

THE VEGETATION TYPES AND VELD CONDITION

of

Maremani

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EXECUTIVE SUMMARY

The aim of this project was to classify, describe and map the vegetation types, assess the veld condition and determine the economic carrying capacity for grazer and browser wildlife of Maremani.

Maremani is situated in the Limpopo Province, east of Messina, between approximately 22E 18' and 22E 32' South, and 30E 13' and 30E 25' East. The reserve covers approximately **36583** ha. The area is characterised by plains, undulating and gravelly hills, rocky outcrops, higher mountain ranges, and rivers and streams. The altitude varies from approximately 427 m along the Limpopo River to 833 m at Mount Ga-Dowe on the farm Palm Grove.

The mean annual rainfall for the Maremani area varies from 331 mm at Messina in the west to 342 mm at Tshipise in the south. The rainy season is predominantly from October to March with about 85% of the mean annual rainfall occurring during these months. The driest months are from June to August. The mean annual temperature measured at Messina is 23.4EC while the extreme maximum and minimum temperatures measured at Messina are 43.8EC and 2.7EC respectively. The area is regarded as frost free.

Stereo aerial photographs were used to stratify the area into relatively homogeneous units on the basis of physiography and vegetation cover, at a scale of 1: 50 000. The vegetation survey consisted of recording all identifiable plant species and allocating a percentage cover value to each species. The density (individuals per ha) of the tree and shrub layers was determined by counting individuals in a number of quadrats. A point survey of the grass layer was made to determine the frequency of grass species to calculate veld condition and the economic carrying capacity. The disc pasture meter was used to determine the amount of grass biomass.

A classification of vegetation data was done with the TURBOVEG and MEGATAB computer programmes. Seventeen plant communities were distinguished on Maremani and the description of the plant communities is accompanied by a vegetation map at a scale of 1: 50 000. The percentage canopy cover, density and height of the different growth forms were used to determine the structure of each plant community.

The veld condition and economic carrying capacity of the plant communities were assessed and the present economic carrying capacity for the entire area is calculated as **39.2** ha/LAU. Other methods were also used to determine the carrying capacity of the area, i.e. the Veld condition/rainfall method (**40.7** ha/LAU); Phytomass method (**48** ha/LAU); Rainfall method (**25.7** ha/LAU); the LAU/BU method (Snyman)(**36.8** ha/LAU for grazers and **9.2** BU/100 ha (browsers)). The recommended carrying capacity according to the LAU/BU method is **41.4** ha/LAU for grazers and **8** BU/100 ha(browsers).

The present low grass biomass and poor species composition indicate veld that is not suitable for high numbers of high-selective grazer species.

Game species that historically occurred in the area are Black Rhinoceros, Blue Wildebeest, Bushbuck, Bushpig, Buffalo, Duiker, Eland, Giraffe, Grey Rhebuck, Hippopotamus, Impala, Klipspringer, Kudu, Ostrich, Reedbuck, Steenbok, Roan antelope, Sable antelope, Tsessebe, Warthog, Waterbuck, White Rhinoceros and Zebra. Species occurring on Maremani that were not historically from that area include Blesbok, Gemsbok and Red Hartebeest. Provision is made for 9% low-selective or bulk feeders (grazers), 13% high selective grazers, 38% mixed grazers/browsers and 40% browsers. The low percentage of grazers is due to the poor condition of the grass layer and at this stage the area is more suitable for mixed feeders and browsers.

Monitoring is an important aspect of veld management. Aspects that should be monitored routinely are rainfall, game numbers, game mortalities, game distribution, herd composition and birth rates. Other aspects that are necessary to monitor include the veld condition in terms of plant species composition, species frequency, density and/or cover; carrying capacity; the effects of water provision on veld condition and animal movements; the effects of bush encroachment; bush control; veld reclamation measures such as soil erosion control; and the effects of browsing on indicator plant species e.g. Baobab (*Adansonia digitata*), Shepherd's tree (*Boscia albitrunca*), Common star chestnut (*Sterculia rogersii*), Sesame bush (*Sesamothamnus lugardii*), Marula (*Sclerocarya birrea*) and Corkwood species (*Commiphora* species).

Approximately 71 tree species, 92 shrub species, 76 grass species, 7 sedge species, 9 geophytes, 30 succulents, 6 parasites, 2 palm species, 2 fern species, 290 forb species and 14 alien species are listed, representing a total of 599 plant species.

TERMS OF REFERENCE

The assignment is interpreted as follows:

Classify, describe and map the vegetation types, assess the veld condition and determine the ecological capacity of suitable grazer and browser game species for the area.

1. Initial preparation

Obtain all relevant maps (topocadastral, geology, land types), stereo aerial photographs, climatic data (rainfall and temperature), as well as information on the infrastructure and natural environment of the area concerned. Stratification of the area into relatively homogeneous units on aerial photographs, by using a stereoscope, on the basis of physiography and vegetation cover.

1. Vegetation and habitat survey

Survey the stratified units and record all identifiable plant species, as well as habitat features, e.g. geology, topography, aspect, slope and rock cover. Classify the data by means of the TURBOVEG and MEGATAB computer programs and describe and map the different plant communities. Identify alien species and possible encroacher/invasive plant species.

Determine the structure of the plant communities in terms of canopy cover and density for different strata. Quantitatively survey the grass species composition to assess veld condition to calculate the economic carrying capacity of each plant community. Determine the aboveground grass biomass was determined.

Identify and map management units based on vegetation types, environmental features, rivers and the present road network. Compile a checklist of the plant species of the area.

2. Economic carrying capacity for game

Determine the grazing and browsing capacity for the area under long-term average rainfall conditions. Calculate the stocking rate based on present game numbers. Recommend game numbers and ratios of grazers and browsers for the area, based on present veld condition and economic capacity.

Identify ecologically sensitive areas and/or problem areas in need of special management, e.g. bush encroached, eroded and degraded areas.

3. Monitoring and recommendations

Recommend aspects of the vegetation that should be managed and monitored.

CHAPTER 2

INTRODUCTION

During the last decade or two, wildlife management has developed into a complicated and sophisticated, scientifically based enterprise. In practice the management of these enterprises is often not based on ecological principles, resulting in the deterioration of the environment, and consequently in the loss of valuable natural assets and also the loss of the potential productivity of the veld. This does not only have economic consequences, but from a conservation viewpoint, the biological diversity of the natural ecosystem is influenced. To enable the assessment of veld condition and economic carrying capacity, an ecological evaluation of the area is necessary.

Vegetation is probably the single-most influential characteristic of the environment that can reveal many pieces of vital information on various aspects of an area under observation. Not only is vegetation a large contributor when assessing environments in terms of mineral wealth and current health status, it is one of the largest role players when it comes to rectifying and rehabilitating lost and damaged habitats.

Plant communities and their associated habitats form the basis of scientifically based environmental and veld management plans. Each plant community has a certain characteristic plant species composition, that is mainly a result of the specific environmental composition of its habitat (climate, geology, rock cover, topography, soil types, drainage, water regime, etc.). The habitat also influences the distribution and structure of plant communities. However, plant communities may also be affected by the utilization history of the area. The specific potential of each plant community, with regard to habitat type for animals, grazing and browsing capacity and resilience to utilization and drought, is a direct result of the combined influence of environmental factors and past management. Consequently each plant community will react differently to certain vegetation management practices, for example grazing pressure, fire and utilization by man. Certain plant communities will show signs of deterioration sooner, under a particular management regime. The soils of certain plant communities are also more susceptible to erosion.

All components of the Maremani ecosystems (physical environment, vegetation, animals) are interrelated and interdependent. A holistic approach is therefore imperative to conserve and utilize the given natural resources effectively. Ideally the area should be managed to be self-sustaining, while the quality and diversity of the resources should not be allowed to decrease, as this would inevitably lead to ecosystem degradation and lower productivity.

The objectives of a vegetation survey and veld management plan for Maremani are therefore to:

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- identify, describe and map the different plant communities;
- contribute to the conservation of the habitats (ecosystems) of the area;
- assess veld condition and economic carrying capacity;
- stock the area with suitable game according to its economic carrying capacity;
- increase the value of the land; and
- contribute to the sustainable utilization of the area.

CHAPTER 2

STUDY AREA

Location

Maremani is situated in the Limpopo Province, east of Messina, between approximately 22E 18' and 22E 32' South, and 30E 13' and 30E 25' East. The study area covers approximately 36583 ha.

Terrain morphology

The terrain morphology of the area is described by Kruger (1983) as very irregular plains and low hills with a relief from 30 m to 210 m, while more than 80% of the slopes has a slope of less than 5%. The area is characterised by plains, undulating and rocky hills, rocky outcrops, higher mountain ranges, rivers and seasonal streams. The altitude varies from approximately 427 m along the Limpopo River to 833 m at Mount Ga-Dowe on the farm Palm Grove. The altitude on the southern border of the farm Solitude is about 488 m (Topocadastral maps at scale of 1: 50 000: 2230AA & AC Messina; 2230AD Esmefour; 2230 Gaandrik; Government Printer, Pretoria).

Geology

Broadly the geology (lithology) of the study area from north-west to south-east includes:

- ! gneiss and quartzite with gabbro in between;
- ! calc-silicate rocks and gneiss;
- ! basalt;
- ! sandstone;
- ! siltstone;
- ! shale and mudstone;
- ! dolerite; and
- ! sandstone and grit.

Alluvium is found along the rivers and streams (see 2230 Messina, 1: 250 000 Geological Series map, Government Printer, Pretoria).

Land Types and soils

Nine land types have been described and mapped for the area. These are: Land types **Ib314**, **Ah88**, **Ah89**, **Ah91**, **Fc482**, **Fc483**, **Fc484**, **Ae265** and **Ae266**.

The **Ib314** land type is described as 'rocky areas with miscellaneous soils' and covers part of the hilly areas in the north. Soils are derived from gneiss and quartzite.

The **Ah88** land type has reddish sandy clay loam soils derived from dolerite, with a high clay content. The **Ah89** land type is characterised by reddish loamy sand to sandy loam derived from gneiss, and the **Ah91** land type has red and yellow loamy sand derived from shale, mudstone and siltstone, with a clay content of less than 15%.

In the **Fc** land types calcrete and calcareous soils are present. The **Fc482** land type is characterised by loamy sand derived from sandstone, calc-silicate and quartzite, the **Fc483** land type has sandy loam soils derived from gneiss, and the **Fc484** land type has loam sandy soils derived from gneiss and quartzite.

The **Ae265** land type consists of reddish sandy loam to sandy clay loam soils derived from basalt. The soils are usually deeper than 300 mm. Within the **Ae266** land type reddish sandy loam soils, derived from gneiss, are found.

Soils derived from gneiss, quartzite and sandstone are usually leached and have a low nutrient content whereas soils derived from shale, siltstone, mudstone, dolerite and basalt are usually more clayey and have a higher nutrient content and water-holding capacity.

Silty and clayey alluvial soils occur on flood plains along the Limpopo and Njelele Rivers as well as along streams and in the wetland of the Mutanga River in the south of the farm Solitude.

Climate

The mean annual rainfall for the Maremani area varies from 331 mm at Messina in the west to 342 mm at Tshipise in the south (Tables 1 & 2; Erasmus 1987; Weather Bureau 1988). The rainy season is predominantly from October to March, with approximately 85% of the mean annual rainfall occurring during these months. The driest months are from June to August (Table 1 and Figure 1). The maximum rainfall measured in 24 hours was 167 mm (Table 3). Evaporation is much higher than the annual rainfall.

Rainfall is the primary driving force influencing productivity of the vegetation, therefore the economic carrying capacity for the area was calculated at a mean annual rainfall of 340 mm. After prolonged drought the area can become totally unsuitable for animal production (especially for grazers) and appropriate measures should be taken to avoid animal losses, e.g. reducing animal numbers and supplementary feeding.

The mean annual temperature for the region is 23.4EC (Table 4). The mean daily maximum for December is 32.3EC and for July 26.6EC. The mean daily minimum for December is 21.1EC and for June 10.6EC. The extreme maximum and minimum temperature measured at Messina over a period of 43 years were 43.8EC and 2.7EC respectively (Table 4). The area is regarded as frost free.

The mean percentage relative humidity for the area is given in Table 5.

CHAPTER 3

METHODS

Approach

Stereo aerial photographs were provided by the client. For proper and efficient surveying, an ecological stratification of 1: 50 000 scale aerial photographs on the basis of terrain morphology and vegetation cover should be made beforehand. This stratification is used to determine the position and number of sample plots, and is the basis for identifying habitat types.

Vegetation surveys

An assessment of the habitat, e.g. dominant plant species, topography, geology, rocky outcrops and rock cover, soil texture, soil depth, slope and aspect, and a visual assessment of veld condition were made at each sampling plot.

The vegetation survey consisted of recording all identifiable trees, shrubs, grasses, sedges, ferns, forbs, geophytes, succulents, palms and alien (exotic) plants within each sample plot. Forbs are herbaceous plants not considered as grasses. Each species was allocated a percentage cover value which is required for the classification and description of the plant communities.

An estimate of the total vegetation cover (%) was given for different strata: trees above 6 m, from 3 m to 6 m, shrubs below 3 m, as well as the herbaceous layer (grasses and forbs). The density (individuals per ha) of the tree and shrub layers was determined by counting individuals in several quadrats. The average height of the different strata was estimated as well as the maximum height of the large trees.

Where possible, a point survey of the grass layer was made to determine the frequency (%) of grass species which is an indication of the dominance or importance of the species. The information was used to calculate veld condition and the economic carrying capacity of each plant community.

The disc pasture meter was used, where possible, to determine the amount of grass biomass (fuel load). The rocky outcrops were excluded from measurements with the disc pasture meter.

Data analyses

A classification of the vegetation data was done with the TURBOVEG and MEGATAB computer programmes (see Table 6). The description of plant communities includes the high tree, tree, shrub, grass and forb (herbaceous) layers. The plant species recorded for the quarter degree grids that include Maremani were obtained from the PRECIS data bank of the National Herbarium at the National Botanical Institute, Pretoria. All species recorded in the sample plots are listed in Table 6 and in Appendix A. The description of the plant communities is accompanied by a vegetation map at a scale of 1: 50 000 (Figure 2).

Vegetation structure in terms of canopy cover, density and height of the woody species are given in Tables 7, 8 & 9 and Figures 3 to 7. The phytomass production of the different vegetation types is given in Table 10.

The subdivision of the area into larger units (zones or management units) is based on floristically related vegetation types, but geology, topography, existing roads and rivers were also taken into account to produce relatively homogeneous and practical units (Figure 8).

The economic carrying capacity of each vegetation unit was determined with the Ecological Index Method. This incorporates the classification of species into ecological groups. These groups e.g. Decreasers and Increasers 1, 2a, 2b and 2c, are based on the reaction of the species to grazing pressure, its palatability, biomass production and preference by herbivores.

Other methods to determine the economic carrying capacity for wildlife on game ranches were used and the values obtained compared with the Ecological Index method e.g. the Combined veld condition and rainfall method (Danckwerts 1989); the Herbaceous Phytomass method (Moore & Odendaal 1987); the Rainfall method (Coe, Cumming & Phillipson 1976); and the Graze/ Browse Unit method (Snyman 1991; Dekker 1996; 1997).

The economic carrying capacity, game numbers obtained from recent (2001) counts, and recommended numbers of species are given in Tables 12 to 15. Game that historically occurred in the area, are listed (see Chapter 10) and the ratio of suitable species in terms of low and high selective grazers, mixed feeders and browsers, are given in Tables 12 & 15.

CHAPTER 4

VEGETATION

The area was described and mapped by Acocks (1988) as Mopane Veld (veld dominated by *Colophospermum mopane*), while Low & Rebelo (1998) classified the area as Mopane Bushveld. According to their estimate about 38% of the Mopane Bushveld is conserved, mainly in the northern Kruger National Park (Low & Rebelo 1998).

Differences in topography, geology, rockiness, drainage, soil texture and depth, slope, the presence of calcrete and previous land-use have resulted in differences in vegetation. Each vegetation unit therefore represents a different ecosystem, with its own set of habitat conditions and plant species composition.

The area is arid and relies on rainfall events for fodder production to sustain the animals. Supplementary feeding is sometimes needed to prevent severe loss of condition or mortalities among animals.

Seventeen plant communities were distinguished on Maremani (Table 6) and mapped as such (Figure 2).

These 17 plant communities on Maremani can be grouped into six main vegetation types:

- A. **Rocky outcrops** with the Small-leaved rock fig (*Ficus tettensis*), Large-leaved rock fig (*Ficus abutilifolia*), Paperbark corkwood (*Commiphora marlothii*) and Mountain grass (*Danthoniopsis dinteri*) the conspicuous species (communities 1, 2 and 3);
- B. **Mopane veld** on gneiss and quartzite dominated by Mopane (*Colophospermum mopane*), Lowveld cluster-leaf (*Terminalia prunioides*), White syringa (*Kirkia acuminata*), Red bushwillow (*Combretum apiculatum*), Resin gardenia (*Gardenia resiniflua*,) and Mountain grass (*Danthoniopsis dinteri*)(communities 4, 5, 6, 7 & 8).

This broad vegetation type is further divided into two subtypes based on environmental features:

- ! **Mopane bushveld on undulating low rocky hills and gravelly slopes on**

shallow soils derived from gneiss and quartzite (community 4, Table 6), with Mopane (*Colophospermum mopane*), Red bushwillow (*Combretum apiculatum*), Jacket-plum (*Pappea capensis*), Stunted plane (*Ochna inermis*), White-stem corkwood (*Commiphora tenuipetiolata*), *Xerophyta viscosa* and Mountain grass (*Danthoniopsis dinteri*) the diagnostic species.

