# A PLANT ECOLOGICAL STUDY AND MANAGEMENT PLAN FOR MOGALE'S GATE BIODIVERSITY CENTRE, GAUTENG

By

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*"Like winds and sunsets, wild things were taken for granted until progress began to do away with them. Now we face the question whether a still higher 'standard of living' is worth its cost in things natural, wild and free. For us of the minority, the opportunity to see geese is more important that television."*

**Aldo Leopold**

# Abstract

The Mogale's Gate Biodiversity Centre is a 3 060 ha reserve located within the Gauteng province. The area comprises grassland with woodland patches in valleys and lower-lying areas. To develop a scientifically based management plan a detailed vegetation study was undertaken to identify and describe the different ecosystems present. From a TWINSPAN classification twelve plant communities, which can be grouped into nine major communities, were identified. A classification and description of the plant communities, as well as, a management plan are presented. The area comprises 80% grassland and 20% woodland with 109 different plant families. The centre has a grazing capacity of 5.7 ha/LSU with a moderate to good veld condition. From the results of this study it is clear that the area makes a significant contribution towards carbon storage with a total of 0.520 tC/ha/yr stored in all the plant communities.

**KEYWORDS**

Mogale's Gate Biodiversity Centre, Braun-Blanquet, TWINSPAN, JUICE, GRAZE, floristic composition, carbon storage

# Declaration

I, Alistair Sean Tuckett, declare that "**A PLANT ECOLOGICAL STUDY AND MANAGEMENT PLAN FOR MOGALE'S GATE BIODIVERSITY CENTRE, GAUTENG**" is my own work and that all sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Signature
(Mr A.S. Tuckett)

Date

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# Chapter 1
# Introduction

*"In our every deliberation, we must consider the impact of our decisions on the next seven generations."*

**From The Great Law of The Iroquois Confederacy**

## Biodiversity and Human Influences

Biological diversity, or biodiversity, is the variability among living organisms and the ecosystems that they inhabit. Biodiversity is the foundation upon which human civilizations have been built (Zedan, 2001). Driver, *et al.* (2003) are of the opinion that "the successful survival of the human race depends on the planet's sufficient biodiversity as a major resource."

There is also a growing realization that businesses need to understand their impact on and reliance on biodiversity, as well as, realize that there are opportunities that come from more sustainable operations. This stems not only from the negative impacts that business can have on biodiversity, but also from the reliance of business, directly or indirectly, on biodiversity resources and services (le Roux & Shava, 2011).

The vegetation of the world is facing numerous challenges as a result of human influences. These include, amongst others, urban and rural development, poor land management, climate change, and development. These threats can dramatically change the natural environment and as a result threaten the biodiversity of the world, the loss of which is now recognised as a global priority (Wilson, 2000). Primack (2008) also feels that the Earth is experiencing an unprecedented loss of biodiversity as a result of human activity, and this has led to ecosystems and their species, that have taken millennia to evolve, being destroyed at an alarming rate. Meffe & Carroll (1997) also believe that every natural ecosystem on Earth has already been altered by humans.

The need for open natural spaces has increased over the years. In many cases the emphasis has shifted to contact with nature, the study thereof, and its aesthetic appreciation. Areas, which are still natural, and that are near or in a city are becoming very important to study and to protect due to the public's growing understanding and concern about environmental issues (Goudie, 1994). The same however, can be said about nature reserves and game farms, which, amongst other things, protect increasingly important and

threatened natural areas of vegetation as well as biodiversity. Sears (1957) believes that it is important to preserve natural areas. Since the study of these natural areas can be used as a benchmark upon which unprotected areas can be compaired with by scientists. Nowers (2010), believes that game farms are important, as most game farmers understand the importance of conserving their biodiversity to increase their profitability.

## Significance of Vegetation Studies

Vegetation forms the basis of all life operations. Being at the base of the trophic pyramid, all animals are directly or indirectly dependant on plants for their survival. Vegetation is therefore, the fundamental measure of the Earth's habitability (Kent & Coker; 1992, Running, 2000; Secretariat of the Convention on Biological Diversity, 2009). It is the most obvious physical representation of the ecosystem, and it is the habitat that other organisms live in, reproduce in, and die in (Kent & Cocker, 1992). Vegetation composition and structure can influence the types of animals attracted to an area, while it also has an influence on the local climate and water availability (http://ecologyexplorers.asu.edu/our-ecosystem/vegetation-study/).

It is therefore important, to manage and utilise vegetation in a responsible way so as to ensure sustainability. To manage land, is to monitor its health. It doesn't matter what the land use is going to be, and whether it is public or privately owned, but it cannot be managed effectively without sound knowledge of its plant and animal species composition (Scott, 2000). Nevertheless, why should land be conserved outside of government run institutions? Large tracts of land are privately owned, and thus provide the potential to conserve large areas of vegetation. Some even possibly under threat. Scholes (2010) is also of the opinion that more veld types can be conserved if a significantly larger fraction of privately owned land can be managed sustainably.

Vegetation descriptions can be used in the recognition and definition of different vegetation types and plant communities (phytosociology), as well as, for the mapping of vegetation communities and types (Kent & Coker, 1992). These classifications and descriptions are used to solve ecological problems for biological conservation and management purposes (Kent & Coker 1992; Causton, 1988). Relationships can also be determined between plant communities and other environmental aspects that affect it. As a result of these studies management plans can be drawn up, monitored and future trends may also be determined (Kent & Coker, 1992). Demers (1991) believes that the role vegetation maps play is significant, as they form a base-line for all studies relating to succession, as well as, provide important ecological indicators, e.g. ecological responses to disturbances to the vegetation.

## Vegetation of Gauteng

South Africa is richly endowed with a wide diversity of plant and animal life. In fact, South Africa has 10% of all the plant species in the world, yet only represents 1% of the world's land surface (Low & Rebelo, 1996). Arnold & De Wet (1993) report that, there are 21 137 indigenous plant species, that can be grouped into 1 930 genera and 226 families in southern Africa. They also state that the flora of southern Africa is among the richest in the world, when you compare it to areas of similar size, including the tropics of Africa. This is confirmed by a number of different authors (Goldblatt, 1978; Gibbs Russell, 1985; Cowling & Hilton-Taylor, 1994).

Macdonald (1989) believes that the survival and continuation of South Africa's plant diversity is under severe threat, as a result of increasing human induced changes to the vegetation. Hilton-Taylor (1996) confirms this, by stating that in 1995 at total of 3 268 plant taxa were threatened in South Africa. According to Raimondo & von Staden (2009) this number has increased to 4 809 plant taxa that are of conservation concern.

Gauteng as the economic heartbeat of South Africa, is the smallest yet most densely populated province. As a result its natural areas are under constant threat from urban development, and the associated impacts thereof. Despite this Gauteng supports a large diversity of ecosystems (Bredenkamp, *et al.,* 2006). Two of South Africa's nine Biomes (Mucina & Rutherford, 2006), are found in Gauteng and on MGBC. These are the Grassland Biome (temperate grasslands), and the Savanna Biome ((sub) tropical grasslands) (Mucina & Rutherford, 2006).

The Savanna Biome borders, amongst others, the Grassland Biome and it represents 32.8% of South Africa. Savannas are largely tropical and occupy the greater parts of the southern continents (Huntley & Walker, 1982). The Savanna Biome is characterised by the seasonality of precipitation, and the (sub) tropical thermal regime with no or usually low incidence of frost (Mucina & Rutherford, 2006). Fire is an important driver of the savanna ecosystem, since the ascension of the grass layer to dominance and has long been regarded as a tool for influencing the woody component (Mucina & Rutherford, 2006). According to Low & Rebelo (1996), 9.9% of the Savanna Biome is protected in South Africa. The Savanna Biome could increase its distribution at the expense of the Grassland Biome as a result of climate change (Ellery *et al.*, 1991). According to Low & Rebelo (1996) the savanna biome makes up 22.5% of the surface area of the province. The Grassland Biome in South Africa, is well defined on the basis of vegetation structure and the combination of various environmental factors, primarily summer rainfall and minimum temperatures in winter (Mucina & Rutherford, 2006).

According to Gibson (2009) grasslands (temperate and tropical) are the largest biome on Earth, and occur on every continent (except Antarctica). They represent a tremendous source of biodiversity and provide humans with important ecological services. Low & Rebelo (1996), state that the Grassland Biome has the highest biodiversity second only to the Fynbos Biome.

Grasslands in South Africa can be found on the Highveld stretching from the Free State into the North West Province, Gauteng, Mpumalanga and into The Drakensburg Mountains in KwaZulu-Natal. Only 2.2% of the Grassland Biome is protected within reserves in South Africa. Grasslands in Gauteng make up 77.5% of the Province's surface area (Low & Rebelo, 1996), while only 1.8% of this is protected in Gauteng (Low & Rebelo, 1996), and is under severe threat from development and climate change (Mucina & Rutherford, 2006). Large sections of the grasslands of Gauteng are transformed as a result of human influences.

## Impact of Climate Change on Vegetation

As part of the monitoring of the health of the land it is becoming increasingly important to take into consideration the impact of climate change on vegetation, as well as determining ways to mitigate the impact of humans' release of greenhouse gasses into the atmosphere.

Due to the increasing concentrations of greenhouse gases, significant changes in climatic patters can be expected (Houghton *et al.*, 1996). This leads to changes in diversity and distribution of species, which in turn results in changes to ecosystems and biodiversity (Bakkenes, *et al.*, 2002; IGBP, 1988; Leemans & Halpin, 1992; Mooney, 1997; Smith *et al.*, 1993; Watson *et al.*, 1996). Bachelet *et al.* (2001) found, that savanna will slowly replace the forests and grasslands of the USA. Condit, *et al.* (1996) found a decrease in abundance of wet forest shrubs and treelets on slopes of Barro Colorado Island, where the average rainfall has decreased from 2 740mm/annum, prior to 1965 to 2 430mm/annum - all, as a result of climate change. There is a decrease in the net ecosystem production as climate changes and as temperatures increase (Cramer, *et al.* 2001). As mentioned above climate change has a huge impact on vegetation and its distribution.

Bachelet *et al.* (2001) found that catastrophic fire scenarios increase under severe climate change, while Cramer *et al.* (2001) found that freshwater availability (runoff) is affected due to changes in vegetation structures, as a result of climate change. Climate change also gives insight into the vulnerability of vegetation diversity of a region (Bakkenes, *et al.,* 2002).

Climate change has brought carbon dioxide to the forefront as a greenhouse gas as it, as a greenhouse gas, contributes 64 percent to the warming the global climate (http://www.news.com.au/breaking-news/greenhouse-gases-rise-to-record-high/story-e6frfku0-1226201925170). Various options need to be looked at to offset the carbon dioxide that individuals and companies are releasing into the atmosphere (http://www.epa.gov/statelocalclimate/local/activities/policy-options.html). It is well know that plants absorb carbon dioxide as part of the photosynthesis process. The storage of carbon can therefore be monitored as part of the general survey of the vegetation and the carbon storage potential can therefore also be determined.

## Conservation on Mogale's Gate Biodiversity Centre

According to Matthews (1991), it is important that the classification of vegetation types takes place within a biome since this results in ecological interpretable units that can be used for environmental planning purposes. It is widely recognised that a detailed description, identification, classification, and mapping of vegetation form the basis of sound land-use management and planning (Brown & Bredenkamp, 1994; Brown, *et al.,* 1996; Mentis & Huntley, (1982); Scheepers, 1983). Mucina & Rutherford (2006) further state that the success of ecological and scientific management of vegetation is dependent on the formation and implementation of spatial management plans.

Plant communities display a regular grouping of plant species of characteristic composition and structure, growing in an area with similar environmental conditions as well as land use history (Gabriel & Talbot, 1984).

Filmalter (2010) also states, that to be able to implement conservation strategies that mitigate the negative effects of human activities on vegetation, it is important to consider the primary production function of vegetation, as well as, vegetation's role in protecting soil and hydrological processes.

The Mogale's Gate Biodiversity Centre (MGBC) is located 20km north-west of Krugersdorp in Gauteng. A few of localised vegetation surveys have been done, by management on, MGBC (a 3 060 ha reserve situated on the southern slopes of the Witwatersberg, extending south into undulating grasslands), over the past 10 years, but these have concentrated on approximately 1 000 ha of the southern section of the property (Mumford, 1996; Tuckett, 1996), or on the habitat suitability for certain game species, i.e. Sable Antelope (*Hippotragus niger*) (van Rooyen, 2010). To develop a management plan focused on biodiversity and

optimal habitat utilization by the animals, a comprehensive survey was needed to provide a complete vegetation description of the entire 3 060 ha.

Franklin (1993), is of the opinion that to be able to protect biodiversity, focus has to be on the ecosystem level as this is the only way to conserve processes and habitats along with their associated species.

Van Rooyen (2010) notes that, to achieve management goals a policy where sensitive communities are protected and existing natural plant species composition is maintained, needs to be followed. Van Rooyen (2010) further states that invasive alien plants should be prevented from entering a property, and that the existing infestations should be systematically eradicated, while acceptable levels of ungulate-induced change to vegetation should be determined.

## Problem Statement and Objectives

MGBC does not have a comprehensive documented management plan or vegetation map, which may lead to management decisions taken that are not based on sound scientific principles. This, in turn, can result in the loss of biodiversity. If the carbon storage potential of MGBC is also known, it can help develop management plans to improve the carbon storage potential of the veld.

Therefore the objective of this research was to:

- Identify, classify, and describe the different plant communities on MGBC.
- Compile a detailed vegetation map of the area based on the classification.
- Determine veld condition and grazing capacity for each plant community identified.
- Develop a veld and game management plan for MGBC.
- Determine the carbon storage potential of MGBC.

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# Chapter 2
# Study Area

*"In all things of Nature there is something of the marvelous*

**Aristotle**

## Location

Mogale's Gate Biodiversity Centre (MGBC) was obtained by its corporate owners in the middle 1980's. Since then it has been transformed from an old cattle and crop farm into a centre biodiversity. The conservation of the biodiversity of the property has become a very important part of the Centre, especially for its ecological and economic future.

MGBC is situated about 20km north-west of Krugersdorp and 15km east of Magaliesburg, between 25°55' – 25°60'S latitude and 27°36' – 27°40'E longitude (Figure 2.1). The property is 3 060 ha in size, comprising old cattle farms, namely Spring Farm, Hekpoort, Waterkloof, Waterpoort and Gloster Farm. MGBC has been managed as a game farm since 1988.

Altitude varies from about 1 390 m.a.s.l. at the lowest point in the northeast to 1 675 m.a.s.l. at the highest point on the Witwatersberg mountain range in the north. This results in a difference in altitude of 285 m from the highest to the lowest points on MGBC. According to Reilly *et al.* (2003) Mogale's Gate is one of the eight game fenced properties that is larger than 3 000 ha out of the total of 89 game fenced properties in Gauteng.

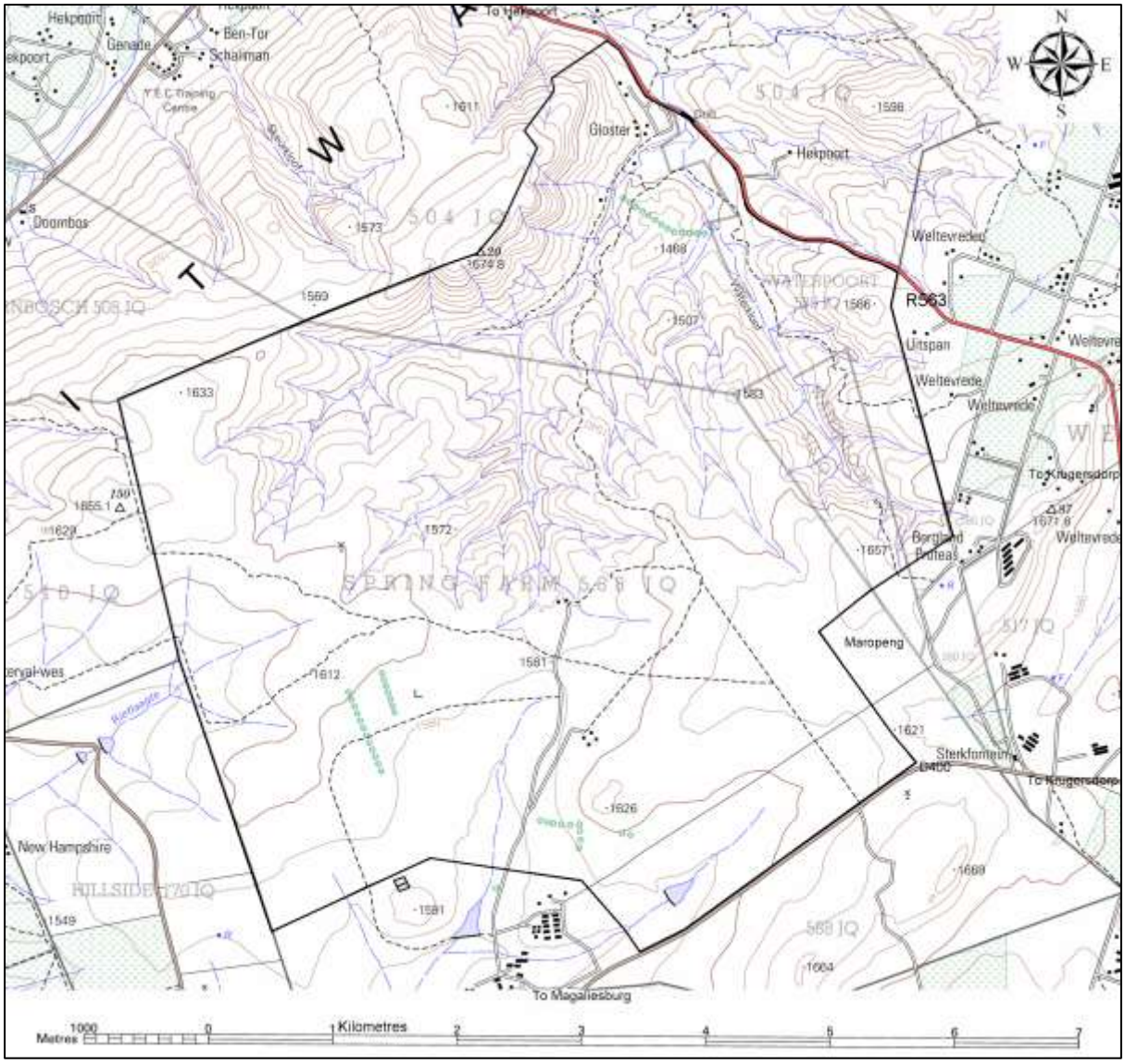


**Figure 2.1. Topographical map of Mogale's Gate Biodiversity Centre.**

## Geology

Geologically the northern part of the study area is classified within the Vaalian Transvaal Sequence, Pretoria Group, with the Timeball Hill, Daspoort, and Stubenkop Formations, which include partly ferruginous quartzite and shale together with diabase (Figure 2.2). The andesitic lava of the Hekpoort Formation, can be found in the central parts of the centre while, partly ferruginous quartzite and ferruginous shale of the Timeball Hill and Quaternary Formations, are found on the southern section of the study area (Geological series, 1973). Clastic sediments (sand, soil, gravel, scree), and minor carbonates and volcanics of the Pretoria group, Transvaal Supergroup characterise the southern section of MGBC (Mucina & Rutherford, 2006; van Rooyen, 2010).

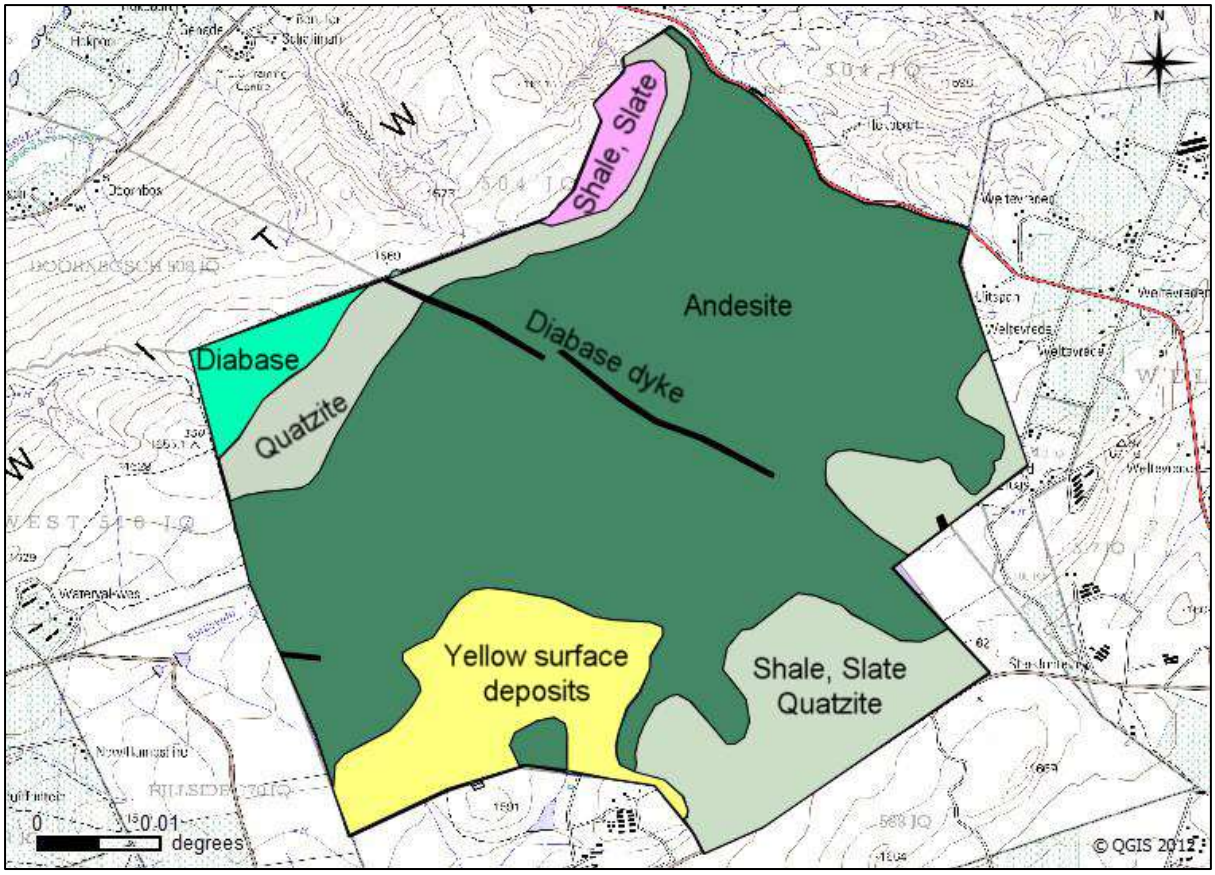


**Figure 2.2. Geological map of Mogale's Gate Biodiversity Centre (adapted from Geological series, 1973).**

## Soil

The soil of the southern section of MGBC (Figure 2.3) belongs to the Hutton (Hu) or Rhodic form of the Oxidic Group, which has an orthic A horizon and a red apedal B horizon which is uniformly coloured with red and/or yellow oxides of iron. A wide degree of weathering is possible and, as a result of this widespread weathering, this soil form has a wide geological distribution (Fey, 2011). This is a well matured soil coupled with free drainage and aeration in the upper solum[1]. It is generally easy to cultivate and less prevalent to erosion than many other soil groups. The oxides provide a micro-aggregating effect which reduces the dispersibility of fine particles, and its associated issues of sealing and hard-setting. A loss though of organic matter through cultivation, has adverse effects on soil quality (Fey, 2010). This soil is very often stony with a clay-loam to clayey texture. According to Land Type Survey Staff (2011), this soil is generally deeper than 600 mm, but can be shallower in places.

[1] That part of the soil profile that reflects the results of the soil forming process (Soil Classification Working Group, 1991).

The Mispah (Ms) or Orthic form of the Lithic Group, which is formed by the weathering of andesite, is found on the central and northern sections of MGBC (Figure 2.3). It has an orthic A horizon overlaying hard rock, and has a clear affinity with the underlying parent rock. Diagnostic hard rock defines the Mispah form. Natural erosion occurs more rapidly than weathering and, as a result the lithic soils dominate much of the landscape. Provided the slope angle is not excessive, the Mispah form can be ripped and cultivated, if the economic returns are high (Fey, 2010). On MGBC there are very few small old cultivated lands falling within the northern section of the property. Soils are generally shallow, less than 300 mm deep with deeper soils found on the footslope and valley bottom. (Land Type Survey Staff, 2011).

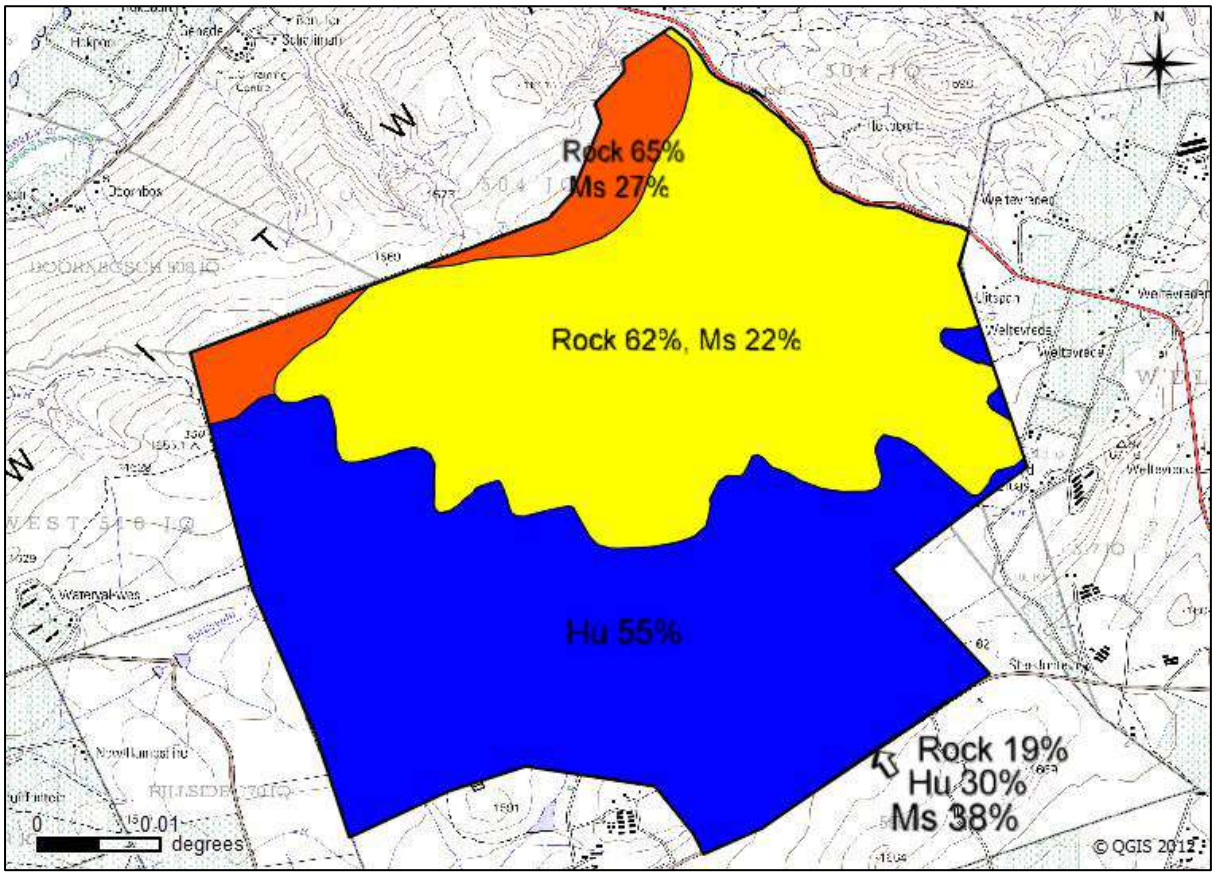


**Figure 2.3. Soil map of Mogale's Gate Biodiversity Centre (adapted from DEAT, 2000).**

## Land Types

Areas with a uniform climate, terrain form and soil pattern are referred to as land types while any part of the land surface with homogeneous form and slope, are referred to as terrain units (van Rooyen, 2010).

Three land types are present on MGBC, namely Ba44, Ib3 and Ib4 (Figure 2.4).

The Ba44 land type is characterised by fine-textured sandy clay loam to clayey soil with clay contents ranging from 15% to 30% in the A-horizon, and between 15% and 35% in the B-horizon (and relates with the Hutton soil form found in Figure 2.3). Terrain units 1 (crest) and 3 (midslope), make up the majority of this land type on MGBC. Terrain unit 5 (valley bottom), is also present in the two wetland areas in the southern section of this land type on MGBC. This characterises the land type on MGBC and covers 35%, 45%, and 5% of the land type respectively. Slopes vary from flat to 5% in terrain unit 1, 3-8% in terrain unit 3, and flat to 1% in terrain unit 5. Rocks form 4% of terrain unit 1 and 2% of terrain unit 3. The terrain type for Ba44 is A3 (Figure 2.5), which means that more than 80% of the land type has slopes that are less than 8% (Land Type Survey Staff, 2011), and the estimated local relief difference on MGBC between the highest (unit 1) and lowest (unit 3) points is approximately 76 m.

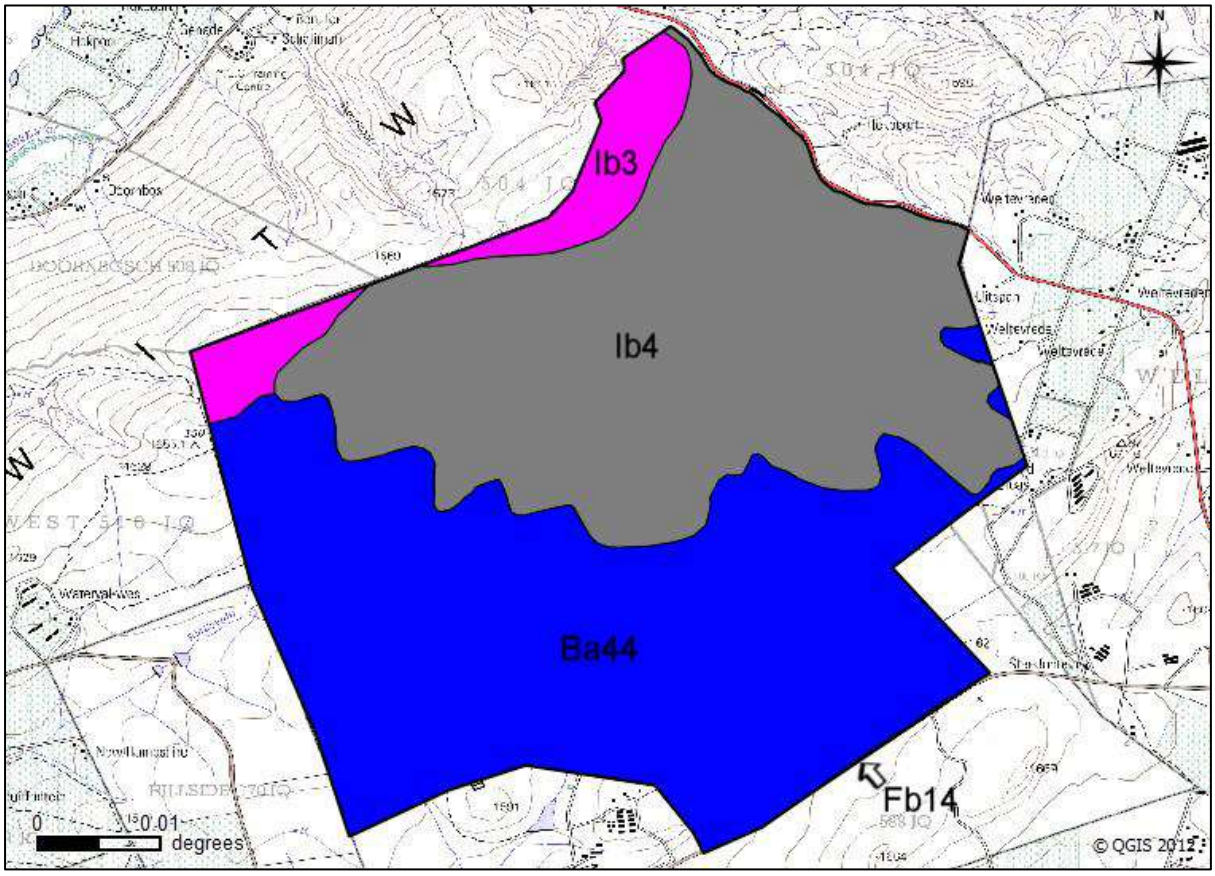


**Figure 2.4. Land Types of Mogale's Gate Biodiversity Centre (adapted from DEAT, 2000).**

On the northern sections of MGBC the Ib3 and Ib4 land types can be found.

Land type Ib3 is found along the mountain section of MGBC and is characterised by medium to coarse textured sandy loam to sandy clay loam with clay contents, varying from 8% to 30% in the A-horizon and 10% to 40% in the B-horizon. Terrain units 1, 2 (scarp), and 3

characterise this land type on MGBC and covers 10%, 8%, and 71% respectively of the land type. The slopes vary from flat to 5% in terrain unit 1, up to 100% in terrain unit 2, and 10-100% in terrain unit 3. Rocks make up 80% of terrain unit 1, 100% of terrain unit 2, and 67% of terrain unit 3. The terrain type for Ib3 is D5 (Figure 2.5), which means that less than 20% of the land type has slopes that are less than 8% and the estimated local relief difference over the land type between the highest (unit 1) and lowest (unit 3) is 284 m on MGBC (Figure 2.1).

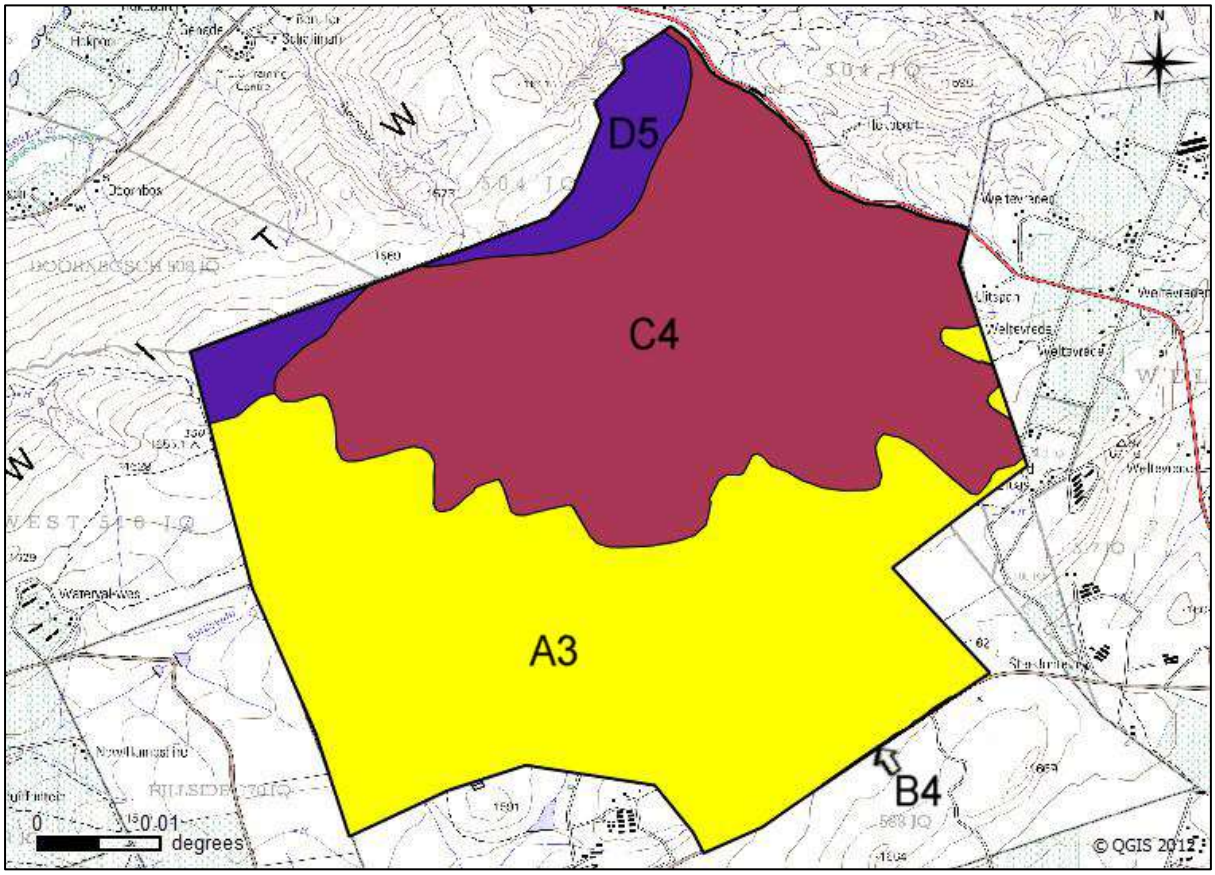


**Figure 2.5. Terrain type map of Mogale's Gate Biodiversity Centre (adapted from DEAT, 2000).**

Land type Ib4 is characterised by fine-textured sandy clay loam to sandy clay soils with 12-35% clay content in the A-horizon and 15-40% clay content in the B-horizon. Terrain units 1, 2 , 3, 4 (footslope) and 5 characterise this land type on MGBC and covers 12%, 1%, 67%, 15% and 5% of the land type respectively. The slopes are very variable in this land type, terrain unit 1 has a slope of up to 6%, terrain unit 2 has a slope up to 100%, terrain unit 3's slope varies from 7-40%, terrain unit 4' slope changes from 2-6% and terrain unit 5's slope varies from 1-100%. Rocks make up 58% of terrain unit 1, 100% of terrain unit 2, 78% of terrain unit 3, 7% of terrain unit 4 and 10% of terrain unit 5. The terrain type for Ib4 is C4 (Figure 2.5), which means that 20-50% of the land type has slopes that are less than 8%,

and the estimated local relief difference over the land type on MGBC between the highest (unit 1) and lowest (unit 5) is approximately 230 m.

## Climate

MGBC falls within the summer rainfall area, experiencing temperate summers and frosty winters (Figure 2.6).

Data obtained from the nearby Krugersdorp west Weather Station (Kock, 1991) shows an average monthly maximum temperature for January of 20°C, while the average monthly minimum temperature is 15.1°C. The average monthly maximum temperature in July is 17.8°C, and the monthly minimum temperature is 1.6°C. With the recent inclusion of a weather station in the centre of the property at the end of 2009, temperatures that have been recorded indicate a maximum temperature of 35°C (October 2011) and a minimum of -7°C. (June 2010) The readings also indicate an average temperature of 18.77°C across the year. January has an average maximum temperature of 25.31°C and an average monthly minimum of 15.5°C while the average monthly maximum temperature in July is 17.37°C and the average monthly minimum temperature is 2.11°C.

Rainfall has been recorded on MGBC at two points for over 14 years, in 2003 a third point was added in the centre of the property (Figure 2.7).

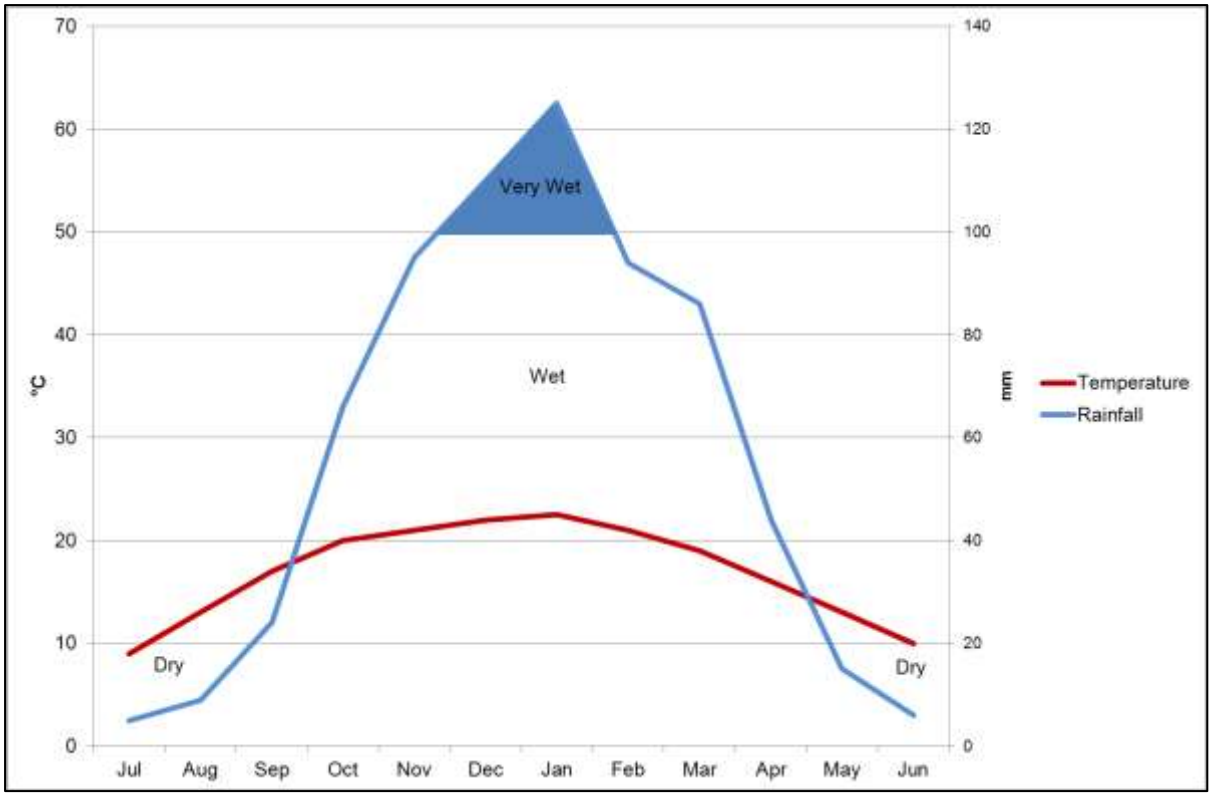


**Figure 2.6. Climatic diagram of Mogale's Gate Biodiversity Centre.**

The average rainfall on MGBC, between the three recording points, is 790.9 mm as recorded from January 1997 to December 2011 (Figure 2.7). The average rainfall varies from 768.2 mm in the southern part of the property to 792.6 mm in the northern part of the property, with the central part having the highest average at 826.1 mm. The long term average rainfall, based on the Hekpoort and Magaliesburg Weather stations, is 658 mm per annum (Weather Bureau, 1996a; Weather Bureau, 1996b).

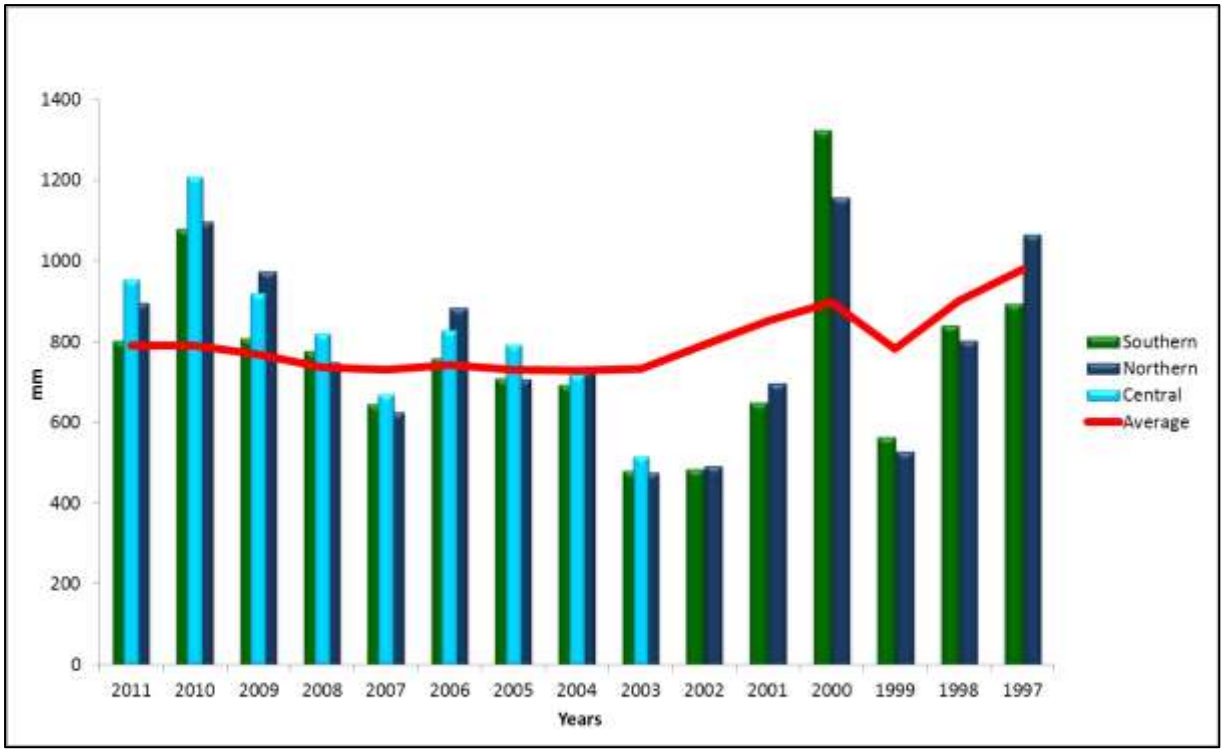


**Figure 2.7. Total rainfall at three points on Mogale's Gate Biodiversity Centre from 1997 – 2011.**

## Vegetation

Mucina & Rutherford (2006) classify the veld types of MGBC as Moot Plains Bushveld (SVcb8), Gold Reef Mountain Bushveld (SVcb9), and Andesite Mountain Bushveld (SVcb11) of the Savanna Biome (Figure 2.8).

Mucina & Rutherford (2006) describe Moot Plains Bushveld (SVcb8), as an open to closed often thorny savanna dominated by a variety of *Acacia*s, with woodlands of varying heights and densities, while grasses dominate the herbaceous layer. This vegetation type is characterised on MGBC by *Searsia lancea, Buddleja saligna, Olea europea* subsp. *africana, Heteropogon contortus, Setaria sphacelata,* and *Themeda triandra*. Its conservation status is vulnerable, with some 13% of this veld type conserved and about 28% transformed by cultivation and urbanisation.

Gold Reef Mountain Bushveld (SVcb9) is described by Mucina & Rutherford (2006) as rocky hills and ridges, with variable tree cover and the herbaceous layer dominated by grasses. The plants that can be used to indicate this vegetation type on MGBC include *Acacia caffra, Protea caffra, Loudetia simplex, Panicum natalense, Schizachyrium sanguineum* and *Trachypogon spicatus.* The forb *Aloe peglerae* and geophytes *Frithia pulchra* are endemic to this veld type. This veld type is least threatened with 23% conserved and 15% transformed.

The Andesite Mountain Bushveld (SVcb11) is described as undulating hills with dense, medium-tall thorny bushveld with a well-developed grassland layer (Mucina & Rutherford, 2006). Characteristic species of this vegetation type on MGBC include *Acacia caffra, Acacia karroo, Asparagus laricinus, Euclea crispa,* subsp. *crispa, Searsia pyroides* subsp. *pyroides, Eragrostis curvula, Hyparrhenia hirta, Setaria spacelata,* and *Themeda triandra.* This veld type has about 9% conserved and 25% transformed areas, and is classified as least threatened (Mucina & Rutherford, 2006).

O'Connor & Bredenkamp (1997) describe the vegetation of the surrounding area as transitional between grasslands of the high inland plateau and savanna of the low inland plateau. This surrounding area is characterized by rocky hills and ridges, with shallow rocky soil. Due to the variety of microhabitats created by the rocky habitat, with mosaics of extremely shallow and deep soils occurring within a few metres, no single species attains dominance. Instead, the vegetation is characterized by mosaics of many co-dominants with high species diversity (O'Connor & Bredenkamp, 1997).

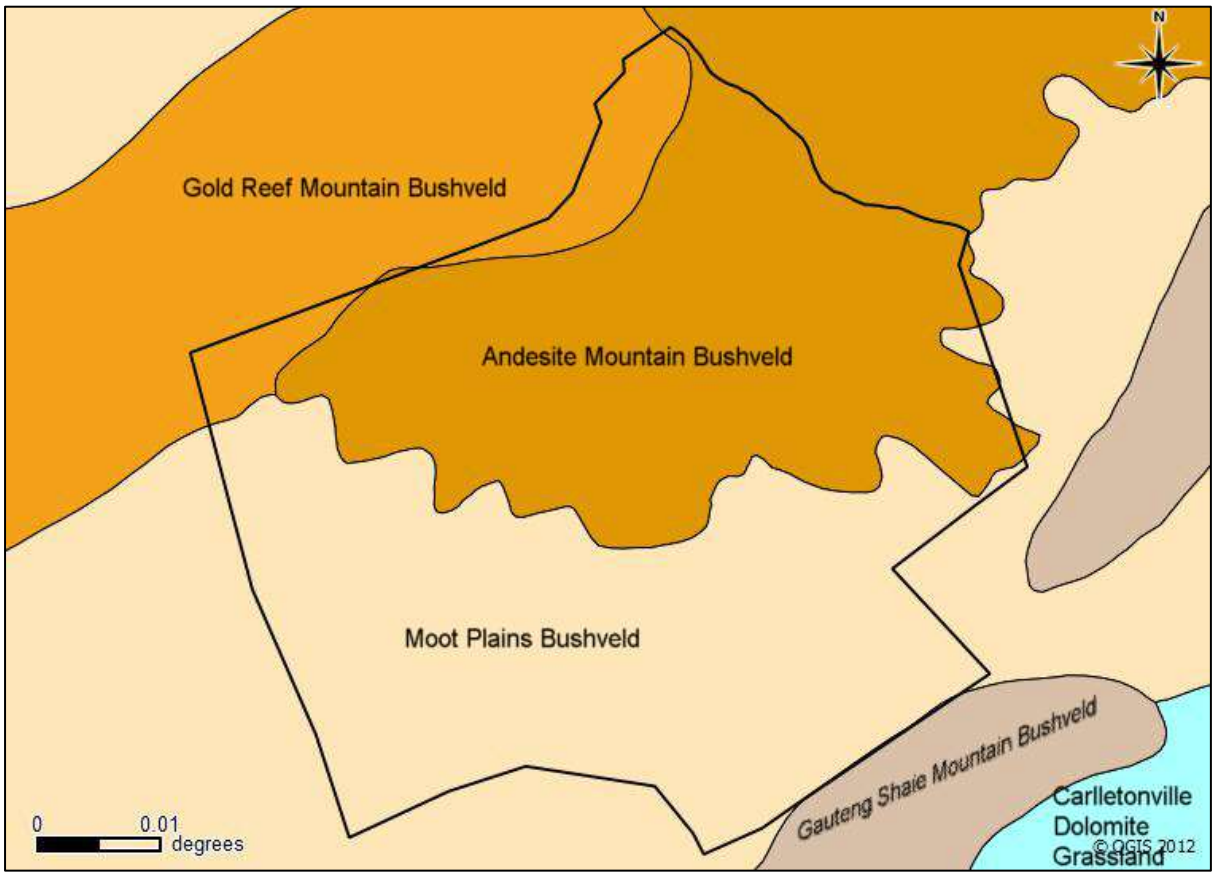


**Figure 2.8. Vegetation Types of Mogale's Gate Biodiversity Centre (Mucina & Rutherford, 2006).**

## Water Resources

MGBC forms the upper catchment of the Hekpoortspruit and is also a catchment area for the Blaaubankspruit. The Hekpoortspruit flowing from the South converges in the northern part of the property where it exits the property where it eventually joins up with the Magaliesburg River and then the Crocodile River. The Blaaubankspruit exits MGBC on two spots (one flowing from the East and the other flowing from the North) on the southern section of the property.

There are numerous natural springs, seepage and sponge areas within the property, especially on the lower-lying southern part of the property. MGBC also has numerous earth dams increasing the wetland areas on the centre.

## Fauna of Mogale's Gate Biodiversity Centre

MGBC is home to 19 game species (Annexure A), these include the threatened or protected species, Black Wildebeest *(Connochaetes gnou*) and Oribi *(Ourebia ourebi*). Of the current game species present on the centre 30.74% are bulk grazers, 57.75% selective, 17.18% mixed feeders and 3.68% browsers.

Predators also occur naturally on MGBC (Annexure A) and include *inter alia*, Caracal (*Felis caracal*) and Leopard (*Panthera pardus*). Black-backed Jackal (*Canis mesomelas*) and Brown Hyena (*Hyaena brunnea*) can be found in high concentrations as a result of the Vulture Restaurant found in the central part of the property.

