological and cultural assets of the Soutpansberg*. Leach Printers and Signs, Makhadu.

Foord, S.H., Dippenaar–Schoeman, A.S. and Van Der Merwe, M. 2002. A checklist of the spider fauna of the Western Soutpansberg, South Africa (Arachnida: Araneae). *Koedoe* 45: 35–43.

Fuls, E.R., Bredenkamp, G.J., Van Rooyen N. and Theron, G.K. 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. and Whittaker, R.H. 1981. Hierarchical classification of community data. *Journal of Ecology* 69: 537–557.

Geldenhuys, C.J. 1987. Distribution and classification of the indigenous evergreen forest and deciduous woodland in South Africa. Pp. 443–453. *In*: Gadow, K.

(ed.). *South African forestry handbook*. Southern African Institute of Forestry, Pretoria.

Geldenhuys, C.J. 1992. Richness, composition and relationships of the floras of selected forests in southern Africa. *Bothalia* 22: 205–233.

Geldenhuys, C.J. and Murray, B. 1993. Floristic and structural composition of Hanglip forest in the Soutpansberg, Northern Transvaal. *South African Forestry Journal* 165: 9–20.

Geldenhuys, C.J. and Venter, S. 2002. Plant communities and biodiversity of indigenous forests on state forestry land, Northern Province. Report FW–01/02. Forestwood cc, Pretoria.

Germishuizen, G. and Meyer, N.L. 2003. Plants of southern Africa: an annotated checklist. *Strelitzia* 14: 1–1231.

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

Gertenbach, W.P.D. 1987. 'n Ekologiese studie van die suidelikste Mopaneveld in die Nasionale Krugerwildtuin. DSc thesis, University of Pretoria, Pretoria.

Gibson, L.A., Wilson, B.A. and Aberton, J.G. 2004. Landscape characteristics associated with species richness and occurrence of small native mammals inhabiting a coastal heathland: a spatial modelling approach. *Biological Conservation* 120: 75–89.

Gillison, A.N. and Liswanti, N. 2004. Assessing biodiversity at landscape level in northern Thailand and Sumatra (Indonesia): the importance of environmental context. *Agriculture, Ecosystems and Environment* 104: 75–86.

Good, R., 1953. The Geography of the Flowering Plants. (second ed.) Longman, London.

Götze, A. R. 2002. Plant communities and restoration technologies – Vhembe–Dongola National Park. MSc thesis, Potchefstroom University for Christian Higher Education, Potchefstroom.

Goudie, A. 2000. *The human impact on the natural environment*. Oxford, Blackwell Publishers.

Granger, E. and Bredenkamp, G.J. 1996. 46. Alti Mountain Grassland. P. 49. *In*: Low, A.B. and Rebelo, A.G. (eds.). *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

Grobler, C.H., Bredenkamp, G.J. and Brown, L.R. 2002. Primary Grassland communities of urban open spaces in Gauteng, South Africa. Ekotrust cc pp 1-54

Grundling, P.L. and Grobler, R. 2005. Peatlands and Mires of South Africa. Stapfia 85, zugleich Kataloge der Oö. *Landesmuseen Neue Serie* 35: 379–396.

Guisan, A. and Zimmermann, N.E. 2000. Predictive habitat distribution models in ecology. *Ecological Modelling* 135: 147–186.

Hahn, N. 1994. *Tree list of the Soutpansberg*. Fantique Publishers, Pretoria.

Hahn, N. 1996. Rubiaceae. A new species of *Vangueria* from the Soutpansberg. *Bothalia* 27(1): 45–48.

Hahn, N. 1997. Rare and endangered flora of Tshikondeni. In house manuscript: Tshikondeni Mining Company (Pty) Ltd.

Hahn, N. 1999. Rubiaceae. A new species of *Pavetta* from the Soutpansberg, South Africa. *Bothalia* 29(1): 107–109.

Hahn, N. 2002. *Endemic flora of the Soutpansberg*. MSc thesis, University of Natal, Pietermaritzburg.

Hahn, N. 2003. Endemic flora. Pp. 29–33. *In*: Berger, K., Craffort, J.E., Gaiger, I., Gaiger, M.J., Hahn, N. and MacDonald, I. (eds.). *A first synthesis of the environmental, biological and cultural assets of the Soutpansberg*. Leach Printers and Signs, Makhadu.

HAHN, N. *in prep*. Endemism and biogeography of the Soutpansberg, Limpopo Province, South Africa. PhD thesis, University of Pretoria, Pretoria.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J. Parker, V. and Brown, C.J. 1997. *The atlas of southern African birds*. Avian Demography Unit, Bird Life South Africa

Hattingh, C. 1991. Die plantegroei van Fort Skanskop en Voortrekkermonument-omgewings, Pretoria. BSC Honours scription, University of Pretoria, Pretoria

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

Hennekens, S. 1996b. MEGATAB: A visual editor for phytosociological tables. Version 1.0. Giesen and Geurts, Ulft.

Hennekens, S.M. and Schaminée, J.H.J. 2001. TURBOVEG, a comprehensive data base management system for vegetation data. *Journal of Vegetation Science* 12: 589-591.

Henning, B.J. 2002. The relevance of ecosystems to ecotourism in the Waterberg Biosphere Reserve. PhD thesis, University of Pretoria, Pretoria.

Henns, L. and Nath, B. 2003. The Johannesburg conference. *Environment, Development and Sustainability* 5(1): 7–39.

Hill, M.O. 1973. Diversity and evenness: a unifying notation and its consequences. *Ecology* 54: 427-432

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, New York.

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

Hockey, P.A.R., Dean, W.R.J. and Ryan, P.G. 2005. *Roberts – Birds of Southern Africa*, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town.

Hoffman, T. and Ashwell, A. 2000 *Land degradation: Northern Province fact sheet*. Salty Print.

Holdridge, L.R., 1967. *Life Zone Ecology*. Tropical Science Center, San Jose´, Costa Rica.

Hudak, A.T., Fairbanks, D.H.K. and Brockett, B.H. 2004. Trends in fire patterns in a southern African savanna under alternative land use practices. *Agriculture, Ecosystems and Environment* 101: 307–325.

Huffman, T. N. 1996. Archaeological evidence for climatic change during the last 2000 years in southern Africa. *Quaternary International* 33: 55–60.

Jongman, R.H.G., Ter Braak, C.J.F and Van Tongerren, O.F.R. 1995. *Data analysis in community and landscape ecology*. Cambridge University Press, New York.

Kabanda, T.A. 2003. Climate. Pp. 10–11. *In*: Berger, K., Craffort, J.E., Gaiger, I., Gaiger, M.J., Hahn, N. and MacDonald, I. (eds.). *A first synthesis of the environmental, biological and cultural assets of the Soutpansberg*. Leach Printers and Signs, Makhadu.

Kent, M. and Ballard, J. 1988. Trends and problems in the application of classification and ordination methods in plant ecology. *Vegetatio* 78: 109–124.

Kent, M. and Coker, P. 1992. *Vegetation description: A practical approach*. J. Wiley and Sons, Chichester.

Klopper, H.L. A vegetation study of the Blouberg S.A.D.T. Nature Reserve with special reference to veld evaluation and grass production. Unpublished management report for the Centre of Wildlife Management, University of Pretoria, Pretoria.

Kooij, M.S., Bredenkamp, G.J. and Theron, G.K. 1990. The vegetation of the north-western Orange Free State, South Africa. 1. Physical environment. *Bothalia* 20(2): 233–240.

Kooij, M.S., Scheepers, J.C., Bredenkamp, G.J. and Theron, G.K. 1991. The vegetation of the north-western Orange Free State. 2. The D land types. *Bothalia* 20(2): 241–482.

Kovar, P. 2000. Is plant community organization level relevant to monitoring landscape heterogeneity? Two case studies of mosaic landscapec in the urban zones of Prague, Czech Republic. *Landscape and Urban Planning* 32: 137–151.

Kramer, P.J. 1969. *Plant and soil water relationships: a modern synthesis.* McGraw–Hill, United States of America.

Krebs, C.J. 1989. *Ecological methodology*. HarperCollins, New York, NY.

Krebs, C.J. 2001. *Ecology: the Experimental Analysis of Distribution and Abundance* (5th edn). Benjamin Cummings, San Francisco.

Kunin, W.E., Lawton, J.H. 1996. 11 Does biodiversity matter? Evalusting the case for conservating species. In: Gaston, K.J. (ed.). *Biodiversity: A biology of number difference*. Blackwell Science Ltd, Oxford, UK.

Lawes, M.J., Mander, M. and Cawe, S. 2000. The value and uses of natural forests. Pp. 613–624. *In*: Owen, D. (ed.). *Southern African Institute of Forestry Handbook*. 4th Edition, SAIF, Pretoria. ISBN 0–620–06439–0.

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.

Le Roux, C.J.G., Grunow, J.O., Morris, J.W., Bredenkamp, G.J. and Scheepers, J.C. 1988. A classification of the vegetation of the Etosha National Park. *South African Journal of Botany* 54(1): 1–10.

Liversidge, R. and Berry, M.P.S. 2002. Veld management. Pp 568–569. *In*: *Game ranch managment*. Bothma, J. du P. (ed.). Van Schaik publishers, Pretoria.

Louw, A.J. 1970 Mopane veld noord van die Soutpansberg. DSc thesis, University of Pretoria, Pretoria.

Louw, J., Chapman, A. and Strydom, H. 1994. Site classification and evaluation of Entabeni plantation: Northern Transvaal. Report FOR–DEA 818, Environmentek, CSIR, Pretoria. 98 pp.