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Mopane woodland on plains with moderately deep, to deep soils derived from gneiss and quartzite, and a low rock cover (communities 5, 6, 7 & 8, Table 6). Tall trees of Mopane (*Colophospermum mopane*), White syringa (*Kirkia acuminata*) and Marula (*Sclerocarya birrea*) are prominent. Other abundant trees include Red bushwillow (*Combretum apiculatum*), Velvet corkwood (*Commiphora mollis*), Common star chestnut (*Sterculia rogersii*), Blue-thorn (*Acacia erubescens*), Silver raisin (*Grewia monticola*) and False marula (*Lannea schweinfurthii*).

- C. **Low Mopane bushveld and thickets on calcrete, shale and basalt** dominated by Mopane (*Colophospermum mopane*), Stink shepherd's tree (*Boscia foetida*), Mopane pomegranate (*Rhigozum zambesiaceum*), Trumpet thorn (*Catophractes alexandri*), Transvaal sesame bush (*Sesamothamnus lugardii*), Narrow-leaved mustard tree (*Salvadora australis*), the grasses *Tetrapogon tenellus* and Thimble grass (*Fingerhuthia africana*) and the forb *Monechma divaricatum* (communities 9, 10 and 11).
- D. **Species-poor Mopane thickets and forests** in lowlands and along watercourses, where Mopane (*Colophospermum mopane*), Lowveld cluster-leaf (*Terminalia prunioides*) and Shepherd's tree (*Boscia albitrunca*) are the dominant species (communities 11, 12 and 13).
- E. **Disturbed areas** (overgrazed veld, old fields, watering points and kraals) where Umbrella thorn (*Acacia tortilis*) and Sickie bush (*Dichrostachys cinerea*) are the dominant species (community 14); and
- F. **Riverine communities** on alluvial floodplains, with Leadwood (*Combretum imberbe*), Apple-leaf (*Philenoptera violacea*), Nyala tree (*Xanthocercis zambesiaca*), Ilala palm (*Hyphaene coriacea*) and *Cyperus sexangularis* the dominant species (communities 15, 16 and 17) (Table 6 and Figure 2).

The following plant communities were distinguished:

1. *Croton gratissimus* - *Danthoniopsis dinteri* rocky outcrops
(Lavender feverberry - Mountain grass rocky outcrops)
- 1.1 *Entandrophragma caudatum* - *Portulacaria afra* mountain bushveld
(Mountain mahogany - Porkbush mountain bushveld)
2. *Androstachys johnsonii* - *Terminalia sericea* sandstone hills
(Lebombo iron wood - Silver cluster-leaf sandstone hills)
3. *Combretum apiculatum* - *Danthoniopsis dinteri* - *Tricholaena monachne* rocky outcrops
(Red bushwillow - Mountain grass - Blue-seed grass rocky outcrops)
4. *Colophospermum mopane* - *Xerophyta viscosa* open to dense bushveld on low hills and rocky outcrops
(Mopane - *Xerophyta viscosa* open to dense bushveld and low hills and rocky outcrops)
5. *Colophospermum mopane* - *Terminalia prunioides* - *Psiadia punctulata* bushveld
(Mopane - Lowveld cluster-leaf - *Psiadia* bushveld)
6. *Sclerocarya birrea* - *Aristida stipitata* - *Eragrostis lehmanniana* open grass and bushveld
(Marula - Long-awned three-awn - Lehmann's love grass open grass and bushveld)
7. *Colophospermum mopane* - *Kirkia acuminata* - *Acacia erubescens* plains bushveld and woodland
(Mopane - White syringa - Blue thorn plains bushveld and woodland)
8. *Colophospermum mopane* - *Boscia albitrunca* - *Terminalia prunioides* open to dense bushveld on plains and low rocky hills
(Mopane - Shepherd's tree - Lowveld cluster-leaf open to dense bushveld on plains and low rocky hills)
9. *Colophospermum mopane* - *Catophractes alexandri* - *Vernonia cinarens* low and dense bushveld
(Mopane - Trumpet thorn - *Vernonia* low and dense bushveld)
10. *Colophospermum mopane* - *Sesamothamnus lugardii* - *Acacia tortilis* open to dense low bushveld
(Mopane - Transvaal sesame bush - Umbrella thorn open to dense low bushveld)
11. *Colophospermum mopane* - *Gardenia resiniflua* - *Tetrapogon tenellus* low thicket
(Mopane - Resin gardenia - *Tetrapogon* low thicket)
12. *Colophospermum mopane* - *Aristida adscensionis* bushveld
(Mopane - Nine-awned grass bushveld)
13. *Colophospermum mopane* - *Acacia tortilis* - *Eragrostis lehmanniana* low dense bushveld
(Mopane - Umbrella thorn - Lehmann's love grass low dense bushveld)
14. *Acacia tortilis* - *Eragrostis lehmanniana* old fields
(Umbrella thorn - Lehmann's love grass old fields)

15. *Pechuel-loeschia leubnitziae* - *Urochloa mosambicensis* open grassland to dense bushveld
(Wild sage - Common signal grass open grassland to dense bushveld)
16. *Combretum imberbe* - *Philenoptera violacea* stream community
(Leadwood - Apple-leaf stream community)
17. *Xanthocercis zambeziaca* - *Acacia robusta* - *Cyperus sexangularis* riparian community
(Nyala tree - Brack thorn - *Cyperus* riparian community)

Description of the plant communities:

1. *Croton gratissimus* - *Danthoniopsis dinteri* rocky outcrops (Lavender feverberry - Mountain grass rocky outcrops)

This community occurs scattered on sandstone, dolerite and gneiss rocky outcrops in the Steenbokrandjes and Palm Grove area and in the east and south on Frampton, Skirbeek, Dawn, Solitude and Bosbokpoort, and covers approximately 936 ha (Figure 2). It occurs on shallow red to brown sandy loam soils with a rock cover of 60% to 100%.

The **diagnostic species** are the Lavender feverberry (*Croton gratissimus*), Cork bush (*Mundulea sericea*) and Natal guarri (*Euclea natalensis*) (species group 1, Table 6).

High trees (>6 m) have an average canopy cover of 2% and are characterised by the Shepherd's tree (*Boscia albitrunca*), Paperbark corkwood (*Commiphora marlothii*), White syringa (*Kirkia acuminata*), Mountain False-thorn (*Albizia brevifolia*) and Small-leaved rock fig (*Ficus tettensis*).

Trees cover on average 5% of the area and the dominant species are the Lavender fever-berry (*Croton gratissimus*), Red bushwillow (*Combretum apiculatum*), Large-leaved rock fig (*Ficus abutilifolia*), Sjambokpod (*Cassia abbreviata*) and the Lowveld milkberry (*Manilkara mochisia*).

Shrubs cover on average 20% of the area and are characterised by the Corkbush (*Mundulea sericea*), Natal guarri (*Euclea natalensis*), and Knobbly creeper (*Combretum mossambicense*).

The **grass** layer covers on average 40% of the area. Grass species such as Mountain grass (*Danthoniopsis dinteri*), Finger grass (*Digitaria eriantha*), Sand quick (*Schmidtia pappophoroides*), and Blue-seed grass (*Tricholaena monachne*) are locally abundant.

Herbaceous species in this community cover 5% of the area, with *Barleria affinis* a prominent perennial species.

1.1 ***Entandrophragma caudatum* - *Portulacaria afra* mountain bushveld**

(Mountain mahogany - Porkbush mountain bushveld)

This community occurs on gneiss and quartzitic mountains in the north of Maremani. The vegetation on these high mountains of Palm Grove and Malalahoek e.g. Ga-Dowe, differ floristically from the other hills and rocky outcrops on Maremani due to the presence of diagnostic species such as Mountain mahogany (*Entandrophragma caudatum*), Porkbush (*Portulacaria afra*), Wild apricot (*Ancylobotrys capensis*) and *Aloe globuligemma*. This community covers approximately 381 ha.

2. ***Androstachys johnsonii* - *Terminalia sericea* sandstone hills**

(Lebombo iron wood - Silver cluster-leaf sandstone hills)

This community occurs mainly on the rocky sandstone ridge in the south-eastern parts of Maremani and covers approximately 491 ha (Figure 2). It forms the southern border of the farms Dawn, Frampton and Skirbeek, and the northern border of Solitude. It occurs on shallow to deep red-brown loamy sand with a rock cover varying from 50 to 100%.

Some of the **diagnostic species** are the Lebombo iron wood (*Androstachys johnsonii*), Silver cluster-leaf (*Terminalia sericea*), Herringbone grass (*Pogonarthria squarrosa*), the grass *Digitaria milanjiana* and the sedge *Coleochloa pallidior* (see species group 2, Table 6).

High trees (>6 m) have an average canopy cover of 1% and are characterised by Mountain false-thorn (*Albizia brevifolia*), Propeller tree (*Gyrocarpus americanus*), Shepherd's tree (*Boscia albitrunca*) and the Lowveld milk berry (*Manilkara mochisia*).

Trees (>3 - 6 m) cover on average 13% of the area and the dominant species are the Lebombo iron wood (*Androstachys johnsonii*), Silver cluster-leaf (*Terminalia sericea*), Small-leaved rock fig (*Ficus tettensis*) and Paperbark corkwood (*Commiphora marlothii*).

Shrub species (<3 m) cover on average 22% of the area and are characterised by the Giant raisin (*Grewia hexamita*), Bluebush (*Diospyros lycioides*), Small lavender fever berry (*Croton*

pseudopulchellus), Shakama plum (*Hexalobus monopetalus*) and the Large-leaved rock fig (*Ficus abutilifolia*).

The **grass** layer is well developed and covers on average 85% of the area. The dominant grass species and their percentage frequency are:

Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	74%
Herringbone grass (<i>Pogonarthria squarrosa</i>)	14%
Guinea grass (<i>Panicum maximum</i>)	10%
Annual three-awn (<i>Aristida adscensionis</i>)	2%

Other conspicuous grass species are *Aristida transvaalensis*, *Danthoniopsis dinteri*, *Tricholaena monachne* and *Digitaria milanjana*.

Herbaceous **forb, fern and sedge** species in this sub-community cover 5% of the area and include *Tephrosia villosa*, *Coleochloa pallidior* and *Pellaea calomelanos*.

An interesting feature found in the Tshipise sandstone ridges to the south of Dawn, Frampton and Skirbeek are the round or oval-shaped hollows on the rocky summits. These hollows are usually one to three metres in diameter and more or less 1 metre deep. They resemble potholes and were probably created by water and wind erosion. These 'rock tanks' or pools accumulate some soil at the bottom where plants become established. During the rainy season the hollows are filled with water and the plant species have to complete their life cycle before the pools dry up during winter. Some species are submerged, e.g. bladder wort (*Utricularia stellaris*) and 'babergas' (*Lagarosiphon crispus*); floating species are duck weed (*Lemna* species), rooted and floating species are the water lily (*Nymphaea caerulea*) and *Aponogeton junceus*; and in the moist soil on the edges, sedge species (*Cyperus* spp.) as well as water clover (*Marsilea ephippiocarpa*), *Kyllinga alba* and the grass *Eragrostis tenella* are found. When the hollows dry out these plants survive as seed, spores or rhizomes until the next rainy season.

3. *Combretum apiculatum* - *Danthoniopsis dinteri* - *Tricholaena monachne* rocky outcrops (Red bushwillow - Mountain grass - Blue-seed grass rocky outcrops)

This community occurs widespread on mostly isolated gneiss and quartzite rocky outcrops and the crests of ridges (Figure 2). It covers approximately 763 ha (Figure 2) and occurs on shallow and gravelly red-brown loamy sand to sandy loam soils with a rock cover varying from 40% to 100%. Slopes vary from 8 to 15°. The vegetation composition occurring on the white and black rocky outcrops is very similar.

The **diagnostic species** are the Carrot tree (*Steganotaenia araliaceae*), Spear grass (*Heteropogon contortus*) and *Abutilon pycnodon* (species group 4, Table 6).

High trees (>6 m) have an average canopy cover of 3% and are characterised by the Small-leaved rock fig (*Ficus tettensis*), Mopane (*Colophospermum mopane*), White syringa (*Kirkia acuminata*), Shepherd's tree (*Boscia albitrunca*), Marula (*Sclerocarya birrea*) and Boabab (*Adansonia digitata*).

Trees (>3 - 6 m) cover on average 14% of the area and the dominant species are the Large-leaved rock fig (*Ficus abutilifolia*), Red bushwillow (*Combretum apiculatum*), Mopane (*Colophospermum mopane*), Lowveld cluster-leaf (*Terminalia prunioides*), Common star chestnut (*Sterculia rogersii*) and the Giant raisin (*Grewia hexamita*).

Shrubs (<3 m) cover on average 9% of the area and are characterised by the Stunted plane (*Ochna inermis*), Mallow raisin (*Grewia villosa*), Resin Gardenia (*Gardenia resiniflua*), *Anisotis rogersii*, *Tinnea rhodesiana*, Blue sourplum (*Ximenia americana*) and Knobbly creeper (*Combretum mossambicense*).

The **grass** layer is poorly developed with an average canopy cover of 11% of the area, although patches with higher cover occur. The dominant grass species and their percentage frequency are:

Mountain grass (<i>Danthoniopsis dinteri</i>)	30%
Annual three-awn (<i>Aristida adscensionis</i>)	17%
Blue-seed grass (<i>Tricholaena monachne</i>)	11%
Natal Redtop (<i>Melinis repens</i>)	9%
Nine-awned grass (<i>Enneapogon cenchroides</i>)	8%
False signal grass (<i>Brachiaria deflexa</i>)	7%
Guinea grass (<i>Panicum maximum</i>)	4%

Other grass species with a frequency of less than 4% include Finger grass (*Digitaria eriantha*), Spear grass (*Heteropogon contortus*) and Dwarf grass (*Oropetium capense*).

Forb species in this community cover 5% of the area and include *Abutilon pycnodon*, *Barleria affinis* and *Indigofera heterotricha*.

4. ***Colophospermum mopane* - *Xerophyta viscosa* open to dense bushveld on low hills and**

rocky outcrops

(Mopane - *Xerophyta viscosa* open to dense bushveld and low hills and rocky outcrops)

This community occurs on the rocky crests and slopes of the lower hills and ridges in the northern part of Maremani, north-west of the Malaladrif road and covers approximately 1398 ha (Figure 2). The slopes vary from 5 to 20E. It occurs on a shallow and gravelly red to brown sandy loam soil derived from gneiss and quartzite with a rock cover varying from 20% against the lower slopes to 80% on the crests of the low hills.

Locally the vegetation resembles a woodland with high trees of White syringa (*Kirkia acuminata*) and Marula (*Sclerocarya birrea*) the prominent species. Small knobwood (*Zanthoxylum capense*), Mountain grass (*Danthoniopsis dinteri*) and Blue-seed grass (*Tricholaena monachne*) are also conspicuous species.

The **diagnostic species** are Jacket-plum (*Pappea capensis*), *Xerophyta viscosa* and *Hippocratea africana* (species group 6, Table 6).

High trees (>6 m) have an average canopy cover of 6% and are characterised by White syringa (*Kirkia acuminata*), Mopane (*Colophospermum mopane*), Marula (*Sclerocarya birrea*), Shepherd's tree (*Boscia albitrunca*) and Knobthorn (*Acacia nigrescens*).

Trees (>3 m - 6 m) cover on average 10% of the area and the dominant species are Mopane (*Colophospermum mopane*), Red bushwillow (*Combretum apiculatum*), Lowveld cluster-leaf (*Terminalia prunioides*) and White-stem corkwood (*Commiphora tenuipetiolata*).

Shrubs (<3 m) cover on average 14% of the area and are characterised by *Anisotis rogersii*, Stunted-plane (*Ochna inermis*), Knobbly creeper (*Combretum mossambicense*), Small knobwood (*Zanthoxylum capense*), Sandpaper raisin (*Grewia flavescens*) and White raisin (*Grewia bicolor*).

The **grass** layer is poorly developed and covers on average 14% of the area. The dominant grass species and their percentage frequency are:

Mountain grass (<i>Danthoniopsis dinteri</i>)	22%
Blue-seed grass (<i>Tricholaena monachne</i>)	22%
Dwarf grass (<i>Oropetium capense</i>)	11%
Annual three-awn (<i>Aristida adscensionis</i>)	9%
Natal Redtop (<i>Melinis repens</i>)	6%

Species such as Stink grass (*Bothriochloa radicans*) and Nine-awn grass (*Enneapogon cenchroides*) occur locally abundant.

Forb species in this community cover 4% of the area and dense stands of *Tephrosia villosa* occur locally. Other forb species include *Indigofera heterotricha*, *Justicia betonica* and *Ptycholobium contortum*.

5. Colophospermum mopane - Terminalia prunioides - Psiadia punctulata bushveld (Mopane - Lowveld cluster-leaf - Psiadia bushveld)

This mopane bushveld occurs on the low hills of the farms Bosbokpoort, Dawn, Reitz and Senator in the central parts of Maremani. The geological substrate consists mainly of gneiss, quartzite and basalt (Figure 2). This bushveld covers approximately 893 ha and occurs on shallow and gravelly greyish sandy loam soils with a rock cover varying from 10% to 70%. Slopes vary from 1 to 4°.

The **diagnostic species** are *Psiadia punctulata* and *Abutilon angulatum* var. *angulatum* (species group 7, Table 6).