Over 270 bird species (Annexure A) have been identified on MGBC and these include *inter alia*, Martial eagle *(Polemaetus bellicosus*), Secretary bird *(Sagittarius serpentarius*), Cape vulture *(Gyps coprotheres*), Whitebacked vulture *(Gyps africanus*), Lappetfaced vulture *(Torgos tracheliotus*), and Ostrich *(Struthio camelus*).

Thirty-two (32) Reptile species (Annexure A) have been identified on MGBC, with an additional 24 possible species based on distribution (although not yet identified on the property) and includes the rare Striped Harlequin Snake (*Homoroselaps dorsalis*). Of the 32 reptile species identified to date there are 2 tortoises, 1 terrapin, 3 geckos, 1 chameleon and 1 monitor lizard.

There are seven recorded amphibian species (Annexure A) found on MGBC, with an additional eight possibilities based on distribution. The most interesting being the near threatened Giant Bullfrog (*Pyxicephalus adspersus*).

*Barbus trimaculatus* (Threespot barb) has been identified in the river system on MGBC.

During a recent International Geometrid Conference (Forum Herbulot 2012) held at MGBC over 1 000 invertebrate species were collected and are currently being identified and DNA bar-coded (Hausmann, 2012; Hebert, 2012). Of the invertebrates found on MGBC and identified, 146 Geometrid moths have been identified, which roughly represents 10% of the geometrid fauna occurring in Southern Africa. This relatively high number of species occurring in one locality is a fair indication of the high biodiversity of the area (Staudé, 2011.). A total of 50 arachnid species have been identified to date on MGBC. These include 1 scorpion, 2 baboon spiders and 3 trapdoor spiders (Annexure A).

## Uses

Along with the environmental education program (been in operation for the past 15 years with an average of 2 800 learners visiting the facility annually) presented on the property the other main aims of MGBC are to preserve its biodiversity, promote sustainable utilization of its resources, and to provide the prefect venue for its corporate owners so that they are able to hold conferences and teambuilding exercises, without harming the natural environment.

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# Chapter 3
# Vegetation classification and description

*"The creation of a thousand forests is in one acorn."*

**Ralph Waldo Emerson**

## Introduction

Vegetation classification and mapping forms an integral part of ecological planning (Edwards, 1972). If full quantitative measures of biodiversity are to be used in making conservation decisions biological inventories are needed (Harper & Hawksworth, 1995). Ecosystems react differently to different management practices (Bezuidenhout, 1993; Bredenkamp, 1982; Brown & Bezuidenhout, 2000). It is therefore important to investigate the natural resources of an area, in order to compile scientifically sound management programmes and conservation policies (Bredenkamp & Theron, 1978; Bredenkamp *et al.*, 1993; Brown, 1997; Brown & Bezuidenhout, 2000; Brown *et al.,* 1996; van Rooyen *et al.*, 1981).

Plant communities represent ecosystems and form the basis of any management plan for natural areas (Brown *et al.,* 2005). If these ecosystems and their different potentials are not known, they can't be managed successfully (Brown & Brand, 2004). Animal species occupy and utilise various plant communities for various reasons, e.g. resting, foraging, etc. (Brown *et al.,* 2005). The classification and identification of the plant communities of a nature reserve or natural area, should therefore form the basis of game management decisions.

Private reserves such as Mogale's Gate Biodiversity Centre (MGBC) are going to become more important in the future in terms of biodiversity conservation, due to the fact that the public sector's funding is going to diminish more and more as "more important" issues in the eyes of the general public are going to have to be funded (http://projects.iq.harvard.edu/cces/).

To enable MGBC management to contribute more efficiently to conservation and make scientifically justifiable decisions on the management and protection of the natural environment, it is important that the plant communities of MGBC are classified and related to

specific environmental factors. The purpose of this chapter is therefore to classify, describe, and map the vegetation of MGBC.

# Materials and Methods

## Sampling

### *Vegetation Mapping and Habitat Description*

The entire area was stratified into relative homogeneous physiographic-physiognomic vegetation units using a 1:10 000 aerial photograph. A vegetation and habitat survey was conducted in each of the identified units by placing out a total of 151 sample plots (20m x 20m), (Brown & Bezuidenhout, 2000). Sample plots were placed out on a randomly stratified basis (Bezuidenhout, 1993; Bredenkamp, 1982; Brown & Bredenkamp, 1994). The number of sample plots allocated within each homogeneous unit depended on the size of the area - the larger the area the higher the number of sampling plots allocated to the unit. The positions of the sampling plots were determined beforehand on the stratified aerial photograph, however each section within the different stands had the same chance of being selected. Where a sample plot chosen was not representative of the general vegetation it was moved in accordance with the requirements for Braun-Blanquet surveys to be more representative of the vegetation (Mueller-Dombois & Ellenberg, 1974).

In each sample plot all plant species present (trees, shrubs, grasses and forbs) were recorded and their cover abundance assessed using the modified Braun-Blanquet cover abundance scale (Mueller-Dombois & Ellenberg, 1974). Environmental data recorded included, geology, soil texture (Loamy, Sandy, Sandy Clay and Clay), degree of erosion (none, low (>0-15%), medium (>15-50%), high (>50-75%) and very high (>75%)), a measurement of aspect using a compass, and slope with a clinometer.

By using the guidelines set out by Edwards (1983), trees and shrubs were distinguished from each other. Trees are classified as rooted, woody, self-supporting plants greater than three meters in height with one or a few definite trunks and shrubs are classified as rooted woody, self-supporting, multi-stemmed or single-stemmed plants less than three meters high (Brown & Bezuidenhout, 2005).

The plant taxon names conform to those of Germishuizen, *et al. (*2006) while the red data status of plants species is based on Raimondo, *et al.* (2009).

## Data analysis

### *Vegetation Mapping and Habitat Description*

The floristic data was captured on TURBOVEG the floristic database (Hennekens, 1996). The data was then exported to the JUICE program (Tichý, 2002), a multifunctional editor of phytosociological tables from where the modified Two-Way Indicator Species Analysis, TWINSPAN (Roleček *et al.,* 2009), was used (using the Whittaker's beta-diversity) to derive a first approximation of the floristic data. Pseudospecies cut levels were set at 0, 5, 15, 25, 50, 75 (Brown *et al.,* 2013), while the Fisher Exact Fidelity Test at P<0.001 was used. Further refinement was done by the repositioning of species into species groups only (Werger, 1974), with no rearrangements of relevés. Plant communities were identified and described by using characteristic species as defined by Westhoff & van der Maarel (1978).

# Results

## Classification of Plant Communities

The analysis resulted in the identification of twelve plant communities that can be grouped into nine major communities. The results are presented in a phytosociological table (Table 3.1 – See Annexure B) and are indicated on a vegetation map (Figure 3.1). All references made to species groups in the descriptions of the plant communities refer to Table 3.1 (Annexure B).

1. *Schoenoplectus corymbosus-Typha capensis* Wetland.
2. *Hemarthria altissima-Arundinella nepalensis* Wetland.
3. *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana* Woodland.
   - 3.1. *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Setaria megaphylla* Woodland.
   - 3.2. *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland.
4. *Senecio inornatus-Hyparrhenia tamba* Grassland.
5. *Sporobolus africanus-Hyparrhenia hirta* Grassland.
   - 5.1. *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* Woodland.
   - 5.2. *Sporobolus africanus-Hyparrhenia hirta-Cynodon dactylon* Grassland.
   - 5.3. *Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus* Grassland.
6. *Seriphium plumosum-Alloteropsis semialata* subsp. *eckloniana* Grassland.
7. *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland.
8. *Protea caffra* subsp. *caffra-Melinis nerviglumis* Woodland.
9. *Xerophyta retinervis-Loudetia simplex* Grassland.

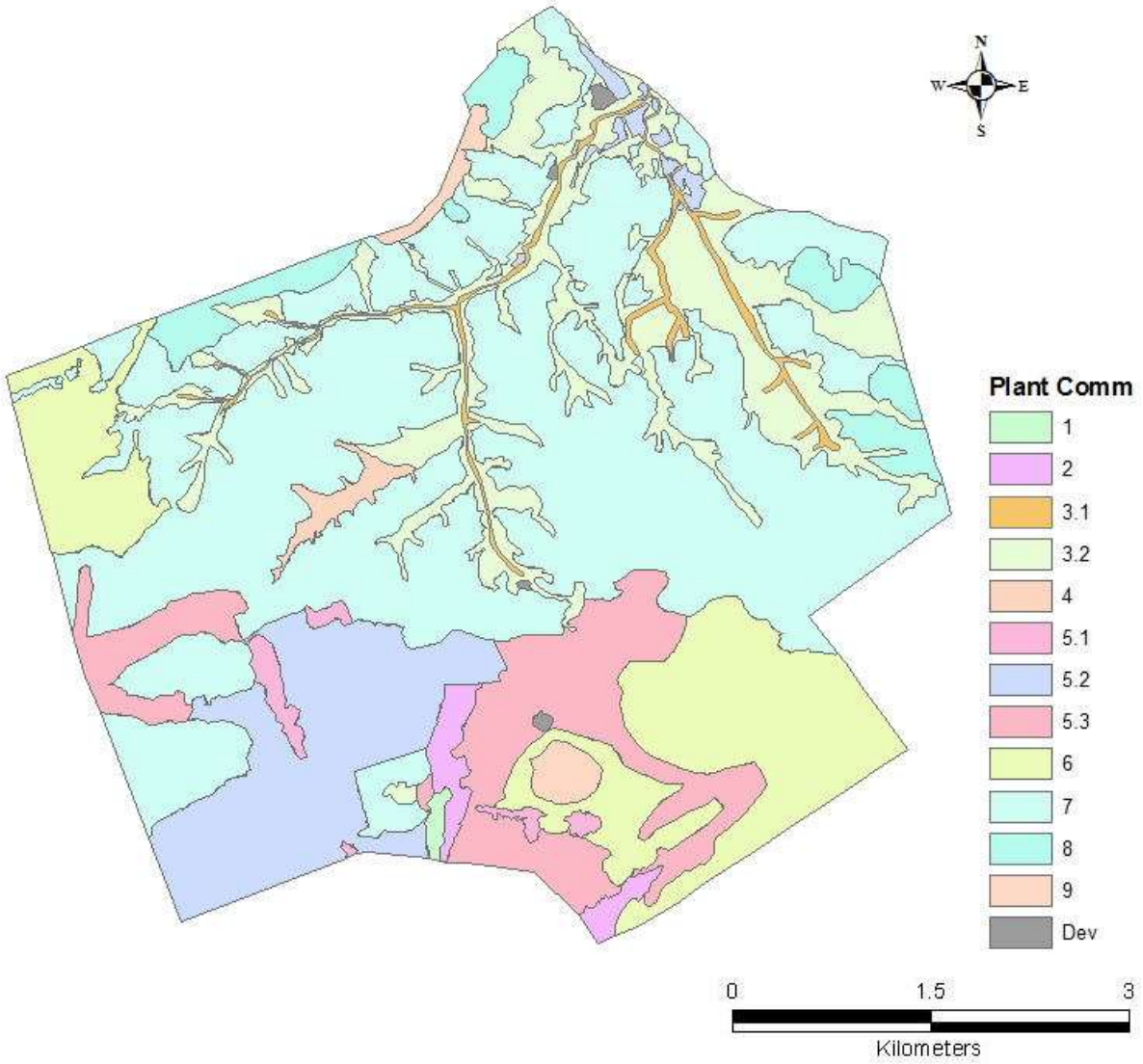


**Figure 3.1. Plant Communities of Mogale's Gate Biodiversity Centre.**

## Description of Plant Communities

The study area consists of undulating grasslands with wooded rocky outcrops and a few wetlands to the south and wooded valleys feeding the Hekpoortspruit to the north. The southern slopes of the Witwatersberg Mountain can be found on the north-western border of the study area. The average species richness of the study area was 39.27 plant species per 400m$^2$. There is a strong presence of the grasses *Themeda triandra* and *Hyparrhenia hirta* throughout the study area.

The general vegetation of the study area, is characterised by the presence of species found in species group T occurring in all the plant communities except *Schoenoplectus corymbosus-Typha capensis* Wetland (1). These species include the woody plants *Heteromorpha arborenscens* var. *abyssinica, Diospyros lycioides* subsp. *guerkei,* the grasses *Themeda triandra, Hyparrhenia hirta* and the forbs *Conyza podacephala* and

*Conyza albida* The grasses *Melinis nerviglumis* and *Brachiaria serrata* (species group S) is prominent in *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2), *Seriphium plumosum-Alloteropsis semialata* subsp. *eckloniana* Grassland (6), *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland (7), *Protea caffra* subsp. *caffra-Melinis nerviglumis* Woodland (8) and *Xerophyta retinervis-Loudetia simplex* Grassland (9) while the forb *Helichrysum rugulosum* (species group S) is prominent in *Sporobolus africanus-Hyparrhenia hirta-Cynodon dactylon* Grassland (5.2), *Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus* Grassland (5.3), *Seriphium plumosum-Alloteropsis semialata* subsp. *eckloniana* Grassland (6), and *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland (7).

### 1. *Schoenoplectus corymbosus-Typha capensis* Wetland

**Figure 3.2. Example of *Schoenoplectus corymbosus-Typha capensis* Wetland Plant community.**

This plant community (Figure 3.2) is located in the southern part of MGBC (Figure 2.1) It covers 0.21% of the study area (6.6 ha) and occurs on wet clay soil with a gentle slope of 1° and south-south-west aspect. The altitude varies from 1 556 – 1 568 meters above sea level (m.a.s.l.). No signs of fire or erosion were noted.

The forbs, *Typha capensis,* and *Schoenoplectus corymbosus* of species group A are characteristic for this plant community. These are the only two species found in this small plant community.

Game paths were found in this community while signs of Common Reedbuck (*Redunca arundinum*) were observed within this wetland.

### 2. *Hemarthria altissima-Arundinella nepalensis* Wetland

**Figure 3.3. Example of *Hemarthria altissima-Arundinella nepalensis* Wetland.**

The *Hemarthria altissima-Arundinella nepalensis* Wetland (Figure 3.3) is found on the southern part of MGBC. This sub-community has clay soil and covers 1.18% of the study area (36.3 ha). No rocks were found in this sub-community as well as no signs of recent fire or erosion. The altitude varies from 1 570 to 1 580 m.a.s.l. The area is mostly level with a slight slope of 1 to 2° generally with a southerly aspect.

Species from species group B are characteristic for this community and include the grasses, *Arundinella nepalensis, Hemarthria altissima, Imperata cylindrica* and the forbs, *Cyperus congestus, Haplocarpha lyrata, Plantago longissima, Acroceras macrum, Alectra sessiliflora, Epilobium hirsutum* and *Ranunculus multifidus*.

As expected there is no woody layer with the grass *Arundinella nepalensis* (species group B) dominating the vegetation while the grasses, *Sporobolus africanus* (species group G), *Hemarthria altissima* (species group B), *Bewsia biflora* (species group L) are co-dominant. Prominent forbs include *Verbena bonariensis* (species group T) and *Senecio erubescens* (species group R).

When these wetlands were part of a cattle and maize farm they were drained with canals. The majority of these canals have been filled up with soil by MGBC management over 20 years ago in an attempt to return the water flow to its natural state and to reduce the draining of the wetland. This has resulted in the wetlands recovering to the state in which they are now found in. A species richness of 21 plant species per 400m$^2$ was recorded for this wetland. This area is often used by the Common Reedbuck (*Redunca arundinum*).

### *3. Euclea crispa subsp. crispa-Olea europea subsp. africana Woodland*

The *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana* Woodland is found in the valleys on the northern part on the study area. This community covers 14.95% of MGBC (458.8 ha) and occurs on stony to clay soil. The altitude is varies between 1 422 and 1 641 m.a.s.l.

Species belonging to species group C are characteristic for this plant community. The vegetation is characterised by the dominance of the woody plants, *Ziziphus mucronata* subsp. *mucronata*, *Olea europea* subsp. *africana*, *Euclea crispa* subsp. *crispa*, *Celtis africana*, *Gymnosporia buxifolia*, *Grewia occidentalis* var. *occidentalis* (species group C), *Diospyros lycioides* subsp. *guerkei* (species group T) and the forb, *Privia cordifolia* var. *abyssinica* (species group C). This plant community is divided into two sub-communities:

### 3.1 *Euclea crispa subsp. crispa-Olea europea subsp. africana-Setaria megaphylla Woodland*

**Figure 3.4. Example of *Euclea crispa* subsp. crispa-*Olea europea* subsp. *africana*-*Setaria megaphylla* Woodland Sub-community.**

This dense closed sub-community (Figure 3.4), is found on the northern part of MGBC at the lower-lying sections the valleys along the Hekpoortspruit. This sub-community is found in mosaic patches within the major plant community. The soil varies from sandy clay to clay on altitudes of 1 422 to 1 586 m.a.s.l. Slope varies from 0.5° to 16°, with a northerly to easterly aspect while rock cover ranges between 0 and 25%. There was no indication of recent fire in this sub-community. Low levels of erosion were recorded.

Species belonging to species group D are characteristic for this plant community and include the tree, *Combretum erythrophyllum,* the grasses, *Setaria megaphylla, Setaria lindenbergiana,* and the forb, *Solanum pseudocapsicum.*

The species composition is indicative of more moist warm conditions with the vegetation dominated by the trees, *Celtis africana, Searsia pyroides* var. *pyroides, Acacia ataxacantha* (species group C) and *Combretum erythrophyllum* (species group D). The herbaceous layer is dominated by the grasses, *Setaria megaphylla, S. lindenbergiana* and the forb, *Privia cordifolia* var. *abyssinica* (species group C). The red data plant, *Bowiea volubilis* subsp. *volubilis* (species group U) is found in this sub-community where it is locally prominent.

This sub-community is found at the lowest points of MGBC, in the drainage lines, usually in deep valleys sometimes under a thick canopy. As a result of this, pioneer plants like the forbs, *Privia cordifolia* var. *abyssinica* (species group C) *Bidens pilosa* and *Tagetes minuta* (species group T), are locally prominent in this sub-community growing where most other plants would struggle to grow due to light limitations. The species richness of this plant community was 31.73 species per 400m$^2$.

Due to its close proximity to water there are a number of game paths running through this plant community, which could lead to erosion problems and will need to be monitored. Areas of concern have already been worked on. This sub-community is often used by Eland (*Tragelaphus oryx*), Kudu (*Tragelaphus strepsiceros*), Bushbuck (*Tragelaphus scriptus*), Nyala (*Tragelaphus angasii*), Burchell's Zebra (*Equus burchellii*), Warthog (*Phacochoerus africanus*), and Common Duiker (*Sylvicapra grimmia*).

### 3.2 *Euclea crispa subsp. crispa-Olea europea subsp. africana-Acacia caffra Woodland*

**Figure 3.5. Example of *Euclea crispa* subsp. crispa-*Olea europea* subsp. *africana*-*Acacia caffra* Woodland sub community.**

This sub-community (Figure 3.5) is found along the upper slopes of the *Olea europea* subsp. *africana-Setaria megaphylla* Woodland (sub-community 3.1), and covers the majority of the main plant community. The soils vary from stony sand to clay and rockiness varies between

1 and 50%. The slopes can vary from a level 0.5° to a steep 30° generally with an easterly aspect. Little to no erosion was found in this community and there were a few signs of recent fire, especially on the eastern side.

The characteristic species belong to species group E and they include the woody plants, *Searsia leptodictya, Acacia caffra* and *Zanthoxylum capense,* the grass, *Eustachys paspaloides* and the forb, *Lantana rugosa*.

The vegetation is dominated by the woody layer with a variety of species dominant. The most dominant species are *Acacia caffra, Searsia leptodictya* (species group E), *Euclea crispa* subsp. *crispa, Ziziphus mucronata* subsp. *mucronata, Olea europea* subsp. *africana* (species group C). The most dominant grasses are *Melinis nerviglumis* (species group S) and *Themeda triandra* (species group T). Other species that are prominent include the trees, *Gymnosporia buxifolia, Celtis africana, Grewia occidentalis* var. *occidentalis* (species group C), *Heteromorpha arborenscens* var. *abyssinica* (species group T) and the forbs, *Lippia javanica* (species group S), *Tagetes minuta, Corchorus confuses, Conyza podacephala, Bidens pilosa*, *Teucrium trifidum* (species group T) and *Zinnia peruviana* (species group C).

The red listed plants, *Bowiea volubilis* subsp. *volubilis* (species group U) which can be locally prominent, *Hypoxis hemerocallidea* and *Eucomis autumnalis* subsp. *clavata* (species group M) as well as the medicinally important *Artemisia afra* (species group U) are present in this sub-community.

This is a diverse sub-community with 44.75 species found per 400m$^2$. This area is used by the same game species as those in sub-community 3.1 with the addition of Giraffe (*Giraffa camelopardalis*), Red Hartebeest (*Alcelaphus buselaphus*) Impala (*Aepyceros melampus* subsp. *melampus*) and Gemsbok (*Oryx gazella*).

### 4. *Senecio inornatus-Hyparrhenia tamba Grassland*

**Figure 3.6. Example of *Senecio inornatus-Hyparrhenia tamba* Grassland plant community.**

This plant community (Figure 3.6) is found in the central area of MGBC and covers 0.71% (21.8 ha) of the area. Clay soil with no rocks is characteristic of this community. The slopes are mild 5° and the aspect varies from east to east-south-east. The altitude changes from 1 534 to 1 555 m.a.s.l. No signs of recent fire or erosion could be identified in this community.

Plant species from species group F are characteristic for this community, and include the dominant grass, *Hyparrhenia tamba,* and forb, *Agrimonia procera* together with the grass, *Helictotrichon turgidulum,* and the forbs, *Monsonia angustifolia*, *Trifolium africanum*, *Lithospermum* species, and *Cirsium vulgare*.

The vegetation is dominated by the grass, *Hyparrhenia tamba* (Species group F) and the forb, *Senecio inornatus* (species group Q). Both species are indicative of moist conditions (Van Wyk & Malan, 1998).

The shrublet, *Ziziphus zeyheriana* (species group M), the grass, *Setaria nigrirostris* (species group T) and the forbs, *Senecio isatideus* (species group J), *Conyza podacephala, Bidens pilosa, Corchorus confuses* and *Salvia runcinata* (species group T) are prominent in this plant community.

The grass present in this community is mostly moribund and has resulted in a few pioneer plants growing in this community. The species richness of this community is 29.5 species per 400m$^2$.

### *5. Sporobolus africanus-Hyparrhenia hirta Grassland*

The *Sporobolus africanus-Hyparrhenia hirta* Grassland is found on the undulating areas on the southern part on the study area. This community covers 20.03% of the study area (614.6 ha) and occurs on sandy to clay soil. The altitude varies from 1 393 to 1 617 m.a.s.l. No signs of erosion were noted. Some areas of this community were burnt as part of the annual block burn program in 2007.

Species belonging to species group G are characteristic for this plant community and include the grasses, *Sporobolus africanus* and *Eragrostis plana* and the forb, *Hermannia depressa.*

The vegetation is dominated by the grass, *Hyparrhenia hirta* and the forb, *Conyza podacephala* (Species group T).

This plant community is made up of old maize lands, planted pastures, and wetlands that were drained in the past. Over the past 20 years MGBC management has attempted to remove all the drainage canals from the wetlands. The average species richness per 400m$^2$ in this plant community is 27.13 species. This plant community can be subdivided into three sub-communities.

### 5.1 Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis Woodland

**Figure 3.7. Example of *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* Woodland sub-community.**

These old planted woodlots (Figure 3.7) are found in patches on the southern part of the study area and covers 0.89% (27.3 ha) of MGBC. It has sandy soil, with few rocks and no signs of erosion or fire. The aspect is generally south facing and the slope varies from 0 to 2°. The altitude varies from 1 608 to 1 615 m.a.s.l.

The plants in species group H are characteristic of this sub-community and include the woody plant, *Eucalyptus camaldulensis* and the forb, *Plectranthus* species.

The vegetation is dominated by the declared alien invasive tree, *Eucalyptus camaldulensis* (species group H) the grass, *Cynodon dactylon* (species group R), and the forbs, *Tagetes minuta, Bidens pilosa,* and *Conyza podocephala* (species group T). Other species that are prominent include the grasses, *Eragrostis cholomelas* (species group R), *Eragrostis curvula* (species group T) and the forbs, *Teucrium trifidium* (species group T), *Solanum lichtensteinii* (species group T) and *Verbena brasiliensis* (Species group I).

These woodlots were planted as windbreaks when the old lands in the area were maize lands. This sub-community is now used as a woodlot for MGBC. This is the least diverse sub-community within the *Sporobolus africanus-Hyparrhenia hirta* Grassland with just an

average of 17.3 species per 400m$^2$. A number of raptors use this sub-community for nesting, species identified include the African Hawk-Eagle (*Aquila spilogaster*) and the Black Sparrowhawk (*Accipiter melanoleucus*). It is also used by the Amur falcon (*Falco amurensis*) for roosting during summer nights. The Black Wildebeest (*Connochaetes gnou*), Blesbok (*Damaliscus pygargus* subsp. *phillipsi*), Eland (*Tragelaphus oryx)*, Burchell's Zebra (*Equus burchellii*), Red Hartebeest (*Alcelaphus buselaphus*), and Gemsbok (*Oryx gazella*) are often found in this sub-community. Leopard (*Panthera pardus*) has also been identified in this sub-community.

### 5.2 *Sporobolus africanus-Hyparrhenia hirta-Cynodon dactylon Grassland*

**Figure 3.8. Example of *Sporobolus africanus-Hyparrhenia hirta-Cynodon dactylon* Grassland sub-community.**

Mainly found on the south eastern side of MGBC, some patches of this sub-community (Figure 3.8) also occur on the northern side of the study area on sandy to clay soil. It covers 9.87% of the study area (302.9 ha). Hardly any rocks were found in this community with rockiness varying between 0 and 1%. Altitude ranges from 1 393 to 1 603 m.a.s.l and the area is mostly level with a slight slope of between 0° – 3°. With an easterly to southerly aspect. No erosion or signs of recent fire were identified for this plant community.

The characteristic species (species group I), include the grasses, *Digitaria eriantha* and *Paspalum dilatatum* and the forbs, *Verbena brasiliensis, Lactuca inermis, Plantago lanceolata* and *Oxalis corniculata*.

The vegetation is dominated by the grasses, *Cynodon dactylon* (species group R) and *Hyparrhenia hirta* (species group T), together with the forbs, *Conyza podacephala* (species group T) and *Verbena bonariensis* (species group I). The grasses, *Digitaria eriantha, Paspalum dilatatum* (species group E), *Eragrostis plana* (specis group F), *Eragrostis curvula* (species group T) and the forbs, *Oxalis corniculata* (species group I), *Solanum lichtensteinii* (species group T) are also prominent.

This sub-community includes old maize and lucerne fields and planted pastures. The *Digitaria eriantha* grass present in this community was planted as a pasture grass more than 20 years ago on sections of this sub-community. There are some moist areas present within this sub-community as indicated by the presence of the moist-loving grasses, *Paspalum dilatatum,* and *Eragrostis plana.* A total of 27 species per 400m$^2$ was recorded within this sub-community that is utilised by Black Wildebeest (*Connochaetes gnou*), Blesbok (*Damaliscus pygargus* subsp. *phillipsi*), Springbok (*Antidorcas marsupialis*), Burchell's Zebra (*Equus burchellii*), and Red Hartebeest (*Alcelaphus buselaphus*).

### 5.3 *Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus Grassland*

**Figure 3.9. Example of *Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus* Grassland sub-community.**

This sub-community (Figure 3.9) is found on the southern and western side of MGBC and generally feeds into community 2. It covers 9.27% of the study area (284.4 ha) and has sandy clay to clay soil. No rocks or signs of erosion were found in this community. Some areas of this community were part of a 2009 block burn. The altitude varies from 1 566 to 1 617 m.a.s.l and the slope from 1 to 4°. The aspect generally has a westerly orientation.

This sub-community is characterised by the presence of species from species group J and include the grasses, *Digitaria diagonalis* var. *diagonalis, Cymbopogon nardus* and the forbs, Senecio *isatideus* and *Pelargonium luridum*.

This sub-community is dominated by the grass, *Hyparrhenia hirta* and the forb *Conyza podocephala* (species group T). The grasses, *Cymbopogon caesius* (species group Q), *Eragrostis chloromelas* (species group R), and *Sporobolus africanus* (species group G) are co-dominant. Prominent forbs include and the forbs*, Oenothera tetraptera* and *Conyza albida* (species group T), *Senecio inornatus* (species group Q), *Helichrysum rugulosum* and *Hermannia depressa* (species group S).

The red data species, *Hypoxis hemerocallidea* (species group M) as well as *Eucomis autumnalis* subsp. *clavata* (species group M) and the important medicinal plant *Artemisia afra* (species group U) are also present in this sub-community.

This grassland community has 30.4 species per 400m$^2$ and is well used by Blesbok (*Damaliscus pygargus* subsp. *phillipsi*), Black Wildebeest (*Connochaetes gnou*), Eland (*Tragelaphus oryx)*, Burchell's Zebra (*Equus burchellii*), Springbok (*Antidorcas marsupialis*) and Oribi (*Ourebia ourebi*).

### 6. *Seriphium plumosum-Alloteropsis semialata subsp. eckloniana* Grassland

**Figure 3.10. Example of *Seriphium plumosum-Alloteropsis semialata* subsp. *eckloniana* Grassland plant community.**

This plant community (Figure 3.10), covers 13.15% of mainly the southern and north western sections of MGBC (403.6 ha) with mostly sandy clay soil. Rockiness varies from 0% to 20%. The altitude varies from 1 580 to 1 649 m.a.s.l, while the slope varies from 0° to 5°. The aspect is mainly south to westerly. Part of this plant community was burnt in the 2009 block burn, otherwise there are no other signs of fire. There are little to no signs of erosion.

The plant species from species group K are characteristic for this plant community and include the grasses, *Alloteropsis semialata* subsp. *eckloniana, Monocymbium ceresiiforme,*

and the forbs, *Selago densiflora, Rotheca hirsuta, Helichrysum acutatum* and *Indigofera spicata.*

The vegetation is dominated by the grasses, *Alloteropsis semialata* subsp. *eckloniana* (species group K), *Hyparrhenia hirta, Themeda triandra* (species group T) and *Cymbopogon caesius* (species group Q). The woody layer is dominated by the shrublets, *Elephantorrhiza elephantina* (species group L), *Seriphium* plumosum (species group S) and the tree, *Heteromorpha arborenscens* var. *abyssinica* (species group T). Other species prominent include the grasses, *Eragrostis curvula* (species group T), *Brachiaria serrata* and *Eragrostis racemosa*, and*Trachypogon spicatus* (species group S) and the forbs, *Helichrysum rugulosum* (species group S), *Helichrysum nudifolium, Senecio venosus, Pentanisia angustifolia* (species group Q)*, Conyza albida, Hypoxis rigidula* (species group T) and *Helichrysum coriaceum* (species group L).

This is a species rich plant community with an average of 40.56 plant species found per 400m$^2$. The red data species, *Hypoxis hemerocallidea* (species group M), *Eucomis autumnalis* subsp. *clavata* and *Boophane disticha* (species group M) as well as the veld orchid, *Brachycorythis tenuior* (species group K) are found in this plant community.

This area falls within the old cattle camps of Spring Farm (one of the old properties making up MGBC). The presence of *Seriphium plumosum* indicates the overgrazing that took place on MGBC over 20 years ago. Steenbok (*Raphicerus campestris*) and Oribi (*Ourebia ourebi*) often utilise this plant community along with *inter alia,* Common Reedbuck (*Redunca arundinum*), Eland (*Tragelaphus oryx)*, Burchell's Zebra (*Equus burchellii*), Waterbuck (*Kobus ellipsiprymnus*) and Red Hartebeest (*Alcelaphus buselaphus*).

### 7. *Setaria sphacelata var. sphacelata-Themeda triandra Grassland*

**Figure 3.11. Example of *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland plant community.**

The *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland plant community (Figure 3.11), is the largest of the plant communities found in the study area and covers 44.89% (1 377.6 ha) of the central sections of MGBC. The soil varies from sandy to sandy clay with 0 to 50 % rockiness. The slope varies from flat to 24° while the aspect is varied. The altitude changes from 1 405 to 1 640 m.a.s.l. Some areas are still showing signs of a wild winter fire in 2007. Generally no signs of erosion were identified.

Species group M plants are characteristic for this community and they include the grasses, *Setaria sphacelata* var. *sphacelata,* and *Setaria pumila,* the shrublets, *Ziziphus zeyheriana, Diospyros austro-africana* var*. microphylla, and Searsia discolor and* the forbs, *Acalypha angustata, Ruellia cordata* and *Scabiosa columbaria*.

The vegetation is characterised by the dominance of various species, however the tree, *Heteromorpha arborsenscens* var. *abyssinica*, the grass, *Themeda triandra* and the forb, *Conyza podacephala* (species group T), are the most prominent. Other species that are prominent include the shrublets, *Athrixia* elata (species group S), *Lantana rugosa* (species group E), the grasses, *Brachiaria serrata, Melinis nerviglumis* (species group S), *Dihetropogon amplectens* (species group N), the forbs, *Senecio venosus, Pentanisia*

*angustifolia, Helichrysum nudifolium* (species group Q), *Conyza albida* (species group T), *Helichrysum rugulosum, Helichrysum coriaceum* and *Hermannia depressa* (species group S).

This is the most diverse plant community with an average species richness of 48.77 species per 400m$^2$. One 400m$^2$ plot alone had 71 species identified in it. This community is utilised by most of the game species on MGBC including Sable Antelope (*Hippotragus niger*). It is the least disturbed veld of all the plant communities. Some areas though have become moribund.

The red data species, *Hypoxis hemerocallidea* (species group M), *Bowiea volubilis* subsp. *volubilis* (species group U), *Eucomis autumnalis* subsp. *clavata* and *Boophane disticha* (species group M), and the important medicinal plants *Artemisia afra* (species group U) and the wild orchids, *Brachycorythis tenuior* (species group K), *Habenaria epipactidea* and *Eulophia ovalis* var. *ovalis* (species group U) are present in this plant community.

### 8. *Protea caffra* subsp. *caffra-Melinis nerviglumis* Woodland

**Figure 3.12. Example of *Protea caffra* subsp. *caffra-Melinis nerviglumis* Woodland plant community.**

This plant community (Figure 3.12) is located in patches on the higher lying western and eastern parts of MGBC and covers 3.61% of the study area (110.9 ha). The soil is mainly sandy clay. The slope varies from flat to a steep 26°, while the aspect is mostly westerly or

southerly facing. Altitude varies from 1 535 to 1 648 m.a.s.l while no signs of erosion or fire were recorded.

The characteristic plants of this plant community can be found in the very weak species group O. These plants include the woody plant, Searsia *rigida* var. *rigida,* the grass, *Urelytrum agropyroides* and the forb, Tephrosia *longipes* subsp. *longipes*.

The vegetation is dominated by the tree, *Protea caffra* subsp. *caffra* (species group N) and the grasses, *Themeda triandra* (species group T), *Melinis nerviglumis,* and *Loudetia simplex* (species group N). Prominent species include the tree, *Searsia zeyheri* (species group E), the grasses, *Eragrostis racemosa, Brachiaria serrata* (species group S) *Alloteropsis semialata* subsp. *eckloniana* (species group K), and the forbs, *Athrixia elata, Helichrysum coriaceum* (species group S) and *Conyza albida* (species group T).

The red data plant, *Hypoxis hemerocallidea* (species group M) was found in this plant community along with the succulent *Aloe peglerae* (endangered) the latter identified outside the sample plot. The average species richness of this plant community is 32.75 plant species per 400m$^2$. Signs found indicate that this plant community is utilised by Mountain Reedbuck (*Redunca fulvorufula*), Burchell's Zebra (*Equus burchellii*), Waterbuck (*Kobus ellipsiprymnus*), Eland (*Tragelaphus oryx),* and Gemsbok (*Oryx gazella*).

### 9. *Xerophyta retinervis-Loudetia simplex* Grassland

**Figure 3.13. Example of *Xerophyta retinervis-Loudetia simplex* Grassland plant community.**

Found on the exposed high points on the northern and southern sections of the study area, this plant community (Figure 3.13) covers 1.09% of MGBC (33.6 ha). The soil is sandy with 40-50% of the community covered with rocks. Slopes vary from a flat to fairly level (4.5°), while the aspect is either northerly or easterly facing. Altitude varies from 1 617 to 1 681 m.a.s.l. No signs of erosion were identified in this plant community. Part of this community was burnt as part of a block burn in 2009.

Species group P, is characteristic of this plant community, and includes the forbs, *Oldenlandia herbacea* var. *herbacea, Indigofera comosa,* the woody, *Parinari capensis* subsp. *capensis, Xerophyta retinervis* and the grass, *Digitaria brazzae*.

This community is dominated by the shrublet, *Xerophyta retinervis* (species group P), and the grass, *Loudetia simplex* (species group N), while the grasses, *Themeda triandra* (species group T), *Brachiaria serrata, Eragrostis racemosa, Melinis nerviglumes* (species group S), *Dihetropogon amplectens* (species group N), and *Elionurus muticus* and the forbs, *Solanum lichtensteinii* (species group T), *Senecio venosus* (species group Q), *Bulbostylis burchellii* (species group N), and *Conyza albida* (species group T) are prominent throughout this community.

The red listed plant, *Boophane disticha* (species group M) can be found in this plant community. The species richness of this plant community is 40.5 species per 400m$^2$. This plant community is used by the rare Brown Hyena (*Parahyaena brunnea*), Gemsbok (*Oryx gazella*), and Mountain Reedbuck (*Redunca fulvorufula*).

# Discussion and Conclusion

Grasslands are mainly formed by the presence of frost and fire and if these factors were removed this veld would transform into savanna. The grassland biome is defined by the dominance of hemicryptophytes[2] of the Poaceae (Rutherford & Westfall, 1986), while the savanna biome is co-dominated by hemicryptophytes and phanerophytes[3] (Rutherford & Westfall, 1986). MGBC has the presence of both biomes, grassland and savanna. The grasslands are found more on the southern sections of the farm and the savanna more on the northern sections.

## Savanna Communities

Plant community 3 (*Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana* Woodland) occurs in and along the valleys of MGBC, with its sub-communities 3.1 (*Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Setaria* megaphylla Woodland), along the stream and 3.2 (*Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia* caffra Woodland), moving further up the valley feeding into plant community 7 (*Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland), in the grasslands. Although *Celtis africana* is present throughout community 3 it is more dominant in 3.1 closer to the water and where it is more protected. *Acacia caffra* occurs on the higher-lying areas of community 3 namely 3.2 which is because it is a more hardy plant than *Acacia karroo* that would normally occur more lower down in Gauteng. Plant community 5 (*Sporobolus africanus-Hyparrhenia hirta* Grassland), is mainly found on the old cattle farm section of MGBC, and this can be seen by the presence mainly of the grass, *Hyparrhenia hirta* and the shrublet, *Seriphium plumosum,* which indicates human disturbance in the past.. Plant community 5 is degraded grasslands and even though MGBC has been a game farm for over 20 years the signs of its past misuse are still evident.

The diversity of sub community 3.2 is due to the good condition of the veld and the varying aspect and slope. The rocky areas found in this community contribute to the diversity as they provide a variety of habitats for different species as well as acting as a refuge for species.

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[2] Plants with buds at soil level (Walker, 1990).
[3] Woody plants with perennating buds more than 25cm above the soil surface (Walker, 1990).

## Grassland Communities

Plant species in species group L show the affinities of the plant communities 6 (*Seriphium plumosum-Alloteropsis seminialata* subsp. *eckloniana* Grassland), 7 and 8 (*Protea caffra* subsp. *caffra-Melinis nerviglumis* Woodland) and these share the following plant species with plant community 5.3 (*Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus* Grassland); *Athrixia elata, Helichrysum coriaceum, Elionurus muticus, Trachypogon spicatus, Seriphium plumosum* (species group S)*,* and *Tragypogon dubius* (species group R) *.* Species group N show the affinities between communities 7, 8 and 9 (*Xerophyta retinerrvis-Loudetia simplex* Grasslands). The plant communities 6, 7, 8 and 9 share the plant species in species group Q. Species group R show the affinities between the plant communities 5, 6, 7, 8 and 9, while species group S shows the affinity between plant communities 3.2, 4 (*Senecio inornatus-Hyparrhenia hirta* Woodland), 5, 6, 7, 8, and 9.

The 5.2 sub community (*Sporobolus africanus-Hyparrhenia hirta-Cynodon dactylon* Grassland) is the most diverse within the *Sporobolus africanus-Hyparrhenia hirta* community, due to its pioneer and secondary successional stages with so many pioneer fords present. This continued utilization by game species as well as the dominance of *Hyparrhenia hirta* prevents this sub-community from moving into a more improved successional stage.

Plant community 7 shares similar plant species with community 3, including *Ziziphus mucronata* subsp. *mucronata, Euclea crispa* subsp. *crispa, Olea europea* subsp. *africana, Celtis africana* and *Searsia dentata,* even more so with sub-community 3.2, which feeds into community 7 with the following plants *Searsia leptodactyia, Lantana rugosa, Searsia zeyheri* and *Ruellia cordata*. Community 5 also shares the plant species *Hermannia depressa* with plant community 7 and plant community 8 shares *Alloteropsis seminialata* subsp. *eckloniana* with plant community 6.

The *Sporobalus africana-Hyparrhenia hirta* Grassland (community 5), and the *Seriphium plumosum-Alloteropsis semialata* subsp. *eckloniana* Grassland (community 6), show affinities with the *Hyparrhenia hirta* Anthropogenic Grassland of Bredenkamp & Brown (2003), with the dominance of the plant species, *Hyparrhenia hirta* and *Seriphium plumosum*, while the grasses, *Cynodon dactylon, Eragrostis plana, Eragrostis curvula,* and *Aristida congesta* along with the forbs, *Conyza podacephala* and *Helichrysum rugulosum,* are prominent within these two plant communities. While the *Seriphium plumosum-Alloteropsis semialata* subsp. *eckloniana* Grassland (community 6), *Protea caffra* subsp. *caffra-Melinis nerviglumis* Woodland (community 8), and *Xerophyta retinervis-Loudetia simplex* Grassland (community 9) show affinities with the *Monocymbium ceresiiforme-*

*Loudetia simplex* Grassland of Bredenkamp and Brown (2003), with the presence of the characteristic woody species, *Protea welwitschii,* the grasses, *Monocymbium ceresiiforme, Alloteropsis semialata, Bewsia biflora,* and the forbs, *Sphenostylis angustifolia* and *Pentanisia angustifolia.* The presence of the grasses, *Monocymbium ceresiiforme, Loudetia simplex, Trachypogon spicatus, Alloteropsis semialata, Panicum natalense Themeda triandra* and the forb, *Senecio venosus,* according to Bredenkamp and Brown (2003), also shows infinity to the Drakensberg Highveld Sourveld vegetation. Bredenkamp & Brown's (2003) *Themeda triandra-Acacia karroo* Microphyllous Woodland, shows affinity with sub-community 3.2 (*Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland), with the presence of the following woody plant species, *Acacia karroo, Ziziphus mucronata, Asparagus suaveolens, Asparagus laricinus* and the forb, *Teurium trifidum*. With the presence of the woody plants, *Protea caffra*, *Acacia caffra,* the grasses, *Themeda triandra, Eragrostis racemosa, Dihetropogon amplectans, Brachiaria serrata* and the forbs, *Athrixia elata, Veronia natalensis* and *Pentanisia angustifolia* the *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland (community 7) shows affinities to the *Tristachya biseriata-Protea caffra* Cool Temperate Mountain Bushveld (Bredenkamp & Brown, 2003). *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Setaria megaphylla* Woodland shows affinities to the *Combretum erythrophyllum* Riparian Forest of Bredenkamp and Brown (2003), with the presence of the woody plants, *Combretum erythrophyllum, Euclea crispa, Grewia occidentalis, Diospyros lycioides, Searsia pyroides* and *Celtis africana*.

The classification of the plant communities on MGBC has resulted in clearly defined vegetation units that can be defined by past veld management practices and environmental factors. This classification will provide very important information to MGBC management for future veld management decisions. This study can also form the baseline study of future research on MGBC, especially in tracking the possible changes climate change and current veld management practices could have on biodiversity.

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# Chapter 4
# Floristic Analysis of Mogale's Gate Biodiversity Centre

*"Of all the wonderful things in the wonderful universe of God, nothing seems to me more surprising than the planting of a seed in the blank earth and the result thereof."*

**Julie Moir Messervy**

## Introduction

Natural areas are under increasing pressure from human influences such as development, agricultural practices, human population increase, or even climate change. Natural areas are the last areas available for the protection of plant and animal species. Grasslands are the most threatened of all biomes as most of the country's farming and cities are developed on this very productive land (Dugmore, 2012; http://www.grasslands.org.za/the-biodome/threats, South Africa, 2012; SANBI, 2012; van Wyk, 2012). Protected natural areas like Mogale's Gate Biodiversity Centre (MGBC) represent a refuge for a diversity of plant and animal species (Church, 1992; Dorse, 2011). Vegetation surveys provide important information on the different plant communities, and plant species composition and form the basis of any management plan for a specific area (Brown et al, 1996).

Little is known about the different taxa of MGBC. No extensive vegetation surveys have been done on the entire 3 060 ha of MGBC. Localised surveys were undertaken on smaller sections of the property by Mumford (1996) and Tuckett (1996), or they have been habitat evaluations for species like the Sable Antelope by van Rooyen (2010) or the White Rhinoceros by Tuckett (2007). Although plant specimens have been collected and identified in parts of the Centre since the mid 1980's by staff and volunteers, no detailed plant species list exist for the Centre.

## Methods

The detailed species list (Annexure C) has been compiled from all the plants identified on MGBC over the past 25 years by various people on MGBC and that from this study. The trees were identified using Palgrave (1981) and van Wyk & van Wyk (1997, 2007), the wild

flowers were identified using Germishuizen (1997), Manning (2009), and Van Wyk & Malan (1997) while the grasses were identified using Van Oudsthoorn (2009), and the sedges were identified using Germishuizen (1997) and Van Wyk & Malan (1997) . Information completed by Germishuizen *et al.* (2006) was used for nomenclature, the latest taxonomic changes and arrangements, as well as an author update. Alien plant species are marked with an A. The conservation status of the different plant species was checked against Raimondo *et al.* (2009). South African endemic or near endemic plant species were obtained from Germishuizen *et al.* (2006).

## Results

A total of 702 vascular plant species have been identified on MGBC (Table 4.1) and comprises 109 families and 381 genera. Flowering plants belonging to the Monocotyledoneae consist of 215 species, 97 genera in 16 families. The Dicotyledoneae comprises a total of 477 species that belong to 276 genera and 87 families. The Pteridophyta constitutes nine species that are grouped in seven genera and five families, while one alien gymnosperm was found on MGBC (table 4.1). The largest percentage of families (80%) belongs to the Dicotyledoneae, followed by the Monocotyledoneae with 15%. The Pteridophyta and one alien gymnosperm comprise 4% and 1% of the flora respectively (Figure 4.1).

**Table 4.1. Plant Divisions of vascular plants found on Mogale's Gate Biodiversity Centre.**

| | Family | Genera | Species |
|---|---|---|---|
| **Pterophyta** | 5 | 7 | 9 |
| **Gymnosperma** | 1 | 1 | 1 |
| **Monocotyledonodae** | 16 | 97 | 215 |
| **Dicotyledonondae** | 87 | 276 | 477 |
| | **109** | **381** | **702** |

The complete plant species list is included in Annexure C. The plant species list is divided into the different plant divisions, and sorted into the various plant families. It also indicates the red data status of a plant and whether a plant is endemic to South Africa. This study added at total of 113 new species to the existing MGBC species list.

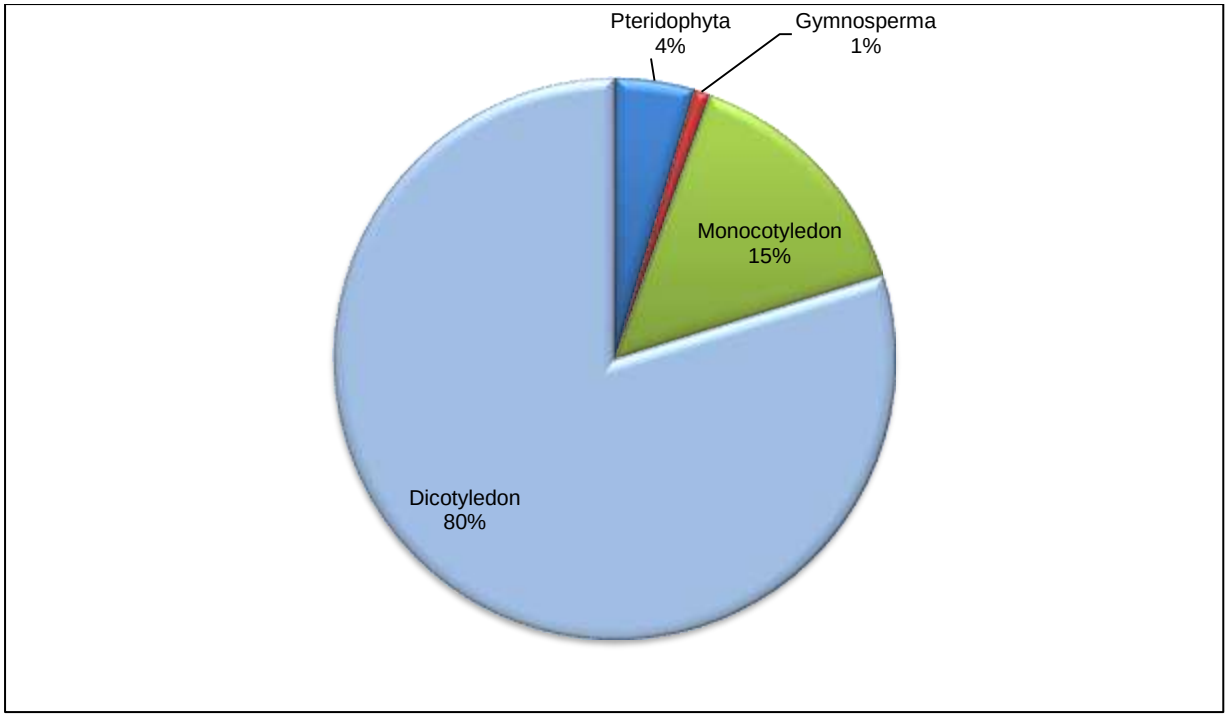


**Figure 4.1. Plant division reflected as a percentage of the total number of plant families.**

The total flora of MGBC is represented by 109 families, as reflected in Table 4.2.

Fifteen different families dominate the flora of MGBC. All of these families have more than 10 species. The three most prominent families are the Poacea with 122 species (17%), Asteracea with 92 species (13%) and Fabaceae with 62 species (9%). These are followed by much smaller, yet significant families, represented by Apocynaceae with 20 species (3%), Lamiaceae 16 (2%), Cyperaceae 15 (2%), Hyacianthaceae 14 (2%), Acanthaceae 14 (2%), Convolvulaceae 14 (2%), Rubiacee 14 (2%), Anacardiaceae 13 (2%), Malvaceae 12 (2%), Solanaceae 12 (2%), Iridaceae 11 (2%) and the Orchidaceae also with 11 species and 2% of the species total (Figure 4.2). Together these 15 families represent 63% of the flora on MGBC. The remaining 94 families represent 37% of the flora of MGBC and all have less than 10 species per family.