Louw, W.J. 1951. An ecological account of the vegetation of the Potchefstroom area. *Memoirs of Botanical Surveys South Africa* 24.

Lubke, R.A. and McKenzie, B. 1996. 2. Afromontane Forest. P. 12. *In*: Low, A.B. and Rebelo, A.G. (eds.). *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

Lubke, R.A., Tinley, K.L. and Cowling, R.M. 1988. Vegetation of the Eastern Cape: Tension zones and chorological complexity. Pp.68–87. *In*: Bruton, M.N. and Gess, F.W. (eds.). *Towards an environmental plan for the Eastern Cape*. Rhodes University, Grahamstown.

MacDevette, D.R. 1993. The woody vegetation of the Zululand coastal dunes. Pp. 633–637. *In*: Van Der Sejde, A. (ed.). *South African forestry handbook / Suid-Afrikaanse bosbouhandboek*. Southern African Institute of Forestry, Pretoria.

MacDevette, D.R., Mac Devette, D.K., Gordon, I.G. and Bartholomew, R.I.C. 1989. Floristics of the Natal indigenus forests of southern Africa. *Occasional Report* 45. Foundation for Research and Development, Pretoria.

MacVicar, C.N., Bennie, A.T.P. and De Villiers, J.M. 1991. Soil classification: A taxonomic system for South Africa. Department of Agricultural Development, Pretoria.

Margules, C.R. and Pressy, R.L. 2000. Review article: systematic conservation planning. *Nature* 405: 243–253.

Marneweck, G.C., Grundling, P.L. and Muller, J.L. 2001. Defining and classification of peat wetland eco–regions in South Africa, Wetland Consulting Services (Pty) Ltd. Report to the Institute for Soil, Climate and Water (ISCW), Agricultural Research Council for the Directorate for Land and Resources Management (DLRM), Department of Agriculture, Pretoria, South Africa.

Matthews, W.S. 1991. *Phytosociology of the North–Eastern Mountain Sourveld*. MSc thesis, University of Pretoria, Pretoria.

Matthews, W.S., Bredenkamp, G.J. and Van Rooyen, N. 1991. The grassland–associated vegetation of the Black Reef Quartzite and associated large rocky outcrops in the north–eastern mountain sourveld of the Transvaal Escarpment. *South African Journal of Botany* 57: 143–150.

Matthews, W.S., Bredenkamp, G.J. and Van Rooyen, N. 1992a. The vegetation of the dry dolomitic regions of the north–eastern mountain sourveld of the Transvaal Escarp, South Africa. *Phytocoenologia* 20: 467–488.

Matthews, W.S., Bredenkamp, G.J. and Van Rooyen, N. 1992b. The phytosociology of the high altitude hygrophilous vegetation regions of the North–eastern Mountain Sourveld in the eastern Transvaal, South Africa. *Phytocoenologia* 20: 559–574.

Matthews, W.S., G.J. Bredenkamp and N. Van Rooyen. 1994. The phytosociology and syntaxonomy of relatively low-altitude areas in the North-eastern Mountain Sourveld, in the eastern Transvaal escarpment region. *Koedoe* 37(2): 73–87.

Matthews, W.S., Van Wyk, A.E. and Bredenkamp, G.J. 1993. Endemic flora of he north–eastern Transvaal Escarpment. *Biological Conservation* 63: 83–94.

McArthur, R.H. 1972. *Geographical Ecology: Patterns in the Distribution of Species*. Harper and Row, New York.

McCann, K.S. 2000. Review article: global patterns in biodiversity. *Nature* 405: 220–227.

McCracken, D.P. 1986. The indigenous forests of colonial Natal and Zululand. *Natalia* 16: 19–38.

McCune, B. and Mefford, M.J. 1999. PC-ORD for Windows. Multivariate analysis of ecological data, version 4.10. MjM Software, Gleneden Beach, Oregon, U.S.A.

Mentis, M.T., Grossman, D., Hardy, M.B. O'Connor, T.G. and O'Reagain, P.J. 1989. Paradigm shifts in South African range science, management and administration. *South African Journal of Science* 85: 684–687.

Midgley, J. J., M. C. Cameron, and W. J. Bond. 1995. Gap characteristics and replacement patterns in the Knysna Forest, South Africa. *Journal of Vegetation Science* 6:29–36.

Mitsch, W.J. and Gosselink, J.G. 1986. *Wetlands*. Van Nostrand Reinhold Company Inc., New York.

Moleele, N.M. and Mainah, J. 2003. Resource use conflicts: the future of the Kalahari ecosystem. *Journal of Arid Environments* 54: 405–423.

Moll, E.J. 1972. The current status of mistbelt mixed *Podocarpus* forest in Natal. *Bothalia* 10: 595–589.

Moll, E.J. 1976. The vegetation of the Three Rivers region, Natal. Natal Town and Regional Planning Reports 33. Town and Regional Planning Commission,

Mostert, T.H.C., Bredenkamp, G.J., Schaminée, J.H.J. and Stortelder, A. *in prep*. Proposed syntaxonomy for the vegetation of the Kruger National Park.

Mucina, L. 1997. Classification of vegetation: Past, present and future. *Journal of Vegetation Science* 8: 751–760.

Mueller-Dombois, D. and Ellenberg, H. 1974. *Aims and methods of vegetation ecology*. John Wiley, New York.

Muller, D.B. 1986. Plantekologie van die Willem Pretorius Wildtuin. PhD thesis, University of Orange Free State, Bloemfontein.

Muburg, W.J. and Bredenkamp, G.J. 2004. Macro-channel riparian vegetation of the Olifants River System in the Grassland Biome, Mpumalanga. *Koedoe* 47(1): 41–54.

Myklestad, A. and Birks, H.J.B. 1993. A numerical analysis of the distribution patterns of Salix L. species in Europe. *Journal of Biogeography* 20: 1–32.

Nemudzivhadi, M. 1985. *Lini na Zwini, Thangela ya ndavhuko ya Histori ya Venda*. Thohoyandou Press.

Nichols, N. 1991. The El Nino / Southern Oscillation and Australian vegetation. *Vegetatio* 91: 23–36.

Noy–Meir, I. 1982. Stability of plant–herbivore models and possible application to savanna. Pp 591–609. *In*: Huntley , B.J. and Walker, B.H. (eds.). *Ecology of tropical savannas*. Springer–Verlag, Berlin.

Obermeyer, A.A., Schweickerdt, H.G. and Verdoorn, I.C. 1937. An enumeration of the plants collected in the northern Transvaal. *Bothalia* 3(2): 223–258.

Obiri, J. A. F. 2002. Resource quantification, use and sustainable managment of coastal forests in the Eastern Cape province. PhD dissertation. School of Botany and Zoology. University of Natal, Pietermaritzburg. 164 pp.

Obiri, J. A. F., Lawes, M. and Mukolwe, M. 2002. The dynamics and sustainable use of high-value tree species of the coastal Pondoland forests of the Eastern Cape Province, South Africa. *Forest Ecology and Management* 199: 131–148.

Olivier, J. and Rautenbach, C.J. 2002. The implementation of fog water collection systems in South Africa. *Atmospheric Research* 64(4): 227–239.

Patterson, D.G. and Ross, P.G. 2004a. Land types of the map 2228 Alldays. *In:* MacVicar, C.N. (ed.). *Memmoirs on the Agricultural Natural Resources of South Africa.* Department of Agriculture and Water Supply, www.arc.agric.za/institutes/iscw/main/maps/htm

Patterson, D.G. and Ross, P.G. 2004b. Land types of the map 2328 Alldays. *In:* MacVicar, C.N. (ed.). *Memmoirs on the Agricultural Natural Resources of South Africa.* Department of Agriculture and Water Supply, www.arc.agric.za/institutes/iscw/main/maps/htm

Pickard, J. 1991. Land management in semi–arid environments of New South Wales. *Vegetatio* 91: 191–208.

Pienkowski, M.W., Bignal, E. M., Galbraith, C. A., McCracken, D. I., Stillman, R. A. and Boobyer, M. G. 1996. A simplified classification of land-type zones to assist the integration of biodiversity objects in land-use policies. *Biological Conservation* 75: 11–25.

Pignatti, S. Oberdorfer, E., Schaminée, J.H.J. and Westhoff, V. 1995. On the concept of vegetation class in phytosociology. *Journal of Vegetation Science* 6: 143–152.

Poynton, R.J. 1971. A silvicultural map of South Africa. *South African Journal of Science* 67: 58–60.

Pressey, R.L. and Taffs, K.H. 2001. Scheduling conservation action in production landscapes: priority areas in western New South Wales defined by irreplaceability and vulnerability to vegetation loss. *Biological Conservation* 100: 355–376.

Pulina, G., Salimei, E., Masala, G. and Sikosana, J.L.N. 2004. A spreadsheet model for the assessment of sustainable stocking rate in the semi-arid and sub-humid regions of southern Africa. *Livestock Production Science* 61:287–299.

Raal, P.A. and Burns, M.E.R. 1996. Mapping and conservation importance rating of the South African coastal vegetation as an aid to development planning. *Landscape and Urban Planning* 34: 389–400.

Reno, B.M., Jansson, R. and Nilsson, C. 2005. Spatial patterns of plant invasiveness in a riparian corridor. *Landscape Ecology* 20 (2): 165–176.

Reyers, B. 2003. Incorporating anthropogenic threats into evaluations of regional biodiversity and prioritisation of caonservation areas in the Limpopo Province, South Africa. *Biological Conservation* 118: 521–531.

