

CHAPTER 4

THE VEGETATION OF RUSTENBURG NATURE RESERVE

INTRODUCTION

A detailed analysis of the physical environment and associated plant communities of a conservation area is necessary to enable a manager to compile an efficient wildlife management programme (Bredenkamp & Theron 1976; Bredenkamp & Theron 1991; Bezuidenhout 1995). This will contribute to ecologically sound land use planning and management and ensure sustainable resource utilization. The description and classification of homogenous vegetation units form the primary basis for the delineation of homogenous physiographic units for management purposes (Schulze *et al.* 1994).

Vegetation types are the result of a specific set of environmental factors and therefore constitute different habitats (Dekker *et al.* 1995) which respond differently to similar environmental impacts and management practises (Bredenkamp & Theron 1976). An analysis of the vegetation of an area is important to determine and explain the relationships between plant associations and environmental variables.

The aim of this study was to classify, describe and map the vegetation of Rustenburg Nature Reserve. This will be used to delineate homogenous physiographic units for management purposes.

Classification and mapping of landscape features and habitats are an essential first step in ecological monitoring, as it enables the delineation of the ecosystem that will serve as basis for data collection and analysis (Grimsdell 1978). These management units and associated vegetation communities will form the basis of

a monitoring programme to establish trends in vegetation changes. Successful management of natural vegetation depends on a knowledge of the composition of the vegetation, the extent it is being utilized and the rates and direction of changes that may take place in response to management practises such as herbivory and fire (Walker 1976). This knowledge depends on a reliable and efficient programme to monitor whether the management practices in place do have the desired effect on the attainment of specific goals for conservation areas.

METHODS

Species Composition

The Braun-Blanquet approach of vegetation classification was used to describe the vegetation of Rustenburg Nature Reserve. These procedures have been used successfully by various researchers (Bredenkamp & Theron 1978; Schulze 1992; Bezuidenhout 1993, 1994; Brown & Bredenkamp 1994; Brown *et al.* 1995) and has been recommended by Scheepers (1983) for the standardization of phytosociological studies in South Africa. It is an informal method using ecological knowledge of the area to arrange species and samples to best described the inherent structure of the data. The Braun-Blanquet approach is based on three principles (Gaugh 1989):

- Plant communities are conceived as vegetation types recognised by floristic composition, apart from environmental information
- Certain species in a vegetation community are more sensitive indicators of a given environmental or competitive gradient than others
- Communities are arranged into a hierarchical classification on the basis of diagnostic species.

An arranged table is a species-by-sample data matrix that displays at once both the general and the full detail of the data set. This method of classification is the

earliest classification technique in community ecology. The most frequently used method for analysing plant community data through table arrangement is the Braun-Blanquet method. It is an informal, subjective method.

The Braun-Blanquet method proceeds in three phases

- The analytical phase consists of reconnaissance and data collection
- The synthetic phase involves arranging samples and species to show the inherent structure of the data by an arranged table
- The syntaxinomial phase involves the assignment of samples to previously recognised associations or the establishment of new associations, the hierarchical arrangement of associations into higher units and the development of formal standardized nomenclature

Coetzee (1975) used Braun-Blanquet procedures to classify the vegetation of the farm Rietvallei. Vegetation data for the farm Baviaanskrans was collected and consolidated with Coetzee's data to develop a single vegetation map for the reserve. The entire data set was re-analysed to investigate possible rearrangements which may result as certain vegetation groups become more or less pronounced. To ensure compatibility between the two data sets, the procedures as described by Coetzee (1975) were being adhered to as far as possible.

With a fair knowledge of the terrain and associated vegetation and geological and soil type boundaries, the farm Baviaanskrans was investigated with the aid of a stereoscope and 1:10 000 scale paired stereophotographs. The area was stratified into relative homogenous physiographic and physiognomic units and 113 sampling plots were randomly placed in these physiographic-physiognomic units.

As one is not bound to a fixed plot size (Werger 1974), a 16 m² quadrant was considered sufficient for studying the herbaceous stratum. A plot size of 200 m² was adequate to represent the structural composition of the woody layer (Schulze

1992; Schmidt 1992; Bredenkamp & Deutschländer 1995, Brown & Bredenkamp 1994; 1996). This follows the plot sizes suggested by Coetzee (1975). In each plot, all plant species together with the following information, were recorded:

- Braun-Blanquet cover-abundance values for each species were estimated using the Braun-Blanquet scale described by Werger (1974)
- Percentage rock cover (0 = no rocks, 1= 1-10%, 2 = 10%+)
- Size of rocks:

Boulders	}	absent, rare, frequent, abundant
Large rocks		
Medium rocks		
Gravel		
- Slope (in degrees)
- Aspect
- Terrain unit (5,4,3,2,1)
- Surface erosion (1=none, 2 = splash erosion, 3 = donga erosion)

The raw data sets from Rietvallei (Coetzee 1975) and Baviaanskrans were consolidated into one data set. Two-way indicator species analysis (TWINSPAN) (Hill 1979b) was applied to the full data set as a first approximation. The resulting classification was refined by means of Braun-Blanquet procedures (Bredenkamp & Theron 1978; Matthews *et al.* 1992, 1994; Schmidt 1992; Schulze 1992; Smit *et al.* 1993; Fuls *et al.* 1993; Bezuidenhout 1993, 1994; Brown & Bredenkamp 1994; Brown *et al.* 1995).

A synoptic table was compiled using the final phytosociological tables. An ordination algorithm, Detrended Correspondence Analysis (DECORANA) (Hill 1979a) was applied to the synoptic data set to determine possible gradients between communities and to detect possible habitat gradients associated with vegetation gradients (Matthews *et al.* 1992; Bezuidenhout *et al.* 1994; Schulze *et al.* 1994; Bezuidenhout 1995). The association of the different communities along the first and second axes of the ordination diagram was used to determine the different management units (Schulze *et al.* 1994).

The naming of the vegetation units was done according to the method used by Schmidt (1992). The first species name was that of a species diagnostic to the vegetation unit and the second species name that of a dominant species. A physiognomic term, as described by Edwards (1983) was used to describe the vegetation structure of the unit.

Structural Analysis of the Woody Vegetation

Additional information on the structure of the woody vegetation was determined by the Variable quadrant-size method as described by Coetzee and Gertenbach (1977). The woody structure. In accordance with this method the following information for each sampling site were determined:

- Species compositional data of the tree and shrub layer
- Density and distribution of the trees and shrubs in each of the following height classes:
 - ◆ <0.75m
 - ◆ 0.75m - <1.5m
 - ◆ 1.5m - <2.5m
 - ◆ 2.5m - <3.5m
 - ◆ 3.5m - <5.5m
 - ◆ >5.5m
- The growth form of the stem:
 - ◆ Tree form - Individual with single stem
 - ◆ Light shrub form - Individual with 2-4 stems
 - ◆ Bushy shrub form - Individual with more than 5 stems
- The total density of the tree and shrub layer, expressed as individuals. hectare⁻¹

Thirty-one plots were randomly placed in vegetation communities with notable woody stratum and were analysed separately with the use of Quattro Pro Spreadsheet functions.

RESULTS

Classification

In total 611 plant species were recorded. Through the application of TWINSpan, four main vegetation groups were identified from the initial data set. The delineation of the four groups was based on underlying mother rock, soil depth, clay content and moisture content:

Vegetation associated with very shallow soils and bedrock, overlaid by quartz, mainly on the northern slopes

Vegetation associated with deep to medium-deep soils, overlaid by quartz, in the central basin and north western plateau

Vegetation associated with deep clayish soils, overlaid by diabase, mainly in the eastern valleys

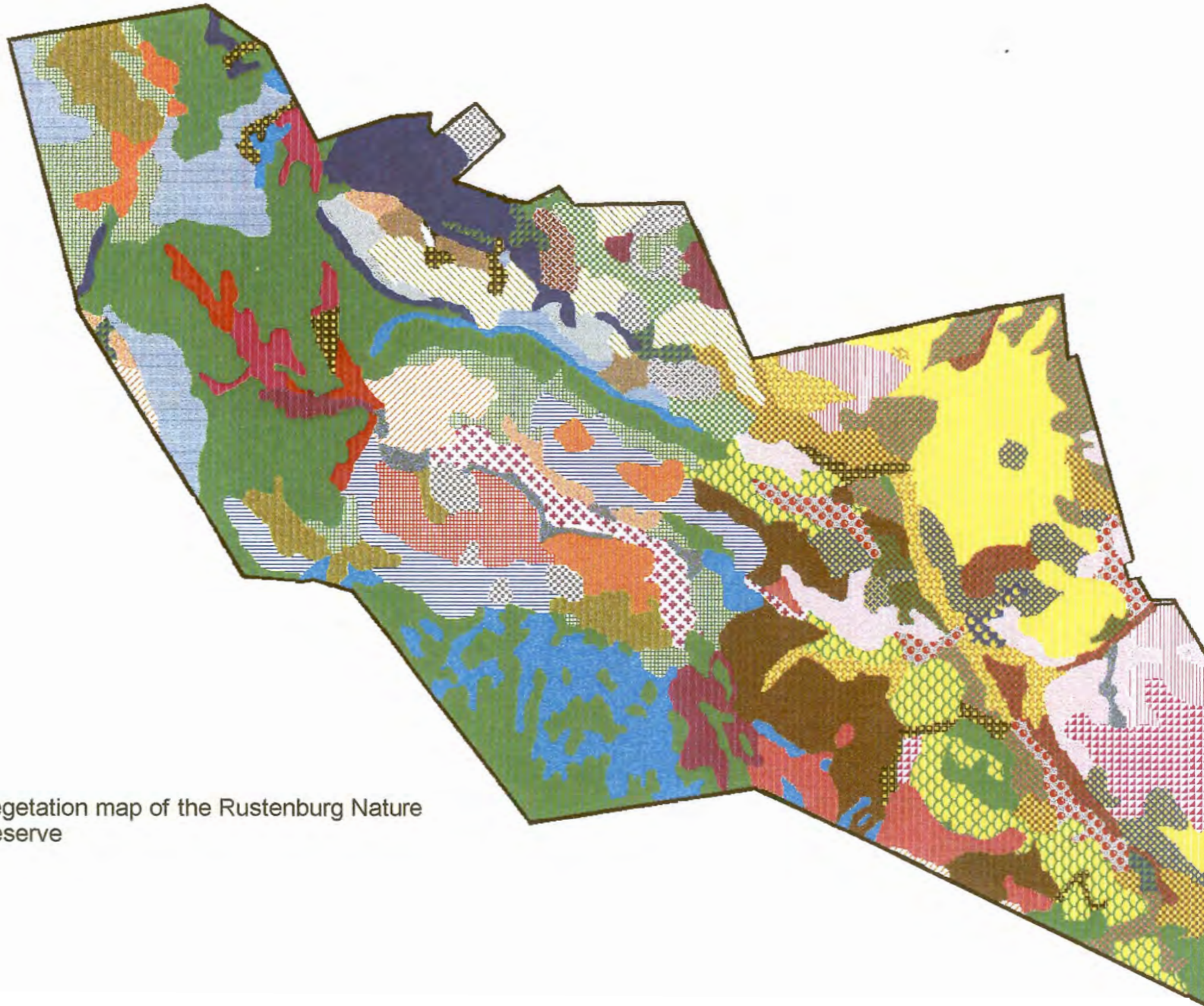
Vegetation associated with the moist habitats along Waterkloofspruit and drainage lines

Four phytosociological tables were developed for the vegetation in Rustenburg Nature Reserve. From the final phytosociological tables 51 vegetation communities and their associated sub-communities and variations were identified.





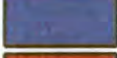





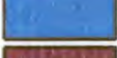






























1. ***Englerophytum magalismsontanum - Ancylobotrys capensis* Tall Open Shrub land**
 - 1.1 *Aristida transvaalensis - Bulbostylis burchellii* Tall Sparse Shrub land
 - 1.2 *Cederach cordatum - Tristachya leucotrix* Tall Sparse Shrub land
 - 1.3 *Croton gratissimus - Combretum molle* Short Sparse Woodland
 - 1.4 *Faurea saligna - Cyperus sphaerospermus* Short Open Woodland
 - 1.5 *Diospyros lycioides - Cymbopogon validus* Tall Sparse Shrub land
 - 1.6 *Asparagus krebsianus - Senecio venosus* High Open Shrub land
 - 1.7 *Loudetia flavida - Tristachya biseriata* Tall Closed Shrub land

2. ***Eragrostis nindensis* - *Cyperus rupestris* Short Open Grassland**
 - 2.1 *Lopholaena coriifolia* - *Lapeirousia sandersonii* Short Open Grassland
 - 2.1.1 *Diheteropogon amplexans* - *Tristachya biseriata* Tall Open Grassland
 - 2.1.2 *Themeda triandra* - *Aristida diffusa* Short Open Grassland
 - 2.1.3 *Frithia pulchra*- *Selaginella dregei* Low Sparse Grassland
 - 2.1.4 *Coleocloa setifera* - *Indigofera comosa* Short Open Grassland
 - 2.1.5 *Trachypogon spicatus* - *Bulbostylis burchellii* Short Open Grassland
 - 2.2 *Themeda triandra* - *Eragrostis racemosa* Short Open Grassland
- 3 ***Bulbostylis burchellii* - *Themeda triandra* Short Open Grassland**
- 4 ***Tristachya biseriata* -*Protea caffra* Short Sparse Woodland**
 - 4.1 *Blumea alata* - *Parinari capensis* sub-community
 - 4.2 *Indigofera burkeana*-*Rhynchosia totta* Short Closed Woodland
 - 4.3 *Diheteropogon amplexans* - *Ficinia filiformis* Short Closed Woodland
 - 4.4 *Cryptolepis oblongifolia* - *Loudetia simplex* Tall Sparse Woodland
 - 4.5 *Trachypogon spicatus* - *Sphenostylis angustifolia* Tall Closed Grassland
 - 4.6 *Burkea africana* - *Setaria sphacelata* Tall Open Woodland
 - 4.6.1 *Combretum zeyheri* - *Trachypogon spicatus* Tall Sparse Woodland
 - 4.6.2 *Burkea africana* - *Themeda triandra* Tall Open Woodland
 - 4.7 *Aloe greatheadii*- *Themeda triandra* Tall Open Woodland
- 5 ***Protea gagedi* - *Monocymbium cerasiiforme* Short Open Shrub land**
- 6 ***Indigofera comosa* - *Schizachyrium sanguineum* Tall Closed Grassland**
- 7 ***Plexipus hederaceus* - *Cymbopogon excavatus* Tall Closed Grassland**
- 8 ***Tristachya leucotrix* - *Setaria sphacelata* Tall Sparse Woodland**
 - 8.1 *Heteropogon contortus* - *Trachypogon spicatus* Tall Open Woodland
 - 8.2 *Ruellia cordata* - *Senecio venosus* Tall Sparse Woodland
 - 8.3 *Trachypogon spicatus* - *Bulbostylis burchellii* Short Sparse Woodland

- 9 *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland**
- 9.1 *Cheilanthes viridus* - *Combretum molle* Short Open Woodland
- 9.2 *Digitaria eriantha* - *Lippia javanica* Tall Closed Woodland
- 9.3 *Setaria lindenbergiana* - *Artemisia afra* Tall Closed Woodland
- 9.4 *Becium obovatum* - *Protea caffra* Tall Closed Woodland.
- 9.4.1 *Turbina oblongata* - *Phyllanthus glaucophyllus* High Closed Shrub land
- 9.4.2 *Diospyros lycioides* - *Rhus rigida* Tall Closed Woodland
- 9.4.3 *Themeda triandra* - *Elionurus muticus* Tall Closed Woodland
- 9.5 *Ruellia patula* - *Melinis nerviglumis* Short Open Woodland
- 9.5.1 *Hypericum aethopicum* - *Acacia karroo* Short Closed Woodland
- 9.5.2 *Loudetia flavida* - *Andropogon schirensis* Short Open Woodland
- 9.6 *Heteropogon contortus* - *Faurea saligna* Tall Open Woodland
- 9.7 *Senecio venosus* - *Heteropogon contortus* Tall Closed Woodland
- 9.8 *Setaria sphacelata* - *Themeda triandra* Tall Closed Woodland
- 9.9 *Euclea crispa* - *Panicum maximum* Tall Closed Woodland
- 9.10 *Asparagus virgata* - *Celtis africana* Tall Closed Woodland
- 9.11 *Olea europaea* - *Grewia occidentalis* Tall Closed Woodland
- 10 *Mimusops zeyheri* - *Hypoestes forskali* Tall Forest**
- 11 *Brachylaena rotundata* - *Englerophytum magalismsontanum* High Open Shrub land**
- 11.1 *Pittosporum viridiflorum* - *Halleria lucida* Short Open Shrub land
- 11.2 *Ancylobotrys capensis* - *Tricalysia lanceolata* Short Open Shrub land
- 12 *Cynodon dactylon* - *Panicum maximum* Tall Sparse Woodland**
- 12.1 *Tagetes minuta* - *Commelina africana* Sparse Open Woodland
- 12.2 *Hyparrhenia hirta* - *Bidens pilosa* Short Sparse Woodland
- 13 *Pteridium aquilinum* - *Miscanthus junceus* Tall Closed Grassland**
- 13.1 *Phragmites australis* - *Cyperus* species Reeds swamp
- 13.2 *Vernonia hirsuta* - *Pteridium aquilinum* Tall Closed Grassland
- 13.3 *Pycnostachys reticulata* - *Buddleja saligna* Tall closed Shrub land
- 14 *Aristida junciformis* - *Arundinella nepaliensis* Tall Closed Grassland**



Vegetation map of the Rustenburg Nature Reserve

	1.1		8.1
	1.2		8.2
	1.3		8.3
	1.4		9.1
	1.5		9.2
	1.6		9.3
	1.7		9.4
	2.1		9.5
	2.2		9.6
	3		9.7
	4.1		9.8
	4.2		9.9
	4.3		9.10
	4.4		9.11
	4.5		10
	4.6		11
	4.7		12.1
	5		12.2
	6		13
	7		14
			

The numbers next to the legend corresponds with the numbers of the communities and variations as outlined on page 57-59 of the text

Description of the vegetation units

1. *Englerophytum magalismontanum* - *Ancylobotrys capensis* Tall Open Shrub land community

This community is generally confined to the steep northern and north eastern slopes (>20°) of the reserve and extends onto the banks of the deeply insized ravines, characteristic of the northern face of the Magaliesberg (Carruthers 1990). Soils are shallow lithosols, restricted to the Mispah and Glenrosa soil forms. A lithosol-rock complex of sheetlike to broken quartzite occurs on the steep upper slopes (Coetzee 1975). Exposed rock and shallow Mispah soils are limited to the crest of the Magaliesberg, although a mosaic of these exposed areas is interspersed among the deeper soils on the middle- and footslopes. Deep Glenrosa soils are found further down the slope where eroded material accumulate. Characteristic of the Mispah soil form on the reserve is the high content of decomposed organic matter (Coetzee 1975), the result of a high occurrence of pioneer plant roots in the top layer (% carbon > 3.04%).