**Table 4.2. An alphabetical list of plant families identified on Mogale's Gate Biodiversity Centre, indicating the number of genera and species in each family.**

| Families | Genera | Species | Families | Genera | Species |
|---|---|---|---|---|---|
| **PTERIDOPHYTA** | | | Fabaceae | 25 | 62 |
| Anemiaceae | 1 | 1 | Gentianaceae | 2 | 3 |
| Dennstaedtiaceae | 1 | 1 | Geraniaceae | 2 | 3 |
| Equisetaceae | 1 | 1 | Gunneraceae | 1 | 1 |
| Pteridaceae | 3 | 5 | Hypericaceae | 1 | 1 |
| Selaginellaceae | 1 | 1 | Icacinaceae | 2 | 2 |
| **GYMNOSPERMA** | | | Lamiaceae | 11 | 16 |
| Pinaceae | 1 | 1 | Linaceae | 1 | 1 |
| **ANGIOSPERMA** | | | Lobeliaceae | 3 | 5 |
| MONOCOTYLEDONEAE | | | Loranthaceae | 2 | 2 |
| Alliaceae | 2 | 2 | Lythraceae | 2 | 3 |
| Amaryllidaceae | 2 | 2 | Malpighiaceae | 1 | 1 |
| Antheriaceae | 1 | 5 | Malvaceae | 4 | 12 |
| Asparagaceae | 1 | 6 | Meliaceae | 1 | 1 |
| Asphodelaceae | 3 | 6 | Mesembryanthemaceae | 1 | 1 |
| Colchicaceae | 1 | 2 | Moraceae | 1 | 2 |
| Commelinaceae | 2 | 7 | Myricaceae | 1 | 1 |
| Cyperaceae | 8 | 15 | Myrothamnaceae | 1 | 1 |
| Eriospermaceae | 1 | 1 | Myrsinaceae | 1 | 1 |
| Hyacinthaceae | 5 | 14 | Myrtaceae | 1 | 1 |
| Hypoxidaceae | 1 | 8 | Nyctaginaceae | 1 | 1 |
| Iridaceae | 6 | 11 | Ochnaceae | 1 | 2 |
| Orchidaceae | 5 | 11 | Olacaceae | 1 | 1 |
| Poaceae | 57 | 122 | Oleaceae | 1 | 2 |
| Typhaceae | 1 | 1 | Oliniaceae | 1 | 1 |
| Velloziaceae | 1 | 2 | Onagraceae | 2 | 3 |
| DICOTYLEDONEAE | | | Orobanchaceae | 3 | 5 |
| Acanthaceae | 10 | 14 | Oxalidaceae | 1 | 4 |
| Achariaceae | 1 | 1 | Papaveraceae | 1 | 1 |
| Amaranthaceae | 6 | 6 | Phyllanthaceae | 1 | 2 |
| Anacardiaceae | 3 | 13 | Phytolaccaceae | 1 | 2 |
| Apiaceae | 7 | 7 | Pittosporaceae | 1 | 1 |
| Apocynaceae | 11 | 20 | Plantaginaceae | 1 | 3 |
| Aquifoliaceae | 1 | 1 | Polygalaceae | 1 | 3 |
| Araliaceae | 1 | 1 | Polygonaceae | 2 | 3 |
| Asteraceae | 42 | 92 | Portulaceae | 1 | 1 |
| Boraginaceae | 4 | 4 | Proteaceae | 2 | 3 |
| Brassicaceae | 4 | 5 | Ranunculaceae | 2 | 2 |
| Buddlejaceae | 2 | 3 | Rhamnaceae | 5 | 6 |
| Cactaceae | 1 | 1 | Rosaceae | 6 | 6 |
| Campanulaceae | 1 | 3 | Rubiaceae | 11 | 14 |
| Capparaceae | 1 | 1 | Rutaceae | 2 | 2 |
| Caryophyllaceae | 2 | 2 | Salicaceae | 4 | 5 |
| Celastraceae | 3 | 5 | Santalaceae | 2 | 3 |
| Celtidaceae | 2 | 2 | Sapindaceae | 2 | 2 |
| Chenopodiaceae | 1 | 2 | Sapotaceae | 3 | 2 |
| Chrysobalanceae | 1 | 1 | Scrophulariaceae | 8 | 9 |
| Cleomaceae | 1 | 2 | Solanaceae | 3 | 12 |
| Combretaceae | 1 | 3 | Sterculiaceae | 3 | 3 |
| Convolvulaceae | 6 | 14 | Stryhnaceae | 1 | 1 |
| Crassulaceae | 3 | 9 | Thymelaeaceae | 1 | 3 |
| Cucurbitaceae | 3 | 5 | Tiliaceae | 2 | 4 |
| Dichapetalaceae | 1 | 1 | Urticaceae | 1 | 1 |
| Dipsacaceae | 1 | 1 | Vahliaceae | 1 | 1 |
| Ebenaceae | 2 | 5 | Verbenaceae | 3 | 6 |
| Elatinaceae | 1 | 1 | Viscaceae | 1 | 2 |
| Euphorbiaceae | 4 | 8 | Vitaceae | 2 | 2 |
| | | | TOTAL | 381 | 702 |

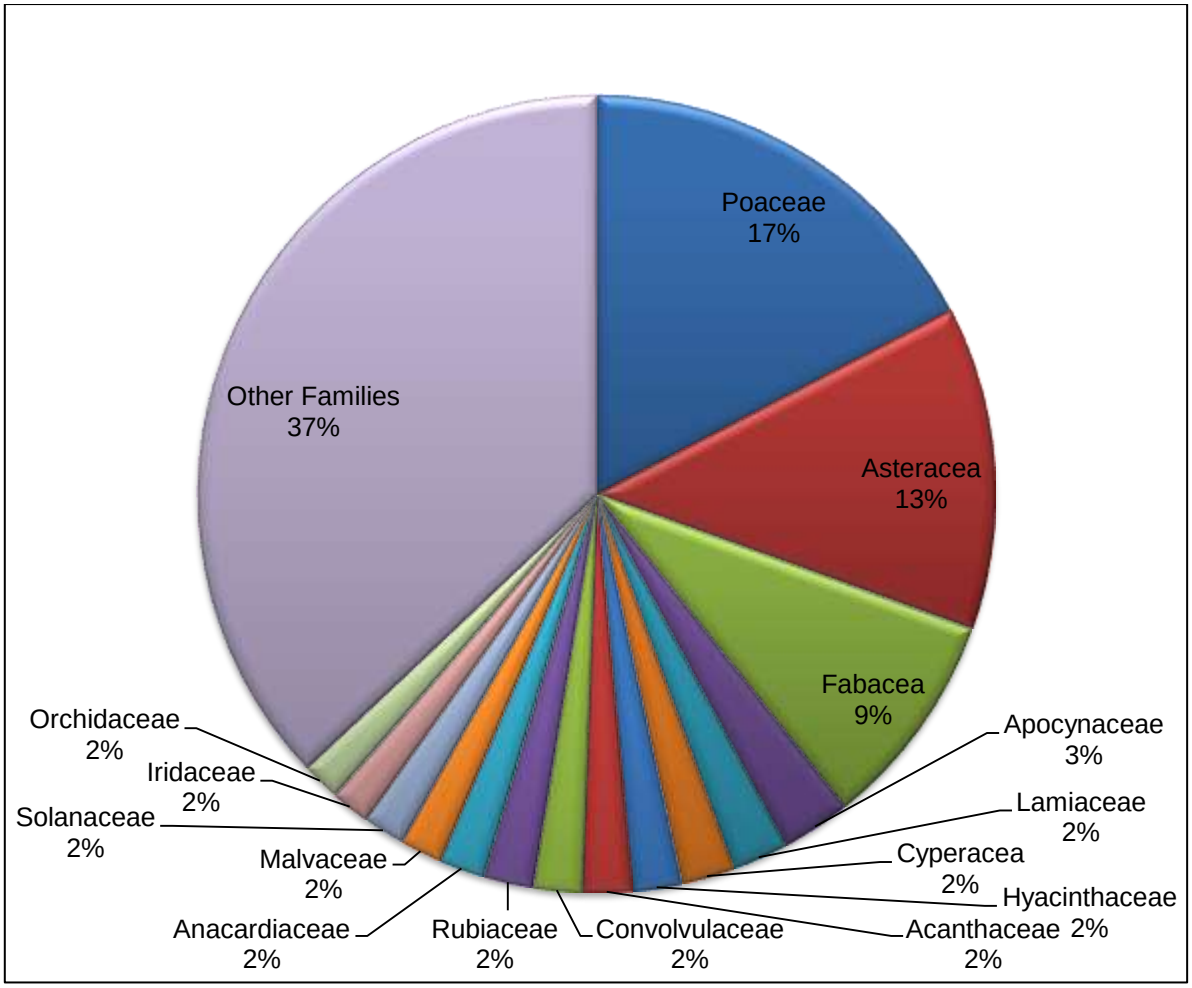


**Figure 4.2. Dominant plant families reflecting the percentage of total flora.**

Twenty-eight genera are represented by five or more species (Table 4.3).

**Table 4.3. Dominant genera and number of species per genus.**

| Genus | No of species | Genus | No of species |
|---|---|---|---|
| *Eragrostis* | 17 | *Commelina* | 6 |
| *Senecio* | 15 | *Ledebouria* | 6 |
| *Helichrysum* | 13 | *Eulophia* | 6 |
| *Indigofera* | 11 | *Sporobolus* | 6 |
| *Searsia* | 10 | *Asclepias* | 6 |
| *Solanum* | 9 | *Berkeya* | 6 |
| *Hypoxis* | 8 | *Vernonia* | 6 |
| *Aristida* | 8 | *Tephrosia* | 6 |
| *Digitaria* | 8 | *Chlorophytum* | 5 |
| *Setaria* | 8 | *Ornithogalum* | 5 |
| *Ipomoea* | 8 | *Gladiolus* | 5 |
| *Cyperus* | 7 | *Crassula* | 5 |
| *Acacia* | 7 | *Acalypha* | 5 |
| *Asparagus* | 6 | *Hibiscus* | 5 |

A total of eight Red Data species have been identified on MGBC, and represents 1.1% of the total flora on MGBC (Figure 4.3). The Red Data species of MGBC fall within three categories, namely Endangered[4], Vulnerable[5] and Declining[6] and are indicated as such in the species list of Annexure C and in Figure 4.4.

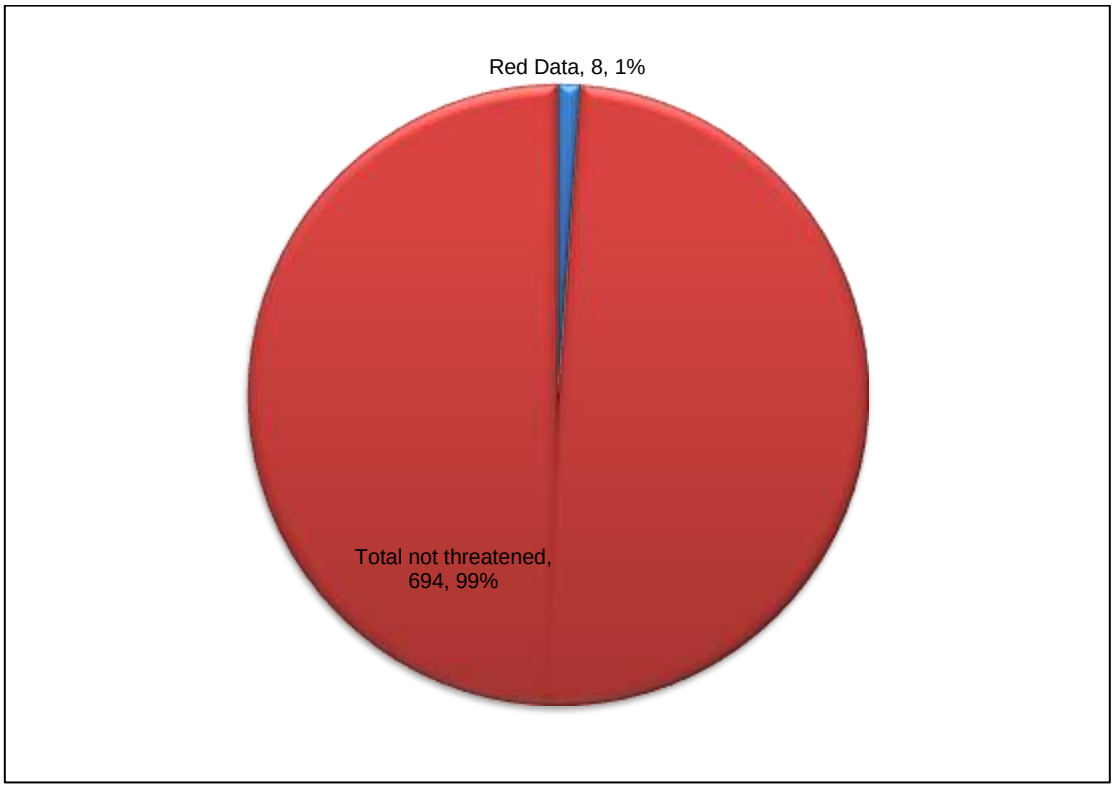


**Figure 4.3. Number of Red Data species on Mogale's Gate Biodiversity Centre according to Raimondo et al. (2009).**

[4] A taxon is Endangered when the best available evidence indicates that it meets any of the five IUCN criteria for Endangered, and is therefore facing a very high risk of extinction in the wild (Raimondo *et al.,* 2009).
[5] A taxon is Vulnerable when the best available evidence indicates that it meets any of the five IUCN criteria for Vulnerable, and is therefore facing a high risk of extinction in the wild (Raimondo *et al.*2009).
[6] A taxon is Declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline in the population (Raimondo *et al.,* 2009).

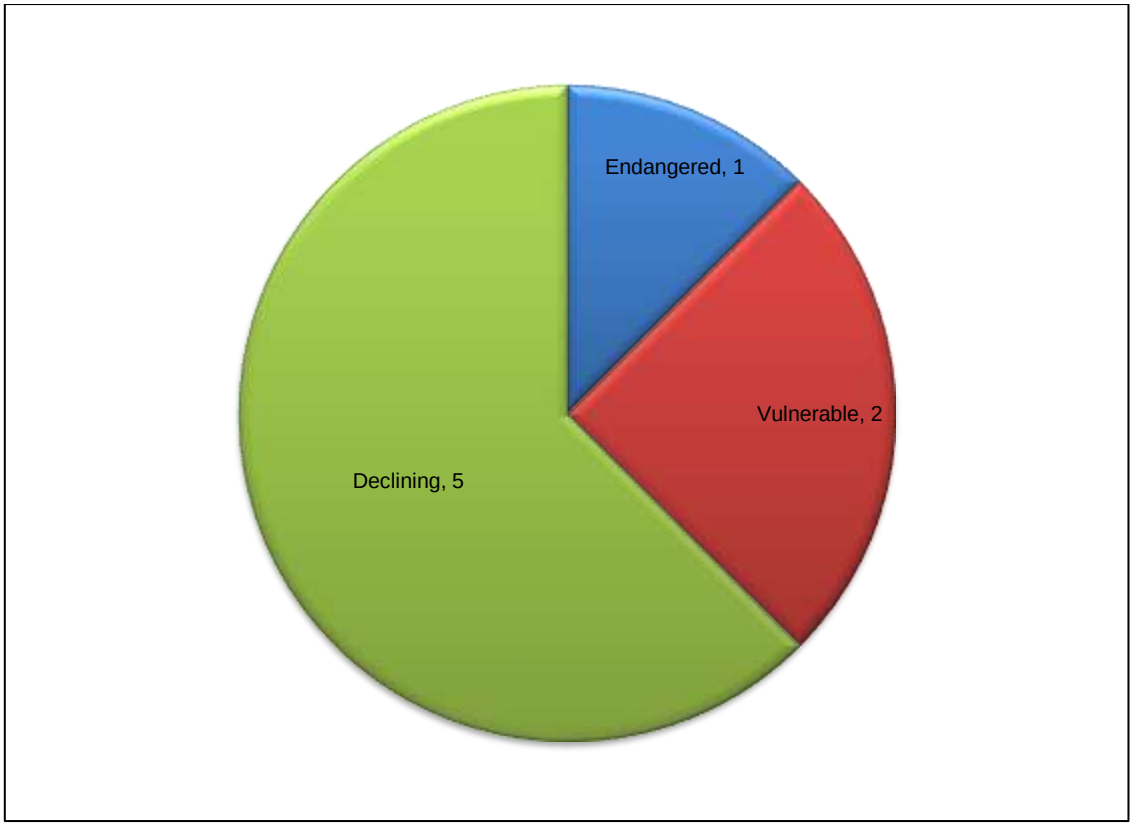


**Figure 4.4. Status of Red Data Species on Mogale's Gate Biodiversity Centre acording to Raimondo *et al.* (2009).**

Alien or introduced species account for 9.7% of the flora on MGBC, with a total of 68 different species (Annexure C). Two-thirds of these species belong mainly to the families Asteracea (16 species), represented by the genera: *Agerytum, Bidens, Campulclinum, Cirsium, Conyza, Cosmos, Crepis, Galinsoga, Schkuhria, Sonchus, Tagetes, Tolpis, Tragopogon and Zinnia; Poacea* (9 species): *Agrostis, Arundo, Bromus, Cortaderia, Paspalum, Pennisetum* and *Poa*; *Solanaceae* (9 species): *Datura* and *Solanum*; *Amaranthaceae* (4 species): *Achryranthus*, *Amaranthus*, *Gomphrena* and *Guilleminea*; *Rosaceae* (4 species): *Agrimonia*, *Duchesnea*, *Pyracantha and Rubis*; *Lantana* and *Verbena*.

## Discussion & Conclusion

MGBC has a total of 702 species in 381 genera and 109 families. The high diversity of the plant species in the Centre is indicated by the presence of only 255 species at the Sterkfontein Caves (Siebert & Siebert, 2005) which falls within the Grassland Biome within the Carletonville Dolomite Grassland (Gh15) with possibly Egoli Granite Grassland (Gm10) (Mucina & Rutherford, 2006), and the 293 species that Eloff (2010) identified in the Cradle of

Humankind World Heritage Site (COHWHS), which falls within the following five vegetation types, Egoli Granite Grassland (Gm10); Carletonville Dolomite Grassland (Gh15); Gauteng Shale Mountain Bushveld (SVcb10); Andesite Mountain Bushveld (SVcb11); Moot Plains Bushveld (SVcb8) and Gold Reef Mountain Bushveld (SVcb9) (Murcina & Rutherford, 2006).

According to Mucina & Rutherford (2006), grasslands are structurally simple and strongly dominated by grasses (Poaceae), while the woody component, where they occur, is limited to specialised habitats. The forbs are an important component, and although not usually dominant, contribute more to the species richness of grasslands than grass species do. Mucina and Rutherford (2006), classify MGBC's vegetation under the savanna biome with the veld types Moot Plains Bushveld (SVcb8), Gold Reef Mountain Bushveld (SVcb9) and Andesite Mountain Bushveld (SVcb11). In the past the southern sections of MGBC under Bredenkamp and van Rooyen (1996) (Rocky Highveld Grassland) and Acocks (1988) (central variation of Bankenveld), have fallen under the Grassland Biome.

As seen in Figure 4.2 the largest plant family is the Poacea and four of the top 10 genera are grasses, i.e. *Eragrostis, Aristida, Digitaria* and *Setaria*. The second largest plant family is the herbaceous family Asteraceae with Fabaceae (combination of woody and herbaceous) coming in third.

This is comparable with other reserves found in the Grassland Biome. By analysing the species lists from Siebert & Siebert (2005) for the Sterkfontein Caves, the three most dominant plant families are Poaceae (45 species), Asteraceae (40), and Fabaceae (26). At Jack Scott Nature Reserve the three dominant families were Poaceae (47), Asteraceae (15), and Fabaceae (13) (Data extracted from Coetzee, 1973). While at Rietvlei Nature Reserve (Rand Highveld Grassland (Gm11) (Murcina & Rutherford, 2006)), near Pretoria, the data shows that the three dominant families are also Poaceae (96), Asteraceae (78), and Fabaceae (50) (Data extracted from Marais (2004)). The plants found in the Proposed Highveld National Park near Potchefstroom (Vaal Reefs Dolomite Sinkhole Woodland (Gh12), Rand Highveld Grassland (Gm11), Klerksdorp Thornveld (Gh13) and Carletonville Dolomite Grassland (Gh15) (Murcina & Rutherford, 2006)), again show that the three dominant plant families are Poaceae (61), Asteraceae (40) and Fabaceae (25) (Data extracted from Daemane, *et al*. (2010)). According to Brand, *et al.* (2010) the vegetation of Platberg, (Eastern Free State Sandy Grassland (Gm4) (Mucina & Rutherford, 2006)), the three most dominant plant families are Asteraceae (126 species), Poaceae (73) and Cyperaceae (39), with Fabaceae (33) forth.

In the Savanna Biome the pattern changes slightly. From the species list provided by Brown (1997), from the Borakalalo Nature Reserve (Springbokvlakte Thornveld (SVcb15) and

Western Sandy Bushveld (SVcb16) (Mucina & Rutherford, 2006)), the three most dominat plant families are Poacea (83), Fabeacea (53) and Asteraceae (27). In the Kruger National Park (KNP) Letaba exclosures (Lowveld Rugged Mopaneveld (SVmp6) (Mucina & Rutherford, 2006), Siebert, *et al.* (2010) found that the three dominant plant families were Fabaceae (34 species), Poaceae (30) and Malvaceae (11), with Asteraceae (7) eighth. While in the Nkhuhlu Exclosures of KNP, Siebert & Eckhardt (2008) found that Poaceae (66 species), Fabaceae (58) and Asteraceae (22) were the three most dominant species.

Grasslands make up 78.84% on MGBC, while woodlands only make up 19.59%. Even though MGBC falls within the Savanna Biome according to Mucina & Rutherford (2006) both elements of the two biomes can be found on MGBC due to MGBC being an ecotone between the two biomes (O'Conner & Bredenkamp, 1997).

Of the 109 plant families 80% are Dictoyledoneae and 15% Monocoyledoneae (Figure 4.1). Monocotyledoneae are made up generally of herbaceous plants, whereas the Dicotyledoneae are a combination of the woody and herbaceous plants.

Red Data Species make up 1.1% of the species of MGBC (Figure 4.3), which is low especially if compared to areas like the Fynbos that can show an average of 3-7% of Red Data species (Pond *et al.*, 2002). The endangered *Aloe peglerea* is one of the red data species present on MGBC. This species is found in the rocky northern slopes of *Protea caffra* subsp. *caffra-Melinis nerviglumis* Woodland (8) along the north-western border of MGBC. *Prunus africana* (vulnerable) and *Bowiea volubilis* (vulnerable) are both found in *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2), in the kloofs of MGBC. *Aloe peglerea and Prunus africana are* more commonly found on the Magaliesberg Mountain Range.

Of the alien species found on MGBC a total of 35% are annuals. These species occur mostly on old secondary successional grassland areas that formed part of cattle and crop farms approximately 25 year ago. These areas have still not recovered to its original climax stage and are mostly dominated by the anthropogenic grass *Hyparrhenia hirta.* Some of the alien woody plants have been planted on the property by previous owners in their gardens or as wind breaks for the old croplands. One species of grave concern to the management of MGBC is the forb *Campuloclinium macrocephalum.* As a category 1 declared invader this is a very invasive plant that requires urgent attention not only on MGBC but throughout the Gauteng province, to prevent it destroying the natural grasslands.

MGBC has a species richness of 22.94 species per 100ha. The species richness of MGBC is the result of various soil, rainfall, climatic, elevation factors as well as fire and variations in habitat. As stated above, MGBC is considered an ecotone between the Grassland and

Savanna Biome, and as a result shows a very rich variety of plant species, habitats, and vegetation types from both biomes.

According to Low and Rebelo (1996), only 2.24% of the Grassland Biome and 9.94% of the Savanna Biome is conserved. The Moot Plains Bushveld (SVcb11) present on MGBC is classified as vulnerable by Mucina & Rutherford (2006). Together with the two other vegetation types and the high species richness present, MGBC fulfils an important role in the conservation of plant and animal species. Measures need to be put in place to protect this very important resource. This analysis will form the basis of the habitat management plan for MGBC.

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# Chapter 5
# Veld Condition and Grazing Capacity

*"In a moment the ashes are made, but a forest is a long time growing."*

**Seneca**

## Introduction

Brown (1997) describes veld management as a component of biota management, which can be described as the utilization and conservation of natural veld without negatively affecting the vegetation. Brown (1997), along with Mentis (1989), state that to be able to manage veld correctly it is necessary to monitor its condition and to set objectives and targets for its management.

One of the first steps that follows the identification and classification of plant communities is a veld condition assessment (Van Rooyen, 2010a). According to Bancroft *et al.* (1998) veld condition assessments are accepted tools in identifying and quantifying the impacts of using the veld, and give an indication of the condition of the veld with respect to certain functional characteristics.

Veld condition is a functional characteristic of the veld, for example food productivity or palatability (Bancroft *et al.*, 1998). The assessment thereof, if repeated at regular intervals, can produce a descriptive measure of the rate of change of the veld, as well as the direction of change in response to the current management practices (Brown, 1997).

Brown (1997), and Van Oudtshoorn (2012), describe grazing capacity as the number of animals that an area can sustain without deterioration of the vegetation or soil. It is usually expressed as hectares/large stock unit (ha/LSU), where one livestock unit is equivalent to a 450 kg grazing animal (Van Oudtshoorn, 2012).

The veld condition and resultant grazing capacity will vary annually due to factors like rainfall and to a certain extent present and previous grazing practices (Teague & Dankwerts, 1989; Van Oudtshoorn, 2012). Each of the recognised plant communities of an area is associated with specific habitats, and each has its own set of characteristic and dominant species, resulting in each plant community having its own grazing capacity (Van Rooyen, 2010a).

It is essential that the veld condition and grazing capacity of each plant community, and the farm as a whole, are known and understood. This influences veld and wildlife management

decisions, based on the goals of the management team. Decisions can then be made on scientifically based data to determine if there are for example, too many animals or if the number of certain game species could be increased, or whether certain plant communities need to be burnt within the next burn cycle or not.

## Materials and Methods

The step-point method adapted from Mentis (1981) was used to determine the grass species composition in each plant community. At each of the 151 sample points (Chapter 3) with in Mogale's Gate Biodiversity Centre (MGBC), 100 point readings were taken. If there was no plant within 30 cm of the point it was recorded at bare. This resulted in a minimum of 300 points and a maximum of 5 600 points being recorded in the different plant communities except for community 1 where only 200 points were recorded due to the small size of the community and the community being very homogenous.

The Ecological Index Method (EIM), first described by Voster (1982), and modified by Heard *et al.* (1986), was used to indicate the health or condition of the veld, in terms of the grasses present. The condition of the veld was based on Van Rooyen (2010b), with less than 40% indicating poor veld condition, 40-60% indicating moderate veld condition and greater than 60% good veld condition.

The ecological status of the grasses was recorded based on Van Oudtshoorn (2012), and were grouped as follows:

- Decreasers – Grasses that are abundant in good veld but decrease in numbers as the veld is overgrazed.
- Increaser 1 – Grasses that are abundant in under-utilised veld and are usually unpalatable, robust climax grasses that can grow without any defoliation.
- Increaser 2 – Grasses that are abundant in overgrazed veld and includes mostly pioneer and sub-climax grass species.
- Increaser 3 – Grasses that are mainly found in overgrazed veld and are usually unpalatable, dense climax grasses.

The GRAZE veld condition assessment model (Bredenkamp, 1990; Brown, 1997) was used to determine the veld condition and grazing capacity. Aspects that were taken into account when determining grazing capacity are:

- Size of the plant community (ha),
- Estimated percentage tree canopy cover per plant community,

- Estimated percentage shrub canopy cover per plant community,
- Estimated percentage grass canopy cover per plant community,
- Accessibility for game per plant community,
- Fire regime per plant community, and
- MGBC's average annual rainfall (mm).

## Results

The sizes (in hectares) and percentage contribution of each plant community within MGBC are given in Table 5.1.

**Table 5.1. Plant communities and their sizes on Mogale's Gate Biodiversity Centre.**

| Community | Size (ha) | Percentage of MGBC |
|---|---|---|
| 1. *Schoenoplectus corymbosus-Typha capensis* Wetland | 6.6 | 0.22 |
| 2. *Hemarthria altissima-Arundinella nepalensis* Wetland | 36.3 | 1.18 |
| 3.1. *Euclea crispa* subsp*. crispa-Olea europea* subsp. *africana-Setaria megaphylla* Woodland | 37 | 1.21 |
| 3.2. *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland | 426 | 13.88 |
| 4. *Senecio inornatus-Hyparrhenia tamba* Grassland | 21.8 | 0.71 |
| 5.1. *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* Woodland | 27.3 | 0.89 |
| 5.2. *Sporobolus africanus-Hyparrhenia hirta-Cynodon dactylon* Grassland | 298.7 | 9.73 |
| 5.3. *Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus* Grassland | 284.4 | 9.27 |
| 6. *Seriphium plumosum-Alloteropsis semialata* subsp. *eckloniana* Grassland | 403.6 | 13.15 |
| 7. *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland | 1 377.6 | 44.89 |
| 8. *Protea caffra* subsp. *caffra—Melinis nerviglumis* Woodland | 110.9 | 3.61 |
| 9. *Xerophyta retinervis-Loudetia simplex* Grassland | 33.6 | 1.09 |

The *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland (7) constitutes the largest single plant community, (1 377 ha = 45% of the study area) on MGBC. Other large plant communities include the *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2) (426 ha), the *Sporobolus africanus-Hyparrhenia hirta-Cynodon dactylon* Grassland (5.2) (298 ha), *Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus* Grassland (5.3) (284 ha), and the *Seriphium plumosum-Alloteropsis semialata* subsp. *eckloniana* Grassland (6) (403 ha) (Table 5.1). The total grazing capacity for MGBC is 5.7 ha/LSU for game (Table 5.2), meaning that a total of 534.8 LSU of game can be stocked during average rainfall years which declines to 338 LSU's during below average rainfall years (Table 5.2).

## Table 5.2. GRAZE Analysis for the plant communities on Mogale's Gate Biodiversity Centre.

| Plant community | 2 | 3.1 | 3.2 | 4 | 5.1 | 5.2 | 5.3 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size (ha) | 36 | 37 | 426 | 22 | 27 | 299 | 284 | 404 | 1378 | 111 | 34 | 3057 |
| Trees % cover | 0 | 35 | 27 | 1 | 33 | 0 | 1 | 0 | 3 | 11 | 4 | |
| Shrubs % cover | 0 | 10 | 13 | 3 | 2 | 1 | 1 | 8 | 8 | 6 | 13 | |
| Bush factor | 1.00 | 0.74 | 0.78 | 0.99 | 0.77 | 1.00 | 0.99 | 0.97 | 0.95 | 0.91 | 0.93 | |
| | | | | | | | | | | | | |
| Decreasers | 117 | 464 | 768 | 15 | 0 | 236 | 241 | 412 | 2537 | 446 | 107 | |
| Increasers 1 | 29 | 42 | 251 | 78 | 1 | 138 | 845 | 707 | 1263 | 387 | 84 | |
| Increasers 2 | 59 | 116 | 290 | 0 | 248 | 453 | 238 | 336 | 1122 | 259 | 97 | |
| Increasers 3 | 0 | 0 | 19 | 0 | 0 | 0 | 0 | 0 | 29 | 6 | 0 | |
| Encroachers | 95 | 431 | 197 | 107 | 9 | 273 | 171 | 134 | 624 | 69 | 83 | |
| Bare soil | 0 | 47 | 75 | 0 | 42 | 0 | 5 | 11 | 25 | 33 | 29 | |
| Total | 300 | 1100 | 1600 | 200 | 300 | 1100 | 1500 | 1600 | 5600 | 1200 | 400 | |
| **Veld Condition Index %** | **55.2** | **51.0** | **67.0** | **37.5** | **33.5** | **48.0** | **62.4** | **65.5** | **69.7** | **68.7** | **52.2** | |
| | | | | | | | | | | | | |
| Grass cover % | 73 | 23 | 28 | 53 | 43 | 62 | 66 | 60 | 52 | 54 | 20 | |
| Rainfall (mm/yr) | 791 | 791 | 791 | 791 | 791 | 791 | 791 | 791 | 791 | 791 | 791 | |
| Accessibility | 1.0 | 0.8 | 0.6 | 0.8 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.7 | 0.6 | |
| Fire (0.8\1) | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | |
| | | | | | | | | | | | | |
| **Grazing Capacity** | | | | | | | | | | | | |
| *Average year* | | | | | | | | | | | | |
| ha/LSU Game | 6.1 | 7.1 | 7.8 | 8.9 | 5.2 | 6.6 | 5.7 | 5.4 | 5.1 | 6.4 | 12.7 | |
| **Number LSU Game** | **5.9** | **5.2** | **54.5** | **2.4** | **5.2** | **45.4** | **49.7** | **75.1** | **271.4** | **17.2** | **2.6** | **534.8** |
| | | | | | | | | | | | | |
| **Grazing Capacity** | 5.4 | 10.9 | 11.2 | 8.7 | 7.7 | 6.0 | 5.2 | 5.3 | 5.3 | 7.5 | 15.6 | |
| *Below average year* | | | | | | | | | | | | |
| ha/LSU Game | 9.7 | 12.2 | 12.8 | 14.7 | 8.7 | 10.6 | 9.0 | 8.4 | 8.0 | 10.1 | 22.4 | |
| **Number LSU Game** | **3.8** | **3.0** | **33.4** | **1.5** | **3.1** | **28.2** | **31.6** | **47.9** | **173.0** | **11.0** | **1.5** | **338.0** |
| **Total Grazing Capacity for Game (ha/LSU)** | | | | **5.7** | | | | | | | | |

The individual plant communities and sub-communities are discussed in the following section of this chapter. Full breakdowns of all the plant communities on MGBC, except *Schoenoplectus corymbosus-Typha capensis* Wetland (1) can be found in Table 5.2 (refer to Chapter 3 for descriptions of the various plant communities).

# Discussion

## 1. *Schoenoplectus corymbosus-Typha capensis* Wetland

The veld condition index for this plant community is low as it contains no grasses and is dominated by a cyperiod and a forb species, both being hydrophytes. As a result it has a low grazing capacity. It is the smallest plant community on MGBC with a size of 6.6 ha (Table 5.1) but as a wetland it has a high ecosystem functioning in retaining and regulating water flow while also acting as a water retention area.

## 2. *Hemarthria altissima-Arundinella nepalensis* Wetland

This community's veld condition index is 55.2% (Table 5.2) and has a grazing capacity of 6.1 ha/LSU for game in an average rainfall year. Since the community is 36.3 ha in size (Table 5.1) it can support 5.9 LSU game.

The condition of the veld is moderate and it has a 73% grass cover. This community has a high percentage of exotic species, especially *Paspalum* spp., which are often found in wetlands. The veld shows signs of good utilisation with a high percentage (39%) of Decreaser species. One of the main game species using this plant community is the Common Reedbuck (*Redunca arundinum*), although they have small numbers on MGBC, the community is also fairly small, resulting in a well utilized community.

In a below average rainfall year the grazing capacity is reduced to 9.7 ha/LSU for game (Table 5.2).

## 3.1. *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Setaria megaphylla* Woodland

The veld condition index of this sub-community is 51% (Table 5.2) and has a grazing capacity of 7.1 ha/LSU in an average rainfall year. As the size of this sub-community is 37 ha (Table 5.1) it can theoretically support 5.2 LSU game (Table 5.2).

The condition of the veld is moderate although it has a low grass cover of 22.5%. This is because there is a high forb component in this sub-community (38%), under the canopies of the trees. The veld shows good signs of utilisation with a high percentage of decreaser species (42%). The high percentage encroachers (forbs) should be monitored since they are indicative of local overgrazing. Due to the close proximity to the river system trampling by games species like Eland (*Tragelaphus oryx*), Kudu (*Tragelaphus strepsiceros*), Bushbuck (*Tragelaphus scriptus*), Nyala (*Tragelaphus angasii*), Burchell's Zebra (*Equus burchellii*) and

Warthog (*Phacochoerus africanus*) to get to the water has also resulted in the high forb component, in the form of pioneer plants.

In a below average rainfall year the grazing capacity will reduce to 12.2 ha/LSU for game (Table 5.2).

## 3.2. *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland

In this sub-community the veld condition index is 67% (Table 5.2), while the grazing capacity is 7.8 ha/LSU for game in an average rainfall year. With a size of 426 ha (Table 5.1) this sub-community could support 54.5 LSU game.

The condition of the veld is regarded as good while the grass cover is 48%, as a result of the low shrubs (13%) and forbs (16%) under the tree canopies. The veld shows signs of utilization, but high percentages of decreaser species (48%) are still present indicating that the area is not overutilised and has a wide variety of game species using it, including those found in *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2), as well as, Giraffe (*Giraffa camelopardalis*), Red Hartebeest (*Alcelaphus buselaphus*), Impala (*Aepyceros melampus*), and Gemsbok (*Oryx gazella*). The number of Increaser 2 and forb species should however, be monitored to detect increases in their numbers.

The grazing capacity will decrease to 12.8 ha/LSU for game (Table 5.2) under below average rainfall years.

## 4. *Senecio inornatus-Hyparrhenia tamba* Grassland

This plant community's veld condition index is the second lowest at 37.5%, and has the second lowest grazing capacity of 8.9 ha/LSU for game under average rainfall conditions. This community could support only 2.4 LSU game (Table 5.2) due to its size of 21.8 ha (Table 5.1).

This community shows signs of underutilisation as it has a high percentage of Increaser I grass species (39%), while it has a grass cover of 53%. It seems as though this community has become encroached with forbs (43.5%) which could be as a result of underutilisation and die-off of perennial palatable grasses accompanying underutilisation. This is probably due to the community being moist, in open light, and on slopes. The encroachment of forbs has also occurred due to leaching to an extent as well as the lack of fire.

During a below average rainfall year the grazing capacity will reduce to 14.7 ha/LSU for game.

## 5.1. *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* Woodland

The veld condition index for this sub-community is the lowest of all the plant communities on MGBC at 33.5%, while its grazing capacity is 5.2 ha/LSU for game, under an average rainfall year. This sub-community has a size of 27.3 ha (Table 5.1) and could therefore theoretically support 5.2 LSU game (Table 5.2).

This sub-community is dominated by alien vegetation but is frequently used by most of the grassland game species, e.g. Black Wildebeest (*Connochaetes gnou*), Blesbok (*Damaliscus pygargus* subsp. *phillipsi*), Eland (*Tragelaphus oryx)*, Burchell's Zebra (*Equus burchellii*), Red Hartebeest (*Alcelaphus buselaphus*), and Gemsbok (*Oryx gazella*). Although animals are often seen in this community seeking cover from rain and heat there are signs of overgrazing and trampling (14% bare soil), with a high percentage of Increaser 2 species (83%) present. The grass cover is 43.3%.

With a below average rainfall year the grazing capacity of this sub-community will drop to 8.7 ha/LSU for game.

## 5.2. *Sporobolus africanus-Hyparrhenia hirta-Cynodon dactylon* Grassland

This sub-community has a moderate veld condition index of 48% and a grazing capacity under an average rainfall year of 6.6 ha/LSU for game. The size of this sub-community is 298.7 ha (Table 5.1) which means that it could support 45.4 LSU of game (Table 5.2).

This sub-community comprises old agricultural lands, as indicated with the high percentage of pioneer Increaser II species (41.2%). This sub-community has very good grass cover at 61.9%. It is also well utilised by Black Wildebeest (*Connochaetes gnou*), Blesbok (*Damaliscus pygargus* subsp. *phillipsi*), Springbok (*Antidorcas marsupialis*), Burchell's Zebra (*Equus burchellii*) and Red Hartebeest (*Alcelaphus buselaphus*).

The grazing capacity will decrease to 10.6 ha/LSU for game (Table 5.2) under below average rainfall years.

## *5.3 Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus* Grassland

In this sub-community the veld condition index is a high 62.4% (Table 5.2), while the grazing capacity is 5.7 ha/LSU for game in an average rainfall year. Being 284.4 ha in size (Table 5.1), this sub-community could support 49.7 LSU game.

This community shows signs of underutilisation and has a high percentage of Increaser 1 grass species (56.3%). The grasses have and average cover of 66.4%.

Under a below average rainfall year the grazing capacity will reduce to 9.0 ha/LSU for game (Table 5.2).

## 6. *Seriphium plumosum-Alloteropsis semialata* subsp. *eckloniana* Grassland

The veld condition index for this plant community is a high 65.5% (good veld condition), and has a grazing capacity of 5.4 ha/LSU for game under an average rainfall year (Table 5.2). Since the size of this community is 403.6 ha (Table 5.1) it can support 75.1 LSU game.

Due to the high percentage of Increaser 1 species (44.2%), this plant community shows signs of underutilization, but has a good grass cover of 59.7%. The high number of the dwarf shrub *Seriphium plumosum* is concerning as it indicates historical poor veld management. This area was previously used for grazing by cattle.

The grazing capacity of this community will decrease to 8.4 ha/LSU for game (Table 5.2) under below average rainfall years.

## 7. *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland

This plant community has the highest veld condition index of 69.7% as well as the highest grazing capacity of 5.1 ha/LSU for game (Table 5.2), of all the plant communities on MGBC. It is also the largest plant community (1 377.6 ha) (Table 5.1) and can support 271.4 LSU game under average rainfall conditions.

This plant community is well utilized and has a good percentage of Decreaser species (45.3%). The grass cover is good at 51.8%, but due to its high grazing value and utilisation by most of the games species on MGBC, localised patches are trampled and overgrazed explaining the relatively high forb content (28.9%).

Under a below average rainfall year the grazing capacity of this community changes to 8.0 ha/LSU (Table 5.2).

## 8. *Protea caffra* subsp. *caffra-Melinis nerviglumis* Woodland

The veld condition index of this plant community is the second highest for MGBC at 68.7%, with a grazing capacity under an average rainfall year of 6.54 ha/LSU game (Table 5.2). With its size of 110.9 ha (Table 5.1), this plant community can theoretically support 17.2 LSU game under an average rainfall year.

This community has a relatively even mix between the Decreaser species and Increaser species, which shows fairly good utilization. It has a good grass cover of 53.8%.

The grazing capacity of this plant community decreases to 10.1 ha/LSU game if MGBC experiences a below average rainfall year.

### 9. *Xerophyta retinervis-Loudetia simplex* Grassland

This plant community as a veld condition index of 52.2% with a grazing capacity of 12.7 ha/LSU game (Table 5.2). This is a relatively small community of 33.6 ha (Table 5.1) and relatively difficult to access, but could support 2.6 LSU game with an average rainfall year.

This plant community also has an even mix of Decreaser species and Increaser species, but has a low grass cover of 20.3%, but this is due to the high rocky cover of 47.5%.

If a below average rain year is experienced this plant communities grazing capacity will decrease to 22.4 ha/LSU game (Table 5.2).

## Conclusion

Overall the veld condition of the different plant communities on MGBC can be regarded as moderate to good. MGBC has an average veld condition index across the various plant communities of 55.5%, with an average grass cover of 49%. Generally the communities have a good mix of Decreasers and Increasers, with the Decreaser species comprising the largest proportion namely 36.9% of all the herbaceous species (Figure 5.1).

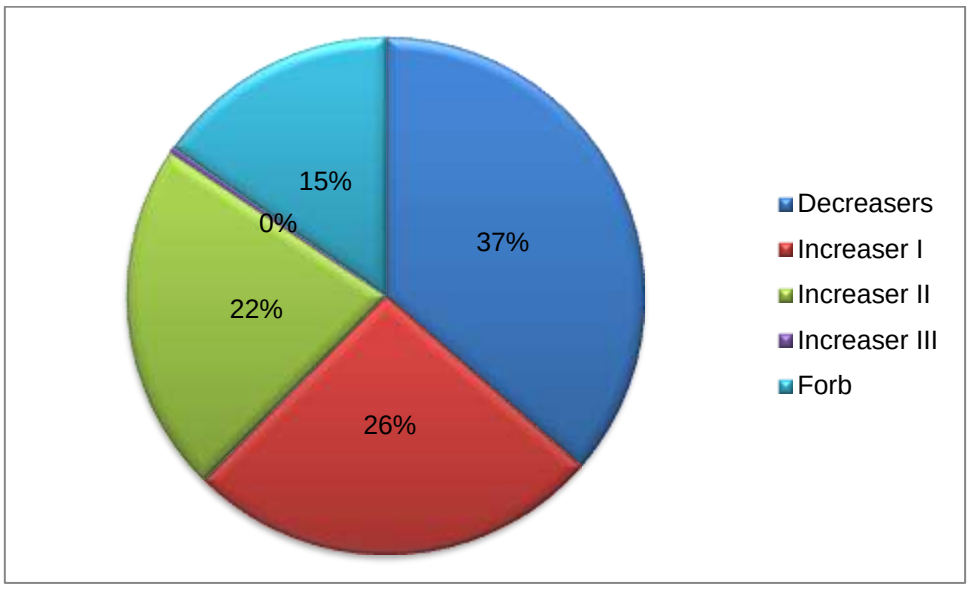


**Figure 5.1. Ecological Index of Mogale's Gate Biodiversity Centre.**

According Stuart-Hill (1989) we conduct veld condition assessments to assess what plants grow in an area, to serve as a reference point for future predictions and to monitor vegetation change. The monitoring of vegetation changes is becoming more important especially with the variable rainfall and the changing climate. By doing these veld condition assessments one is able then to constancy monitor changes in the veld condition index and can then manage the game species numbers on the property accordingly to prevent damage to the vegetation. A management plan can now be developed for MGBC to assist with decision making, based on sound scientific findings.

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# Chapter 6
# Biomass and Carbon Storage

*"Nature is the greatest server of humanity, but has become the victim of humans avarice and cruelty."*

**Taseem Hammed**

## Introduction

The biodiversity of our planet is dwindling due to human-induced actions worldwide (Van As *et al.,* 2012). All parts of the ecosystem are interrelated and interdependent. Any change in the environment or a species population will therefore affect other organisms and could create instability of the ecosystem (Van As *et al.,* 2012). As a result biodiversity conservation has become more important over the past few years. South Africa a country endowed with a rich diversity of plant and animal life is also facing this challenge to limit biodiversity loss. A major threat to our biodiversity is climate change (Van As *et al.,* 2013) and specifically global warming.

Carbon dioxide ($CO_2$) exists as a gas in the earth's atmosphere. The environmental impact of this gas is of significance since it is regarded as one of the most important greenhouse gases, contributing to global warming (Khademi *et al.*, 2009; Whitaker, 2007). Carbon dioxide is the primary source of carbon for living organisms on earth and its concentration has been regulated by photosynthetic organisms. However, due to the burning of carbon-based resources and industrial advancement, the atmospheric concentrations of carbon has increased to such an extent, that it reduces the outward radiation of sunlight from the earth's surface thereby causing the earth to become warmer. According to Houghton *et al.* (1995), $CO_2$ in the atmosphere has increased from 280 to 365 parts per million (ppm) since the industrial revolution, and could increase to 700ppm by the second half of the 21$^{st}$ century. The $CO_2$ concentration in the atmosphere has been fluctuating between 180ppm and 280ppm over the past half a million years, but increased rapidly to 369 ppm in 1999 (Scholes, 2004). The cause of this dramatic increase is as a result of human activities (Prentice *et al*, 2001). Scholes (2004) states that two-fifths of the accumulation is as a result of the conversion of natural vegetation into farmland and three-fifths are because of the burning of fossil fuels.

This increase in the atmospheric $CO_2$ levels contributes to global warming and is expected to alter the climate on earth (Bazzaz, 1990; Bazzaz & Fajer, 1992; Gribben & Gribben, 1996; Houghton, 1997; Houghton *et.al.,* 1992; Leggett, 1990; Sedjo, 1990). $CO_2$ accounts for 55% of the major greenhouse gasses (Figure 6.1) (Houghton *et al.,* 1991). Global warming is becoming a very important topic and part of the everyday lives of individuals as well as corporations. Corporations, as well as individuals, have to take a more serious role in reducing their carbon footprint. The international concern over global warming has resulted in an international investigation into ways of reducing the greenhouse effect and improving the way the greenhouse effect is approached (IPCC, 2000). Since plants fix carbon through the process of photosynthesis in the form of stored sugars, they act as carbon sinks. This process has resulted in a focus to study terrestrial vegetation in facilitating carbon sinks (Brown, 2002; IPCC, 2000; Messelman & Fox, 1991; Savidge, 2001). The sequestration of carbon by vegetation from the atmosphere is a way of buying time to implement other more definitive changes to the way that humans use carbon-based energy sources (Mills *et al*., 2003, Bateman *et al.*, 2005), although it is not a permanent fix.

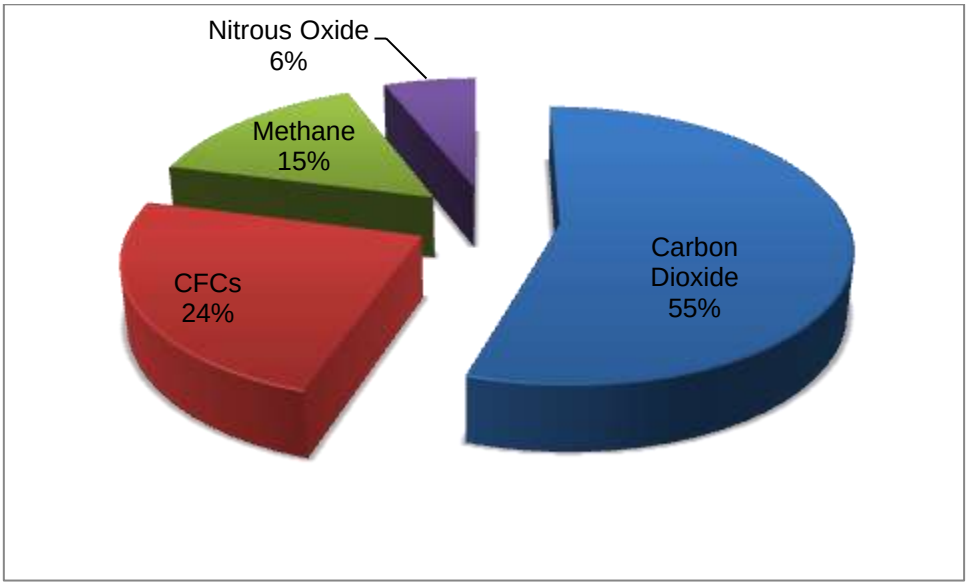


**Figure 6.1. The major greenhouse gasses (Houghton *et al.*, 1991).**

Aboveground plant biomass determines the potential for carbon storage of an ecosystem, as it plays an important role in the regulation of $CO_2$ and climate change (Bunker *et al.,* 2005; Houghton *et al.*, 2000; Schimel *et al.*, 2001).Therefore, the best way to determine how plants are storing carbon is to determine the biomass of the plants and plant communities. Biomass is an important part of vegetation and is the central variable in determining harvest yield, whether it is for standing crop, firewood, browse, fruits, or even timber in woodlots. Unfortunately it is totally impractical to measure biomass directly, as this would require the destruction of an area, so that the plants can be dried and weighed. In practice biomass has

to be measured using various measurable variables of the plants and then various equations can be applied to determine the biomass.

In the past, woodlands were cleared for cultivation, and an increased demand for the removal of products for urban lifestyles (Campbell & Byron, 1996). This resulted in erosion and soil leaching. The sequestration of carbon therefore, has other side effects as this has in tropical woodlands resulted in improved land management, by preventing the loss of woodlands and therefore soil, and a consequence of this is the alleviation of poverty, by providing products that can be used sustainably, and protecting biodiversity (Williams *et al.*, 2008).

MGBC management plan is aimed at maintaining its biodiversity and is also investigating ways to assist its corporate owners in reducing their carbon footprint by managing MGBC as efficiently and scientifically as possible.

# Materials and Methods

Eight randomly chosen sites were demarcated in each of the 12 plant communities identified on MGBC, except for *Schoenoplectus corymbosus-Typha capensis* Wetland (1). Due to its small size and homogeneity only four sites, were used, while in *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland (7) an additional four sites were added due to the size of the community.

## Grass Component

At each site the grass biomass was measured using a disc pasture meter as described by Bransby & Tainton (1977). A total of 50 Disk Pasture Meter (DPM) readings were taken at each site in each plant community.

This resulted in a total of 4 800 readings at the 96 sites with a total of 400 DPM readings per plant community, excluding *Schoenoplectus* corymbosus-*Typha* capensis Wetland (1), which had 200 disk pasture meter measurements and *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland (7), which had 600 DPM readings.

Various authors have developed calibration techniques for the Disk Pasture Meter. Danckwerts & Trollope (1980) and Trollope (1983) have developed a calibration formula for the Eastern Cape, Brockett (1996), a technique for the Zululand coastal grasslands, and Trollope *et al.* (2000) for the eastern Caprivi of Namibia. Trollope & Potgieter (1986) also developed a calibration for the Kruger National Park, which was refined by Zambatis *et al.* (2006). For the purposes of this study the technique as described by Zambatis *et al.* (2006)

was used for the calibration of the DPM. This eliminates the “edge effect” associated with harvesting small circular quadrats described by Bransby & Tainton (1977) which according to Zambatis *et al,* (2006) jeopardizes the accuracy of the regression. The results of the calibration were plotted:

$$Kg/ha = [31.7176(0.3218^{1/x})x^{0.2834}]^2$$

$$with\ r^2=0.951;\ p<0.0005$$

where x is the mean disk pasture meter height in cm of a site.