High trees (>6 m) have an average canopy cover of 5% and are characterised by scattered individuals of White syringa (*Kirkia acuminata*), Knobthorn (*Acacia nigrescens*), Mopane (*Colophospermum mopane*), Tall common corkwood (*Commiphora glandulosa*), Slender three-hook thorn (*Acacia senegal* var. *leiorhachis*) and Shepherd's tree (*Boscia albitrunca*).

Trees >3 m - 6 m) cover on average 12% of the area and the dominant species are Mopane (*Colophospermum mopane*), Lowveld cluster-leaf (*Terminalia prunioides*), Red bushwillow (*Combretum apiculatum*), Common star chestnut (*Sterculia rogersii*) and Velvet corkwood (*Commiphora mollis*)

Shrubs (<3 m) cover on average 17% of the area and are characterised by White raisin (*Grewia bicolor*), Sickie bush (*Dichrostachys cinerea*), *Maerua parvifolia*, Sandpaper raisin (*Grewia flavescens*) and Velvet raisin (*Grewia flava*).

The **grass** layer is poorly developed and covers on average 15% of the area. The dominant grass species and their percentage frequency are:

Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	29%
False signal grass (<i>Brachiaria deflexa</i>)	13%
Annual three-awn (<i>Aristida adscensionis</i>)	8%

Sand quick (<i>Schmidtia pappophoroides</i>)	3%
Blue buffalo grass (<i>Cenchrus ciliaris</i>)	2%
Dwarf grass (<i>Oropetium capense</i>)	2%

Species with a frequency of 2% and lower are listed in Table 6.

Forb species in this community cover 6% of the area and include *Tephrosia villosa*, *Abutilon austro-africanum* and *Ocimum americanum*.

**6. *Sclerocarya birrea* - *Aristida stipitata* - *Eragrostis lehmanniana* open grass and bushveld
(Marula - Long-awned three-awn - Lehmann's love grass open grass and bushveld)**

This open sandveld covers approximately 1106 ha and occurs mainly on the plains and gentle foot slopes of the hills as well as old fields or previously cultivated areas on Frampton, Skirbeek and Dawn in the south of Maremani (Figure 2). It occurs on deep red loamy sand derived from sandstone, calc-silicate and quartzite. The sandy soils are underlain by calcrete in places. Rocks are mostly absent in this community. Silver cluster-leaf (*Terminalia sericea*), Sand quick (*Schmidtia pappophoroides*) and Silky bushman grass (*Stipagrostis uniplumis*) are some of the characteristic species.

The **diagnostic species** are Long-awned three-awn (*Aristida stipitata*) and Wild medlar (*Vangueria infausta*) (Species group 8, Table 6).

High trees (>6 m) have an average canopy cover of 3% and are characterised by scattered individuals of Marula (*Sclerocarya birrea*), Mopane (*Colophospermum mopane*) and Boabab (*Adansonia digitata*).

Trees (>3 m - 6 m) cover on average 9% of the area and the dominant species are Mopane (*Colophospermum mopane*), Marula (*Sclerocarya birrea*), Silver cluster-leaf (*Terminalia sericea*), Umbrella thorn (*Acacia tortilis*) and Shepherd's tree (*Boscia albitrunca*).

Shrubs (<3 m) cover on average 11% of the area and are characterised by White raisin (*Grewia bicolor*), Sickie bush (*Dichrostachys cinerea*) and Umbrella thorn (*Acacia tortilis*).

The **grass** layer is well developed and covers on average 66% of the area. The dominant grass species and their percentage frequency are:

Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	55%
Natal Redtop (<i>Melinis repens</i>)	8%
Silky bushman grass (<i>Stipagrostis uniplumis</i>)	8%
Annual three-awn (<i>Aristida adscensionis</i>)	7%
Sand quick (<i>Schmidtia pappophoroides</i>)	7%
Guinea grass (<i>Panicum maximum</i>)	7%
Long-awned three-awn (<i>Aristida stipitata</i>)	6%

Species with a frequency of 6% or lower are listed in Table 6 and include Giant three-awn (*Aristida meridionalis*).

Forb species in this community cover 5% of the area and include *Abutilon austro-africanum*, *Ocimum americanum*, *Dicerocaryum eriocarpum* and *Ptycholobium contortum*.

7. *Colophospermum mopane* - *Kirkia acuminata* - *Acacia erubescens* plains bushveld and woodland
(Mopane - White syringa - Blue thorn plains bushveld and woodland)

Communities 7 and 8 are closely related, but the presence of species such as Blue thorn (*Acacia erubescens*), Zebra-bark corkwood (*Commiphora viminea*), *Cissus cornifolia* and *Jatropha spicata* differentiate between these two communities. The veld of community 7 is also in very poor condition in comparison with community 8.

This community is found north and west of the Njelele River, mainly on undulating low hills and plains (valleys)(Figure 2). This open woodland is characterise by high trees of White syringa (*Kirkia acuminata*), Marula (*Sclerocarya birrea*) and Mopane (*Colophospermum mopane*), with Red bushwillow (*Combretum apiculatum*) one of the prominent lower trees. This community covers approximately 6630 ha (Figure 2) and occurs on shallow and gravelly red to brown loamy sand to sandy loam soils derived from gneiss and quartzite, with a rock or gravel cover varying from 5 to 20%, and locally up to 80% where outcrops occur. The area is mostly flat and the gentle slopes vary from 1 to 5E.

The **diagnostic species** consist of Blue thorn (*Acacia erubescens*), *Cissus cornifolia* and *Jatropha spicata* (species group 9, Table 6).

High trees (>6 m) have an average canopy cover of 7% and are characterised by White syringa (*Kirkia acuminata*), Marula (*Sclerocarya birrea*), Mopane (*Colophospermum mopane*), Boobab (*Adansonia digitata*), Slender three-hook thorn (*Acacia senegal* var. *leiorhachis*) and Knobthorn (*Acacia nigrescens*).

Trees (>3 m - 6 m) cover on average 15% of the area and the dominant species are Mopane (*Colophospermum mopane*), Red bushwillow (*Combretum apiculatum*), Zebra-bark corkwood (*Commiphora viminea*), Velvet corkwood (*Commiphora mollis*), Lowveld cluster leaf (*Terminalia prunioides*), Tall common corkwood (*Commiphora glandulosa*) and Common star chestnut (*Sterculia rogersii*).

Shrubs (<3 m) cover on average 14% of the area and are characterised by White raisin (*Grewia bicolor*), Stunted plane (*Ochna inermis*), Sickle bush (*Dichrostachys cinerea*), *Anisotes rogersii*, Velvet raisin (*Grewia flava*), Silver raisin (*Grewia monticola*), Sandpaper raisin (*Grewia flavescens*) and Resin gardenia (*Gardenia resiniflua*).

The **grass** layer is in a poor condition and covers on average 15% of the area. The dominant grass species and their percentage frequency are:

Annual three-awn (<i>Aristida adscensionis</i>)	40%
Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	11%
Natal Redtop (<i>Melinis repens</i>)	7%
Dwarf grass (<i>Oropetium capense</i>)	7%
Silky bushman grass (<i>Stipagrostis uniplumis</i>)	6%
False signal grass (<i>Brachiaria deflexa</i>)	3%
Christmas tree grass (<i>Sporobolus panicoides</i>)	3%

Blue-seed grass (*Tricholaena monachne*), Flaccid finger grass (*Digitaria velutina*) and Nine-awned grass (*Enneapogon cenchroides*) occur locally. Other grass species are indicated in Table 6.

Forb species in this community cover 4% of the area and include *Indigofera heterotricha*, *Justicia betonica*, *Abutilon austro-africanum*, *Ocimum americanum* and *Ptycholobium contortum*.

8. ***Colophospermum mopane* - *Boscia albitrunca* - *Terminalia prunioides* open to dense bushveld on plains and low rocky hills**
(Mopane - Shepherd's tree - Lowveld cluster-leaf open to dense bushveld on plains and low rocky hills)

This vegetation type varies from a low and dense bushveld to an open woodland in places. It occurs on the undulating plains and lowlands (valleys) north and west of the Njelele River (Figure 2) and covers approximately 9813 ha (Figure 2). It occurs on shallow and gravelly to moderately deep red to brown sandy loam soils derived from gneiss and quartzite. The gravel and rock cover varying from 3 to 20% and up to 40% in places. The slopes vary from 1 to 12E.

Diagnostic species are absent, but the absence of species from species groups 6 to 9 (Table 6), and the presence of species from species groups 10, 11 and 12 , characterise this community.

High trees (>6 m) have an average canopy cover of 7% and are characterised by White syringa (*Kirkia acuminata*), Shepherd's tree (*Boscia albitrunca*), Slender three-hook thorn (*Acacia senegal* var. *leiorhachis*), Mopane (*Colophospermum mopane*), Marula (*Sclerocarya birrea*), and Baobab (*Adansonia digitata*).

Trees (>3 m - 6 m) cover on average 17% of the area and the dominant species are Red bushwillow (*Combretum apiculatum*), Velvet corkwood (*Commiphora mollis*), Mopane (*Colophospermum mopane*), Tall common corkwood (*Commiphora glandulosa*), Green-stem corkwood (*Commiphora neglecta*), Common star chestnut (*Sterculia rogersii*), False marula (*Lannea schweinfurthii*) and Lowveld cluster-leaf (*Terminalia prunioides*). The valleys have dense stands of *Colophospermum mopane*, while Corkwoods (*Commiphora* species) form dense stands locally.

Shrubs (<3 m) cover on average 16% of the area and are characterised by Mallow raisin (*Grewia villosa*), Stunted plane (*Ochna inermis*), Blue sourplum (*Ximenia americana*), Velvet raisin (*Grewia flava*) and Resin gardenia (*Gardenia resiniflua*).

The **grass** layer is poorly developed and covers on average 20% of the area. The dominant grass species and their percentage frequency are:

Annual three-awn (<i>Aristida adscensionis</i>)	37%
Natal Redtop (<i>Melinis repens</i>)	18%
Nine-awned grass (<i>Enneapogon cenchroides</i>)	8%
False signal grass (<i>Brachiaria deflexa</i>)	5%
Silky bushman grass (<i>Stipagrostis uniplumis</i>)	5%
Mountain grass (<i>Danthoniopsis dinteri</i>)	4%
Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	4%

Dwarf grass (<i>Oropetium capense</i>)	3%
Flaccid finger grass (<i>Digitaria velutina</i>)	3%

Blue-seed grass (*Tricholaena monachne*), Sand Quick (*Schmidtia pappophoroides*) and Guinea grass (*Panicum maximum*), occur locally. Other grass species with a frequency of less than 3% are listed in Table 6.

Forb species cover 11% of the area and include *Indigofera bainesii*, *Blepharis subvolubilis*, *Barleria prionitis*, *Abutilon austro-africanum*, *Tephrosia villosa* and *Ocimum americanum*.

9. Colophospermum mopane - Catophractes alexandri - Vernonia cinarens low and dense bushveld
(Mopane - Trumpet thorn - Vernonia low and dense bushveld)

This community covers approximately 7000 ha (Figure 2) and can be found on the gabbro plains of Boschrand, Steenbokrandjes, Vryheid and Bokveld in the north-west, as well as on the basalt, calc-silcrete and gneiss of Woodhall, Skirbeek, Frampton and Njeleles Drift in the east of Maremani. It occurs on shallow and gravelly red to brown sandy loam calcareous soils and although rocks are absent in places, up to 30% of the area can be covered by rocks. The slopes vary from 0 to 2E. Calcrete is common in the soil horizon. Bush densification is clearly visible in this vegetation type as a result of an abundance of watering points and overgrazing in the past and the presence of abandoned old fields.

The presence of Stink shepherd's tree (*Boscia foetida*), Trumpet thorn (*Catophractes alexandri*) and Mopane pomegranate (*Rhigozum zambesiacum*) shows the relationship between communities 9, 10 and 11 (species group 17, Table 6).

The **diagnostic species** are Trumpet thorn (*Catophractes alexandri*), *Gymnosporia pubescens* and *Vernonia cinarens* (species group 13, Table 6).

High trees (>6 m) have an average canopy cover of 1% and are characterised by Mopane (*Colophospermum mopane*), Tall common corkwood (*Commiphora glandulosa*), Slender three-hook thorn (*Acacia senegal* var. *leiorhachis*) and Shepherd's tree (*Boscia albitrunca*).

Trees (>3 m - 6 m) cover on average 19% of the area and the dominant species are Mopane (*Colophospermum mopane*), Lowveld cluster-leaf (*Terminalia prunioides*), Common star chestnut (*Sterculia rogersii*), White-stem corkwood (*Commiphora tenuipetiolata*) and Velvet corkwood

(*Commiphora mollis*).

Shrubs (<3 m) cover on average 19% of the area and are characterised by Stink shepherd's tree (*Boscia foetida*), Mopane pomegranate (*Rhigozum zambeziacum*), *Vernonia cinarescens*, White raisin (*Grewia bicolor*), *Anisotes rogersii*, Mallow raisin (*Grewia villosa*) and Snot berry (*Cordia monoica*).

The **grass** layer is poorly developed and covers on average 20% of the area. The dominant grass species and their percentage frequency are:

Annual three-awn (<i>Aristida adscensionis</i>)	26%
Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	21%
Silky bushman grass (<i>Stipagrostis uniplumis</i>)	11%
Nine-awned grass (<i>Enneapogon cenchroides</i>)	9%
Natal Redtop (<i>Melinis repens</i>)	9%
Sand Quick (<i>Schmidtia pappophoroides</i>)	5%
Spreading three-awn (<i>Aristida congesta</i> subsp. <i>barbicollis</i>)	4%

Species with a frequency of 4% or lower are listed in Table 6.

Forb species in this community cover 20% of the area and include *Monechma divaricata*, *Barleria prionites*, *Monechma debile*, *Ptycholibium contortum*, *Abutilon austro-africanum* and *Indigofera bainesii*.

Monechma divaricatum is prominent in local patches along with the shrub *Catophractes alexandri*.

10. *Colophospermum mopane* - *Sesamothamnus lugardii* - *Acacia tortilis* open to dense low bushveld

(Mopane - Transvaal sesame bush - Umbrella thorn open to dense low bushveld)

This plant community occurs on the uneven plains of Solitude, south of the high sandstone ridge and in small patches on Woodhall, Skirbeek, Senator and Lenin (Figure 2). It covers approximately 1461 ha (Figure 2) and it occurs on shallow to deep, brown to grey loamy sand to clayey soils derived from shale, mudstone, siltstone, gneiss, dolerite and basalt. The area is characterised by numerous gullies and small hilly areas. The soils are underlain by calcrete in most places. The rock and loose stone cover varies from 2 to 20% and locally up to 70%. The slopes are less than 4E. The soils in this community are prone to erosion and roads can easily convert to gullies (see also community 9). This community is very sensitive to overgrazing and the grass layer of Solitude is in very poor condition in places.

There are also open grassy patches dominated by Pan dropseed (*Sporobolus ioclados*), dense patches of high Mopane forest as well as dense low scrub Mopane, especially along the drainage lines.

The **diagnostic species** are Transvaal sesame bush (*Sesamothamnus lugardii*), Three-hook thorn (*Acacia senegal* var. *rostrata*), Horned thorn (*Acacia grandicornuta*), Small green thorn (*Balanites pedicellaris*) and the Kalahari sand raisin (*Grewia retinervis*) (species group 14, Table 6).

High trees (>6 m) have an average canopy cover of 3% and are characterised by Mopane (*Colophospermum mopane*).

Trees (>3 m - 6 m) cover on average 14% of the area and the dominant species are Umbrella thorn (*Acacia tortilis*), Mopane (*Colophospermum mopane*), Horned thorn (*Acacia grandicornuta*), Lowveld cluster leaf (*Terminalia prunioides*), Tall common corkwood (*Commiphora glandulosa*) and Shepherd's tree (*Boscia albitrunca*).

Shrubs (<3 m) cover on average 24% of the area and are characterised by Three-hook thorn (*Acacia senegal* var. *rostrata*), Stink shepherd's tree (*Boscia foetida*), Narrow-leaved mustard tree (*Salvadora australis*), Small green thorn (*Balanites pedicellaris*), Mopane pomegranate (*Rhigozum zambeziacum*), Blue sourplum (*Ximenia americana*) and Kalahari sand raisin (*Grewia retinervis*). The Transvaal sesame bush (*Sesamothamnus lugardii*) is locally a prominent species.

The **grass** layer is poorly developed and covers on average 23% of the area. The dominant grass species and their percentage frequency are:

Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	24%
Annual three-awn (<i>Aristida adscensionis</i>)	19%
Guinea grass (<i>Panicum maximum</i>)	12%
Nine-awned grass (<i>Enneapogon cenchroides</i>)	12%
Silky bushman grass (<i>Stipagrostis uniplumis</i>)	7%
Common signal grass (<i>Urochloa mosambicensis</i>)	5%
Spreading three-awn (<i>Aristida congesta</i> subsp. <i>barbicollis</i>)	4%

Species with a frequency of 2% or lower include *Tetrapogon tenellus* and Blue buffalo grass (*Cenchrus ciliaris*) (Table 6).

Forb species in this community cover 9% of the area and include *Blepharis diversispina*, *Abutilon austro-africanum* and *Ocimum americanum*.

**11. Colophospermum mopane - Gardenia resiniflua - Tetrapogon tenellus thicket
(Mopane - Resin gardenia - Tetrapogon thicket)**

This thicket community occurs in the south on the plains of the farms Woodhall, Frampton and Dawn and the irregular terrain of Solitude and covers approximately 418 ha (Figure 2). It occurs on moderately deep red sands on calcrete as well as shallow yellow to red sandy clay loam derived from shale, mudstone and siltstone. The sandy soils are underlain by calcrete in some places. The rock cover varies from 3 to 20% and locally up to 80%. The slopes are less than 4E.