This community corresponds with the *Englerophytum magalismontanum* - *Ancylobotrys capensis* Shrub land identified by Coetzee (1975). Coetzee (1975) regarded this community as inferior to the *Loudetia simplex* - *Aristida aequiglumis* Woodlands, Shrub lands and Grasslands. The inclusion of the vegetation of the farm Baviaanskrans in the classification elevates this community to be prominent in the reserve. The *Englerophytum magalismontanum* - *Ancylobotrys capensis* Shrub land is extensively spread over the northeast facing slopes of Baviaanskrans.

The community is represented by 35 relevés and is characterised by species group A (Table 4). Dominant species in this community are *Englerophytum magalismontanum*, *Ancylobotrys capensis*, *Ochna pulchra*, *Indigofera melinoides* and *Tapiphyllum parvifolium*. This community is also recognised for the extensive

occurrence of the pioneer plant *Selaginella dregei* (Species group T), which forms extensive mats on seasonally wet sheetrock and flat rock surfaces (Jacobsen 1989).

On the basis of presence and absence of species groups in this community, seven sub - communities can be recognised.

1.1 *Aristida transvaalensis* - *Bulbostylis burchellii* Tall Sparse Shrub land

This shrub land is situated on the shallow soils on the upper regions of the north eastern facing slopes of Baviaanskrans. Conspicuous species present in this community are *Aristida transvaalensis* (species group B; Table 4), *Indigofera melinoides* (species group A; Table 4), *Cetarach cordatum* (species group C; Table 4) and the sedge *Bulbostylis burchellii* (species group T; Table 4). The cover abundance value of the grass species *Aristida transvaalensis* in this sub-community varies between 1 and 25%. This species is confined to this sub-community and validates this distinction. The shrub stratum in this sub - community is inconspicuous and limited to individual stands of *Englerophytum magalimontanum* (cover abundance value 1%-25%).

The lithophyte *Selaginella dregei* (species group T) is distinctly absent in this sub - community. According to Gibbs-Russell *et al.* (1991) *Aristida transvaalensis* is a chasmophyte limited to dry, rocky outcrops, while *Selaginella dregei* prefers at least seasonally wet and flat rock surfaces (Jacobsen 1989).

1.2 *Ceterach cordatum* - *Tristachya leucotrix* Tall Sparse Shrub land

This sub - community can be found on the upper northeastern slopes of Baviaanskrans, as well as the upper southern slopes and the crests of a secluded quartzite hill in part of the study area. The habitat is rocky with huge boulders and the slope varies between 5° and 25°. The clay content of the soil is low and does not exceed 15%.

This sub-community is characterised by the occurrence of the fern *Ceterach cordatum* (species groups C; Table 4). Van Vuuren and van der Schijff (1970) also found this forb to be abundant in the crevices on the northern slopes. This forb is confined to sheltered and moist sub-habitats in the shade among rocks. Other prominent species in this community is *Bulbostylis burchellii*, *Loudetia simplex*, *Trachypogon spicatus* and *Selaginella dregei* (species group T; Table 4).

1.3 *Croton gratissimus* - *Combretum molle* Short Sparse Woodland

The *Croton gratissimus* - *Combretum molle* Short Sparse Woodland is situated on the northeastern facing foothills of the northern regions of the reserve. The community occurs on an incline that exceeds 30°. Large rocks occur in the relevés situated on a scree slope. The clay content of the subsoils is low, not exceeding 10%.

Diagnostic species for this sub-community are species group D (Table 4), including *Crassula argyrophylla*, *Combretum molle*, *Croton gratissimus*, *Portulaca kermesina* and *Anthospermum hispidulum*. This sub-community is distinguished by the presence of species from species groups A, H, I, M, O and T. The *Croton*

gratissimus - *Ancylobotrys capensis* variant, identified by Coetzee (1975) corresponds to this sub-community. According to Coetzee's (1975) classification *Combretum molle* is prominent in the *Englerophytum magalismontanum* - *Ancylobotrys capensis* shrub land. However, with the inclusion of the Baviaanskrans sub-data set, the prominence of *Combretum molle* was reduced. The forb *Coleocloa setifera* (Species group O; Table 4) is also prominent in this community. The grass layer is inconspicuous and limited to secluded stands of *Aristida diffusa*, *Cymbopogon validus*, *Diheteropogon amplexans* and *Melinis nerviglumis*.

1.4 *Faurea saligna* - *Cyperus sphaerospermus* Short Open Woodland

The *Faurea saligna* - *Cyperus sphaerospermus* Short Open Woodland sub-community is associated with the moist environments on the steep south and east facing slopes in the kloof opening in the northwestern slopes of the central basin. This habitat consists of barren rock faces and the dominant vegetation is limited to forbs and shrubs growing from crevices and narrow ledges associated with the deep drainage lines in the Magaliesberg. The slope is steep and varies between 27° and 44°. This sub - community reveals a resemblance to the *Faurea saligna* - *Ancylobotrys capensis* sub-variation identified by Coetzee (1975), which includes the vegetation associated with the deep drainage lines on the farm Rietvalley.

Species group E (Table 4) is diagnostic for this sub-community, including the woody species *Faurea saligna*, the forb *Scadoxus puniceus*, *Oxalis obliquifolia* and *Gerbera pilosa*, the sedge *Cyperus sphaerospermus* and the grass *Setaria lindenbergiana*. This sub-community is distinguished by the presence of species groups F, G, H, I, M, O and T. The shrub stratum, including *Diospyros lycioides* subs *guerkei* (species group F), *Brachylaena rotundata* (species group H), *Nuxia congesta* (species group H), *Zanthoxylum capense* (species group I) and *Rhus magalismontanum* (species group O) is more conspicuous than the tree stratum. Other prominent species are *Clutea pulchella* and *Canthium gilfillanii* (species group F), *Commelina erecta* (species group I) and *Coleocloa setifera* (species group O). The grass layer in this sub - community is restricted to the diagnostic

grass species *Setaria lindenbergiana* associated with shaded rocky habitats (van Wyk & Malan 1988; van Oudtshoorn 1992). Other grass species associated with shallow soils that are less significant in this sub-community is *Melinis nerviglumis*, *Themeda triandra* and *Brachiaria serrata* (species group T).

1.5 *Diospyros lycioides* - *Cymbopogon validus* Tall Sparse Shrub land

Contrary to the *Faurea saligna* - *Cyperus sphaerospermus* Short Open Woodland, the *Diospyros lycioides* - *Cymbopogon validus* Tall Sparse Shrub land is confined to the steep, warm north and east facing slopes of the kloofs opening in the northwestern slopes of the central basin area, as well as certain ravines on the northern slopes of the Magaliesberg. Slope varies between 19° and 32°. Large rocks and boulders are absent.

The soil consists predominantly of fine quartzite gravel. Dominant shrub and forb species associated with the shallow soils and rock faces that characterise this sub-community includes the shrubs *Diospyros lycioides* (species group F), *Ficus ingens* (species group G) and *Zanthoxylum capense* (species group I) and the forbs *Clutea pulchella*, (species group F), an unidentified *Crassula* species (species group I), *Coleocloa setifera*, *Pellaea calomelanos* (species group O) and *Selaginella dregei* (species group T). Important grass species in the sub-community are *Cymbopogon validus*, *Melinis nerviglumis*, *Schizachyrium sanguineum* and *Diheteropogon amplexans* (species group T).

1.6 The *Asparagus krebsianus* - *Senecio venosus* High Open Shrub land

The *Asparagus krebsianus*- *Senecio venosus* High Open Shrub land is found in the shallow drainage lines on the northeastern and southeastern slopes in the southwestern part of the study area. The slopes are gradual and do not exceed 19°. The soil surface is covered with quartzite gravel and large rocks or boulders are absent.

This sub-community is represented by species groups G, H, I, O, S and T. Species included in this sub-community corresponds with the *Croton gratissimus* - *Ancylobotrys capensis* variation defined by Coetzee(1975). The absence of species group F distinguishes this sub-community from sub-communities 1.5. Trees are absent and the shrub layer is, excluding species group A, represented by *Asparagus krebsianus* (species group G), *Brachylaena rotundata* (species group H), and *Rhus magalimontanum* (species group O). Forbs in this sub-community include *Senecio venosus* (species group I), *Coleocloa setifera*, *Pellaea calomelanos* (species group O) , *Anthospermum rigidum* (species group S), the sedge *Bulbostylis burchellii* and the lithophyte *Selaginella dregei* (species group T) . The dominant grasses in this high open shrub land are *Cymbopogon validus* (species group O), *Schizachyrium sanguineum*, *Melinis nerviglume*, *Diheteropogon amplexens* and *Themeda triandra* (species group T) .

1.7 *Loudetia flavida* - *Tristachya biseriata* Tall Closed Shrub land

This shrub land is situated in various localities on the northern section of the study area. It occurs on the upper northeastern to southwestern slopes and crests with an incline of between 6° and 36°. The texture of the subsoil varies from a sand to sandclayloam (MacVicar *et al.* 1991).

The presence of species groups I, J, M, O, S and T characterise this sub-community. The grass *Tristachya biseriata* (species group J) is pronounced in this sub-community and cover-abundance values indicate that at least 25% of the area is covered by this species. Species group J, including *Tristachya biseriata* and *Vangueria infausta* represents a transitional species group between communities 1 and 2. The herbaceous layer in this sub-community is furthermore represented by the grasses *Loudetia flavida* (species group I), *Cymbopogon validus* (species group O), *Andropogon schirensis* (species group S) , *Trachypogon spicatus*, *Loudetia simplex*, *Schizachyrium sanguineum*, *Melinis nerviglumis*, *Diheteropogon amplexens*, *Themeda triandra* and *Brachiaria serrata* (species group T). Conspicuous forbs in this sub-community are *Senecio venosus* (species group I), *Coleocloa setifera*, *Pellaea calomelanos* (species group O), *Cyanotis speciosa*,

Tephrosia elongata (species group S), the sedge *Bulbostylis burchellii* and *Selaginella dregei* (species group T). The species representing the shrub layer in this sub-community is confined to the shrubby species in species group A.

2. *Eragrostis nindensis* - *Cyperus rupestris* Short Open Grassland

The largest part of the summit plateau and the south western brim of the central vlei area is covered by this community. It is situated on the warm, dry northeastern and southeastern gentle and relative flat slopes on the reserve. Excluding two relevés, the slope do not exceed 15°. The soils are shallow with interspersed sheet and quartzite boulder outcrops. The soils are characterised by an orthic A layer with a high content of decomposed organic matter (Coetzee 1975) (Table 2).

The clay content of these soils is low and varies between sand and sandloam (MacVicar *et al.* 1991).

Coetzee(1975) recognised this community as a sub-community of the *Coleocloa setifera-Selaginella dregei* plant community. However, the inclusion of the Baviaanskrans data set resulted in different species groups and plant communities. Species group O (Table 4), virtually absent from sub-community 1.1 and 1.2., is regarded as a transitional group between communities 1 and 2. Species group K, L, Q and R (Table 4), diagnostic to community 2, are discernibly absent in community 1 and resulted in the differentiation between communities 1 and 2.

Fifty-five relevés represent this community. It is characterised by diagnostic species group K (Table 4). The grass species *Eragrostis nindensis* and the non-grassy herbaceous species *Indigofera comosa*, *Andromiscus umbraticola*, *Albuca setosa*, *Dicoma anomala* and *Khadia acupetala* are diagnostic species for this community. The lithophyte pioneer *Selaginella dregei* is also abundant in this community and covers large areas of exposed sheet outcrops.

Two sub - communities are recognised due to the presence and absence of species groups in this community.

2.1 *Lopholaena coriifolia* - *Lapeirousia sandersonii* Short Open Grassland

The *Lopholaena coriifolia* - *Lapeirousia sandersonii* sub-community occurs on shallow soils on slopes surrounding the central basin area. The soil is sandloam and the bedrock consists mainly of recrystallised quartzite gravel. Boulders and large rocks are absent. The slope is moderate and the gradient does not exceed 15°.

This sub-community is characterised by the presence of diagnostic species group L and the virtual absence of species group P (Table 4). Coetzee (1975) regarded the species of this sub-community as diagnostic species for the *Cyperus rupestris* - *Eragrostis nindensis* sub-community. The inclusion of the Baviaanskrans data set resulted in a clear distinction between sub-communities 2.1 and 2.2 (Table 4). The protected plant (Transvaal Ordinance, No 12 of 1983) *Lapeirousia sandersonii* has a significant cover abundance (1-25%) in this sub-community.

Five variations can be distinguished based on the presence and absence of species groups in this sub-community:

2.1.1 *Diheteropogon amplexans* - *Tristachya biseriata* Tall Open Grassland

This variation is found on the upper slopes and crests of the Magaliesberg in the southwestern region of the reserve. The soils are shallow sandloam. Exposed quartzite sheets cover large areas. The aspect is northeast and the slope does not exceed 6°. Huge rocks and boulders are absent and the substrate varies from small rocks to quartzite gravel.

This variation is characterised by the presence of species group J, K, L, M, O, S and T and the absence of species from species groups N, Q and R. Dominant

species in this variation are the grasses *Tristachya biseriata* (species group J), *Aristida aequiglumis* (species group S), *Diheteropogon amplexans*, *Melinis nerviglumis*, *Trachypogon spicatus* and *Themeda triandra* (species group T), and the non-grassy herbaceous species *Coleocloa setifera* (species group O), *Bulbostylis burchellii* and *Commelina africana* (species group T). The shrub layer is inconspicuous and limited to individual stands of *Rhus magalismsontanum* (species group O).

2.1.2 *Themeda triandra* - *Aristida diffusa* Short Open Grassland

The *Themeda triandra* - *Aristida diffusa* Short Open Grassland is situated on the northeastern facing slopes in the southwestern section, as well as on the slopes in the extreme northeastern regions of the reserve. The slopes are gentle with few boulders and rocks. The soil is sandloam.

This variation is distinguished by the presence of species groups M, O, R, S and T and the absence of species groups N, and Q (Table 4). This variation is not characterised by a diagnostic species group. Species that are abundant include the grasses *Eragrostis nindensis* (species group K), *Aristida diffusa* (species group M), *Aristida aequiglumis* (species group S), *Trachypogon spicatus*, *Schizachyrium sanguineum*, *Melinis nerviglumis*, *Diheteropogon amplexans*, *Themeda triandra* and *Brachiaria serrata* (species group T), the forbs *Kalanchoe thrysiflora* (species group M), *Coleocloa setifera*, *Aloe peglarae* (species group O), *Raphionacme burkei* (species group R), *Cyanotis speciosa* (species group S), and the sedges *Bulbostylis burchellii* and *Cyperus rupestris* (species group T), all of which occurred consistently in all relevés in this variant.

2.1.3 *Frithia pulchra*- *Selaginella dregei* Low Sparse Grassland

This low grassland occurs on the gravel soils of the undulating plains that lie below the northern summit plateau. It also occurs in the western regions of the reserve, where it is localized to small secluded areas on the upper northeastern aspect. Single relevés representing this variation was found on the southwestern

aspect of the central quartzite ridge. The slope is less than 15°. The subsoil consists of quartzite gravel and small rocks. No boulders or large rocks are present in this variant.

This variation is differentiated by the presence of diagnostic species group N, consisting of the small xerophyte, *Frithia pulchra*, a plant endemic to the Magaliesberg (Carruthers 1990). Coetzee (1975) regarded this variation as part of the *Cyperus rupestris*- *Eragrostis nindensis* Grassland. Except for species groups K and L, this variation is also represented by species groups N, O, Q, R, S and T. *Selaginella dregei* were found to be growing in close association with *Frithia pulchra*. Abundant grass species in this variation are *Cymbopogon validus* (species group O), *Aristida aequiglumis*, *Andropogon schirensis* (species group S), *Melinis nerviglumis*, *Diheteropogon amplexans*, *Themeda triandra* and *Brachiaria serrata*, (species group T). The herbaceous layer is dominated by the forbs *Coleocloa setifera* (species group O), *Cyanotis speciosa*, *Anthospermum rigidum* (species group S) and the sedge *Bulbostylis burchellii* (species group T). The shrub layer is limited to individual stands of *Rhus magaliesmontanum* (species group O).

2.1.4 *Coleocloa setifera* - *Indigofera comosa* Short Open Grassland

The *Coleocloa setifera* - *Indigofera comosa* Short Open Grassland variation is found on the gentle hill slopes surrounding the northern section of the central basin area. Except for two relevés, the gradient does not exceed 10°. The soil is coarse-grained sandloam. Boulders and rocks are absent.

Indications of similarity between variants 2.1.3 and 2.1.4 (Table 4) occur due to the presence of species groups O, Q, R, S and T, but they are distinguished by the absence of species group N in variation 2.1.4. No diagnostic species group has been identified for this variation. Species abundantly present in this variation include *Eragrostis nindensis* (species group K), *Lopholaena coriifolia*, *Lapeirousia sandersonii* (species group L), *Coleocloa setifera*, *Pellaea calomelanos* (species group O), *Aristida aequiglumis*, *Cyanotis speciosa*, *Andropogon schirensis*

(species group S) as well as the species of species group T.

2.1.5 *Trachypogon spicatus* - *Bulbostylis burchellii* Short Open Grassland

Relevés representing this variation are scattered in community 2 on slopes of less than 4°. The soil is coarse-grained sandloam.

This variation is distinguished by the absence of species groups M, N and O and the presence of species groups K, L, Q, R, S and T (Table 4). The abundance of *Trachypogon spicatus* and *Bulbostylis burchellii* are also a conspicuous feature in this variation. Other species are the grasses *Aristida aequiglumis* (species group S), *Diheteropogon amplexans*, *Themeda triandra* and *Brachiaria serrata* (species group T), the forbs *Nidorella hottentotica*, *Xerophyta viscosa* (species group R), *Cyanotis speciosa* (species group S) and the chasmophyte *Selaginella dregei* (species group T). The shrub and tree layer are absent.

2.2 *Themeda triandra* - *Eragrostis racemosa* Short Open Grassland

This open grassland is found scattered along the summit plateau. The slopes are gentle and the gradient does not exceed 10°. The soil texture is sand loam. Boulders and rocks are absent and the soil consists of quartzite gravel on bedrock. The aspect varies from northeastern to southeastern.

This sub-community is distinguished by the presence of the diagnostic species group P, including the forb *Becium obovatum* and the grass *Eragrostis racemosa*, as well as species groups K and Q, R, S and T (Table 4). Species that occur in this sub-community includes the forbs *Thesium transvaalense*, *Anacampteros subvelutinum* (species group Q), *Raphionacme burkei*, *Nidorella hottentotica* (species group R), *Cyanotis speciosa*, *Anthospermum rigidum* (species group S) and the sedges *Bulbostylis burchellii* and *Cyperus rupestris* (species group T). The dominant grass is *Themeda triandra* with a cover-abundance value of between 5% and 50%. Other conspicuous grasses are *Aristida aequiglumis* (species group S), *Melinis nerviglume*, *Diheteropogon amplexans* and *Brachiaria serrata* (species

group T).