According to Scholes (2004), the conversion multiplier to convert the carbon content from both herbaceous and woody dry matter can be easily determined by using the average carbon content of dry matter which is 0.45 (this is the percentage carbon found in dry matter).

## Woody Component

The circular plot method as described by Scholes (1997) was used to determine woody plant density and to measure the woody plants. The plot sizes varied to have a minimum number of five individual woody plants in each plot (Philip, 2005). The plot radius was then determined from a central point to the furthest woody plant ($5^{th}$ woody plant) (Scholes, 1997). Each of the species was identified and the basal circumference at 20cm above ground level within the plot radius was measured (Shackleton & Scholes, 2011). Woody plants that had multiple stems below the 20 cm above ground level were measured separately, and then added together as a single stem. In each of the randomly chosen sites five plots were recorded in each plant community that had a woody component. If no woody plants fell within the circular plot it was recorded that zero woody plants occurred within that plot, a maximum plot radius of 100 m was used to determine no woody plants, as this meant that no woody plants could be found within an maximum area of 31 415 m².

A total of 1 752 woody plants were recorded in the possible 480 plots at the 96 sites. A maximum of 247 woody component measurements per plant community were recorded, except for *Schoenoplectus corymbosus-Typha capensis* Wetland (1) and *Hemarthria altissima-Arundinella nepalensis* Wetland (2) where no woody component measurements were recorded as there was no woody species present within these communities and *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland (7), where 425 woody component readings were taken due to the size of the community.

Since the total biomass of wood is strongly related to stem circumference (Shackleton & Scholes, 2011), various allometric equations[7] are available (Abbot *et al,* 1997; Brown *et al.,* 1989; Chave, 2005; Chidumayo, 1997; Dayton, 1978; Frost, 1996; Goodman, 1990; Martin *et al.,* 1998; Rutherford, 1979; Scholes, 1987; Tietema, 1993; Tinker *et al.*, 2010) to calculate the biomass of woody component. There are however no species specific equations for southern African trees so the generic allometric equation of Shackleton (1997) as refined by Shackleton & Scholes (2011), for South African savanna trees was used for biomass calculations of the tree component:

$$Log(tree\ dry\ mass) = 2.397(log(circ.)) - 2.441$$
$$\text{with } r^2 = 0.94;\ p < 0.00001$$

where *tree dry mass* is the biomass (kg) and *circ*. the stem circumference (cm) at 20 cm above ground level.

Shackleton & Scholes (2011) have further refined the above equation to differentiate between trees and shrubs (multi-stemmed species, generally less than 4 m maximum height). The following equation was then used for the shrub component:

$$Log(shrub\ dry\ mass) = 2.320(log(circ.)) - 2.30$$
$$\text{with } r^2 = 0.94;\ p<0.00001$$

where *shrub dry mass* is the biomass (kg) and *circ*. the stem circumference (cm) at 20 cm above ground level.

The carbon calculations are based on the whole tree biomass estimates, which include aboveground and belowground biomass. The leaf biomass of 5.4% was subtracted from the total calculated aboveground biomass as suggested by Rutherford (1982). The belowground or root biomass was calculated using a root : shoot ratio of 0.78 (Scholes & Walker, 1993). Scholes & Walker (1993) also recommend using carbon content for the above ground biomass of 45% and root carbon of 42% for the root biomass.

# Results

## Grass Component

The average DPM readings for the different plant communities on MGBC for 2011 are presented in Table 6.1 and for 2013 in Table 6.2.

[7] An allometric equation is a relationship between easily measurable variables and hard to measure variables.

**Table 6.1. Average plant community Disk Pasture Meter readings and resulting biomass for Mogale's Gate Biodiversity Centre for 2011.**

| Plant community | Average Disk Pasture Meter Reading | Average Biomass (kg/ha) |
|---|---|---|
| 1 | 0.0 | 0.0 |
| 2 | 23.41 | 8 366.3 |
| 3.1 | 13.57 | 7 799.3 |
| 3.2 | 12.04 | 7 635.3 |
| 4 | 17.97 | 8 124.4 |
| 5.1 | 4.94 | 5 823.8 |
| 5.2 | 15.13 | 7 934.8 |
| 5.3 | 13.84 | 7 824.0 |
| 6 | 12.19 | 7 653.0 |
| 7 | 11.23 | 7 532.5 |
| 8 | 13.58 | 7 800.2 |
| 9 | 9.71 | 7 297.8 |

*Hemarthria altissima-Arundinella nepalensis* Wetland (2), had the highest average readings from the disc pasture meter with 23.41, and an average biomass of 8 366.3 kg/ha while the lowest average was *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* Woodland (5.1), which had a disk pasture reading of 4.94 and an average biomass of 5 823.8 kg/ha (Table 6.1). The average disk pasture reading for the entire MGBC is 16.45 with a biomass of 7 716.6 kg/ha. No readings were taken in *Schoenoplectus corymbosus-Typha capensis* Wetland (1), as there was no grassy or woody component present.

**Table 6.2. Average plant community Disk Pasture Meter readings and resulting biomass for Mogale's Gate Biodiversity Centre for 2013.**

| Plant community | Average Disk Pasture Meter Reading | Average Biomass (kg\ha) |
|---|---|---|
| 1 | 0.00 | 0.0 |
| 2 | 23.71 | 8 382.3 |
| 3.1 | 13.89 | 7 834.0 |
| 3.2 | 12.23 | 7 662.7 |
| 4 | 18.12 | 8 138.5 |
| 5.1 | 5.00 | 5 861.9 |
| 5.2 | 15.23 | 7 947.8 |
| 5.3 | 13.98 | 7 842.1 |
| 6 | 12.28 | 7 667.8 |
| 7 | 11.41 | 7 561.8 |
| 8 | 13.67 | 7 813.4 |
| 9 | 9.86 | 7 327.8 |

In 2013 *Hemarthria altissima-Arundinella nepalensis* Wetland (2), still had the highest average readings from the disc pasture meter with 23.71, and an average biomass of 8 382.3 kg/ha, while *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* Woodland (5.1) remains the lowest with a disk pasture meter reading of 5.00, and an average biomass of 5 861.9 kg/ha. In 2013 the average disk pasture meter reading for MGBC was 16.67 with a biomass of 7 737.8 kg/ha. Table 6.3 indicates the carbon storage of the herbaceous layer for the different plant communities of MGBC for 2011 and Table 6.4 represents 2013.

**Table 6.3. Carbon storage of the herbaceous layer of each of the 12 plant communities present on Mogale's Gate Biodiversity Centre in 2011.**

| Plant community | Average carbon storage (t C/ha) |
|---|---|
| 1 | 0.0 |
| 2 | 3.765 |
| 3.1 | 3.510 |
| 3.2 | 3.436 |
| 4 | 3.656 |
| 5.1 | 2.621 |
| 5.2 | 3.571 |
| 5.3 | 3.521 |
| 6 | 3.444 |
| 7 | 3.390 |
| 8 | 3.510 |
| 9 | 3.284 |

The resulting carbon storage values for 2011 of the herbaceous layer of the various plant communities (Table 6.3), indicates that the *Hemarthria altissima-Arundinella nepalensis* Wetland (2) stores the most carbon per hectare, followed then by the *Senecio inornatus-Hyparrhenia tamba* Grassland (4), and the *Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus* Grassland (5.2). The lowest being the *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* woodland (5.1), a disturbed woodlot that is trampled a lot by animals, and as a result does not have a tall grass component (also see Chapter 3). The average across the entire study area is 3.427 tC/ha.

**Table 6.4. Carbon storage of the herbaceous layer of each of the 12 plant communities present on Mogale's Gate Biodiversity Centre in 2013.**

| Plant community | Average carbon storage (t C/ha) |
|---|---|
| 1 | 0.000 |
| 2 | 3.772 |
| 3.1 | 3.525 |
| 3.2 | 3.448 |
| 4 | 3.662 |
| 5.1 | 2.638 |
| 5.2 | 3.576 |
| 5.3 | 3.529 |
| 6 | 3.451 |
| 7 | 3.403 |
| 8 | 3.516 |
| 9 | 3.298 |

The results for 2013's carbon storage values of the herbaceous layer of the various plant communities (Table 6.4), show the same trend as in 2011, that the *Hemarthria altissima-Arundinella nepalensis* Wetland (2), stores the most carbon per hectare, followed then by the *Senecio inornatus-Hyparrhenia tamba* Grassland (4), and the *Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus* Grassland (5.2), while the lowest is still the *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* woodland (5.1). The average across the entire study area for 2013 is 3.438 tC/ha.

## Woody Component

Table 6.5 gives the woody species density of the different plant communities in MGBC for 2011, while Table 6.6 gives 2013's woody species density of the different plant communities in MGBC. This shows that there is no significant difference between the two years.

**Table 6.5. Woody species density of the different plant communities of Mogale's Gate Biodiversity Centre for 2011.**

| Plant community | Trees /ha | Shrubs /ha | Total Woody plants/ha |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 |
| 3.1 | 2 146.7 | 592.2 | 2 738.9 |
| 3.2 | 3 448.4 | 2 741.0 | 6 189.6 |
| 4 | 0.1 | 0.4 | 0.6 |
| 5.1 | 1 117.7 | 388.8 | 1 506.5 |
| 5.2 | 0.01 | 0 | 0.007 |
| 5.3 | 0.01 | 0.02 | 0.03 |
| 6 | 0.001 | 0.01 | 0.01 |
| 7 | 0.3 | 0.8 | 1.1 |
| 8 | 38.3 | 61.9 | 100.3 |
| 9 | 161.5 | 466.6 | 628.1 |

**Table 6.6. Woody species density of the different plant communities of Mogale's Gate Biodiversity Centre for 2013.**

| Plant community | Trees /ha | Shrubs /ha | Total Woody plants/ha |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 |
| 3.1 | 2 146.5 | 592.3 | 2 738.8 |
| 3.2 | 3 449.4 | 2 740.8 | 6 190.2 |
| 4 | 0.1 | 0.4 | 0.6 |
| 5.1 | 1 117.8 | 388.6 | 1 506.4 |
| 5.2 | 0.01 | 0 | 0.007 |
| 5.3 | 0.01 | 0.02 | 0.03 |
| 6 | 0.001 | 0.01 | 0.01 |
| 7 | 0.3 | 0.8 | 1.1 |
| 8 | 38.4 | 61.8 | 100.2 |
| 9 | 161.3 | 466.5 | 627.8 |

There are clear differences between the different plant communities (Table 6.5 & Table 6.6). *Schoenoplectus corymbosus-Typha capensis* Wetland (1) and *Hemarthria altissima-Arundinella nepalensis* Wetland (2) did not have any woody plants within them. The plant community with the highest density is *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana* Woodland (3), with both the sub-communities *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Setaria megaphylla* Woodland (3.1), and *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2) having a high density.

**Table 6.7. Tree component biomass per hectare for each plant community on Mogale's Gate Biodiversity Centre for 2011.**

| Plant community | Above ground biomass (kg) per community | Below ground biomass (kg) per community | Total biomass (kg) per community |
|---|---|---|---|
| 1 | 0 | 0 | **0** |
| 2 | 0 | 0 | **0** |
| 3.1 | 3 384 216 | 2 790 368 | **6 174 584** |
| 3.2 | 68 151 430 | 56 192 511 | **124 343 940** |
| 4 | 1 518 | 1 252 | **2 771** |
| 5.1 | 9 399 503 | 7 750 119 | **17 149 622** |
| 5.2 | 4 037 | 3 328 | **7 365** |
| 5.3 | 6 368 | 5 250 | **11 618** |
| 6 | 115 411 | 95 159 | **210 571** |
| 7 | 123 968 | 28 696 | **152 664** |
| 8 | 272 662 | 224 817 | **497 479** |
| 9 | 183 667 | 151 438 | **335 105** |

As a result of the high density of trees (Table 6.5 & Table 6.6) found in *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2), it has the highest tree biomass compared to other plant communities (Table 6.7 & Table 6.8). Although *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Setaria megaphylla* Woodland (3.1), has a higher tree density compared to *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* Woodland (5.1) (Table 6.5 & Table 6.6), the latter has larger older planted exotic trees and this results in it having a higher biomass.(Table 6.7 & Table 6.8).

**Table 6.8. Tree component biomass per hectare for each plant community on Mogale's Gate Biodiversity Centre for 2013.**

| Plant community | Above ground biomass (kg) per community | Below ground biomass (kg) per community | Total biomass (kg) per community |
|---|---|---|---|
| 1 | 0.00 | 0.00 | **0.00** |
| 2 | 0.00 | 0.00 | **0.00** |
| 3.1 | 3 505 016 | 2 889 971 | **6 394 987** |
| 3.2 | 70 126 402 | 57 820 924 | **127 947 326** |
| 4 | 1 593 | 1 313 | **2 906** |
| 5.1 | 9 561 669 | 7 883 828 | **17 445 497** |
| 5.2 | 4 476 | 3 691 | **8 167** |
| 5.3 | 6 854 | 5 651 | **12 506** |
| 6 | 143 911 | 118 658 | **262 570** |
| 7 | 364 543 | 308 734 | **673 277** |
| 8 | 284 623 | 234 678 | **519 301** |
| 9 | 199 132 | 164 189 | **363 322** |

The highest shrub component biomass, across both years is again with *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2), compared to other plant communities (Table 6.9 & Table 6.10). *Xerophyta retinervis-Loudetia simplex* Grassland (9) has the second highest density of shrubs (Table 6.7 & Table 6.8), and therefore, also has the second highest shrub component biomass (Table 6.9 & Table 6.10). *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Setaria megaphylla* Woodland (3.1), has a higher shrub density compared to *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* Woodland (5.1) (Table 6.7 & Table 6.8), and as a result it has a higher shrub component biomass (Table 6.9 & Table 6.10).

**Table 6.9. Average shrub component biomass per hectare for each plant community on Mogale's Gate Biodiversity Centre in 2011.**

| Plant community | Above ground biomass (kg) per community | Below ground biomass (kg) per community | Total biomass (kg) per community |
|---|---|---|---|
| 1 | 0 | 0 | **0** |
| 2 | 0 | 0 | **0** |
| 3.1 | 15 632 | 12 889 | **28 521** |
| 3.2 | 952 216 | 785 125 | **1 737 341** |
| 4 | 48 | 40 | **88** |
| 5.1 | 13 136 | 10 831 | **23 967** |
| 5.2 | 0 | 0 | **0** |
| 5.3 | 132 | 109 | **240** |
| 6 | 5 893 | 4 859 | **10 752** |
| 7 | 2 017 | 1 756 | **3 773** |
| 8 | 4 422 | 3 646 | **8 067** |
| 9 | 46 103 | 38 013 | **84 116** |

**Table 6.10. Average shrub component biomass per hectare for each plant community on Mogale's Gate Biodiversity Centre in 2011.**

| Plant community | Above ground biomass (kg) per community | Below ground biomass (kg) per community | Total biomass (kg) per community |
|---|---|---|---|
| 1 | 0 | 0 | **0** |
| 2 | 0 | 0 | **0** |
| 3.1 | 20 808 | 17 156 | **37 964** |
| 3.2 | 1 138 369 | 938 613 | **2 076 982** |
| 4 | 58 | 47 | **105** |
| 5.1 | 15 985 | 13 180 | **29 166** |
| 5.2 | 0 | 0 | **0** |
| 5.3 | 170 | 140 | **310** |
| 6 | 6 184 | 5 099 | **11 284** |
| 7 | 2 132 | 1 847 | **3 979** |
| 8 | 5 210 | 4 296 | **9 506** |
| 9 | 50 746 | 41 841 | **92 587** |

**Table 6.11. Total woody component carbon stored per plant community on Mogale's Gate Biodiversity Centre in 2011.**

| Plant community | Tree C Storage (kg) | Shrub C Storage (kg) | Total C Storage (kg) |
|---|---|---|---|
| 1 | 0 | 0 | **0** |
| 2 | 0 | 0 | **0** |
| 3.1 | 2 694 852 | 12 448 | **2 707 299** |
| 3.2 | 54 268 998 | 758 250 | **55 027 247** |
| 4 | 1 209 | 38 | **1 247** |
| 5.1 | 7 484 827 | 10 460 | **7 495 287** |
| 5.2 | 3 214 | 0 | **3 214** |
| 5.3 | 5 071 | 105 | **5 176** |
| 6 | 91 902 | 4693 | **96 595** |
| 7 | 67 838 | 1 645 | **69 483** |
| 8 | 217 121 | 3 521 | **220 642** |
| 9 | 146 254 | 36 712 | **182 966** |

For 2011 *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2), has the highest carbon storage, although *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* Woodland (5.1), and *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Setaria megaphylla* Woodland (3.1), store second and third respectively in storing carbon as a result of the large concentration of woody plants (Table 6.11).

**Table 6.12. Total woody component carbon stored per plant community on Mogale's Gate Biodiversity Centre in 2013.**

| Plant community | Tree C Storage (kg) | Shrub C Storage (kg) | Total C Storage (kg) |
|---|---|---|---|
| 1 | 0 | 0 | **0** |
| 2 | 0 | 0 | **0** |
| 3.1 | 2 791 045 | 16 569 | **2 807 615** |
| 3.2 | 55 841 669 | 906 483 | **56 748 153** |
| 4 | 1 269 | 46 | **1 314** |
| 5.1 | 7 613 959 | 12 729 | **7 626 688** |
| 5.2 | 3 565 | 0 | **3 565** |
| 5.3 | 5 458 | 135 | **5 594** |
| 6 | 114 597 | 4 925 | **119 522** |
| 7 | 293 713 | 1 735 | **295 448** |
| 8 | 226 645 | 4 149 | **230 794** |
| 9 | 158 570 | 40 409 | **198 979** |

*Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2), again in 2013 has the highest carbon storage, and the trend stays the same with *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* Woodland (5.1), and *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Setaria megaphylla* Woodland (3.1), coming in second and third respectively in storing carbon in 2013 (Table 6.12).

**Table 6.13. The difference in carbon storage of the woody component of each of the 12 plant communities present on Mogale's Gate Biodiversity Centre between 2011 and 2013.**

| Plant community | Average carbon storage (tC/ha) 2011 | Average carbon storage (tC/ha) 2013 | Average difference between 2011 and 2013 (tC/ha) | Average carbon storage per year (tC/ha/yr) |
|---|---|---|---|---|
| 1 | 0 | 0 | **0** | **0** |
| 2 | 0 | 0 | **0** | **0** |
| 3.1 | 73.170 | 75.881 | **2.711** | **1.356** |
| 3.2 | 129.172 | 133.212 | **4.040** | **2.020** |
| 4 | 0.057 | 0.060 | **0.003** | **0.002** |
| 5.1 | 274.553 | 279.366 | **4.813** | **2.406** |
| 5.2 | 0.011 | 0.012 | **0.001** | **0.000** |
| 5.3 | 0.018 | 0.020 | **0.002** | **0.001** |
| 6 | 0.239 | 0.296 | **0.057** | **0.029** |
| 7 | 0.050 | 0.214 | **0.164** | **0.082** |
| 8 | 1.990 | 2.081 | **0.091** | **0.046** |
| 9 | 5.445 | 5.922 | **0.477** | **0.238** |

Even though *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2) has the highest carbon storage, *Sporobolus africanus-Hyparrhenia hirta-*

*Eucalyptus camaldulensis* Woodland (5.1) stores the most carbon per hectare per year (Table 6.13), due to the large older exotic trees and the smaller community size.

**Table 6.14. Carbon storage per hectare per plant community on Mogale's Gate Biodiversity Centre.**

| Plant community | Type of community | Plant community size (ha) | Woody carbon storage (tC/ha/yr) | Grass carbon storage (tC/ha/yr) | Total carbon storage (tC/ha/yr) |
|---|---|---|---|---|---|
| 1 | Wetland | 6.6 | 0 | 0 | **0** |
| 2 | Wetland | 36.3 | 0 | 0.003 | **0.003** |
| 3.1 | Woodland | 37.0 | 1.356 | 0.008 | **1.363** |
| 3.2 | Woodland | 426 | 2.020 | 0.006 | **2.026** |
| 4 | Grassland | 21.8 | 0.002 | 0.003 | **0.005** |
| 5.1 | Woodland | 27.3 | 2.406 | 0.008 | **2.415** |
| 5.2 | Grassland | 298.7 | 0.000 | 0.002 | **0.003** |
| 5.3 | Grassland | 284.4 | 0.001 | 0.004 | **0.005** |
| 6 | Grassland | 403.6 | 0.029 | 0.004 | **0.032** |
| 7 | Grassland | 1 377.6 | 0.082 | 0.006 | **0.089** |
| 8 | Woodland | 110.9 | 0.046 | 0.003 | **0.049** |
| 9 | Grassland | 33.6 | 0.238 | 0.007 | **0.245** |
| TOTAL | | **3063.8** | **0.515** | **0.005** | **0.520** |

According to Table 6.14 the grass component stores 0.005 tC/ha/yr while the woody component stores 0.515 tC/ha/yr. This gives an average of 0.520 tC/ha/yr MGBC.

## Discussion & Conclusion

Forests and wooded areas have received a lot of attention when it comes to carbon storage and sequestration. In southern Africa these studies have been focused more in the Miombo Woodlands and the indigenous forest areas. According to Bunker *et al.* (2005) forests, woodlands, and savannas account for 84% of carbon stored in vegetation worldwide. Grasslands have not received too much attention. Grasslands should however not be forgotten, because even if burnt still play an important role in the carbon cycle as grasslands also play a role in absorbing $CO_2$ out of the atmosphere. The accrual of carbon is as a result of the carbon fixed by photosynthesis less the carbon released by the respiration of the plant (Mills *et al.*, 2003).

Even though plants are absorbing $CO_2$ from the atmosphere they are releasing some back through respiration, and the carbon stored can be released back into the atmosphere through fire. Fires also play an important part in the cycling of carbon back into the atmosphere. Scholes & Walker (1993) has found that the carbon released due to infrequent fires (every 2 – 5 years), is less that the carbon that would be released by decomposition of that same matter. Kuhlbusch *et al.,* (1996) and Scholes (2004) go on to say that fire has a further effect of converting a small amount of carbon into the 'black carbon' pool (also known

as elemental carbon or soot). This form of carbon is effectively removed from the atmosphere forever (Scholes, 2004). Since some ecosystems, especially savannah and grasslands, are reliant on fire this is important to remember, as long as the frequency of the fire is not too high. It has also been discovered that nearly 2 kg of $CO_2$ is released into the atmosphere for every 1kg dry matter burnt, but that an equal amount of $CO_2$ is absorbed back from the atmosphere within a few months when the plant life returns after a burn (Christie, 2010).

The storage of carbon in soil is also important and needs investigation. According to Woodbury (2007) 8% of the world's carbon sequestration takes place in soils and forest floors. Khademi *et al.* (2009) found that 1.42 t C/ha is stored in soil. In fact it is estimated that there is more carbon in the earth's soils than in the atmosphere and all plants combined (Juniper, 2013). No soil samples were taken and measured for carbon on MGBC and this needs further research.

In Northern Ethiopia Cleemput *et al.* (2004) found that the aboveground carbon storage of herbaceous and woody species was estimated at 0.828 tC/ha/yr (converted). In the City of Tshwane Stoffberg *et al.* (2010) found that depending on the combination of trees between 0.008 tC/ha/yr- 0.029 tC/ha/yr (converted), can be stored. Mills *et al.* (2003) found that the carbon storage in restored renosterveld was 40 tC/ha/yr, restored thicket was 95 tC/ha/yr and restored grassland was 11 tC/ha/yr. In Iran the annual $CO_2$ uptake in coppice stands was 5.94 tC/ha/yr (Khademi *et al.,* 2009). Nowack & Crane (2002) give the average annual gross C storage rate for several cities within the United States of America as 3 tC/ha/yr. Engelbrecht *et al.* (2004) give a mean of 0.16 tC/ha/yr for South Africa.

Based on the data in Table 6.14 MGBC stores 0.520 tC/ha/yr this is above the mean for South Africa of Engelbrecht, *et al.* (2004) of 0.16 tC/ha/yr. This means that MGBC stores 1 593.2 tC/yr.

It is important to determine what role plant communities play in carbon storage, as this could provide much needed protection for the natural environment by large corporations, as large corporations could use such areas like MGBC to offset their carbon emissions, which they generate through travel, electricity usage, etc.

The need to obtain accurate and reliable estimates of carbon pools and rates of biomass accumulation in wooded and grassland ecosystems becomes more important, especially as the carbon trading market develops (Tinker *et al.*, 2010). Further research will need to be done to determine more accurate equations for the unique South African habitats and the role grasslands play, however small, should not be underestimated. Further research is also needed in the role soil plays in storing carbon, as this was not covered in this research.

Once again the correct scientific management of the biological diversity of the veld is imperative, as management options that support high biodiversity will maximise carbon storage, since as variability decreases with species richness (Bunker *et al.*, 2005) so does the impact that plants can play in storing carbon decrease.

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# Chapter 7
# Recommendations

*"Civilization has so cluttered this elemental man-earth relationship with gadgets and middlemen that awareness of it is growing dim. We fancy that industry supports us, forgetting what supports industry."*

**Aldo Leopold, A Sand County Almanac**

## Introduction

Humans face their greatest challenge of all time on how to reconcile continued economic development, with the constraints of a reducing natural resource base, and an increasingly degraded environment (Dangana & Tropp, 1995; Van As *et al.,* 2012).

Even though there appears to be a merging of scientific, engineering, political and public awareness and thinking regarding the natural environment, conservation priorities remain hampered by insufficient knowledge and willpower. This leads to the designing of systems that are generally practical in either engineering or economics, but lack in producing the desired outcome when the natural environment is concerned (Warren & French, 2001).

In 1982, the United Nations General Assembly adopted the World Charter for Nature, prepared by UNEP and IUCN (Bjorklund, 1995). The World Charter for Nature has five general principles (Table 7.1). These could be used as a guideline when developing a management plan. These principles provide a framework which ensures that the natural ecosystem and its resources are used in a sustainable manner.

**Table 7.1. The Five General Principles of the United Nations' World Charter for Nature (UN General Assembly, 1982).**

| **World Charter for Nature General Principles.** |
|---|
| 1. Nature shall be respected and its essential processes shall not be impaired. |
| 2. Genetic viability shall not be compromised; the population levels shall be sufficient for their survival and habitats shall be safeguarded. |
| 3. Special protection shall be given to unique areas. |
| 4. Resources utilised by humans shall be managed to achieve and maintain optimum sustainable productivity, but not in such a way as to endanger the integrity of those other ecosystems or species with which they co-exist |
| 5. Nature shall be secured against degradation caused by warfare or other hostile activities. |

There is a growing recognition of the importance of an ecosystems approach when managing natural resources (Boyce & Haney, 1997; Franklin, 2010; Payne & Brant, 1998). According to Franklin (2010), there is a link between human induced climate change and long-term effects on the health of individual animals, and as a result, populations. It is therefore, important to understand ecosystems and their functioning when making wildlife management decisions. A holistic approach is thus, important when developing a management plan for Mogale's Gate Biodiversity Centre (MGBC).

Wildlife management is a scientific process whereby the appropriate management principles and practices are identified, developed, implemented, and thereafter monitored to determine the success of the management plan (Franklin, 2010; Giles, 1978). To be able to develop a management plan and monitor its success the objectives of MGBC are needed. These objectives are:

- To expose and educate people about the importance of the natural environment in their daily lives and why its resources need to be utilised sustainably.
- To maintain the biodiversity of MGBC so that it can sustainably evolve with climate change.
- To ethically and sustainably utilise the natural resources on MGBC, without having a detrimental effect on the species or biodiversity of the centre.
- To produce game that is healthy and productive.

# Biodiversity Management

## Game Management

The diversity of habitats (grasslands, open bushveld, dense bush to forests) on MGBC makes the centre suitable to a wide variety of species (van Rooyen, 2010a). This is also proved by the results of this study with the different types of plant communities identified and described.

To be able to manage the animals found on MGBC, the grazing capacity and stocking rate needs to be known. Dankwerts (1989) describes stocking rate as an area of land that has been allocated to each animal unit in a managed system per year. Bartholomew (1991) defines stocking rate as the number of animals of a particular class, which have been allocated to a unit of land for a specific period of time. Stocking rate is expressed as animal numbers per unit area (LSU/ha), or as land area available for each animal (ha/LSU) (Tainton *et al.,* 1999).

**Table 7.2. Present Game numbers on Mogale's Gate Biodiversity Centre.**

| Maximum LSU game (minus cattle) | | | 535 | |
|---|---|---|---|---|
| **Game type** | **Number** | **LSU Conversion** | **LSU Equivalent** | **% of capacity** |
| **Non-selective grazers** | | | | |
| Buffalo | 0 | 1.00 | 0.0 | 0.0 |
| Hippopotamus | 0 | 0.55 | 0.0 | 0.0 |
| Ostrich | 12 | 3.50 | 3.4 | 0.6 |
| Rhinoceros, White | 4 | 0.41 | 9.8 | 1.8 |
| Zebra, Burchell's | 309 | 1.84 | 167.9 | 31.4 |
| **Total** | **325** | | **181.1** | **33.9** |
| | | | | |
| **Selective grazers** | | | | |
| Blesbok | 543 | 4.97 | 109.3 | 20.4 |
| Gemsbok | 170 | 2.30 | 73.9 | 13.8 |
| Hartebeest, Red | 90 | 2.61 | 34.5 | 6.4 |
| Reedbuck, Common | 12 | 6.14 | 2.0 | 0.4 |
| Oribi | 4 | 15.00 | 0.26 | 0 |
| Sable Antelope | 0 | 1.95 | 0.0 | 0.0 |
| Springbok | 206 | 9.00 | 22.9 | 4.3 |
| Waterbuck | 70 | 2.17 | 32.3 | 6.0 |
| Wildebeest, Black | 350 | 2.69 | 130.1 | 24.3 |
| **Total** | **1441** | | **404.9** | **75.7** |
| | | | | |
| **Mixed grazers** | | | | |
| Eland | 68 | 1.23 | 55.28 | 10.3 |
| Impala | 60 | 6.14 | 9.77 | 1.8 |
| Nyala | 20 | 3.91 | 5.12 | 1.0 |
| Reedbuck, Mountain | 20 | 7.00 | 2.86 | 0.5 |
| Warthog | 25 | 5.62 | 4.45 | 0.8 |
| **Total** | **193** | | **77.5** | **14.5** |
| | | | | |
| **Browsers** | | | | |
| Bushbuck | 10 | 7.62 | 1.31 | 0 |
| Duiker, Grey | 10 | 12.00 | 0.83 | 0 |
| Giraffe | 8 | 0.68 | 11.76 | 2 |
| Klipspringer | 0 | 12.00 | 0.00 | 0 |
| Kudu | 50 | 2.45 | 20.41 | 4 |
| Steenbok | 10 | 15.00 | 0.67 | 0 |
| **Total** | **88** | | **35.0** | **6.5** |
| | | | | |
| **Grand total** | **2047** | | **698.4** | **130.6** |

Stocking rates have an immediate effect on the quality of forage available for herbivores, and as a result this affects the intake of an animal as well as its productivity (Tainton *et al.,* 1999). The negative effects of long-term incorrect stocking rates can include the change of

biological composition to less productive grasses and forbs (Tainton *et al.*, 1999), and a reduction in the vigour of plants that inevitably leads to a reduction in animal productivity (Van Niekerk, *et al.*, 1984). One must however, also take into consideration the economic capacity of MGBC, and how this can influence the structure of the stocking rates. The economic capacity is the extent to which an area can accommodate sustainable use of its resources by making a profit, without overutilising and therefore damaging the natural resources over the long term.

Present numbers of game on MGBC (Table 7.2), after the annual census in February 2012 was obtained from the current management of MGBC. These numbers were used to calculate the Large Stock Unit (LSU) equivalents, and the percentage of the grazing capacity of the area, that these game numbers occupy by using the Graze model (Bredenkamp, 1990; Brown 1997).

The data indicates that MGBC is overstocked by 30% (163.4 LSU). This has been permitted due to the above average rainfall that was experienced over a three year period from 2010 to 2012, but numbers were reduced in 2012 after the census due to expected poorer rainfall. As a result a large scale removal of animals through game capture and various harvesting options took place.

An adaptation from Bothma & van Rooyen (1990) and Bothma, *et al.* (2010) was used to determine the feeding spectrum of game for MGBC, and is presented in Table 7.3. The recommended game numbers, as well as suggested sex ratios and minimum herd sizes based on the feeding spectrum (presented in Table 7.3), are presented in Table 7.4. The four categories as described by Bothma *et al.*, (2010) were used namely: Non-selective grazers, Selective grazers, Mixed grazers, and Browsers. The total percentage capacity was allowed to go to 110% due to the fact that browsers do not utilize the grass and only trample it (Brown, 1997).

**Table 7.3. Feeding spectrum of Game on Mogale's Gate Biodiversity Centre (adapted from Bothma & van Rooyen, 1990 & Bothma *et al.* 2010).**

| Game type | Low selective grazers or roughage and bulk feeders | Highly selective grazers | Mixed feeders | Highly selective browsers, fruits & forbs | Tall grass grazers | Short grass grazers | Area selective | Selective: plant species | Selective: plant parts |
|---|---|---|---|---|---|---|---|---|---|
| **Non-selective grazers** | | | | | | | | | |
| Ostrich | | | ✓ | | | ✓ | | | |
| Rhinoceros, White | ✓ | | | | | ✓ | ✓ | | |
| Zebra, Burchell's | ✓ | | | | ✓ | ✓ | | | ✓ |
| **Selective grazers** | | | | | | | | | |
| Blesbok | | ✓ | | | | ✓ | | | |
| Gemsbok | | ✓ | | | ✓ | ✓ | | | ✓ |
| Hartebeest, Red | | ✓ | | | | ✓ | | | |
| Oribi | | ✓ | | | | ✓ | ✓ | ✓ | ✓ |
| Reedbuck, Common | | ✓ | | | ✓ | | ✓ | ? | |
| Sable Antelope | | ✓ | ✓ | | ✓ | | | ✓ | |
| Springbok | | | ✓ | | | ✓ | | | ✓ |
| Waterbuck | | ✓ | | | ✓ | | ✓ | | |
| Wildebeest, Black | | ✓ | | | | ✓ | ✓ | | |
| **Mixed grazers** | | | | | | | | | |
| Eland | | | ✓ | | | | ✓ | | |
| Impala | | | ✓ | | | ✓ | ✓ | | |
| Reedbuck ,Mountain | | ✓ | ✓ | | ✓ | | ✓ | ? | |
| Nyala | | | ✓ | | | | ✓ | | ✓ |
| Warthog | | | ✓ | | | ✓ | ✓ | | |
| **Browsers** | | | | | | | | | |
| Bushbuck | | | | ✓ | | | ✓ | | ✓ |
| Duiker, Grey | | | | ✓ | | | ✓ | | ✓ |
| Giraffe | | | | ✓ | | | | ✓ | ✓ |
| Kudu | | | | ✓ | | | | | ✓ |
| Steenbok | | | | ✓ | | ✓ | ✓ | ✓ | ✓ |

## Table 7.4. Recommended Game Numbers for Mogale's Gate Biodiversity Centre, along with Sex Ratio and Minimum Herd Size.

| Game type | % of Capacity | LSU Conversion | LSU Equivalent | Number Animals | Sex Ratio | Number Male | Number Female | Minimum Herd Size |
|---|---|---|---|---|---|---|---|---|
| **Non-selective grazers** | | | | | | | | |
| Ostrich | 1.0 | 4 | 5.35 | 19 | 1:1 | 9 | 9 | 6 |
| Rhinoceros, White | 0.0 | 0 | 0.00 | 0 | 1:2 | 0 | 0 | 6 |
| Zebra, Burchell's | 33.0 | 2 | 176.47 | 325 | 3:7 | 97 | 227 | 10 |
| **Total** | **34.0** | | **181.81** | **344** | | | | |
| **Selective grazers** | | | | | | | | |
| Blesbok | 9.0 | 5 | 48.13 | 239 | 3:7 | 72 | 167 | 10 |
| Gemsbok | 0.0 | 2 | 0.00 | 0 | 1:4 | 0 | 0 | 5 |
| Hartebeest, Red | 15.0 | 3 | 80.21 | 209 | 3:5 | 79 | 131 | 8 |
| Oribi | 0.1 | 15 | 0.27 | 4 | 1:1 | 2 | 2 | 6 |
| Reedbuck, Common | 0.5 | 6 | 2.67 | 16 | 3:7 | 5 | 11 | 10 |
| Sable Antelope | 1.0 | 2 | 5.35 | 10 | 3:5 | 4 | 7 | 8 |
| Springbok | 7.5 | 9 | 40.11 | 361 | 1:4 | 72 | 289 | 25 |
| Waterbuck | 6.0 | 2 | 32.09 | 70 | 3:5 | 26 | 44 | 8 |
| Wildebeest, Black | 12.5 | 3 | 66.84 | 180 | 3:5 | 67 | 112 | 8 |
| **Total** | **51.6** | | **275.67** | **1090** | | | | |
| **Mixed grazers** | | | | | | | | |
| Eland | 10.0 | 1 | 53.48 | 66 | 1:3 | 16 | 49 | 12 |
| Impala | 1.5 | 6 | 8.02 | 49 | 1:4 | 10 | 39 | 25 |
| Nyala | 1.0 | 4 | 5.35 | 21 | 3:7 | 6 | 15 | 10 |
| Reedbuck, Mountain | 0.5 | 7 | 2.67 | 19 | 1:3 | 5 | 14 | 8 |
| Warthog | 1.0 | 6 | 5.35 | 30 | 2:3 | 12 | 18 | 10 |
| **Total** | **14.0** | | **74.87** | **185** | | | | |
| **Browsers** | | | | | | | | |
| Bushbuck | 0.5 | 8 | 2.67 | 20 | 1:3 | 5 | 15 | 8 |
| Duiker, Grey | 0.5 | 12 | 2.67 | 32 | 1:1 | 16 | 16 | 4 |
| Giraffe | 3.5 | 1 | 18.72 | 13 | 3:5 | 5 | 8 | 8 |
| Kudu | 5.4 | 2 | 28.88 | 71 | 1:3 | 18 | 53 | 12 |
| Steenbok | 0.5 | 15 | 2.67 | 40 | 1:1 | 20 | 20 | 6 |
| **Total** | **10.4** | | **55.61** | **176** | | | | |
| **Grand total** | **110.0** | | **588.23** | **1 794** | | | | |

### *Non-Selective Grazers*

#### *Ostrich (*Struthio camelus*)*

**Figure 7.1. Ostrich on Mogale's Gate Biodiversity Centre.**

The Ostrich (Figure 7.1) is a very successful, unique, flightless animal and is the largest living terrestrial bird (Olivier & Burger, 2010). It is an arid grassland bird that prefers open, short grasslands (Hockey, *et al.*, 2005; Olivier & Burger, 2010), and is not dependent on water but will drink when available (Olivier & Burger, 2010). Ostrich often occur in pairs, they can however be found in small groups of five to six birds (Hockey, *et al.,* 2005).

It is a mixed feeder and the selection of its food is influenced by the plant species composition of the habitat (Olivier & Burger, 2010). Hockey *et al.* (2005) mentions that they feed on small succulent plants and grasses, which they pull up roots and all and swallow the plant whole. They strip leaves from branches and also feed on flowers, seeds and seed pods (Hockey, *et al.,* 2010).

MGBC falls within the historical distribution of Ostrich and therefore you can find this species on the property. It is recommended that their numbers be increased to 19 birds. This bird

also can act as an additional security measure on the property. Its IUCN conservation status is “least concern” (Birdlife International, 2012).

### *White Rhinoceros (*Ceratotherium simum*)*

**Figure 7.2. Example of a White Rhinoceros in its preferred habitat.**

According to Player & Feely (1960) White Rhinoceros (Figure 7.2) need four basic habitat requirements. These are areas of short grass, which include stands of medium tall *Panicum maximum*, the availability of water for drinking and wallowing, adequate bush cover, and relatively flat terrain. This is confirmed by Pienaar & du Toit (2010) who recommends that White Rhinoceros area an open shrub layer (<2m), abundant grass, permanent water and adequate shade. As can be seen from their habitat preference White Rhinoceros are grazers, cropping grass to within 25-60mm of the ground (Owen-Smith, 1988). White Rhinoceros are water dependant and drink regularly although they can go up to four days without water during the dry season (Skinner & Smithers, 1990).

Owen-Smith (1973) found that the White Rhinoceros grazed on certain grass species in Natal of which the following are present on MGBC: *Themeda triandra*, *Panicum maximum, Urochloa* spp., with *T. triandra* being the most heavily utilized.

Various plant communities on MGBC meet these requirements, however due to the pressure on this species by poaching all of the White Rhinoceros on MGBC were sold and removed in 2012. It is therefore recommended that this species should not be reintroduced at this time. Once these threats are reduced, this species should be returned to MGBC. If reintroduced it is suggested that two bulls and two cows are started with, since according to Skinner & Smithers (1990) they occur in small groups consisting of a single dominant bull, a sub-ordinate bull, cows, and their offspring. This is a ToPS regulated species (Threatened or Protected Species Regulations 2007, Biodiversity Act (Act 10 of 2004)) (South Africa, 2004). Its IUCN conservation status is “near threatened” (Emslie, 2012).

***Burchell’s Zebra (*Equus burchellii*)***

**Figure 7.3. Burchell’s Zebra on Mogale’s Gate Biodiversity Centre.**

These are a savanna plains species, partial to open woodlands, open scrub, and grasslands and are very dependent on water (Bothma *et al*., 2010; Skinner & Chimimba, 2005; Zieger & Cauldwell, 1998). Even though Smuts (1972) found that Burchell’s Zebra (Figure 7.3) are a very adaptable species they do show habitat preferences and as a result they migrate to preferred grazing areas and water supplies when available.

Burchell’s Zebra are predominantly grazers although Smuts (1972) did find that they did browse a little on herbs and fruit. According to Skinner & Chimimba (2005) Burchell’s Zebra

will feed on any grass species, as long as it is short and in the young stages of growth. They prefer *Themeda triandra* and *Cynodon dactylon* (Stewart & Stewart, 1970).

MGBC has more than suitable habitat for Burchell's Zebra and due to the nature of their feeding it is recommended that their numbers be increased to 325 animals, as they will perform the main role of bulk or non-selective grazers, especially after the removal of the White Rhinoceros. Its IUCN conservation status is "least concern" (Hack & Lorenzen, 2008).

### *Selective Grazers*

#### *Blesbok (*Damaliscus dorcas *subsp.* phillipsi*)*

**Figure 7.4. Blesbok, with a white colour variant lamb, on Mogale's Gate Biodiversity Centre.**

Blesbok (Figure 7.4) are historically restricted to the Highveld grasslands where water is available (Bothma, *et al.,* 2010; Skinner & Chimimba, 2005). It is an endemic species to southern Africa. (Skinner & Chimimba, 2005).

They are gregarious, diurnal grazers and are active during the early morning and late evenings. They tend to lie down during the hotter parts of the day (Skinner & Chimimba, 2005).

They are predominantly grazers, although van Zyl (1965) has recorded them browsing on occasion. They move very quickly into burnt areas, even before the new growth starts. Du Plessis (1968) recorded that Blesbok avoid grasses with more than one season's growth and that they prefer the following species also present on MGBC: *Themeda triandra, Eragrostis curvula, Chloromelas* sp., *Setaria nigrirostris* and *E. pseudosclerantha*.

It is recommended that the Blesbok numbers be reduced to 239 animals, and can be reduced even more if the Black Wildebeest numbers are increased for meat production purposes. Its IUCN conservation status is "least concern" (IUCN SSC Antelope Specialist Group, 2008).

### *Gemsbok (*Oryx gazella*)*

**Figure 7.5. Gemsbok on Mogale's Gate Biodiversity Centre.**

Gemsbok (Figure 7.5) are naturally found in open, arid country that includes open grassland, open bushveld, and light open woodland (Skinner & Chimimba, 2005). They are however not indigenous to the area of MGBC. The availability of water is not essential, but is desired (Bothma, *et al.*, 2010).

The gemsbok is a gregarious species that are often found in small herds of 2 to 30 animals, but can be found in herds of up to 300 animals. They occur in mixed herds and males are

territorial, but they are tolerant of other males (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005).

They are selective grazers, but will browse if grass cover is low (Dieckmann, 1980). They have an effective digestive system that breaks down plant material in both the rumen and the hindgut (Hofmann, 1973; Reissig, 1995). Knight (1991), found that their diet consists of 89% grass, 7% browse and 8% dicotyledons in summer and 76% grass, 16% browse, and 8% dicotyledons in winter.

It is recommended that the gemsbok on MGBC be removed as it is an "alien" species to MGBC, even though it makes a great asset to meat production on MGBC and is a pleasant trophy animal for photographers and hunters. Its IUCN conservation status is "least concern" (IUCN SSC Antelope Specialist Group, 2008).

***Red Hartebeest (Alcelaphus buselaphus)***

**Figure 7.6. Red Hartebeest on Mogale's Gate Biodiversity Centre.**

Red Hartebeest (Figure 7.6) are commonly found on open veld and include areas like floodplains and vleis, and to a lesser extent open savanna (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005).

Red Hartebeest are also a gregarious species that occur in small herds of up to 20 individuals, although this can get to 300 according to Smithers (1971) and prefer short grasses (Table 7.3).

They are predominantly grazers, although van Zyl (1965) discovered that they do browse in some occasions. Grass species that form an important part of their diet include the following grasses found on MGBC, *Eragrostis* sp., *Cyndodon dactylon*, *Sporobolus* spp., and *Themeda triandra*, the latter which is a palatable species that is utilised throughout the year (Kok & Opperman, 1975).

On MGBC, there is suitable habitat for Red Hartebeest and it is recommended that their numbers be increased to 209 animals, as they can also provide a good carcass weight (88-100kg (Bothma, *et al.*, 2010)) for meat production. Its IUCN conservation status is "least concern" (IUCN SSC Antelope Specialist Group, 2008).

***Oribi (Ourebia ourebi)***

**Figure 7.7. Oribi ram found on Mogale's Gate Biodiversity Centre.**

Oribi (Figure 7.7) is found in open grasslands, floodplains and vleis, which preferably are in good condition with a combination of short grasses for food and long grasses for protection

(Bothma, *et al.,* 2010; Skinner & Chimimba, 2005; Zieger & Cauldwell, 1998). They require a high proportion of decreaser grass species (Perrin & Everett, 1992; Rowe-Rowe, 1994) and are not dependent on drinking water (Bothma, *et al.,* 2010; Viljoen, 1982).

They are usually solitary animals or found in pairs or small groups consisting of a ram, one or two ewes and their offspring, with the adult pair being the most common grouping (Skinner & Chimimba, 2005).

Oribi are very selective grazers with grass comprising 90% of their diet (Bothma, *et al.,* 2010). Viljoen (1982) lists three grasses that the Oribi prefer, which are found on MGBC, i.e. *Themeda triandra, Monocymbium ceresiiforme* and *Hyparrhenia hirta,* and four species that are used less during the winter months, i.e. *Trachypogon spicatus*, *Tristachya leucothrix, Brachiaria serrata*, and *Diheteropogon amplectens.*

It is recommended that the numbers of Oribi on MGBC are kept at four as this is a highly selective animal. Its IUCN conservation status is "least concern" (IUCN SSC Antelope Specialist Group, 2008). This is a ToPS regulated species and is not an easily seen animal.

***Common Reedbuck (Redunca arundinum)***

**Figure 7.8. Reedbuck ewe on Mogale's Gate Biodiversity Centre.**

The Common Reedbuck (Figure 7.8) is a water dependant species whose habitat requirements are tall grass or reeds near open water, with a woody component nearby (Bothma, *et al.,* 2010; Skinner & Chimimba, 2005; Zieger & Cauldwell, 1998). There are few other species that compete with Common Reedbuck for this type of habitat (Bothma, *et al.,* 2010). Common Reedbuck are however sensitive to overgrazing (Child & Child, 1991).

The common reedbuck is not a gregarious species, and they are usually found singularly or in pairs or family parties of between two or three (Bothma, *et al.,* 2010; Skinner & Chimimba, 2005).

They are almost exclusively grazers, but will browse during the dry winter season (Bothma, *et al.,* 2010; Skinner & Chimimba, 2005). Jungius (1971) has found that the following grasses *Trachypogon spicatus, Panicum maximum, Heteropogon contortus, Leersia hexandra, Imperata cylindrica, Cenchrus ciliaris,* and the reed *Phragmites communis*, that can be found on MGBC, are important in its diet.

Habitat for Common Reedbuck on MGBC is limited to *Schoenoplectus corymbosus-Typha capensis* Wetland (1), *Hemarthria altissima-Arundinella nepalensis* Wetland (2), and *Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus* Grassland (5.3) (See Chapter 3), so it is recommended that their numbers be kept to 16 animals. It should be noted that this is a ToPS regulated species. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

***Sable Antelope (Hippotragus niger)***

**Figure 7.9. Sable Antelope bull on Mogale's Gate Biodiversity Centre.**

Sable Antelope (Figure 7.9) are savanna woodland species (Skinner & Chimimba, 2005) that are dependent on water as well as cover. They prefer medium to tall grasses in open tree veld, with scattered shrubs near vleis (Bothma, *et al.,* 2010; Skinner & Chimimba, 2005; Zieger & Cauldwell, 1998). According to Bothma, *et al.* (2010) Sable Antelope has to drink 9 litres of water a day and therefore will not move too far away from water. They are a sensitive species that may be affected by overgrazing (Child & Child, 1991).

They are a gregarious species, that would usually be found in herds of about 10-30 individuals in size. They have territorial bulls, nursery herds, and bachelor herds. Sable is most active during the early morning and late afternoon, with most members of the herd resting during the heat of the day (Skinner & Chimimba, 2005).

Sable Antelope are mainly grazers with their diets comprising up of 85% grass, 10% browse and fruit, and 5% forbs (Bothma, *et al.,* 2010). They are selective though, with a preference to fresh growth and also select plant parts that are high in crude protein and low in crude fibre (Grobler, 1981). They have been recorded eating the following grass species, *Panicum maximum, Heteropogon contortus, Eragrostis gummiflua*, *Themeda triandra, Hyparrhenia*

*hirta,* and *Urochloa* spp. that can be found on MGBC, of which *P. maximum, H. contortus,* and *T. triandra* are the most abundant (Grobler, 1974; Magome, 1991; Wilson, 1975). The following browse plants found on MGBC are also important *Acacia karroo, Searsia lancea, Dichrostachys cinerea, Ziziphus mucronata; Dombeya rotundifolia; Grewia flava; Lippia javanica,* and *Tarchonanthus camphoratus* (Grobler, 1974; Wilson, 1969).

With the habitat available for Sable Antelope on MGBC, it is recommended that MGBC start with 10 animals. It must be noted that this is a ToPS regulated species. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008). The reintroduction of Sable Antelope to MGBC will be significant as the first species of Sable Antelope was described in the area by Cornwallis Harris in the eighteen hundreds and the area is the type locality for the species (Carruthers, 2000).

***Springbok (Antidorcas marsupialis)***

**Figure 7.10. Springbok on Mogale’s Gate Biodiversity Centre.**

The Springbok (Figure 7.10) is typically a species of the arid and grassland regions of southern Africa (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005). When water is available they will drink, but their habitat requirements are not dependant on water (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005).

They are gregarious, move in small herds in the dryer months, and congregate into larger herds during the wetter months (Skinner & Chimimba, 2005). Males are territorial and will remain permanently in their territories (Jackson *et al.*, 1993; Novellie, 1975).

Springbok are mixed feeders with their diets consisting of 68% browse and 32% grasses and forbs (Bothma, *et al.*, 2010). Van Zyl (1965) determined that 9 grasses and 11 shrubs are the main food plants for springbok, and these include *Themeda triandra, Cynodon* sp.*, Panicum* spp., *Eragrostis* spp.*,* and *Sporobolus* spp., all of which are found on MGBC. Smithers (1971) recorded that the following plants (that are found on MGBC) are also used by Springbok: *Grewia* spp., *Ziziphus mucronata,* and *Solanum* spp.

It is recommended that the number of Springbok on MGBC is increased to 361 as MGBC has prime habitat for the species. The meat of Springbok is also highly sought after (Bothma, *et al.*, 2010), and it would make a valuable addition to the abattoir. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

***Waterbuck (Kobus ellipsiprymnus)***

**Figure 7.11. Waterbuck cows on Mogale’s Gate Biodiversity Centre.**

The waterbuck (Figure 7.11) prefers open savannas with tall grass near surface water, floodplains, or wetlands (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005; Zieger & Cauldwell, 1998), and have a very high water requirement (Taylor, *et al.,* 1969).