Rhoads, A.F. and Thompson, L. 1992. Integrating herbarium data into a geographic information system: requirements for spatial analysis. *Taxon* 41: 43–49.

Roberts, B.R. 1991. The role of land use planning in semi–arid areas. *Vegetatio* 91: 15–21.

Rutherford, M. C. and R. H. Westfall. 1994. Biomes of Southern Africa: an objective categorization. *Memoirs of the Botanical Survey of South Africa* 63: 1–94.

Salisbury, E.J., 1926. The geographical distribution of plants in relation to climatic factors. *Geography Journal* 57: 312–335.

Schaminée, J.H.J., Stortelder, A.H.F. and Vesthoff, V. 1995. De Vegetatie van Nederland 1. Inleiding tot de plantensociologie: grondslagen, metoden en toepassingen. Opulus, Upsala/Leiden, 296pp.

Scholes, R.J. 1978. The vegetation of the Blouberg. BSc honorus project, University of the Witwatersrand, Johannesburg.

Schultze, R.E. and McGee, O.S. 1978. Climatic indices and classification in relation to the biogeography of southern Africa. *In*: Werger, M.J.A. (ed.). *Biogeography and ecology in southern Africa*, The Hague, Junk.

Schutte, J.M. 1971. Die onttrekking van water uit die newellaag en lae wolke by Mriepskop. S.A. Department of Water Affairs, Division Hydrological Research, Technical note 20: 1–21.

Scott, D.F. and Le Maitre, D.C. 1998. The interaction between vegetation and groundwater: research priorities for South Africa. Water Research Commission WRC Report; no. 730/1/98, Pretoria.

Scott, L. 1982. A 5000-year old polen sequence from the spring deposits in the Bushveld at the north of the Soutpansberg, South Africa. *Palaeoecology of Africa and the surrounding islands* 14: 45–55.

Seydack, A.H.W. 2000. Theory and practice of yield regulation systems for sustainable management of tropical and subtropical moist natural forests. Pp. 257–317. *In*: Von Gadow, K., Pukkala, T. and Tomé, M. *Sustainable Forest Management*. Kluwer Academic Publishers, Netherlands.

Shackleton, C.M and Shackleton, S.E. 2000. Direct use values of secondary resources harvested from communal savannas in the Bushbuckridge Lowveld, South Africa. *Journal of Tropical Forest Products* 6: 28–47.

Shackleton, C.M., Cawe, S.G., and Geldenhys, C.J. 1999. Review of the definitions and classifications of South African indigenous forests and woodlands. ENV–P–C 99007, CSIR, Pretoria.

Siebert, F., Bredenkamp, G.J. and Siebert, S.J. 2003b. A comparson of Mopaneveld vegetation in South Africa, Namibia and Zimbabwe. *Bothalia* 33(1): 121–134.

Siebert, S.J. 2001. Vegetation on the ultramafic soils of the Sekhukhuneland Centre of Endemism. PhD thesis, University of Pretoria, Pretoria.

Siebert, S.J., Van Wyk, A.E. and Bredenkamp, G.J. 2003a. Vegetation ecology of Sekhukhuneland, South Africa: *Kirkia wilmsii–Terminalia prunioides* Closed Mountain Bushveld. *South African Journal of Botany* 68: 497–517.

Siebert, S.J., Van Wyk, A.E., Bredenkamp, G.J. and Siebert, F. 2003b. Vegetation of the rock habitats of the Sekhukhuneland Centre of Plant Endemism, South Africa. *Bothalia* 33(2): 207–228.

Sinclair, I., Hockey, P. and Tarboton, W. 1995. *Birds of southern Africa*. Sasol.

Smit, J.H.L. 2000. Phytosociology and veld management of the eastern Kalahari Thornveld. MSc thesis, University of Pretoria, Pretoria.

Smuts, W.J. 1992. Peatlands of the Natal Mire Complex: geomorphology and characterization. *South African Journal of Science* 88: 474–483.

Snyman, H.A. 1998. Dynamics and sustainable utilization of rangeland ecosystems in arid and semi-arid climates of southern Africa. *Journal of Arid Environments* 39: 645–666.

South African Weather Buro 2004. South African Weather Service, http://www.weathersa.co.za

Stirton, C.H. 1982. A new species of *Rhynchosia* from Venda. *Bothalia* 14(1): 76–77.

Stott, P., 1981. *Historical Plant Geography: An Introduction*. George Allen and Uwin, London.

Straub, A.F. 2002. The vegetation of Breslau Game Farm, Northern Province, South Africa, MSc thesis, University of Pretoria, Pretoria.

Tainton, N.M. and Hardy, B.M. 1999. Introduction to the concepts of development of vegetation. Pp1-21. *In*: Tainton , N.M. (ed.). Veld management in South Africa. University of Natal Press, Pietermaritzburg.

Ter Braak, C.J.F. 1987. The analysis of vegetation-environment relationships by canonical correspondence analysis. *Vegetatio* 69: 69-77.

Ter Braak, C.J.F. and ämilauer, P. 1999. Canoco for Windows Version 4.02. Wageningen, The Netherlands: Centre for Biometry Wageningen, CPRO-DLO.

Tichý, L. 2002. JUICE, software for vegetation classification. *Journal of Vegetation Science* 13(3): 451–453.

Tichý, L. 2005. New similarity indices for the assignment of relevés to the vegetation units of an existing phytosociological classification. *Plant ecology* 179(1): 67–72.

Trollope, W.S.W. 1974. Fire as a method of controlling macchia (fynbos) vegetation on the Amatole Mountains of the eastern Cape. *Proceedings of the Grassland Society of southern Africa* 8: 35–41.

Turpie, J.K., Heydenrych, B.J. and Lamberth, S.J. 2003. Economic value of terrestrial and marine biodiversity in the Cape Floristic region: implications for defining effective and socially optimal conservation strategies. *Biological Conservation* 112: 233–251.

UNESCO 2002. *Convention concerning the protection of the world cultural and natural heritages*. UNESCO World Heritage Centre, France (http://www.unesco.org)

Van Den Berg, H.M. 1993. Die identifisering en kartering van veldekotope in die noordwes-Transvaalse suur- en gemngde-bosveld. MSc thesis, University of Pretoria, Pretoria.

Van der Maarel, E. 1979. Multivariate methods in phytosociology, with reference to The Netherlands. Pp. 163–225. *In*: Werger, M.J.A. (ed.). *The study of vegetation*. Junk, The Hague.

Van Der Maarel, E. 1980. On the interpretability of ordination diagrams. *Vegetatio* 42: 43–45.

Van Der Maarel, E. 1996. Vegetation dynamics and dynamic vegetation science. *Acta Botanica Neerlandica* 45: 421–442.

Van Der Maarel, E., Espejel, I. and Moreno-Casasola, P. 1987. Two-step vegetation analysis based on very large data sets. *Vegetatio* 68: 139–143.

Van Der Meulen, F. 1979. Plant sociology of the western Transvaal Bushveld, South Africa: a syntaxonomic and synegological study. *Dissertationes Botanicae* 49: 1–192.

Van Der Schijff, H.P. 1957. 'n Ekologiese studie van die flora van die Nasionale Krugerwildtuin. DSc thesis, Potchefstroomse Universiteit vir Christelike Hoër Onderwys, Potchefstroom.

Van Groenewoud, H. 1992. The robustness of correspondence, detrended-correspondence and TWINSPAN analysis. *Journal of Vegetation Science* 3: 239.

Van Jaarsveld, E. and Hardy, D. 1991. The Blouberg botanical expedition, with specific reference to the succulent vegetation. *Aloe* 28(3): 78–83.

Van Rooyen, N. 1978. 'n Ekologiese studie van die plantgemeenskappe van die Punda Milia–Pafuri–Wambiyagebied in die Nasionale Krugerwildtuin, MSc thesis, University of Pretoria, Pretoria

Van Rooyen, N., Theron, G.K. and Grobbelaar, N. 1981. A floristic description and structural analysis of the plant communities of the Punda Milia–Pafuri–Wambia area of the Kruger National Park, Republic of South Africa: 3. The *Colophospermum mopane* communities. *South African Journal of Botany* 47(4): 585–626.

Van Rooyen, N. and Bredenkamp, G.J. 1996a. 11 Soutpansberg Arid Mountain Bushveld. P 22. *In*: Low, A.B. and Rebelo, A.G. (eds.). *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

Van Rooyen, N. and Bredenkamp, G.J. 1996b. 17 Sweet Bushveld. P 21. *In*: Low, A.B. and Rebelo, A.G. (eds.). *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

Van Rooyen, N. and Bredenkamp, G.J. 1996c. 12 The Waterberg Moist Mountain Bushveld. P 22. *In*: Low, A.B. and Rebelo, A.G. (eds.). *Vegetation of South*

Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

Van Staden, P.J. 2002. An ecological study of the plant communities of the Marakele National Park. MSc thesis, University of Pretoria, Pretoria.

Van Staden, P.J. and Bredenkamp, G.J. 2005. Major plant communities of the Marakele National Park. *Koedoe* 48(2): 59–70.

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

Van Wyk, A.E. 1984. A new species of *Combretum* from Venda and taxonomic notes on the section *Angustimarginata* (Combretaceae). *South African Journal of Botany* 3(2): 125–135.

Van Wyk, A.E. 1996. Biodiversity of the Maputaland Center. *The biodiversity of African plants* 198–207.