3 *Bulbostylis burchellii* - *Themeda triandra* Short Open Grassland

This grassland is confined to the upper northeastern and southeastern slopes of the southeastern valley of the study area. The soil is coarse-grained sandloam with rocks and boulders occurring frequently. The slope varies between 15° and 35°.

No diagnostic species group are characteristic of this community. It is distinguished from the other communities by the absence of all species groups, except the general species included in species group T (Table 4). Conspicuous species includes the grasses *Loudetia simplex*, *Schizachyrium sanguineum*, *Melinis nerviglumis*, *Diheteropogon amplexans*, *Themeda triandra* and *Brachiaria serrata*, the sedges *Bulbostylis burchellii* and *Cyperus rupestris* and the chasmophyte *Selaginella dregei*.

4 *Tristachya biseriata* - *Protea caffra* Short Sparse Woodland

This community is spread on the slopes of the valley between the summit and the eastern range of quartzite ridges running through the reserve. The *Tristachya biseriata* - *Protea caffra* Short Sparse Woodland is confined to the shallow Glenrosa soils on the foothills and mid-slopes. The gradient varies between 3° and 30°, except for three relevés on slopes of up to 40°. The soil texture are sand loam to sand clay loam (MacVicar *et al.* 1991).

The differentiation of this community in the study area is confirmed by the findings of Coetzee (1975). He identified a *Tristachya biseriata* - *Protea caffra* woodland, but regarded it as a sub-community in a larger phytocoen, the *Loudetia simplex* - *Aristida aequiglumis* Woodlands, shrub lands and grasslands. This phytocoen were divided in two, one occurring on deep litholitic soils and the second on shallow litholitic soils and bouldery outcrops. In this classification the *Tristachya biseriata* - *Protea caffra* Short Sparse Woodland is regarded as a transition

between the shallow and deep soils on the reserve which explains the amount of variation in the habitat features.

The grasses *Tristachya biseriata* (cover-abundance values 1%-75%), *Loudetia simplex* (cover-abundance values 1%-50%) *Themeda triandra* (cover-abundance values 1% - 75%), *Trachypogon spicatus* (cover-abundance values 1%-50%) and *Diheteropogon amplexans* (cover-abundance values 1%-25%) dominate the herbaceous layer (Table 5).

Based on the presence and absence of species, seven sub-communities can be identified (Table 5):

4.1 *Blumea alata* - *Parinari capensis* sub-community

This sub-community is located on the eastern slopes of the central quartzite ridge in the study area. The slope varies between 9° and 23°, with an eastern and north eastern aspect. Shallow Glenrosa soils, with protruding quartzite are dominant in this sub-community. An abundance of gravel was recorded in all the relevés, with smaller rocks occurring frequently and solitary rocks and boulders scattered throughout the sub-community. The soil is sand clay loam (MacVicar *et al.* 1991).

Species group B (Table 5) is diagnostic for this sub-community, including the forbs *Blumea alata*, *Conyza aegyptica*, *Dicoma zeyheri* and *Gazania krebsiana*. This sub-community is represented by the species in species groups E, F, I, N, S, X and the general species in species group Y. Coetzee (1975) regarded relevés in this sub-community as representative of the *Cryptolepis oblongifolia-Protea caffra* variation of the *Tristachya biseriata-Protea caffra* woodland. Other abundant species in this sub-community are the forbs *Athrixia elata*, *Pearsonia aristata*, *Bulbostylis oritrephes* (species group E), *Sphenostylis angustifolia*, *Helichrysum coriaceum*, (species group F) *Cryptolepis oblongifolia* (species group H), *Kohoutia amatymbica*, *Chamaecrista mimosoides*, *Tephrosia elongata*, *Chaetachantus setiger*, *Diplacne biflora*, *Pentharidium insipidum* (species group S), *Parinari capensis* (species group X) and *Becium obovatum* (species group Y).

The grass species *Tristachya biseriata* (species group A) dominate the herbaceous layer in this sub-community (cover-abundance values 25% to 75%), with *Loudetia simplex*, *Panicum natalensis*, *Urelytrum agropyroides*, *Schizachyrium sanguineum* (species group N) and *Themeda triandra* (species group Y) prominent. *Panicum natalensis* and *Themeda triandra* are conspicuous with cover-abundance values between 1% and 25%. The shrub and tree stratum are confined to *Protea caffra* (species group A).

4.2 *Indigofera burkeana*-*Rhynchosia totta* Short Closed Woodland

This woodland is restricted to the southern and southeastern slopes of the quartzite ridge northeast of Bosbokkloof. The soil associated with these slopes, is coarsely-grained lithocutanic. The texture varies from sand loam to sand clay loam.

Species groups C, D, E, F, I, N, R, S, X and Y characterise this sub-community. Diagnostic species include the forbs *Indigofera burkeana*, *Rhynchosia totta*, *Aster harveyanus*, *Hypericum aethiopicum* and *Scleria bulbifera* (species group C) (Table 5). The herbaceous layer is furthermore dominated by the grass *Tristachya biseriata* (species group A), *Alloteropsis semialata* (species group D), *Themeda triandra*, *Bewisia biflora* (species group X) and *Trachypogon spicatus* (species group Y) and the tree *Protea caffra*. Abundant forb species are *Vernonia natalensis*, *Oxalis obliquifolia* (species group A), *Anomatheca laxa* (species group D), *Athrixia elata* (species group E), *Vernonia galpinii*, *Pentharidium insipidum* (species group S) and *Becium obovatum* (species group Y). The tree and shrub layer are confined to *Protea caffra*.

4.3 *Diheteropogon amplexans* - *Ficinia filiformis* Short Closed Woodland

This sub-community is confined to a small area on the southern and southeastern slopes of the hill in the northern division between the farms Rietvallei and Baviaanskrans. The soil is restricted to the Glenrosa soil form with a coarse-

grained texture. The soil is sandloam to sandclayloam and the slope varies between 16° and 40°.

Coetzee (1975) considered this sub-community as a variation of the *Tristachya biseriata* - *Protea caffra* Woodlands. This variation occurs on the southerly aspects in the series of valleys between the summit areas in the reserve and the western side of the Magaliesberg. The absence of species group C in this sub-community distinguished it from the *Indigofera burkeana* - *Rhynchosia totta* sub-community found further north on the central quartzite ridge.

No diagnostic species group has been identified for this sub-community (Table 5). The presence of species groups D, E, F, I, M, N, R, S and Y characterise this sub-community. Prominent species are the forbs *Anomatheca laxa*, *Ficinia filiformis* (species group D), *Athrixia elata*, *Pearsonia aristata*, the sedge *Bulbostylis orithrephes* (species group E), *Helichrysum coriaceum* (species group F), *Anthospermum rigidum*, *Pellaea calomelanos* (species group H), *Nidorella hottentotica* (species group N), *Senecio erubescens*, *Thesium transvaalense* (species group R), *Chaetachantus setiger* (species group S) and *Becium obovatum* (species group Y). Grass species dominant in this sub-community includes *Tristachya biseriata* (species group A), *Alloteropsis semialata* (species group D), *Loudetia simplex*, *Panicum natalensis* (species group N), *Diheteropogon amplexans*, *Eragrostis racemosa* (species group S), *Themeda triandra*, *Trachypogon spicatus* and *Brachiaria serrata* (species group Y). *Protea caffra* is the only tree species in the sub-community.

4.4 *Cryptolepis oblongifolia* - *Loudetia simplex* Tall Sparse Woodland

The *Cryptolepis oblongifolia* - *Loudetia simplex* Tall Sparse Woodland is located on the north eastern slopes of the valley between the summit and the eastern range of hills. The gradient range between 19° - 29°. The subsoil is coarsely-grained with large rocks and boulders occurring frequently. The soil texture varies from sandloam to sandclayloam (MacVicar *et al.* 1991)

Coetzee (1975) recognised a *Cryptolepis oblongifolia* - *Protea caffra* variation of the *Tristachya biseriata* - *Protea caffra* Woodlands. The *Cryptolepis oblongifolia* - *Protea caffra* variation identified by Coetzee (1975) contains the species in species group B (Table 5), which are diagnostic of the *Blumea alata* - *Parinari capensis* sub-community.

The presence of species groups E, F, I, L, N, Q, S, X and Y are characteristic of this sub-community. Dominant species are the small shrub *Cryptolepis oblongifolia* (species group I) and the grasses *Aristida aequiglumis* (species group L), *Loudetia simplex*, *Panicum natalensis*, *Andropogon schirensis*, *Schizachyrium sanguineum* (species group N), *Diheteropogon amplexans*, *Eragrostis racemosa* (species group S), *Bewsia biflora* (species group X), *Themeda triandra*, *Trachypogon spicatus*, *Brachiaria serrata* and *Melinis nerviglume* (species group Y). Forbs present are *Sphenostylis angustifolia* (species group F), *Anthospermum rigidum*, *Pellaea calomelanos* (species group I), *Vernonia galpinii* and *Chaetacanthus setiger* (species group S).

4.5 *Trachypogon spicatus* - *Sphenostylis angustifolia* Tall Closed Grassland

This sub-community occurs in isolated locations on the northeastern brim of the central basin and the summit of the hill in the northeastern section of the study area. A common habitat factor of this sub-community is a northwestern to southwestern aspect and slope that varies between 6° and 13°. Shallow, coarse-grained soils of the Glenrosa soil form with few rocks and boulders underlies this sub-community.

Prominent species in this sub-community are *Sphenostylis angustifolia* (species group F), *Cyanotis speciosa* (species group L), *Indigofera comosa* (species group M), *Nidorella hottentotica* (species group N), *Tephrosia elongata* (species group S) and the sedge *Bulbostylis burchellii* (species group Y). The grass layer is dominated by *Tristachya biseriata* (species group A), *Aristida aequiglumis* (species group L), *Loudetia simplex* (species group N), *Diheteropogon amplexans*, *Eragrostis racemosa* (species group S), *Themeda triandra*, *Trachypogon spicatus*

and *Brachiaria serrata* (species group Y). A conspicuous feature of this sub-community is the absence of trees, in particular *Protea caffra* which is diagnostic for the *Tristachya biseriata* - *Protea caffra* community. This can be attributed to the fact that *Protea caffra* prefers cooler south facing slopes (van Wyk *et al.* 1988; Vogt 1982; van Gogh & Anderson 1988). This sub-community is further distinguished from the other sub-communities in this vegetation community by the absence of species groups B, C, D, E and G. It is characterised by the occurrence of species groups F, I, L, M, N, Q, S, X and Y.

4.6 *Burkea africana* - *Setaria sphacelata* Tall Open Woodland

This sub-community occurs in secluded areas with an eastern aspect on the northern foothills of the Magaliesberg as well as in the central basin area. The tree species *Burkea africana* and the shrub *Ochna pulchra* are the two diagnostic species of this sub-community (species group G). This Tall Open Woodland is further characterised by the dominance of *Setaria sphacelata* (species group T) with cover-abundance values of 25% to 75%. Species groups I, L, M, N, Q, R, S, X and Y are also present in this sub-community.

Two distinct variations are found in this sub-community. This distinction is due to a difference in soil depth between the two variations, resulting in distinct differences in species composition. Coetzee (1975) also distinguished two variations of the *Burkea africana* - *Ochna pulchra* Woodlands. He ascribed this distinction to a difference in soil depth, as well as a difference in aspect and locality.

4.6.1 *Combretum zeyheri* - *Trachypogon spicatus* Tall Sparse Woodland

This variation is associated with the litholitic soils on the northern foothills of the Magaliesberg. The aspect is east and the gradient varies between 15° and 31°. The soil is coarsely-grained with a sandloam to sandclayloam texture. Large rocks and boulders occur frequently throughout the variation.

This variation can be distinguished from the former by the presence of species group H, consisting of *Combretum zeyheri* and *Faurea saligna*. A significant feature of this variation is the absence of *Protea caffra*, because this plant prefers the cooler southern slopes of the Magaliesberg (van Wyk and Malan 1988; van Gogh & Anderson 1988).

4.6.2 *Burkea africana* - *Themeda triandra* Tall Open Woodland

The *Burkea africana* - *Themeda triandra* Tall Open Woodland variation occurs on the deep (>0.8m) sand loam Hutton soils in the central basin area. The slope is gradual and the gradient does not exceed 4°. Aspect is mostly northerly, but varies from northwesterly to northeasterly. No rocks or boulders are present.

This variant is further distinguished from the *Combretum zeyheri* - *Trachypogon spicatus* Tall Sparse Woodland variation in the sub-community by the absence of species group H (Table 5). It is characterised by species groups G, I, L, M, N, Q, S, T, X and Y. *Burkea africana* is the dominant tree species with a cover-abundance value of 25% - 75% (Coetzee 1975). The shrub layer is represented by *Ochna pulchra* (species group G). Other prominent species are the forbs *Commelina africana*, (species group L), *Pygmaeothamnus zeyheri* (species group Q) and *Chamaecrista mimosoides* (species group S).

The structural analysis depicted of the woody component of the *Burkea africana* - *Themeda triandra* Tall Open Woodland (Figure 9) indicates that the trees *Burkea africana*, *Combretum zeyheri* and *Protea caffra* represent the >5.5 m height class. The shrub stratum (< 0.75 m - 1.5 m) is dominated by *Ochna pulchra*, *Diospyros lycioides* and *Rhus rigida*.

Coetzee (1975) found however that the 5 - 8m tall *Burkea africana* trees covered up to 25% of the relevés, whereas the smaller *Burkea africana* trees covered 25%-55% of the relevés. It contributes significantly to the captivating view tourists' experienced when driving around the central basin. Game occurs regularly in this area and the view of this open savanna with its flat topped *Burkea africana* is

highly valued. The *Burkea africana* tree clumps need to be conserved and maintained due to their aesthetic value in the reserve.

4.7 *Aloe greatheadii*- *Themeda triandra* Tall Open Woodland

This woodland represents the composite of vegetation on the deep Hutton soils of the *Tristachya biseriata* - *Protea caffra* community. It is found on the foothills on the southern side of the central basin area as well as on the plateau in the northern regions of the study area. These areas are flat and the gradient is 3°. The soil is finely grained with a sandloam texture. Aspect of the relevés is northeast.

The presence of species groups K, L, M, N, P, Q, R, S, W, X and Y characterise this sub-community. Dominant species are the grasses *Setaria sphacelata* (cover-abundance values 25%-75%) (species group T), *Themeda triandra* (cover-abundance values 50%-75%) and *Trachypogon spicatus* (cover-abundance values 25%-50%) (species group Y). Forbs included are *Indigofera hedyantha*, *Vernonia natalensis* (species group A), *Aloe greatheadii* (species group K), *Albuca setosa* (species group M), *Acalypha angusta*, *Ledebouria marginata*, *Crabbea hirsuta*, *Rhynchosia nervosa* (species group P), *Pygmaeothamnus zeyheri* (species group Q), *Kohoutia amatymbica*, *Hypoxis rigidula* (species group S), *Asparagus suaveolens* (species group X) and *Becium obovatum* (species group Y). Other prominent grass species are *Digitaria diagonalis* (species group A), *Urelytrum agropyroides*, (species group N), *Cymbopogon excavatus* (species group P), *Diheteropogon amplexans*, *Eragrostis racemosa* (species group S), and *Brachiaria serrata* (species group Y).

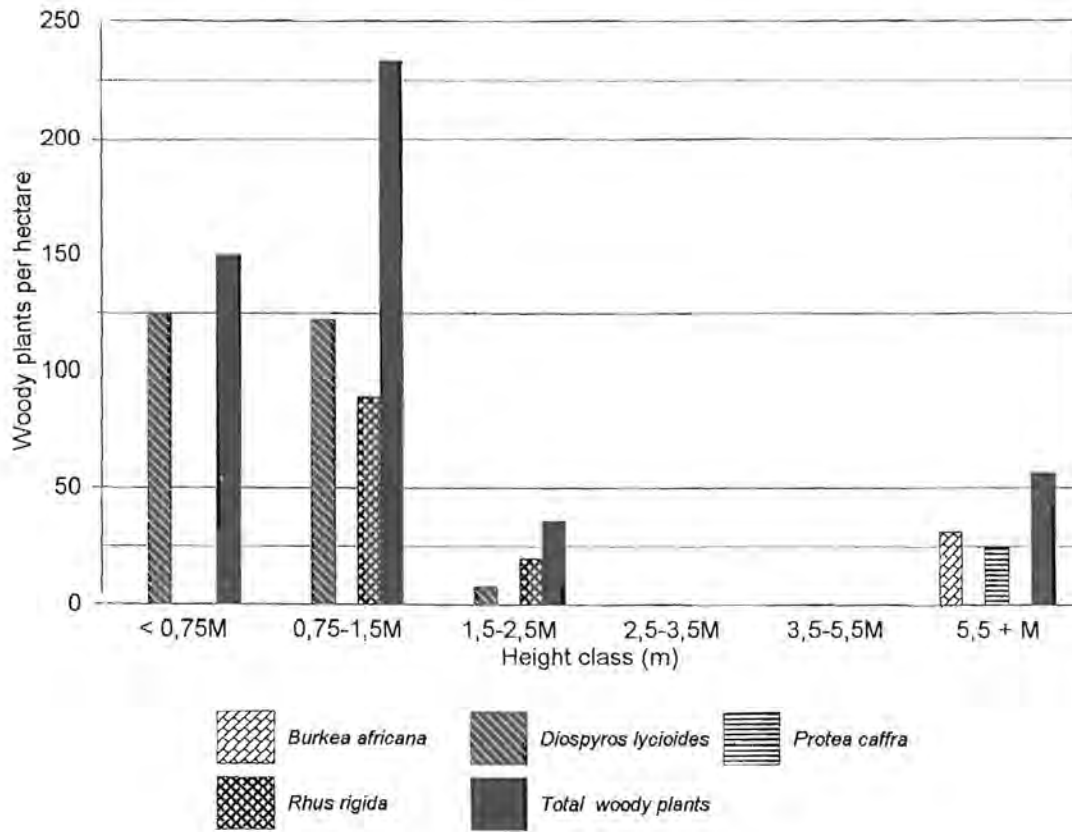


Figure 9: A histogram of the structure of the woody component of the *Burkea africana* - *Themeda triandra* Tall Open Woodland variation of the *Burkea africana* - *Setaria sphacelata* Tall Open Woodland sub-community on Rustenburg Nature Reserve.