They are gregarious and are usually found in small herds of between 6 – 12 animals, though herds of up to 30 animals have been recorded (Skinner & Chimimba, 2005).

Waterbuck are selective grazers, selecting the most abundant species available (Tomlinson, 1980), although its diet can contain up to 16% browse (Bothma, *et al.,* 2010; Skinner & Chimimba, 2005). Grasses commonly grazed include *Brachiara* spp., *Chloris* spp., *Cynodon dactylon*, *Digitaria* spp., *Heteropogon contortus*, *Panicum* spp., and *Themeda triandra* (Skinner & Chimimba, 2005).

It is recommended that the Waterbuck number be kept at 70 animals. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

***Black Wildebeest (Connochaetes gnou)***

**Figure 7.12. Black Wildebeest on Mogale’s Gate Biodiversity Centre.**

Black Wildebeest (Figure 7.12) prefer open grassland plains and is an endemic species of the central plateau open plains of South Africa (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005).

Black Wildebeest are gregarious with territorial males, female and bachelor herds. They are predominantly grazers, although van Zyl (1965) did find that they feed on dwarf karroid shrubs. Black Wildebeest are dependent on water and generally drink during the late afternoon (Skinner & Chimimba, 2005).

The important grasses utilised by Black Wildebeest are *Sporobolus* spp.*, Themeda triandra* and *Cynodon dactylon* (Skinner & Chimimba, 2005).

As indicated in Table 7.3, Black Wildebeest prefer areas with short grass, and are known on MGBC to keep grass short in the areas that they utilize. It is recommended that their numbers be reduced to 180 animals, although this number can be increased if the suggested Blesbok numbers are reduced. Black Wildebeest do provide a heavier carcass weight (50-88kg (Bothma, *et al.,* 2010)) for meat production. It must also be noted that this is a ToPS regulated species. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

### *Mixed Feeders*

#### *Eland (Tragelaphus oryx)*

**Figure 7.13. Eland bull & cow on Mogale's Gate Biodiversity Centre.**

This is the largest of the spiral-horned antelope in South Africa and a very versatile species that can be found in habitats ranging from bushveld to open dry regions (Bothma, *et al.,* 2010; Skinner & Chimimba, 2005; Zieger & Cauldwell, 1998). According to Skinner & Chimimba (2005), this versatility is as a result of the Eland not being dependant on water.

Eland (Figure 7.13) is a gregarious species that is often found in small herds, although herds of over 700 animals have been recorded (Smithers, 1971; Wilson, 1975). There is no territorial behaviour and bulls form bachelor herds during the non-breeding season and mixed herds with the cows during mating season (Bothma *et al.*, 2010; Rowe-Rowe, 1994).

Eland are mixed feeders that feed mainly at night, and their diet consists of 50% browse and fruit, and 50% grasses and forbs (Bothma, *et al.*, 2010). Buys (1987), found that Eland graze during the summer months and browse during the winter months. Scotcher (1982) found that the following woody species present on MGBC, are important in an Eland's diet: *Kiggelaria africana, Heteromorpha arborescens, Halleria lucida, Buddleja salviifolia,* and *Maytenus*

*undata*. The following grasses found on MGBC are also important in their diet: *Harpochloa falx, Themeda triandra,* and *Tristachya leucothrix.*

It is recommended that the Eland numbers are kept at approximately 66 animals as the browse component is limited, especially during winter. This species can contribute significantly to the meat production of MGBC. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

***Impala (Aepyceros melampus)***

**Figure 7.14. Impala ram and ewes on Mogale’s Gate Biodiversity Centre.**

Impala (Figure 7.14) are found in open bushveld often associated with *Acacia* species. Cover and water availability are essential habitat requirements (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005; Zieger & Cauldwell, 1998). According to Child & Child (1991), Impala is a species that can benefit from the degradation of habitats by bush encroachment.

They are a gregarious species that occur in herds of up to 20 animals although they can be found in larger herds during the wet season. The rams are territorial only during the rutting season and otherwise form bachelor herds. Bachelor herds however avoid the breeding herds (Skinner & Chimimba, 2005).

Impala are mixed feeders and during summer 79% to 92% of their diet consists of forbs, and grasses, while in winter their diets changes to include 32% to 67% browse (Bothma, *et al.*, 2010). Important grasses on MGBC that are in their diets include *Digitaria eriantha, Themeda triandra, Cynodon dactylon, Panicum maximum, Eragrostis*, spp.*,* and *Urochloa* spp. (Skinner & Chimimba, 2005). Browse plants on MGBC that play an important role in their diet include: *Combretum* spp., *Grewia*, spp., *Ziziphus* spp., *Gymnosporia* spp., and *Dichrostachys* spp. (Skinner & Chimimba, 2005).

It is recommended that the Impala numbers be maintained at 49 animals. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

### *Nyala (Tragelaphus angasii)*

**Figure 7.15. Nyala Bull on Mogale’s Gate Biodiversity Centre.**

These antelope are often found in the thickets of the dry savanna woodlands (Skinner & Chimimba, 2005). Its habitat preference does however overlap with that of the bushbuck and according to Bothma, *et al.* (2010) Nyala will displace bushbuck in areas where they occur together. Even though the habitat that Nyala often find themselves in contains water, they are not water dependent (Skinner & Chimimba, 2005). They can benefit as a species from the destruction of habitats (Child & Child, 1991).

Nyala (Figure 7.15) is a gregarious species often found in herds of up to 30 animals, although usually smaller groups of 2 to 5 animals occur. They are not territorial and occupy overlapping home ranges (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005).

They are mixed feeders (Hofmann, 1988), and will consume up to 80% grasses during summer, and 90% browse during the dry season (Bothma, *et al.,* 2010). Tello & Van Gelder (1975), have recorded 108 browse species that Nyala will utilize and these include *Acacia spp.,* Strychnos *sp., Ziziphus mucronata* and a variety of legumes, that are found on MGBC. Nyala have also been known to feed on the alien invasive species *Lantana camara* and *Solanum mauritianum* (Skinner & Chimimba, 2005), and could therefore also aid in their distribution.

There is limited habitat available on MGBC (*Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana* Woodland (3), see Chapter 3), for nyala and there is also Bushbuck present on MGBC. It is therefore recommended that the numbers of Nyala be kept low at 21 species as this does make a nice trophy species for photographers and hunters. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

***Mountain Reedbuck (Redunca fulvorufula)***

**Figure 7.16. Mountain Reedbuck ewe and ram on Mogale’s Gate Biodiversity Centre.**

Mountain Reedbuck (Figure 7.16) is found in dry, grass-covered, stoney slopes of hills and mountains, where there is scattered bush and trees. Water availability is essential (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005).

They are often found in small herds of 3-8 animals, and usually take the form of territorial rams, non-territorial rams, female herds with young, and bachelor herds, although they are a semi-social species. They tend to move out of their territories when the vegetation is burnt (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005).

They are mixed feeders, although they prefer to graze even low quality grass species especially in the dry season (Hofmann & Stewart, 1972). Irby (1977), found that *Themeda triandra* and *Hyparrhenia* spp. rank high in their diets.

Mountain Reedbuck on MGBC are limited to *Protea caffra* subsp. *caffra-Melinis nerviglumis* Woodland (8), and the neighbouring parts of *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland (7), on the mountainous areas in the northern part of the property. Since these habitats are limited it is recommended that the Mountain Reedbuck numbers be limited to 19 animals. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

***Warthog (Phacochoerus* africanus)**

**Figure 7.17. Warthog on Mogale's Gate Biodiversity Centre.**

Warthogs (Figure 7.17) prefer open woodland, short grasslands, floodplains, and vleis (Bothma, et al., 2010; Skinner & Chimimba, 2005; Zieger & Cauldwell, 1998). It has been found that even though they are often found in areas with water, it is not a habitat requirement and in fact they have been found in areas where water is only seasonally available (Bigourdan, 1948; Smithers, 1971).

Warthogs are mostly mixed feeders, feeding on grasses, herbaceous plants, roots and bulbs (Bothma, et al., 2010). They are partial to freshly sprouted grasses after a burn, as well as the rhizomes of grasses (Skinner & Chimimba, 2005). Mason (1982) recorded that they graze on *Urochloa* spp., *Panicum maximum*, *Chloris virgata*, *Sporobolus*, spp. and *Cynodon dactylon*, which are present on MGBC. They are also known to eat fruit, strip bark from trees and shrubs (Cumming, 1975) and eat carrion (Wilson, 1975).

Various plant communities (Sporobolus africanus-Hyparrhenia hirta-Cynodon dactylon Grassland (5.2), Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus Grassland (5.3), Seriphium plumosum-Alloteropsis semialata subsp. eckloniana Grassland (6), and Setaria sphacelata var. sphacelata-Themeda triandra Grassland (7)) on MGBC suit the Warthog and

it is therefore recommended, that the numbers of the Warthog are allowed to go up to 30 animals. Excess animals may contribute to the meat production of the rural abattoir. Its IUCN conservation status is “least concern” (d’Huart, et al., 2011).

### *Browsers*

#### *Bushbuck (Tragelaphus scriptus)*

**Figure 7.18. Bushbuck ram on Mogale’s Gate Biodiversity Centre.**

Bushbuck (Figure 7.18) are found in riparian thickets dense shrub or other types of underbrush, which is always near a permanent water supply (Bothma *et al.,* 2010; Skinner and Chimimba, 2005; Zieger & Cauldwell, 1998).

They are not territorial and groups tend to avoid each other rather than have a territorial display. They are often found in pairs or up to three animals, but never occur in large groups (Bothma, *et al.,* 2010; Skinner & Chimimba, 2005).

Bushbuck are browsers that feed on succulent food, leaves, growing tips, flowers and fruit of a variety of trees and shrubs, Grass and forbs makes up about 10% of their diet (Bothma, *et al.,* 2010). Simpson (1974) has listed over 40 species and Jacobsen (1974) 104 species of

browse plants eaten by bushbuck, with *Acacia* spp., *Combretum* spp., *Ficus* sp., *Ziziphus mucronata and Phyllanthus* spp. present on MGBC.

*Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana* Woodland (3) is best suited for Bushbuck. It is however a small community and it is therefore recommended that the numbers of Bushbuck are maintained at 12 animals. It makes a nice trophy animal for photographers and hunters and its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

***Grey Duiker (Sylvicapra grimmia)***

**Figure 7.19. Grey Duiker on Mogale’s Gate Biodiversity Centre.**

Grey Duiker (Figure 7.19) prefers habitats that have thickets, shade, and shelter. The presence of bushes is an essential requirement, as they provide the Grey Duiker with its food (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005; Zieger & Cauldwell, 1998). It is a species that is independent of surface water (Bothma, *et al.*, 2010).

They are normally solitary, but male/female pairs are sometimes found together (Skinner & Chimimba, 2005). Generally though, each male and female has its own territory (Bothma, *et*

*al.* 2010). They are mainly active late afternoon and into the evening (Skinner & Chimimba, 2005).

Grey Duiker are browsers with grass and forbs only making up 10% of their diet (Bothma, *et al.,* 2010). They have extensive tastes with Wilson (1966) listing the leaves of 45 plant species, the fruit and seed of 33 species and the flowers of 15 species.

This is a naturally occurring species on MGBC and has never been introduced. It is recommended that their numbers be allowed to increase to 32 individuals. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

***Giraffe (Giraffa camelopardalis)***

**Figure 7.20. Giraffe on Mogale’s Gate Biodiversity Centre.**

Giraffe (Figure 7.20) occur in dry open bushveld (Bothma & van Rooyen, 1990; Zieger & Cauldwell, 1998), associated with their particular range of food plants (Skinner & Chimimba, 2005). Giraffe are not dependent on water as they can get their moisture from their food plants (Skinner & Chimimba, 2005).

They are predominantly browsers, utilizing a wide variety of food plants, but have been known to graze on fresh sprouting palatable grasses (Skinner & Chimimba, 2005). Although *Acacia caffra* and *A. karroo* are important components of their diet (Sauer *et al.*, 1982) they also feed on other *Acacia* species and also on *Combretum* spp. and *Ziziphus* spp. (Hall-

Martin, 1974) *Euclea* spp., *Gymnosporia* spp. and *Diospyros* spp. during drier months (Skinner & Smithers, 1990).

MGBC has limited habitat available for Giraffe (*Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2) and the rocky outcrops found in plant community 7). As a result a limited number of Giraffe can be kept on MGBC. It is recommended that MGBC has reached its carrying capacity of Giraffe and therefore numbers should remain below 10 individuals. Its IUCN conservation status is "least concern" (Fennessy & Brown, 2010).

***Kudu (Tragelaphus strepsiceros)***

**Figure 7.21. Kudu bull on Mogale's Gate Biodiversity Centre.**

Kudu (Figure 7.21) are found in open to dense savannas, broken veld, and rocky terrain (Bothma, *et al.*, 2010; Skinner & Chimimba, 2005; Zieger & Cauldwell, 1998). They require sufficient woodland for protection and food and are water dependant, needing permanent water supply (Bothma, *et al.*, 2010). Bush encroachment can benefit Kudu according to Child & Child (1991).

They are gregarious, but herd sizes are generally small, hardly ever exceeding 14 individuals, more commonly 6-8 individuals (Skinner & Chimimba, 2005).

Kudu are predominantly browsers and rarely eat grass, and utilise a great variety of browse plants, more than any other bovid (Skinner & Chimimba, 2005). Brynard & Pienaar (1960) list 148 species of plants eaten by the Kudu. They prefer leaves and shoots, and have been known to eat seed pods of some *Acacia* species. Some of the species that they browse on include *Dichrostachys cinerea, Combretum* spp., *Grewia* spp., *Ochna pulchra, Strychnos* spp., and *Aloe* spp. (Owen-Smith & Cooper, 1989; Skinner & Chimimba, 2005), which can be found on MGBC.

Due to the limited amount of woodland savannas available on MGBC (mainly *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana* Woodland (3)), it is recommended that the numbers of Kudu should not exceed 66 animals. This animal provides a high carcass weight (86-172 kg (Bothma, *et al.*, 2010)) and the excess animals could therefore be used for meat production. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

### *Steenbok (Raphicerus campestris)*

The Steenbok is found in open plains, undulating grasslands with short to medium-tall grass and scattered trees and shrubs for cover. They are not a water dependant species (Bothma, *et al*., 2010; Skinner & Chimimba, 2005).

They are territorial animals that are normally found alone, unless it is breeding season, where you will find pairs or a ewe and her lamb. If they are in an area with high human activity they become nocturnal, otherwise will normally be active during the early morning or late afternoon (Skinner & Chimimba, 2005).

Bothma, *et al*. (2010) classifies the Steenbok as a browser. Steenbok have the ability, however, to live exclusively on forbs and this ability allows it to occupy areas that are marginal for other herbivores (Bothma, *et al.*, 2010). The forb consumption is related to forb availability. Grass in only utilized in summer when fresh shoots are produced (Skinner & Chimimba, 2005). Huntley (1972) found that they dig for bulbs and make use of remaining portions of bulbs and tubers left in the excavations of porcupines.

It is recommended that the Steenbok population is maintained at 12 animals. Its IUCN conservation status is “least concern” (IUCN SSC Antelope Specialist Group, 2008).

## *Monitoring of Game*

Zieger & Cauldwell (1998) are of the opinion that animals should be monitored on a regular basis, so that if there are any problems with the population or an individual, they can be detected early and rectified as soon as possible. According to Bothma (2010a), counting of game is the cornerstone of effective wildlife management. Van Rooyen (2010a) states that a

monitoring program serves as an early warning system. It is therefore possible to detect changes or possible trends as a result of management practices early enough to implement adaptive strategies if needed. Early detection of an issue can also lead to the prevention of possible loss to the population or even revenue.

Numerous techniques are available to monitor game and these include, *inter alia*, Drive counts, Road strip counts, Field strip counts, Known group or individuals counts, ratio methods, Aerial counts and camera trap counts. Each technique has its own set of advantages and disadvantages. Any or even a combination of these techniques can be used to count game. Different techniques may have to be used for different species, especially considering the size of MGBC, terrain of MGBC, vegetation make up of MGBC as well as the distribution of game on MGBC.

It is recommended that game counts should be done bi-annually on MGBC - in February to determine the number of new born animals and in August to determine trends in population change. August is also a suitable month to count the bush animals as most of the trees would have thinned out by losing their leaves during winter. These counts are important as they will provide the management of MGBC accurate information that can be used to justify certain management decisions with their directors and auditors.

It is also recommended that when game drives are done that the ranger involved with the drive, makes notes on species seen and maps the species as well. This can also be done with trophy sized antelope as well as injured or sick animals. Both van Rooyen (2010a) and Zieger & Cauldwell (1998) recommend that the following items be captured when doing the game drive monitoring:

- Game species,
- Number of individuals,
- Habitat preference (location),
- Herd sex ratios, where possible, and
- Age ratios, where possible.

### *Removal of Game*

To ensure that the vegetation component is not damaged, game numbers need to be controlled. Once the desired numbers of each species have been reached, excess game will have to be removed to safeguard the health and productivity of the game population. In the past there were a number of natural controlling mechanisms in place, which would control the game numbers, including *inter alia*, predators, diseases, droughts, fires, and food shortages (Bothma, 2010b). On any enclosed system like game farms and nature reserves, many of these mechanisms are now controlled or even prevented, and thus management practices have to be put in place to control game numbers.

There are two main options available namely, the cropping or harvesting of game and the live capture of game.

### *Cropping/Harvesting of Game*

According to Zieger & Cauldwell (1998) a number of factors need to be known to determine the annual harvest quota for a species. These include the current population size, and the minimum number of animals that need to remain at the end of the harvesting. The minimum numbers safeguard the viability of the population. Once these are known the number of male and female, as well as, the various ages of the animals that need to be removed can be determined (Bothma, 2010b).

Bothma (2010b) gives the requirements of an ideal harvesting system as:

- Harvesting should not negatively affect the population structure, thereby preventing a positive population growth.
- A harvesting system should cause minimal disturbance with regards to behaviour of the animals and their reproductive ability.
- The system needs to be flexible and adaptable to a varying number of species.
- Harvesting should be done economically and in as short a time as possible.
- The end products should be of a high standard, especially if using meat production as a tool.
- Facilities needed for the system should be economically justifiable.
- It must be effective over all plant community types.
- The system should eliminate the number of injured or wounded animals.
- A harvesting system should be designed on a scientific basis and planned on reliable repeatable data.
- The spread of disease and parasites must be prevented.
- The harvesting system must be ethical and aesthetically acceptable.

Child & Child (1991) believe that to be able to sustainably harvest from a wild population, the biological capacity of the population must be understood. This is important since it governs the ability of the population to recover itself, and this in turn governs what can be removed.

Cropping or harvesting of animals off MGBC is a necessity, as MGBC has reached its carrying capacity. Removal is the most economical option available on MGBC, although it does put pressure on certain species during the breeding season. The most important aspect to consider at all times, with the use of this management tool is reputational risk and must therefore be performed ethically with minimal disturbance to the different populations.

The ultimate system for MGBC is to use trophy hunting and meat production to its benefit. Even under the current economic climate there is still a demand for healthy meat products that can be to the benefit of MGBC. Trophy hunting goes through its various cycles, but should be kept as an option for MGBC, when necessary.

### *Game Capture*

The second option available to remove game is the live sale of animals and their capture. Costs are however a consideration that needs to be taken into account when organising a game capture. Various techniques are available for use, but generally a specialised team is used (le Grange, *et al.*, 2010). The most commonly used techniques suited to MGBC are the use of mass capture bomas (Figure 7.22) and chemical capture.

Game capture is an effective way to remove large numbers of animals over a short period of time and reduce the overall stress on the animal populations. The disadvantage of game capture is however, that generally young productive animals could be captured, which leaves behind the older animals that can negatively affect the population. Financially this is not as profitable as harvesting, but is less stressful for the population in general.

**Figure 7.22. Game capture of Burchell's Zebra on Mogale's Gate Biodiversity Centre using a mass capture boma.**

## Vegetation Management

### *Monitoring*

High stocking density will result in overgrazing and could cause large scale irreparable damage to the grass sward. Overgrazing will reduce the quantity of more palatable species, in favour of more grazing resistant and unpalatable species (Ausden & Treweek, 2000).

There are however, other sources that influence the species composition of vegetation. These can include climate change as well as various management practices. A monitoring program serves as an early warning system of possible changes to vegetation (van Rooyen, 2010a). That is why a monitoring program is needed to detect these changes in species composition and veld condition of the different plant communities over time.

Van Rooyen (2010a) recommends that the following aspects need to be monitored on a regular basis:

- Veld condition.
- Biomass of grass.
- Carrying capacity.
- Effects of water provision.
- Bush encroachment and its control.
- Veld reclamation and soil erosion control measures.
- Game numbers, growth (including natality), distribution, and herd composition.

It is recommended that fixed monitoring points be set up in each plant community identified in this study and that it is selectively monitored on a 7-year cycle at the end of the growing season. This time period is recommended due to time constrains and to determine over time if there is any change in species composition. From these fixed point, it is also recommended that annually photographs are taken, as by taking photographs over a regular basis at regular intervals, a visual record of the plant community can be established. It is also possible then to determine over time, if bush densification is occuring. Disk pasture meter readings and the step-point method are also recommended annually (minimum two years) at these fixed to determine the biomass of the grass as well as to determine the effects of the burning program on MGBC. The step-point results can then be used to adjust the stocking rate accordingly.

There have been suggestions that habitats be modified for a specific species. Habitat modification may proof to be temporarily beneficial. This however changes the faunal composition and in the long term induces changes to the vegetation that tend to be unstable (Child, & Child, 1991). Warren (2001) believes that habitat diversity is by far the strongest influence on ecological patterns. It is recommended that habitat modification is not an option for MGBC.

### *Bush Encroachment*

Bush encroachment has a very important effect on biodiversity and in South Africa it affects between ten to twenty million hectares of land (Ward, 2005). Smit (2004) states that there are two processes that increase woody plant numbers, i.e. vegetative growth or reproduction. There are however a number of factors that can influence the rate of

abundance, either positively or negatively. These factors are diverse and complex (Smit, *et al.*, 1999), but are generally affected by climate, soil fire and the impacts of herbivores (Teague & Smit, 1992). Generally then when the grass layer is reduced due to a disturbance, for example, overutilization, then the tree seedlings stand an increased chance of survival due to the lack of competition from the grasses and the reduced likelihood of a fire. Although the presence of older, bigger trees also plays an important role in the suppression of tree seedlings (Smit, 2004). The removal of repeated fires or feeding by herbivores can also increase the number of trees (Scholes & Archer, 1997). Once the tree seedlings are fully established, bush encroachment/densification can occur (Wiegand, *et al.*, 2006).

Smit (2004) and Van Rooyen (2010a & b) give the possible causes of bush encroachment. This list has been expanded to show each cause's relevance to MGBC. (Table 7.5)

Bush encroachment/densification leads to an increase in the density of the woody plant cover to the detriment of the grass layer, thereby reducing the potential grazing capacity of an area (Thurow, 2000; Van Rooyen, 2010b). This also leads to a change in species composition. Surface run-off and as a result soil erosion could increase due to the lack of grasses slowing the movement of run-off water, while organic material is also washed away (Thurow, 2000; Van Rooyen, 2010b). The soil nutrient status and organic material in the soil is then negatively affected (Thurow, 2000; Van Rooyen, 2010b). Palatable grasses are replaced by less palatable grasses and due to the increasing density of the woody plants, less browse is available for browsers to feed on (van Rooyen, 2010b; Ward. 2005).

Van Rooyen (2010a) states that a bush density of less than 400 tall shrubs per hectare represents a healthy balance between the woody and grass component. Brown (1997) found that at Borakalalo Nature Reserve this was 1 800 ind/ha and Orban (1995) found for Lionspruit Game Reserve between 1 500 and 1 700 ind/ha. Roques et al. (2001), found that in the dryland savannas of Ethiopia the borderline between bush encroachment and natural vegetation was 2 400 woody plants/ha.

**Table 7.5. Causes of bush encroachment and its relevance to Mogale's Gate Biodiversity Centre.**

| Causes of Bush Encroachment | Relevance to MGBC |
|---|---|
| **Changing rainfall patterns.** | Monitoring essential for MGBC. |
| **Poor grazing practices, e.g. sustained heavy overgrazing, with lack of rest periods.** | Only evident on MGBC in the old lands of plant community 5.2 where *Digitaria eriantha* is dominant. |
| **Weakened grass stratums as a result of drought or plague, which are unable to burn and thus control woody plants.** | Not evident on MGBC. |
| **Misuse of burning, e.g. burning to frequently or at the incorrect time of the year.** | Not evident on MGBC as there is an existing fire program where the veld is burnt depending on the condition of the vegetation and rainfall. Fire frequencies are low and variable. |
| **Absence of fires.** | Not evident on MGBC as there is an existing fire program. |
| **Absence of browsers.** | Browsers present on MGBC. |
| **Absence of migration.** | Most of the grassland species migrate to newly burnt blocks on MGBC. |
| **Absence of animals that cause damage to trees, e.g. Porcupines.** | Not relevant as there are Porcupines, Eland and Kudu on MGBC that damage the woody plants. |
| **Incorrect positioning of waterholes.** | On MGBC there are five earth dams, three weirs, six reservoirs, seasonal pools, and the drainage lines of the Hekpoortspruit. On the southern sections of MGBC, water tends to be seasonal, except in the reservoirs, but these are fairly evenly distributed across MGBC. In the northern section water is more permanent, in the drainage lines.<br>This is something that needs to be monitored to see if encroachment/densification is taking place. |
| **Incorrect positioning of lick sites.** | 15 Lick sites are distributed on MGBC. Lick sites should not be put in preferred areas, but in underutilised areas to lessen the grazing pressure.<br>This is something that needs to be monitored to see if encroachment/densification is taking place. |
| **Seed dispersal of woody plants by browsing herbivores.** | As this has not been monitored no comment can be made and further research in this regard is needed. |

Even though these studies were done in bushveld areas the same trends can be noted for MGBC. On MGBC, the mean woody plant density in all plant communities is less than the highest example listed, except for the plant community, *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2). It is however more of a woodland and riverine forest and would be expected to have a higher woody plant density.

Bush encroachment therefore does not seem to be an issue on MGBC, but regular monitoring is recommended.

### *Fire Management and Controlled Burning*

Fire is a natural phenomenon in the grassland and savanna areas (Tainton & Mentis, 1984; Trollope, 1984; Van Oudtshoorn, 2012; Van Rooyen, 2010b) and one of the main factors influencing the ignition of fires (excluding man) is lightning (Edwards, 1984).

Fire is a determining factor in the dynamics of most of the terrestrial ecosystems (van Wilgen & Scholes, 1997). The presence of fires is however dependent on a number of different factors such as enough fuel and suitable climatic conditions (van Wilgen & Scholes, 1997). Grazing competes with fire for the available grass fuel and may prevent fires in some areas due to a lack of fuel (van Wilgen & Scholes, 1997).

Fire is therefore regarded as an important management tool in natural areas (Edwards, 1984; Tainton *et al.,* 1999). According to Van Rooyen (2010b) fire acts at a landscape level and is a disturbance agent for creating diversity in time and space. The absence of fires may result in bush encroachment (Van Rooyen, 2010b). The misuse of fires can however lead to an increase in exposed soil, which can also lead to bush encroachment and accelerated soil erosion with resultant poorer infiltration of rainfall into the soil (Child, 1987).

Thus the primary uses of fire as a management tool are to (Teie, 2003; Van Rooyen, 2010b):

- Provide nourishing grazing by the removal of old unpalatable moribund material.
- Manage bush encroachment, especially of those woody plants that reduce the productivity of the grass layer.
- Stimulate grazing pressure in underutilized areas.

The National Veld and Forest Fire Act (No 101 of 1998) (South Africa, 1998) places the responsibility on owner/s of a property to prepare and maintain firebreaks along their boundaries to prevent the spread of runaway veld fires. The act also stipulates that neighbours as well as the Fire Protection Association (FPA) for the area should be notified when burning is planned (South Africa, 1998). MGBC is a member of the Orient-Weltevrede FPA and falls under the constitutional requirements of the FPA as a member. MGBC also receives a daily Fire Danger Index (FDI) rating. All burning decisions are based on the FDI

rating: if the ratings are Blue, Green, or Yellow then burning is permitted on MGBC. If the FDI rating is Orange or Red then burning is not permitted on MGBC.

### ***Ecological Effects of Fire***

Fires play an important role in the natural vegetation of the grassland and savanna biome, be it positive or negative. Listed below are a few of the effects that fires can have:

- Fires do not significantly affect the release of carbon dioxide ($CO_2$) into the atmosphere nor does it significantly affect soil respiration. However, if moisture is added there is a marked increase in $CO_2$ emissions over a very short period of time (Levine, *et al*., 1997)
- According to Tainton & Mentis (1984) the quality of grazing improves over the long term in fire climax grasslands but if the vegetation is allowed to advance beyond the fire climax stage, productivity decreases.
- Some geophytes depend on regular fire for their survival (Tainton & Mentis, 1984).
- The exclusion of fire in grasslands and savanna could result in these areas becoming scrub or forests (Tainton & Mentis, 1984: Trollope, 1984). Ausden & Treweek (2000) believe that humans have played a very important role in the distribution of grasslands and that grasslands would largely have been restricted to areas where woody plants could not grow, before the influence of fire from people.
- There is increased water run-off in burnt areas immediately after a fire before the grass component has had a change to recover (Child, 1987; Tainton & Mentis, 1984; Trollope, 1984).

### ***Recommendations***

It is recommended that MGBC continue with its firebreak policy to prevent run-away fires from entering the property during the dry winter months. It is also recommended that MGBC continue with its block burning program (Figure 7.23), where burning takes place only after the first significant rains (>20mm in a 24 hour period) and when the FDI rating is blue, green or yellow. Burning should take place during the early evening into the night when the wind is more stable and at a lower intensity. This will lead to a less intense fire (cool fire).

**Figure 7.23. Block being burnt on Mogale's Gate Biodiversity Centre.**

It is very important that the climatic conditions are known before blocks are burnt (Teie, 2003). If a storm comes through when burning a large block, it could become difficult to control the fire and a larger area than planned could be burnt.

It is recommended that lightning fires should be controlled as soon as possible to prevent them from spreading unless they occur in a block scheduled for a burn. In such a case it should be contained within the block.

It is recommended that there be 3 to 4 year rest period between a block being burnt again on MGBC. If there is a high increase in biomass production in a block to more than 4 000 kg DM/ha the block could be considered for an earlier burn.

To relieve the grazing pressure on newly burnt areas, it is recommended that large areas are burnt. This will prevent concentration of animals on a small burnt area that could cause trampling and erosion (van Oudtshoorn, 2012; Van Rooyen, 2010b).

Seven burning blocks are recommended for MGBC (Figure 7.24). The distribution of the blocks is based on the existing annual firebreaks, the road network, and how practical it is to burn the block due to the lack of accessibility of the terrain. The northern-most block over the

mountain is the most difficult block to burn due to the terrain and lack of accessibility, it is recommended that this block be burnt when outside runaway fires have been controlled along the boundary of MGBC, as it is then safe to burn this block.

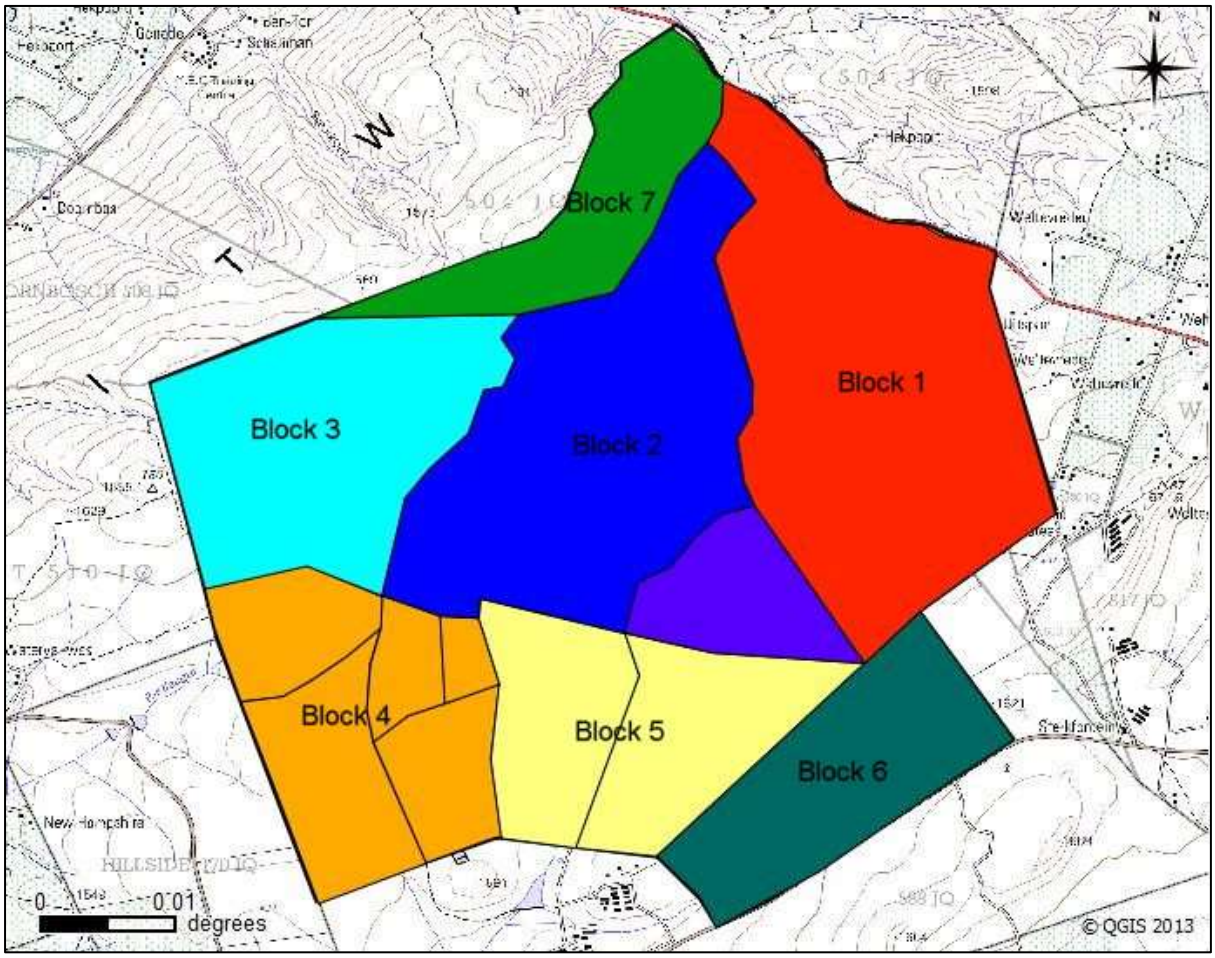


**Figure 7.24. Recommended blocks for burning on Mogale's Gate Biodiversity Centre along with the various plant communities.**

### *Invasive Alien Control*

Natural ecosystems are being put under increased pressure due to invasive alien species (Richardson & van Wilgen, 2004). An invasive species is any species that spreads outside of its natural range, threatens other ecosystems, habitats or even the survival of other species, and may also threaten economic and/or environmental wellbeing (Bromilow, 1995; Henderson, 2001; Joubert, 2009). Alien plants alter the functionality of ecosystems and thus the productivity of an ecosystem (Henderson, 2001). After direct habitat destruction, biological invasion poses the largest global threat to biodiversity (Richardson & van Wilgen, 2004; Walker & Steffen, 1999; Wilcove, *et al.*, 1998).

Not all alien plants found on MGBC are declared invasive species. Some alien plants were deliberately planted by pervious farmers, for example the *Eucalyptus* trees that were planted

as windbreaks in *Sporobolus africanus-Hyparrhenia hirta-Eucalyptus camaldulensis* Woodland (5.1).

A total of 68 alien plants have been identified on MGBC, of these 20 are declared invaders according to the Conservation of Agricultural Resources Act No 43 of 1983 (CARA) (South Africa, 1983).

The various invasive plants found on MGBC are listed in Table 7.6 and are categorised according to CARA (South Africa, 1983). While the remaining alien plants found on MGBC are listed in Table 7.7.

**Table 7.6. Invasive alien plants on Mogale's Gate Biodiversity Centre based on the Conservation of Agricultural Resources Act 43 of 1983 (South Africa, 1983).**

| Category 1 | Category 2 | Category 3 |
|---|---|---|
| *Ageratum conyzoides*<br>*Campuloclinium macrocephalum*<br>*Cirsium vulgare*<br>*Cortaderia selloana*<br>*Datura ferox*<br>*Datura stramonium*<br>*Lantana camara*<br>*Opuntia ficus-indica*<br>*Rubus cuneifolius*<br>*Solanum elaeagnifolium*<br>*Solanum mauritianum*<br>*Solanum seaforthianum*<br>*Solanum sisymbrifolium* | *Acacia mearnsii*<br>*Eucalyptus spp.*<br>*Populus x canescens* | *Melia azedarach*<br>*Phytolacca dioica*<br>*Pyracantha angustifolia*<br>*Pinus* spp. |

The control of the category 1 plants (Table 7.6) is compulsory under CARA (South Africa, 1983) and special attention needs to be focused on *Campuloclinium macrocephalum* as this is a very invasive plant that is currently destroying the grasslands in South Africa (McConnachie, *et al.*, 2011). Henderson, *et al.* (2003) classifies *C. macrocephalum* as one of the most important invaders in the Grassland Biome. *Solanum pseudocapsicum* also needs attention. Even though is it currently not a declared invasive plant, it is taking over the drainage lines on MGBC where it is displacing the natural vegetation. Most of the remaining category 1 plants are not common on MGBC, but should be controlled before they become a problem.

**Table 7.7. Uncategorised alien plants found on Mogale's Gate Biodiversity Centre.**

| | |
|---|---|
| *Achyranthus aspera* var. *aspera* | *Nasturtium officinale* |
| *Agrimonia procera* | *Nothoscordum borbonicum* |
| *Agrostis montevidensis* | *Oenothera rosea* |
| *Amaranthus hybridus* subsp. *hybridus* var. *hybridus* | *Oenothera tetraptera* |
| *Arundo donax* | *Oxalis corniculata* |
| *Bidens bipinnata* | *Paspalum dilatatum* |
| *Bidens pilosa* | *Paspalum urvillei* |
| *Bromus catharticus* | *Pennisetum clandestinum* |
| *Chenopodium album* | *Persicaria lapathifolia* |
| *Chenopodium carinatum* | *Physalis viscosa* |
| *Conyza albida* | *Phytolacca octandra* |
| *Conyza bonariensis* | *Poa annua* |
| *Cortaderia jubata* | *Richardia brasiliensis* |
| *Cosmos bipinnatus* | *Rumex crispus* |
| *Crepis hypochaeridea* | *Schkuhria pinnata* |
| *Cuscuta campestris* | *Solanum nigrum* |
| *Cyperus rotundus* subsp. *rotundus* | *Solanum pseudocapsicum* |
| *Duchesnea indica* | *Sonchus oleraceus* |
| *Galinsoga parviflora* | *Tagetes minuta* |
| *Gomphrena celosioides* | *Tolpis capensis* |
| *Guilleminea densa* | *Tragopogon dubius* |
| *Ipomoea purpurea* | *Verbena bonariensis* |
| *Medicago sativa* | *Verbena brasiliensis* |
| *Mirabilis jalapa* | *Zinnia peruviana* |

The control of the category 1 plants (Table 7.6) is compulsory under CARA (South Africa, 1983) and special attention needs to be focused on *Campuloclinium macrocephalum* as this is a very invasive plant that is currently destroying the grasslands in South Africa (McConnachie, *et al.*, 2011). Henderson, *et al.* (2003) classifies *C. macrocephalum* as one of the most important invaders in the Grassland Biome. *Solanum pseudocapsicum* also needs attention. Even though is it currently not a declared invasive plant, it is taking over the drainage lines on MGBC where it is displacing the natural vegetation. Most of the remaining category 1 plants are not common on MGBC, but should be controlled before they become a problem.

The category 2 trees found on MGBC are localised and restricted to planted stands. These stands need to be controlled under CARA (South Africa, 1983), however these plants provide a value woodlot for MGBC, and should be used as such. It is recommended that a permit is obtained to keep these species, but to prevent their spread into adjacent areas.

# Infrastructure Management

## Roads

According to Du Toit & van Rooyen, (2010) “A road is a disturbance to the natural environment”. It is therefore important to take into consideration the natural environment, as well as, what the objective of a road is before one is made.

There are three types of roads that MGBC has in place, they are:

- Tourist Roads – the objective of these roads are to provide MGBC’s clients the opportunity to view and experience the wildlife, scenery and other natural resources (Du Toit & Van Rooyen, 2010).
- Firebreak Roads – the aim of these roads are to provide MGBC with already in place annual firebreaks, which can be used as starting points for wider firebreaks. A firebreak road may also serve as a tourist road.
- Hunting Roads – the goal of these roads are to provide as little disturbance to the vegetation as possible, but still providing easy access to areas for the collection of harvested animals.

Roads have a number of impacts on the environment, they include according to Du Toit and Van Rooyen (2010):

- They damage trees and affect the habitat of small animals.
- They may create erosion problems, if poorly planned.
- They provide escape routes for animals during fires.
- They are used by animals as routes between grazing areas and watering points.
- Certain bird and game species will use the road at night to sleep on for protection or warmth.
- Culverts and storm water drains serve as burrows for warthogs and jackals.
- Pioneer plants attract Hares and Steenbok alongside the road.
- Snakes use the road to bask in the sun.
- Ground nesting birds generally nest next to roads for protection.
- Thickets that develop next to the roads due to the excessive runoff can become too thick for the animals to move through and for the tourism to see through.

Most of the main tourist roads on MGBC are not wider than 8m, and therefore according to Du Toit & Van Rooyen (2010), they cannot serve as firebreak roads. They are however used on MGBC as a starting point for a wider firebreak. There is an extensive road network on MGBC (Figure 7.25), and it is not recommended that additional roads be added.

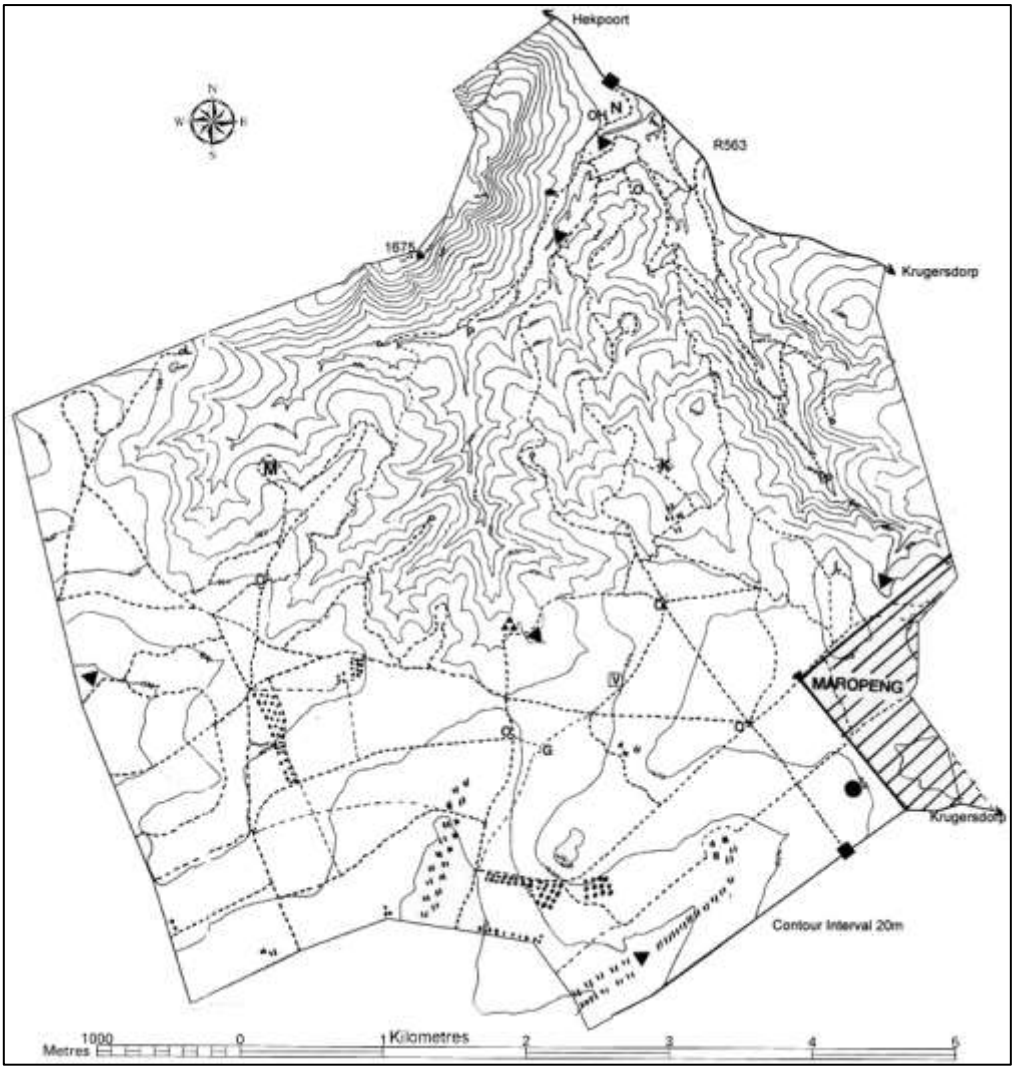


**Figure 7.25. A map of Mogale's Gate Biodiversity Centre indicating the road network.**

## Tourism/Clients

MGBC caters for its corporate clients, and is as such not a true tourism destination. It has however, made use of some facilities to make the clients stay on MGBC as memorable, and educational as possible.

MGBC has an incredibly scenic beauty with the undulating grassland plains on the southern section of the property and the valley and mountain on the northern parts. As a result of the scenic beauty and to support the clients and directors of MGBC various look-out points (marked as L in Figure 7.25) have been set-up on MGBC. A hide at the vulture restaurant (marked V in Figure 7.25) has also been set up, where clients often get the opportunity to observe Cape Vultures, Black-backed Jackal (Figure 7.26) and Brown Hyena feed. This hide also provides a very important role in further studies of these scavengers. Some bird hides

could be set up at the two main earth dams on MGBC, one at the southern Redunca Dam (Figure 7.27) and one at the northern Vocifer Dam (Figure 7.28).

**Figure 7.26. Common sighting from the hide at the Vulture Restaurant on Mogale's Gate Biodiversity Centre.**

**Figure 7.27. Potential bird sightings at Redunca Dam on Mogale's Gate Biodiversity Centre.**

**Figure 7.28. View of Vocifer Dam on Mogale's Gate Biodiversity Centre.**

## Environmental Education

At the United Nations Stockholm Conference in 1972, the recommendation was put forward, that,

"*the Secretary-General, the organizations of the United Nations system, especially UNESCO, and the other organizations concerned, should … take the necessary steps to establish an international program in environmental education, interdisciplinary in its approach, in school and out of school, encompassing all levels of education and directed towards the general public, in particular the ordinary citizen living in rural and urban areas, youth and adult alike, with a view to educating him as to the simple steps he might take, within his means, to manage and control his environment*" (Atchia, *et al.* 1995).

In 1975 UNESCO and UNEP launched IEEP (International Environmental Education Programme) to develop a "*citizenry that is aware of, and concerned about, the total environment and its associated problems and that has the knowledge, attitudes, motivations, commitments and skills to work individually and collectively towards solutions of current problems and prevention of new ones"* (Atchia, *et al.* 1995).

As a result of the growing need for schools to be supported with environmental education, MGBC set up and started running its environmental education program in 1997. Since then over 38 000 children have participated in its environmental education programs. It is recommended that this very important aspect of MGBC be continued and that it should be strengthened to increase the capacity of MGBC to involve more children in the program.

## Climate Change

There has been an acceleration of warming over the past century. Since 1880 there has been a 0.4°C average increase in temperature across the world (Agnew & Fennessy, 2001). This unprecedented temperature increase has caused great concern and has bought the impact of greenhouse gasses, in particular carbon dioxide ($CO_2$) to the fore (Agnew & Fennessy, 2001; Bothma, 2010c). The concentrations of $CO_2$ in the atmosphere have risen from 270ppm (1750-1800) to 355ppm (1990). In 2007 it was estimated that 99% of the global warming issues are anthropogenic in nature (Bothma, 2010c). In 1995 the IPCC confirmed that the emissions of greenhouse gasses into the atmosphere will influence the global climate (Agnew & Fennessy, 2001). Houghton *et al.* (1996) suggest that it is important to protect ecosystems as they are under threat by climate change and provide humans with much needed resources,

An increase in temperature affects numerous everyday cycles that include the absorption of $CO_2$, temperature and rainfall. Each has its own effect on the vegetation and as a result the ecosystem.

- Absorption of $CO_2$

  The climate influences the assimilation rate of biomass through the supply of sunlight, heat, and moisture. $C_3$ grasses would then respond positively to warmer temperatures, while $C_4$ grasses would not. The gains that would be achieved by $C_3$ grasses would however be offset by the higher respiration rates and water deficiencies in a warmer world (Agnew & Fennessy, 2001).

- Temperature

  Temperature affects the distribution of plants (Good, 1970; Woodward, 1987). Therefore, as temperature increase so does the rate of chemical reactions in plants (Forbes & Watson, 1992). Higher temperatures will increase both photosynthesis, and respiration rates. As a result leaf temperatures would have to be maintained at an optimum through evaporative cooling, and this may not be possible with a reduced water supply (Agnew & Fennessy, 2001). The average temperature is however less important that the extremes, and the number of frost-free days may be a greater constraint than maximum temperatures (Agnew & Fennessey, 2001).

- Rainfall

  The assimilation of $CO_2$ is governed by the water status of the plant (Agnew & Fennessy, 2001). Kramer (1983) noted that plant growth and crop yield was reduced by water shortages more than any other environmental variable.

Due to the increasing threat of global warming and the need to assimilate $CO_2$ from the atmosphere and store it within soil and plants, MGBC management decided that there was a need to determine what the carbon storage potential was for MGBC and thus reduce its carbon footprint. To determine an accurate measure of carbon storage on MGBC in the long-term it is recommended that the points used in this study are monitored every two years, to determine how much carbon in stored in the woody and grassy components of MGBC.

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# Chapter 8
# Conclusion

*"The future depends on what we do in the present."*

**Mahatma Gandhi**

## Introduction

The International Union for Conservation of Nature and Natural Resources (1980) set out that the primary conservation goals include:

1. The maintenance of essential ecological processes and life support systems;
2. The preservation of ecological diversity; and
3. The sustainable utilization of species and ecosystems.

The IUCN (1987) also noted that the value of natural ecosystems are often overlooked and undervalued, at the expense of the ideas of making as much land agriculturally productive as possible. Child & Child (1991) feel that there is a lack of appreciation of the value of wildlife and wildlife systems, as there isn't an understanding of the "hidden costs" to society, if these systems were lost. They also state that there is a lack of understanding to the potential ecological and economic advantages of the sustainable use of natural ecosystems.

It is therefore important that areas like Mogale's Gate Biodiversity Centre (MGBC) are protected and managed under the principles of conservation. MGBC provide a huge value to the larger environment in terms of biodiversity, water provision, and carbon storage.

Continuous monitoring of the veld condition and game numbers should become a more central part of the management of MGBC.

## Findings

All objectives set for this study were met. The analysis of MGBC resulted in the classification of twelve plant communities, which can be grouped into nine major communities. The classification of these plant communities has resulted in clearly defined vegetation units, that can be defined by past veld management practices and environmental factors. All plant communities are indicated on a vegetation map for the Centre. This classification and

vegetation map will provide very important information to MGBC management for future veld management decisions.

The general vegetation of MGBC is characterised by the presence of species found in species group T (Annexure B). These species are found in all the plant communities, except for *Schoenoplectus corymbosus-Typha capensis* Wetland (1). They include the woody plants, *Heteromorpha arborensens* var. *abyssinica, Diospyros lycoides* subsp. *guerkei*, the grasses, *Themeda triandra, Hyparrhenia hirta*, and the forbs, *Conyza podacephala, and C. albida*. The plants of species group S (Annexure B) are prominent in the plant communities *Euclea crispa* subsp. *crispa-Olea europea* subsp. *africana-Acacia caffra* Woodland (3.2), *Seriphium plumosum-Alloteropsis semialata* subsp. *eckloniana* Grassland (6), *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland (7), *Protea caffra* subsp. *caffra-Melinis nerviglumis* Woodland (8) and *Xerophyta retinervis-Loudetia simplex* Grassland (9). The forb *Helichrysum rugulosum* (species group S – Annexure B) is prominent in *Sporobolus africanus-Hyparrhenia hirta-Cynodon dactylon* Grassland (5.2), *Sporobolus africanus-Hyparrhenia hirta-Senecio isatideus* Grassland (5.3), *Seriphium plumosum-Alloteropsis semialata* subsp. *eckloniana* Grassland (6), and *Setaria sphacelata* var. *sphacelata-Themeda triandra* Grassland (7).