Van Wyk, A.E. and Smith, G.F. 2001. *Regions of floristic endemism in southern Africa*. Umdaus Press, Pretoria.

Van Wyk, P. 1994. *Field guide to the trees of the Kruger National Park* Struik Publishers, Cape Town.

Venter, C.E. 2003. The vegetation ecology of Mfabeni peat swamp, St. Lucia, KwaZulu-Natal. MSc thesis, University of Pretoria, Pretoria.

Voigt, E.A. and Plug, I. 1984. Happy Rest: the earliest Iron Age Fauna from the Soutpansberg. *South African Journal of Science* 80: 22–227.

Von dem Bussche, G.H. 1984. *The western Soutpansberg*. Unpublished NAKOR report, Department of Environmental Affairs, Pretoria.

Von Maltitz, G.P., Mucina, L., Geldenhuys, C., Lawes, M., Eeley, H., Adie, H., Vink, D., Fleming, G. and Voster, T. 2003. Classification system for South African Indigenous Forests: an objective classification for the Department of Water Affairs and Forestry. Environmentek report ENV–P–C 2003–017 CSIR, Pretoria.

Walker, B. 1989. Diversity and stability in ecosystem conservation. *In*: Western, D. and Pearl, M. (eds.). *Conservation for the twenty–first century*. Oxford University Press, New York.

Walter, H., 1985. *Vegetation of the Earth and Ecological Systems of Geobiosphere*. Springer, Heidelberg.

Weare, P.R. and A. Yalala 1971. Provisional vegetation map of Botswana. *Botswana Notes and Records* 3: 131–147.

Weisser, P.J., Hahn, N., Van Der Waal, C. Tshisikawe, P. and Todd, C.B. Anthropology. Pp. 24–26. *In*: Berger, K., Craffort, J.E., Gaiger, I., Gaiger, M.J., Hahn, N. and MacDonald, I. (eds.). *A first synthesis of the environmental, biological and cultural assets of the Soutpansberg*. Leach Printers and Signs, Makhadu.

Werger, M.J.A. 1973. An account of the plant communities of Tussen die Riviere Game Farm, Orange Free State. *Bothalia* 11(2): 165–176.

Werger, M.J.A. 1974. On concepts and techniques applied in the Zurich-Montpellier method of vegetation survey. *Bothalia* 11: 309–323.

Werger, M.J.A. 1980. Phytosociology of the Uper Orange River Valley, South Africa. *Memoirs of the Botanical Surveys of South Africa* 46: 1–222.

Werger, M.J.A. and Coetzee, B.J. 1978. The Sudano–Zambesian Region. Pp 231–299.*In*: Werger, M.J.A. (ed.). *Biogeography and ecology in southern Africa*, The Hague, Junk.

Wessels, K.J., Reyers, B., Van Jaarsveld, A.S. and Rutherford, M.C. 2003. Identification of potential conflict areas between land transformation and biodiversity conservation in north-eastern South Africa. *Agriculture, Ecosystems and Environment* 95: 157–178.

Westfall, R.H. 1981. The plant ecology of the farm Groothoek, Thabazimbi District. MSc thesis, University of Pretoria, Pretoria.

Westfall, R.H., Van Rooyen, N. and Theron, G.K. 1985. The plant ecology of the farm Groothoek, Thabazimbe District. II. Classification. *Bothalia* 14: 655–688.

Westhoff, V. 1979. Phytosociology in The Netherlands: history, present state and future. Pp. 81–121. *In*: Werger, M.J.A. (ed.). *The study of vegetation*. Junk, The Hague.

Westhoff, V. and Van Der Maarel, E. 1973. The Braun-Blanquet aproach. Pp. 617-726 *In*: Whittaker, R.H. (ed.). 5. Ordination and classification of communities. *In*: Tuxen, R. (ed.). *Handbook of vegetation science*. The Hague: Junk.

Westhoff, V. and Van Der Maarel, E. 1978. The Braun-Blanquet approach. Pp. 289–374. *In*: Whittaker, R.H. (ed.). *Classification of plant communities*. The Hague, Junk.

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

Westoby, M., Walker, B. and Noy–Meir, I. 1989a. Opportunistic management for rangelands not at equilibrium. *Journal of Rangeland Management* 42(4): 266–274.

Westoby, M., Walker, B. and Noy–Meir, I. 1989b. Range management on the basis of a model which does not seek to establish equilibrium. *Journal of Arid Environments* 17: 235–239.

White, F. 1978a. The Afromontane Region. Pp. 463–513. *In*: M.J.A. Werger (ed.). *Biogeography and ecology of southern Africa*. Junk, The Hage.

White, F. 1978b. The history of the Afromontane archipelago and the scientific need for its conservation. *African Journal of Ecology* 19: 33–54.

White, F. 1983. The vegetation of Africa: a descriptive memoir to accompany the UNESCO/AETFAT/UNSO vegetation map of Africa. *Natural Resources Research* 20. UNESCO, Paris.

White, R.E. 1995. *Introduction to the principles and practices of soil science.* Second edition, Blackwell Sciences (Ltd), Oxford.

Wiens, J.A. 1984. On understanding a non-equilibrium world: myth and reality in community patterns and processes. *In*: Strong, D.R., Simberloff, Jr., D. Abele, L.G. and Thistle, A.B. (eds.). *Ecological communities: Conceptual issues and the evidence*. Princeton University Press, Princeton, New Jersey.

Winstanley, T.J. 2001. Analysis of the legislative and institutional context for wetland rehabilitation. EnAct International report for a project on the development of tools to support planning, implementation and monitoring of wetland rehabilitation. Department of Environmental Affairs and Tourism, Pretoria.

Winterbach, R. 1998. A phytososiological synthesis of *Acacia tortilis* communities in the north–western savanna of South Africa. MSc thesis, University of Pretoria, Pretoria.

Winterbach, R., Bredenkamp, G.J., Deutschlander, M.S. and Mucina, L. 2000. Preliminary syntaxonomic scheme of vegetation classes for the Central Bushveld of South Africa. Pp. 123–127. *In*: Whyte, P.S., Mucina, L., Leps, J.S. and Van der Maarel, E. (eds.). *Proceedings IAVS Symposium*. Opulus Press, Upsala.

Witkowski, E.T.F. and O'Connor, T.G. 1996. Topo-edaphic, floristic and physiognomic gradients of woody plants in a semi-arid African savanna woodland. *Vegetatio* 124: 9–23.

Wright, R.G., Murray, M.P. and Merrill, T. 1998. Ecoregions as a level of ecological analysis. *Biological Conservation* 86: 207–213.

Wright, R.G., Scott, J.M., Mann, S. and Murray, M.P. 2001. Identifying unprotected and potentially at risk plant communities in the western USA. *Biological Conservation* 98: 97–106.

Yeo, M.J.M., Blackstock, T.H. and Stevens, D.P. The use of phytosociological data in conservation assesment: a case study of lowland grasslands in mid Wales. *Biological Conservation* 86: 125–138.

APPENDIX A

PLANT SPECIES CHECKLIST

The following species were recorded within the study area during the data collection phase of the study. This list contains 846 species represented by 114 families. Taxonomic names conform to those of Germishuizen & Meyer (2003).

Pteridophyta

ANEMIACEAE

Anemia simii Tardieu

DENNSTAEDTIACEAE

Pteridium aquilinum (L.) Kuhn

EQUISETACEAE

Equisetum ramosissimum Desf.

PTERIDACEAE

Cheilanthes involuta (Sw.) Schelpe & N.C.Anthony

Pellaea calomelanos (Sw.) Link var. *calomelanos*

SELAGINELLACEAE

Selaginella dregei (C.Presl) Hieron.

THELYPTERIDACEAE

Christella guenziana (Mett.) Holtum

Pneumatopteris unita (Kunze) Holttum

Thelypteris confluens (Thunb.) Morton

Gymnosperms

CUPRESSACEAE

Widdringtonia nodiflora (L.) Powrie

PODOCARPACEAE

Podocarpus falcatus (Thunb.) R.Br. ex Mirb.

Podocarpus latifolius (Thunb.) R.Br. ex Mirb.

Dicotyledons

ACANTHACEAE

Asystasia schimperi T.Anderson

Barleria affinis C.B.Clarke

Barleria crossandriformis C.B.Clarke

Barleria elegans S.Moore ex C.B.Clarke

Barleria gueinzii Sond.

Barleria obtusa Nees

Barleria ovata E.Mey. ex Nees

Barleria pretoriensis C.B.Clarke

Barleria rotundifolia Oberm.

Barleria saxatilis Oberm.

Barleria species

Barleria wilmsiana Lindau

Blepharis aspera Oberm.

Blepharis diversispina (Nees) C.B.Clarke

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

Blepharis species

Blepharis subvolubilis C.B.Clarke

Crabbea acaulis N.E.Br.

Crabbea angustifolia Nees

Crabbea nana Nees

Crabbea velutina S.Moore

Dicliptera heterostegia C.Presl ex Nees

Dyschoriste transvaalensis C.B.Clarke

Hypoestes forskaolii (Vahl) R.Br.

Hypoestes triflora (Forssk.) Roem. & Schult.

Isoglossa grantii C.B.Clarke

Isoglossa hypoestiflora Lindau

Justicia anagalloides (Nees) T.Anderson

Justicia betonica L.

Justicia flava (Vahl) Vahl

Justicia montis-salinarum A.Meeuse

Justicia odora (Forssk.) Vahl

Lepidagathis scabra C.B.Clarke

Monechma divaricatum (Nees) C.B.Clarke

Rhinacanthus xerophilus A.Meeuse

Ruspolia hypocrateriformis (Vahl) Milne-Redh. var. *australis*

Ruttya ovata Harv.