Thimble grass (*Fingerhuthia africana*) is a poor diagnostic species for community 11 (species group 15, Table 6), but other characteristic species are *Tetrapogon tenellus* and Resin gardenia (*Gardenia resiniflua*).

High trees (>6 m) have an average canopy cover of less than 1% and are characterised by Mopane (*Colophospermum mopane*) and the Shepherd's tree (*Boscia albitrunca*).

Trees (>3 m - 6 m) cover on average 19% of the area and the dominant species are Mopane (*Colophospermum mopane*) and the Shepherd's tree (*Boscia albitrunca*).

Shrubs (<3 m) cover on average 28% of the area and are characterised by Mopane pomegranate (*Rhigozum zambeziacum*), Stink shepherd's tree (*Boscia foetida*), Resin gardenia (*Gardenia resiniflua*) and Blue sourplum (*Ximenia americana*).

The **grass** layer is in very poor condition and covers on average 7% of the area. The dominant grass species and their percentage frequency are:

Pan dropseed (<i>Sporobolus ioclados</i>)	22%
Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	17%
Annual three-awn (<i>Aristida adscensionis</i>)	10%
Dwarf grass (<i>Oropetium capense</i>)	10%
Silky bushman grass (<i>Stipagrostis uniplumis</i>)	6%
Thimble grass (<i>Fingerhuthia africana</i>)	6%

Tetrapogon tenellus

5%

Species with a frequency of 5% or lower include Nine-awned grass (*Enneapogon cenchroides*), Flaccid finger grass (*Digitaria velutina*), Sweet signal grass (*Brachiaria erusiformis*), Natal Redtop (*Melinis repens*), False signal grass (*Brachiaria deflexa*) and Blue buffalo grass (*Cenchrus ciliaris*). Thimble grass (*Fingerhuthia africana*) and *Tetrapogon tenellus* are conspicuous on the hilly and gravelly areas.

Forb species in this community cover 3% of the area and include *Abutilon austro-africanum*.

**12. Colophospermum mopane - Aristida adscensionis bushveld
(Mopane - Nine-awned grass bushveld)**

This plant community occurs scattered over Maremani (Vryheid, Palm Grove, Njelele's Drift, Woodhall, Lenin) on the lowlands, plains and lower slopes of the hills and covers approximately 2041 ha (Figure 2). It occurs on a shallow to deep red sandy loam derived from sandstone, gneiss and gabbro. The rock cover varies from 0 to 30% and the slopes are less than 4E. Forests of Mopane are found locally in the valleys in the west.

A **diagnostic species** group is absent but species such as Stunted plane (*Ochna inermis*), Mallow raisin (*Grewia villosa*), *Melhania rehmannii* and Zebra-bark corkwood (*Commiphora viminea*) are characteristic species (species groups 18 & 19, Table 6).

High trees (>6 m) have an average canopy cover of 8% and are characterised by Mopane (*Colophospermum mopane*), Shepherd's tree (*Boscia albitrunca*) and White syringa (*Kirkia acuminata*).

Trees (>3 m - 6 m) cover on average 19% of the area and the dominant species are Mopane (*Colophospermum mopane*), Shepherd's tree (*Boscia albitrunca*), Zebra-bark corkwood (*Commiphora viminea*), Lowveld cluster-leaf (*Terminalia prunioides*) and Slender three-hook thorn (*Acacia senegal* var. *leiorhachis*).

Shrubs (<3 m) cover on average 20% of the area and are characterised by White raisin (*Grewia bicolor*), *Anisotis rogersii* and Blue sourplum (*Ximenia americana*).

The **grass** layer is poorly developed and covers on average 14% of the area. The dominant grass species and their percentage frequency are:

Annual three-awn (*Aristida adscensionis*)

49%

Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	14%
Dwarf grass (<i>Oropetium capense</i>)	9%
False signal grass (<i>Brachiaria deflexa</i>)	4%
Silky bushman grass (<i>Stipagrostis uniplumis</i>)	4%
Natal Redtop (<i>Melinis repens</i>)	4%
Carrot seed grass (<i>Tragus berteronianus</i>)	3%

Forb species in this community cover 6% of the area and include *Abutilon austro-africanum* and *Barleria prionitis*.

**13. Colophospermum mopane - Eragrostis lehmanniana low dense bushveld
(Mopane - Lehmann's love grass low dense bushveld)**

This species poor thicket to open bushveld occurs mainly on the plains of Senator and Lenin but is also found locally in Riverview, Reitz, Njelele's Drift and Dawn (Figure 2). It is dominated by Mopane (*Colophospermum mopane*), and Lowveld cluster-leaf (*Terminalia prunioides*). It covers approximately 1738 ha. This community occurs on shallow to deep grey to red sandy loam soils derived from gneiss and quartzite. The rock cover varies from 1 to 10% and locally up to 50%. The slopes are less than 2E.

A **diagnostic** species group is absent but species such as Mopane (*Colophospermum mopane*), Lowveld cluster leaf (*Terminalia prunioides*) and the Shepherd's tree (*Boscia albitrunca*) are abundant species (species groups 20 & 21, Table 6). This community is therefore also characterised by the absence of diagnostic species from species groups 1 to 19 (Table 6).

High trees (>6 m) have an average canopy cover of 3% and are characterised by the Mopane (*Colophospermum mopane*), Shepherd's tree (*Boscia albitrunca*), Marula (*Sclerocarya birrea*) and Boabab (*Adansonia digitata*).

Trees (>3 m - 6 m) cover on average 11% of the area and the dominant species are Mopane (*Colophospermum mopane*), Lowveld cluster-leaf (*Terminalia prunioides*), Velvet corkwood (*Commiphora mollis*), Common star chestnut (*Sterculia rogersii*), Red bushwillow (*Combretum apiculatum*) and Tall common corkwood (*Commiphora glandulosa*).

Shrubs (<3 m) cover on average 17% of the area and are characterised by Velvet raisin (*Grewia flava*), White raisin (*Grewia bicolor*) and Sickie bush (*Dichrostachys cinerea*).

The **grass** layer is in poor condition and covers on average 15% of the area. The dominant grass species and their percentage frequency are:

Annual three-awn (<i>Aristida adscensionis</i>)	25%
Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	24%
Silky bushman grass (<i>Stipagrostis uniplumis</i>)	7%
Spreading three-awn (<i>Aristida congesta</i> subsp. <i>barbicollis</i>)	6%
False signal grass (<i>Brachiaria deflexa</i>)	6%
Sand quick (<i>Schmidtia pappophoroides</i>)	2%

Forb species in this community cover 4% of the area and include *Abutilon austro-africanum*, *Ocimum americanum* and *Indigofera bainesii*.

14. ***Acacia tortilis* - *Eragrostis lehmanniana* old fields** **(Umbrella thorn - Lehmann's love grass old fields)**

These disturbed areas (overgrazed veld, old fields, watering points and kraals) occur scattered over the plains of Maremani (Figure 2). This community covers approximately 460 ha and occurs on deep red sandy loam soils derived from gneiss, sandstone and basalt, as well as on alluvial soils along the seasonal streams. Rocks are absent.

A **diagnostic** species group is absent but species such as Umbrella thorn (*Acacia tortilis*), Sickie bush (*Dichrostachys cinerea*), Mopane (*Colophospermum mopane*), Lehmann's love grass (*Eragrostis lehmanniana*) and Annual three-awn (*Aristida adscensionis*) are prominent (species groups 22 & 23, Table 6). This community is therefore also characterised by the absence of species from species group 20 & 21, for example Lowveld cluster-leaf (*Terminalia prunioides*), Red bushwillow (*Combretum apiculatum*), Slender three-hook thorn (*Acacia senegal* var. *leiorhachis*), Tall common corkwood (*Commiphora glandulosa*), White syringa (*Kirkia acuminata*), Common star chestnut (*Sterculia rogersii*) and Blue sourplum (*Ximenia americana*).

High trees (>6 m) cover less than 1% and are characterised by Mopane (*Colophospermum mopane*) and Marula (*Sclerocarya birrea*).

Trees (>3 m - 6 m) cover on average 5% of the area and the dominant species is Umbrella thorn (*Acacia tortilis*), Mopane (*Colophospermum mopane*), Shepherd's tree (*Boscia albitrunca*) and Knobthorn (*Acacia nigrescens*).

Shrubs (<3 m) cover on average 4% of the area and are characterised by Sickle bush (*Dichrostachys cinerea*), Umbrella thorn (*Acacia tortilis*) and White raisin (*Grewia bicolor*).

The **grass** layer is well developed and covers on average 79% of the area. The dominant grass species and their percentage frequency are:

Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	39%
Annual three awn (<i>Aristida adscensionis</i>)	24%
Sand quick (<i>Schmidtia pappophoroides</i>)	8%
Long-awn three-awn (<i>Aristida stipitata</i>)	6%
Silky bushman grass (<i>Stipagrostis uniplumis</i>)	3%
Spreading three-awn (<i>Aristida congesta</i> subsp. <i>barbicollis</i>)	2%

Grass species with a frequency of 2% or lower are listed in Table 6.

Forb species in this community cover 2% of the area and include *Abutilon austro-africanum*, *Ocimum americanum*, *Flaveria bidentis*, *Alternanthera pungens*, *Heliotropium ovalifolium*, *Tribulus terrestris* and *Abutilon angulatum*.

15. Pechuel-loeschia leubnitziae - Urochloa mosambicensis open grassland to dense bushveld

(Wild sage - Common signal grass open grassland to dense bushveld)

This plant community occurs mainly on old fields and flood plains on deep alluvial soils along the Limpopo and Njelele Rivers (Figure 2) and covers approximately 260 ha (Figure 2). These patches vary from open grassland with scattered individuals of Umbrella thorn (*Acacia tortilis*) to areas where Sickle bush (*Dichrostachys cinerea*) is fairly abundant.

The **diagnostic species** are Pan dropseed (*Sporobolus ioclados*), Couch grass (*Cynodon dactylon*), Sticky thorn (*Acacia nebrownii*) and Hairy love grass (*Eragrostis trichophora*) (species group 24, Table 6). Species such as *Pechuel-loeschia leubnitziae*, *Abutilon angulatum* and *Urochloa mosambicensis* are also very prominent in this community (species group 25, Table 6).

Trees taller than 6 m are mostly absent.

Trees (>3 m - 6 m) cover on average 5% of the area and the dominant species are the Umbrella thorn (*Acacia tortilis*).

Shrubs (<3 m) cover on average 4% of the area and are characterised by Wild sage (*Pechuel-loeschia leubnitziae*) and Sickie bush (*Dichrostachys cinerea*).

The **grass** layer is well developed in places and covers on average 78% of the area. The dominant grass species and their percentage frequency are:

Common signal grass (<i>Urochloa mosambicensis</i>)	63%
Pan dropseed (<i>Sporobolus ioclados</i>)	17%
Nine-awned grass (<i>Enneapogon cenchroides</i>)	12%
Guinea grass (<i>Panicum maximum</i>)	3%
Hairy love grass (<i>Eragrostis trichophora</i>)	2%

Grass species with a frequency of 2% or lower are listed in Table 6.

Herbaceous species in this community cover 2% of the area and include *Flaveria bidentis*, *Alternanthera pungens*, *Heliotropium ovalifolium*, *Tribulus terrestris* and *Abutilon angulatum*.

16. Combretum imberbe - Philenoptera violacea stream community (Leadwood - Apple-leaf stream community)

This community occurs along all the seasonal streams in Maremani on deep greyish sand-clay-loam alluvial soils (Figure 2). It covers approximately 210 ha.

On a flood plain of the Mutanga River at the southern tip of Solitude a dense stand of high trees with a canopy cover of 35 to 45% occurs with Leadwood (*Combretum imberbe*) and Buffalo thorn (*Ziziphus mucronata*) the conspicuous trees. The dense grass cover consists mainly of Guinea grass (*Panicum maximum*). Surrounding the zone of dense riverine trees, grassland developed where species such as *Sporobolus consimilis*, Pan dropseed (*Sporobolus ioclados*) and Common signal grass (*Urochloa mosambicensis*) are dominant, indicating an area that is brackish and periodically flooded. Scattered trees of Sticky thorn (*Acacia nebrownii*) and Umbrella thorn (*Acacia tortilis*) occur on the clayey soils in this grassland.

The **diagnostic species** are for example Leadwood (*Combretum imberbe*), Buffalo thorn (*Ziziphus mucronata*), Ilala palm (*Hyphaene coriacea*), *Sporobolus consimilis* and Weeping boer-bean (*Schotia brachypetala*) (species group 26, Table 6). Species such as *Cyperus sexangularis*, Apple-leaf (*Philenoptera violacea*), Red spike-thorn (*Gymnosporia senegalensis*) and Nyala tree (*Xanthocercis zambeziaca*) are also prominent species in this community (species group 28, Table 6). Community 16 is related to community 17 through the presence of species from species group 28 (Table 6).

High trees (>6 m) have an average canopy cover of 10% and are characterised by Leadwood (*Combretum imberbe*), Weeping boer-bean (*Schotia brachypetala*) and Knobthorn (*Acacia nigrescens*).

Trees (>3 m - 6 m) cover on average 8% of the area and the dominant species are Umbrella thorn (*Acacia tortilis*) and Buffalo thorn (*Ziziphus mucronata*).

Shrubs (<3 m) cover on average 5% of the area and are characterised by White raisin (*Grewia bicolor*) and Red spike-thorn (*Gymnosporia senegalensis*).

The **grass** layer is well developed and covers on average 95% of the area. The dominant grass species and their percentage frequency are:

Common signal grass (<i>Urochloa mosambicensis</i>)	58%
Lehmann's love grass (<i>Eragrostis lehmanniana</i>)	18%
Feathered grass (<i>Chloris virgata</i>)	16%
Nine-awned grass (<i>Enneapogon cenchroides</i>)	8%

Guinea grass (*Panicum maximum*) and Blue buffalo grass (*Cenchrus ciliaris*).

17. *Xanthocercis zambeziaca* - *Acacia robusta* - *Cyperus sexangularis* riparian community (Nyala tree - Brack thorn - *Cyperus* riparian community)

This plant community forms the narrow riverine vegetation on deep alluvial soils along the Limpopo, Sand and Njelele Rivers (Figure 2) and covers approximately 584 ha (Figure 2). This community was almost destroyed along the Sand River during the floods of 2000.

The **diagnostic species** are for example Brack thorn (*Acacia robusta* subsp. *clavigera*), Common cluster fig (*Ficus sycomorus*), Bulrush (*Typha capensis*), Common reed (*Phragmites australis*), Flame thorn (*Acacia ataxacantha*) and Flame creeper (*Combretum paniculatum*) (species group 27, Table 6). Species such as *Pechuel-loeschia leubnitziae*, *Abutilon angulatum* and *Urochloa mosambicensis* are also very

prominent species in this community (species group 25, Table 6) as well as *Cyperus sexangularis*, Apple-leaf (*Philenoptera violacea*), Red spike-thorn (*Gymnosporia senegalensis*), Nyala tree (*Xanthocercis zambeziaca*), Leadwood (*Combretum imberbe*) (species group 28, Table 6).

High trees (>6 m) include the Common cluster fig (*Ficus sycomorus*), Nyala tree (*Xanthocercis zambeziaca*), Brack thorn (*Acacia robusta* subsp. *clavigera*), Leadwood (*Combretum imberbe*), Apple-leaf (*Philenoptera violacea*), Large-leaved false thorn (*Albizia versicolor*), Ana tree (*Faidherbia albida*), and Fever tree (*Acacia xanthophloea*).

The dominant **tree species** are Flame thorn (*Acacia ataxacantha*), Apple-leaf (*Philenoptera violacea*), Knobthorn (*Acacia nigrescens*), Umbrella thorn (*Acacia tortilis*), Buffalo thorn (*Ziziphus mucronata*), Brown ivory (*Berchemia discolor*), Jackal berry (*Diospyros mespiliformis*), Large feverberry (*Croton megalobotrys*) and Flame creeper (*Combretum paniculatum*).

Shrubs cover on average 9% of the area and are characterised by Red spike-thorn (*Gymnosporia senegalensis*), Large feverberry (*Croton megalobotrys*), Savanna gardenia (*Gardenia volkensii*), Magic guarri (*Euclea divinorum*), Wild sage (*Pechuel-loeschia leubnitziae*), Bulrush (*Typha capensis*), and Woolly caper bush (*Capparis tomentosa*).

The **grass** layer is well developed and covers on average 49% of the area. The dominant sedge species is *Cyperus sexangularis* while grass species are represented by the Common reed (*Phragmites australis*), Broad-leaved panicum (*Panicum deustum*), Guinea grass (*Panicum maximum*), Common signal grass (*Urochloa mosambicensis*), Swamp grass (*Diplachne fusca*), Blue buffalo grass (*Cenchrus ciliaris*) and Pearly love grass (*Eragrostis rotifer*). Herbaceous and weedy species in this community cover 10% of the area and include *Abutilon angulatum*, *Pluchea dioscoridis*, *Xanthium strumarium*, *Ageratum conyzoides*, *Schoenoplectus corymbosus* and *Datura stramonium*.

CHAPTER 5

VEGETATION STRUCTURE

Introduction

The primary elements of vegetation structure are growth form, stratification and cover. Vertical structure is a function of different growth forms (or size classes) dominating certain layers and can be expressed in terms of canopy cover and/or density of each growth form. Density also indicates the spatial distribution of different growth forms, populations or individual species. Vegetation can be classified according to structure without reference to species names, and layer or size class diagrams can be used to illustrate structure by using for example cover or density of each layer.