A total of 702 plant species in 381 genera and 109 families have been identified on MGBC, with the three dominant plant families being, Poaceae (122 species), Asteraceae (92 species), and Fabaceae (62 species) (Annexure C).

Grasslands make up 78.84% on MGBC, while woodlands only make up 19.59%. Even though MGBC falls within the Savanna Biome according to Mucina & Rutherford (2006), both elements of the two biomes can be found on MGBC, due to MGBC being an ecotone between the two biomes (O'Conner & Bredenkamp, 1997). This combination of the two biomes and the various soil, rainfall, climatic and elevation factors, as well as, fire and variation in habitat has resulted in MGBC having a species richness of 22.94 species per 100ha.

Of the 109 plant families, 80% are Dictoyledoneae and 15% Monocoyledoneae. Red data species make up 1.1% of the species of MGBC, and there are 68 species of alien plants (not all invasive), of which 35% are annuals.

Overall the veld condition of the different plant communities on MGBC can be regarded as moderate to good. MGBC has an average veld condition index across the various plant communities of 55.5%, with an average grass cover of 49%. Generally the communities have a good mix of Decreasers and Increasers, with the Decreaser species comprising the largest proportion namely 36.9% of all the herbaceous species.

MGBC stores 0.520 tC/ha/yr. This means that MGBC stores 1 593.2 tC/yr.

# Recommendations

The management of MGBC needs to be flexible due to the changing ecological and economic climate. The following recommendations should therefore be adjusted, as the needs or management practices of MGBC change.

## Wildlife Management

Game monitoring is an integral and difficult part of managing an enclosed natural system, so it is recommended that monitoring of game is done bi-annually in February and in August. It is also recommended that game drives should be used to monitor less seen animals. The continuation of hunting in the form of trophies and meat should continue as excess animals have to be removed to prevent over utilization of the veld. However, live capture should not be ruled out as an alternative for the relatively quick and less stressful removal of animals. This could also potentially become another source of income to the Centre. The game numbers are generally well managed and it is recommended that this continues.

## Veld Management

The classification of the plant communities on MGBC provides very important information to MGBC management. This can now be used for future management plans. Regular monitoring of the communities is recommended, as it can assist with monitoring changes like bush encroachment and invasion by alien plant species.

MGBC has a fire program in place and it is recommended that MGBC continues with this program.

There are few places where rehabilitation or restoration is needed. It is recommended that alien plant control should be a priority, especially the category 1 invasive weed *Campuloclinium macrocephalum*.

It is important to determine what role plant communities play storing carbon. This could provide a much needed incentive to large corporations to protect the natural environment, as large corporations could use such areas like MGBC to offset their carbon emissions, which they generate through travel, electricity usage, etc.

The need to obtain accurate and reliable estimates of carbon pools, and rates of biomass accumulation in wooded and grassland ecosystems, is becoming very important in view of the development of the carbon trading market (Tinker *et al.*, 2010). Further research will

need to be done to determine more accurate equations for the different plant communities on MGBC, as well as, the role grasslands play in the storage of carbon. Further research on MGBC is also needed in the role soil plays in storing carbon, as this was not covered in this research.

## Tourism Management

MGBC has an extensive road network and no additional roads are recommended. It also has a number of facilities available that can be developed further, for example, hides at various dams. The vulture restaurant hide is an exceptional point from which the monitoring of numerous animals and their behaviour can take place.

The environmental education program is a very important aspect to MGBC and it is recommended that this program continues and is strengthened.

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# Annexure A:
# Fauna Species Lists of Mogale's Gate Biodiversity Centre

| Scientific Name | English Name | Afrikaans Name |
|---|---|---|

## Arthropoda

## Arachnida[8]

### Scorpiones

#### Liochelidae

| | |
|---|---|
| Opistophthalmus pugnax | Highveld burrowing scorpion. |

### Solifugae

#### Solpugidae

### Araneae

#### Theraphosidae

**Baboon Spiders**

| | |
|---|---|
| *Harpactira hamiltoni* | Common baboon spider. |

#### Amaurobiidae

| | |
|---|---|
| *Vidole* species | Hackled meshweb weavers. |

#### Araneidae

**Orbweb Spiders**

| | |
|---|---|
| *Araneus apricus* | Green orbweb spider. |
| *Argiope australis* | Yellow & black striped garden spider. |
| *Cyclosa insularis* | Garbage line spider. |
| *Gasteracantha versicolor* | Yellow & black kite spider. |
| *Larinia* species. | Grass orbweb spider. |
| *Neoscona blondeli* | Hairy field spider. |
| *Neoscona rufipalpis* | |
| *Neoscona* species | |
| *Caerostris sexcuspidata* | Bark spider. |
| *Cyrtophora citricola* | Tropical tent-web spider. |
| *Pycnacatha tribulus* | Hedgehog spider. |
| *Nemoscolus vigintipunctatus*. | Stone-nest spiders. |

#### Clubionidae

| | |
|---|---|
| *Clubiona* species | Sac spider. |

#### Dictynidae

| | |
|---|---|
| *Dictyna* species | Meshweb spiders. |

#### Eresidae

**Velvet spiders**

| | |
|---|---|
| *Gandanameno* species | Tree/Black velvet spider. |
| *Stegodyphus dumicola* | Community nest spiders. |
| *Dresserus* species | Ground/Brown velvet spider. |

#### Gnaphosidae

| | |
|---|---|
| *Xerophaeus* species | Flat bellied ground spiders or mouse spiders. |
| *Zelotes* species | Flat bellied ground spiders or |

[8] MGBC assisted up by John and Astri Leroy and The Spider Club of SA in drawing up this list

| | |
|---|---|
| | mouse spiders. |
| *Camillina* species | Flat-bellied ground spider or mouse spider. |
| *Micaria* species | Ant-imitating sac spider. |

### Linyphiidae

| | |
|---|---|
| *Microlinyphia sterllis* | Hammock web spider. |

### Lycosidae

| | |
|---|---|
| *Pardosa* species | Wolf spider |
| *Hogna* species | |
| *Lycos asp*. | |

### Mituridae

| | |
|---|---|
| *Cheiracanthium* species | Sac spider |

### Oxyopidae

| | |
|---|---|
| *Hamataliwa* species | Golden lynx spiders. |

### Palpimanidae

| | |
|---|---|
| *Ikuma* species | Palp-footed spider. |

### Philodrpmidae

| | |
|---|---|
| *Tibellus* species | Grass huntsman spiders. |

### Pholcidae

| | |
|---|---|
| *Smeringopus* species | Daddy longlegs spider. |
| *Spermophora* species | Dwarf daddy longlegs. |

### Pisauridae

| | |
|---|---|
| *Rothus purpurissatus.* | Nursery web spiders. |

### Salticidae

| | |
|---|---|
| Species 1 | Jumping spiders |
| Myrmarachne species | Ant-imitating jumping spider. |

### Segesyriidae

| | |
|---|---|
| *Ariadna* species | Tubeweb spiders. |

### Selenopidae

| | |
|---|---|
| *Anyphops* species | Flatties or wall spiders. |

### Tetragnathidae

| | |
|---|---|
| *Leucauge* species | Silver vlei (or swamp) spiders. |
| *Nephila pilipes* | Black legged Nephila or black legged golden orbweb spider. |
| *Nephila senegalensis* | Banded-legged golden orb web spider |

### Therodoidae

**Comb-footed spiders**

| | |
|---|---|
| *Steatoda* species 1 | False button spider. |
| *Stearoda* species 2 | |
| *Theridion* species | False house button spider. |
| **Achaearanea tepidariorum*. | Ant-eating comb footed spiders. |

### Thomisidae

**Crab spiders**

| | |
|---|---|
| *Thomisus* species | Flower crab spiders. |
| *Synema imitator.* | African mask crab spider. |

### Uloboridae

| | |
|---|---|
| *Uloborus plumipes.* | Hackled orbweb weaver. |

## Insecta

### Thysanura

**Silverfish**

#### Lepismatidae

| | |
|---|---|
| *Ctenolepisma longicaudata** | Grey silverfish |

### Ephemeroptera

**Mayflies**

#### Baetiodea

| | | |
|---|---|---|
| | Small minnow mayflies | |

## Odonata

### Zygoptera

**Damselflies**

#### Calopterygidae

| | | |
|---|---|---|
| *Phaon irridipennis* | Demoiselles | |

#### Protoneuridae

| | | |
|---|---|---|
| | Threadtails | |

### Anisoptera

**Dragonflies**

#### Gomphidae

| | | |
|---|---|---|
| *Ceratogomphus pictus* | Common Thorntail | |

#### Libellulidae

| | | |
|---|---|---|
| *Trithemis arteriosa* | Red-veined Dropwing | |
| *Orthetrum julia* | Julia Skimmer | |
| *Brachythemis leucosticta* | Banded Groundling | |

## Blattodea

**Cockroaches**

#### Blattidae

| | | |
|---|---|---|
| *Periplaneta americana** | American/Common Cockroach | |
| *Deropeltis erythrocephala* | | |

#### Blatellidae

| | | |
|---|---|---|
| *Blatella germanica** | German Cockroach | |

#### Pseudophyllodromiidae

| | | |
|---|---|---|
| *Supella dimidiata* | | |

## Isoptera

**Termites**

#### Hodotermitidae

| | | |
|---|---|---|
| *Hodotermes mossambicus* | Northern Harvester Termite, | Rysmier |

#### Termitidae

| | | |
|---|---|---|
| *Odontotermes badius* | Common Fungus-growing Termite | |
| *Trinervitermes* species | Snouted Harvester Termites | |

## Mantodea

**Mantids**

#### Hymenopodidae

| | | |
|---|---|---|
| *Harpagomantis tricolor* | Flower Mantid | |

#### Mantidae

| | | |
|---|---|---|
| *Tarachodes* species | Bark Mantids | |
| *Sphodromantis gastrica* | Common Green/Giant Mantid | |
| *Miomantis* species | | |
| *Pyrgomantis rhodesica* | Grass Mantid | |

## Dermaptera

**Earwigs**

#### Labiduridae

| | | |
|---|---|---|
| *Labidura riparia** | Sand earwing/ Striped earwig | |

## Plecoptera

**Stoneflies**

#### Perlidae

| | | |
|---|---|---|
| *Neoperla* species | True Stoneflies | |

## Orthoptera

#### Anostostomatidae

**King Crickets**

*Onosandrus* species

### Tettigoniidae

**Katydids**

| | | |
|---|---|---|
| *Eurycorypha* species | Leaf Katydid | |
| *Phaneroptera* species | Leaf Katydids | |

### Gryllidae

**Crickets**

| | | |
|---|---|---|
| *Acanthogryllus foripes* | Brown Cricket | |
| *Gryllus bimaculatus* | Common Garden Cricket | |

### Gryllotalpidae

**Mole Crickets**

| | | |
|---|---|---|
| *Gryllotalpa africana* | Mole crickets | |

### Tridactylidae

**Pygmy Mole Crickets**

Pygmy mole crickets

### Pyrgomorphidae

**Foam Grasshoppers**

| | | |
|---|---|---|
| *Phymateus morbillosus* | Common Milkweed Locust | |
| *Phymateus viridipes* | Green Milkweed Locust | |
| *Dictyophorus spumans* | Koppie Foam Grasshopper | Rooibaadjie |
| *Zonocerus elegans* | Elegant Grasshopper | |

### Acrididae

**Short-horned Grasshoppers**

| | | |
|---|---|---|
| *Acrida acuminata* | Common Stick Grasshopper | |
| *Cyrtacanthacris aeruginosa* | Green Tree Locust | |
| *Locustana pardalina* | Brown Locust | |
| *Acanthacris ruficornis* | Garden Locust | |
| *Schistocerca gregaria* | Desert Locust | |
| *Gastrimargus* species | | |
| *Heteracris* species | | |
| *Acrotylus* species | Burrowing grasshoppers | |

## Phasmatodea

**Stick Insects**

### Heteronemiidae

| | | |
|---|---|---|
| *Bactrododema tiaratum* | Giant Stick Insect | |

## Hemiptera

**Bugs**

## Heteroptera

### Reduviidae

| | | |
|---|---|---|
| *Ectrichodia crux* | Millipede Assassin | |

### Aradidae

Flat bugs, bark bugs

### Coreidae

| | | |
|---|---|---|
| *Petascelis remipes* | Giant Twig Wilter | |

### Alydidae

*Mirperus jaculus*

### Pyrrhocoridae

| | | |
|---|---|---|
| *Dysdercus nigrofasciatus* | Cotton Stainer | |

### Pentatomidae

| | | |
|---|---|---|
| *Coenomorpha* species | Bark stink bugs | |
| *Nezara viridula* | Green Vegetable Bug | |

### Hydrometridae

Water striders

### Mesoveliidae

Water treaders, pondweed bugs

### Corixidae

Water boatmen

### Notonectidae

| | |
|---|---|
| *Anisops* species | Common backswimmers |

### Nepidae

| | |
|---|---|
| *Laccotrephes* species | Common water scorpions |

## Auchenorrhyncha

### Cercopidae

| | |
|---|---|
| *Ptyelus grossus* | Rain-tree Bug, Tipuana Spittle Bug |
| *Locris arithmetica* | Red-spotted Spittle Bug |

### Cicadidae

| | |
|---|---|
| *Platypleura haglundi* | Orange-wing |
| *Stagira* species | Green-wings |

### Membracidae

| | |
|---|---|
| *Centrotus* species | |

## Sternorrhyncha

### Aphididae

| | |
|---|---|
| *Aphis gossypii** | Cotton Aphid, Melon Aphid |

# Thysanoptera

**Thrips**

### Phlaeothripidae

Tube-tailed thrips

### Aeolothripidae

Banded thrips

# Neuroptera

**Lacewings & Antlions**

### Hemerobiidae

Brown lacewings, aphid wolves

### Chrysopidae

| | |
|---|---|
| *Chrysoperla* species | Green lacewings |

### Mantispidae

Mantidflies, mantispids

### Myrmeleontidae

| | |
|---|---|
| *Cueta* species | Pit-building antlions |
| *Myrmeleon* species | Pit-building antlions |
| *Macronemurus tinctus* | White-tip Grassland Antlion |
| *Palpares sobrinus* | Dotted Veld Antlion |

### Ascalaphidae

| | |
|---|---|
| *Timesibasis lacerata* | Blotched Long-horned Antlion |

# Coleoptera

**Beetles**

### Carabidae

| | |
|---|---|
| *Thermophilum homoplatum* | Two-spotted Ground Beetle |
| *Caminara* species | Starred ground beetles |

### Dytiscidae

| | |
|---|---|
| *Cybister tripunctatus* | Yellow-edge water beetle |

### Scarabaeidae

| | |
|---|---|
| *Pachnoda sinuata* | Garden/Brown-and yellow Fruit Chafer |
| *Rhabdotis aulica* | Emerald Fruit Chafer |
| *Cyrtothyrea marginalis* | Common Dotted Fruit Chafer |
| *Plaesiorrhinella plana* | Yellow-belted Fruit Chafer |
| *Porphyronota hebreae* | Marbled Fruit Chafer |
| *Diplognatha gagates* | Large Black Nest Chafer |
| *Adoretus ictericus* | Wattle Chafer |
| *Oryctes boas* | Rhinoceros Beetle |
| *Gymnopleurus humanus* | Small Green Dung Beetle |

| | |
|---|---|
| *Heteronitis castelnaui* | Grooved Dung Beetle |
| *Onitis alexis* | Bronze Dung Beetle |
| *Sisyphus* species | Spider dung beetles |
| *Proagoderus tersidorsis* | Bi-coloured Dung Beetle |
| Buprestidae | |
| *Evides pubiventris* | Emerald Jewel Beetle |
| Lampyridae | |
| | Fireflies, glow worms |
| Lycidae | |
| *Lycus trabeatus* | Tailed Net-winged Beetle |
| Cleridae | |
| *Exkorynetes analis* | Green Bacon Clerid |
| Melyridae | |
| *Astylus atromaculatus** | Spotted Maize Beetle |
| Cocconellidae | |
| *Hippodamia variegate** | Spotted Amber Ladybird |
| *Cheilomenes lunata* | Lunate Ladybird |
| *Henosepilachna bifasciata* | Cucurbit Ladybird |
| *Epilachna dregei* | Potato Ladybird |
| Tenebrionidae | |
| *Dichtha incantatoris* | White-legged Toktokkie |
| Meloidae | |
| *Mylabris oculata* | CMR Bean Beatle |
| Cerambycidae | |
| *Macrotoma palmata* | Large Brown Longhorn |

## Diptera

**Flies**

| | |
|---|---|
| Tipulidae | |
| *Nephrotoma* species | |
| Chironomidae | |
| *Chironomus formosipennis* | Bloodworm |
| Culicidae | |
| *Culex* species | House mosquitoes |
| Asilidae | |
| *Daspletis placodes* | |
| *Genioscelis ventralis* | |
| *Hyperechia marshalli* | Carpenter Bee Robber Fly |
| Bombyliidae | |
| *Bombomyia discoidea* | |
| *Notolomatia pictipennis* | |
| Syrphidae | |
| *Eristalinus taeniops* | |
| *Pyrgotidae* species | Fruit beetle-parasite flies |
| Lauxaniidae | |
| Muscidae | |
| *Musca domestica* | House Fly |
| *Stomoxys calcitrans* | Stable Fly |
| Hippoboscidae | |
| *Hippobosca rufipes* | Cattle Louse Fly |
| Calliphoridae | |
| *Chrysomya chloropyga* | Copper-tailed Blowfly |
| *Lucilia sericata** | European Green Blowfly |

## Lepidoptera[9]

**Moths & Butterlies**

### Geometridae

#### *Ennominae*

*Acanthovalva inconspicuaria*
*Aphilopota patulata* subsp. *patulata*
*Aphilipota* species
*Aphilopota subalbata*
*Agryrophora variabilis*
*Ascotis reciprocaria*
*Cabera elatina*
*Cabera strigata*
*Chiasmia brongusaria* subsp. *brongusaria*
*Chiasmia confuscata*
*Chiamsia inconspicua* subsp. *inconspicua*
*Chiamsia kirbyi*
*Chiamsia multistrigata* subsp. *multistrigata*
*Chiamsia procidata* subsp. *semispurcata*
*Chiamsia streniata* subsp. *streniata*
*Chiamsia turbulentata*
*Coenina poecilaria*
*Colocleora faceta* cf.1
*Drepanogynis confuse*
*Drepanogynis costipicta* subsp. *olearis*
*Drepanogynis epione*
*Drepanogynis glaucichorda*
*Drepanogynis gloriola*
*Drepanogynis mixtaria*
*Drepanogynis olivescens* subsp. *olivescens*
*Drepanogynis tripartite*
*Ectropis delosaria*
*Ectropis obliquilinea*
*Erastria leucicolor* subsp. *leucicolor*
*Eulycia grisea grisea*
*Eulycia subpunctata*
*Heterostegane rectistriga*
*Hypomecis ectropodes*
*Hypomecis gonophore*
*Isturgia catalaunaria* subsp. *cataunaria*
*Isturgia deerraria*
*Isturgia supergressa*
*Lhommeia biskraria* subsp. *illiturata*
*Lhommeia subapcata*
*Ligdia batesii*
*Lomographa indularia*
*Mauna ardescens*
*Mauria ava* subsp. *ava*
*Mauna pictifimbria*
*Menophra jansei*
*Nassunia caffraria* subsp. *caffraria*

[9] MGBC assisted by the Lepidopterist's Scociety of Southern Africa for the butterflies list and H.S. Staude for the Geometrid moths list

*Nassinia pretoria*
*Obolcola petronaria*
*Odontopera homales*
*Omphalucha albosignata*
*Omphalucha indeflexa*
*Omphalucha maturnaria*
*Orbamia octomaculata*
*Plateoplia acrobelia*
*Platypepla persubtilis*
*Platypepla spurcata*
*Psilocerea pulverosa*
*Xanthisthisa niveifrons*
*Xenimpa lactesicnata*
*Xykopteryx arcuata*
*Xylopteryx prasinaria*
*Zamarada metallicata*
*Zamarada cosecuta*
*Zamarada pulverosa*
*Zamarada* species
*Zeuctoboarmia catimena*
*Zeuctoboarmia hyrax* cf.1

### *Geometrinae*

*Acollesis fraudulenta*
*Centrochria deprensa*
*Chlorissa attenuate*
*Chlorocoma clopia*
*Comibaena coryphata*
*Comostolopsis stillata* subsp*. stillata*
*Heterorachis devocata*
*Heterorachis perviridis*
*Heterorachis haploa*
*Microloxia ruficomis*
*Neromia cohaerens*
*Neromia rubripunctilla*
*Omphacodes punctilineata*
*Omphax bacoti*
*Omphax idonea*
*Omphax plantaria* subsp*. planteria*
*Paragathia albimarginata*
*Paraprasina discolor*
*Prasinocyma panchlora*
*Proasinocyma pictifimbria*
*Prasinocyma germinaria*
*Prasinocyma immaculate* subsp*. immaculata*
*Syndromodes cellulata*
*Syndromodes prasinops*
*Victoria fuscithorax*

### *Larentiinae*

*Cholroclystis jansei*
*Conchylia sesquifascia*
*Eupithecia dilucida*
*Eupithecia gradatilinea*
*Eupithecia infectaria*
*Eupithecia infelix*
*Eupithecia rubiginifera*
*Horisme minuata*
*Horisme obscurata* subsp*. obsurata*
*Lobidiopteryx* species
*Mesocolpia consobrina* subsp*. consobrina*
*Mesocolpia lita*
*Mimoclystia explanata*
*Mimoclystia pudicata* subsp*.*

*guaggaria*
*Mimoclystia undulosata*
*Orthonama obstipata* subsp. *obstipata*
*Pseudolarentia megalaria*
*Scotopteryx* species
*Scotopteryx deversa*
*Xanthorhoë exorista*

### *Sterrhinae*

*Rhodometra sacraria*
*Scopula acentra*
*Scopula caearia caesaria*
*Scopula deserta*
*Scopula erinaria* subsp. *erinaria*
*Scolpula erinaria* subsp. *isolata*
*Scolpula fimbrilineata* subsp. *fimbrilineata*
*Scopula gazellaria*
*Scopula latitans*
*Scopula minorata* subsp. *minorata*
*Scopula nesciaria* subsp.
*Scopula nigrinotata* cf.14
*Scopula opperta* cf2.
*Scopula oryx*
*Scopula perstrigulata*
*Scopula punctilineata*
*Scopula ruficolor*
*Scopula rufisalsa* subsp. *rufisalsa*
*Scopula sanguinisecta* subsp. *sanguinisecta*
*Scopula serena*
*Scopula sincera*
*Scopula sinnaria* subsp. *sinnaria*
*Scopula* species
*Scopula subobliquata*
*Somatina ctenophora*
*Sterrha sinuilinia*
*Sterrha torrida*
*Traminda vividaria*

## Uraniidae

### *Epipleminae*

*Epiplema asinine*
*Epiplema inconspicua*
*Epiplema* species

## Nymphalidae

### *Danainae*

| | | |
|---|---|---|
| *Danaus chrysippus* subsp. *aegyptius* | African Monarch | Afrikaanse Melkbosskoenlapper |

### *Satyrinae*

| | | |
|---|---|---|
| *Pseudonympha narycia* subsp. *narycia* | Spotted-eye Brown | Koloogbruintjie |
| *Strygionympha wichgrafi* subsp. *wichgrafi* | Wichgraf's Brown | |

### *Helioconiinae*

| | | |
|---|---|---|
| *Acraea horta* | Garden Acraea | Tuinrooitjie |
| *Acraea neobule* subsp. *neobule* | Wandering Donkey Acraea | Dwaalesel-rooitjie |
| *Acraea natalica* subsp. *natalica* | Natal Acraea | Natal-rooitjie |

### *Nymphalinae*

| | | |
|---|---|---|
| *Hypolimnas misippus* | Diadem | Gewone Na-aper |
| *Junonia hierta* subsp. *cebrene* | Yellow Pansy | Geelgesiggie |
| *Junonia oenone* subsp. *oenone* | Blue Pansy | Bluegesiggie |
| *Junonia orithya* subsp. *madagascariensis* | Eyed Pansy | Padwagtertjie |
| *Precis archesia* | Garden Inspector | Rots-blaarvlerk |

| | | |
|---|---|---|
| *Catacroptera cloanthe* subsp. *cloanthe* | Pirate | Seerower |
| *Cynthia cardui* | Painted Lady | Sondagsrokkie |
| *Phalanta phalantha* subsp. *aethiopica* | Common Leopard | Afrikaanse Luiperd |
| *Byblia ilythia* | Spotted Joker | Lelie-grasvegter |

### *Charaxinae*

| | | |
|---|---|---|
| *Charaxes jasius* subsp. *saturnis* | Foxy Charaxes | Koppiedubbelstert |
| *Charaxes jahlusa* subsp. *rex* | Pearl-spotted Charaxes | Silverkol-dubbelstert |

### Lycaenidae

| | | |
|---|---|---|
| *Lachnocnema bibulous* | Common Woolly-legs | Wolpootjie |
| *Iolaus mimosae rhodosense* | Mimosa Sapphire | Doringboom Saffier |
| *Lampides boeticus* | Longtailed Pea Blue | Lusern-ertjiebloutjie |
| *Cyclyrius pirithous* | | |
| *Tuxentius melaena* subsp. *melaena* | | |
| *Zintha hinza* subsp. *hintza* | | |
| *Zizeeria knysna* | | |
| *Zizula hylax* subsp. *hylax* | | |
| *Eicochrysops messapus* subsp. *mahallokoaena* | | |
| *Lepidochrysops patricia* | | |
| *Freyeria trochylus* | | |

### Pieridae

| | |
|---|---|
| *Catopsilia florella* | African Migrant |
| *Eurema brigitta* subsp. *brigitta* | Broad-bordered Grass Yellow |
| *Pinacopteryx eriphia* subsp. *eriphia* | Zebra White |
| *Colotis euippe* subsp. *omphale* | Smoky Orange Tip |
| *Belenois zochalia* subsp. *zochalia* | |
| *Belenois aurota* subsp. *aurota* | Brown-veined White |
| *Mylothris agathina* | Common Dotted Border |
| *Mylothris rueppellii* subsp. *haemus* | |

### Papilionidae

| | |
|---|---|
| *Papilio demodocus* subsp. *demodocus* | Citrus Swallowtail |
| *Papilio nireus* subsp. *lyaeus* | Green-banded Swallowtail |

### Heperiidae

| | |
|---|---|
| *Coeliades pisistratus* | Two-pip Policeman |
| *Ertis umbra* subsp. *umbra* | |
| *Spialia spio* | |
| *Spialia colotes* subsp. *transvaaliae* | |
| *Metisella willemi* | |
| *Platylesches ayresii* subsp. *ayresii* | |
| *Gegenes niso* subsp. *niso* | Common Hottentot Skipper |

## Hymenoptera

**Wasps, Bees & Ants**

## Apocrita

### Ichneumonidae

*Osprynchotus gueinzii*

### Mutillidae

Velvet ants

### Pompilidae

*Tachypompilus ignitus*
*Hemipepsis tamisieri*

### Vespidae

*Belonogaster dubia*

### Eumenidae

*Anterhynchium natalense*

| | | |
|---|---|---|
| *Delta hottentottum* | | |

### Anthophoridae

| | | |
|---|---|---|
| *Xylocopa caffra* | Carpenter Bee | |

### Apidae

| | | |
|---|---|---|
| *Apis mellifera* | Honey Bee | |

### Formicidae

| | | |
|---|---|---|
| *Dorylus helvolus* | Red Driver Ant | |
| *Messor capensis* | Harvester Ant | |
| *Anoplolepis custodiens* | Pugnacious Ant | |

# Chordata

## Pisces

### Cypriniformes

#### Cyprinidae

| | | |
|---|---|---|
| *Barbus trimaculatus* | Threespot Barb | Driekol-ghieliemientjie |

## Amphibia

### Anura

#### Bufonidae

| | | |
|---|---|---|
| *Amietophrynus (Bufo) gutturalis* | Guttural Toad | Gorrelskurwepadda |
| *Schismaderma carens* | Red Toad | Rooiskurwepadda |

#### Hyperoliidae

| | | |
|---|---|---|
| *Kassina senegalensis* | Bubbling Kassina | Borrelvleipadda |

#### Petropedetidae

| | | |
|---|---|---|
| *Cacosternum boettgeri* | Common Caco | Gewone Blikslanertjie |

#### Pipidae

| | | |
|---|---|---|
| *Xenopus laevis* | Common Platanna | Gewone Platanna |

#### Pyxicephalidae

| | | |
|---|---|---|
| *Amietia (Afrana) angolensis* | Common River Frog | Gewone Rivierpadda |
| *Pyxicephalus adspersus* | Giant Bullfrog | Grootbrulpadda |

## Reptilia

### Chelonii

#### Testudinidae

| | | |
|---|---|---|
| *Stigmachelys (Geochelone) pardalis* | Leopard Tortoise | Bergskilpad |
| *Kinixys belliana* | Bell's Hinged Tortoise | Bell se Skarnierskilkpad |

#### Pelomedusidae

| | | |
|---|---|---|
| *Pelomedusa subrufa* | Marsh/helmeted Terrapin | Moeras/Helmwaterskuilpad |

### Squamata

#### Serpentes

#### Typhlopidae

| | | |
|---|---|---|
| *Rhinothphlops bibronii* | Bibron's Blind Snake | Bibrons se Blindeslang |
| *Rhinotyphlops lalandei* | Delalande's Blind Snake | Delalande se Blindeslang |

#### Boidae

| | | |
|---|---|---|
| *Python natalensis* | Southern African Rock Python | Afrika-rotsluislang |

#### Colubridae

| | | |
|---|---|---|
| *Lamprophis aurora* | Aurora House Snake | Aurora-huisslang |
| *Lamprophis capensis* | Brown House Snake | Bruin Huisslang |
| *Lycophidion capensis* | Cape Wolf Snake | Kaapse Wolfslang |
| *Pseudaspis cana* | Mole Snake | Molslang |
| *Philothamnus semivariegatus* | Spotted Bush Snake | Gespikkelde bosslang |
| *Dasypeltis scabra* | Common Egg-eater | Gewone Eiervreter |

| | | |
|---|---|---|
| Crotaphopeltis hotamboeia | Herald/red-lipped Snake | Rooilipslang |
| *Dispholidus typus* | Boomslang | Boomslang |
| Homoroselaps dorsalis | Striped Harlequin Snake | Streep Kousbandjie |
| **Elapidae** | | |
| *Naja annulifera* | Snouted Cobra | Egiptiese/Bosveldkobra |
| *Naja mossambica* | Mozambique Spitting Cobra | Mosambiekse Spoegkobra |
| *Hemachatus haemachatus* | Rinkhals | Rinkals |
| **Viperidae** | | |
| *Causus rhombeatus* | Common Night Adder | Gewone Nagadder |
| *Bites arietans* | Puffadder | Pofadder |
| **Sauria** | | |
| **Scincidae** | | |
| *Panapsis wahlbergii* | Wahlberg's Snake-eyed Skink | Wahlberg se slangoogskink |
| *Trachylepis punctatissima* | Montane Speckled Skink | |
| *Trachylepis striata* | Eastern Striped Skink | Gestreepte Skink |
| *Trachylepis varia* | Variable Skink | Wisselskink |
| **Cordylidae** | | |
| *Gerrhossaurus flavigularis* | Yellow-throated Plated Lizard | Geelkeel-pantserakkedis |
| *Cordylus vittifer* | Transvaal Girdled Lizard | Transvaalse Gordelakkedis |
| **Varanidae** | | |
| *Varanus albigularis* | Rock Monitor/ white-throated Monitor | Veldlikkewaan |
| **Agamidae** | | |
| *Agama aculeate distant* | Distant's Ground Agama | Grondkoggelmander |
| **Chamaeleonidae** | | |
| *Chamaeleo dilepis* | Flap-necked Chameleon | Flapnek-verkleurmannetjie |
| **Gekkomidae** | | |
| *Lygodactylus capensis* | Cape Dwarf Gecko | Kaapse Dwerggeitjie |
| *Pachydactylus affinis* | Transvaal Thick Toed Gecko | Traanvaalse Geitjie |
| *Pachydactylus capensis* | Cape Gecko | Kaapse Geitjie |

## Aves[10]

### Struthioniformes

#### Struthionidae

| | | |
|---|---|---|
| *Struthio camelus* | Ostrich | Volstruis |

### Galliformes

#### Phasianidae

| | | |
|---|---|---|
| *Peliperdix coqui* | Coqui Francolin | Swempie |
| *Peliperdix sephaena* | Crested Francolin | Bospatrys |
| *Scleroptila levaillantii* | Red-wing Francolin | Rooivlerkpatrys |
| *Scleroptila levaillantoides* | Orange River Francolin | Kalaharipatrys |
| *Pternistes natalensis* | Natal Spurfowl (Francolin) | Natalse Fisant |
| *Pternistes swainsonii* | Swainson's Spurfowl (Francolin) | Rooibekfisant |
| *Coturnix coturnix* | Common Quail | Afrikaanse Kwartel |
| *Coturnix delegorguei* | Harlequin Quail | Bontkwartel |

#### Numididae

| | | |
|---|---|---|
| *Numida meleagris* | Helmeted Guineafowl | Gewone Tarentaal |

### Anseriformes

#### Dendrocygnidae

| | | |
|---|---|---|
| *Dendrocygna viduata* | White-faced Duck | Nonnetjie-eend |
| *Thalassornis leuconotus* | White-backed Duck | Witrugeend |

#### Anatidae

| | | |
|---|---|---|
| *Oxyura maccoa* | Maccoa Duck | Bloubekeend |
| *Alopochen aegyptiaca* | Egyptian Goose | Kolgans |

[10] MGBC assisted by various bird clubs in drawing up this list

| | | |
|---|---|---|
| *Tadorna cana* | South African Shelduck | Kopereend |
| *Plectropterus gambensis* | Spur-winged Goose | Wildemakou |
| *Anas undulate* | Yellow-billed Duck | Geelbekeend |
| *Anas sparsa* | African Black Duck | Swarteend |
| *Anas capensis* | Cape Teal | Teeleend |
| *Anas erythrorhyncha* | Red-billed Teal | Rooibekeend |

## Piciformes

### Indicatoridae

| | | |
|---|---|---|
| *Indicator indicator* | Greater Honeyguide | Grootheuningwyser |
| *Indicator minor* | Lesser Honeyguide | Klienheuningwyser |
| *Prodotiscus regulus* | Brown-backed Honeybird (Sharpbilled Honeyguide) | Skerpbekheuningvoël |

### Picidae

| | | |
|---|---|---|
| *Jynx ruficollis* | Red-throated Wryneck | Draaihals |
| *Campethera bennettii* | Bennett's Woodpecker | Bennettse Speg |
| *Campethera abingoni* | Golden-tailed Woodpecker | Goustertspeg |
| *Dendropicos fuscescens* | Cardinal Woodpecker | Kardinaalspeg |
| *Dendropicos namaquus* | Bearded Woodpecker | Baardspeg |

### Lybiidae

| | | |
|---|---|---|
| *Pogoniulus chrysoconus* | Yellow-fronted Tinkerbird (Tinkerbarbet) | Geelblestinker |
| *Tricholaema leucomelas* | Acacia Pied Barbet | Bonthoutkapper |
| *Lybius torquatus* | Black-collared Barbet | Rooikophoutkapper |
| *Trachyphonus vaillantii* | Crested Barbet | Kuifkophoutkapper |

## Bucerotiformes

### Buccerotidae

| | | |
|---|---|---|
| *Tockus nasutus* | African Grey Hornbill | Grysneushoringvoël |

## Upupiformes

### Upupidae

| | | |
|---|---|---|
| *Upupa africana* | African Hoopoe | Hoephoep |

### Phoeniculidae

| | | |
|---|---|---|
| *Phoeniculus purpureus* | Green (Red-billed) Wood-hoopoe | Gewone Kakelaar |

## Coraciiformes

### Coraciidae

| | | |
|---|---|---|
| *Coracias garrulus* | European Roller | Europese Troupant |
| *Coracias caudata* | Lilac-breasted Roller | Gewone Troupant |

### Alcedinidae

| | | |
|---|---|---|
| *Alcedo semitorquata* | Half-collared Kingfisher | Blouvisvanger |
| *Alcedo cristata* | Malachite Kingfisher | Kuifkopvisvanger |
| *Ispidina picta* | African Pygmy-kingfisher | Dwegvisvanger |

### Dacelonidae

| | | |
|---|---|---|
| *Halcyon senegalensis* | Woodland Kingfisher | Bosveldvisvanger |
| *Halcyon albiventris* | Brown-hooded Kingfisher | Bruinkopvisvanger |

### Cerylidae

| | | |
|---|---|---|
| *Megaceryle maxima* | Giant Kingfisher | Reusevisvanger |
| *Ceryle rudis* | Pied Kingfisher | Bontvisvanger |

### Meropidae

| | | |
|---|---|---|
| *Merops apiaster* | European Bee-eater | Europese Byvreter |
| *Merops bullockoides* | White-fronted Bee-eater | Rooikeelbyvreter |
| *Merops pusillus* | Little Bee-eater | Kleinbyvreter |

## Coliiformes

### Coliidae

| | | |
|---|---|---|
| *Colius striatus* | Speckled Mousebird | Gevlekte Muisvoël |
| *Colius colius* | White-backed Mousebird | Witkruismuisvoël |
| *Urocolius indicus* | Red-faced Mousebird | Rooiwangmuisvoël |

## Cuculiformes

### Cuculidae

| | | |
|---|---|---|
| *Clamator levaillantii* | Levaillant's (Striped) Cuckoo | Gestreepte Nuwejaarsvoël |
| *Cuculus solitarius* | Red-chested Cuckoo | Piet-my-vrou |
| *Cuculus clamosus* | Black Cuckoo | Swartkoekoek |
| *Chrysococcyx klaas* | Klaas's Cuckoo | Meitjie |
| *Chrysococcyx caprius* | Diderick (Diederik) Cuckoo | Diederikkie |

### Centropodidae

| | | |
|---|---|---|
| *Centropus burchelli* | Burchell's Coucal | Gewone vleiloerie |

## Apodiformes

### Apodidae

| | | |
|---|---|---|
| *Cypsiurus parvus* | African Palm-swift | Palmwindswael |
| *Apus caffer* | White-rumped Swift | Witkruiswindswael |
| *Apus affinis* | Little Swift | Kleinwindswael |

## Musophagiformes

### Musiphagidae

| | | |
|---|---|---|
| *Corythaixoides concolor* | Grey Go-way Bird (Lourie) | Kwêvoël |

## Strigiformes

### Tytonidae

| | | |
|---|---|---|
| *Tyto alba* | Barn Owl | Nonnetjie-uil |
| *Tyto capensis* | African Grass Owl | Grasuil |

### Strigidae

| | | |
|---|---|---|
| *Otus senegalensis* | African Scops-Owl | Skopsuil |
| *Bubo africanus* | Spotted Eagle-Owl | Gevlekte Ooruil |
| *Glaucidium perlatum* | Pearl-spotted Owlet | Witkoluil |
| *Asio capensis* | Marsh Owl | Vlei-uil |

### Caprimulgidae

| | | |
|---|---|---|
| *Caprimulgus pectoralis* | Fiery-necked Nightjar | Rooiwangnaguil |
| *Caprimulgus rufigena* | Rufous-cheeked Nightjar | Afrikaanse Naguil |

## Columbiformes

### Columbidae

| | | |
|---|---|---|
| *Columba livia** | Rock Dove (Feral Pigeon) | Tuinduif |
| *Columba guinea* | Speckled (Rock) Pigeon | Kransduif |
| *Columba arquatrix* | African Olive-pigeon (Rameron Pigeon) | Geelbekbosduif |
| *Streptopelia semitorquata* | Red-eyed Dove | Grootringduif |
| *Streptopelia capicola* | Cape Turtle-dove | Gewone Tortelduif |
| *Streptopelia senegalensis* | Laughing Dove | Rooiborsduifie |
| *Turtur chalcospilos* | Emerald-spotted Wood-dove (Dove) | Groenvlekduifie |
| *Oena capensis* | Namaqua Dove | Namakwaduifie |
| *Treron calva* | African Green-Pigeon | Papegaaiduif |

## Gruiformes

### Otididae

| | | |
|---|---|---|
| *Eupodotis cafra* | White-bellied (Barrow's) Korhaan | Witpenskorhaan |
| *Eupodotis caerulescens* | Blue Korhaan | Bloukorhaan |
| *Eupodotis ruficrista* | Red-crested Korhaan | Boskorhaan |
| *Eopodotis melanogaster* | Black-bellied Bustard (Korhaan) | Langbeenkorhaan |
| *Eupodotis afraoides* | Northern Black Korhaan | Witvlerkkorhaan |

### Gruidae

| | | |
|---|---|---|
| *Anthropoides paradisea* | Blue Crane | Bloukraanvoël |

### Rallidae

| | | |
|---|---|---|
| *Amaurornis flavirostris* | Black Crake | Swartriethaan |
| *Gallinula chloropus* | Common Moorhen | Grootwaterhoender |
| *Fulica cristata* | Red-knobbed Coot | Bleshoender |

## Charadriiformes

### Scolopacidae

| | | |
|---|---|---|
| *Gallinago nigripennis* | African (Ethiopian) Snipe | Afrikaansesnip |
| *Tringa glareola* | Wood Sandpiper | Bosruiter |

### Burhinidae

| | | |
|---|---|---|
| *Burhinus capensis* | Spotted Thick-knee (Dikkop) | Dikkop |

### Charadriidae

| | | |
|---|---|---|
| *Charadrius tricollaris* | Three-banded Plover | Driebandstrandkiewiet |
| *Vanellus coronatus* | Crowned Lapwing (Plover) | Kroonkiewiet |
| *Vanellus armatus* | Black-smith Lapwing (Plover) | Bontkiewiet |
| *Vanellus senegallus* | African Wattled Lapwing (Plover) | Lelkiewiet |

### Glareolidae

| | | |
|---|---|---|
| *Cursorius temminckii* | Temminck's Courser | Trekdrawwertjie |
| *Glareola nordmanni* | Black-winged Pratincole | Swartvlerksprinkaanvoël |

## Falconiformes

### Accipitridae

| | | |
|---|---|---|
| *Elanus caeruleus* | Black-shouldered Kite | Blouvalk |
| *Milvus migrans* | Black Kite | Swartwou |
| *Milvus aegytius* | Yellow-billed Kite | Geelbekwou |
| *Haliaeetus vocifer* | African Fish-Eagle | Visarend |
| *Gyps coprotheres* | Cape Vulture | Kransaasvoël |
| *Gyps africanus* | White-backed Vulture | Witrugaasvoël |
| *Aegypius tracheliotos (Torgos tracheliotus)* | Lappet-faced Vulture | Swartaasvoël |
| *Circaetus cinereus* | Brown Snake-eagle | Bruinslangarend |
| *Circaetus pectoralis* | Black-chested (Black-breasted) Snake- Eagle | Swartborsslangarend |
| *Polyboroides typus* | African Harrier-Hawk (Gymnogene) | Kaalwangvalk |
| *Melierax canorus* | Southern Pale Chanting Goshawk | Bleeksingvalk |
| *Melierax gabar (Micronisus gabar)* | Gabar Goshawk | Kleinsingvalk |
| *Accipiter ovampensis* | Ovambo Sparrowhawk | Ovambosperwer |
| *Accipiter minullus* | Little Sparrowhawk | Kleinsperwer |
| *Accipiter melanoleucus* | Black Sparrowhawk | Swartsperwer |
| *Buteo vulpinus* | Steppe Buzzard | Bruinjakkalsvoël |
| *Aquila verreauxii* | Verreaux's (Black) Eagle | Witkransarend |
| *Aquila nipalensis* | Steppe Eagle | Steppe-arend |
| *Aquila wahlbergi* | Wahlberg's Eagle | Bruinarend |
| *Aquila fasciatus* | African Hawk-Eagle | Afrikaanse jagarend |
| *Polemaetus bellicosus* | Martial Eagle | Breëkoparend |

### Sagittariidae

| | | |
|---|---|---|
| *Sagittarius serpentarius* | Secretarybird | Sekretarisvoël |

### Falconidae

| | | |
|---|---|---|
| *Falco peregrinus* | Peregrine Falcon | Swerfvalk |
| *Falco biarmicus* | Lanner Falcon | Edelvalk |
| *Falco vesperitinus* | Western Red-footed Falcon | Westelike Rooipootvalk |
| *Falco amurensis* | Amur (Eastern Red-footed) Falcon | Oostelike Rooipoortvalk |
| *Falco rupicolis* | Rock Kestrel | Kransvalk |
| *Falco rupicoloides* | Greater Kestrel | Grootrooivalk |
| *Falco naumanni* | Lesser Kestrel | Kleinrooivalk |

## Ciconiiformes

### Podicipeidae

| | | |
|---|---|---|
| *Tachybaptus ruficollis* | Little Grebe (Dabchick) | Kleindobbertjie |

### Anhingidae

| | | |
|---|---|---|
| *Anhinga rufa* | African Darter | Slanghalsvoël |

### Phalacroracidae

| | | |
|---|---|---|
| *Phalacrocorax lucidas* | White-breasted Cormorant | Witborsduiker |
| *Phalacrocorax africanus* | Reed Cormorant | Rietduiker |

### Ardeidae

| | | |
|---|---|---|
| *Ardea cineria* | Grey Heron | Bloureier |
| *Ardea melanocephala* | Black-headed Heron | Swartkopreier |
| *Ardea purpurea* | Purple Heron | Rooireier |
| *Bubulcus ibis* | Cattle Egret | Borsluisvoël |
| *Ardeola ralloides* | Squacco Heron | Ralreier |
| *Ixobrychus sturmii* | Dwarf Bittern | Dwegrietreier |

### Scopidae

| | | |
|---|---|---|
| *Scopus umbretta* | Hamerkop | Hamerkop |

### Threskiornithidae

| | | |
|---|---|---|
| *Plegadis falcinellus* | Glossy Ibis | Glansibis |
| *Bostrychia hagedash* | Hadeda Ibis | Hadeda |
| *Threskiornis aethiopicus* | Sacred Ibis | Skoorsteenveër |
| *Platalea alba* | African Spoonbill | Lepelaar |

### Ciconiddae

| | | |
|---|---|---|
| *Ciconia ciconia* | White Stork | Witooievaar |
| *Ciconia abdimii* | Abdim's Stork | Kleinswartooievaar |
| *Leptoptilos crumeniferus* | Marabou Stork | Maraboe |

## Passeriformes

### Oriolodae

| | | |
|---|---|---|
| *Oriolus oriolus* | European Golden Oriole | Europese Wielewaal |
| *Oriolus larvatus* | Black-headed Oriole | Swartkopwielewaal |

### Dicruridae

| | | |
|---|---|---|
| *Dicrurus adsimilis* | Fork-tailed Drongo | Mikstertbyvanger |

### Monarchidae

| | | |
|---|---|---|
| *Terpsiphone viridis* | African Paradise-flycatcher | Paradysvlieëvanger |

### Malaconotidae

| | | |
|---|---|---|
| *Nilaus afer* | Brubru | Bontroklaksman |
| *Dryoscopus cubla* | Black-backed Puffback (Shrike) | Sneeubal |
| *Tchagra australis* | Brown-crowned (Threestreaked) Tchagra | Rooivlerktjagra |
| *Tchagra senegalus* | Black-crowned Tchagra | Swartkroontjagra |
| *Laniarius ferrugineus* | Southern Boubou | Suidelike waterfiskaal |
| *Laniarius atrococcineus* | Crimson-breasted Shrike | Rooisborslaksman |
| *Telophorus zeylanus* | Bokmakierie | Bokmakierie |
| *Malaconotus blanchoti* | Grey-headed Bush-shrike | Spookvoël |
| *Prionops plumatus* | White-crested (White) Helmet-shrike | Withelmlaksman |
| *Batis molitor* | Chinspot Batis | Witliesbosbontrokkie |

### Corvidae

| | | |
|---|---|---|
| *Corvus capensis* | Cape (Black) Crow | Swartkraai |
| *Corvus albus* | Pied Crow | Witborskraai |

### Laniidae

| | | |
|---|---|---|
| *Lanius minor* | Lesser Grey Shrike | Gryslaksman |
| *Lanius collaris* | Common Fiscal (Fiscal Shrike) | Fiskaallaksman |
| *Lanius collurio* | Red-backed Shrike | Rooiruglaksman |

### Campephagidae

| | | |
|---|---|---|
| *Campephaga flava* | Black Cuckooshrike | Swartkatakoeroe |

### Paridae

| | | |
|---|---|---|
| *Anthoscopus caroli* | Grey Penduline-tit | Gryskapokvoël |
| *Parus niger* | Southern Black Tit | Gewone Swartmees |

### Hirundinidae

| | | |
|---|---|---|
| *Riparia paludicola* | Brown-throated Martin | Afrikaanse Oewerswael |
| *Riparia cincta* | Banded Martin | Gebande Oewerswael |
| *Hirundo rustica* | Barn (European) Swallow | Europese Swael |
| *Hirundo albigularis* | White-throated Swallow | Witkeelswael |
| *Hirundo semirufa* | Red-breasted Swallow | Rooiborsswael |
| *Hirundo cucullata* | Greater Striped Swallow | Grootstreepswael |
| *Hirundo abyssinica* | Lesser Striped Swallow | Kleinstreepswael |
| *Delichon urbicum* | Common House-martin | Huisswael |

## Pycnonotidae

| | | |
|---|---|---|
| *Pycnonotus tricolor* | Dark-capped (Blackeyed) Bulbul | Swartoogtiptol |

## Sylviidae

| | | |
|---|---|---|
| *Sphenoeacus afer* | Cape Grassbird | Grasvoël |
| *Sylvietta rufescens* | Long-billed Crombec | Bosveldstompstert |
| *Hippolais icterina* | Icterine Warbler | Spotvoël |
| *Phylloscopus trochilus* | Willow Warbler | Hofsanger |
| *Turdoides jardineii* | Arrow-marked Babbler | Pylvlekkatlagter |
| *Parisoma subcaeruleum* | Chestnut-vented Tit-babbler | Bosveldtjeriktik |

## Zosteropidae

| | | |
|---|---|---|
| *Zesterops capensis* | Cape White-eye | Kaapse Glasogie |

## Cisticolidae

| | | |
|---|---|---|
| *Cisticola juncidis* | Zitting (Fantailed) Cisticola | Landeryklopkloppie |
| *Cisticola aridula* | Desert Cisticola | Woestynklopkloppie |
| *Cisticola textrix* | Cloud Cisticola | Gevlekte Klopkloppie |
| *Cisticola ayresii* | Wing-snapping (Ayres') Cisticola | Kleinste Klopkloppie |
| *Cisticola chiniana* | Rattling Cisticola | Bosveldtinktinkie |
| *Cisticola tinniens* | Levaillant's Cisticola | Vleitinktinkie |
| *Cisticola aberrans* | Lazy Cisticola | Luitinktinkie |
| *Cisticola fulvicapilla* | Neddicky | Neddikkie |
| *Prinia subflava* | Tawny-flanked Prinia | Bruinsylangstertjie |
| *Prinia flavicans* | Black-chested Prinia | Swartbandlangstertjie |
| *Apalis thoracica* | Bar-throated Apalis | Bandgeelkleinjantjie |
| *Camaroptera brevicaudata* | Grey-backed Camaroptera (Bleating Warbler) | Grysrugkwêkwêvoël |

## Alaudidae

| | | |
|---|---|---|
| *Mirafra africana* | Rufous-naped Lark | Rooineklewerik |
| *Mirafra fasciolata* | Eastern Clapper Lark | Hoëveldklappertjie |
| *Calendulauda sabota* | Sabota Lark | Sabotalewerik |
| *Chersomanes albofasciata* | Spike-heeled Lark | Vlaktelewerik |
| *Calandrella cinerea* | Red-capped Lark | Rooikoplewerik |