Ruttya X *Ruspolia*

Sclerochiton harveyanus Nees

Sclerochiton ilicifolius A.Meeuse

Thunbergia atriplicifolia E.Mey. ex Nees

AMARANTHACEAE

Achyranthes aspera L.

Alternanthera pungens Humb., Bonpl. & Kunth

Cyathula orthacantha (Hochst. ex Asch.) Schinz

Gomphrena celosioides Mart.

Hermbstaedtia linearis Schinz

Kyphocarpa angustifolia (Moq.) Lopr.

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

Sericocoma avolans Fenzl

ANACARDIACEAE

Lannea discolor (Sond.) Engl.

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

Ozoroa paniculosa (Sond.) R.& A.Fern. var. *salicina* (Sond.)

Rhus chirindensis Baker f.

Rhus gueinzii Sond.

Rhus lancea L.f.

Rhus leptodictya Diels

Rhus lucida L.

Rhus magalismontana Sond. subsp. *coddii* (R.& A.Fern.) Moffett

Rhus pentheri Zahlbr.

Rhus pyroides Burch.

Rhus rehmanniana Engl. var. *glabrata* (Sond.) Moffett

Rhus rigida Mill. var. *rigida*

Rhus tumulicola S.Moore var. *meeuseana* (R.& A.Fern.) Moffett

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

ANNONACEAE

Artabotrys brachypetalus Benth.

Artabotrys monteiroae Oliv.

Hexalobus monopetalus (A.Rich.) Engl. & Diels var. *monopetalus*

APIACEAE

Centella glabrata L.

Heteromorpha arborescens (Spreng.) Cham. & Schltdl. var. *abyssinica*

Steganotaenia araliacea Hochst. var. *araliaceae*

APOCYNACEAE

Acokanthera oppositifolia (Lam.) Codd

Acokanthera species

Ancylobotrys capensis (Oliv.) Pichon

Ancylobotrys petersiana (Klotzsch) Pierre

Carissa bispinosa (L.) Desf. ex Brenan subsp. *zambesiensis* Kup

Carissa edulis Vahl

Ceropegia species

Cryptolepis cryptolepioides (Schltr.) Bullock

Diplorhynchus condylocarpon (Müll.Arg.) Pichon

Gomphocarpus tomentosus Burch. subsp. *tomentosus*

Landolphia kirkii Dyer

Raphionacme procumbens Schltr.

Sarcostemma viminale (L.) R.Br.

Secamone parvifolia (Oliv.) Bullock

Stapelia gettliffei R.Pott

Stapelia gigantea N.E.Br.

Stapelia hirsuta L.

Strophanthus speciosus (Ward & Harv.) Reber

Wrightia natalensis Stapf

AQUIFOLIACEAE

Ilex mitis (L.) Radlk. var. *mitis*

ARALIACEAE

Cussonia natalensis Sond.

Cussonia spicata Thunb.

Cussonia transvaalensis Reyneke

Schefflera umbellifera (Sond.) Baill.

ASTERACEAE

Acanthospermum species

Arctotis species

Berkheya insignis (Harv.) Thell.

Berkheya zeyheri (Sond. & Harv.) Oliv. & Hiern

Bidens bipinnata L.

Bidens biternata (Lour.) Merr. & Sherff

Bidens pilosa L.

Blainvillea gayana Cass.

Brachylaena discolor DC.

Brachylaena huillensis O.Hoffm.

Cineraria parvifolia Burtt Davy

Cineraria species

Dicoma anomala Sond.

Dicoma galpinii Wilson

Dicoma montana Schweick.

Dicoma schinzii O.Hoffm.

Dicoma species

Dicoma tomentosa Cass.

Emilia transvaalensis (Bolus) C.Jeffrey

Felicia clavipilosa Grau

Felicia muricata (Thunb.) Nees

Gerbera jamesonii Bolus ex Adlam

Helichrysum argyrosphaerum DC.

Helichrysum cephaloideum DC.

Helichrysum cerastioides DC.

Helichrysum griseum Sond.

Helichrysum harveyanum Wild

Helichrysum kraussii Sch.Bip.

Helichrysum nudifolium (L.) Less. var. *nudifolium*

Helichrysum nudifolium (L.) Less. var. *pilosellum* (L.f.) Beentjie

Helichrysum retortum (L.) Willd.

Helichrysum setosum Harv.

Hirpicium species

Kleinia longiflora DC.

Lopholaena festiva Brusse

Philyrophyllum schinzii O.Hoffm.

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

Psiadia punctulata (DC.) Oliv. & Hiern ex Vatke

Schistostephium crataegifolium (DC.) Fenzl ex Harv.

Senecio barbertonicus Klatt

Senecio coronatus (Thunb.) Harv.

Senecio erubescens Aiton

Senecio gerrardii Harv.

Senecio inornatus DC.

Senecio isatideus DC.

Senecio lydenburgensis Hutch. & Burtt Davy

Senecio madagascariensis Poir.

Senecio oxyriifolius DC.

Senecio purpureus L.

Senecio speciosus Willd.

Senecio tamoides DC.

Senecio thamathuensis Hilliard

Senecio venosus Harv.

Tarchonanthus camphoratus L.

Tarchonanthus trilobus DC. var. *galpinii* (Hutch. & E.Phillip

Ursinia nana DC.

Vernonia capensis (Houtt.) Druce

Vernonia centaureoides Klatt

Vernonia fastigiata Oliv. & Hiern

Vernonia glabra (Steetz) Vatke

Vernonia natalensis Sch.Bip. ex Walp.

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

Vernonia steetziana Oliv. & Hiern

Vernonia triflora Bremek.

BALANITACEAE

Balanites maughamii Sprague subsp. *maughamii*

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

BIGNONIACEAE

Catophractes alexandri D.Don

Markhamia zanzibarica (Bojer ex DC.) K.Schum.

Rhigozum obovatum Burch.

Rhigozum zambesiacum Baker

Tecoma capensis (Thunb.) Lindl.

BOMBACACEAE

Adansonia digitata L.

BORAGINACEAE

Cordia grandicalyx Oberm.

Cordia monoica Roxb.

Ehretia obtusifolia Hochst. ex DC.

Ehretia rigida (Thunb.) Druce

Heliotropium steudneri Vatke

BUDDLEJACEAE

Buddleja saligna Willd.

Buddleja salviifolia (L.) Lam.

Nuxia floribunda Benth.

BURSERACEAE

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

Commiphora glandulosa Schinz

Commiphora marlothii Engl.

Commiphora mollis (Oliv.) Engl.

Commiphora pyracanthoides Engl.

Commiphora schimperi (O.Berg) Engl.

Commiphora species

Commiphora tenuipetiolata Engl.

Commiphora viminea Engl.

CACTACEAE

Opuntia ficus-indica (L.) Mill.

CAMPANULACEAE

Wahlenbergia grandiflora Brehmer

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

CAPPARACEAE

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

Boscia foetida Schinz subsp. *filipes* (Gilg) Lötter

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

Capparis fascicularis DC. var. *fascicularis*

Capparis tomentosa Lam.

Cleome angustifolia Forssk. subsp. *petersiana* (Klotzsch ex Son

Cleome gynandra L.

Cleome hirta (Klotzsch) Oliv.

Cleome macrophylla (Klotzsch) Briq. var *macrophylla*

Cleome monophylla L.

Maerua angolensis DC.

Maerua cafra (DC.) Pax

Maerua edulis (Gilg & Gilg-Ben.) DeWolf

Maerua juncea Pax subsp. *juncea*

Maerua parvifolia Pax

CARYOPHYLLACEAE

Pollichia campestris Aiton

CELASTRACEAE

Catha edulis (Vahl) Forssk. ex Endl.

Elaeodendron croceum (Thunb.) DC.

Elaeodendron transvaalense (Burtt Davy) R.H.Archer

Gymnosporia buxifolia (L.) Szyszyl.

Gymnosporia mossambicensis (Klotzsch) Loes.

Gymnosporia senegalensis (Lam.) Loes.

Gymnosporia tenuispina (Sond.) Szyszyl.

Loeseneriella crenata (Klotzsch) N.Hallé

Maytenus acuminata (L.f.) Loes. var. *acuminata*

Maytenus undata (Thunb.) Blakelock

Mystroxylon aethiopicum (Thunb.) Loes. subsp. *aethiopicum*

Mystroxylon aethiopicum (Thunb.) Loes. subsp. *schlechteri*

Pristimera longipitiolata (oliv.) N.Hallé

Pterocelastrus echinatus N.E.Br.

Robsonodendron eucleiforme (Eckl. & Zeyh.) R.H.Archer

Salacia rehmannii Schinz

CELTIDACEAE

Celtis africana Burm.f.

Trema orientalis (L.) Blume

CHENOPODIACEAE

Chenopodium album L.

CHRYSOBALANACEAE

Parinari capensis Harv. subsp. *capensis*

Parinari curatellifolia Planch. ex Benth.

CLUSIACEAE

Garcinia livingstonei T.Anderson

COMBRETACEAE

Combretum apiculatum Sond. subsp. *apiculatum*

Combretum collinum Fresen.

Combretum hereroense Schinz

Combretum imberbe Wawra

Combretum kraussii Hochst.

Combretum moggii Exell

Combretum molle R.Br. ex G.Don

Combretum mossambicense (Klotzsch) Engl.

Combretum species

Combretum vendae A.E.van Wyk

Combretum zeyheri Sond.