The tree stratum is confined to *Protea caffra* trees with individual *Faurea saligna* trees. Figure 10 illustrates the structure of the tree and shrub layer in this sub-community. The tall height classes are represented by *Protea caffra* and individuals of *Faurea saligna*. *Ochna pulchra*, *Ozoroa paniculosa* and *Rhus rigida* represents the shorter height classes. The structure of the woody component in this section of the sub-community is open and a maximum of 175 trees per hectare were recorded. Most of the trees were in the tall height classes.

Figure 11 is a histogram of the density of the woody plants in the different height classes in this sub-community situated on the summit plateau in the northern regions of the study area. *Protea caffra* is only present in the 2.5m - 5.5+ m height classes (Figure 11), representing the total woody layer in these height classes. A severe fire in 1990 damaged the *Protea caffra* trees in the <2.5m height class, resulting in a visible reduction in the overall height structure of this sub-community. The trunks coppiced, resulting *Protea caffra* to become pronounced in the lower height classes.

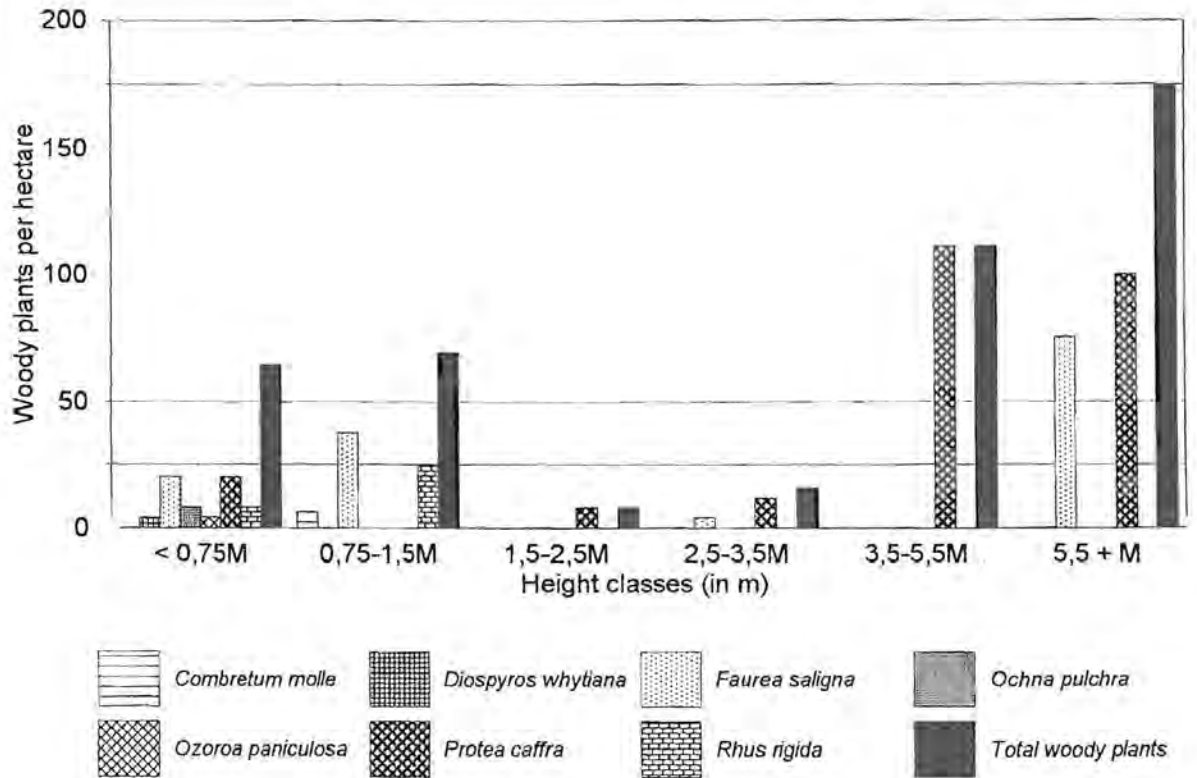


Figure 10: A histogram of the structure of the woody component of the *Aloe greatheadii*-*Themeda triandra* Tall Open Woodland in the southern section of the central basin on Rustenburg Nature Reserve.

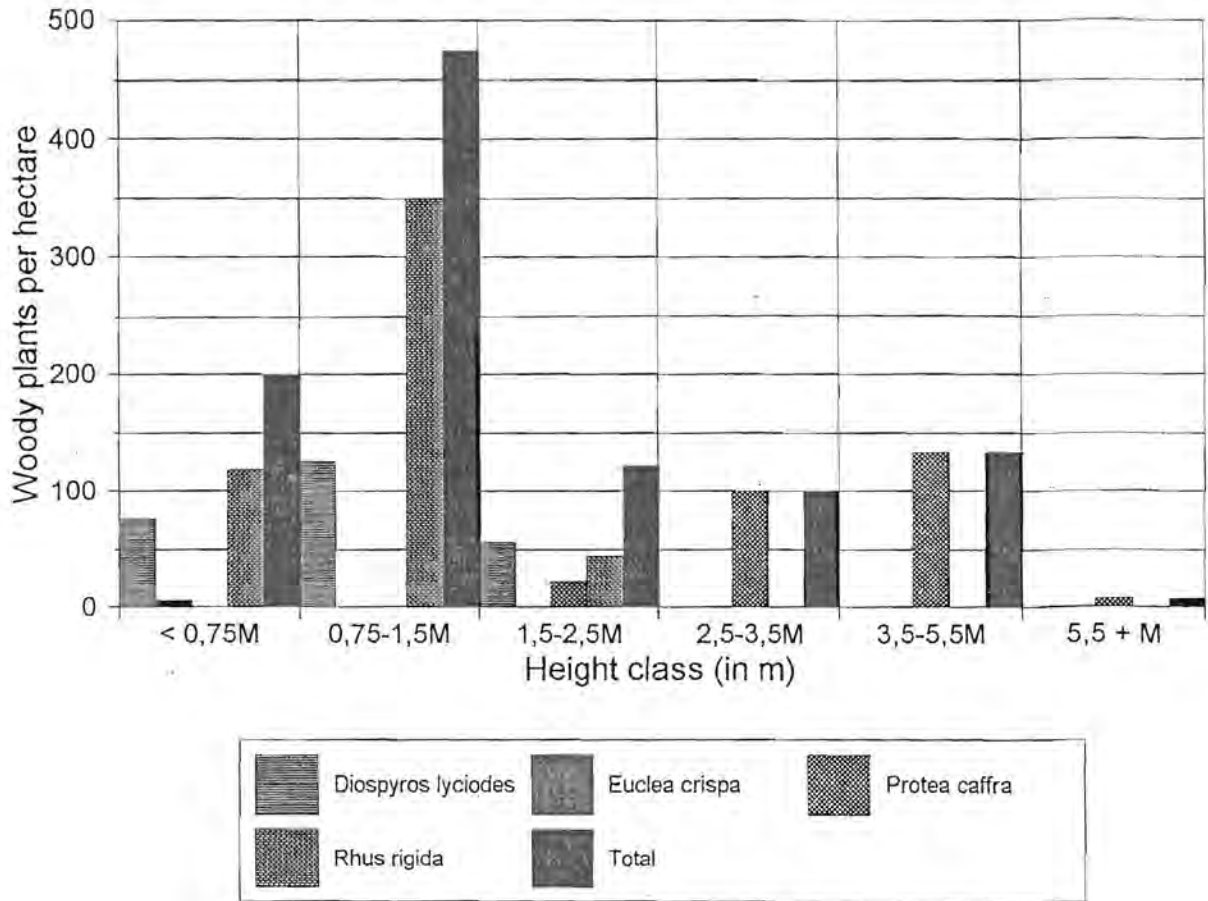


Figure 11: A histogram of the structure of the woody component of the *Aloe greatheadii-Themeda triandra* Tall Open Woodland on the northern plateau on Rustenburg Nature Reserve.

5 *Protea gaguedi* - *Monocymbium ceresiiforme* Short Open Shrubland

Coetzee (1975) distinctly differentiated the existence of this community in the study area, describing it as a variation of the *Digitaria brazzae*- *Tristachya rehmannii* Short Open Shrubland. It is distinguished from the *Tristachya biseriata* - *Protea caffra* community by the absence of species group A. This vegetation community is restricted to the concave areas with deep soils on the lower slopes of the summit plateau (Coetzee 1975) and the deeper soils on the southern slopes around the central basin area. The gradient in this community does not exceed 5°. The soil texture of the A-horizon varies from sandloam to sandclayloam.

The community is dominated by *Protea gaguedi* - shrubs (Table 5), which is restricted to the 0.75-1.5m height class (Figure 12). Species group J is diagnostic for this community, consisting of *Protea gaguedi* and the grass species *Monocymbium ceresiiforme* and *Digitaria monodactyla*. Coetzee(1975) also found this association of species on the reserve. Other species groups in this community are K, L, M, N, P, Q, R, S, W, X and Y (Table 5). Prominent forb species in this community includes *Aloe greatheadii* (species group K), *Indigofera comosa* (species group M), *Nidorella hottentotica* (species group N), *Pygmaeothamnus zeyheri* (species group Q), *Dicoma anomala* (species group S), *Elephanthoriza elephantina* (species group W), *Parinari capensis* (species group X), *Becium obovatum* and *Bulbostylis burchellii* (species group Y). The diagnostic grass species are *Monocymbium ceresiiforme*, where as *Aristida aequiglumis* (species group L), *Loudetia simplex* (species group M), *Digitaria brazzae*, *Tristachya rehmannii* (species group P) and *Eragrostis racemosa* (species group S) are prominent and *Diheteropogon amplexans* (species group S)(cover-abundance values 1%-25%), *Themeda triandra* (cover-abundance values 1%-25%), *Trachypogon spicatus* (cover-abundance values 1%-75%), *Brachiaria serrata* and *Melinis nerviglume* (cover-abundance values 1%-50%) (species group Y) dominant. No trees occur in this community.

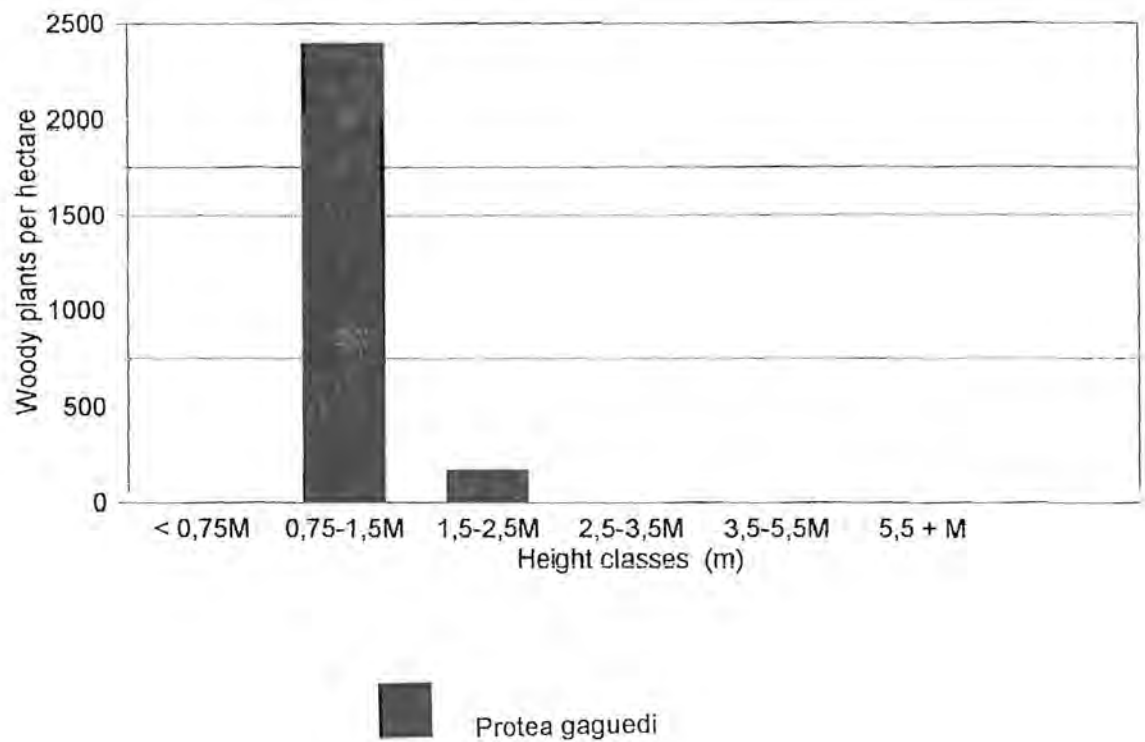


Figure 12: A histogram of the structure of the woody component of the *Protea gagedi* - *Monocymbium cerasiiforme* Short Open Shrub land on the northern plateau on Rustenburg Nature Reserve.

6 *Indigofera comosa* - *Schizachyrium sanguineum* Tall Closed Grassland

Medium deep Glenrosa soils, restricted to northeastern facing slopes accommodate this community. The slopes are gentle and the gradient does not exceed 6°. The loamsand texture of the soil is caused by the coarse quartzite substrate. Soil depth is limited (≈0.6m) and surface rocks or boulders are absent.

Schizachyrium sanguineum (species group N) (cover-abundance values 1% - 50%), *Diheteropogon amplexans* (species group S), *Themeda triandra* (cover-abundance values 0% - 75%) and *Trachypogon spicatus* (species group Y) are the dominant species in this community (Table 5). Other important grass species are *Loudetia simplex* (species group N), *Diheteropogon amplexans* and *Eragrostis racemosa* (species group S). Forbs occurring in this community are *Nidorella hottentotica*, *Thesium cytisoides* (species group N), *Pygmaeothamnus zeyheri*, *Rhynchosia monophylla* (species group Q), *Chamaecrista mimosoides* (species group S) and *Parinari capensis* (species group X).

7 *Plexipus hederaceus* - *Cymbopogon excavatus* Tall Closed Grassland

This tall grassland are situated at the bottom of the central basin area. It is located on the deep soils (1m +) of the north eastern slopes. The area is flat and the gradient is between 3° and 4°. The loam sand to sandloam soils consists of finely-grained sand.

Species group O, diagnostic for this community, includes the forbs *Plexipus hederaceus* and *Raphionacme hirsuta* (Table 5). This community is characterised by dense stands of tufted, perennial grasses, consisting predominantly of *Cymbopogon excavatus* (species group P), *Diheteropogon amplexans* (species group S), *Themeda triandra*, *Trachypogon spicatus* and *Melinis nerviglume* (species group Y). Other prominent grass species include *Digitaria brazzae* (species group P) and *Eragrostis racemosa* (species group S). The abundant forb

species include *Acalypha angustata*, *Ledebouria marginata* (species group P), *Pygmaeothamnus zeyheri* (species group Q), *Vernonia galpinii*, *Kohoutia amatymbica*, *Chamaecrista mimosoides*, *Conyza aegyptica*, *Ipomoea ommaneyi* (species group S), *Elephanthoriza elephantina* (species group W) and *Becium obovatum* (species group Y). Individuals of *Protea caffra* shrubs occur in this grassland community.

8 *Tristachya leucotrix* - *Setaria sphacelata* Tall Sparse Woodland

This woodland is associated with shallow Glenrosa soils found in the south eastern part of the study area. This community is situated on the crests or southern midslopes of the eastern range of hills. The slopes vary from flat ($< 5^\circ$) to moderate (20° - 35°). At least 10% of this community is covered with rocks.

This community is distinguished by the presence of diagnostic species group T, consisting of *Tristachya leucotrix* and *Setaria sphacelata*. The grass *Tristachya leucotrix* is dominant, covering an average of 50% of the relevés. Other prominent species are *Themeda triandra*, *Trachypogon spicatus*, *Brachiaria serrata* and *Melinis nerviglumis* (species group Y) and the sedge *Bulbostylis burchellii* (species group Y). The trees and shrub layer are inconspicuous and limited to scattered individuals of *Protea caffra* and *Burkea africana* (Table 5).

Three sub-communities can be distinguished in this community according to aspect:

8.1 *Heteropogon contortus* - *Trachypogon spicatus* Tall Open Woodland

This sub-community is confined to the east and north facing slopes. The occurrence of boulders and large rocks varies from absent or rare to abundant on the hillcrest in the southeast of the reserve. Splash erosion do occur in some of the relevés.

This Tall Open Woodland is differentiated from 8.2 by the absence of species

group V (Table 5). The grasses *Heteropogon contortus* and *Trachypogon spicatus* are dominant in this sub-community. Other prominent grasses include *Themeda triandra* and *Brachiaria serrata* (species group Y). Forbs occurring in this sub-community are *Ruellia cordata* (species group U), *Elephantorrhiza elephantina*, *Ophresia oblongifolia* (species group W), *Parinari capensis* (species group X) and *Bulbostylis burchellii* (species group Y). The tree layer is inconspicuous and scattered individuals of *Faurea saligna* (species group H) (Table 5) are found.

8.2 *Ruellia cordata* - *Senecio venosus* Tall Sparse Woodland

The sub-community occurs on the rocky norite slopes in the eastern region of the study area. Aspect varies considerably in this sub-community and cannot be considered as a diagnostic habitat feature. This woodland occurs on the summit and the upper slopes of the eastern range of hills. Slope varies from flat on the summit to a gradient of 30° on the slopes. The soil has a sandclayloam to sandclay texture.

Dense stands of *Tristachya leucotrix* (cover-abundance values 25%-100%) is enclosed in this sub-community. It is further differentiated from the other two sub-communities by the presence of the diagnostic species groups V, including the forbs *Chaetacanthus costatus*, *Mariscus congesta* and *Polygala uncinata* (Table 5). Grasses abundant in this sub-community are *Setaria sphacelata*, (species group T), *Heteropogon contortus* (species group W), *Themeda triandra*, *Trachypogon spicatus* and *Brachiaria serrata* (species group Y). Prominent forbs include *Sphenostylis angustifolia* (species group F), *Ruellia cordata*, *Thesium utile* (species group V) and *Bulbostylis burchellii* (species group Y). The tree layer is inconspicuous and scattered individuals of *Faurea saligna* and *Protea caffra* in the 5.5 m height class are present (Figure 13). The shrub layer (0.75 m - 2.5 m) is inconspicuous and represented by *Englerophytum magalismontanum*, *Diospyros lycioides* and *Rhus rigida*.