## Muscicapidae

| | | |
|---|---|---|
| *Monticola rupestris* | Cape Rock-thrush | Kaapse Kliplyster |
| *Psophocichla litsitsirupa* | Ground-scraper Thrush | Gevlekte Lyster |
| *Turdus libonyanus* | Kurrichane Thrush | Rooibeklyster |
| *Turdus smithi* | Karoo (Olive) Thrush | Olyflyster |
| *Bradornis marquensis* | Marico Flycatcher | Maricovlieëvanger |
| *Melaenornis pammelaina* | Southern Black Flycatcher | Swartvleëvanger |
| *Sigelus silens* | Fiscal Flycatcher | Fiskaalvlieëvanger |
| *Muscicapa striata* | Spotted Flycatcher | Europese Vlieëvanger |
| *Cossypha caffra* | Cape Robin-chat (Robin) | Gewone Janfrederik |
| *Cossypha humeralis* | White-throated Robin-chat (Robin) | Witkeeljanfrederik |
| *Cercotrichas leucophrys* | White-browed Scrub-robin (Robin) | Gestreepte Wipstert |
| *Cercotrichas paena* | Kalahari Scrub-robin (Robin) | Kalahariwipstert |
| *Saxicola torquatus* | African (Common) Stonechat | Gewone Bontrokkie |
| *Oenanthe monticola* | Mountain Wheatear (Chat) | Bergwagter |
| *Oenanthe pileata* | Capped Wheatear | Hoëveldskappwagter |
| *Cercomela familiaris* | Familiar Chat | Gewone Spekvreter |
| *Myrmecocichla formicivora* | Anteating Chat | Swartpiek |
| *Thamnolaea cinnamomeiventris* | Mocking Cliff-chat (Chat) | Dassievoël |

## Sturnidae

| | | |
|---|---|---|
| *Onychognathus morio* | Red-winged Starling | Rooivlerkspreeu |
| *Lamprotornis nitens* | Cape Glossy Starling | Kleinglansspreeu |
| *Cinnyricinclus leucogaster* | Violet-backed (Plumcoloured) Starling | Witborsspreeu |
| *Spreo bicolor* | Pied Starling | Witgatspreeu |
| *Creatophora cinerea* | Wattled Starling | Lelspreeu |
| *Acridotheres tristis** | Common (Indian) Myna | Indiese Spreeu |

## Nectariniidae

| | | |
|---|---|---|
| *Chalcomitra amethystina* | Amethyst (Black) Sunbird | Swartsuikerbekkie |
| *Nectarinia famosa* | Malachite Sunbird | Rooiborssuikervoël |
| *Cinnyris chalybeus* | Southern (Lesser) Double-collared Sunbird | Klein-Rooiborssuikervoël |
| *Cinnyris afra* | Greater Double-collared Sunbird | Grootborssuikervoël |

| | | |
|---|---|---|
| *Cinnyris talatala* | White-bellied Sunbird | Geelpenssuikerbekkie |

### Ploceidae

| | | |
|---|---|---|
| *Ploceus capensis* | Cape Weaver | Kaapse wewer |
| *Ploceus velatus* | Southern Masked-weaver | Swartkeelgeelvink |
| *Ploceus intermedius* | Lesser Masked-weaver | Kleingeelvink |
| *Ploceus xanthops* | Golden Weaver | Goudwewer |
| *Quelea quelea* | Red-billed Quelea | Rooibekkwelea |
| *Euplectes orix* | Southern Red Bishop | Rooivink |
| *Euplectes afer* | Yellow-crowned (Golden) Bishop | Goudgeelvink |
| *Euplectes albonotatus* | White-winged Widowbird (Widow) | Witvlerkflap |
| *Euplectes ardens* | Red-collared Widowbird (Widow) | Rooikeelflap |
| *Euplectes progne* | Long-tailed Widowbird (Widow) | Langstertflap |
| *Amblyospiza albifrons* | Thick-billed Weaver | Dikbekwewer |

### Estrildidae

| | | |
|---|---|---|
| *Ortygospiza atricollis* | African Quailfinch | Gewone kwartelvinkie |
| *Amadina erythrocephala* | Red-headed Finch | Rooikopvink |
| *Estrilda astrild* | Common Waxbill | Rooibeksysie |
| *Granatina granatina* | Violet-eared Waxbill | Koningblousysie |
| *Uraeginthus angolensis* | Blue Waxbill | Gewone blousysie |
| *Pytilia melba* | Green-winged Pytilia (Melba Finch) | Gewone Melba |
| *Lagonosticta rubricata* | Blue-billed Firefinch | Kaapse Vuurvinkie |
| *Lagonosticta rhodopareia* | Jameson's Firefinch | Jamesonse Vuurvinkie |
| *Lagonosticta senegala* | Red-billed Firefinch | Rooibekvuurvinkie |
| *Spermestes cucullata* | Bronze Mannikin | Gewone Fret |

### Viduidae

| | | |
|---|---|---|
| *Vidua macroura* | Pin-tailed Whydah | Koningrooibekkie |
| *Vidua paradisaea* | Long-tailed Paradise-whydah | Gewone paradysvink |
| *Vidua funereal* | Dusky Indigobird (Black Widowfinch) | Gewone blouvinkie |
| *Vidua parpurascens* | Purple Indigobird (Widowfinch ) | Witpootblouvinkie |

### Passeridae

| | | |
|---|---|---|
| *Passer domesticus** | House Sparrow | Huismossie |
| *Passer melanurus* | Cape Sparrow | Gewone Mossie |
| *Passer diffuses* | Southern Grey-headed Sparrow | Gryskopmossie |
| *Petronia superciliaris* | Yellow-throated (Sparrow) Petronia | Geelvlekmossie |

### Motacillidae

| | | |
|---|---|---|
| *Motacilla capensis* | Cape Wagtail | Gewone Kwikkie |
| *Macronyx capensis* | Cape (Orange-throated) Longclaw | Geelbekkalkoetjie |
| *Anthus cinnamomeus* | African (Grassveld) Pipit | Gewone Koester |
| *Anthus similis* | Long-billed Pipit | Nocholsonse Koester |
| *Anthus leucophrys* | Plain-backed Pipit | Donkerkoester |
| *Anthus vaalensis* | Buffy Pipit | Vaalkoester |

### Fringillidae

| | | |
|---|---|---|
| *Serinus mozambicus* | Yellow-fronted (Yellow-eyed) Canary | Geeloogkanarie |
| *Serinus atrogularis* | Black-throated Canary | Berkanarie |
| *Serinus flaviventris* | Yellow Canary | Geelkanarie |
| *Serinus gularis* | Streaky-headed Seed-eater (Canary) | Streepkopkanarie |
| *Emberiza flaviventris* | Golden-breasted Bunting | Rooirugstreepkoppie |
| *Emberiza capensis* | Cape Bunting | Rooivlerkstreepkoppie |
| *Emberiza tahapisi* | Cinnamon-breasted (Rock) Bunting | Klipstreepkoppie |

## Mammalia

### Chiroptera

#### Emballonuridae

| | | |
|---|---|---|
| *Taphozous mauritianus* | Mauritian tomb bat | Witlyfvlermuis |

#### Vespertilionidae

| | | |
|---|---|---|
| *Scotophilus dinganii* | Yellow house bat | Geel Dakvlermuis |

#### Nycteridae

| | | |
|---|---|---|
| *Nycteris thebaica* | Common slit-faced bat | Gewone spleetneusvlermuis |

### Rhinolophidae

| | | |
|---|---|---|
| *Rhinolophus clivosus* | Geoffroy's Horseshoe Bat | Geoffroy se saalneusvlermuis |

## Insectivora

### Soricidae

| | | |
|---|---|---|
| *Suncus lixus* | Greater Dwarf Shrew | Groter dwergskeerbek |
| *Crocidura hirta* | Lesser Red Musk Shrew | Klein rooiskeerbek |

### Erinaceidae

| | | |
|---|---|---|
| *Atelerix frontalis* | South African Hedgehog | Suid-Afrikaanse krimpvarkie |

## Macroscelidea

### Macroselididae

| | | |
|---|---|---|
| *Elephantulus myurus* | Rock Elephant Shrew | Klipklaasneus |

## Rodentia

### Cricetidae & Muridae

| | | |
|---|---|---|
| *Lemniscomys rosalia* | Single-striped Mouse | Gestreepte muis |
| *Mus minutoides* | Pygmy Mouse | Dwergmuis |
| *Graphiurus murinus* | Woodland Dormouse | Boswaaierstertmuis |
| *Rattus rattus** | House rat | Huisrot |

### Bathyergidae

| | | |
|---|---|---|
| *Cryptomys hottentotus* | Common Molerat | Vaalmol |

### Hystricidae

| | | |
|---|---|---|
| *Hystrix africaeustralis* | Porcupine | Ystervark |

## Lagomorpha

### Leporidae

| | | |
|---|---|---|
| *Lepus saxatilis* | Scrub Hare | Kolhaas |
| *Pronolagus randensis* | Jameson's Red Rock Rabbit | Jameson se rooiklipkonyn |

## Hydracoidea

### Procaviidae

| | | |
|---|---|---|
| *Procavia capensis* | Rock Dassie | Klipdas |

## Perissodactyla

### Equidae

| | | |
|---|---|---|
| *Equus burchelli* | Burchell's Zebra | Bontsebra |

### Rhinocerotidae

| | | |
|---|---|---|
| *Ceratotherium simum* | Square-lipped (White) Rhinoceros | Witrenoster |

## Artiodactyla

### Suidae

| | | |
|---|---|---|
| *Phacochoerus aethiopicus* | Warthog | Vlakvark |

### Giraffidae

| | | |
|---|---|---|
| *Giraffa camelopardalis* | Giraffe | Kameelperd |

### Bovidae

| | | |
|---|---|---|
| *Connochaetes gnou* | Black Wildebeest | Swartwildebees |
| *Alcelaphus buselaphus* | Red Hartebeest | Rooihartebees |
| *Damaliscus dorcas plillipsi* | Blesbok | Blesbok |
| *Sylvicapra grimmia* | Common Duiker | Gewone Duiker |
| *Antidorcas marsupialis* | Springbok | Springbok |
| *Ourebia ourebi* | Oribi | Oorbietjie |
| *Raphicerus campestris* | Steenbok | Steenbok |
| *Aepyceros melampus* | Impala | Rooibok |
| *Oryx gazella* | Gemsbok | Gemsbok |
| *Tragelaphus strepsiceros* | Kudu | Koedoe |
| *Tragelaphus angasii* | Nyala | Njala |
| *Tragelaphus scriptus* | Bushbuck | Bosbok |
| *Taurotragus oryx* | Eland | Eland |

| | | |
|---|---|---|
| *Redunca arundium* | Common Reedbuck | Rietbok |
| *Redunca fulvorufula* | Mountain Reedbuck | Rooiribbok |
| *Kobus ellipsiprymnus* | Waterbuck | Waterbok |

### Carnivora

#### Protelidae

| | | |
|---|---|---|
| *Proteles cristatus* | Aardwolf | Aardwolf |

#### Hyaenidae

| | | |
|---|---|---|
| *Hyaena brunnea* | Brown Hyena | Strandjut |

#### Felidae

| | | |
|---|---|---|
| *Panthera pardus* | Leopard | Luiperd |
| *Felis nigripes* | Small-spotted Cat | Swartpootkat |
| *Felis caracal* | Caracal | Rooikat |
| *Leptailurus (Felis) serval* | Serval | Tierboskat |

#### Canidae

| | | |
|---|---|---|
| *Canis mesomelas* | Black-backed Jackal | Rooijakkals |

#### Mustelidae

| | | |
|---|---|---|
| *Mellivora capensis* | Honey Badger | Ratel |

#### Viverridae

| | | |
|---|---|---|
| *Genetta tigrina* | Large-spotted Genet | Rooikolmuskejaatkat |
| *Genetta genetta* | Small-spotted Genet | Kleinkolmuskejaatkat |
| *Atilax paludinosus* | Water Mongoose | Kommetjiegatmuishond |
| *Cynictis penicillata* | Yellow Mongoose | Witkwasmuishond |
| *Galerella sanguinea* | Slender Mongoose | Swartkwasmuishond |

### Primates

#### Lorisidae

| | | |
|---|---|---|
| *Galago moholi* | Lesser Bushbaby | Nagapie |

#### Cercopithecidae

| | | |
|---|---|---|
| *Papio ursinus* | Chacma Baboon | Kaapse Bobbejaan |
| *Cercopithecus aethiops* | Vervet Monkey | Blouaap |

### Tubilidentata

#### Orycteropodidae

| | | |
|---|---|---|
| *Orycteropus afer* | Antbear | Aardvark |

## Possible Species Based on Distribution.

## Amphibia

### Anura

#### Breviceptidae

| | | |
|---|---|---|
| *Breviceps adspersus* subsp. *adspersus* | Bushveld Rain Frog | Bosveldreënpadda |

#### Bufonidae

| | | |
|---|---|---|
| *Amietophrynus (Bufo) garmani* | Eastern Olive Toad | Olyfskurwepadda |
| *Amietophrynus poweri* | Western Olive Toad | Power se Skurwepadda |
| *Amietophrynus (Bufo) rangeri* | Raucous Toad | Lawaaiskurwapadda |
| *Poyntonophrynus fenoulheti* | Northern Pygmy Toad | Noordelike dwergskurwepadda |

#### Microhylidae

| | | |
|---|---|---|
| *Phrynomantis bifasciatus* | Red-banded Rubber Frog | Rooiband-rubberpadda |
| *Phrynobatrachus natalensis* | Snoring Puddle Frog | Snorkmodderpadda |

#### Ptychadenidae

| | | |
|---|---|---|
| *Ptychadena anchietae* | Plain Grass Frog | Rooirug-graspadda |

#### Petropedetidae

| | | |
|---|---|---|
| *Amietia (Afrana) fuscigula* | Cape River Frog | Kaapse Rivierpadda |

#### Pyxicephalidae

| | | |
|---|---|---|
| *Strongylopus fasciatus* | Striped Stream Frog | Destreepte langtoonpadda |

| | | |
|---|---|---|
| *Tomopterna cryptotis* | Tremolo Sand Frog | Trillersandpadda |
| *Tomopterna natalensis* | Natal Sand Frog | Natalse Sandpadda |
| *Tomopterna tandyi* | Tandy's Sand Frog | Tandy se sandpadda |

# Reptilia

## Squamata

### Sauria

#### Scinoidae

| | | |
|---|---|---|
| *Trachylepis capensis* | Cape Skink | Kaapse Skink |

#### Lacertidae

| | | |
|---|---|---|
| *Nucras taeniolata* | Striped Sandveld Lizard | Prag-sandveldakkedis |
| *Pedioplanis lineoocellata* | Spotted Sand Lizard | Gevlekte Sandakkedis |

# Annexure B: Table 3.1. A phytosociological table of Mogale's Gate Biodiversity Centre

See foldout

# Annexure C:
# Flora Species List of Mogale's Gate Biodiversity Centre

| Aliens | Endemic | Red Data | Scientific name | English Name | Afrikaans Name |
|---|---|---|---|---|---|
| A | E | | | | |
| | | | **Lycopodiophyta** | | |
| | | | Selaginellaceae | | |
| | | | **Spikemosses** | | |
| | | | *Selaginella dregei* (C.Presl) Hieron | | |
| | | | **Pteridophyta** | | |
| | | | Equisetaceae | | |
| | | | **Horsetails or Scouring Rushes** | | |
| | | | *Equisetum ramosissimum* Desf. subsp. *ramisissimum* | | |
| | | | Anemiaceae | | |
| | | | **Flowering Ferns or Scented Ferns** | | |
| | | | *Mohria vestita* Baker | Parsley Fern | |
| | | | Dennstaedtiaceae | | |
| | | | **Bracken and Ground Ferns** | | |
| | | | *Pteridium aquilinum* (L.) Kuhn subsp. *capense* (Thunb.) C.Chr. | Braken Fern | |
| | | | Sinopteridaceae | | |
| | | | **Cliff Brakes and Lip Ferns** | | |
| | | | *Cheilanthes hirta* Sw var. *hirta* | | |
| | | | *Cheilanthes inaequalis* (Kunze) Mett. | | |
| | | | *Cheilanthes eckloniana* (Kunze) Mett. | | |
| | | | *Cheilanthes viridis* (Forssk.) Sw var. *glauca* (Sim) Schelpe & N.C. Anthony | | |
| | | | *Pellaea calomelanos* (Sw.) Link var. *calomelanos* | Hard Fern | |
| | | | Adiantaceae | | |
| | | | **Maidenhairs and Shoelace Ferns** | | |
| | | | *Adiantum capillus-veneris* L. | Maidenhair Fern | |
| | | | **Gymnosperma** | | |
| | | | Pinaceae | | |
| | | | **Pine Family** | | |
| A | | | *Pinus* L. species. | Pine Tree | Denneboom |

# Angiosperma

## Monocotyledons

### Alliaceae

**Onion Family**

| | | | | |
|---|---|---|---|---|
| A | | *Nothoscordum borbonicum* Kunth | Fragrant False Garlic | Basterknoffel |
| | | *Tulbaghia acutiloba* Harv. | Wild garlic | Wildeknoffel |

### Amaryllidaceae

**Amaryllis Family**

| | | | | |
|---|---|---|---|---|
| | Dec | *Boophane disticha* (L.f.)Herb. | Poison Bulb | Kopseerblom |
| | | *Scadoxus puniceus* (L.) Friis & Nordal | Red Paintbrush | Rooiwas |

### Antheriaceae

**Anthericum Family**

| | | | | |
|---|---|---|---|---|
| | | *Chlorophytum bowkeri* Baker | | |
| | | *Chlorophytum cooperi* (Baker) Nordal | | |
| | | *Chlorophytum fasciculatum* (Baker) Kativu | | |
| | | *Chlorophytum transvaalense* (Baker) Kativu | | |
| E | | *Chlorophytum trichophlebium* (Baker) Nordal | | |

### Asparagaceae

**Asparagus Family**

| | | | | |
|---|---|---|---|---|
| | | *Asparagus africanus* Lam. | | |
| | | *Asparagus falcatus* L. | | |
| | | *Asparagus laricinus* Burch. | Wild Asparagus | Katbos |
| | | *Asparagus setaceus* (Kunth) Jessop | Asparagus Fern | |
| | | *Asparagus suaveolens* Burch. | Wild Asparagus | Katdoring |
| | | *Asparagus virgatus* Baker | | |

### Asphodelaceae

**Aloe Family**

| | | | | |
|---|---|---|---|---|
| | | *Aloe greatheadii* Schönland var. *davyana* (Schönland ) Glen & D.S.Hardy | | |
| | | *Aloe marlothii* A.Berger subsp. *marlothii* | Mountain Aloe | Bergaalwyn |
| E | En | *Aloe peglerae* Schönland | Turk's Cap | |
| | | *Aloe zebrina* Baker | | |
| | | *Bulbine capitata* Poelln. | | |
| | | *Kniphofia ensifolia* Baker subsp. *ensifolia* | | |

### Colchicaceae

**Colchium Family**

| | | | | |
|---|---|---|---|---|
| | | *Androcymbium melanthioides* Willd. var. *melanthioides* | Pyjama flower | Patrysblom |
| | | *Androcymbium* Willd species. | | |
| | | *Ornithoglossum vulgare* B.Nord. | | |

### Commelinaceae

**Commelina Family**

| | | | | |
|---|---|---|---|---|
| | | *Commelina africana* L. var. *africana* | | |
| | | *Commelina africana* L. *var. barberae* (C.B. Clarke) C.B.Clarke | | |
| | | *Commelina africana* L. var. *lancispatha* C.B.Clarke | | |
| | | *Commelina erecta* L. | | |
| | | *Commelina livingstonii* C.B.Clarke | | |
| | | *Commelina modesta* Oberm. | | |
| | | *Cyanotis speciosa* (L.f.) Hassk. | Doll's powerpuff | Bloupoeier kwassie |

## Cyperaceae

**Sedge Family**

| | | | |
|---|---|---|---|
| | *Bulbostylis burchellii* (Ficalho & Hiern) C.B.Clarke | | |
| | *Bulbostylis hispidula* (Vahl) R.W.Haines subsp. *pyriformis* (Lye) R.W Haines | | |
| | *Coleochloa setifera* (Ridl.) Gilly | | |
| | *Cyperus congestus* Vahl | | |
| | *Cyperus esculentus* L. var. *escalentus* | Yellow nutsedge | Geeluintjie |
| | *Cyperus obtusiflorus* Vahl var. *Flavissimus* (Schrad.) Boeck. | | Geelbossie |
| | *Cyperus obtusiflorus* Vahl var. *obtusiflorus* | | Witbiesie |
| A | *Cyperus rotundus* L. subsp. *rotundus* | Purple nutsedge | Rooiuintjie |
| | *Cyperus rupestris* Kunth var. *rupestris* | | |
| | *Cyperus sexangularis* Nees | | |
| | *Eleocharis dregeana* Steud. | | |
| | *Fimbristylis complanata* (Retz.) Link subsp. *complanata* | | |
| | *Fuirena pubescens* (Poir.) Kunth | | |
| | *Kyllinga erecta* Schumach. subsp. *erecta* var. *erecta* | | |
| | *Schoenoplectus corymbosus* (Roem. & Schult.) J.Raynal | | |

## Eriospermaceae

**Eriospermum Family**

| | | | |
|---|---|---|---|
| | *Eriospermum porphyrovalve* Baker | | |

## Hyacinthaceae

**Hyacinth Family**

| | | | |
|---|---|---|---|
| Vu | *Bowiea volubilis* Harv. Ex Hook.f. subsp. *volubilis* | | |
| Dec | *Eucomis autumnalis* (Mill.) Chitt. subsp. *clavata* (Baker) Reyneke | Pineapple flower | Wildepynappel |
| | *Ledebouria burkei* (Baker) J.C. Manning & Goldblatt subsp. *burkei* | | |
| | *Ledebouria cooperi* (Hook.f.) Jessop | | |
| | *Ledebouria floribunda* (Baker) Jessop | | |
| | *Ledebouria marginata* (Baker) Jessop | | |
| | *Ledebouria ovatifolia* (Baker.) Jessop | | |
| | *Ledebouria revoluta* (L.f.) Jessop | Common ledebouria | |
| | *Ornithogalum glaucescens* J.C.Manning & Goldblatt | | Slymbol |
| | *Ornithogalum seineri* (Engl. & K.Krause) Oberm. | | |
| | *Ornithogalum setosum* (Jacq.) J.C. Manning & Goldblatt | | Slymuintjie |
| | *Ornithogalum tenuifolium* F.Delaroche subsp. *tenuifolium* | Bosui | |
| | *Schizocarphus nervosus* (Burch.) Van der Merwe | | |

## Hypoxidaceae

**Stargrass Family**

| | | | |
|---|---|---|---|
| | *Hypoxis acuminata* Baker | | |
| | *Hypoxis argentea* Harv. Ex Baker var. *argentea* | Small yellow star flower | |
| | *Hypoxis galpinii* Baker | | |
| Dec | *Hypoxis hemerocallidea Fisch.*,C.A. Mey. & Avé-Lall. | Star flower | Gifbol |
| E | *Hypoxis interjecta* Nel | | |
| | *Hypoxis iridifolia* Baker | | |

| | | | |
|---|---|---|---|
| | *Hypoxis multiceps* Buchinger ex Baker | | |
| | *Hypoxis rigidula* Baker var. *rigidula* | Farmer's String | Wildetulp |

## Iridaceae

**Iris Family**

| | | | |
|---|---|---|---|
| | *Babiana bainesii* Baker | | Bobbejaanuintjie |
| | *Freesia grandiflora* (Baker) Klatt | | |
| | *Gladiolus crassifolius* Baker | | |
| | *Gladiolus dalenii* Van Geel | Wild gladiolus | Wildeswaardlielie |
| | *Gladiolus elliotii* Baker | | |
| | *Gladiolus papilio* Hook.f. | | |
| | *Gladiolus permeabilis* D.Delaroche subsp. *edulis* (Burch. Ex Ker Gawl.) Oberm. | | Patrysuintjie |
| | *Lapeirousia sandersonii* Baker | | |
| | *Moraea simulans* Baker | | |
| | *Moraea thomsonii* Baker | | |
| | *Tritonia nelsonii* Baker | | |

## Orchidaceae

**Orchid Family**

| | | | |
|---|---|---|---|
| | *Bonatea speciosa* (L.f.) Willd. var. *antennifera* (Rolfe) Sommerv. | | |
| | *Brachycorythis tenuior* Rchb.f. | | |
| | *Eulophia hians* Spreng.var. *hians* | | |
| | *Eulophia hians* Spreng. var. *inaequalis* (Schltr.) S.Thomas | | |
| | *Eulophia ovalis* Lindl. var. *bainesii* (Rolfe) P.J.Cribb & la Croix | | |
| | *Eulophia ovalis* Lindl. var. *ovalis* | | |
| | *Eulophia tuberculata* Bolus | | |
| | *Eulophia welwitschii* (Rchb.f.) Rolfe | | |
| | *Habernaria epipactidea* Rchb.f. | | |
| | *Habernaria falcicornis* (Burch.ex Lindl.) Bolus subsp. *caffra* (Schltr.) J.C. Manning | | |
| E | *Satyrium cristatum* Sond. var. *cristatum* | | |

## Poaceae

**Grass Family**

| | | | |
|---|---|---|---|
| | *Acroceras macrum* Stapf | Nile Grass | |
| A | *Agrostis montevidensis* Spreng. ex Nees | | |
| | *Alloteropsis semialata* (R.Br.) Hitchc. subsp. *eckloniana* (Nees) Gibbs Russ. | Blackseed Grass | Donkersaadgras |
| | *Andropogon appendiculatus* Nees | Vlei Bluestem | Rooivleigras |
| | *Andropogon chinensis* (Nees.) Merr. | Hairy Blue Grass | Harige blougras |
| | *Andropogon eucomus* Nees | Snowflake Grass | Kleinwitbaardgras |
| | *Andropogon schirensis* A.Rich. | | |
| | *Aristida adscensionis* L. | Annual Three-awn | Eenjarige Steekgras |
| | *Aristida bipartita* (Nees) Trin. & Rupr. | Rolling Grass | Grootrolgras |
| | *Aristida congesta* Roem. & Schult. subsp. *barbicollis* (Trin. & Rupr.) De Winter | Spreading Three-awn | Lossteekgras |
| | *Aristida congesta* Roem. & Schult. subsp. *congesta* | Tassel Three-awn | Katstertsteekgras |
| | *Aristida diffusa* Trin. subsp. *burkei* (Strapf) Melderis | Iron Grass | Ystergras |
| | *Aristida junciformis* Trin. & Rupr. subsp. *junciformis* | Ngongoni Three-awn | Ngongoni Steekgras |
| | *Aristida stipitata* Hack. subsp. *graciliflora* (Pilg.) Melderis | Long-awnedGrass | |
| | *Aristida transvaalensis* Henrard | | |
| | *Arundinella nepalensis* Trin. | River Grass | Riviergrass |

| | | | |
|---|---|---|---|
| A | *Arundo donax* L. | | |
| | *Bewsia biflora* (Hack.) Gooss. | False Love grass | Vals eragrostis |
| | *Bothriochloa bladhii* (Retz.) S.T.Blake | Purple Plume Grass | Persklossiegras |
| | *Bothriochloa insculpta* (A.Rich.) A.Camus | Pinhole Gras | Stippelgras |
| | *Brachiaria brizantha* (A.Rich) Stapf | Common Signal Grass | Broodgras |
| | *Brachiaria eruciformis* (Sm.) Griseb. | Sweet Signal Grass | Litjiesinjaalgras |
| | *Brachiaria serrata* (Thunb.) Stapf | Velvet Signal Grass | Fluweelsinjaalgras |
| A | *Bromus catharticus* Vahl | Rescue Grass | |
| | *Cenchrus ciliaris* L. | Foxtail Buffalo Grass | Bloubuffel gras |
| | *Chloris virgata* Sw. | Spiderwebgrass | Spinnerakgras |
| A | *Cortaderia jubata* (Lem.) Stapf | Feather-top Chloris | Witpluim-chloris |
| A | *Cortaderia selloana* (Schult.) Asch. & Graebn. | | |
| | *Cymbopogon caesius* (Hook. & Arn.) Stapf | Broad-leaved Turpentine Grass | Breëblaar Terpentyn gras |
| | *Cymbopogon nardus* (L.) Rendle | Gaint Turpentine Grass | Reuse Terpentyn gras |
| | *Cymbopogon pospischilii* (K.Schum.) C.E. Hubb. | Narrow-leaved Turpentine Grass | Smalblaar Terpentyn gras |
| | *Cynodon dactylon* (L.) Pers. | Couch Grass | Kweekgras |
| | *Dactyloctenium aegyptium* (L.) Willd. | Common Crowfoot Grass | Hoenderspoor gras |
| | *Digitaria argyrograpta* (Nees) Stapf | Silver Finger Grass | Silvervingergras |
| | *Digitaria brazzae* (Franch.) Stapf | | |
| | *Digitaria diagonalis* (Nees) Stapf *var. diagonalis* | Brown-seed Finger Grass | Bruinsaadvingergras |
| | *Digitaria eriantha* Steud. | Common Finger Grass | Gewone Vinger gras |
| | *Digitaria monodactyla* (Nees) Stapf | One-finger Grass | Eenvingergras |
| | *Digitaria ternata* (A.Rich.) Stapf | Black-seed Finger Grass | Swartsaadvingergras |
| | *Digitaria tricholaenoides* Stapf | Purple Finger Grass | |
| | *Digitaria velutina* (Forssk.) P.Beauv. | Long-plumed Finger Grass | Slapvingergras |
| | *Diheteropogon amplectens* (Nees) Clayton | Broad leaved Bluestem | Breëblaarblougras |
| | *Echinochloa colona* (L.) Link | Jungle Rice | Watergras |
| | *Eleusine coracana* (L.) Gaertn. subsp. *africana* (Kenn.-O'Byrne) Hilu & de Wet | Goose Grass | Afrikaanse-osgras |
| | *Elionurus muticus* (Sprent.) Kuntze | Wire Grass | Koperdraadgras |
| | *Enneapogon cenchroides* (Roem. & Schult.) C.E.Hubb | | |
| | *Enneapogon scoparius* Stapf | Bottle-brush Grass | Kalkgras |
| | *Eragrostis biflora* Hack. ex Schinz | Shade Eragrostis | |
| | *Eragrostis capensis* (Thunb.) Trin. | Heart-seed Love Grass | Hartjiesgras |
| | *Eragrostis chloromelas* Steud. | (Narrow) Curly Leaf Grass | (Smal)- Krulblaar gras |
| | *Eragrostis cilianensis* (All.) Vignolo ex Janch. | Stink Lover Gras | Stink-eragrostis |
| | *Eragrostis curvula* (Schrad.) Nees | Weeping Love Grass | Oulandsgras |
| | *Eragrostis gummiflua* Nees | | |
| | *Eragrostis heteromera* Stapf | Bronze Love Grass | Rooikopergras |
| | *Eragrostis lehmanniana* Nees var. *lehmanniana* | Lehmann's Love Grass | Knietjiesgras |
| | *Eragrostis nindensis* Ficalho & Hiern | Wether Love Grass | Hamelgras |
| | *Eragrostis obtusa* Munro ex Ficalho & Hiern | Dew Grass | Douvatgras |
| | *Eragrostis pallens* Hack. | Broom Love Grass | Besemgras |
| | *Eragrostis patentipilosa* Hack. | Footpath Love Grass | Voetpadgras |
| | *Eragrostis plana* Nees | Tough Love Grass | Taaipol-eragrostis |
| | *Eragrostis racemosa* (Thunb.) Steud. | Narrow Heart Love Grass | Smalhartjiesgras |
| | *Eragrostis rigidior* Pilg. | (Broad) Curly Leaf Grass | (Breë) Krulblaar gras |
| | *Eragrostis superba* Peyr. | Saw-tooth Love Grass | Weeluisgras |

| | | | |
|---|---|---|---|
| | *Eragrostis trichophora* Coss. & Durieu | Hairy Love Grass | Harige-pluimgras |
| | *Eustachys paspaloides* (Vahl) Lanza & Mattei | Brown Rhodes Grass | Bruinhoenderspoor gras |
| | *Harpochloa falx* (L.f.) Kuntze | Caterpillar Grass | Ruspergras |
| | *Helictotrichon turgidulum* (Stapf) Schweick. | Small Oats Grass | Kleinhawergras |
| | *Hemarthria altissima* (Poir.) Stapf & C.E.Hubb. | | |
| | *Heteropogon contortus* (L.) Roem. & Schult. | Spear Grass | Assegaaigras |
| | *Hyparrhenia dregeana* (Nees) Stapf ex Stent | | |
| | *Hyparrhenia hirta* (L.) Stapf | Common Thatching Grass | Gewone dekgras |
| | *Hyparrhenia tamba* (Steud.) Stapf | | |
| | *Imperata cylindrica* (L.) Raeusch. | Cotton Wool grass | Donsgras |
| | *Leersia hexandra* Sw. | Rice Grass | Rysgras |
| | *Loudetia flavida* (Stapf) C.E.Hubb. | | |
| | *Loudetia simplex* (Nees) C.E.Hubb. | Common Russet Grass | Stingelgras |
| | *Melinis nerviglumis* (Franch.) Zizka | Bristle-leaved Ted Top Grass | Steekblaar-rooipluim gras |
| | *Melinis repens* (Willd.) Zizka subsp. *repens* | Natal Red Top Grass | Natal Rooipluim gras |
| | *Microchloa caffra* Nees | Pincushion Grass | Elsgras |
| | *Monocymbium ceresiiforme* (Nees) Stapf | Boat Grass | Bootjiesgras |
| | *Oropetium capense* Stapf | Dwarf Grass | |
| | *Panicum maximum* Jacq. | Guinea grass | Buffelsgras |
| | *Panicum natalense* Hochst. | Natal panicum | Suurbuffelsgras |
| | *Panicum schinzii* Hack. | Sweetgrass | Soetgras |
| A | *Paspalum dilatatum* Poir. | Dallis Grass | Gewone-paspalum |
| | *Paspalum distichum* L. | Couch Paspalum | Kweekpaspalum |
| | *Paspalum scrobiculatum* L. | Veld paspalum | Veldpaspalum |
| A | *Paspalum urvillei* Steud. | Vasey Grass | Langbeen-paspalum |
| A | *Pennisetum clandestinum* Hochst. Ex Chiov. | Kikuju Grass | Kikoejoe-gras |
| | *Pennisetum thunbergii* Kunth | Thunberg's Pennisetum | Thunberg-se-pennisetum |
| | *Phragmites australis* (Cav.) Steud. | Common Reed | Fluitjiesriet |
| A | *Poa annua* L. | Annual Blue Grass | Eenjarige Blougras |
| | *Pogonarthria squarrosa* (Roem. & Schult.) Pilg. | Herringbone Grass | Sekelgras |
| | *Schizachyrium sanguineum* (Retz.) Alston | Red Autumn Grass | Rooiherfsgras |
| | *Sehima galpinii* Stent | | |
| | *Setaria incrassata* (Hochst.) Hack. | Vlei Bristle Grass | Vleimannagras |
| | *Setaria lindenbergiana* (Nees) Stapf | Mountain Bristle Grass | Berg-setaria |
| | *Setaria megaphylla* (Steud.) T.Durand & Schinz | Broad-leaved Bristle Grass | Riffelblaar-setaria |
| | *Setaria nigrirostris* (Nees) T.Durand & Schinz | Black-seed Bristle Grass | Swartsaad mannagras |
| | *Setaria pumila* (Poir.) Roem & Schult. | Garden Bristle Grass | Tuinmannagras |
| | *Setaria sphacelata* (Schumach.) Moss var. *sphacelata* | Common Bristle Grass | Gewone mannagras |
| | *Setaria sphacelata* (Schumach.) Moss var. *torta* (Stapf) Clayton | Creeping Bristle Grass | Kruipmannagras |
| | *Setaria verticillata* (L.) P.Beauv. | Bur Bristle Grass | Klitsgras |
| | *Sorghum bicolor* (L.) Moench | | |
| | *Sorghum versicolor* Andersson | Black-seed Sorghum | Swartsaadsrghum |
| | *Sporobolus africanus* (Poir.) A.Robyns & Tournay | Ratstail Dropseed | Taaipol |
| | *Sporobolus centrifuges* (Trin.) Nees | Olive Dropseed | |
| | *Sporobolus fimbriatus* (Trin.) Nees | Dropseed Grass | Bosveldfynsaadgras |
| E? | *Sporobolus pectinatus* Hack. | Fringed Dropseed | Kammetjiesgras |
| | *Sporobolus pyramidalis* P.Beauv. | Catstail Dropseed | Kat-stert taaipol |
| | *Sporobolus stapfianus* Gand. | | |
| | *Themeda triandra* Forssk. | Red Grass | Rooigras |

| | | | |
|---|---|---|---|
| | *Trachypogon spicatus* (L.f.) Kuntze | Gaint Spear Grass | Bokbaardgras |
| | *Tragus berteronianus* Schult. | Carrot-seed grass | Kousklits |
| | *Tricholaena monachne* (Trin.) Stapf & C.E.Hubb. | | |
| | *Trichoneura grandiglumis* (Nees) Ekman | Small Rolling Grass | Klein-rolgras |
| | *Triraphis andropogonoides* (Steud.) E.Phillips | Broom Needle Grass | Perdegras |
| | *Tristachya leucothrix* Nees | Hairy Trident Grass | Harige-drieblomgras |
| | *Tristachya rehmannii* Hack. | Broom Trident Grass | Besem-drieblomgras |
| | *Urelytrum agropyroides* (Hack.) Hack. | Quinine Grass | Varkstertgras |
| | *Urochloa oligotricha* (Fig. & De Not.) Henrard | Perennial Signal Grass | |
| | *Urochloa panicoides* P.Beauv. | Garden Urochloa Grass | Tuinbees gras |

### Typhaceae

**Cat-tail Family**

| | | | |
|---|---|---|---|
| | *Typha capensis* (Rohrb.) N.E.Br. | | |

### Velloziaceae

**Black-stick Lily Family**

| | | | |
|---|---|---|---|
| | *Xerophyta retinervis* Baker | Monkey's tail | Bobbejaanstert/besem-bos |
| | *Xerophyta viscosa* Baker | | |

## Dicotyledons

### Acanthaceae

**Acanthus Family**

| | | | |
|---|---|---|---|
| | *Barleria obtusa* Nees | | |
| | *Blepharis integrifolia* (L.f.) E.Mey. Ex Schinz var. *integrifolia* | | Rankklits |
| E? | *Chaetacanthus costatus* Nees | | |
| | *Chaetacanthus setiger* (Pers.) Lindl. | | |
| | *Crabbea acaulis* N.E.Br. | | |
| E | *Crabbea angustifolia* Nees | | |
| | *Crabbea hirsuta* Harv. | | |
| | *Crabbea ovalifolia* Ficalho & Hiern | | |
| | *Crossandra greenstockii* S.Moore | | |
| | *Hypoestes forskaolii* (Vahl) R.Br | | |
| | *Isoglossa grantii* C.B.Clarke | | |
| | *Justicia anagalloides* (Nees) T.Anderson | | |
| | *Ruellia cordata* Thunb | | |
| | *Thunbergia atriplicifolia* E. Mey. ex Nees | | |

### Achariaceae

**Wild Peach Family**

| | | | |
|---|---|---|---|
| | *Kiggelaria africana* L. | Wild Peach | Wildeperske |

### Amaranthaceae

**Amaranth Family**

| | | | |
|---|---|---|---|
| A | *Achyranthus aspera* L. var. *aspera* | | |
| | *Aerva leucura* Moq. | | Aambeibossie |
| A | *Amaranthus hybridus* L. subsp. *hybridus* var. *hybridus* | Pigweed | |
| | *Cyathula uncinulata (Schrad.) Schinz* | | |
| A | *Gomphrena celosioides* Mart. | Bachelor's button | |
| A | *Guilleminea densa* (Willd. ex Roem. & Schult.) Moq. | | |

### Anacardiaceae

**Mango Family**

| | | | |
|---|---|---|---|
| | *Lannea discolor* (Sond.) Engl. | False Marula | Dikbas |
| | *Lannea edulis* (Sond) Engl. var. *edulis* | Wild Grape | Wildedruif |
| | *Ozoroa paniculosa* (Sond.) R.Fern. & A.Fern. | Common Resin Tree | Gewone Harpuisboom |

| | | | |
|---|---|---|---|
| | var. *paniculosa* | | |
| | *Searsia dentata* Thunb. | Nana-berry | Nanabessie |
| | *Searsia discolor* E.Mey. ex Sond. | | Ghwarrie |
| | *Searsia gueinzii* Sond. | | |
| | *Searsia lancea* L.f. | Karee | Karee |
| | *Searsia leptodictya* Diels | Mountain Karee | Bergkaree |
| | *Searsia magalismontana* Sond. subsp. *magaliesmontana* | | Bergtaaibos |
| | *Searsia pyroides* Burch. var. *gracilis* (Engl.) Burtt Davy | | |
| | *Searsia pyroides* Burch. var. *pyroides* | Common Wild Current | Gewone Taaibos |
| E | *Searsia rigida* Mill. *var. rigida* | | Kliptaaibos |
| E | *Searsia zeyheri* Sond. | Blue Current | Bloutaaibos |

## Apiaceae

**Carrot Family**

| | | | |
|---|---|---|---|
| | *Alepidea setifera* N.E.Br. | | |
| | *Berula erecta* (Huds.) Coville subsp. *thunbergii (DC.)* | | |
| | *Centella asiatica* (L.) Urb. | Pennywort | Varkoortjies |
| | *Heteromorpha arborenscens* (Spreng.) Cham.&Schltdl. var. *abyssinica* (A.Rich.) H.Wolff | Parsley Tree | WildePietersieliebos |
| | *Peucedanum magalismontanum* Sond. | Wild parsley | Wildepietersielie |
| | *Pimpinella transvaalensis* H. Wolff | | |
| | *Sium repandum* Welw.ex Hiern | | |

## Apocynaceae

**Oleander Family**

| | | | |
|---|---|---|---|
| | *Acokanthera oppositifolia* (Lam.) Codd | Bushman's Poison | Boesmansgif |
| | *Acokanthera rotundata* (Codd) Kupicha | | |
| | *Ancylobotrys capensis* (Oliv.) Pichon | Wild Apricot | Wildeapplekoos |
| | *Asclepias adscendens* (Schltr.) Schltr. | | |
| | *Asclepias albens* (E. Mey.) Schltr. | Cartwheels | |
| | *Asclepias aurea* (Schltr.) Schltr | | |
| | *Asclepias eminens* (Harv.) Schltr. | Large turret flower | Bloumelkbos |
| E | *Asclepias fallax* (Schltr.) Schltr. | | |
| | *Asclepias meliodora* (Schltr.) Schltr. | | |
| | *Aspidoglossum lamellatum* (Schltr.) Kupicha | | |
| | *Cryptolepis oblongifolia* (Meisn.) Schltr. | | |
| | *Gomphocarpus fruticosus* (L.) Aiton f.subsp. *fruticosus* | Milkweed | Melkbos |
| | *Gomphocarpus glaucophylla* Schltr. | | Bloublommetjie, Bloumelkbos |
| | *Gomphocarpus tomentosus* Burch. subsp. *tomentosus* | | |
| | *Pachycarpus schinzianus* (Schltr.) N.E.Br. | | |
| | *Pentarrhinum insipidum* E.Mey. | | |
| | *Raphionacme hirsuta* (E.Mey.) R.A.Dyer ex E.Phillips | False gentian | Khadi-wortel |
| | *Raphionacme velutina* Schltr. | | |
| | *Secamone alpini* Schult. | (climber) | |
| | *Xysmalobium undulatum* (L) Aiton f. var. *undulatum* | Wild cotton/milk bush | Melkbos/biterhout |

## Aquifoliaceae

**Holly Family**

| | | | |
|---|---|---|---|
| Dec | *Ilex mitis* (L.) Radlk. var. *mitis* | Cape Holly | Without |

## Araliaceae

**Cabbage-tree Family**

| | | | |
|---|---|---|---|
| | *Cussonia paniculata* Eckl & Zeyh subsp. *sinuata* (Reyneke & Kok) De Winter | Mountain Cabbage Tree | Bergkiepersol |

## Asteraceae

**Daisy Family**

| | | | |
|---|---|---|---|
| A | *Ageratum conyzoides L.* | | |
| | *Artemisia afra Jacq. ex Willd.* | Wild wormwood | Wilde-als |
| | *Aster bakerianus Burtt Davy ex C.A, Sm.* | | |
| | *Aster harveyanus Kuntze* | | Bloublommetjie |
| E | *Aster peglerae* Bolus | | |
| | *Athrixia elata Sond.* | Daisy-tea bush | Bostee |
| E | *Berkheya carlinopsis* Welw. ex O.Hoffm. subsp. *magalismontana* (Bolus) Roessler | | Bergdisseldoring |
| | *Berkheya insignis (Harv.) Thell.* | | |
| | *Berkheya radula (Harv.)De Wild.* | | |
| E | *Berkheya seminivea* Harv. & Sond. | | Disseldoring |
| | *Berkheya setifera DC* | | |
| | *Berkheya zeyheri Sond. & Harv.) Oliv. & Hiern subsp. zeyheri* | | |
| A | *Bidens bipinnata L* | Spanish Blackjack | |
| A | *Bidens pilosa L.* | Blackjack | Kakiebos |
| | *Blumea dregeanoides Sch.Bip. Ex A.Rich.* | | |
| | *Brachylaena rotundata S.Moore* | Mountain Silver Oak | Bergvaalbos |
| A | *Campuloclinium macrocephalum (Less.) DC.* | Pom-pom flower | |
| A | *Cirsium vulgare (Savi) Ten.* | Scottish thistle | Skotse-dissel |
| A | *Conyza albida Sptrng.* | | |
| A | *Conyza bonariensis (L.) Cronquist* | Flax-leaf fleabane | |
| | *Conyza pinnata (L.f.) Kuntze* | | |
| | *Conyza podocephala DC.* | | |
| A | *Cosmos bipinnatus Cav.* | Cosmos | |
| A | *Crepis hypochaeridea (DC.) Thell.* | | |
| | *Dicoma anomala Sond.* subsp. *anomala* | | Koorsbossie/Gryshout |
| | *Euryops laxus* (Harv.) Burtt Davy | Resin bush | Harpuisbos |
| | *Felicia filifolia* (Vent.) Burtt Davy subsp. *filifolia* | | Draaibos |
| | *Felicia muricata (Thunb.) Nees* subsp. *muricata* | White Felicia | Blouheuning karooblom |
| A | *Galinsoga parviflora Cav.* | Gallant soldier | |
| | *Gazania krebsiana Less.* subsp. *Serrulata (DC.) Roessler* | Common gazania | Botterblom |
| | *Geigeria burkei Harv.*subsp. *burkei* var. *Intermedia (S Moore)* | | |
| | *Gerbera ambigua \|(Cass.) Sch. Bip.* | Pink and white Gerbera | Griekwaterbossie |
| | *Gerbera piloselloides (L.) Cass.* | Yellow gerbera | Swartteebossie |
| | *Gerbera viridifolia (DC.) Sch. Bip* | | Griekwaterbossie |
| E | *Haplocarpha lyrata* Harv. | | |
| | *Haplocarpha scaposa Harv.* | | |
| | *Helichrysum acutatum DC.* | Sticky everlasting | Taaisewejaartjie |
| | *Helichrysum aureonitens* Sch.Bip. | | |
| | *Helichrysum caespititium \|(DC.) Harv.* | | Speelwonderboom |
| | *Helichrysum callicomum Harv.* | | Kob |
| | *Helichrysum cephaloideum* DC. | | |
| | *Helichrysum cerastioides* DC. var. cerastioides | | Wolbossie |

| | | | |
|---|---|---|---|
| | *Helichrysum dasymallum* Hilliard | | |
| | *Helichrysum kraussii* Sch.Bip. | | |
| | *Helichrysum miconiifolium DC.* | | |
| | *Helichrysum nudifolia (L.) Less.* var. *pilosellum (L.f.) Beetje* | Hottentot's tea | Vaalteebossie |
| | *Helichrysum nudifolium(L.) Less.* var. *nudifolium* | | |
| | *Helichrysum rugulosum Less.* | | |
| | *Helichrysum setosum Harv.* | Yellow everlasting | Geelsewejaartjie |
| | *Lactuca inermis* Forssk. | Wild lettuce | |
| | *Lopholaena coriifolia (Sond.) E.Phillips & C.A.Sm.* | Small-leaved Fluff Bush | Pluisbossie |
| | *Macledium zeyheri (Sond.) S.Ortiz* subsp. *zeyheri (Dicoma zeyheri subsp. zeyheri)* | | |
| | *Nidorella anomala Steetz* | | |
| | *Nidorella hottentotica DC.* | | |
| | *Osteospermum muricatum E.Mey. Ex DC.* subsp. *muricatum* | | |
| | *Phymaspermum athanasioides (S.Moore) Källersjö* | | |
| | *Pseudognaphalium luteo-album (L.) Hillard & B.L. Burtt* | Cud weed | |
| | *Schistostephium crataegifolium* (DC.) Fenzl ex Harv. | | Bergkruie |
| A | *Schkuhria pinnata (Lam.) cabrera* | | |
| | *Senecio affinis DC.* | | |
| | *Senecio barbertonicus Klatt* | | |
| | *Senecio coronatus (Thunb.)Harv.* | | Sybossie |
| | *Senecio erubescens Aiton* var. *crepidifolius DC.* | | |
| | *Senecio glanduloso-pilosus Volkens & Muschl.* | | |
| | *Senecio inornatus DC.* | | |
| | *Senecio isatideus DC.* | Dan's cabbage | Blouvleibossie |
| E | *Senecio lydenburgensis* Hutch. & Burtt Davy | | |
| | *Senecio othonniflorus* DC. | | |
| | *Senecio oxyriifolius DC.* subsp. *oxyriifolius* | False nasturtium | Kappertjieblaar |
| E? | *Senecio pentactinus* Klatt | | |
| | *Senecio polyodon DC.* var. *polyodon* | | |
| | *Senecio scitus Hutch & Burtt Davy* | | |
| | *Senecio serratuloides DC.* | Two-day plant | |
| | *Senecio venosus Harv.* | | Besembossie |
| | *Seriphium plumosum L.* | Bankrupt bush | Asbossie/ slangos/bankrot bos |
| | *Sonchus dregeanus DC.* | | |
| | *Sonchus nanus Sond. Ex Harv.* | | |
| A | *Sonchus oleraceus L.* | Sow Thistle | Sydissel |
| | *Sonchus wilmsii* R.E.Fr. | Milk thistle | Melkdissel |
| | *Sphaeranthus peduncularis DC.* subsp. *peduncularis* | | |
| A | *Tagetes minuta L.* | Khaki weed | |
| | *Tarchonanthus camphoratus L.* | Wild Camphor Bush | Wildekanferbos |
| A | *Tolpis capensis (L.) Sch. Bip.* | | |
| A | *Tragopogon dubius Scop.* | Yellow goat's beard | |
| | *Ursinia nana DC. subsp. nana* | | |
| | *Vernonia galpinii Klatt* | | Kwasbossie |

| | | | | |
|---|---|---|---|---|
| | | *Vernonia natalensis Oliv. & Hiern* | Silver veronica | Silwerveronia |
| | | *Vernonia oligocephala (DC.) Sch.Bip. Ex Walp.* | Cape veronia | Bitterbossie/Amara-bossie |
| | | *Vernonia poskeana Vatke & Hildebr.*subsp. *Botswanica G.V.Pope* | | |
| | E | *Vernonia staehelinoides* Harv. | | Blouteebossie |
| | | *Vernonia sutherlandii* Harv. | | |
| A | | *Zinnia peruviana (L.) L.* | | Wildejakobregop |
| | | Boraginaceae | | |
| | | **Forget-Me-Not Family** | | |
| | | *Cynoglossum hispidum Thunb.* | Hound's tongue | Ossetongblaar |
| | | *Ehretia rigida (Thunb) Druce* subsp. *nervifolia Retief & A.E.van Wyk* | Puzzlebush | Deurmakaarbos |
| | | *Heliotropium ciliatum* Kaplan | | |
| | | *Lithospermum* L. species | | |
| | | Brassicaceae | | |
| | | **Mustard Family** | | |
| | | *Lepidium africanum* (Burn.f.) DC.subsp. *africanum* | | |
| | E? | *Lepidium capense Thunb.* | | |
| A | | *Nasturtium officinale R.Br.* | | |
| | | *Rorippa nudiuscula Thell.* | | |
| | | *Sisymbrium thellungii O.E. Schulz* | | |
| | | Buddlejaceae | | |
| | | **Wild Elder Family** | | |
| | | *Buddleja saligna Willd.* | False Olive | Witolienhout |
| | | *Buddleja salviifolia (L.) Lam* | Sagewood | Wildesalie |
| | | *Nuxia congesta R.Br.ex Fresen.* | Wild Elder | Wildevlier |
| | | Cactaceae | | |
| | | **Cactus Family** | | |
| A | | *Opuntia ficus-indica (L.) Mill.* | Prickley-pear | |
| | | Campanulaceae | | |
| | | **Bellflower Family** | | |
| | | *Wahlenbergia denticulata* (Burch.) A.DC. var. *denticulata* | | |
| | | *Wahlenbergia krebsii Cham. subsp. krebsii* | | |
| | | *Wahlenbergia undulata (L.f.) A.DC.* | | |
| | | Capparaceae | | |
| | | **Caper Family** | | |
| | | *Maerua cafra (DC.) Pax* | White Wood | Witbos |
| | | Caryophyllaceae | | |
| | | **Carnation Family** | | |
| | E? | *Dianthus mooiensis F.N.Williams subsp. Kirkii (burtt Davy\|)* | | |
| | | *Pollichia campestris Aiton* | Waxberry | Teesuikerbossie |
| | | Celastraceae | | |
| | | **Spike-Thorn Family** | | |
| | | *Gymnosporia buxifolia (l.) Szyszyl.* | Common Spike Thorn | Gewone Pendoring |
| | | *Gymnosporia polycantha (Sond.) Szyszyl. subsp. vaccinifolia* | Kraal Spike Thorn | Kraal Pendoring |
| | | *Gymnosporia tenuispina (Sond.) Szyszyl.* | | |
| | | *Maytenus undata (Thunb.) Blakelock* | Koko Tree | Kokoboom |
| | E | *Mystroxylon aethiopicum(Thunb.) Loes subsp. burkeanum (Sond.)* | Transvaal Kooboo-berry | Transvaalse Koekoebessie |
| | | Celtidaceae | | |

| | | | | |
|---|---|---|---|---|
| | **Celtis Family** | | | |
| | *Celtis africana Burm.f* | White Stinkwood | Witstinkhout |
| | *Chaetacme aristata Planch* | | |
| | Chenopodiaceae | | |
| | **Goosefoot Family** | | |
| A | *Chenopodium album L.* | | |
| A | *Chenopodium carinatum R.Br.* | | |
| | Chrysobalanceae | | |
| | **Mobola Plum Family** | | |
| | *Parinari capensis Harv. subsp. capensis* | Dwarf mobola | Grysappeltjie |
| | Cleomaceae | | |
| | **Cleome Family** | | |
| | *Cleome maculata* (Sond.) Szyszyl. | | |
| | *Cleome monophylla L.* | | |
| | Combretaceae | | |
| | **Bushwillow Family** | | |
| | *Combretum erythrophyllum (Burch.) Sond.* | River Bushwillow | Riviervaderlandswilg |
| | *Combretum molle R.Br. ex G.Don* | Velvet Bushwillow | Fluweelboswilge |
| | *Combretum zeyheri Sond.* | Large-fruited Bushwillow | Raasblaar |
| | Convolvulaceae | | |
| | **Morning-glory Family** | | |
| | *Convolvulus aschersoni Engl.* | | |
| | *Convolvulus sagittatus Thunb.* | | |
| A | *Cuscuta campestris Yunck.* | Dodder | |
| | *Evolvulus alsinoides (L.) L* | | |
| E | *Ipomoea bathycolpos Hallier f.* | Veld sambreeltjies | Veldsambreeltjies |
| | *Ipomoea crassipes Hook.* | Leafy-flowered ipomoea | Wildewinde |
| | *Ipomoea oblongata E.Mey. Ex Choisy (10)* | | |
| | *Ipomoea obscura (L.) Ker Gawl. var. obscura (8)* | | |
| | *Ipomoea ommaneyi Rendle* | | Beespatat |
| A | *Ipomoea purpurea (L.) Roth* | | |
| | *Ipomoea simplex Thunb.* | | |
| | *Ipomoea transvaalensis A. Meeuse* | | |
| | *Merremia palmata Hallier f. (3)* | | |
| | *Seddera capensis (e.Mey. Ex Choisy) Halliwe f.* | | |
| | Crassulaceae | | |
| | **Crassula Family** | | |
| | *Adromischus umbraticola* C.A.Sm. subsp. *umbraticola* | | Bontplakkie |
| | *Crassula alba Forssk. var.* alba | | |
| | *Crassula capitella* Thunb. subsp. *nodulosa* (Schönland) Toelken | | |
| | *Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp.subsp. transvaalensis (Kuntze) Toelken* | | |
| | *Crassula setulosa Harv.* var. *setulosa* | | |
| | *Crassula swaziensis* Schönland | | |
| | *Kalanchoe paniculata* Harv. | | Krimpsiektebossie |
| | *Kalanchoe rotundifolia (Haw.) Haw.* | | Nentabos, plakkie |
| | *Kalanchoe thyrsiflora* Harv. | White lady | Geelplakkie |
| | Cucurbitaceae | | |