Terminalia prunioides M.A.Lawson

Terminalia sericea Burch. ex DC.

CONVOLVULACEAE

Convolvulus sagittatus Thunb.

Evolvulus alsinoides (L.) L.

Ipomoea adenioides Schinz

Ipomoea albivenia (Lindl.) Sweet

Ipomoea oblongata E.Mey. ex Choisy

Ipomoea species

Seddera suffruticosa (Schinz) Hallier f.

CORNACEAE

Curtisia dentata (Burm.f.) C.A.Sm.

CRASSULACEAE

Cotyledon barbeyi Schweinf. ex Baker

Cotyledon orbiculata L.

Crassula swaziensis Schönland

Kalanchoe brachyloba Welw. ex Britten

Kalanchoe crundallii I.Verd.

Kalanchoe paniculata Harv.

Kalanchoe sexangularis N.E.Br. var. *sexangularis*

CUCURBITACEAE

Coccinia rehmannii Cogn.

Coccinia sessilifolia (Sond.) Cogn.

Kedrostis foetidissima (Jacq.) Cogn.

Momordica species

DICHAPETALACEAE

Dichapetalum cymosum (Hook.) Engl.

DIPSACACEAE

Cephalaria pungens Szabó

Scabiosa columbaria L.

EBENACEAE

Diospyros lycioides Desf. subsp. *guerkei* (Kuntze) De Winter

Diospyros lycioides Desf. subsp. *sericea* (Bernh.) De Winter

Diospyros villosa (L.) De Winter var. *parvifolia* (De Winter)

Diospyros whyteana (Hiern) F.White

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

Euclea divinorum Hiern

Euclea linearis Zeyh. ex Hiern

Euclea natalensis A.DC. subsp. *angustifolia* F.White

Euclea natalensis A.DC. subsp. *natalensis*

Euclea schimperi (A.DC.) Dandy var. *schimperi*

Euclea undulata Thunb.

EUPHORBIACEAE

Acalypha glabrata Thunb.

Acalypha indica L.

Acalypha species

Androstachys johnsonii Prain

Bridelia cathartica Bertol.f.

Bridelia micrantha (Hochst.) Baill.

Bridelia mollis Hutch.

Clutia pulchella L. var. *pulchella*

Croton gratissimus Burch.

Croton megalobotrys Müll.Arg.

Croton menyhartii Pax

Croton pseudopulchellus Pax

Croton sylvaticus Hochst.

Dalechampia species

Drypetes gerrardii Hutch.

Erythrococca trichogyne (Müll.Arg.) Prain

Euphorbia aeruginosa Schweick.

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

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

Euphorbia crotonoides Boiss.

Euphorbia excelsa A.C.White, R.A.Dyer & B.Sloane

Euphorbia griseola Pax subsp. *griseola*

Euphorbia guerichiana Pax

Euphorbia ingens E.Mey. ex Boiss.

Euphorbia tirucalli L.

Euphorbia zoutpansbergensis R.A.Dyer

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

Jatropha schlechteri Pax

Phyllanthus incurvus Thunb.

Phyllanthus macranthus Pax var. *macranthus*

Phyllanthus maderaspatensis L.

Phyllanthus nummulariifolius Poir. var. *nummulariifolius*

Phyllanthus parvulus Sond. var. *garipensis* (E.Mey. ex Drège)

Phyllanthus pentandrus Schumach. & Thonn.

Phyllanthus pinnatus (Wight) G.L.Webster

Phyllanthus reticulatus Poir. var. *reticulatus*

Pseudolachnostylis maprouneifolia Pax

Spirostachys africana Sond.

Suregada africana (Sond.) Kuntze

FABACEAE

Acacia ataxacantha DC.

Acacia burkei Benth.

Acacia caffra (Thunb.) Willd.

Acacia davyi N.E.Br.

Acacia erioloba E.Mey.

Acacia erubescens Welw. ex Oliv.

Acacia gerrardii Benth. var. *gerrardii*

Acacia karroo Hayne

Acacia mellifera (Vahl) Benth. subsp. *detinens* (Burch.) Brenan

Acacia nebrownii Burtt Davy

Acacia nigrescens Oliv.

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

Acacia permixta Burtt Davy

Acacia rehmanniana Schinz

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

Acacia robusta Burch. subsp. *robusta*

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

Acacia sieberiana DC. var. *woodii* (Burtt Davy) Keay & Brenan

Acacia species

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

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

Albizia adianthifolia (Schumach.) W.Wight

Albizia anthelmintica (A.Rich.) Brongn.

Albizia brevifolia Schinz

Albizia harveyi E.Fourn.

Albizia versicolor Welw. ex Oliv.

Alistilus bechuanicus N.E.Br.

Bolusanthus speciosus (Bolus) Harms

Burkea africana Hook.

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

Chamaecrista absus (L.) Irwin & Barneby

Chamaecrista mimosoides (L.) Greene

Crotalaria capensis Jacq.

Crotalaria laburnifolia L.

Crotalaria lanceolata E.Mey.

Crotalaria monteiroi Taub. ex Baker f.

Crotalaria species

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

Dalbergia nitidula Baker

Dichrostachys cinerea (L.) Wight & Arn.

Dichrostachys cinerea (L.) Wight & Arn. subsp. *africana* Brenan

Elephantorrhiza burkei Benth.

Elephantorrhiza elephantina (Burch.) Skeels

Erythrina lysistemon Hutch.

Erythrophleum africanum (Welw. Ex Benth) Harms

Hoffmannseggia burchellii (DC.) Benth. ex Oliv.

Indigofera adenoides Baker f.

Indigofera circinnata Benth. ex Harv.

Indigofera cryptantha Benth. ex Harv. var. *cryptantha*

Indigofera hilaris Eckl. & Zeyh.

Indigofera jucunda Schrire

Indigofera lyalli Baker subsp. *lyalli*

Indigofera rhytidocarpa Benth. ex Harv.

Indigofera schimperi Jaub. & Spach

Indigofera species

Macrotyloma axillare (E.Mey.) Verdc.

Mundulea sericea (Willd.) A.Chev.

Ormocarpum trichocarpum (Taub.) Engl.

Otoptera burchellii DC.

Peltophorum africanum Sond.

Philenoptera violacea (Klotzsch) Schrire

Psoralea pinnata L.

Pterocarpus angolensis DC.

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

Pterolobium stellatum (Forssk.) Brenan

Rhynchosia komatiensis Harms

Rhynchosia monophylla Schltr.

Rhynchosia nervosa Benth. & Harv.

Rhynchosia sordida (E.Mey.) Schinz

Rhynchosia vendae C.H.Stirt.

Rhynchosia venulosa (Hiern) K.Schum.

Schotia brachypetala Sond.

Senna bicapsularis (L.) Roxb.

Senna petersiana (Bolle) Lock

Stylosanthes fruticosa (Retz.) Alston

Tephrosia longipes Meisn. subsp. *longipes*

Tephrosia macropoda (E.Mey.) Harv.

Tephrosia purpurea (L.) Pers.

Xanthocercis zambesiaca (Baker) Dumaz-le-Grand

Zornia species

FLACOURTIACEAE

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

Dovyalis rhamnoides (Burch. ex DC.) Harv.

Dovyalis zeyheri (Sond.) Warb.

Flacourtia indica (Burm.f.) Merr.

Kiggelaria africana L.

Oncoba spinosa Forssk. subsp. *spinosa*

Scolopia zeyheri (Nees) Harv.

Trimeria grandifolia (Hochst.) Warb.

GENTIANACEAE

Chironia palustris Burch.

Chironia purpurascens (E.Mey.) Benth. & Hook.f.

GERANIACEAE

Monsonia angustifolia E.Mey. ex A.Rich.

GISEKIACEAE

Gisekia africana (Lour.) Kuntze

GUNNERACEAE

Gunnera perpensa L.

HAMAMELIDACEAE

Trichocladus grandiflorus Oliv.

HERNANDIACEAE

Gyrocarpus americanus Jacq. subsp. *africanus*

HETEROPYXIDACEAE

Heteropyxis natalensis Harv.

HYPERICACEAE

Hypericum aethiopicum Thunb. subsp. *sonderi* (Bredell) N.Robson

Hypericum lalandii Choisy

ICACINACEAE

Apodytes dimidiata E.Mey. ex Arn. subsp. *dimidiata*

Kirkia acuminata Oliv.

Kirkia wilmsii Engl.

Pyrenacantha grandiflora Baill.

LAMIACEAE

Becium angustifolium (Benth.) N.E.Br.

Becium filamentosum (Forssk.) Chiov.

Becium obovatum (E.Mey. ex Benth.) N.E.Br. subsp. *obovatum*

Clerodendrum glabrum E.Mey. var. *glabrum*

Clerodendrum makanjanum H.J.P.Winkl.

Endostemon tereticaulis (Poir.) M.Ashby

Leonotis ocymifolia (Burm.f.) Iwarsson

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

Leucas sexdentata Skan

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

Orthosiphon labiatus N.E.Br.

Plectranthus neochilus Schltr.

Rotheca myricoides (Hochst.) Steane & Mabb. sensu lato

Tetradenia brevispicata (N.E.Br.) Codd

Tetradenia riparia (Hochst.) Codd

Tinnea rhodesiana S.Moore

Vitex mombassae Vatke

Vitex rehmannii Gürke

LAURACEAE

Cryptocarya transvaalensis Burtt Davy

Ocotea kenyensis (Chiov.) Robyns

LOBELIACEAE

Cyphia angustifolia Eckl. & Zeyh.