Size classes are considered to be good indicators of browse quality and quantity. Although a plant community is defined to have a relatively homogeneous floristic composition, structure and habitat, different floristic communities can have the same structure or *vice versa*. Structure can also relate to the feeding pattern of animals as well as the suitability of a habitat for different animal species. The available leaf mass and volume at different height levels are valuable in determining the suitability of a habitat for browser species.

Density of the woody species can affect the condition of the herbaceous layer. Several studies have indicated that the grass production declines when the tree and shrub density exceeds 1500 individuals per hectare.

Cover

The mean percentage canopy cover and the variation within the communities for different strata and vegetation types are summarised in Table 7 and Figures 3 & 4. The percentage cover of the high tree stratum is the lowest in communities 1, 2, 9, 11, 14 and 15, representing the communities on rocks, calcareous soils and disturbed areas (old fields)(Figure 3). Tree cover was higher than 15% in communities 7, 8, 9, 11 and 12, while communities with a dense shrub layer are communities 2, 10, 11 and 12. The highest grass cover was found in the south-east on the footslopes of the gneiss and sandstone hills (community 6), as well as in the old fields along the major rivers and the riverine communities (communities 15, 16 and 17)(Figure 4). Forbs were abundant in areas where calcrete occurs, for example community 9. It is apparent that the communities with the lowest shrub and rock cover were associated with a high grass cover (communities 6, 15, 16 and 17).

Density

The mean densities of the different height classes and the variation within the communities are summarised in Figures 5, 6 and 7 and Table 8. Community 4 has the most tall trees, with community 9 and 11 the most trees per ha (Table 8 and Figures 5, 6 and 7). The highest mean shrub density of all the communities was found in communities 11, 12 and 13 where up to 2400 individuals per hectare occurred in places. This seems to be above the threshold where the vegetation density has an effect on grass production.

Tree height

The mean height of the woody strata, as well as the maximum height of the high tree stratum are summarised in Table 9.

CHAPTER 6

VELD CONDITION AND ECONOMIC CARRYING CAPACITY

Introduction

Maremani is representative of the Mopane Bushveld and the grazing can be considered as sweet veld. Veld condition as well as the carrying capacity of the area in general, will vary from season to season, depending mainly on the rainfall, and also to a certain extent on past and present utilization. Each of the recognised plant communities is associated with a specific habitat, has its own diagnostic species composition, and therefore also has its own grazing and browsing potential and economic and ecological carrying capacity.

The concepts of **economic** and **ecological carrying capacities** need to be explained. Game numbers will increase from an initial low to a level where the available food, water and shelter resources become limiting (Caughley 1977). Numbers increase slowly at first and once a critical stage is reached, the growth rate is exponential and numbers increase rapidly. At a certain upper level, density-dependent factors such as competition for resources, lower fecundity and increased mortalities result in a leveling-off of population growth to a point where births equal deaths, and net growth (or yield) is zero. In practice, the ultimate population density fluctuates around a fluctuating upper level, which arises from, for example, variations in rainfall, inter-specific competition, predator-prey relations or accidental fires. The level around which the population oscillates is known as the **ecological carrying capacity**. It is the population level that is likely to exist in unmanaged large natural areas. Fluctuations in numbers can be quite dramatic, with severe crashes occurring during periods of prolonged drought or disease epidemics. Allowing certain species to attain high densities may impact negatively on other more sensitive species. Therefore, should the management objective be to increase species diversity, the numbers of aggressively competitive species need to be controlled.

If a population is maintained below the ecological carrying capacity by cropping, the net growth of the population is positive, as there is room for expansion in the form of resource abundance. The population is then at an **economic carrying capacity**. There is no one single economic carrying capacity but there is a point at which maximum sustained yield (MSY) is obtained, usually around 70 to 80% of the ecological carrying capacity.

Different equations have been proposed to calculate carrying capacity of an area. In general, by combining an ecological or veld condition index, the grass production and/or canopy cover, rainfall, the incidence of fire, accessibility of the terrain, grazing habits and social behaviour of animal species, it is

possible to estimate an economic capacity for a particular plant community or game ranch. The ecological capacity is usually conservatively estimated to be 20% to 30% higher than the economic capacity.

Methods

The following approach is based on the *Ecological Index Method* (Vorster 1982), but was adapted for the specific area.

The grass species found in the different plant communities were arranged according to their percentage frequencies within the communities. This indicates of the degree of dominance and the distribution of the relevant species. The grass species were also classified into categories that are based on their reaction to grazing, palatability and production potential (see Appendix A - grasses).

The categories are:-

D = Decreaser - these species are abundant in veld in a good condition and decrease when the veld is over- or under-utilized (valuable grass species)

I1 = Increaser 1 - these species increase in veld that is under-utilized.

I2a = Increaser 2a - these species increase in veld that is lightly and/or selectively over-utilized.

I2b = Increaser 2b - these species increase in veld that is moderately and/or selectively over-utilized.

I2c = Increaser 2c - these species increase in veld that is severely over-utilized (weeds and encroacher species).

Bare areas were recorded when there was no grass species within a metre from the step point.

By using these categories, an ecological index is calculated to express veld condition. Theoretically, the maximum ecological index value that can be obtained, is 100 %, i.e. if all species present are classified as Decreasers. Veld in a good condition, with a high grazing capacity, has a high percentage Decreaser and Increaser 1 grass species. By using the ecological index, the total grass canopy cover, the percentage canopy cover of trees and shrubs, annual rainfall, fire regime and accessibility of the area, an economic capacity is calculated for each plant community. The economic capacity of Maremani was calculated for game at a mean annual rainfall of 340 mm. The availability of bush (for browsing), the selective grazing habits of many game species, social behaviour (home range and territoriality) and also the restrictions of a

one-camp system (lack of control over animal movements), are taken into consideration in the calculation of the economic carrying capacity for game.

The grazing capacity for livestock is given in large animal units per hectare or hectares per large animal unit (LAU). One large animal unit is regarded as a steer of 450 kg. Conversion values to convert from game to large animal units or *vice versa* are used (see Table 12) and on the basis of the metabolizable energy requirements and probable food intake of the animals, comparisons are then made in large animal units. For example a value of 6.03 impala is given as equivalent to one large animal unit.

However, because the conversion table does not take into account the differences in food and habitat preferences of the different game species, the diversity in vegetation types, their condition and production, availability of browse and grazing, and accessibility of the terrain, these tables should be used with circumspection and only as a broad and general guideline. Nevertheless, it is a practical method with which the different habitat types on a game ranch can be compared to estimate the potential economic carrying capacity of the ranch.

The predictive value of this approach can be enhanced with an intensive study of the habitats on a game ranch, which includes surveys of the veld condition and grass and browse production of each of these habitats. The area covered by each habitat and its suitability for different game species should be included when determining grazer/browser capacity. Varying rainfall influences range condition and frequent assessments are essential to assist in management decisions.

Results and discussion

The total economic carrying capacity for Maremani was calculated from the economic capacities of the individual plant communities, excluding communities 1 (rocky outcrops) and 17 (riverine areas) (Table 12). The present economic capacity with a mean annual rainfall of 340 mm is calculated as **39.2 ha/LAU** for game. The area will be able to support a high number of browsers as browsing material is in abundance. However, it should be emphasized that the carrying capacity decreases drastically during prolonged periods of drought. The carrying capacity according to the previous Department of Agriculture was **17 ha/LAU**, but presently the Limpopo extension officers prescribe a stocking rate of **25 ha/LAU**.

The veld condition and economic capacities for the individual plant communities are discussed below: Communities 1 (rocky outcrops) and 17 (riverine vegetation) are not included. A veld condition index lower than 45%, reflects a low grass cover, unpalatable grasses, low biomass production and annual grass species, and consequently indicates veld in poor condition for grazing species. Veld in good condition should have an index of higher than 60%, with a high grass cover and a high presence of perennial

Decreaser, Increaser 1 and some Increaser 2a species.

**2. *Androstachys johnsonii* - *Terminalia sericea* sandstone hills
(Lebombo iron wood - Silver cluster-leaf sandstone hills)**

This community covers approximately 491 ha and has a veld condition index of 48.6% (Table 12). The mean grass cover is only 15% and the presence of mostly Decreaser and Increaser 2a species indicates that the area is in moderate condition. The high percentage rock cover contributes to the low grass cover. The economical capacity for this veld is 25 ha/LAU for game.

**3. *Combretum apiculatum* - *Danthoniopsis dinteri* - *Tricholaena monachne* rocky outcrops
(Red bushwillow - Mountain grass - Blue-seed grass rocky outcrops)**

This community covers approximately 763 ha and has a veld condition index of 44.7% (Table 12). The mean grass cover is only 11% and although some Decreaser species occur, the high presence of Increaser 2a, 2b and 2c species indicates that the community is in a relatively poor condition for grazers. This is due to either high grazing pressure and/or the result of frequent droughts. The high percentage rock cover contributes to the low grass cover. Unpalatable grass species are also associated with sandy soils. The grazing capacity for this veld is 51.7 ha/LAU for game.

**4. *Colophospermum mopane* - *Xerophyta viscosa* open to dense bushveld on low hills and rocky outcrops
(Mopane - *Xerophyta viscosa* open to dense bushveld and low hills and rocky outcrops)**

This community covers about 1398 ha and is in poor condition with a veld condition index of only 31.7% (Table 12). The mean grass cover is only 15% and the high presence of Increaser 2a and 2c species indicates that the area has been over-utilized and/or subjected to frequent droughts. The high percentage rock cover contributes to the low grass cover. The grazing capacity for this veld is 56.6 ha/LAU for game.

**5. *Colophospermum mopane* - *Terminalia prunioides* - *Psiadia punctulata* bushveld
(Mopane - Lowveld cluster-leaf - *Psiadia* bushveld)**

This community covers about 893 ha and is in poor condition with a veld condition index of 37.9% (Table 12). The mean grass cover is 15% and the high presence of Increaser 2c species indicates that the area has been over-utilized and/or subjected to frequent droughts. The grazing capacity for this veld is 38.5 ha/LAU for game.

**6. *Sclerocarya birrea* - *Aristida stipitata* - *Eragrostis lehmanniana* open grass and bushveld
(Marula - Long-awned three-awn - Lehmann's love grass open grass and bushveld)**

This community covers about 1106 ha and has a veld condition index of 50.5% (Table 12). The mean grass cover is 66% and the presence of mostly Decreaser and Increaser 2a species indicates that the area is in moderate to good condition. The grazing capacity for this veld is 11.8 ha/LAU for game.

**7. *Colophospermum mopane* - *Kirkia acuminata* - *Acacia erubescens* plains bushveld and woodland
(Mopane - White syringa - Blue thorn plains bushveld and woodland)**

This community covers approximately 6630 ha and is in a very poor condition for grazers with a veld condition index of only 26.3% (Table 12). The mean grass cover is 15% and the high presence of Increaser 2c species indicates that the area has been severely over-utilized and/or subjected to frequent droughts. The grazing capacity for this veld is 83.7 ha/LAU for game, indicating the poor condition of this vegetation type.

**8. *Colophospermum mopane* - *Boscia albitrunca* - *Terminalia prunioides* open to dense bushveld on plains and low rocky hills
(Mopane - Shepherd's tree - Lowveld cluster-leaf open to dense bushveld on plains and low rocky hills)**

This community covers about 9813 ha and is in a poor condition for grazers with a veld condition index of 33.8% (Table 12). The mean grass cover is 20% and the high presence of Increaser 2a, 2b and 2c species indicates that the area has been over-utilized and/or subjected to frequent droughts. The grazing capacity for this veld is 35.1 ha/LAU for game.

**9. *Colophospermum mopane* - *Catophractes alexandri* - *Vernonia cinarens* low and dense bushveld
(Mopane - Trumpet thorn - *Vernonia* low and dense bushveld)**

This community covers about 7000 ha and is in a poor condition for grazers with a veld condition index of 33.4% (Table 12). The mean grass cover is 20% and the high presence of Increaser 2a, 2b and 2c species and bare soil indicates that the area has been severely over-utilized and/or is very sensitive to frequent droughts. The grazing capacity for this veld is 36 ha/LAU for game, indicating the poor condition

of this vegetation type.

10. *Colophospermum mopane* - *Sesamothamnus lugardii* - *Acacia tortilis* open to dense low bushveld

(Mopane - Transvaal sesame bush - Umbrella thorn open to dense low bushveld)

This community covers about 1461 ha and has a veld condition index of 44.1% (Table 12). The mean grass cover is 23% and the fairly high percentage Decreaser and Increaser 2a species, indicates that the area is in poor to moderate condition. The grazing capacity for this veld is 19.7 ha/LAU for game.

11. *Colophospermum mopane* - *Gardenia resiniflua* - *Tetrapogon tenellus* thicket

(Mopane - Resin gardenia - *Tetrapogon* thicket)

This community covers about 418 ha and has a veld condition index of 48.3%, indicating veld in moderate good condition. Although a high percentage Decreasers occurs in this community, the mean grass cover is however only 11% and contributes to the relatively low grazing capacity of 40.3 ha/LAU.

12. *Colophospermum mopane* - *Aristida adscensionis* bushveld

(Mopane - Nine-awned grass bushveld)

This community covers approximately 2041 ha and has a veld condition index of 24.1% (Table 12). The grass cover is only 14% and the very high presence of Increaser 2c species indicates that this area has been severely over-utilized and/or is very sensitive to frequent droughts. The carrying capacity for this veld is 124 ha/LAU for game.

13. *Colophospermum mopane* - *Acacia tortilis* - *Eragrostis lehmanniana* low dense bushveld

(Mopane - Umbrella thorn - Lehmann's love grass low dense bushveld)

This community covers about 1738 ha. The veld condition index is poor at 29.7% and with a grass cover of 12% and high percentages of Increaser 2a and 2c species, the carrying capacity is a low 81.7 ha/LAU.

14. *Acacia tortilis* - *Eragrostis lehmanniana* old fields

(Umbrella thorn - Lehmann's love grass old fields)

This area covers about 460 ha and is in poor condition with a veld condition index of only 34.4%. The mean grass cover is 24% and the high presence of Increaser 2a and 2c species indicates that the area

has been disturbed and over-utilized in the past. The grazing capacity for this veld is 32.8 ha/LAU for game.

15. *Pechuel-loeschia leubnitziae* - *Urochloa mosambicensis* open grassland to dense bushveld

(Wild sage - Common signal grass open grassland to dense bushveld)

This area covers about 260 ha. The veld condition index is fairly high at 50.8%, indicating veld in moderate to good condition in places. The grass cover is also high at 79% and the relatively high presence of Decreaser and Increaser 2b species indicates light to moderately utilized veld. The grazing capacity for this veld is 12.3 ha/LAU, the highest of all the communities.

16. *Combretum imberbe* - *Philenoptera violacea* stream community

(Leadwood - Apple-leaf stream community)

This area covers approximately 210 ha and has a veld condition index of 43.4% (Table 12). The mean grass cover is 49% and because no Increaser 2c species were recorded, the grazing capacity for this veld is relatively high at 15.8 ha/LAU for game. The high Increaser 2a and 2b species indicates some moderately utilized veld.

Alternative approaches to determine economic carrying capacity

Other methods can be used to estimate short and long-term economic carrying capacities. These methods were developed in savanna regions of South Africa.

□ **Combined veld condition and rainfall method (Danckwerts 1989)**

The model was developed in the Eastern Cape:

$$GC = \{-0.03 + 0.00289 \times (X1) + [(X2 - 419.7) \times 0.000633]\}$$

where: GC = grazing capacity in large stock units per hectare (LAU/ha)

X1 = percentage veld condition score

X2 = mean annual rainfall (mm)

The above model requires sample site veld condition scores to be expressed as percentages of a benchmark veld condition score. Because of the present fairly poor veld condition of the area it was not possible to use a reference or benchmark sample area. When the veld condition indices given in Table 12 were used, the average economic grazing capacity for Maremani was calculated as **40.7 ha/LAU**. The grazing capacity between communities varied from 15.1 to 185 ha/LAU. The herbaceous layer in communities 7 and 12 are in such a poor condition that this model indicates a zero grazing capacity.

□ **Herbaceous phytomass method (Moore & Odendaal 1987)**

The stocking rate for grazer species is calculated from herbaceous phytomass data and the method was developed in the eastern Kalahari Thornveld:

$$SR = \text{phytomass (kg/ha)} \times 0.35^b / 10^{bb} \times 365^{bbb}$$

where: SR = stocking rate in large stock units per hectare per year

b = utilisation factor: only 35% of the herbaceous material is grazed while 40% remains as tufts and stubbles and 25% is lost to environmental factors

bb = 10 kg feed per day is required per large stock unit

bbb = number of days in a year

The phytomass of the herbaceous layer was determined with the Disc-Pasture Meter (Trollope & Potgieter 1986) during 2001 following a good rainy season. The grass biomass after the relatively dry 2002 season was very poor to non-existent.

Disc Pasture Meter measurements for Maremani are summarised in Table 10 and the variations measured indicated. Community 1 was not measured due to the high rockiness. In parts of the other communities where the grass cover was minimal, no measurements could be taken. The flood plains in the south of Solitude recorded up to 7 800 kg/ha. Within a community, grass biomass showed large spatial variation. The grazing capacity for Maremani according to this method is approximately **48 ha/LAU**.