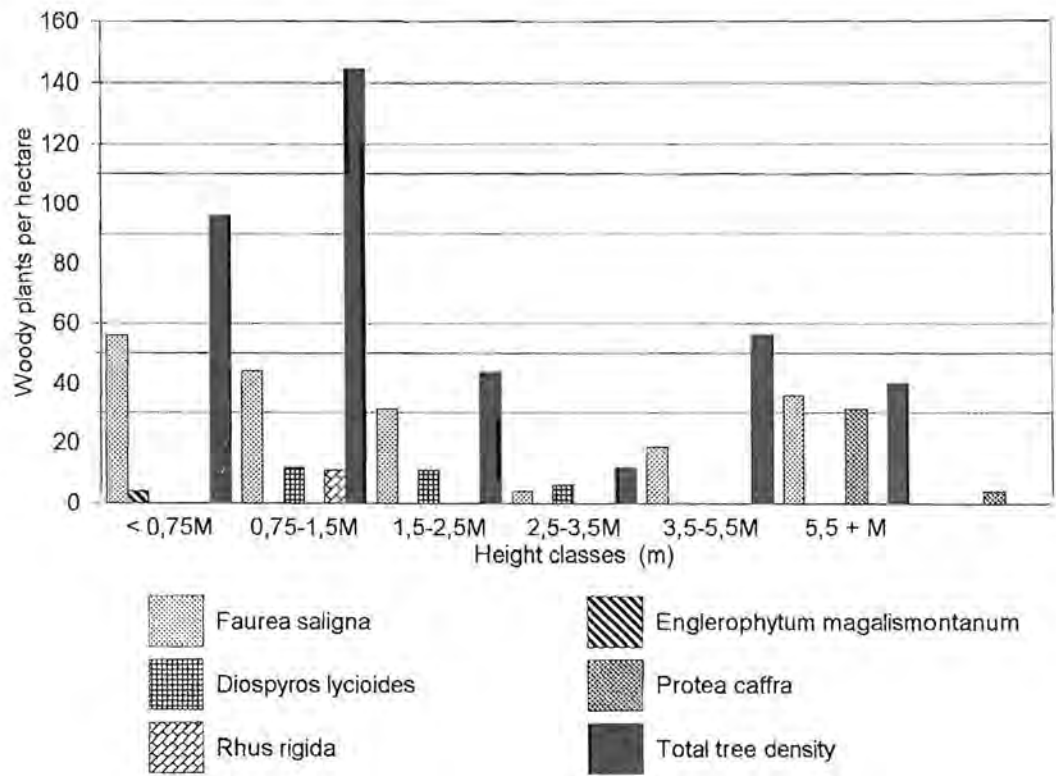


Figure 13: A histogram of the structure of the *Ruellia cordata* - *Senecio venosus* Tall Sparse Woodland sub-community of the *Tristachya leucotrix* - *Setaria sphacelata* Tall Sparse Woodland community on Rustenburg Nature Reserve.

8.3 *Trachypogon spicatus* - *Bulbostylis burchellii* Short Sparse Woodland

The *Trachypogon spicatus* - *Bulbostylis burchellii* Short Sparse Woodland is situated on the crests and upper western to northeastern facing slopes in the south eastern regions of the study area. It lies on sandloam to sandclayloam soils with boulders and large rocks. The soil texture are coarse-grained. Splash erosion was recorded in several relevés.

This sub-community is recognised by the absence of species groups U, V and W (Table 5). No diagnostic species group has been identified for this sub-community. The dominant forb species are *Parinari capensis* (species group X) and *Bulbostylis burchellii* (species group Y), whereas the dominant grasses are *Tristachya leucotrix* (species group T) and *Loudetia simplex* (species group N). Other grass species present are *Themeda triandra*, *Trachypogon spicatus* and *Brachiaria serrata* (species group Y). The tree layer is absent in this sub-community.

9 *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland

Acacia caffra is a widely distributed species occurring in various habitats in the Magaliesberg (van Wyk *et al.* 1988; van Gogh *et al.* 1988; van Vuuren *et al.* 1970; Coetzee 1975). In various habitats in the study area, this species dominates where it is associated with different other species groups. The *Acacia caffra* - *Ziziphus mucronata* community is widely distributed throughout the study area. A general habitat characteristic associated with this community is shallow to moderately deep Glenrosa soil forms occurring on the rocky slopes and foothills of the eastern range of valleys in the study area. However, some variations occur in deep Hutton soils (>1.5m).

A gradient from a distinct open xeric environment to a closed mesic environment can be detected in this community. The open xeric woodlands are confined to the eastern and northern aspects, distinguished by species groups B, C and D (Table 6). The closed mesic vegetation is restricted to the foothills and drainage lines in

the valleys and is distinguished by the presence of especially species groups T, U and W.

Evident from table 6, the woody component is very conspicuous in the *Acacia caffra* - *Ziziphus mucronata* vegetation community. General species (species group X) occurring throughout the community are predominantly woody species and includes prominent species viz. *Rhus leptodictya*, *Dombeya rotundifolia*, *Maytenus undata*, *Euclea crispa*, *Pappea capensis* and *Combretum molle*.

Eleven sub-communities and five variations were recognised based on soil depth and aspect:

9.1 *Cheilanthes viridus* - *Combretum molle* Short Open Woodland

This variation is confined to the mesic habitat associated with the rocky western to northeastern facing slopes on the foothills of the Magaliesberg. The gradient of the slope varies between 24° and 26°. The soil is shallow and the texture of the orthic A horizon is sand loam to sand clay loam.

Coetzee (1975) distinguished the *Kalanchoe paniculata* - *Acacia caffra* variation in the *Eustachys paspaloides* - *Acacia caffra* woodland that display a resemblance with the *Cheilanthes viridus* - *Combretum molle* Short Open Woodland sub-community. The *Kalanchoe paniculata* - *Acacia caffra* variation occurs below cliffs on the convex slopes on the western side of the Magaliesberg.

The diagnostic species for this sub-community is represented by species group B (Table 6), consisting of *Cheilanthes viridus*, *Tragia rupestris*, *Kalanchoe paniculata* and *Croton gratissimus* var. *subgratissimus*. Other species occurring in this sub-community are the forbs *Pellaea calomelanos* (species group N), *Thunbergia atriplicifolia* (species group N) and *Solanum panicoides* (species group R). The grass layer is represented by *Eustachys paspaloides*, *Elionurus muticus*

(species group N) and *Heteropogon contortus* (species group R). Trees and shrubs in this sub-community are *Lannea discolor*, *Combretum zeyheri*, (species group S), *Pappea capensis* and *Combretum molle* (species group X).

9.2 *Digitaria eriantha* - *Lippia javanica* Tall Closed Woodland

The *Digitaria eriantha* - *Lippia javanica* Tall Closed Woodland is confined to deep alluvial soils in the valley in the northeastern section of the study area. The soil texture is sand clay loam and rocks and boulders are absent.

Coetzee (1975) differentiated the *Digitaria smutsii* - *Acacia caffra* variation in the *Eustachys paspaloides* - *Acacia caffra* woodland. This variation is restricted to the well-differentiated alluvial soils of the flats between the northeastern foothills of the Magaliesberg (Coetzee 1975) and demonstrates similarities with the *Digitaria eriantha* - *Lippia javanica* Tall Closed Woodland.

Diagnostic species group C distinguishes this sub-community from the other sub-communities. It consists of the forbs *Psiadia punctulata*, *Polygala hottentotta* and the grass *Sporobolus fimbriatus* (Table 6). Species groups J, N, Q, S, X and EE are also present in this sub-community. The tree and shrub layer are conspicuous. A prominent tree species is *Dombeya rotundifolia* (species group X). Figure 14 illustrates the structure of the woody component in this sub-community. The <0.75 m height class dominates the structure in this woodland sub-community, with *Combretum zeyheri* particularly prominent. The >3.5 m height classes is markedly inconspicuous in this sub-community.

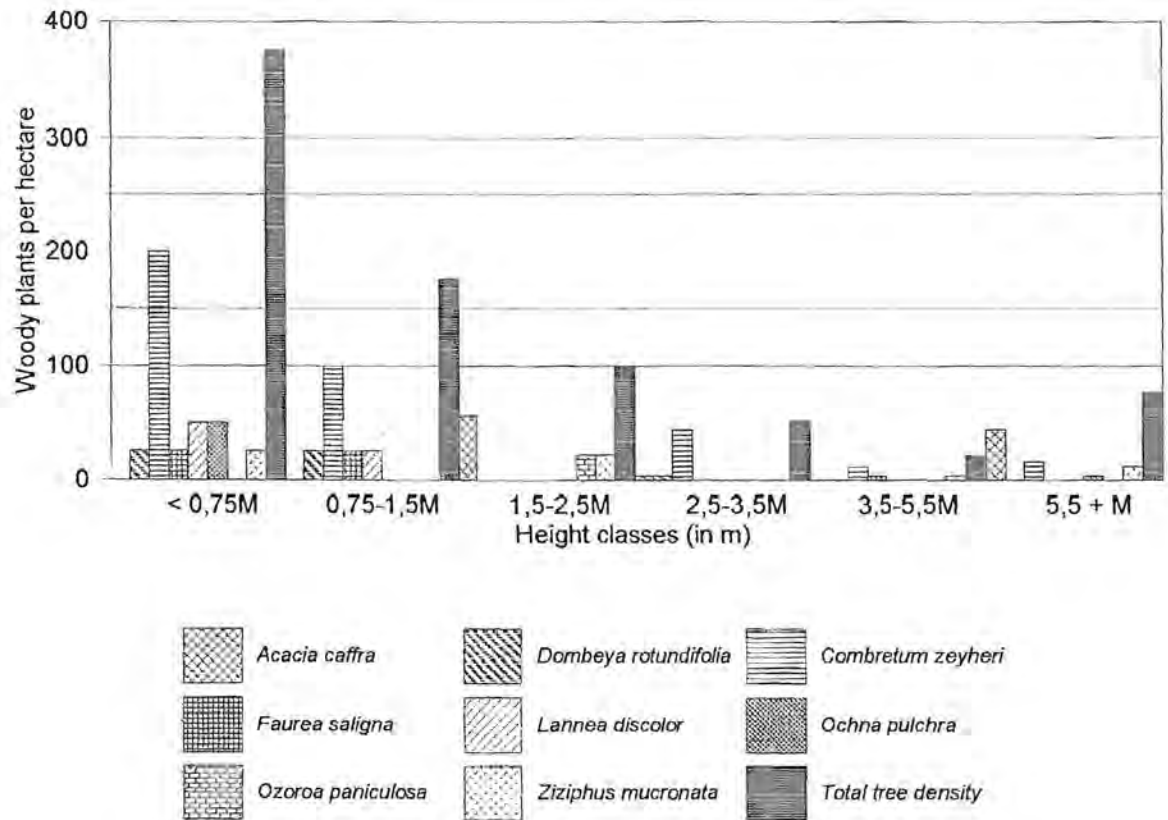


Figure 14: A histogram of the structure of the *Digitaria eriantha* - *Lippia javanica* Tall Closed Woodland of the *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland on Rustenburg Nature Reserve.

The grass species in this variation are *Digitaria eriantha*, (cover-abundance values 1% - 50%), *Eustachys paspaloides* (species group N), *Setaria sphacelata*, *Heteropogon contortus* and *Eragrostis curvula* (cover-abundance value 50%-75%) (species group Q).

9.3 *Setaria lindenbergiana* - *Artemisia afra* Tall Closed Woodland

The *Setaria lindenbergiana* - *Artemisia afra* Tall Closed Woodland sub-community is confined to the shallow soils at the bottom of the valley situated between the summit areas in the northeastern regions of the study area. The slopes are fairly steep and vary between 19° and 44°. Aspect is southwest to east. Rocks and boulders occur frequently in the area. The soil has a sandclayloam texture.

This sub-community corresponds with the *Setaria lindenbergiana* - *Acacia caffra* woodland identified by Coetzee (1975). According to Coetzee (1975) the *Setaria lindenbergiana* - *Acacia caffra* woodland is regarded as a sub-unit within the *Eustachys paspaloides* - *Acacia caffra* Woodlands. This Tall Closed Woodland is restricted to the cool slopes in the valleys between the summit areas.

Diagnostic species for this sub-community are species group D (Table 6). These species include *Artemisia afra*, *Mohria caffrorum*, *Maytenus heterophylla*, *Cussonia panicoides* and *Rhus discolor*. Other species groups occurring in this sub-community are species group I, J, N, Q, X and EE. These species groups contain the grasses *Eustachys paspaloides* (species group N), *Setaria sphacelata* (cover-abundance values 50%) and *Eragrostis curvula* (species group Q). The grass *Setaria lindenbergiana*, diagnostic to this sub-community is dominant and cover-abundance values of between 25% and 75% were recorded. The *Acacia caffra* - *Setaria lindenbergiana* association was also described by van Vuuren *et al.* (1970). He found this sub-community to be distinctive of the south-facing slopes and characteristic of open woodlands.

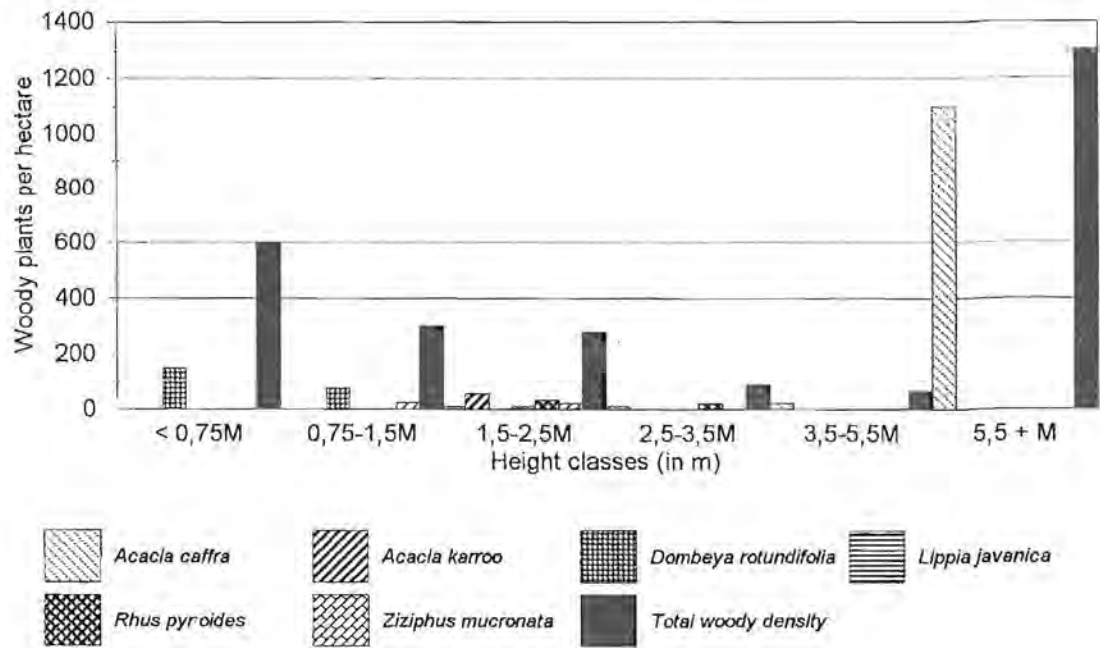


Figure 15: A histogram of the structure of the *Setaria lindenbergiana* - *Artemisia afra* Tall Closed Woodland sub-community of the *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland community on Rustenburg Nature Reserve.

Trees and shrubs occurring in this sub-community are *Acacia caffra*, *Ziziphus mucronata* (species group A), *Maytenus heterophylla* (species group D), *Rhus rigida* (species group I), *Dombeya rotundifolia*, *Rhus pyroides* (species group X) and *Acacia karroo* (species group EE) (Figure 15). The shrub layer in the < 0.75m height class is dominated by *Dombeya rotundifolia*, while *Acacia caffra* is dominant in the >5.5m height class (Figure 15). The 2.5m to 5.5m height classes is inconspicuous in this sub-community (Figure 15).

9.4 *Becium obovatum* - *Protea caffra* Tall Closed Woodland.

This distinctive sub-community is restricted to the northern section of the central basin area where most of the reserve's infrastructure is situated. This sub-community is confined to deep Hutton soils, although one variation is found on shallow Glenrosa soils. The gradient in this sub-community varies from gentle to steeper slopes, not exceeding 33°. This sub-community occurs on the southeastern to southwestern facing slopes. Large rocks and boulders are limited to variation 9.4.3 of this sub-community.

Coetzee (1975) described the vegetation in this sub-community as the *Protea caffra* - *Acacia caffra* variation of the *Brachiaria serrata* - *Acacia caffra* sub-community. This variation is regarded by Coetzee(1975) as a transition between *Eustachys paspaloides* - *Acacia caffra* and the *Eragrostis racemosa* - *Bewisia biflora* communities because of the large amount of species shared.

In this classification, the differentiating species group is species group E, containing the trees *Protea caffra* and *Rhus lancea*, which, together with *Acacia caffra* (species group A) forms the main constituents of the tree layer (Table 6). Diagnostic forbs include *Helichrysum setosum* (species group E), *Ledebouria marginata* (species group G) and *Elephanthoriza elephantina* (species group F). Based on aspect and soil depth, three variations can be distinguished in this sub-community.

9.4.1 *Turbina oblongata* - *Phyllanthus glaucophyllus* High Closed Shrubland

This variation is found on westerly to southerly facing slopes on deep fine grained Hutton soils. Rocks and boulders are absent. The clay content of the soil in this variation is higher than the other two variations.

Species group F is diagnostic for this variation. This species group includes the forbs *Turbina oblongata*, *Phyllanthus glaucophyllus*, *Senecio inornatus*, *Eucomis clavata* and *Conyza podocephala*, and the geophyte *Eulophia ovalis*. Other species groups occurring in this variation are G, H, I, J, K, N, O, P, Q, S, X and EE (Table 6). Prominent grasses in this variation are *Hyparrhenia filipendula* var. *pilosa* (species group G), *Digitaria diagonalis* (species group H), *Setaria nigrirostris* (species group J), *Brachiaria serrata* (species group O), *Setaria sphacelata* (cover-abundance values 75% - 100%) (species group Q) and *Themeda triandra* (species group S). Significant forbs are *Aloe greatheadii*, *Rubia petiolaris*, *Hypoxis rigidula* (species group G), *Kohautia amatymbica*, *Chaetacanthus setiger* (species group H), *Conyza albida*, *Lantana rugosa* (species group J), *Becium obovatum* (species group K) and *Vernonia oligocephala* (species group N).