MAESACEAE

Maesa lanceolata Forssk.

MALPIGHIACEAE

Sphedamnocarpus pruriens (A.Juss.) Szyszyl.

MALVACEAE

Abutilon angulatum (Guill. & Perr.) Mast. var. *angulatum*

Abutilon austro-africanum Hochr.

Abutilon grantii A.Meeuse

Abutilon guineense (K.Schum.) Baker f. & Exell

Abutilon species

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

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

Hibiscus calyphyllus Cav.

Hibiscus meyeri Harv.

Hibiscus micranthus L.f. var. *micranthus*

Hibiscus praeteritus R.A.Dyer

Hibiscus pusillus Thunb.

Hibiscus sidiformis Baill.

Hibiscus vitifolius L.

Pavonia dentata Burtt Davy

Pavonia senegalensis (Cav.) Leistner

Sida alba L.

Sida cordifolia L.

Sida ovata Forssk.

Sida pseudocordifolia Hochr.

MELASTOMATACEAE

Dissotis canescens (E.Mey. ex R.A.Graham) Hook.f.

Dissotis princeps (Kunth) Triana

MELIACEAE

Ekebergia capensis Sparrm.

Ekebergia pterophylla (C.DC.) Hofmeyr

Entandrophragma caudatum (Sprague) Sprague

Trichilia dregeana Sond.

Trichilia emetica Vahl

Turraea obtusifolia Hochst.

MESEMBRYANTHEMACEAE

Khadia borealis L.Bolus

MOLLUGINACEAE

Corbichonia decumbens (Forssk.) Exell

Hypertelis salsoloides (Burch.) Adamson

Limeum fenestratum (Fenzl) Heimerl

Limeum sulcatum (Klotzsch) Hutch.

Limeum viscosum (J.Gay) Fenzl

MONIMIACEAE

Xymalos monospora (Harv.) Baill.

MORACEAE

Ficus abutilifolia (Miq.) Miq.

Ficus burkei (Miq.) Miq.

Ficus craterostoma Warb. ex Mildbr. & Burret

Ficus glumosa (Miq.) Delile

Ficus ingens (Miq.) Miq. var. *ingens*

Ficus natalensis Hochst. subsp. *natalensis*

Ficus sur Forssk.

Ficus sycomorus L. subsp. *sycomorus*

Ficus tettensis Hutch.

MYRICACEAE

Morella pilulifera (Rendle) Killick

Rapanea melanophloeos (L.) Mez

MYROTHAMNACEAE

Myrothamnus flabellifolius Welw.

MYRSINACEAE

Myrsine africana L.

MYRTACEAE

Eugenia natalitia Sond.

Eugenia woodii Dummer

Syzygium cordatum Hochst.

Syzygium gerrardii (Harv. ex Hook.f.) Burtt Davy

Syzygium legatii Burtt Davy & Greenway

OCHNACEAE

Ochna holstii Engl.

Ochna inermis (Forssk.) Schweinf.

Ochna natalitia (Meisn.) Walp.

Ochna pulchra Hook.

OLACACEAE

Olax dissitiflora Oliv.

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

Ximenia caffra Sond. var. *caffra*

OLEACEAE

Chionanthus battiscombei (Hutch.) Stearn

Chionanthus foveolatus (E.Mey.) Stearn

Jasminum breviflorum Harv. ex C.H.Wright

Jasminum multipartitum Hochst.

Olea capensis L. subsp. *enervis* (Harv. ex C.H.Wright) I.Verd.

Olea capensis L. subsp. *macrocarpa* (C.H.Wright) I.Verd.

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

Schrebera alata (Hochst.) Welw.

OLINIACEAE

Olinia emarginata Burtt Davy

Olinia rochetiana Juss.

PASSIFLORACEAE

Adenia digitata (Harv.) Engl.

Adenia repanda (Burch.) Engl.

Adenia spinosa Burtt Davy

PEDALIACEAE

Ceratotheca triloba (Bernh.) Hook.f.

Dicerocaryum eriocarpum (Decne.) Abels

Harpagophytum species

Pterodiscus species

Sesamothamnus lugardii N.E.Br. ex Stapf

PITTOSPORACEAE

Pittosporum viridiflorum Sims

POLYGALACEAE

Polygala gracilenta Burtt Davy

Polygala hottentotta C.Presl

Polygala uncinata E.Mey. ex Meisn.

POLYGONACEAE

Persicaria attenuata (R.Br.) Soj k

Persicaria decipiens (R.Br.) Wilson

Persicaria species

PORTULACACEAE

Anacampseros subnuda Poelln. subsp. *subnuda*

Avonia rhodesica (N.E.Br.) G.D.Rowley

Portulaca kermesina N.E.Br.

Portulaca pilosa L.

Portulaca quadrifida L.

Portulaca species

Portulacaria afra Jacq.

Talinum crispatulum Dinter ex Poelln.

PROTEACEAE

Faurea saligna Harv.

Protea caffra Meisn. subsp. *caffra*

Protea roupelliae Meisn. subsp. *roupelliae*

RHAMNACEAE

Berchemia zeyheri (Sond.) Grubov

Phylica burchellii Pillans

Rhamnus prinoides L'Hér.

Ziziphus mucronata Willd. subsp. *mucronata*

Ziziphus rivularis Codd

RHIZOPHORACEAE

Cassipourea malosana (Bak.) Alston

ROSACEAE

Prunus africana (Hook.f.) Kalkman

Rubus rigidus Sm.

RUBIACEAE

Agathisanthemum bojeri Klotzsch subsp. *bojeri*

Anthospermum hispidulum E.Mey. ex Sond.

Anthospermum welwitschii Hiern

Canthium ciliatum (Klotzsch) Kuntze

Canthium inerme (L.f.) Kuntze

Canthium mundianum Cham. & Schltdl.

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

Conostomium natalense (Hochst.) Bremek.

Conostomium zoutpansbergense (Bremek.) Bremek.

Coptosperma rhodesiacum (Bremek.) Degreef

Coptosperma supra-axillare (Hemsl.) Degreef

Fadogia homblei De Wild.

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

Hyperacanthus amoenus (Sims) Bridson

Keetia gueinzii (Sond.) Bridson

Lagynias dryadum (S.Moore) Robyns

Oldenlandia herbacea (L.) Roxb.

Otiophora calycophylla (Sond.) Schltr. & K.Schum.

Oxyanthus speciosus DC. subsp. *gerrardii* (Sond.) Bridson

Pachystigma bowkeri Robyns

Pavetta eylesii S.Moore

Pavetta gardeniifolia A.Rich.

Pavetta schumanniana F.Hoffm. ex K.Schum.

Pavetta trichardtensis Bremek.

Pentanisia prunelloides ssp. *prunelloides* (Klotzsch ex Eckl. & Zeyh.) Walp.

Plectroniella armata (K.Schum.) Robyns

Psychotria capensis (Eckl.) Vatke subsp. *capensis* var. *capensi*

Psydrax livida (Hiern) Bridson

Psydrax locuples (K.Schum.) Bridson

Pygmaeothamnus zeyheri (Sond.) Robyns var. *zeyheri*

Pyrostria hystrix (Bremek.) Bridson

Rothmannia capensis Thunb.

Sericanthe andongensis (Hiern) Robbr. var. *andongensis*

Spermacoce senensis (Klotzsch) Hiern

Tricalysia capensis (Meisn. ex Hochst.) Sim var. *capensis*

Tricalysia junodii (Schinz) Brenan var. *kirkii* (Hook.f.) Rob

Vangueria infausta Burch. subsp. *infausta*

Vangueria parvifolia Sond.

Vangueria soutpansbergensis N.Hahn

Calodendrum capense (L.f.) Thunb.

Clausena anisata (Willd.) Hook.f. ex Benth. var. *anisata*

Oricia bachmannii (Engl.) I.Verd.

Ptaeroxylon obliquum (Thunb.) Radlk.

Toddaliopsis bremekampii I.Verd.

Vepris lanceolata (Lam.) G.Don

Vepris reflexa I.Verd.

Zanthoxylum capense (Thunb.) Harv.

Zanthoxylum davyi (I.Verd.) P.G.Waterman

SALVADORACEAE

Salvadora australis Schweick.

SAPINDACEAE

Allophylus africanus P.Beeauv. var. *africanus*

Cardiospermum halicacabum L.

Pappea capensis Eckl. & Zeyh.

SAPOTACEAE

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

Mimusops zeyheri Sond.

SCROPHULARIACEAE

Aptosimum lineare Marloth & Engl.

Aptosimum patulum Bremek.

Craterostigma species

Halleria lucida L.

Jamesbrittenia tenuifolia (Bernh.) Hilliard

SOLANACEAE

Lycium cinereum Thunb. sensu lato

Lycium species

Solanum catombelense Peyr.

Solanum lichtensteinii Wild.

Solanum macrocarpon L.

Solanum panduriforme E.Mey.

Solanum tettense Klotzsch var. *renschii* (Vatke) A.E.Gonc.

Solanum tomentosum L. var *coccinium* (Jacq.) Wild.

STERCULIACEAE

Dombeya burgessiae Gerrard ex Harv.

Dombeya rotundifolia (Hochst.) Planch. var. *rotundifolia*

Hermannia boraginiflora Hook.

Hermannia depressa N.E.Br.

Hermannia grandiflora Aiton

Hermannia grisea Schinz.

Hermannia quartiniana A.Rich.

Melhania forbesii Planch. ex Mast.

Melhania prostrata DC.