□ **Rainfall method (Coe, Cumming & Phillipson 1976)**

A significant relationship was found $r^2 = 0.94$, $P < 0.001$) between rainfall (range: 165 to 650 mm) and large herbivore biomass (range: 405 to 4 848 kg/km²). The equation that was derived for wildlife areas receiving less than 650 mm rainfall annually, was:

Large Herbivore Biomass (kg/km²) = 8.684 x (mean annual rainfall) - 1205.9

The herbivore biomass data included game census data from east and southern Africa and a wide range of the most common large African grazers and browsers. Herbivore biomass estimates obtained from the above equation would therefore represent first approximations of the combined grazing and browsing capacity of an area. Shortcomings of this approach are that the broad relationship between biomass and rainfall does not take into account local temporal and spatial variations in the habitats. Furthermore, the model was based on animal numbers obtained from a wide variety of count methods.

According to this equation, the Large Herbivore Biomass for Maremani is 1747 kg/km². Maremani covers about 366 km², which gives a total of 639 402 kg. In terms of LAU this converts to 1 421 LAU. This is about 38% higher than calculated with the Ecological Index method (884 LAU). If the total area of 36583 ha is used in the calculations, an economic carrying capacity of **25.7 ha/LAU** is derived.

! **Large animal unit (LAU) and Browser Unit method of Snyman (1991), related to rainfall**

Stocking rates for animals in terms of LAU's and BU's, based on mean annual rainfall, are given by Snyman (1991) in Table 11. Accordingly the stocking rate for **grazers** on Maremani should be approximately **2.72 LAU/100 ha** or **36.8 ha/LAU**, which is comparable to the value of **39.2 ha/LAU** found for Maremani with the Ecological Index method (Table 12). The **browsing capacity** according to Table 11 is approximately **9.0 BU/100 ha** (see following method and Table 16).

Browsing capacity

Browse is the sum total of woody plant material that is potentially edible to a specific set of animals in a specific area. The term *available browse* is a more restricted quantity and includes all the leaves, twigs, bark, flowers and pods that are within reachable height of a given type of animal species. The browsable volume is usually limited to the foliage up to 2 m for most browsers, and up to 5.5 m for giraffe and elephant.

The available browse on a game ranch is influenced by:

- § the density of woody plants;
- § the amount of leaf material within reach of an animal;
- § the species composition of the woody vegetation;

- § the palatability and digestibility of the woody vegetation for example tannin content;
- § the growth potential of woody species;
- § phenology of woody species;
- § chemical defences of woody plants e.g. condensed tannins;
- § structural defences e.g. thorns.

Browsers are limited by food supply rather than other factors such as territoriality. They will starve to death before they kill their resource. The browse supply in the late dry season imposes a limit on the stocking rate for browsers. Kudu mortalities in Limpopo have been attributed to sudden cold spells (pneumonia), disease (anthrax) and very important, the lack of evergreen palatable plant species for the animals to survive the late dry season (low resource availability).

The browsing capacity of a given area indicates the area's potential to carry a certain number of animals in a healthy productive and reproductive condition over a prolonged period of time, without the deterioration of the resources. The browsing capacity for game farms should ideally be determined separately from the grazer component. Browsing capacity is defined in terms of the number of browser units that can be carried per hectare (BU/ha). A browser unit (BU) is taken as the equivalent of a 140kg browser.

Large animal units (LAU's) and browser unit (BU) replacement values (or equivalents) can be used to calculate the browsing capacity for an area. In Table 14 the LAU and BU unit conversions for game species are given.

The application of only the agricultural LAU concept does not allow for the ecological separation of herbivorous ungulates and thus overlooks the potential for using the specialised and complementary resource-use habits of wild ungulates to maximise veld utilisation (Snyman 1991; Peel *et al.* 1994; Dekker 1996, 1997).

An adapted version of the LAU/BU method was used to determine the present and recommended carrying capacity for Maremani (see Tables 12 to 16):

Present carrying capacity:

The total number of LAU's recommended for grazers is 884 LAU (Table 12). The browsing capacity is estimated at 8 BU's per 100 ha (see Table 11), which gives a total of 2927 BU's. To convert to LAU, the BU's are multiplied by 0.42 (that is the LAU value per kudu) for a total of 1229 LAU's. The total recommended LAU's is **2113 LAU's**.

The present numbers of game (2000) are given in Table 13 and the percentage of the recommended capacity calculated per feeding class. The present numbers of game indicate overstocking by approximately 16% (Table 13).

When the grazer and browser components are separated according to the feeding spectrum of each animal (Table 14), the carrying capacity for **grazers** is then **34.6 ha/LSU** which is higher than the calculated capacity of 39.2 ha/LAU. This indicates a 16% overstocking of grazers. The **browsing capacity of 9.1 BU's per 100 ha** is higher than the 8.0 BU per 100 ha recommended for the area. This indicates a 23% overstocking of browsers. If the browser units are converted to LAU's, the LAU's for grazers (1056) and browsers (1403) add up 2459 LAU's, giving a carrying capacity of **14.9 ha/LAU**. However, the important aspect is that only **42.9%** of this capacity is allocated to grazers.

Recommended carrying capacity:

The recommended percentage ratio of feeding classes as well as the recommended numbers of game are indicated in Table 15. An indication of the population growth per annum in terms of animal numbers is also indicated. The recommended numbers of the animals indicated in Table 15 are then used in Table 16 to calculate the grazing and browsing capacity. The grazing and browsing is separated according to the feeding strategies of the animals. The grazing capacity is calculated as **41.4 ha/LAU** and the browsing capacity as **8 BU's per 100 ha**.

If substitution ratios are therefore based on metabolic mass only, without consideration of ungulate species differences in resource utilisation (grazing and browsing), stocking density could be underestimated for an area.

In summary, the results from the different methods are:

Ecological Index method		39.2 ha/LAU
Veld condition/rainfall method		40.7 ha/LAU
Phytomass method		48 ha/LAU
Rainfall method		25.7 ha/LAU
LAU/BU method (Snyman):	Grazing	36.8 ha/LAU
	Browsing	9.2 BU/100 ha
LAU/BU method:		

Present capacity:	Grazing	34.6 ha/LAU
	Browsing	9.1 BU/100 ha
	Combined:	14.9 ha/LAU
Recommended capacity:	Grazing	41.4 ha/LAU
	Browsing	8.0 BU/100 ha
	Combined:	18.6 ha/LAU

CHAPTER 7

GAME

Game species that historically occurred in the area are Black rhinoceros, Blue wildebeest, Bushbuck, Bushpig, Buffalo, Grey duiker, Eland, Giraffe, Grey rhebuck, Hippopotamus, Impala, Klipspringer, Kudu, Ostrich, Reedbuck, Steenbok, Roan antelope, Sable antelope, Tsessebe, Warthog, Waterbuck, White rhinoceros and Zebra. Species at present on Maremani that were not historically from the area are Blesbok, Gemsbok (*Oryx*) and Red hartebeest.

According to the present game numbers (based on the count of 2001), the area is stocked to approximately **116.1%** of its capacity (Table 14). The total area of approximately 36583 ha is used to recommend animal numbers (Table 15). The total number of 1967 LAU's is based on the grazing browsing capacity indicated in Table 16.

The recommended game suitable for Maremani are Blue wildebeest, Bushbuck, Bushpig, Grey duiker,

Eland, Elephant, Giraffe, Impala, Klipspringer, Kudu, Ostrich, Steenbok, Warthog, Waterbuck, White rhinoceros and Zebra (Table 15). The numbers of each species are also given. Black rhinoceros could be considered in future. The following aspects should be emphasized:

The introduction of more grazer species such as buffalo, roan antelope, sable antelope and tsessebe is not recommended considering the poor condition of the grass layer.

According to Table 15, provision is made for 9% low-selective or bulk feeders, 13% high selective grazers, 38% mixed grazers/browsers and 40% browsers. The low percentage grazers recommended is due to the poor condition of the grass layer and at this stage the area is more suitable for mixed feeders and browsers.

Harvesting, culling or hunting should be introduced to keep the populations at economic capacity because population growth is limited at ecological capacity. Overgrazing also results in animals being more susceptible to prolonged periods of drought.

CHAPTER 8

MANAGEMENT

Management strategy

Due to the event-driven and unpredictable climate (rainfall), an adaptive management strategy needs to be implemented. This is necessary to limit mass mortalities of animal species or overgrazing of the veld.

Related plant communities are grouped to form management units based on relatively homogeneous vegetation types, topography, roads and rivers (see Figure 8). Existing roads, fences, power-lines, other existing infrastructure, inaccessibility of the terrain, and the mosaic distribution pattern of the plant communities are also taken into account in the delimitation of these management units. Roads should ideally separate these units and act as firebreaks to prevent veld fires from entering the area.

The infra-structure needed for an efficient game farm is expensive, for example staff housing and game fencing, and, if hunting is introduced, accommodation, abattoir and cold room facilities need to be provided. Poaching may be a problem and regular patrols along the fence should be undertaken.

Measures should be taken to avoid or minimise selective or patch overgrazing by game through the use of salt blocks and/or game licks in areas that are less utilised. The game numbers could be increased or decreased according to rainfall and veld condition and therefore live sales, culling and hunting (trophy and/or biltong) of game are an intrinsic part of an adaptive management approach.

Game

Game species that occurred historically in the area could be re-introduced, preferably from game ranches in the vicinity of Maremani or game adapted to the same vegetation type and climate. The off-loading ramp for game should be as far away from fences, rivers or other obstacles as possible.

Fire

Fire is not recommended due to the low and unpredictable rainfall and the low biomass (fuel load) available.

Veld condition

The low grass biomass and poor species composition indicate veld that is not suitable for high numbers of low and high selective grazer species. Veld condition and carrying capacities need to be monitored as regularly as possible - at least on an annual basis initially.

It is not only the diversity in habitats, geology and terrain morphology that contributes to animal diversity, but also a diversity in veld condition of an area. Some animals prefer veld in good condition while others tend to prefer poorer or slightly over-utilised veld.

Ecologically sensitive and/or problem areas

The riparian vegetation along the rivers and flood plains or wetlands, for example the Limpopo, Sand and Njelele Rivers, and the Mutanga flood plain in the southern part of Solitude, needs to be conserved. Aspects such as overgrazing, water withdrawal and cultivation (associated with bush clearing) are threatening this kind of habitat.

Erosion should be monitored and measures taken to minimise damage to the system. On Solitude some erosion was visible and needs to be monitored or action taken to prevent further erosion.

Indicator plant species

Plant species such as Baobab (*Adansonia digitata*), Shepherd's tree (*Boscia albitrunca*), Common star chestnut (*Sterculia rogersii*), Sesame bush (*Sesamothamnus lugardii*), Marula (*Sclerocarya birrea*) and Corkbushes (*Commiphora* species) should be monitored because they usually show the first signs of over-utilization by browsers and elephants.

Licks

Game licks and salt blocks should ideally be placed away from veld in poor condition. Licks can also be made up using the following ingredients:

- Lick 1: 50 % coarse salt; 45 % dicalcium phosphate; 5 % Calory-3000 (molasses powder) and optionally some mealie meal.
- Lick 2: 50 % coarse salt; 25 % dicalcium phosphate; 20 % Calory-3000 (molasses powder) and 5% ureum. (Ureum should not be used in containers that can not

drain rain water and zebra might have problems with ureum).

Lick 3: 3 - 5 % fish meal; 40 % salt; 50 % dicalcium phosphate; 5 - 8 % Calory 3000; 5 % mealie meal.

Ticks

Ticks are apparently not a serious problem in Maremani, but some of the tick control systems presently available in the game industry include:

1. Duncan Applicator (Tel. (012) 803 6647, Cell 083 263 7897)
2. Tick Off (012) 804 4461, Cell 082 454 0793)
3. Scorpion Dip Applicator (Parasite Management Systems - Mr. Pierre van Niekerk, (012) 667 4755, Cell 082 853 5405)

Water provision

Permanent water should preferably not be provided in areas that are seasonally dry (winter and spring).

Control of indigenous encroacher species

Dense thickets of mopane, sickle bush, umbrella thorn and three-hook thorn occur especially on old cultivated fields. Considering the small areas where these species have encroached compared to the total size of Maremani, it is not necessary to control indigenous plants.

Alien (exotic) vegetation

Alien plants should be eradicated.

The following categories have been allocated to declared weeds and invader plants (Amendment to the regulations of the Conservation of Agricultural Resources Act No. 43 of 1983 - see Regulation 15).

Category 1 plants: They are prohibited and must be controlled by the land user.

Achyranthes aspera (Burweed), *Argemone ochroleuca* (Mexican poppy), *Agave americana* (Sisal), *Ageratum conyzoides* (Ageratum), *Datura ferox* (Large thorn

apple), *Datura innoxia* (Downy thorn apple), *Datura stramonium* (Common thorn apple), *Nerium oleander* (Oleander), *Nicotiana glauca* (Wild tobacco), *Opuntia ficus-indica* (Sweet prickly pear), *Opuntia cf. aurantiaca* (Jointed cactus), *Xanthium strumarium* (Large cocklebur),

Category 2 plants: These are plants that serve a commercial purpose, e.g. shelterbelt, building material, animal fodder, medicinal function etc. Plants may be grown and maintained in demarcated areas provided that there is a permit and that steps are taken to prevent their spread.

Psidium guajava (Guava), *Ricinus communis* (Castor-oil plant)

Category 3 plants: These are ornamentally used plants. These plants may no longer be planted, maintained or multiplied. Existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof. They are not allowed within 30 m of the 1:50 year flood line of water courses and wetlands.

Melia azedarach (Seringa), *Jacaranda mimosifolia* (Jacaranda)

These species should be controlled by mechanical and/or chemical means. Mechanical means include ringbarking (girdling), uprooting, chopping, slashing and felling. An axe or chain saw or brush cutter can be used. Stumps or ringbarked stems should be treated immediately with a chemical weedkiller (see references below). Follow-up treatment is sometimes needed. More information can be found in:

Bromilow, C. 1995. *Problem plants of South Africa*. Briza Publications, Pretoria.

Grobler, Hermien, J.B. Vermeulen and Van Zyl, Kathy. 2000. *A guide to the use of herbicides*. 17th edition. National Department of Agriculture. Formeset, Pretoria.

Henderson, L. 2001. *Alien weeds and invasive plants*. Plant Protection Research Institute Handbook no. 12, Agricultural Research Council, Pretoria.

Ecoguard (Access): (011) 463 6057

Poisonous plants

These species are known to cause poisoning of livestock. However, game species are not necessarily affected in the same way.

Dichapetalum cymosum, *Solanum incanum*, *Solanum panduriforme*, *Gomphocarpus fruticosus*, *Acacia caffra*, *Opuntia ficus-indica*, *Senecio spp.*, *Melia azedarach*

CHAPTER 9

MONITORING

Detecting ecological effects or ecological monitoring is the purposeful and repeated examination of the state or condition of the vegetation in relation to external stress. It is the frequent testing of differences between baseline or initial surveys and follow-up surveys. Ecological monitoring emphasizes changes in living organisms and not merely in the physical environment. A prerequisite in any monitoring programme are permanent reference sites, representative of what is considered necessary to be monitored and depending on the method adopted.

A monitoring programme serves as an early warning system to detect changes or trends as a result of management actions, natural events or those areas where past mismanagement occurred with the goal to adapt management strategies where necessary. On a game ranch certain management actions are implemented and possible changes related to these actions should be monitored over time.

Monitoring is important where changes are possible in the natural veld due to the application of new management programmes. The veld condition and economic capacity of all plant communities need to be monitored regularly when the number of animals increases, which could lead to overgrazing and changes in plant species composition.

Aspects that need to be monitored are:

1. climate (rainfall);
2. veld condition in terms of plant species composition, species frequency, density and/or cover;
3. economic and ecological carrying capacity;
4. vegetation structure;
5. the effects of water provision;
6. the effects of bush encroachment and its control;
7. veld reclamation measures such as soil erosion control; and
8. game numbers, population growth, mortalities, game distribution, herd composition and birth rates. It was found that it is better and more cost effective to a certain extent to count the animals on a farm every three to four years, but then 2 to even 4 times during that specific year.

Monitoring of veld condition is essential when adaptive management is applied on a game ranch. The aim is to determine whether a change in species composition, the ratio of decreaseers, increaseers and invaders

and/or encroachment by woody species has occurred. Depending on the results of monitoring, decisions regarding changes in management actions can be taken.

Methods

Herbaceous component

The wheel-point or step-point method, where 100 nearest plant records are recorded, is used to determine the plant species composition and species frequency, ratio of ecological status classes (decreasers and increasers) and ecological index (veld condition score). The nearest individual (forb or grass species) and the nearest perennial grass are recorded. The annual and perennial vegetation are recorded **separately** to provide for the large yearly variation in annual species composition and frequency in this arid area. If no plants are recorded within a 0.5 m radius from the point, it is recorded as bare soil.

Biomass production

The disc pasture meter is a suitable method to determine the grass production (fuel load) within most of the vegetation types on Marimani.

Woody component

A plot (transect) of 100 m long and 2.5 m wide is surveyed. A 100 m tape is placed on one side of the transect. All woody plants (shrubs and trees) within the transect are identified and their distance from the beginning of the transect, height, maximum canopy diameter in two directions, height of maximum canopy diameter measurement, height and diameter of lowest leaf material (in two directions) and stem diameter (see field form) are recorded. The number of stems is indicated and the diameter of the thickest stem measured. Measurements are done per 5 m sections on the tape i.e. each 5 x 2.5 m section constitutes a unit.

An importance value is calculated for each species and profile diagrams can be drawn for each of the transects.

The collected data are also suitable for the BECVOL model (Smit 1996). BECVOL describes the woody component quantitatively by determining the leaf volume and leaf mass of individual trees, density of the woody species and to analyse the structure of the vegetation.