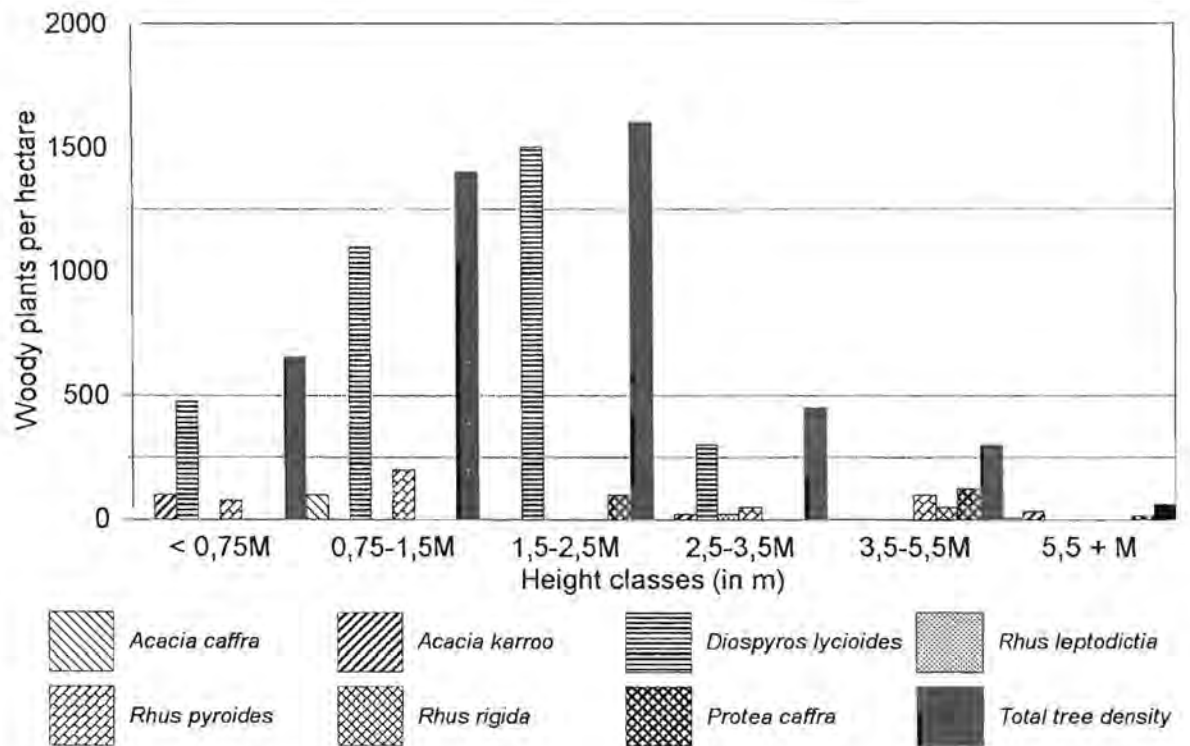


Figure 16: A histogram of the structure of the *Turbina oblongata* - *Phyllanthus glaucophyllus* High Closed Shrub land variation of the *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland community on Rustenburg Nature Reserve.

Individual *Faurea saligna* and *Combretum zeyheri* trees are found in this variation. Figure 16 is a histogram illustrating the structure of the woody component of this variation. The 0.75 - 2.5 m height classes are well developed in this variation, representing a dense undergrowth consisting of *Asparagus lariginus* (species group G), *Rubus rigidus* (species group F), *Rhus pyroides* (species group X) and *Diospyros lycioides* (species group EE). The >2,5m - 5,5m height classes are less abundant and confined to *Protea caffra* and *Acacia caffra*.

9.4.2 *Diospyros lycioides* - *Rhus rigida* Tall Closed Woodland

The *Diospyros lycioides* - *Rhus rigida* Tall Closed Woodland is restricted to the southeast facing slopes in the northern section of the central basin. This variation occurs on slight slopes on soils varying in depth from shallow Glenrosa soils to deep, well-differentiated Hutton soils. The texture of the soil is sand clay loam (MacVicar *et al.* 1991) Rocks occur seldom throughout this variation.

Coetzee (1975) described this variation as the *Protea caffra* - *Acacia caffra* variation of the *Acacia caffra* dominated woodlands. The absence of species group F in this variation distinguished it from the previous variation. This variation is restricted to the southeastern facing slopes, contrary to the *Turbina oblongata* - *Phyllanthus glaucophyllus* variation, occurring predominantly on the western facing slopes. The presence of species groups A, E, G, H, I, J, K, N, O, P, Q, S, X and EE characterise this variation. The dominant trees and shrubs are *Acacia caffra*, *Ziziphus mucronata* (species group A), *Protea caffra* and *Rhus lancea* (species group E). Other prominent trees and shrubs in this variation are *Rhus rigida* (species group I), *Dombeya rotundifolia*, *Rhus pyroides* (species group X), *Acacia karroo* and *Diospyros lycioides* (species group EE).

Figure 17 is a histogram illustrating the structure of the woody component in this variation. The undergrowth in this variation (<2,5m) is dominated by *Diospyros lycioides* and *Rhus pyroides*. *Acacia caffra* and *Protea caffra* represents the 2,5m - 5,5m height classes.

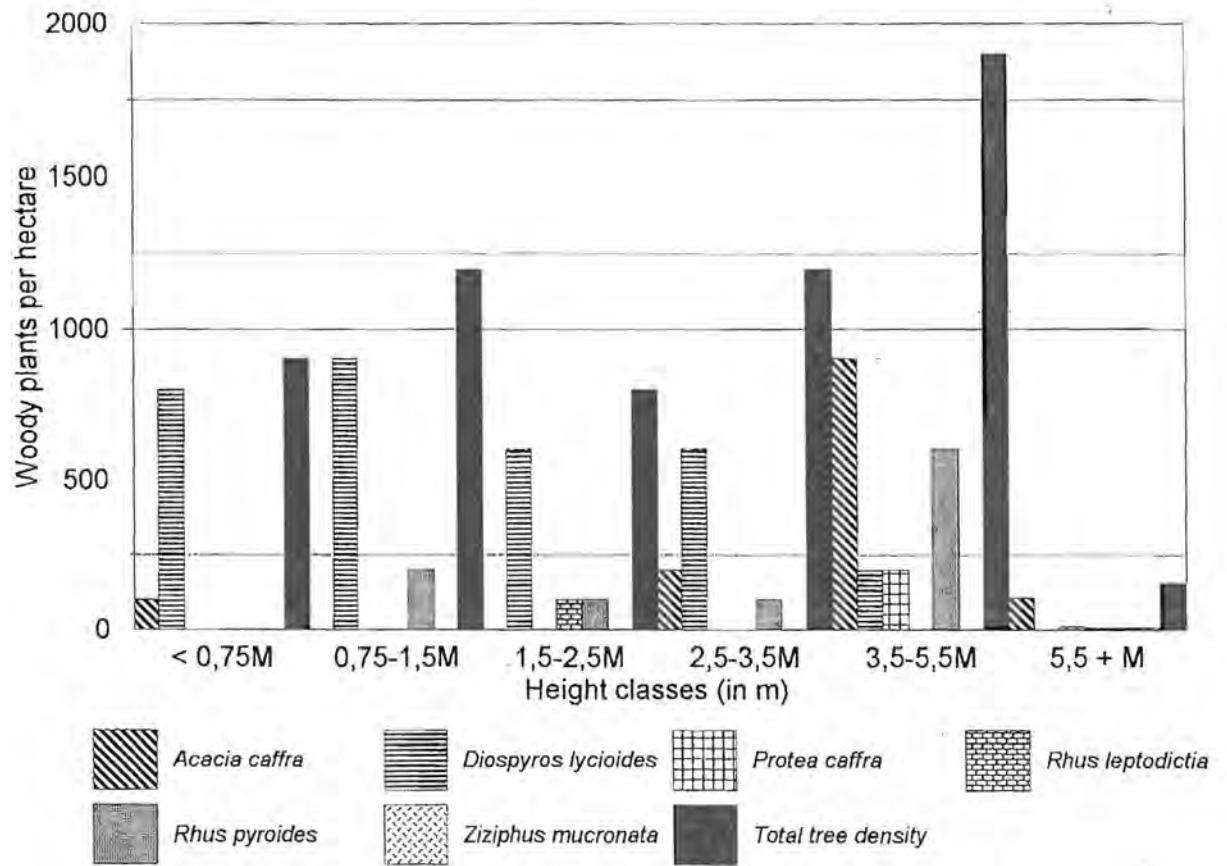


Figure 17: A histogram of the structure of the *Diospyros lycioides* - *Rhus rigida* Tall Closed Woodland variation of the *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland community on Rustenburg Nature Reserve.

The dominant grass in this variation is *Setaria sphacelata* (cover-abundance values 25% - 50%). Other grasses present are *Hyparrhenia filipendula* var. *pilosa* (species group G), *Diheteropogon amplexans* (species group K), *Eustachys paspaloides* (species group N), *Brachiaria serrata*, *Melinis nerviglumis* (species group O), *Trachypogon spicatus* (species group P), *Themeda triandra* (species group S) and *Eragrostis curvula* (species group Q). Forbs constitute the larger part of the cover. Prominent forbs are *Ledebouria marginata*, *Aloe greatheadii* (species group G), *Kohautia amatymbica*, *Chaetachantus setiger* (species group H), *Conyza albida*, *Rhynchosia nervosa*, *Lantana rugosa* (species group J), *Becium obovatum* (species group K), *Vernonia oligocephala* (species group N) and an unidentified *Ledebouria* species (species group Q) (Table 6).

9.4.3 *Themeda triandra* - *Elionurus muticus* Tall Closed Woodland

Small areas of shallow clay soils on the western boundary of the study area are covered by this variation. This shallow clay soils developed from Magaliesberg altered shales (Coetzee 1975). The landscape is broken with rocks and boulders occurring frequently with a gradient varying between 22° and 23°. This variation is utilized by game, especially sable antelope (*Hippotragus niger niger*) and eland (*Taurotragus oryx*).

The dominant forbs in this variation are *Helichrysum setosum* (species group E), *Vernonia natalensis*, *Helichrysum nudifolium*, *Athrixia elata* (species group I), *Pentanisia angustifolia*, *Becium obovatum* (species group K) and *Pellaea calomelanos* (species group N). Grasses occurring in this variation are *Diheteropogon amplexans* (species group K), *Elionurus muticus* (species group N), *Brachiaria serrata* (species group O), *Trachypogon spicatus* (species group P), *Setaria sphacelata* (cover-abundance values 5%-50%)(species group Q) and *Themeda triandra* (cover-abundance values 5%-75%) (species group S).

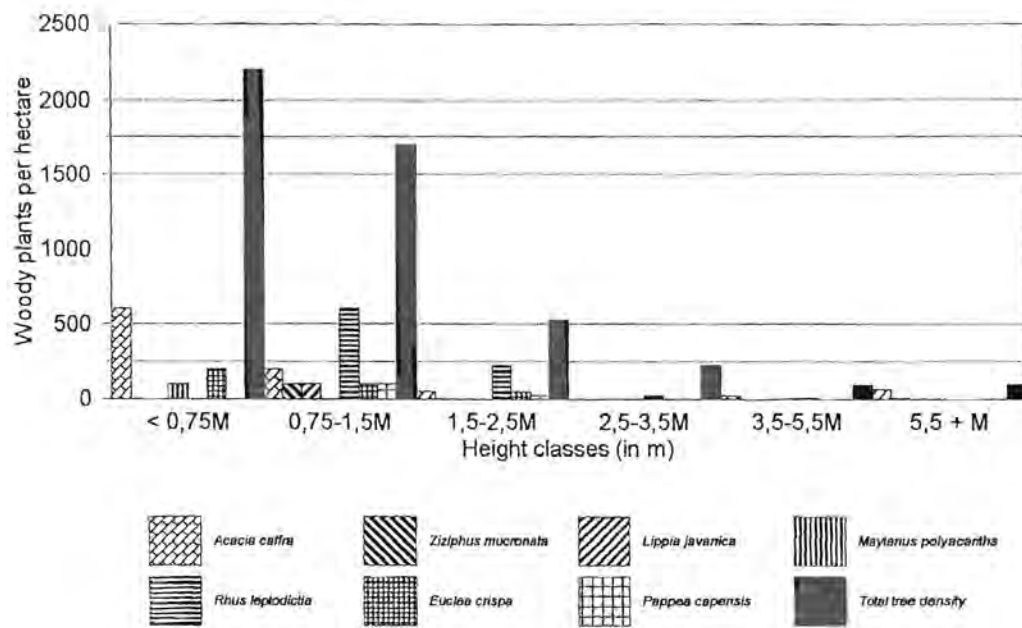


Figure 18: A histogram of the structure of the *Themeda triandra* -*Elionurus muticus* Tall Closed Woodland variation of the *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland community on Rustenburg Nature Reserve.

Conspicuous tree and shrub species are *Acacia caffra*, *Ziziphus mucronata* (species group A), *Protea caffra*, *Rhus lancea* (species group E), *Rhus rigida* (species group I), *Asparagus suaveolens*, *Lippia javanica* (species group S), *Euclea crispa* and *Pappea capensis* (species group X). Figure 18 depicts the structure of the woody component in this variation. Evident from figure 18, is the density of the < 1.5 m height classes, consisting of *Lippia javanica*, *Maytenus polyacantha* and *Euclea crispa*.

9.5 *Ruellia patula* - *Melinis nerviglumis* Short Open Woodland

The *Ruellia patula* - *Melinis nerviglumis* Short Open Woodland occurs on shallow soils of the Glenrosa soil form on the north and eastern facing slopes. It is restricted to the northeastern section of the study area in particular the lower pediment of the valleys between the summit regions. The slopes are gentle, varying from 10° to 30°. Rocks and boulders are frequently found and the soils are sand to sandclayloam.

The *Ruellia patula* - *Melinis nerviglumis* Short Open Woodland is distinguished from the other sub-communities in this community by the presence of species groups L, diagnostic to this sub-community. Based on aspect, two variations can be distinguished.

9.5.1 *Hypericum aethiopicum* - *Acacia karroo* Short Closed Woodland

The *Hypericum aethiopicum* - *Acacia karroo* Short Closed Woodland variation is associated with the eastern facing slopes of the valley between the plateau and northeast lying ridge in the study area. Coetzee (1975) described this variation as the *Blumea alata* - *Acacia caffra* variation of the *Brachiaria serrata* - *Acacia caffra* Woodland, considered the more mesic environments on the northeastern facing slopes of these valleys.

This variation is differentiated from 9.5.2 by the presence of species groups H, I and J and the absence of species group M. Species groups H, I, J, K, L, N, O, P,

Q, S and EE are also present (Table 6). Prominent grass and forb species in this variation are *Oxalis obliquifolia* (species group J), *Setaria nigrirostris* (species group J), *Ruellia patula* (species group L), *Eustachys paspaloides* (species group N), *Brachiaria serrata*, *Melinis nerviglumis* (species group O), *Setaria sphacelata* (cover-abundance values 25% - 75%) (species group Q) and *Themeda triandra* (species group S). The tree layer in this variation is characterised by a very high occurrence of *Acacia caffra* (cover-abundance values 25% - 50%) (species group A) and *Acacia karroo* (cover-abundance values 1% - 50%) (species group EE). Other conspicuous trees and shrubs are *Rhus rigida* (species group I), *Faurea saligna* (species group O) and *Lannea discolor* (species group S).

9.5.2 *Loudetia flavida* - *Andropogon schirensis* Short Open Woodland

This variation is found on the low-lying north facing slopes of the valley situated furthestmost northeasterly in the study area. The soil has a coarsely-grained texture and large rocks and boulders occur frequently throughout the variation.

Species group M, containing the grasses *Loudetia flavida* and *Andropogon schirensis*, and the forbs *Thesium magalismsontanum* and *Triumfetta sonderii*, are diagnostic for this variation. Except for species groups A and L, species groups N, O, P, Q and S are also included in this variation (Table 6). The grasses' *Diheteropogon amplexans* (species group K), *Brachiaria brizantha*, *Tristachya biseriata* (species group L), *Loudetia flavida*, *Andropogon schirensis* (species group M), *Elionurus muticus* (species group N), *Brachiaria serrata*, *Melinis nerviglumis* (species group O), *Setaria sphacelata*, *Heteropogon contortus* (species group Q) and *Themeda triandra* (species group S) occur in the herbaceous layer. Prominent forbs in this variation are *Triumfetta sonderii* (species group M) and *Pellaea calomelanos* (species group N). A distinct feature of the tree layer in this variation is the absence of *Acacia caffra*. Conspicuous tree species in this variation are limited to *Faurea saligna* (species group O), *Burkea africana* (species group P), *Combretum zeyheri* (species group S) and *Combretum molle* (species group X). Shrubs occurring in this variation are limited to *Asparagus suaveolens* and *Lannea discolor* (species group S).

9.6 *Heteropogon contortus* - *Faurea saligna* Tall Open Woodland

This open woodland occurs in the western regions of the study area. It is found on slight to relatively steep slopes, varying from 3° to 40°. Aspect in this sub-community is not consistent, but occurs generally on east facing slopes. Soils varies from loamsand to sandloam (MacVicar *et al.* 1991) with a coarse-grained texture.

Rocks and boulders are frequently found throughout the sub-community. Erosion does occur in small areas, although it is currently confined to splash erosion.

This sub-community is characterised by the presence of species groups O, P, Q, R, S, T, X and EE (Table 6). Dominant trees and shrubs occurring in this sub-community are *Acacia caffra*, *Ziziphus mucronata* (species group A), *Faurea saligna* (species group O), *Asparagus suaveolens* (species group S) and *Combretum zeyheri* (species group S). The herbaceous layer is dominated by the grass *Heteropogon contortus* (species group Q). Other grasses present are *Brachiaria serrata*, *Melinis nerviglumis* (species group O), *Setaria sphacelata* (species group Q) and *Themeda triandra* (species group S). Forbs occurring in this sub-community are *Senecio venosus* (species group P) and *Tagetes minuta* (species group EE).

9.7 *Senecio venosus* - *Heteropogon contortus* Tall Closed Woodland

The *Senecio venosus* - *Heteropogon contortus* Tall Closed Woodland is associated with moderately deep Glenrosa soils on the foothills and flat hill crests of the southeastern regions of the study area. It is situated close to the current main gate complex, on either sides of the road. This area is utilized by game and sable have been recorded to use the open areas next to this sub-community frequently. This Tall Closed Woodland is confined to clay soils on noritic parent rock. The soils are finely-grained and large rocks are frequently encountered. Aspect is northeast to southeast.

Dominant species in this sub-community are the grasses *Setaria sphacelata* and *Heteropogon contortus* (species group Q). Other species include *Senecio venosus* (species group P), *Commelina africana* (species group A) and individual *Burkea africana* trees (Species groups P), as well as the grasses *Themeda triandra* (Species group S) and *Panicum maximum* (Species group EE).

Conspicuous woody species occurring in this sub-community are *Acacia caffra* (species group A), *Asparagus suaveolens*, *Lippia javanica* (species group S) and *Acacia karroo* (species group EE).

Figure 19 is a histogram of the structure of the woody component of this sub-community. Evident from this histogram is the dense <1.5m height class consisting of *Asparagus suaveolens*, *Grewia occidentalis*, *Ziziphus mucronata* and *Maytenus polyacantha*. The 1.5 - 5.5m height classes are represented by *Acacia caffra* and *Ziziphus mucronata*.