**Cucumber Family**

| | | |
|---|---|---|
| *Citrullus lanatus (Thunb.) Matsum. & Nakai* | Tsamma | |
| *Coccinia sessilifolia* (Sond.) Cogn. | | Muisvoëlkomkommer |
| *Cucumis africanus L.f.* | | |
| *Cucumis hirsutus Sond.* | Wild cucumber | Suurkomkommer |
| *Cucumis zeyheri Sond.* | Wild cucumber | Bitterappeltjie |

## Dichapetalaceae

**Poison-Leaf Family**

| | | |
|---|---|---|
| *Dichapetalum cymosum (hook.) Engl.* | Poison leaf | |

## Dipsacaceae

**Scabious Family**

| | | |
|---|---|---|
| *Scabiosa columbaria L.* | Wild scabious | Bitterbos |

## Ebenaceae

**Ebony Family**

| | | |
|---|---|---|
| *Diospyros austo-africana De Winter* var. *mircophylla (Butch.) De Winter* | Fire-sticks | Jakkalsbos |
| *Diospyros lycioides Desf.* subsp. *guerkei (Kuntze) De Winter* | Transvaal Bluebush | Transvaal-bloubos |
| *Diospyros whyteana (hiern) F.White* | Bladder-nut | Swartbas |
| *Euclea crispa* (Thunb.) Gürke subsp. *crispa* | Blue Guarri | Bloughwarrie |
| *Euclea natalensis* A.DC. | Natal guarri | Natalghwarrie |

## Elatinaceae

**Waterwort Family**

| | | |
|---|---|---|
| *Bergia decumbens Planch. Ex Harv.* | | |

## Euphorbiaceae

**Euphorbia Family**

| | | |
|---|---|---|
| *Acalypha angustata Sond.* | Copper leaf | |
| *Acalypha caperonioides Baill.* | | |
| *Acalypha glabrata Thunb. var. glabrata* | Forest False-nettle | Bosvalsnetel |
| *Acalypha indica L.* | | |
| *Acalypha villicaulis Hochst.* | | |
| *Euphorbia inaequilatera Sond.* var. *inaequilatera* | | |
| *Croton gratissimus* Burch. *var. gratissimus* | Lavender Fever-berry | Laventelkoorsbessie |
| *Tragia dioica Sond.* | | |

## Fabaceae

**Pea Family**

| | | |
|---|---|---|
| *Acacia ataxacatha DC.* | Flame Thorn | Vlamdoring |
| *Acacia caffra (thunb.) Willd.* | Common hook-thorn | Gewone Haakdoring |
| *Acacia karroo Hayne* | Sweet Thorn | Soetdoring |
| A *Acacia mearnsii De Wild.* | | |
| *Acacia nilotica (L) Willd. Ex Delile subsp. kraussiana (Benth.) Brenan* | Scented Thorn | Lekkerruikpeul |
| *Acacia robusta Butch. subsp. robusta* | Ankle Thorn | Enkeldoring |
| *Acacia tortillus (Forssk,) Hayne subsp. heteracantha (Burch.) Brenan* | Umbrella thorn | Haak-en-steek |
| *Alysicarpus rugosus* (Willd.) DC. subsp. *perennirufus* J.Léonard | | |
| *Alysicarpus rugosus (Willd.\|) DC. subsp. rugosus* | | |
| *Argyrolobium pauciflorum* Eckl. & Zeyh. var. *pauciflorum* | | |
| *Argyrolobium tuberosum* Eckl. & Zeyh. | | |
| *Burkea africana Hook.* | Wild Syringa | Wildesering |
| *Chamaecrista comosa* E.Mey. var. | | |

| | | | | |
|---|---|---|---|---|
| | | *capricornia* (Steyaert) Lock | | |
| | | *Chamaecrista mimosoides (l.) Greene* | | |
| | | *Crotalaria eremicola* Baker f. subsp. *eremicola* | | |
| | | *Crotalaria laburnifolia* L. subsp. *australis* (Baker f.) Polhill | | |
| | | *Crotalaria orientalis* Burtt Davy ex I.Verd. subsp. *orientalis* | | |
| | | *Crotalaria sphaerocarpa Perr. Ex DC. subsp. sphaerocarpa* | Mealie crotalaria | Mielie crotalaria |
| | | *Dichrostachys cinerea (l.) Wright & Arn. subsp. africana Brenan & Brummit var. africana* | Sickle Bush | Sekelbos |
| | | *Dolichos angustifolius* Eckl. & Zeyh. | Wild pea | Wilde-ertjie |
| | | *Elephantorrhiza burkei Benth.* | Sumach bean | Basboontjie |
| | | *Elephantorrhiza elephantina (Burch.) Skeels* | Elephant's root | Olifantswortel |
| | | *Eriosema burkei* Benth. var. *burkei* | | |
| | | *Eriosema cordatum E. Mey.* | | |
| | | *Eriosema psoraleoides (Lam.) G.Don* | | |
| | | *Eriosema salignum* E.Mey. | | |
| | | *Erythrina lysistemon Hutch.* | Common Coral Tree | Gewone Koraalboom |
| | | *Erythrina zeyheri Harv.* | Plough-breaker | Ploegbreker |
| | | *Indigofera adenoides* Baker f. | | |
| | | *Indigofera comosa N.E. Br.* | | |
| | | *Indigofera daleoides Benth. ex Harv.*var. *daleoides* | | |
| | | *Indigofera filipes Benth. ex Harv.* | | |
| | | *Indigofera hedyantha Eckl. & Zeyh.* | | Aambeibossie |
| | | *Indigofera hilaris Eckl. & Zeyh. var hilaris* | Red indigo bush | |
| | | *Indigofera melanadenia* Benth. ex Harv. | | |
| | | *Indigofera oxytropsis* Benth. ex Harv. | | |
| | | *Indigofera setiflora Baker* | | |
| | | *Indigofera spicata* Forssk. var. *spicata* | (Creeper) | |
| | | *Indigofera zeyheri Spreng. ex Eckl. & Zeyh* | | |
| | | *Lessertia stricta* L.Bolus | | Blaassertjie |
| | | *Lotononis calycina* (E.Mey.) Benth. | | |
| | | *Lotononis eriantha* Benth. | | |
| | | *Lotononis foliosa Bolus* | | |
| A | | *Medicago sativa* L. | Lucerne | Lusern |
| | E | *Melolobium wilmsii Harms* | | Heuningbossie |
| | | *Mundulea sericea (Willd.) A.Chev.* | Cork Bush | Kurkbos |
| | | *Pearsonia sessilifolia (Harv.) Dummersubsp. sessilifolia* | | |
| | | *Rhynchosia minima (L.) DC.* var. *Prostrata (Harv.) Meikle* | | |
| | | *Rhynchosia monophylla Schltr.* | | |
| | | *Rhynchosia nitens Benth.* | | Ferweelboontjie |
| | | *Rhynchosia totta (thunb.) DC.var. totta* | Yellow carpet bean | Tottabossie |
| | | *Sphenostylis angustifolia Sond.* | Wild sweetpea | Wildeertjie |
| | | *Tephrosia capensis (Jacq.) Pers.var. capensis* | | |
| | | *Tephrosia elongata* E.Mey. var. *elongata* | | |
| | | *Tephrosia longipes Meisn.subsp. longipes var. longipes* | | |
| | | *Tephrosia multijuga R.G.N. Young* | | |

| | | | |
|---|---|---|---|
| | *Tephrosia rhodesica Baker f. var. rhodesica* | | |
| | *Tephrosia semiglabra Sond.* | | |
| | *Trifolium africanum* Ser. var *africanum* | Wild clover | Wildeklawer |
| | *Tylosema fassoglense* (Schweinf.) Torre & Hillc. | Gemsbok bean | Gemsbokboontjie |
| | *Vigna vexillata (L.) A.Rich.var. vexillata* | | |
| | *Zornia linearis* E.Mey. | | |
| **Gentianaceae** | | | |
| **Gentian Family** | | | |
| | *Chironia palustris* Burch. subsp. *transvaalensis* (Gilg) I.Verd. | | Bitterwortel |
| | *Sebaea grandis* (E.Mey.) Steud. | | |
| | *Sebaea leiostyla* Gilg | | |
| **Geraniaceae** | | | |
| **Pelargonium Family** | | | |
| | *Monsonia angustifolia E Mey. ex A.Rich* | Crane's bill | Naaldbossie |
| | *Pelargonium dolomiticum R.Knuth* | | |
| | *Pelargonium luridum (Andrews) Sweet* | Stalk-flowered pelargonium | Wildemalvia |
| **Gunneraceae** | | | |
| **Gunnera Family** | | | |
| Dec | *Gunnera perpensa (L.)* | River pumpkin | Rivierpampoen |
| **Hypericaceae** | | | |
| **St. John's Wort Family** | | | |
| | *Hypericum aethiopicum Thunb. subsp. sonderi (Bredell) N.Robson* | St John's wort | Vlieepisbossie |
| **Icacinaceae** | | | |
| **White Pear Family** | | | |
| | *Apodytes dimidiata E.Mey. ex Arn. subsp. dimidiata* | White Pear | Witpeer |
| | *Cassinopsis ilicifolia (Hochst.) kuntze* | Lemon Thorn | Lemoenjiedoring |
| **Lamiaceae** | | | |
| **Mint Family** | | | |
| | *Acrotome hispida* Benth. | | |
| | *Acrotome inflata Benth.* | | |
| | *Ajuga ophrydis Burch. Ex Benth* | | |
| | *Clerodendrum glabrum E.Mey. var. glabrum* | | |
| | *Ocimum obovatum E.Mey. ex Benth subsp. obovatum var.obovatum* | Cat's wiskers | Katsnor |
| | *Hemizygia pretoriae* (Gürke) M.Ashby subsp. *pretoriae* | | |
| | *Hemizygia (Benth.) Briq.* species | | |
| | *Leonotis schinzii* Gürke*(L. ocymifolia* (Burm.f.) Iwarsson var. *schinzii* (Gürke) Iwarsson) | Rock Dagga | Klipdagga |
| | *Leonotis ocymifolia (burm f.) Iwaesson* | Wild dagga | Wildedagga |
| | *Plectranthus madagascariensis (Pers.) Benth.*var. *Ramosior Benth.* | | |
| | *Plectranthus* L'Hér species | | |
| | *Rotheca hirsuta* (Hochst.) R.Fern. in broad sense | | |
| | *Salvia runcinata L.f.* | | Wildesalie |
| E | *Stachys caffra* E.Mey. ex Benth. | | |
| | *Stachys natalensis Hochst.* var. *natalensis* | | |
| | *Teucrium trifidum Retz.* | | Koorsbossie |

## Linaceae

**Flax Family**

| | | | |
|---|---|---|---|
| | *Linum thunbergii* Eckl. & Zeyh. | Wild flax | Wilevlas |

## Lobeliaceae

**Lobelia Family**

| | | | |
|---|---|---|---|
| E | *Cyphia assimilis Sond.* | | |
| | *Cyphia stenopetala Diels* | | |
| | *Lobelia angolensis Engl. & Diels* | | |
| | *Lobelia erinus L.* | Wild lobelia | |
| | *Monopsis decipiens (Sond.) Thulin* | Butterfly lobelia | |

## Loranthaceae

**Showy Mistletoe Family**

| | | | |
|---|---|---|---|
| | *Agelanthus natalitius (Meisn.) Polhill & Wiens* subsp *zeyheri* | | |
| | *Tapinanthus rubromarginatus (Engl.) Danser* | Lighted matches | Vuurhoutjies |

## Lythraceae

**Pride-of-India Family**

| | | | |
|---|---|---|---|
| | *Ammannia senegalensis Lam.ex Poir.* | | |
| | *Nesaea sagattifolia (Sond.) Koehne var. sagittifolia* | | |
| | *Nesaea schinzii* Koehne | | |

## Malpighiaceae

**Barbados Cherry Family**

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

## Malvaceae

**Hibiscus Family**

| | | | |
|---|---|---|---|
| | *Abutilon austro-africanum* Hochr. | | |
| | *Hibiscus aethiopicus L. var. Ovatus Harv.* | Common dwarf hibiscus | |
| | *Hibiscus calyphyllus* Cav. | Wild stockrose | Wildestokroos |
| | *Hibiscus lunarifolius Willd.* | | |
| | *Hibiscus microcarpus* Garcke | | |
| | *Hibiscus trionum L.* | Bladderweed | Terblansbossie |
| | *Pavonia burchelli (DC.) R.A. Dyer* | | |
| | *Sida alba L.* | Spiny sida | Stekeltaaimon |
| | *Sida cordifolia* L. | Fannel weed | Koekbossie |
| | *Sida dregei Burtt Davy* | Spider leg | |
| | *Sida rhombifolia L.*subsp. *rhombifolia* | | |
| | *Sida ternata* L.f. | | |

## Meliaceae

**Mahogany Family**

| | | | |
|---|---|---|---|
| A | *Melia azedarach L.* | | |

## Mesembryanthemaceae

**Vygie Family**

| | | | |
|---|---|---|---|
| | *Delosperma herbeum* (N.E.Br.) N.E.Br. | | |

## Moraceae

**Fig Family**

| | | | |
|---|---|---|---|
| | *Ficus ingens (Miq.) Miq var. ingens* | | |
| | *Ficus salicifola Vahl* | Wonderboom fig | Wonderboomv |

## Myricaceae

**Waxberry Family**

| | | | |
|---|---|---|---|
| | *Morella serrata* (Lam.) Killick | Lance-leaf waxberry | Smalblaarwasbessie |

## Myrothamnaceae

**Resurrection Plant Family**

| | | | |
|---|---|---|---|
| | *Myrothamnus flabellifolius* Welw. | Resurrection plant | Bergboegoe |

## Myrsinaceae

**Myrsine Family**

| | | | |
|---|---|---|---|
| | *Myrsine africana L.* | Cape Myrtle | Vlieebos |

## Myrtaceae

**Guava Family**

| | | | |
|---|---|---|---|
| A | *Eucalyptus species L'Hér.* | | |

## Nyctaginaceae

**'Four o'clock' Family**

| | | | |
|---|---|---|---|
| A | *Mirabilis jalapa* L. | Four o'clock | Vieruurtjie |

## Ochnaceae

**Wild Plane Family**

| | | | |
|---|---|---|---|
| | *Ochna natalita (Meisn.) Walp.* | Natal Plane | Natalrooihout |
| | *Ochna pulchra Hook.f.* | Peeling Plane | Lekkerbreek |

## Olacaceae

**Sourplum Family**

| | | | |
|---|---|---|---|
| | *Ximenia caffra Sond.var. caffra* | Large Sourplum | Groot Suurpruim |

## Oleaceae

**Olive Family**

| | | | |
|---|---|---|---|
| | *Olea capensis L. subsp. Enervis (Harv. Ex C.H. Wright) I. Verd.* | Bushveld Ironwood | Bosveldysterboom |
| | *Olea europaea L. subsp. Africana (Mill) P.S. Green* | Wild Olive | Olienhout |

## Oliniaceae

**Hard Pear Family**

| | | | |
|---|---|---|---|
| | *Olinia emarginata Burtt Davy* | Transvaal Hard Pear | Hardepeer |

## Onagraceae

**Evening Primrose Family**

| | | | |
|---|---|---|---|
| | *Epilobium hirsutum* L. | | |
| A | *Oenothera rosea L'Hér. Ex Aiton* | Rose evening primrose | |
| A | *Oenothera tetraptera L.* | White evening primrose | |

## Orobanchaceae

**Broomrape Family**

| | | | |
|---|---|---|---|
| | *Alectra sessiliflora* (Vahl) Kuntze var. *sessiliflora* | (Parasite) | Verfblommetjie |
| | *Graderia subintegra Mast.* | Wild pentsteman | |
| | *Striga asiatica* (L.) Kuntze | Witchweed | Rooiblom |
| | *Striga bilabiata (thunb.) Kuntze Subsp. bilabiata* | Small witchweed | |
| | *Striga elegans Benth.* | Large witchweed | Rooiblom |

## Oxalidaceae

**Sorrel Family**

| | | | |
|---|---|---|---|
| A | *Oxalis corniculata L.* | Creeping sorrel | |
| | *Oxalis depressa Eckl. & Zeyh.* | Sorrel | Suring |
| | *Oxalis obliquifolia Steud. Ex Rich* | | |
| | *Oxalis semiloba* Sond. subsp. *semiloba* | | |

## Papaveraceae

**Poppy Family**

| | | | |
|---|---|---|---|
| | *Papaver aculeatum Thunb.* | Wild poppy | Koringpapawer |

| | | | |
|---|---|---|---|
| | **Phyllanthaceae** | | |
| | **Phyllanthus Family** | | |
| | *Phyllanthus incurvus Thunb.* | | |
| | *Phyllanthus parvulus Sond. var. ?* | Dye bush | |
| | **Phytolaccaceae** | | |
| | **Pokeweed Family** | | |
| A | *Phytolacca dioica L.* | | |
| A | *Phytolacca octandra L.* | Inkberry | Bobbejaandruif |
| | **Pittosporaceae** | | |
| | **Pittosporum Family** | | |
| | *Pittosporum viridiflorum Sims.* | Cheesewood | Kashout |
| | **Plantaginaceae** | | |
| | **Plantain Family** | | |
| | *Plantago lanceolata L.* | Narrow leaved plantain | Smallweëblaar |
| | *Plantago longissima Decne.* | | |
| | *Plantago major L.* | | |
| | **Polygalaceae** | | |
| | **Milkwort Family** | | |
| | *Polygala amatymbica Eckl. & Zeyh.* | Dwarf polygala | |
| | *Polygala hottentotta C.Presl* | Small purple broom | |
| | *Polygala uncinata E.Mey. Ex Meisn.* | Wild violet | |
| | **Polygonaceae** | | |
| | **Buckwheat Family** | | |
| A | *Persicaria lapathifolia (L.) Gray* | | |
| | *Persicaria decipiens* (R.Br.) K.L. Wilson | Snake root | Slngwortel |
| A | *Leucosidea sericea L.* | | |
| | **Portulaceae** | | |
| | **Purslane Family** | | |
| | *Anacampseros subnuda Poelln.*subsp. *subnuda* | | Haaskos |
| | **Proteaceae** | | |
| | **Protea Family** | | |
| | *Faurea saligna* Harv. | Transvaal Beech | Transvaalboekenhout |
| | *Protea caffra Meisn. subsp. caffra* | Sugarbush | Gewone suikerbos |
| | *Protea welwitschii Rourke* | Clusterhead Sugarbush | Vaalsuikerbos |
| | **Ranunculaceae** | | |
| | **Buttercup Family** | | |
| | *Clematis brachiata Thunb.* | Traveller's joy | Klimop/ Lemoenbloeisels |
| | *Ranunculus multifidus Forssk.* | Buttercup | |
| | **Rhamnaceae** | | |
| | **Buffalo-thorn Family** | | |
| | *Berchemia zeyheri (Sond.) Grubov* | Red-ivory | Rooi Ivoor |
| | *Helinus integrifolius (Lam.) Kuntze* | | |
| | *Phylica paniculata* Willd. | | |
| | *Rhamnus prinoides L'Hér.* | Dogwood | Blinkblaar |
| | *Ziziphus mucronata Willd. subsp. mucronata* | Buffalo Thorn | Blinkblaar-wag-'n-bietjie |
| | *Ziziphus zeyheriana Sond.* | Dwarf Buffalo Thorn | Dwerg Blinkblaar-wag-'n-bietjie |
| | **Rosaceae** | | |
| | **Rose Family** | | |
| A | *Agrimonia procera Wallr.* | | |
| A | *Duchesnea indica* (Andrews) Focke | Wild Strawberry | Wilde-aarbei |

| | | | | |
|---|---|---|---|---|
| | | *Leucosidea sericea* | Old Wood | Ouhoud |
| | Vu | *Prunus africana* (Hook.f.) Kalkman | Red Stinkwood | Rooistinkhout |
| A | | *Pyracantha angustifolia* (Franch.) C.K. Schneid. | | |
| A | | *Rubus cuneifolius* Pursh. | | |

## Rubiaceae

**Coffee Family**

| | | | | |
|---|---|---|---|---|
| | | *Anthospermum hispidulum* E.Mey. ex Sond. | | |
| | | *Anthospermum rigidum* Eckl. & Zeyh subsp. *rigidum* | | |
| | | *Canthium gilfillanii* (N.E. Br.) O.B. Mill. | Velvet Rock Alder | Fluweelklipels |
| | | *Kohautia amatymbica* Eckl. & Zeyh. | Tremble tops | |
| | | *Oldenlandia herbacea* (L.) Roxb.var. *herbacea* | | |
| | | *Oldenlandia* species L. | | |
| | | *Pavetta gardeniifolia* A. Rich. var. *gardeniifolia* | Common Bride's Bush | Gewone Bruidsbos |
| | | *Pentanisia angustifolia* (Hochst.) Hochst. | Wild verbena | Sooibrandbossie |
| | | *Pygmaeothamnus zeyheri* (Somd.) Robyns var. *zeyheri* | Sandapple | Goorappel |
| A | | *Richardia brasiliensis* Gomes | Tropical richardia | |
| | | *Rothmannia capensis* Thunb. | Wild Gardenia | Wildekatjiepeiring |
| | | *Rubia horrida* (Thunb.) Puff | | Kleefgras |
| | | *Vangueria infausta* Burch. subsp. *infausta* | Wild Medler | Wildemispel |
| | | *Vangueria parvifoli* | Mountain Medler | Bergmispel |

## Rutaceae

**Citrus Family**

| | | | | |
|---|---|---|---|---|
| | | *Calodendrum capense* (L.f.) Thunb. | Cape Chestnut | Wildekastaiing |
| | | *Zanthoxylum capense* (Thunb.) Harv. | Small Knobwood | Klienperdepram |

## Salicaceae

**Willow Family**

| | | | | |
|---|---|---|---|---|
| | | *Dovyalis caffra* (Hook.f. & Harv.) Hook.f. | | |
| | | *Dovyalis zeyheri* (Sond.) Warb. | Wild Apricot | Wilde-appelkoos |
| A | | *Populus x canescens (*Aiton) Sm. | | |
| | | *Salix mucronata* Thunb. subsp. *woodii* (Seemen) Immelman | Safsaf Willow | Safsafwilger |
| | | *Scolopia zeyheri* (nees) Harv. | Thorn Pear | Doringpeer |

## Santalaceae

**Sandalwood Family**

| | | | | |
|---|---|---|---|---|
| | | *Osyris lanceolata* Hochst. & Steud. | Transvaal Sumach | Bergbas |
| E | | *Thesium transvaalense* Schltr. | | |
| | | *Thesium utile* A.W. Hill | | Besembossie |

## Sapindaceae

**Litchi Family**

| | | | | |
|---|---|---|---|---|
| | | *Dodonaea viscosa* Jacq. var. *angustifolia* (L.f.) Benth | Sand Olive | Sandolien |
| | | *Pappea capensis* Eckl. & Zeyh. | Jacket Plum | Dopprium |

## Sapotaceae

**Milkwood Family**

| | | | | |
|---|---|---|---|---|
| | | *Englerophytum magalismontanum (*Sond.) T.D. Penn | Transvaal Milk Plum | Stamvrug |
| | | *Mimusops zeyheri* Sond. | Transvaal Red Milkwood | Moepel |

## Scrophulariaceae

**Snapdragon Family**

| | | | | |
|---|---|---|---|---|
| | | *Halleria lucida* L. | Tree Fuchsia | Notsung |
| | | *Jamesbrittenia aurantiaca* (Burch.) Hillard | Cape saffron | |

| | | | |
|---|---|---|---|
| | *Limosella maior* *Diels* | | |
| | *Mimulus gracilis* R.Br. | Wild monkey flower | |
| | *Nemesia fruticans* *(Thunb.) Benth.* | | Wildeleeubekkie |
| | *Selago densiflora* Rolfe | | Koningstapyt |
| E | *Selago tenuifolia* (Rolfe) Hilliard | | |
| | *Sutera levis* Hiern | | |
| E | *Zaluzianskya katharinae* Hiern | | |
| | Solanaceae | | |
| | **Tomato Family** | | |
| A | *Datura ferox* L. | | |
| A | *Datura stramonium* L. | Thorn apple | |
| A | *Physalis viscosa* L. | | |
| A | *Solanum elaeagnifolium* Cav. | Silverleaf/apple | |
| | *Solanum lichtensteinii* Willld. | Bitter apple/Poison apple | Gifappel |
| A | *Solanum mauritianum* Scop. | | |
| A | *Solanum nigrum* L. | | |
| | *Solanum panduriforme* E.Mey. | Poison apple/Bitter apple | Gifappel/bitterappel |
| A | *Solanum pseudocapsicum* L. | Jerusalem cherry | Bosgifappel |
| | *Solanum retroflexum* Dunal | Black nightshade | Nastergal |
| A | *Solanum seaforthianum* Andrews var. *disjunctum* O.E. Schulz | | |
| A | *Solanum sisymbriifolium* Lam. | | |
| | Sterculiaceae | | |
| | **Cacao family** | | |
| | *Dombeya rotundifolia* (Hochst.) Planch. var. *rotundifolia* | Wild Pear | Drolpeer |
| | *Hermannia depressa* N.E. Br. | Creeping red hermannia | Rooi opslag |
| | *Waltheria indica* L. | | Wildebossie |
| | Stryhnaceae | | |
| | **Monkey Orange Family** | | |
| | *Strychnos pungens* Soler. | Spine-leafed Monkey Orange | Stekelblaarklapper |
| | Thymelaeaceae | | |
| | **Fibre-bark Family** | | |
| | *Gnidia caffra* (Meisn.) Gilg. | | |
| | *Gnidia capitata* L.f. | | |
| | *Gnidia kraussiana* Meisn. var. *kraussiana* | | |
| | Tiliaceae | | |
| | **Linden Family** | | |
| | *Corchorus asplenifolius* Burch. | | |
| | *Corchorus confusus* Wild | | |
| | *Grewia flava* DC. | Raisin Bush | Wildeosyntjie |
| | *Grewia occidentalis* L. *var. occidentalis* | Cross Berry | Kruisbessie |
| | Urticaceae | | |
| | **Nettle Family** | | |
| | *Obetia tenax* (N.E.Br.) Friis | Mountain Nettle | Bergbrandnetel |
| | Vahliaceae | | |
| | **Vahlia Family** | | |
| | *Vahlia capensis* (L.f.) Thunb. subsp. *vulgaris* Bridson | Cape Valerian | Wildebalderjan |
| | Verbenaceae | | |
| | **Verbena Family** | | |
| A | *Lantana camara* L. | Lantana | |

| | | | |
|---|---|---|---|
| | *Lantana rugosa* Thunb. | | |
| | *Lippia javanica* (Burm.f.) Spreng. | Fever tree, Wild tea | Beukesbos, Maagbossie, Koorsbossie |
| | *Lippia rehmannii* H.Pearson | | |
| A | *Verbena bonariensis* L. | Wild verbena | |
| A | *Verbena brasiliensis* Vell. | | Perskwasbossie |

## Viscaceae

**Mistletoe Family**

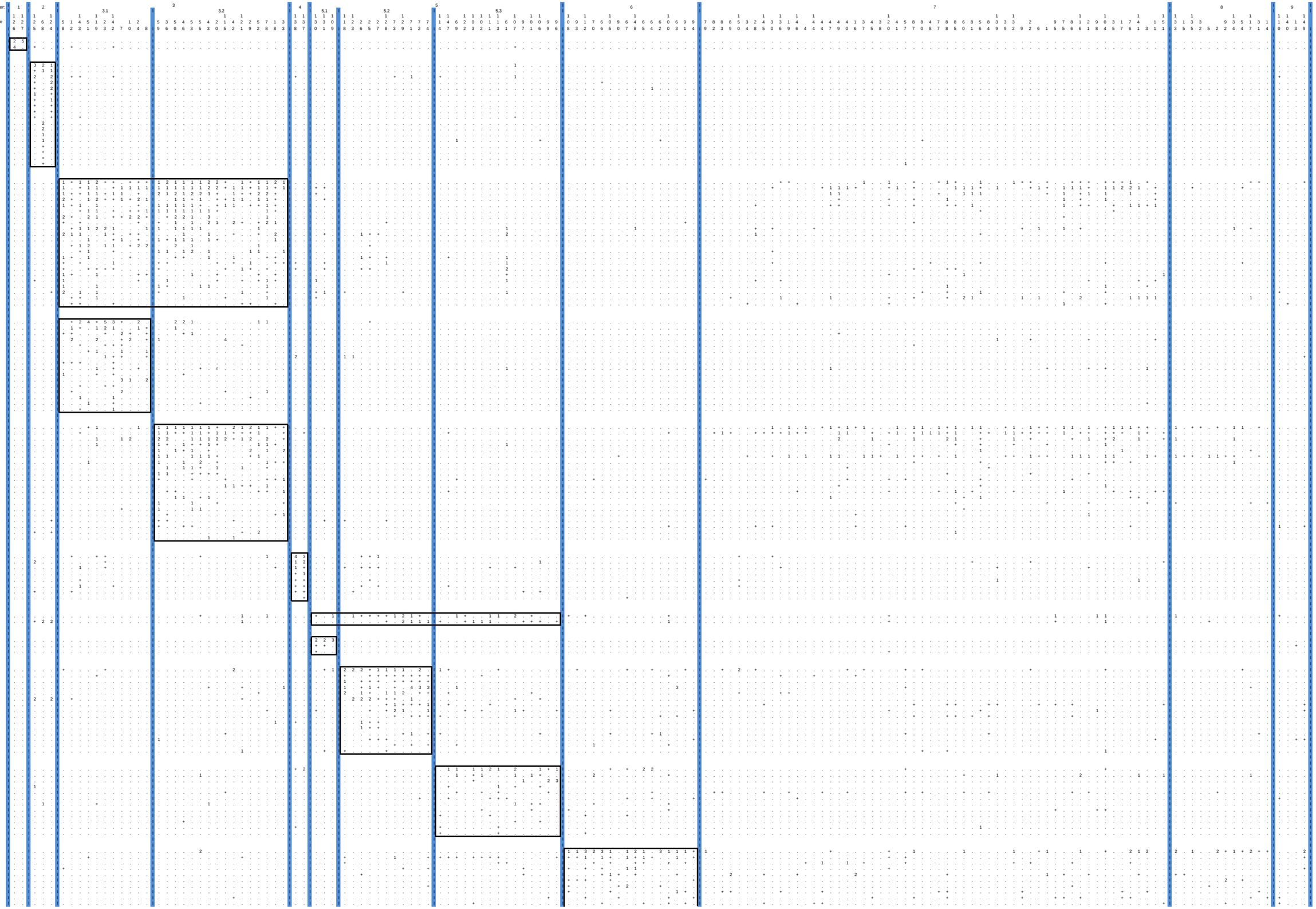
| | | | |
|---|---|---|---|
| | *Viscum combreticola* Engl. | Mistletoe | Voelent |
| | *Viscum rotundifolium* L.f. | | |

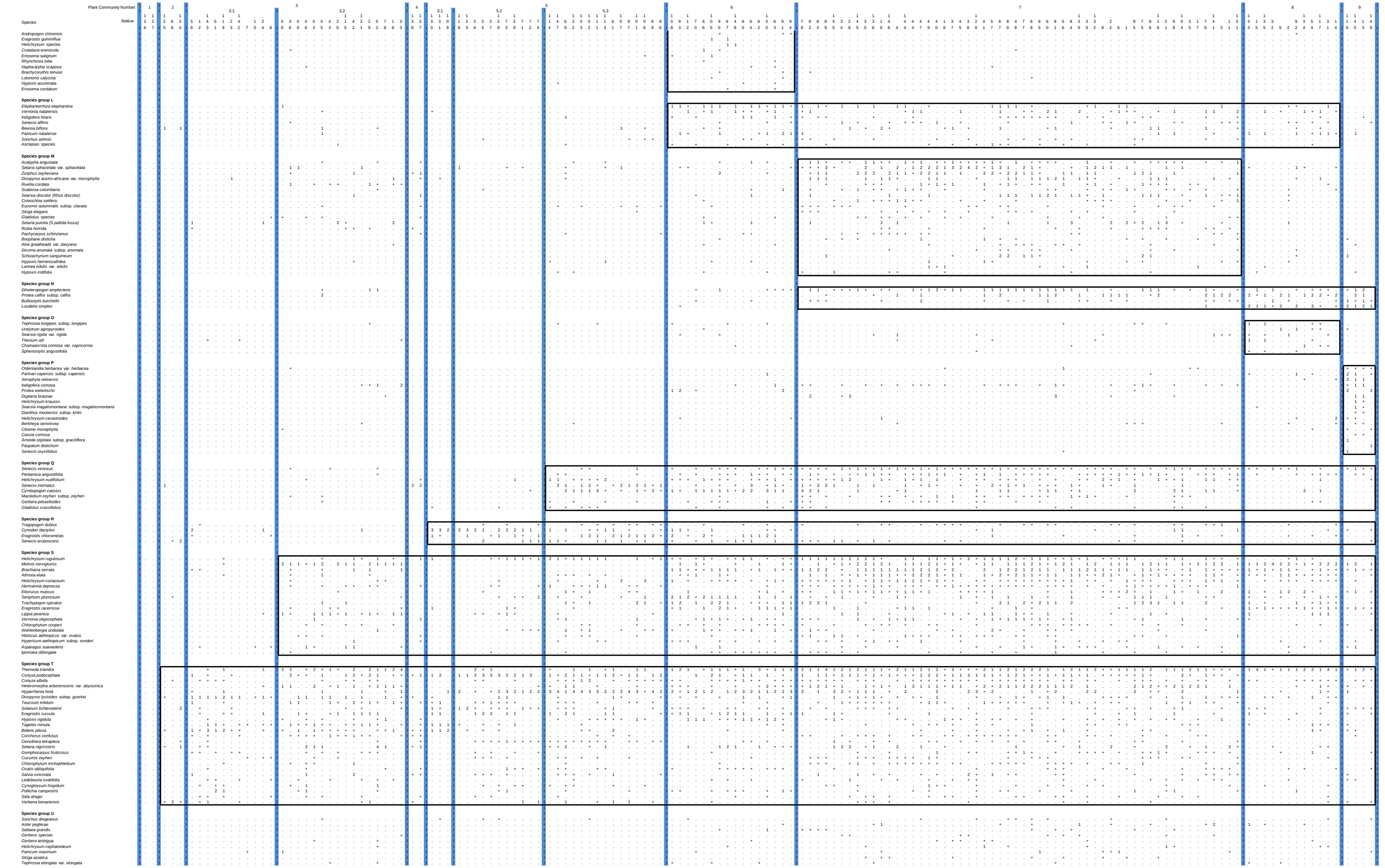
## Vitaceae

**Grape Family**

| | | | |
|---|---|---|---|
| | *Cyphostemma lanigerum* (Harv.) Desc. ex Willd & R.B.Drumm. | | |
| | *Rhoicissus tridentata* (L.f.) Wild & R.B.Drumm. subsp. *cuneifolia* (Eckl. & Zeyh.) Urton | Bushman's Grape | Boesmansdruif |

# Annexure B: Table 3.1. A phytosociological table of Mogale's Gate Biodiversity Centre



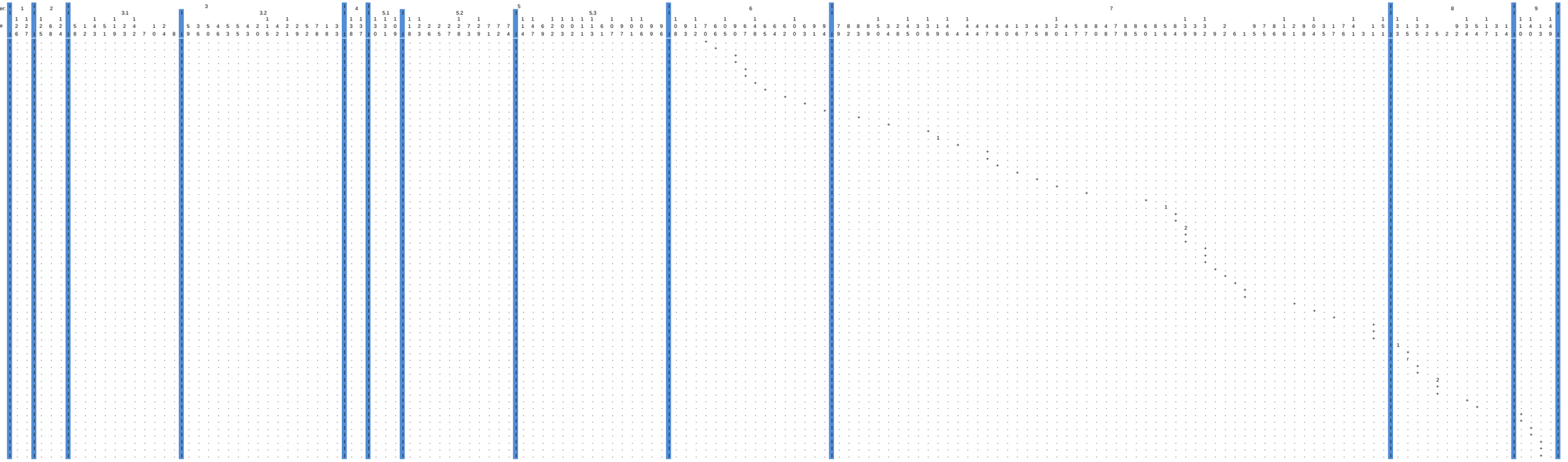

Plant Community Number:
Species
Relève
Species group L
Elephantorrhiza elephantina
Vernonia natalensis
Indigofera hilaris
Senecio affinis
Bewsia biflora
Panicum natalense
Sonchus wilmsii
Asclepias species
Species group M
Acalypha angustata
Setaria sphacelata var. sphacelata
Ziziphus zeyheriana
Diospyros austro-africana var. microphylla
Ruellia cordata
Scabiosa columbaria
Searsia discolor (Rhus discolor)
Coleochloa setifera
Eucomis autumnalis subsp. clavata
Striga elegans
Gladiolus species
Setaria pumila (S pallida-fusca)
Rubia horrida
Pachycarpus schinzianus
Boophane disticha
Aloe greatheadii var. davyana
Dicoma anomala subsp. anomala
Schizachyrium sanguineum
Hypoxis hemerocallidea
Lannea edulis var. edulis
Hypoxis iridifolia
Species group N
Diheteropogon amplectens
Protea caffra subsp. caffra
Bulbostylis burchellii
Loudetia simplex
Species group O
Tephrosia longipes subsp. longipes
Urelytrum agropyroides
Searsia rigida var. rigida
Thesium util
Chamaecrista comosa var. capricornia
Sphenostylis angustifolia
Species group P
Oldenlandia herbacea var. herbacea
Parinari capensis subsp. capensis
Xerophyta retinervis
Indigofera comosa
Protea welwitschii
Digitaria brazzae
Helichrysum kraussii
Searsia magalismontana subsp. magaliesmontana
Dianthus mooiensis subsp. kirkii
Helichrysum cerastioides
Berkheya seminivea
Cleome monophylla
Cassia comosa
Aristida stipitata subsp. graciliflora
Paspalum distichum
Senecio oxyrifolius
Species group Q
Senecio venosus
Pentanisia angustifolia
Helichrysum nudifolium
Senecio inornatus
Cymbopogon caesius
Macledium zeyheri subsp. zeyheri
Gerbera piloselloides
Gladiolus crassifolius
Species group R
Tragopogon dubius
Cynodon dactylon
Eragrostis chloromelas
Senecio erubescens
Species group S
Helichrysum rugulosum
Melinis nerviglumis
Brachiaria serrata
Athrixia elata
Helichrysum coriaceum
Hermannia depressa
Ellerburus muticus
Seriphium plumosum
Trachypogon spicatus
Eragrostis racemosa
Lippia javanica
Vernonia oligocephala
Chlorophytum cooperi
Wahlenbergia undulata
Hibiscus aethiopicus var. ovatus
Hypericum aethiopicum subsp. sonderi
Asparagus suaveolens
Ipomoea oblongata
Species group T
Themeda triandra
Conyza podocephala
Conyza albida
Heteromorpha arborescens var. abyssinica
Hyparrhenia hirta
Diospyros lycioides subsp. guerkei
Teucrium trifidum
Solanum lichtensteinii
Eragrostis curvula
Hypoxis rigidula
Tagetes minuta
Bidens pilosa
Corchorus confusus
Oenothera tetraptera
Setaria nigrirostris
Gomphocarpus fruticosus
Cucumis zeyheri
Chlorophytum trichophlebium
Oxalis obliquifolia
Salvia runcinata
Ledebouria ovatifolia
Cynoglossum hispidum
Pollichia campestris
Sida dregei
Verbena bonariensis
Species group U
Sonchus dregeanus
Aster peglerae
Sebaea grandis
Gerbera species
Gerbera ambigua
Helichrysum cephaloideum
Panicum maximum
Striga asiatica
Tephrosia elongata var. elongata

Plant Community Number: 1 2 3 3.1 3.2 4 5 5.1 5.2 5.3 6 7 8 9

Relève

Species

*Eragrostis capensis*
*Campuloclinium macrocephalum*
*Indigofera setiflora*
*Cymbopogon pospischilii*
*Phymaspermum athanasioides*
*Aristida congesta* subsp. *barbicollis*
*Andropogon schirensis*
*Indigofera zeyheri*
*Crabbea hirsuta*
*Vangueria parvifolia*
*Sebaea leiostyla*
*Gnidia caffra*
*Ipomoea purpurea*
*Schistostephium crataegifolium*
*Englerophytum magalismontana*
*Rhynchosia minima* var. *prostrata*
*Albuca* species
*Bowiea volubilis*
*Eragrostis patentipilosa*
*Osteospermum muricatum* subsp. *muricatum*
*Polygala uncinata*
*Hypoxis argentea*
*Scilla nervosa*
*Phyllica paniculata*
*Heteropogon contortus*
*Searsia lancea*
*Ipomoea bathycolpos*
*Rubus rigidus*
*Nuxia congesta*
*Becium obovatum* subsp. *obovatum* var. *obovatum*
*Vahlia capensis* subsp. *vulgaris*
*Nidorella hottentotica*
*Cyphia assimilis*
*Pentarrhinum insipidum*
*Senecio lydenburgensis*
*Crabbea angustifolia*
*Leucosidea sericea*
*Setaria sphacelata* var. *torta*
*Aristida diffusa* subsp. *burkei*
*Ipomoea crassipes*
*Convolvulus sagittatus* subsp. *sagittatus* var. *sagittatus*
*Berkheya radula*
*Nemesia fruticans*
*Commelina modesta*
*Tritonia nelsonii*
*Striga bilabiata*
*Artemisia afra*
*Aerva leucura*
*Indigofera hedyantha*
*Berkheya zeyheri* subsp. *zeyheri*
*Viscum rotundifolium*
*Gomphrena celosioides*
*Acacia robusta* subsp. *robusta*
*Acrotome hispida*
*Kalanchoe paniculata*
*Dovyalis caffra*
*Sehima galpinii*
*Buddleja salviifolia*
*Xysmalobium undulatum* var. *undulatum*
*Aloe zebrina*
*Senecio pentactinus*
*Gomphocarpus tomentosus*
*Eragrostis pallens*
*Combretum molle*
*Solanum sisymbriifolium*
*Crassula swaziensis*
*Helichrysum dasymallum*
*Lessertia stricta*
*Datura stramonium*
*Kyllinga alba*
*Solanum mauritianum*
*Kalanchoe rotundifolia*
*Cosmos bipinnatus*
*Tarchonanthus camphoratus*
*Setaria verticillata*
*Convolvulus aschersonii*
*Asparagus virgatus*
*Eragrostis rigidior*
*Indigofera* species
*Oenothera rosea*
*Gazania krebsiana* subsp. *serrulata*
*Indigofera adenoides*
*Asclepias adscendens*
*Aspidoglossum lamellatum*
*Cephalaria zeyheriana*
*Chlorophytum fasciculatum*
*Melolobium wilmsii*
*Evolvulus alsinoides*
*Dimiopsis burkei*
*Sphedamnocarpus pruriens*
*Commelina livingstonii*
*Kalanchoe thyrsiflora*
*Cyperus rotundus*
*Gladiolus dalenii*
*Aristida junciformis* subsp. *junciformis*
*Senecio scitus*
*Tristachya leucothrix*
*Crassula capitella*
*Hypoxis galpinii*
*Cyperus* species
*Gladiolus permeabilis*
*Cyperus rupestris*
*Ximenia caffra*
*Euryops laxus*
*Lotononis foliosa*
*Lotononis eriantha*
*Waltheria indica*
*Paspalum scrobiculatum*
*Stachys caffra*
*Limosella maior*
*Persicaria serrulata*
*Citrullus lanatus*
*Kiggelaria africana*
*Hypoestes forskaolii*
*Abutilon austro-africanum*
*Freesia grandiflora*
*Kalanchoe* species
*Asparagus setaceus*
*Sciadoxus puniceus*
*Heliotropium ciliatum*
*Duchesnea indica*
*Lannea discolor*
*Euclea natalensis*
*Rothmannia capensis*
*Urochloa oligotricha*
*Apodytes dimidiata* subsp. *dimidiata*
*Commelina africana*
*Ennealopogon cenchroides*
*Coccinia sessilifolia*
*Pavetta gardeniifolia* var. *gardeniifolia*
*Nesaea schinzii*
*Eragrostis biflora*
*Aloe marlothii* subsp. *marlothii*
*Cyathula uncinulata*
*Viscum combreticola*
*Digitaria argyrograpta*
*Helinus integrifolius*
*Argyrolobium pauciflorum* var. *pauciflorum*
*Vernonia sutherlandii*
*Barleria obtusa*
*Myrsine africana*
*Digitaria tricholaenoides*
*Crotalaria orientalis* subsp. *orientalis*
*Pennisetum clandestinum*
*Chloris virgata*
*Linum thunbergii*
*Jamesbrittenia aurantiaca*
*Androcymbium* species
*Chironia palustris* subsp. *transvaalensis*
*Helichrysum setosum*
*Trichoneura grandiglumis*


Plant Community Number:
Relève
Species
Berkheya insignis
Crotalaria laburnifolia subsp. australis
Babiana hypogea var. hypogea
Eragrostis obtusa
Dichapetalum cymosum
Dipcadi viride
Ornithogalum tenuifolium subsp. tenuifolium
Habenaria epipactidea
Dolichos angustifolius
Andropogon appendiculatus
Zornia linearis
Crabbea species
Tephrosia capensis var. capensis
Asclepias meliodora
Senecio othonniflorus
Asclepias albens
Hypoxis interjecta
Ipomoea ommaneyi
Alysicarpus rugosus subsp. perennirufus
Protasparagus species
Solanum species
Gnidia capitata
Sonchus nanus
Indigofera filipes
Xerophyta viscosa
Crassula setulosa var. setulosa
Gladiolus elliotii
Enneapogon scoparius
Berkheya carlinopsis subsp. magalismontana
Hemizygia pretoriae
Adromischus umbraticola
Argyrolobium tuberosum
Senecio coronatus
Bergia decumbens
Salvia species
Tulbaghia acutiloba
Chlorophytum transvaalense
Eulophia ovalis var. ovalis
Canthium gilfillanii
Sida alba
Psiadia punctulata
Senecio glanduloso-pilosus
Chaetacanthus costatus
Dipcadi species
Pseudognaphalium luteo-album
Gymnosporia tenuispina
Brachylaena rotundata
Oropetium capense
Plectranthus madagascariensis
Eragrostis nindensis
Felicia filifolia
Ochna pulchra
Commelina erecta
Wahlenbergia denticulata var. denticulata
Ursinia nana subsp. nana
Vernonia staehelinoides
Cleome maculata
Fuirena pubescens
Ancylobotrys capensis
Leonotis ocymifolia var. schinzii
Solanum elaeagnifolium