The BECVOL computer program is used to do the following calculations:

Primary calculations (for each individual tree)

Leaf volume, leaf dry mass (DM), ETTE (leaf volume equivalents of a 1.5 m single stem tree), BTE (leaf mass equivalent of a 1.5 m single stem tree) and area covered by the canopy.

Secondary calculations:

Values are calculated per hectare e.g. ETTE/ha, BTE/ha, DM/ha, plants/ha and CSI (canopied subhabitat index: canopy diameter of large trees in the transect expressed as a % of the total transect area). These values are calculated per species and per population. The browse capacity can also be calculated.

Fixed point photography

This is an essential component of monitoring. By taking photographs of the vegetation or landscape from the same point at regular intervals, a visual record is obtained which can later be subjected to objective analysis. The advantages derived from fixed-point photographs include the following:

1. They provide a rapid means for assessing short and medium term trends in the vegetation, and therefore can have predictive value.
2. They provide additional evidence for evaluating and interpreting the impact of various external influences on the vegetation.
3. The method is cheap, easy to apply and provides a permanent record for re-examination when required.

The disadvantage of the method is that it is difficult to quantify the results and therefore there is a lack of statistical analysis.

GPS points

GPS readings should be taken at the beginning and end point of each transect. A metal stake (dropper) is hammered into the soil at the beginning and end point of each transect and spray painted with red paint. The approximate positions of the plots (transects) should be indicated on a map and for each plot a localised map should be drawn to facilitate finding the site in future (Appendix F).

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APPENDIX A

PLANT SPECIES LIST

The list is compiled from own surveys, the list from the PRECIS data bank at the National Herbarium, National Botanical Institute, and species identified in the report of DUBEL.

The following plant species were recorded on Maremani and closely surrounding areas. Approximately 71 tree species, 92 shrub species, 76 grass species, 7 sedge species, 9 geophytes, 30 succulents, 6 parasites, 2 palm species, 2 fern species, 290 forb species and 14 alien species are listed. This represents a total of 599 species. It should be remembered that this list is not complete and collections should be made over all seasons to increase the present preliminary list.

Trees

<i>Acacia caffra</i>	Common hook thorn	Gewone haakdoring
<i>Acacia erioloba</i>	Camel thorn	Kameeldoring
<i>Acacia erubescens</i>	Blue thorn	Blouhaak
<i>Acacia grandicornuta</i>	Horned thorn	Horingdoring
<i>Acacia luederitzii</i>	False Umbrella thorn	Basterhaak-en-steek
<i>Acacia nigrescens</i>	Knob thorn	Knoppiesdoring
<i>Acacia robusta subsp. clavigera</i>	Brack thorn	Brakdoring
<i>Acacia robusta subsp. robusta</i>	Ankle thorn	Enkeldoring
<i>Acacia senegal . var. leiorrhachis</i>	Slender three-hook thorn	Slapdoring
<i>Acacia tortilis subsp. heteracantha</i>	Umbrella thorn	Haak-en-steek
<i>Acacia xanthophloea</i>	Fever tree	Koorsboom
<i>Adansonia digitata</i>	Baobab	Kremetart
<i>Azelia quanzensis</i>	Pod-mahogany	Peul-mahonie
<i>Albizia adianthifolia</i>	Flat-crown	Platkroon
<i>Albizia anthelmintica</i>	Worm-bark false-thorn	Wurmbasvals doring
<i>Albizia brevifolia</i>	Mountain false-thorn	Bergvals doring
<i>Albizia harveyi</i>	Common false-thorn	Bleekblaarboom
<i>Albizia versicolor</i>	Large-leaved false thorn	Grootblaarvals doring
<i>Androstachys johnsonii</i>	Lebombo iron wood	Lebombo ysterhout
<i>Annona senegalensis</i>	Wild custard-apple	Wildesuikerappel
<i>Berchemia discolor</i>	Brown ivory	Bruin-ivoor
<i>Berchemia zeyheri</i>	Red ivory	Rooi ivoor
<i>Boscia albitrunca</i>	Shepherd's tree	Witgatboom
<i>Bridelia cathartica</i>	Blue sweetberry	Blousoetbessie
<i>Cassia abbreviata</i>	Sjambokpod	Sambokpeul
<i>Colophospermum mopane</i>	Mopanie	Mopane
<i>Combretum apiculatum</i>	Red bushwillow	Rooibos
<i>Combretum hereroense</i>	Russet bushwillow	Kierieklapper
<i>Combretum imberbe</i>	Leadwood	Hardekool

<i>Combretum molle</i>	Fluweelboswilg	Velvet Bushwillow
<i>Combretum zeyheri</i>	Large-fruited bushwillow	Raasblaar
<i>Commiphora edulis</i>	Rough-leaved corkwood	Skurweblaarkanniedood
<i>Commiphora glandulosa</i>	Tall Common Commiphora	Gewone kanniedood
<i>Commiphora marlothii</i>	Paperbark corkwood	Papierbaskanniedood
<i>Commiphora mollis</i>	Velvet corkwood	Fluweel kanniedood
<i>Commiphora neglecta</i>	Green-stem corkwood	Groenstam kanniedood
<i>Commiphora pyracanthoides</i>	Common Corkwood	Gewone kanniedood
<i>Commiphora tenuipetiolata</i>	White-stem corkwood	Witstamkanniedood
<i>Commiphora viminea</i>	Zebra-bark corkwood	Sebrabaskanniedood
<i>Croton gratissimus</i>	Lavender feverberry	Laventelkoorsbessie
<i>Croton megalobotrys</i>	Large feverberry	Grootkoorsbessie
<i>Diospyros mespiliformis</i>	Jackal-berry	Jakkalsbessie
<i>Dombeya burgessiae</i>	Pink wild pear	Persdrolpeer
<i>Entandrophragma caudatum</i>	Mountain mahogany	Bergmahonie
<i>Ekebergia capensis</i>	Cape ash	Witessenhout
<i>Faidherbia albida</i>	Ana tree	Anaboom
<i>Ficus sycomorus</i>	Common cluster fig	Gewone trosvy
<i>Ficus tettensis</i>	Small-leaved rock fig	Kleinblaar rotsvy
<i>Garcinia livingstonei</i>	African mangosteen	Laeveldse geelmelkhout
<i>Gyrocarpus americanus</i>	Propeller tree	Helikopterboom
<i>Kirkia acuminata</i>	White seringa	Witsering
<i>Lannea discolor</i>	Live-long	Dikbas
<i>Lannea schweinfurthii</i> var. <i>stuhlmannii</i>	False marula	Baster maroela
<i>Maerua angolensis</i>	Bead-bean tree	Knoppiesboontjieboom
<i>Manilkara mochisia</i>	Lowveld milk berry	Laeveldmelkbessie
<i>Olax dissitiflora</i>	Small sourplum	Kleinsuurpruim
<i>Ozoroa paniculosa</i>	Common resin tree	Gewone harpuisbos
<i>Pappea capensis</i>	Jacket-plum	Doppruim
<i>Philenoptera violacea</i>	Apple-leaf	Appelblaar
<i>Pseudolachnostylis maprouneifolia</i>	Kudu berry	Koedoebessie
<i>Rothmannia capensis</i>	Cape Gardenia	Kaapse katjiepiering
<i>Sclerocarya birrea</i> subsp. <i>caffra</i>	Marula	Maroela
<i>Schotia brachypetala</i>	Weeping boer-bean	Huilboerboon
<i>Steganotaenia araliacea</i>	Carrot tree	Geelwortelboom
<i>Sterculia rogersii</i>	Common star-chestnut	Gewone sterkastaiing
<i>Strychnos madagascariensis</i>	Black monkey orange	Swart klapper
<i>Terminalia prunioides</i>	Lowveld cluster-leaf	Sterkbos
<i>Terminalia sericea</i>	Silver cluster leaf	Vaalboom, Sandgeelhout
<i>Xanthocercis zambesiaca</i>	Nyala tree	Njalaboom
<i>Xeroderris stuhlmannii</i>	Wing bean	Vlerkboon
<i>Ziziphus mucronata</i>	Buffalo thorn	Blink-blaar-wag-'n-bietjie

Shrubs

<i>Acacia ataxacantha</i>	Flame thorn	Vlamdoring
<i>Acacia mellifera</i> subsp. <i>detinens</i>	Black thorn	Swarthaak
<i>Acacia nebrownii</i>	Sticky thorn	Kleefdoring
<i>Acacia senegal</i> var. <i>rostrata</i>	Three-hook thorn	Driehaakdoring
<i>Acacia stuhlmannii</i>	Vlei thorn	Vleidoring

<i>Anisotes rogersii</i>		
<i>Balanites pedicellaris</i>	Small green thorn	Kleingroending
<i>Bauhinia galpinii</i>	Pride-of-the-Cape	Vlam-van-de-Kaap
<i>Boscia foetida</i> subsp. <i>rehmanniana</i>	Stink shepherd's tree	Stinkwitgat
<i>Bridelia mollis</i>	Velvet sweetberry	Fluweelsoetbessie
<i>Cadaba aphylla</i>		Rooi-storm
<i>Caesalpinia gilliesii</i>		
<i>Capparis tomentosa</i>	Wooly caper bush	Wilde Kapperbos
<i>Catophractes alexandri</i>	Trumpet thorn	Trompetdoring
<i>Cissus cornifolia</i>		
<i>Clerodendrum glabrum</i>	Tinder wood	Tontelhout
<i>Cocculus hirsutus</i>		
<i>Combretum mossambicense</i>	Knobbly creeper	Knoppiesklimop
<i>Combretum paniculatum</i>	Flame creeper	Vlamklimop
<i>Commiphora africana</i>	Hairy corkwood	Harige kanniedood
<i>Commiphora angolensis</i>	Sand corkwood	Sandkanniedood
<i>Commiphora schimperi</i>	Glossy-leaved corkwood	Blinkblaarkanniedood
<i>Cordia grandicalyx</i>	Round-leaved saucer-berry	Rondeblaarpieringbessie
<i>Croton menyhartii</i>		
<i>Cordia caffra</i>	Septee tree	Septeeboom
<i>Cordia monoica</i>	Snot berry	Snotbessie
<i>Croton pseudopulchellus</i>	Small lavender fever berry	Kleinlaventelkoorsbessie
<i>Dalbergia melanoxylon</i>	Zebra wood	Sebrahout
<i>Dichapetalum cymosum</i>	Poison leaf	Gifblaar
<i>Dichrostachys cinerea</i>	Sickle bush	Sekelbos
<i>Dioscorea cotinifolia</i>	Wild yam	Olifantsvoet
<i>Diospyros lycioides</i>	Bluebush	Bloubos
<i>Ehretia amoena</i>	Sandpaper bush	Skurweblaarbos
<i>Ehretia obtusifolia</i>		
<i>Ehretia rigida</i>	Puzzle bush	Deurmekaarbos
<i>Euclea divinorum</i>	Magic quarri	Towerghwarrie
<i>Euclea natalensis</i>	Natal quarri	Natalghwarrie
<i>Euclea polyandra</i>		
<i>Ficus abutilifolia</i>	Large-leaved rock fig	Grootblaarrotsvy
<i>Flacourtia indica</i>	Governor's plum	Goewerneurspruim
<i>Flueggea virosa</i>	White-berry bush	Witbessiebos
<i>Gardenia resiniflua</i>	Resin gardenia	Harpuiskatjiepiering
<i>Gardenia volkensii</i>	Savanna gardenia	Bosveldkatjiepiering
<i>Gossypium herbaceum</i> subsp. <i>africanum</i>	Wild cotton	Wilde katoen
<i>Grewia bicolor</i>	White raisin	Witrosyntjie
<i>Grewia hexamita</i>	Giant raisin	Reuse rosyntjie
<i>Grewia flava</i>	Velvet raisin	Fluweelrosyntjie
<i>Grewia flavescens</i>	Sandpaper raisin	Skurwe rosyntjie
<i>Grewia monticola</i>	Silver raisin	Vaalrosyntjie
<i>Grewia retinervis</i>	Kalahari sand raisin	Kalahari sand rosyntjiebos
<i>Grewia subspathulata</i>		
<i>Grewia sulcata</i>		
<i>Grewia villosa</i>	Mallow raisin	Malvarosyntjie
<i>Gymnosporia buxifolia</i>	Common spike-thorn	Gewone pendoring
<i>Gymnosporia pubescens</i>		

<i>Gymnosporia senegalensis</i>	Red spike-thorn	Rooipendoring
<i>Halleria lucida</i>	Tree fuchsia	Notsung
<i>Heteromorpha stenophylla</i> var. <i>transvaalensis</i>		
<i>Hexalobus monopetalus</i>	Shakama plum	Shakamapruim
<i>Hippocratea africana</i> var. <i>richardiana</i>		
<i>Hippocratea longipetiolata</i>		
<i>Hippocratea parvifolia</i>		
<i>Jasminum fluminense</i>		
<i>Lannea edulis</i>		
<i>Lantana rugosa</i>	Bird's brandy	Wilde salie
<i>Maerua parvifolia</i>		
<i>Markhamia zanzibarica</i>	Bell bean tree	Klokkiesboontjieboom
<i>Mundulea sericea</i>	Cork bush	Kurkbas
<i>Nuxia oppositifolia</i>	Water elder	Watervlier
<i>Obetia tenax</i>	Mountain nettle	Bergbrandnetel
<i>Ochna inermis</i>	Stunted plane	Kreupelrooihout
<i>Pechuel-Loeschea leubnitziae</i>	Wild sage	
<i>Phyllanthus reticulatus</i>	Potato bush	Aartappelbos
<i>Pluchea dioscoridis</i>		
<i>Plumbago zeylanica</i>	Plumbago	
<i>Portulacaria afra</i>	Porkbush	Spekboom
<i>Pouzolzia mixta</i>	Soap-nettle	Seepnetel
<i>Psiadia punctulata</i>		
<i>Psydrax livida</i>	Green tree	Groenboom
<i>Pyrostria hystrix</i>	Porcupine bush	Ystervarkbos
<i>Rhigozum zambeziacum</i>	Mopane pomegranate	Mopaniegranaat
<i>Salvadora australis</i>	Narrow-leaved mustard tree	Smalblaarmosterdboom
<i>Schotia capitata</i>		
<i>Sesamothamnus lugardii</i>	Transvaal sesame bush	Transvaal sesamebos
<i>Sesbania sesban</i>		
<i>Solanum coccineum</i>		
<i>Tarenna supra-axillaris</i>	Narrow-leaved false bride's bush	Smalblaarbasterbruidsbos
<i>Tinnea rhodesiana</i>		
<i>Vangueria infausta</i>	Wild medlar	Wilde mispel
<i>Vernonia cinerascens</i>		
<i>Ximenia americana</i>	Blue sourplum	Blousuurpruim
<i>Zanthoxylum capense</i>	Small knobwood	Kleinperdepram

Grasses

			Ecological status
<i>Acracne racemosa</i>			
<i>Andropogon gayanus</i>	Blue grass	Blougras	I1
<i>Andropogon shinensis</i>	Hairy blue grass	Harige blougras I1	
<i>Aristida adscensionis</i>	Annual three-awn	Eenjarige Steekgras	I2c
<i>Aristida congesta</i> subsp. <i>congesta</i>	Tassel three-awn	Katstertsteekgras	I2c
<i>Aristida congesta</i> subsp. <i>barbicollis</i>	Spreading three-awn	Lossteekgras	I2c
<i>Aristida meridionalis</i>	Giant three-awn	Langbeensteekgras	I2b
<i>Aristida</i> cf. <i>pilgeri</i>			

<i>Aristida rhiniochloa</i>	Rough three-awn	Skurwesteekgras	I2c
<i>Aristida spectabilis</i>			I2c
<i>Aristida stipitata</i>	Long-awned three-awn	Langnaaldsteekgras	I2c
<i>Aristida transvaalensis</i>	Rock three-awn	Klipgras	I1
<i>Bothriochloa radicans</i>	Stink grass	Stinkgras	I2b
<i>Brachiaria deflexa</i>	False signal grass	Vals sinjaalgras	D
<i>Brachiaria brizantha</i>	Common signal grass	Broodsinjaalgras	I2a
<i>Brachiaria erusiformis</i>	Sweet signal grass	Litjiessinjaalgras	I2c
<i>Brachiaria nigropedata</i>	Black-footed signal grass	Swartvoetjiegras	D
<i>Cenchrus ciliaris</i>	Blue buffalo grass	Bloubuffelsgras	D
<i>Chloris roxburghiana</i>	Plume chloris	Pluim chloris	I2a
<i>Chloris virgata</i>	Feathered grass	Witpluimgras	I2a
<i>Cynodon dactylon</i>	Couch Grass	Kweekgras	I2c
<i>Dactyloctenium giganteum</i>	Giant crowfoot	Reuse hoenderspoor	I2a
<i>Dactyloctenium aegyptium</i>	Common crowfoot	Hoenderspoorgras	I2c
<i>Danthoniopsis dinteri</i>	Mountain grass	Berghawer	I2a
<i>Digitaria eriantha</i>	Finger grass	Vingergras	D
<i>Digitaria milanjana</i>			
<i>Digitaria sanguinalis</i>	Crab finger grass	Kruisvingergras	
<i>Digitaria seriata</i>			
<i>Digitaria velutina</i>	Flaccid finger grass	Slapvingergras	I2a
<i>Diplachne fusca</i>	Swamp grass	Kuilgras	D
<i>Eleusine coracana</i>	Goose grass	Osgras	I2c
<i>Enneapogon cenchroides</i>	Nine-awned grass	Negenaaldgras	I2b
<i>Enneapogon scoparius</i>	Bottlebrush grass	Kalkgras	I2c
<i>Enneapogon spathaceus</i>			
<i>Enteropogon macrostachyus</i>	Mopane grass	Mopaniegras	D
<i>Eragrostis annulata</i>			
<i>Eragrostis aspera</i>	Rough love grass	Grootpluim eragrostis	I2c
<i>Eragrostis cilianensis</i>	Stink love grass		I2c
<i>Eragrostis curvula</i>	Weeping Love Grass	Oulandsgras	I2b
<i>Eragrostis cylindriflora</i>			
<i>Eragrostis gummiflua</i>	Gum grass	Gomgras	I2b
<i>Eragrostis lehmanniana</i>	Lehmann's Love Grass	Knietjiesgras	I2a
<i>Eragrostis porosa</i>			
<i>Eragrostis rigidior</i>	Broad-leaved curly leaf	Breë krulblaar	I2b
<i>Eragrostis rotifer</i>	Pearly love grass		I2a
<i>Eragrostis superba</i>	Saw-toothed love grass	Weeluisgras	I2a
<i>Eragrostis trichophora</i>	Hairy love grass	Harige pluimgras	I2c
<i>Eragrostis viscosa</i>	Sticky love grass	Klewerige eragrostis	I2c
<i>Eriochloa meyeriana</i>	Black-footed water grass		D
<i>Fingerhuthia africana</i>	Thimble grass	Vingerhoedgras	D
<i>Heteropogon contortus</i>	Spear Grass	Assegaaigras	I2a
<i>Hyperthelia dissoluta</i>	Yellow thatching grass	Geeltamboekiegras	I1
<i>Melinis repens</i>	Natal Redtop	Natal Rooipluim	I2b
<i>Oropetium capense</i>	Dwarf grass	Haasgras	I2c
<i>Panicum coloratum</i>	White buffalo grass	Witbuffelsgras	D
<i>Panicum deustum</i>	Broad-leaved panicum	Breëblaarbuffelsgras	D
<i>Panicum maximum</i>	Guinea grass	Buffelsgras	D
<i>Panicum natalense</i>	Natal panicum	Suurbuffelsgras	D