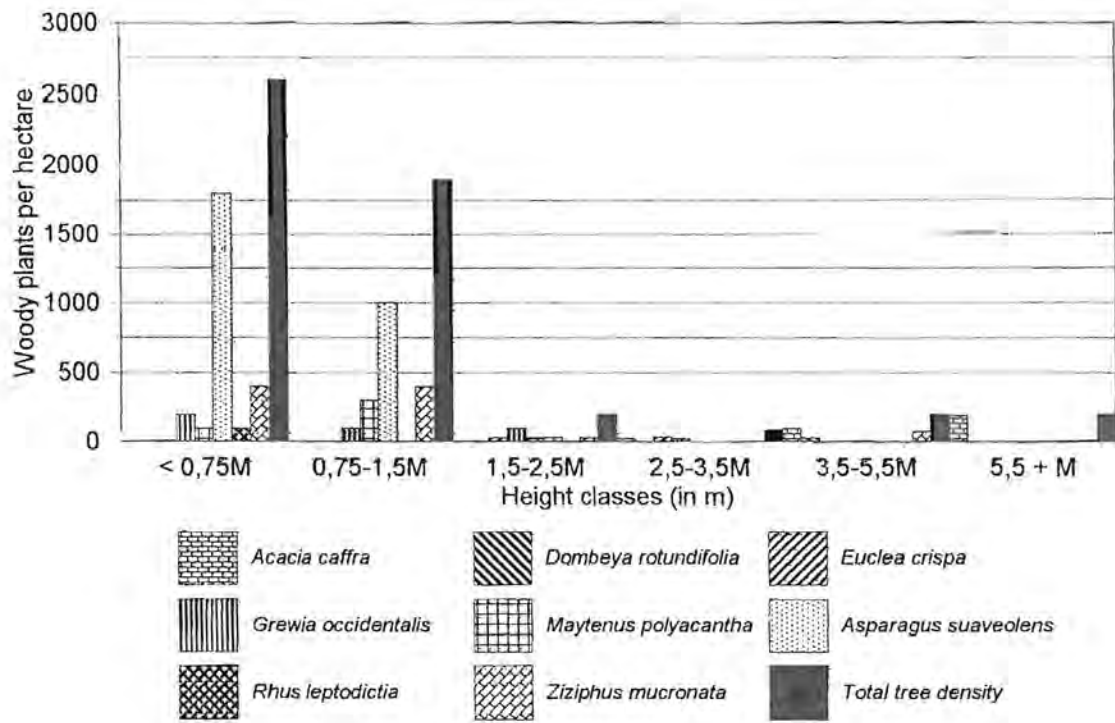


Figure 19: A histogram of the structure of the *Senecio venosus* - *Heteropogon contortus* Tall Closed Woodland of the *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland community on Rustenburg Nature Reserve.

9.8 *Setaria sphacelata* - *Themeda triandra* Tall Closed Woodland

The *Setaria sphacelata* - *Themeda triandra* Tall Closed Woodland occurs on the fine-grained Glenrosa soil forms on the slopes in the southeastern section of the study area. The occurrence of large rocks and boulders in this sub-community is inconsistent and is only found in some relevés. The gradient of these relevés does not exceed 10°.

Woody species occurring in this sub-community are *Berchemia zeyheri* (species group R), *Lippia javanica*, *Combretum zeyheri* (species group S), *Rhus leptodictya*, *Dombeya rotundifolia*, *Euclea crispa* (species group X), *Celtis africana* (species group BB) as well as the species of species group A.

A dense undergrowth in the <0.75 - 1.5m height classes dominate the woody structure. The 1.5 m - 5.5m height classes consist of *Acacia caffra*, *Ziziphus mucronata*. (species group A), *Dombeya rotundifolia* (species group X) and *Zanthoxylum capense* (species group BB).

The herbaceous layer is less conspicuous. Prominent grass species in this sub-community are *Setaria sphacelata*, *Heteropogon contortus*, *Eragrostis curvula* (species group Q), *Themeda triandra* (species group S), and *Panicum maximum* (species group EE). The forbs are limited to *Ceterach cordatum* and *Ruellia cordata* (species group R).

This sub-community includes a disturbed area, previously a cultivated land used for crop production. This area had been cleared of trees and shrubs. Crop production were ceased in the mid to late seventies. Several pioneer plant species has since colonised this disturbed area. The presences of the grasses *Cynodon dactylon*, *Urochloa mosambicensis* and *Perotis patens*, indicated the disturbed nature of the areas (van Oudsthoorn 1992; Gibbs Russell *et al.* 1991). *Hyparrhenia hirta*, an important agent to stabilize disturbed open areas, (van Oudsthoorn 1992) as well as *Diheteropogon amplexans* and *Loudetia simplex* are currently dominating the herbaceous component (Nel 1992). The woody

component in this old land is inconspicuous and *Ziziphus mucronata* and *Celtis africana* are the only trees present in the 0.75 - 1.5m class.

9.9 *Euclea crispa* - *Panicum maximum* Tall Closed Woodland

This sub-community is associated with the medium-deep Glenrosa soil forms on the slopes of the southeastern valley in the study area. The slopes are gentle and the gradient varies between 1° and a maximum of 25°.

This Tall Closed Woodland is distinguished from the other sub-communities by the presence of species groups R, S, X, BB and EE. The woody component is conspicuous and is dominated by *Acacia caffra* and *Ziziphus mucronata* (species group A). Other woody species include *Lippia javanica*, *Lansea discolor*, *Combretum zeyheri* (species group S), *Rhus leptodictya*, *Dombeya rotundifolia*, *Euclea crispa*, *Pappea capensis*, *Combretum molle*, *Grewia occidentalis* (species group X) and *Celtis africana* (species group BB). *Dombeya rotundifolia*, *Euclea crispa* and *Rhus leptodictya* dominates the <0.75m - 1.5 m height classes). *Acacia caffra*, *Celtis africana* and *Ziziphus mucronata* represents the 2.5m -5.5m height classes (Figure 20).

The herbaceous layer is inconspicuous and dominated by the grass *Panicum maximum* (cover-abundance values 1%-100%) (species group EE). Other grass species occurring in this sub-community are *Themeda triandra*, *Melinis repens* (species group S) and *Setaria nigrirostris* (species group J). Forb species are limited to single species that include *Ruellia cordata*, *Sphedamnocarpus pruriens*, (species group R) and *Hermannia depressa* (species group S).

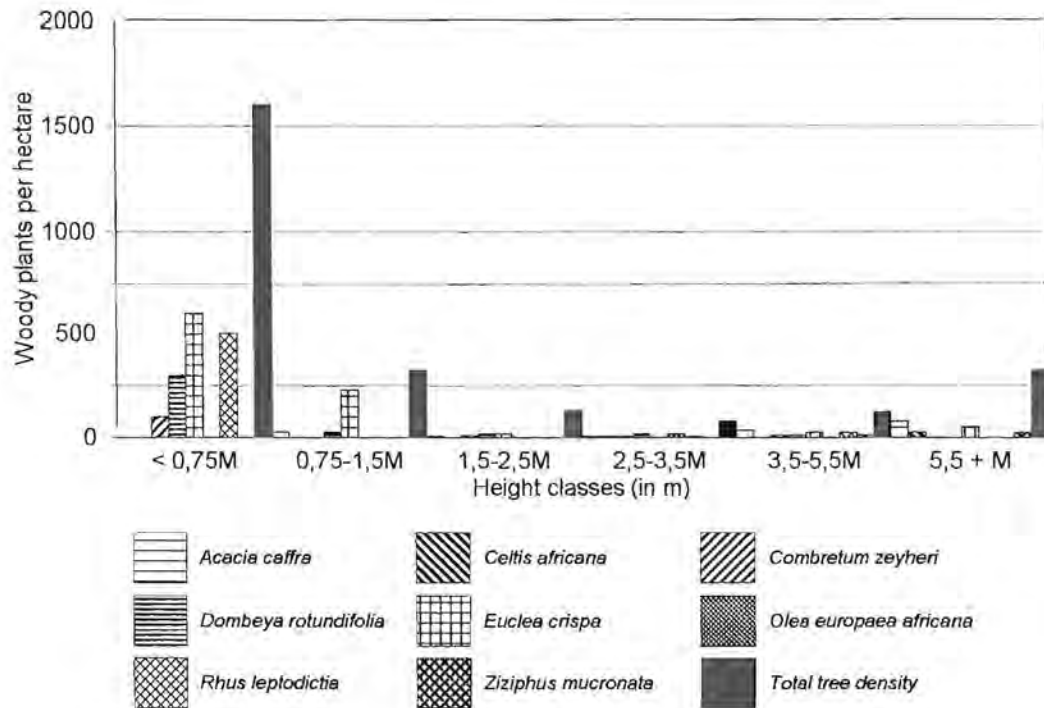


Figure 20: A histogram of the structure of the *Euclea crispa* - *Panicum maximum* Tall Closed Woodland of the *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland community on Rustenburg Nature Reserve.

9.10 *Asparagus virgata* - *Celtis africana* Tall Closed Woodland

This sub-community is associated with the eastern facing foothills in the southeastern valley of the study area, as well as the southwestern slopes of Langkloof. Rock cover does not exceed 10%. The slope is gentle and the gradient is generally less than 15°.

The woody component dominates this sub-community. The diversity of the woody plants in this sub-community is illustrated in Table 7.

Seventeen woody species were recorded for this sub-community. The woody layer consists predominantly of species groups A, X and BB (Table 7). Figure 21 illustrate the structural data of the woody component of this sub-community. Evident from the histogram, the sub-community is dense, containing some forest species such as *Diospyros whyteana* (species group V), *Euclea crispa*, *Pappea capensis*, *Combretum molle* (species group X), *Celtis africana* and *Zanthoxylum capense* (species group BB). Other prominent trees in this sub-community are *Acacia caffra*, *Ziziphus mucronata* (species group A) *Dombeya rotundifolia* (species group X) and *Diospyros lycioides* (species group EE).

Table 7: The number of individuals per hectare in the different height classes for the woody component of the *Asparagus virgata* - *Celtis africana* sub-community of the *Acacia caffra* - *Ziziphus mucronata* vegetation community.

Species	Individuals per hectare						Total
	Height class (m)						
	< 0.75M	0.75-1.5M	1.5-2.5M	2.5-3.5M	3.5-5.5M	5.5 + M	
<i>Acacia caffra</i>	0	0	0	0	0	50	50
<i>Apodetes dimidiata</i>	0	0	0	25	0	0	25
<i>Berchemia zeyheri</i>	0	100	0	0	0	25	125
<i>Celtis africana</i>	600	200	0	25	25	50	900
<i>Combretum molle</i>	200	300	0	0	0	0	500
<i>Combretum zeyheri</i>	0	0	0	0	25	25	50
<i>Diospyros lycioides</i>	900	300	200	0	0	0	1400
<i>Diospyros whyteana</i>	500	600	500	75	25	0	1700
<i>Dombeya rotundifolia</i>	100	100	0	0	0	25	225
<i>Ehretia rigida</i>	0	100	0	0	0	0	100
<i>Euclea crispa</i>	600	600	400	275	0	0	1875
<i>Ficus thonningii</i>	0	100	0	0	0	0	100
<i>Grewia occidentalis</i>	1100	1000	300	425	25	0	2850
<i>Pappea capensis</i>	0	100	0	0	0	0	100
<i>Rhus leptodictya</i>	0	0	100	0	25	0	125
<i>Rhus pyroides</i>	0	200	0	0	50	0	250
<i>Vepris undulata</i>	100	0	0	0	0	0	100
Total woody density	4100	3700	1500	825	175	175	10475

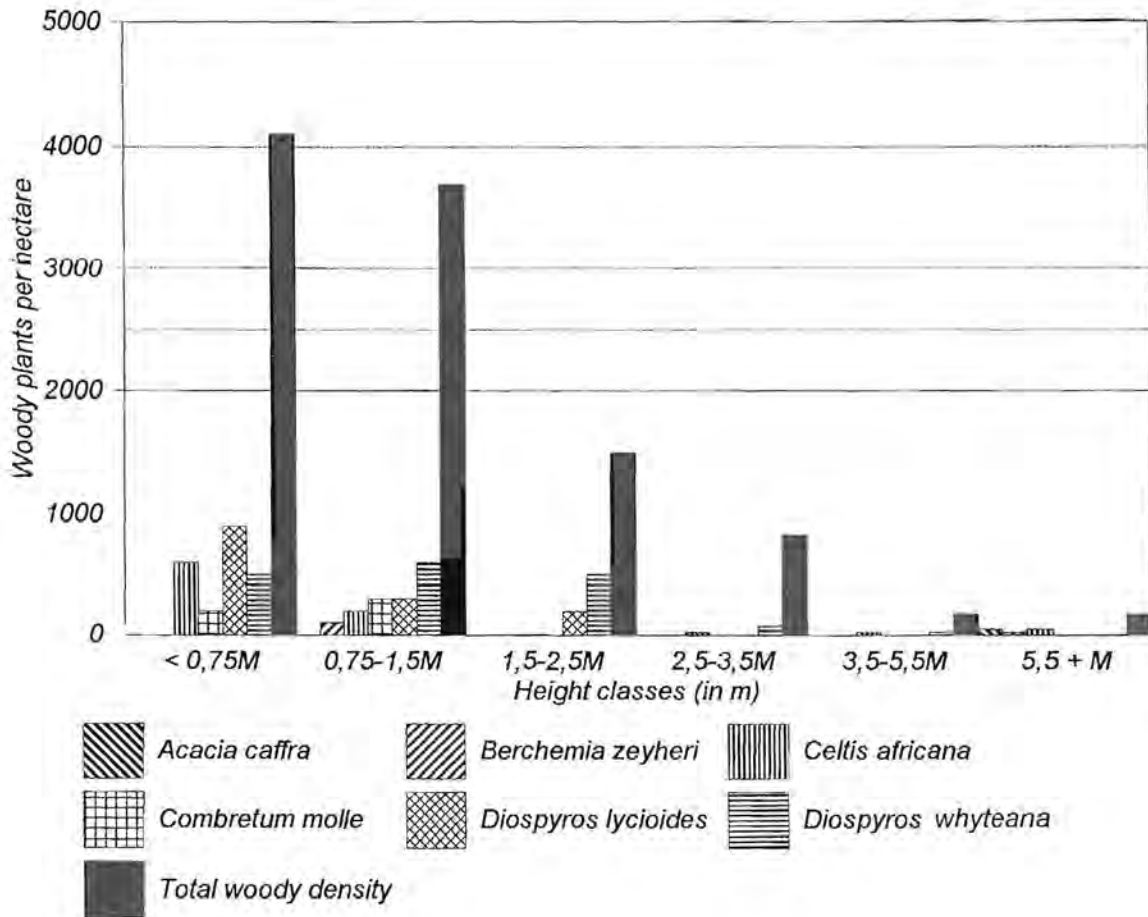


Figure 21: A histogram of the structure of the *Asparagus virgata* - *Celtis africana* Tall Closed Woodland of the *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland community on Rustenburg Nature Reserve.

The herbaceous layer is limited to specimens of the shade loving grasses *Setaria megaphylla* (species group T) and *Panicum maximum* (species group EE) and the forb *Hypoestes forskali* (species group X).

9.11 *Olea europaea* - *Grewia occidentalis* Tall Closed Woodland

This sub-community is situated in the low lying areas of drainage lines in the southeastern parts of the study area. The shallow Glenrosa soil forms are fine grained with a sand loam to sand clay texture (MacVicar *et al.* 1991). Large rocks and boulders occur seldom throughout this sub-community. It is situated on a slight slope and the aspect varies from southeast to southwest. This sub-community was recognised and described by van Vuuren *et al.* (1970) as the *Acacia caffra* - *Olea europaea* var. *africana* variation of the *Acacia caffra* community restricted to western facing foothills.

Species group U is diagnostic to the *Olea europaea* - *Grewia occidentalis* Tall Closed Woodland sub-community. This species group contains the tree species *Olea europaea* var. *africana* and the shrubs *Asparagus cooperi* and *Maytenus polycantha*. Other woody species in this sub-community is *Grewia occidentalis* (species group X) (Table 6). Species groups V, X, BB and EE is also present in this sub-community is. Prominent species occurring in this sub-community are the scrambling shrub *Rhoicissus tridentata* (species group V), *Hypoestes forskali* (species group X) and the grasses *Setaria lindenbergiana* (species group D), *Setaria megaphylla* (species group T) and *Panicum maximum* (species group EE). Although species group X is well represented in this sub-community, *Rhus leptodictya* is absent. This is attributed to the preference of this species for open woodlands in rocky areas (Palgrave 1990; van Wyk *et al.* 1988). It is seldom found in moist areas. The woody species *Acacia caffra*, *Ziziphus mucronata* (species group A), *Maytenus polycantha* (species group U), *Combretum erythrophyllum*, *Diospyros whyteana* (species group V), *Dombeya rotundifolia*, *Euclea crispa*, *Pappea capensis*, *Rhus pyroides* (species group X), *Celtis africana*, *Zanthoxylum capense* (species group BB) and *Diospyros lycioides* (species group EE) are also to be found in this sub-community. The occurrence of these species, and the

presence of species groups V, X, BB and EE indicate that this sub-community is a transition between the relative drier open woodland communities and the cool forest's communities.

10 *Mimusops zeyheri* - *Hypoestes forskaoli* Tall Forest

The *Mimusops zeyheri* - *Hypoestes forskaoli* community represents the cool forest communities of the study area. These forests are restricted to the dry drainage lines in the eastern valleys of the study area, as well as a dry ravine on the western boundary. These drainage lines are seasonal and flow of water in these ravines only occur during an exceptional rainfall period. Coetzee (1975) has suggested the possibility of a concentration of water deep under the soil surface, but within reach of the deep root system needed to support forest trees. Aspect varies, but is generally northeast to northwest. The slopes are relative-steep and the gradient varies 24 - 37°. The soil form varies from a shallow to moderately deep Glenrosa, with no gravel or large rocks.

Diagnostic species associated with this vegetation community are species group V. Species included are the tree *Mimusops zeyheri*, the shrubs *Acalypha angustata* var. *glabra*, *Cyphostemma cirrhosum* subs. *cirrhosum*, *Obetia tenax* and the forbs *Solanum rostratum*, *Commelina bengalensis*, *Droguetia iners* and *Helinus integrifolius*. Other prominent woody species in this community includes *Maytenus undata*, *Combretum erythrophyllum*, *Diospyros whyteana* (species group W), *Rhus leptodictya*, *Dombeya rotundifolia*, *Pappea capensis*, *Combretum molle*, *Grewia occidentalis*, *Rhus pyroides* (species group X), *Celtis africana* and *Zanthoxylum capense* (species group BB). Light penetration is restricted by the dense forests canopy, limiting the herbaceous layer.