Melhania rehmannii Szyszyl.

Sterculia rogersii N.E.Br.

Waltheria indica L.

STRYCHNACEAE

Strychnos madagascariensis Poir.

Strychnos pungens Soler.

Strychnos spinosa Lam.

THYMELAEACEAE

Gnidia cuneata Meisn.

Peddiea africana Harv.

TILIACEAE

Corchorus asplenifolius Burch.

Corchorus confusus Wild

Corchorus kirkii N.E.Br.

Corchorus species

Corchorus trilocularis L.

Grewia bicolor Juss. var. *bicolor*

Grewia flava DC.

Grewia flavescens Juss.

Grewia hexamita Burret

Grewia monticola Sond.

Grewia occidentalis L. var. *occidentalis*

Grewia retinervis Burret

Grewia species

Grewia subspathulata N.E.Br.

Grewia villosa Willd. var. *villosa*

Triumfetta pentandra A.Rich.

TURNERACEAE

Tricliceras schinzii (Urb.) R.Fern.

URTICACEAE

Obetia tenax (N.E.Br.) Friis

Pouzolzia mixta Solms

Urtica urens L.

VERBENACEAE

Lantana camara L.

Lantana rugosa Thunb.

Lippia javanica (Burm.f.) Spreng.

Verbena bonariensis L.

VISCACEAE

Viscum rotundifolium L.f.

Cissus cornifolia (Baker) Planch.

Cyphostemma woodii (Gilg & M.Brandt) Desc.

Rhoicissus revoilii Planch.

Rhoicissus rhomboidea (E.Mey. ex Harv.) Planch.

Rhoicissus species

Rhoicissus tomentosa (Lam.) Wild & R.B.Drumm.

Rhoicissus tridentata (L.f.) Wild & R.B.Drumm. subsp. *tridenta*

ZYGOPHYLLACEAE

Tribulus terrestris L.

Tribulus zeyheri Sond. subsp. *zeyheri*

Monocotyledons

AMARYLLIDACEAE

Boophone disticha (L.f.) Herb.

Scadoxus puniceus (L.) Friis & Nordal

ARECACEAE

Hyphaene petersiana Klotzsch

ASPARAGACEAE

Asparagus africanus Lam.

Asparagus asparagoides (L.) W.Wight

Asparagus bechuanicus Baker

Asparagus cooperi Baker

Asparagus exuvialis Burch. forma *exuvialis*

Asparagus falcatus L.

Asparagus laricinus Burch.

Asparagus racemosus Willd.

Asparagus setaceus (Kunth) Jessop

Asparagus suaveolens Burch.

Asparagus virgatus Baker

ASPHODELACEAE

Aloe angelica Pole-Evans

Aloe arborescens Mill.

Aloe chabaudii Schönland var. *chabaudii*

Aloe globuligemma Pole-Evans

Aloe greatheadii Schönland var. *greatheadii*

Aloe littoralis Baker

Aloe marlothii A.Berger subsp. *marlothii*

Aloe spicata L.f.

Kniphofia species

COLCHICACEAE

Androcymbium eucomoides (Jacq.) Willd.

COMMELINACEAE

Commelina africana L. var. *lancispatha* C.B.Clarke

Commelina benghalensis L.

Commelina erecta L.

Cyanotis speciosa (L.f.) Hassk.

CYPERACEAE

Bulbostylis burchellii (Ficalho & Hiern) C.B.Clarke

Bulbostylis contexta (Nees) M.Bodard

Bulbostylis hispidula (Vahl) R.W.Haines subsp. *pyriformis* (Lye) R.W.Haines

Coleochloa setifera (Ridl.) Gilly

Cyperus albostriatus Schrad.

Cyperus angolensis Boeck.

Cyperus denudatus var. *denuatus* L.f.

Cyperus distans L.f.

Cyperus indecorus Kuth var. *deccurvatus* (C.B.Clarke) Kuk

Cyeprus margaritaceus Vahl var. *margaritaceus*

Cyperus obtusiflorus Vahl var. *obtusiflorus*

Cyperus pseudoleptocladus Kük.

Cyperus rupestris Kunth

Cyperus sexangularis Nees

Cyperus solidus Kunth

Cyperus species

Cyperus sphaerospermus Schrad.

Fimbristylis complanata (Retz.) Link

Fuirena pubescens (Poir.) Kunth

Pycreus polystachyos (Rottb.) P.Beauv.

Schoenoplectus brachyceras (A.Rich.) Lye

DIOSCOREACEAE

Dioscorea cotinifolia Kunth

Dioscorea sylvatica (Kunth) Eckl.

DRACAENACEAE

Sansevieria aethiopica Thunb.

Sansevieria hyacinthoides (L.) Druce

Sansevieria pearsonii N.E.Br.

HYACINTHACEAE

Drimia altissima (L.f.) Ker Gawl.

Drimia robusta Baker

Ledebouria apertiflora (Baker) Jessop

Ledebouria species

Ornithogalum species

HYPOXIDACEAE

Hypoxis argentea Harv. ex Baker var. *argentea*

Hypoxis hemerocallidea Fisch. & C.A.Mey.

IRIDACEAE

Aristea woodii N.E.Br.

Dietes grandiflora N.E.Br.

Lapeirousia sandersonii Baker

ORCHIDACEAE

Eulophia ensata Lindl.

Mystacidium braybonae Summerh.

Polystachya ottoniana Rchb.f.

POACEAE

Alloteropsis semialata (R.Br.) Hitchc.

Andropogon chinensis (Nees) Merr.

Andropogon eucomus Nees

Aristida adscensionis L.

Aristida canescens Henrard subsp. *ramosa* De Winter

Aristida congesta Roem. & Schult. subsp. *barbicollis* (Trin. &

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

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

Aristida junciformis Trin. & Rupr.

Aristida meridionalis Henrard

Aristida rhiniochloa Hochst.

Aristida species

Aristida stipitata Hack. subsp. *graciliflora* (Pilg.) Melderis

Bothriochloa insculpta (A.Rich.) A.Camus

Bothriochloa radicans (Lehm.) A.Camus

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

Brachiaria nigropedata (Ficalho & Hiern) Stapf

Brachiaria serrata (Thunb.) Stapf

Cenchrus ciliaris L.

Centropodia glauca (Nees) Cope

Chloris virgata Sw.

Cymbopogon excavatus (Hochst.) Stapf ex Burtt Davy

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

Cymbopogon species

Cynodon dactylon (L.) Pers.

Dactyloctenium aegyptium (L.) Willd.

Danthoniopsis dinteri (Pilg.) C.E.Hubb.

Dichanthium annulatum (Forssk.) Stapf var. *papillosum* (A.Rich.) de Wet & Harlan

Digitaria eriantha Steud.

Diheteropogon amplectens (Nees) Clayton

Elionurus muticus (Spreng.) Kunth

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

Enneapogon scoparius Stapf

Enteropogon macrostachyus (A.Rich.) Benth.

Eragrostis acraea De Winter

Eragrostis aspera (Jacq.) Nees

Eragrostis biflora Hack. ex Schinz

Eragrostis chloromelas Steud.

Eragrostis ciliaris (L.) R.Br.

Eragrostis gummiflua Nees

Eragrostis lehmanniana Nees var. *lehmanniana*

Eragrostis micrantha Hack.

Eragrostis pallens Hack.

Eragrostis patentipilosa Hack.

Eragrostis racemosa (Thunb.) Steud.

Eragrostis rigidior Pilg.

Eragrostis species

Eragrostis superba Peyr.

Eragrostis trichophora Coss. & Durieu

Eustachys paspaloides (Vahl) Lanza & Mattei

Heteropogon contortus (L.) Roem. & Schult.

Ischaemum fasciculatum Brongn.

Lintonia nutans Stapf

Loudetia filifolia Schweick.

Loudetia flavida (Stapf) C.E.Hubb.

Loudetia simplex (Nees) C.E.Hubb.

Melinis nerviglumis (Franch.) Zizka

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

Odyssea paucinervis (Nees) Stapf

Oplismenus hirtellus (L.) P.Beauv.

Panicum coloratum L. var. *coloratum*

Panicum deustum Thunb.

Panicum maximum Jacq.

Panicum natalense Hochst.

Panicum schinzii Hack.

Pennisetum glaucocladum Stapf & C.E.Hubb.

Perotis patens Gand.

Pogonarthria squarrosa (Roem. & Schult.) Pilg.

Schizachyrium jeffreysii (Hack.) Stapf

Schizachyrium sanguineum (Retz.) Alston

Schmidtia pappophoroides Steud.

Setaria megaphylla (Steud.) T.Durand & Schinz

Setaria nigrirostris (Nees) T.Durand & Schinz

Setaria sphacelata (Schumach.) Moss

Setaria sphacelata (Schumach.) Moss var. *sphacelata*

Setaria sphacelata (Schumach.) Moss var. *torta* (Stapf) Clayt

Setaria verticillata (L.) P.Beauv.

Sporobolus africanus (Poir.) Robyns & Tournay

Sporobolus fimbriatus (Trin.) Nees

Sporobolus ioclados (Trin.) Nees

Stipagrostis hirtigluma (Trin. & Rupr.) De Winter

Stipagrostis uniplumis (Licht.) De Winter var. *uniplumis*

Themeda triandra Forssk.

Trachypogon spicatus (L.f.) Kuntze

Tragus berteronianus Schult.

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

Urochloa mosambicensis (Hack.) Dandy

VELLOZIACEAE

Xerophyta retinervis Baker

Xerophyta viscosa Baker