<i>Phragmites australis</i>	Common Reed	Fluitjiesriet	I2a
<i>Pogonarthria squarrosa</i>	Herringbone Grass	Sekelgras	I2c
<i>Schmidtia pappophoroides</i>	Sand quick	Sandkweek	D
<i>Setaria incrassata</i>	Vlei Bristle grass	Vleimannagras	D
<i>Setaria sagittifolia</i>	Arrow grass	Pylblaargras	I2a
<i>Setaria verticillata</i>	Bur Bristle grass	Klitsgras	I2c
<i>Sporobolus consimilis</i>			
<i>Sporobolus ioclados</i>	Pan dropseed	Panfynsaadgras	D
<i>Sporobolus panicoides</i>	Christmas tree grass	Kersboomgras	I2a
<i>Sporobolus pyramidalis</i>	Catstail dropseed	Katstertfynsaadgras	I2c
<i>Stipagrostis hirtigluma</i>	Blue bushman grass	Blouboesmangras	I2b
<i>Stipagrostis uniplumis</i>	Silky bushman grass	Blinkaarboesmangras	I2a
<i>Tetrapogon tenellus</i>			
<i>Tragus berteronianus</i>	Carrot seed grass	Wortelsaadgras	I2c
<i>Tricholaena monachne</i>	Blue-seed grass	Blousaadgras	I2a
<i>Urochloa mosambicensis</i>	Common signal grass	Bosveldbeesgras	I2b
<i>Urochloa brachyura</i>			
<i>Urochloa panicoides</i>	Garden signal grass	Tuinbeesgras	I2c

Sedges

<i>Bulbostylis hispidula</i>	Fynbiesie	Slender sedge	
<i>Coleochloa pallidior</i>			
<i>Cyperus rupestris</i>			
<i>Cyperus sexangularis</i>			
<i>Kyllinga alba</i>		Witbiesie	
<i>Mariscus rehmannianus</i>			
<i>Schoenoplectus corymbosus</i>			

Geophytes

<i>Camptorrhiza strumosa</i>		Froetang	
<i>Crinum minimum</i>			
<i>Crinum buphanoides</i>			
<i>Dipcadi papillatum</i>			
<i>Gladiolus oatesii</i>			
<i>Ledebouria revoluta</i>			
<i>Pancratium tenuifolium</i>		Aandblommetjie	
<i>Scadoxus multiflorus</i>			
<i>Trachyandra saltii</i>			

Succulents

<i>Adenia fruticosa</i> subsp. <i>simplicifolia</i>			
<i>Adenia repanda</i>			
<i>Adenia spinosa</i>		Olifantsvoet	
<i>Adenium multiflorum</i>	Impala lily	Impala lelie	
<i>Aloe chabaudii</i>			
<i>Aloe globuligemma</i>			
<i>Aloe littoralis</i>			

Aloe lutescens
Aloe marlothii
Cissus quadrangularis
Cyphostemma segmentatum
Cyphostemma schlechteri
Cyphostemma spinosopilosum
Euphorbia cooperi
Euphorbia malevola
Euphorbia monteiri subsp. *ramosa*
Euphorbia schinzii
Euphorbia transvaalensis
Hoodia sp. cf. *currorii*
Huernia zebrina subsp. *magniflora*
Kleinia longiflora
Monadenium lugardiae
Orbeopsis valida
Sansevieria aethiopica
Sansevieria hyacinthoides
Sansevieria pearsonii
Sarcostemma viminale
Stapelia gettliffei
Stapelia kwebensis
Tinospora fragosa

Bowstring hemp Aambeiwortel

Parasites

Alectra orobanchoides
Alectra sessiliflora
Tapinanthus leendertziae
Tapinanthus sambesiacus
Viscum combreticola
Viscum rotundifolium

Mistle toe Voëlent
Mistle toe Voëlent
Mistle toe Voëlent
Mistle toe Voëlent

Palms

Hyphaene coriacea
Hyphaene petersiana

Ilala palm Lalapalm
Real fan palm Opregte waaierpalm

Ferns

Pellaea calomelanos
Selaginella dregei

Resurrection selaginella

Forbs

Abutilon angulatum var. *macrophyllum*
Abutilon angulatum var. *angulatum*
Abutilon austro-africanum
Abutilon fruticosum
Abutilon grandiflorum

Abutilon pycnodon
Abutilon ramosum
Abutilon rehmannii
Acalypha indica
Achyranthes aspera
Acrotome inflata
Ageratum conyzoides
Alternanthera pungens
Amaranthus thunbergii
Antherothamnus pearsonii
Anticharis linearis
Apium graveolens
Aptosimum elongatum
Aptosimum lineare
Aptosimum marlothii
Asparagus africanus
Asparagus aspergillus
Asparagus bechuanicus
Asparagus cooperi
Asparagus nodulosus
Asparagus suaveolens
Barleria affinis
Barleria albostellata
Barleria bremekampii
Barleria crossandrifolius
Barleria elegans
Barleria holubii
Barleria lancifolia
Barleria prionitis
Barleria rogersii
Barleria transvaalensis
Barleria senensis
Becium filamentosum
Bergia salaria
Blepharis aspera
Blepharis diversispina
Blepharis pruinosa
Blepharis subvolubilis
Boerhavia coccinea
Boerhavia diffusa
Calostephane divaricata
Caralluma lugardii
Cardiospermum corindum
Cardiospermum halicacabum
Celosia trigyna
Cephalaria pungens
Ceratotheca sesamoides
Ceratotheca triloba
Chamaecrista absus
Chamaecrista stricta

<i>Chamaesyce inaequilatera</i>		
<i>Chamaesyce neopolycnemoides</i>		
<i>Chascanum incisum</i>		
<i>Cissampelos mucronata</i>		
<i>Cleome angustifolia</i> subsp. <i>petersiana</i>	Wild cleome	
<i>Cleome oxyphylla</i>		
<i>Cleome hirta</i>		
<i>Cleome monophylla</i>		
<i>Clerodendrum ternatum</i>		
<i>Coccinia rehmannii</i>		
<i>Commelina benghalensis</i>		
<i>Commelina eckloniana</i>		
<i>Commelina erecta</i>		
<i>Commicarpus helenae</i>		
<i>Commicarpus pentandrus</i>		
<i>Commicarpus pilosus</i>		
<i>Commicarpus plumbagineus</i>		
<i>Conyza scabrida</i>		
<i>Corallocarpus triangularis</i>		
<i>Corbichonia decumbens</i>		
<i>Corchorus asplenifolius</i>		
<i>Corchorus kirkii</i>		
<i>Corrigiola litoralis</i>		
<i>Crotalaria brachycarpa</i>		
<i>Crotalaria damarensis</i>		
<i>Crotalaria laburnifolia</i>		
<i>Crotalaria schinzii</i>		
<i>Crotalaria steudneri</i>		
<i>Crotalaria podocarpa</i>		
<i>Cucumis africanus</i>	Wild cucumber	Wilde komkommer
<i>Cucumis zeyheri</i>		
<i>Cyathula lanceolata</i>		
<i>Dalechampia galpinii</i>		
<i>Decorsea schlechteri</i>		
<i>Dicerocaryum eriocarpum</i>		
<i>Dicerocaryum senecioides</i>		
<i>Diclis petiolaris</i>		
<i>Dicoma tomentosa</i>		
<i>Dissotis princeps</i>		
<i>Endostemon tenuiflorus</i>		
<i>Endostemon tereticaulis</i>		
<i>Erianthemum ngamicum</i>		
<i>Evolvulus alsinoides</i>		
<i>Fadogia homblei</i>		
<i>Felicia clavipilosa</i> subsp. <i>transvaalensis</i>		
<i>Felicia mossamedensis</i>		
<i>Flaveria bidentis</i>		
<i>Geigeria acaulis</i>		
<i>Geigeria burkei</i>		
<i>Gisekia africana</i>		Vermeersiektebossie

Glinus bainesii
Glinus lotoides
Glinus oppositifolius
Gomphostigma virgatum
Harpagophytum procumbens subsp. *transvaalense*
Harpagophytum procumbens
Helichrysum argyrosphaerum
Helichrysum candolleanum
Helictotrichon turgidulum
Heliotropium ciliatum
Heliotropium giessii
Heliotropium ovalifolium
Heliotropium steudneri
Heliotropium strigosum
Heliotropium zeylanicum
Helixanthera garciana
Hemizygia albiflora
Hemizygia elliottii
Hemizygia petiolata
Hemizygia petrensis
Hermannia glanduligera
Hermannia modesta
Hermannia stellulata
Hermbstaedtia fleckii
Hermbstaedtia linearis
Hermbstaedtia odorata
Hibiscus calyphyllus
Hibiscus engleri
Hibiscus meyeri
Hibiscus micranthus
Hibiscus platycalyx
Hibiscus sidiformis
Hibiscus subreniformis
Hirpicium bechuanense
Hirpicium gorterioides
Holubia saccata
Hybanthus enneaspermus
Hypertelis salsoloides
Indigastrum costatum
Indigofera astragalina
Indigofera bainesii
Indigofera circinnata
Indigofera daleoides
Indigofera filipes
Indigofera flavicans
Indigofera heterotricha
Indigofera ingrata
Indigofera oxalidea
Indigofera schimperi
Indigofera sordida

Indigofera torulosa
Indigofera trita
Ipomoea albivenia
Ipomoea crassipes
Ipomoea magnusiana
Ipomoea obscura
Ipomoea tenuipes
Jamesbrittenia huillana
Jatropha spicata
Jatropha zeyheri
Justicia betonica
Justicia flava
Justicia matammensis
Justicia odora
Justicia protracta
Kohautia caespitosa
Kohautia cynanchica
Kyphocarpa angustifolia
Lagarosiphon muscoides
Lagynias lasiantha
Leucas glabrata
Leucas neuflyzeana
Limeum fenestratum
Limeum sulcatum
Limeum viscosum
Litogyne gariepina
Lotononis bainesii
Lotononis curtii
Lotus mossamedensis
Marsdenia macrantha
Megalochlamys kenyensis subsp. australis
Megalochlamys revoluta subsp. cognata
Melanospermum foliosum
Melhania acuminata
Melhania forbesii
Melhania rehmannii
Mollugo cerviana
Monechma debile
Monechma divaricatum
Monsonia glauca
Monsonia senegalensis
Neorautanenia amboensis
Nesaea schinzii
Neuracanthus africanus
Nidorella resedifolia
Ocimum americanum
Otholobium polyphyllum
Pachystigma thamnus
Pavonia burchellii
Pegolettia senegalensis

<i>Pergularia daemia</i>		
<i>Peristrophe cliffordii</i>		
<i>Peristrophe decorticans</i>		
<i>Petalidium aromaticum</i>		
<i>Petalidium aromaticum</i> var. <i>canescens</i>		
<i>Petalidium oblongifolium</i>		
<i>Phaeoptilum spinosum</i>		
<i>Philyrophyllum schinzii</i>		
<i>Phyla nodiflora</i>		
<i>Phyllanthus burchellii</i>		
<i>Phyllanthus maderaspatensis</i>		
<i>Phyllanthus parvulus</i> var. <i>garipensis</i>		
<i>Phyllanthus pinnatus</i>		
<i>Plectranthus tetensis</i>		
<i>Plicosepalus kalachariensis</i>		
<i>Polygala sphenoptera</i>		
<i>Polygonum plebeium</i>		
<i>Polypogon monspeliensis</i>		
<i>Portulaca kermesina</i>		
<i>Priva africana</i>		
<i>Pseudoconyza viscosa</i>		
<i>Pseudognaphalium luteo-album</i>		
<i>Pterodiscus ngamicus</i>		
<i>Ptychobium contortum</i>		
<i>Pulicaria scabra</i>		
<i>Pupalia lappacea</i>		
<i>Rhinacanthus xerophilus</i>		
<i>Rhynchosia minima</i> var. <i>prostrata</i>		
<i>Rhynchosia minima</i>		
<i>Rhynchosia sublobata</i>		
<i>Rhynchosia totta</i>		
<i>Rhynchosia venulosa</i>		
<i>Schizaea pectinata</i>		
<i>Secamone parvifolia</i>		
<i>Seddera capensis</i>		
<i>Seddera suffruticosa</i>		
<i>Selago cecilae</i>		
<i>Senecio apiifolius</i>		
<i>Senecio pleistocephalus</i>		
<i>Senna italica</i> subsp. <i>arachoides</i>	Wild senna/eland's pea	Swartstorm
<i>Sericorema remotiflora</i>		
<i>Sericorema sericea</i>		
<i>Sesamum alatum</i>	Wild sesame	Wilde sesame
<i>Sida chrysantha</i>		
<i>Sida cordifolia</i>	Flannel weed	Hartblaartaaiman
<i>Sida dregei</i>		
<i>Sida rhombifolia</i>		
<i>Solanum coccineum</i>		
<i>Solanum incanum</i>		
<i>Solanum kwebense</i>		

<i>Solanum panduriforme</i>	Poison apple	Gifappel
<i>Solanum renshii</i>		
<i>Sphaeranthus peduncularis</i>		
<i>Sphedamnocarpus pruriens</i>		
<i>Stomatanthes africanus</i>		
<i>Stomatostemma monteiroae</i>		
<i>Streptopetalum serratum</i>		
<i>Stylosanthes fruticosa</i>		
<i>Tavaresia barklyi</i>		
<i>Tephrosia limpopoensis</i>		
<i>Tephrosia longipes</i>		
<i>Tephrosia polystachya</i>		
<i>Tephrosia polystachya</i> var. <i>hirta</i>		
<i>Tephrosia purpurea</i>		
<i>Tephrosia villosa</i>		
<i>Thesium mossii</i>		
<i>Tieghemia rogersii</i>		
<i>Tragia rupestris</i>		
<i>Tribulus terrestris</i>		Dubbeltjie
<i>Tribulus zeyheri</i>		Dubbeltjie
<i>Tricliceras glanduliferum</i>		
<i>Typha capensis</i>		
<i>Vahlia capensis</i>		
<i>Vernonia amygdalina</i>		
<i>Vernonia cinerea</i>		
<i>Vernonia fastigiata</i>		
<i>Vernonia glabra</i>		
<i>Vernonia sutherlandii</i>		
<i>Vigna unguiculata</i>		
<i>Waltheria indica</i>		
<i>Xenostegia kentrocaulos</i>		
<i>Xenostegia palmata</i>		
<i>Xerophyta humilus</i>		
<i>Xerophyta viscosa</i>		
<i>Zornia milneana</i>		

Alien (exotic) species

<i>Achyranthes aspera</i>	Burweed	Grootklits
<i>Agave americana</i>	Sisal	Garingboom
<i>Ageratum conyzoides</i>	Ageratum	Ageratum
<i>Argemone ochroleuca</i>	Mexican poppy	Bloudissel
<i>Datura ferox</i>	Large thorn apple	Grootstinkblaar
<i>Datura innoxia</i>	Downy thorn apple	Harige stinkblaar
<i>Datura stramonium</i>	Common thorn apple	Gewone stinkblaar
<i>Jacaranda mimosifolia</i>	Jacaranda	Jakaranda
<i>Melia azedarach</i>	Seringa	Maksering
<i>Nerium oleander</i>	Oleander	Selonsroos
<i>Nicotiana glauca</i>	Wild tobacco	Wildetabak
<i>Opuntia ficus-indica</i>	Sweet prickly pear	Turksvy

Opuntia aurantiaca
Psidium guajava
Ricinus communis
Xanthium strumarium

Jointed cactus
Guava
Castor-oil plant
Large cocklebur

Litjieskactus
Koejawel
Kasterolieplant
Kankerroos