11 *Brachylaena rotundata* - *Englerophytum magalismontanum* High Open Shrubland

This small community is restricted to the moist narrow ravines on the plateau in the northwestern section of the study area. The soils is of the shallow Glenrosa form or exposed bedrock. This vegetation community is characterised by the presence of diagnostic species group Y, Z and AA. Based on aspect this vegetation community can be divided into two sub-communities:

11.1 *Pittosporum viridiflorum* - *Halleria lucida* Short Open Shrubland

This sub-community is associated with deep narrow ravines opening on the upper northern slopes. Diagnostic species for this sub-community are *Pittosporum viridiflorum*, *Ilex mitis*, *Halleria lucida*, *Rothmannia capensis*, *Myrsine africana*, *Cyperus albostratus*, *Secamone alpini* and *Scadoxus puniceus* (species group Z). This sub-community shows similarities with the *Mimusops-Englerophytum-Apodytes dimidiata* variation as identified by van Vuuren *et al.* (1970). This variation occurs high up in the ravines on the northern slopes where the influence of the cliffs is least (Vuuren *et al.* 1970). It also demonstrates similar characteristics in terms of species composition than the *Pittosporum viridiflorum* - *Halleria lucida* Short Open Shrubland.

11.2 *Ancylobotrys capensis* - *Tricalysia lanceolata* Short Open Shrubland

This sub-community occurs in the upper regions of a ravine on the western facing slopes on the plateau. The ravine is shallower in this region, and the influence of the cliffs on either side of the ravine are less pronounced. This sub-community shows an affinity with the *Croton - Ancylobotrys capensis* variation as identified by van Vuuren *et al.* (1970). Although not dominant in this sub-community, *Croton gratissimus* var. *subgratissimus* were recorded in this sub-community (species group B; Table 6). *Setaria lindenbergiana* is described by van Vuuren *et al.* (1970) as subdominant in this sub-community, which were also found in this classification (species group D; Table 6). Other species associated with this sub-community

are *Englerophytum magalismontanum* and *Brachylaena rotundata* (species group Y).

In this classification *Ancylobotrys capensis*, *Tricalysia lanceolata*, *Cymbopogon validus*, *Coleocloa setifera* and *Ochna holubi* (species group AA) are the diagnostic species for this sub-community. Other species present are *Maytenus undata* (species group W) and *Zanthoxylum capense* (species group BB).

12 *Cynodon dactylon* - *Panicum maximum* Tall Sparse Woodland

This community is situated on deep alluvial soils on pediments of the southeastern valleys in the study area. The *Cynodon dactylon* - *Panicum maximum* Tall Sparse Woodland community is associated with disturbed areas, old lands or areas previously over utilized by cattle. The community lies on relative flat areas with the gradient not exceeding 3°. Large rocks and boulders are absent. The texture of the soils varies from loam sand to sand loam (MacVicar *et al.* 1991)

Diagnostic species for this community are species group CC. This community is dominated by the grass *Cynodon dactylon* (cover-abundance values 50%), indicative of disturbed areas (van Oudtshoorn 1992). This grass is a valuable species as it protects the soil and provides palatable grazing (Gibbs-Russell *et al.* 1991).

Two sub-communities can be distinguished. One sub-community is found on the deep alluvial soils occurring on the lower foot slopes and the second is restricted to the alluvial soils of the valley. Sub-community 12.1 is associated with a slightly drier environment, whereas sub-community 12.2 occurs in the wetter areas in Langkloof and the southwestern facing slopes of the valley. The presence and absence of species groups can be attributed to different land use practises in the past. No specific soil analysis has been conducted in these relevés to establish possible differences.

12.1 *Tagetes minuta* - *Commelina africana* Sparse Open Woodland

This sub-community occurs on the dry east-facing foot slopes on alluvial soils. It is associated with disturbed areas such as cultivated lands.

The *Tagetes minuta* - *Commelina africana* Sparse Open Woodland is distinguished from the *Hyparrhenia hirta* - *Bidens pilosa* sub-community by the absence of species group DD. Dominant species in this sub-community are *Cynodon dactylon* and *Panicum maximum*. The woody layer is represented by single individual *Diospyros lycioides* (species group EE) and *Rhus leptodictya* trees (species group X; Table 6).

12.2 *Hyparrhenia hirta* - *Bidens pilosa* Short Sparse Woodland

This Short Sparse Woodland is strongly associated with the deep alluvial soils of the low lying areas in the southeastern range of valleys. The soil is fine-grained and has a sand clay texture (MacVicar *et al.* 1991).

This sub-community is recognised by the presence of diagnostic species group DD, consisting of almost homogenous stands of *Hyparrhenia hirta* (cover-abundance values 25% - 75%) and *Bidens pilosa*. The woody layer is inconspicuous and limited to scattered individuals of *Acacia karroo*.

13 *Pteridium aquilinum* - *Miscanthus junceus* Tall Closed Grassland

The unique reed marsh in the central basin of the reserve is included in the *Pteridium aquilinum* - *Miscanthus junceus* Tall Closed Grassland community. The community is situated on the deep (>1m), black clay soils of the Willowbrook and Kroonstad soil forms. Boulders are absent, but rocks occur frequently. This community occurs on a high water table and certain sub-communities are submerged. Species diversity is low and confined to species associated with moist conditions.



Table 8: Phytosociological table for the *Pteridium aquilinum*-*Miscanthus junceus* Tall Closed Grassland and *Aristida junciformis*-*Arundinella nepalensis* Tall Closed Grassland

Community	13					14								
Sub-community	13.1					13.2	13.3							
Variation	3	3	3	3	3	0	3	3	3	3	3	3	3	3
	8	8	8	8	8	5	7	7	8	6	7	7	7	7
Species	1	2	3	4	5	1	5	8	0	8	4	7	9	6

Species group A

Pteridium aquilinum

2	4	4	5	5	+	4	+
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Miscanthus junceus

2	2	+	4	4
---	---	---	---	---

Species group B

Phragmites australis

3	5	5	5	5
4	3	+	3	2
+	+	+	+	+

Cyperus species

Gunnera perpensa

Species group C

Persicaria attenuata

+	+	1	+
	+	+	+
	+	+	

Buddleja saligna

Conyza ulmifolia

Species group D

Aristida junciformis

		2	5	4	5	1
		1	+	+		
	+	+	+	+		

Stiburus etopecuroides

Berkheya speciosa

Species group E

Pycnostachys reticulata

+	+	+	+	+	1
+	+	+	+	+	
+	+	2	2		
+			5		
+	+		+	+	

Helichrysum setosum

Achyrocline stenoptera

Imperata cylindrica

Commelina species

Species group F

Arundinella nepalensis

+	+	+	1	+	1	+
	+	+	2	1	+	
+	1	+		+		

Nidorella auriculata

Vernonia hirsuta

Species group A (Table 8) is diagnostic for this community, containing the fern *Pteridium aquilinum* (cover-abundance values 50%) and the grass *Miscanthus junceus*. Three variations, based on their distant from the reedmarsh, can be distinguished in this community:

13.1 *Phragmites australis* - *Cyperus species* Reedswamp

The reedswamp occurs in the centre of the basin area. It is underlaid by deep (2m+) humic soils of the Willowbrook soil form, submerged in water. The community is dominated by an extensive reedmarsh consisting of *Phragmites australis* (cover-abundance values 50%-100%) (species group A) . Two other species, an unidentified *Cyperus*- species and *Gunnera perpensa*, and also species from species group A are the only species present in this sub-community (Table 8).

13.2 *Vernonia hirsuta* - *Pteridium aquilinum* Tall Closed Grassland

The *Phragmites australis* - *Cyperus species* Reedswamp is encircled by a dense stand of *Pteridium aquilinum* and the species from species group F. This sub-community occurs around the *Phragmites australis* - *Cyperus species* Reedswamp, and extends further along the Waterkloofspruit to include a marshy area adjacent to the potholes. It can be distinguished from the *Phragmites australis* - *Cyperus species* Reedswamp by the absence of species group B,C,E and D. Other plants occurring in this community are *Arundinella nepalensis* and *Nidorella auriculata* (species group F;Table 8).

13.3 *Pycnostachys reticulata* - *Buddleja salviifolia* Tall closed Shrub land

This sub-community is restricted to riverine levees next to streams in the southern section of the central basin. Deep, coarse-grained sandy soils of the Hutton form are found in this sub-community.

This riverine vegetation is distinguished from sub-community 13.1 and 13.2 by the

presence of species groups C, E and F. The vegetation is dominated by the grass *Miscanthus junceus*, the forbs *Arundinella nepalensis*, *Nidorella auriculata* (species group F), *Pycnostachys reticulata*, *Helichrysum setosum*, an unidentified *Commelina* species, (species group E), *Persicaria attenuata*, *Buddleja salviifolia* and *Conyza ulmifolia* (species group C).

14 *Aristida junciformis* - *Arundinella nepalensis* Tall Closed Grassland

The *Aristida junciformis* - *Arundinella nepalensis* Tall Closed Grassland is found in areas adjacent to the Waterkloofspruit. Coetzee (1975) described this community as being slightly elevated with a relative high water table. Certain parts of the sub-community is submerged in water. The texture of the soils varies from sand to sandloam and soil is deeper than one metre.

Species group D is diagnostic for the sub-community. It contains the grass *Aristida junciformis* (cover-abundance values 50%) and the forbs *Stiburus alopecuroides* and *Berkheya speciosa*. Other prominent species in the sub-community are *Arundinella nepalensis*, *Nidorella auriculata* (species group F), *Pycnostachys reticulata* and *Achyrocline stenoptera* (species group E).

IDENTIFICATION OF MANAGEMENT UNITS AS A BASIS FOR ASSESSING CHANGE

Variations in geology, soil and micro-climate result in a complex geographical arrangement of plant communities, on a scale that is usually impossible to use for management purposes. Plant communities are therefore the result of a unique combination of certain environmental conditions and represent a certain ecosystem (Bredenkamp & Theron 1976). These communities respond differently to similar environmental impacts and management practises (Bredenkamp & Theron 1976), i.e. grazing and burning. This requires the grouping of similar

ecological units into management units for the purpose of practical conservation management.

The Braun-Blanquet method of vegetation classification enables the managers to conduct a hierarchical classification of the vegetation. Floristic and environmentally related communities can be grouped together into practical management units. Various factors influence the scale at which management and monitoring programmes have to be implemented.

Grouping of ecologically related units has taken place at various levels and a single descriptive definition for a management unit is difficult to formulate:

- MacVicar *et al.* (1974) defined a land type as
 - “ an area where the microclimate, terrain form and soil pattern each show a clear degree of uniformity. This degree of uniformity is of such nature that there would be little advantage to define smaller, more uniform landscapes on a country-wide basis. One land type differs from the other in one or more of the characteristics mentioned
- Coetzee (1983) described a landscape as
 - “ ...an area with recurrent patterns of plant communities with their associated fauna and abiotic habitat”
- Gertenbach (1983) redefined a landscape as
 - “...an area with a specific geomorphology, microclimate, soil and vegetation and associated fauna
- Ludick (1987) defined a Reasonable Homogenous Farming Unit as
 - “ a demarcated area on a map with specific patterns of soil suitability classes. The climatic factors within each soil suitability class will not vary sufficiently to substantially influence production practises and agriculture potential within each land unit
- Edwards (1988) in Tainton (1988) named such a uniform area an agro-ecological unit and defined it as
 - “... an area in which the climate, landscape, soil and

vegetation are homogenous to the extent that the adaptability and response of any particular plant species would not change markedly from place to place within the unit

- Wildlife Management Course (Transvaal Nature Conservation)
“...an area in which the different components will respond similarly to a specific set of treatments. The distribution and composition of plant species in the unit will ensure even utilization throughout the unit”

Successful management of natural vegetation depends on knowledge of the composition of the vegetation, the extent that it is being utilized and the rates and direction of changes that may take place in response to management practises such as herbivory and fire (Walker 1976). Such knowledge can only be obtained through a reliable and efficient programme to monitor whether the management practices in place do have the desired effect on the attainment of specific goals for conservation areas. Classification and mapping of landscape features and habitats are an essential first step in ecological monitoring, as it helps in the delineation of the ecosystem that will serve as a basis for data collection and analysis (Grimsdell 1978).

The floristic variation within savannas at a regional or local level is strongly influenced by topography and substrate (O'Connor 1992). On Rustenburg Nature Reserve this resulted in 51 different vegetation units and sub-units. Assessing change in vegetation at this scale will be impractical, ineffective and costly. It will be necessary to identify management units reflecting the major physiographic and physiognomic variations on the reserve to be used as a basis for monitoring. The associations of the different plant communities formed the basis for the delineation of homogenous physiognomic-physiographic units. Excessive variation in habitat data in these management units will complicate the interpretation of vegetation responses, as differences in environmental characteristics can also induce certain species responses.

Ordination

From the final phytosociological tables a synoptic table, representing constancy values for the different species in each vegetation community, was compiled. The synoptic table illustrate the association of the different vegetation communities with each other. The synoptic table was used in an ordination to identify the relation between the physical environment and the vegetation. The distribution of the different vegetation units is illustrated along the axes of a scatter diagram of the synoptic data set (Figure 22).

This diagram revealed an apparent discontinuity among these vegetation types. A distinct moisture gradient is evident along the first axis of the ordination. Communities associated with the drier environments on the plateau, hill slopes and the open areas of the central basin are situated to the left of the diagram, and the vegetation communities associated with the wet habitats along the vleis and water streams are positioned to the right of the diagram.

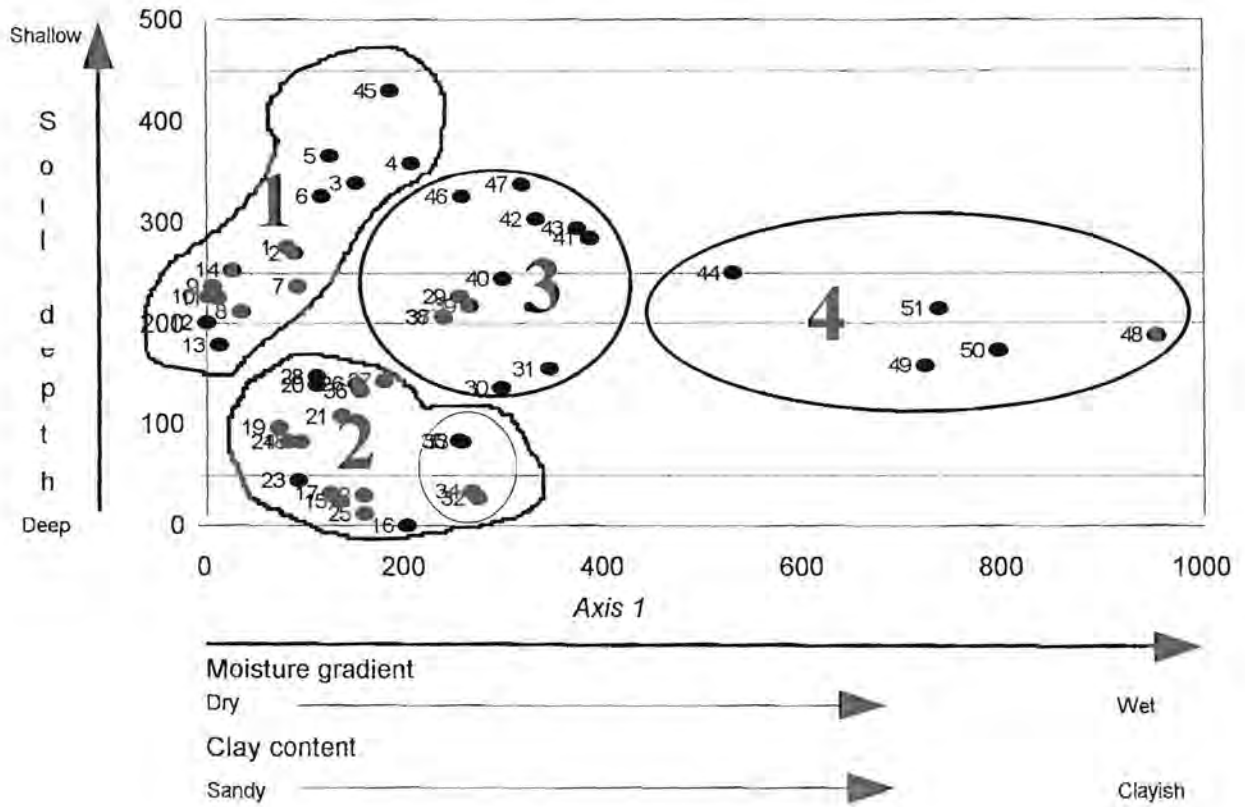


Figure 22: The positions of the different vegetation communities and sub-communities along the two axis of a DECORANA - ordination

A moderate gradient in soil depth exists along the second axes of the scatter diagram (Figure 22). Communities associated with exposed quartzite sheets and shallow Mispah and Glenrosa soils occurring on the plateau and upper hill slopes are situated to the top left of the diagram and communities occurring on the medium-deep to deep Hutton soils in the central basin and small secluded pockets in the valleys are distributed to the bottom left of the diagram. A weak gradient in clay content is illustrated along the first axes. Clayish soils and associated communities, mainly confined to the alluvial soils in the valleys are situated to the right of the diagram, while communities associated with sandy soils are situated to the left of the diagram. Deep Hutton soils with moderate clay content (15% - 25%) are positioned in the centre of the diagram.

Management Units

The broken topography and associated diversity of habitats and environmental conditions resulted in the differentiation of 51 vegetation communities, sub-communities and variations on the reserve. Four management units were identified by using a DECORANA-ordination (Hill 1979a) (Figure 22), illustrating the principal differences of the habitats on the reserve.

The four management units distinguished in the synoptic table (Table 9) differ due to distinct differences in soil depth, percentage clay and moisture content (Figure 22).

- I. *Selaginella dregei* - *Oldenlandia herbacea* Open Shrubland
- II. *Becium obovatum* - *Elionurus muticus* Tall Grassland
- III. *Ziziphus mucronata* - *Rhus leptodictya* Closed Woodland
- IV. *Pteridium aquilinum* - *Miscanthus junceus* Moist Grassland

Management unit I:

***Selaginella dregei* - *Oldenlandia herbacea* Open Shrubland**

The *Selaginella dregei* - *Oldenlandia herbacea* Open Shrubland management unit comprise of the *Englerophytum magalismsontanum* - *Ancylobotrys capensis* Tall Open Shrubland, the *Eragrostis nindensis* - *Cyperus rupestris* Short Open Grassland and the *Bulbostylis burchellii* - *Themeda triandra* Short Open Grassland (Table 9). Species group D, consisting of the pioneer *Selaginella dregei* and the forbs *Oldenlandia herbacea*, *Coleocloa setifera*, the grass species *Cymbopogon validus*, and the shrub *Rhus magalismsontanum* is diagnostic of this management unit. Species groups H, P, T and Z containing the grass species *Schizachyrium sanguineum*, *Melinis nerviglumis*, *Themeda triandra* and *Diheteropogon amplexans*, the forbs *Anthospermum rigidum*, *Pellaea calomelanos*, *Senecio venosus* and *Commelina africana* are also conspicuous in this management unit. The tree and shrub layer are confined to individual specimens of *Englerophytum magalismsontanum* (species group D), *Zanthoxylum capense*, *Ancylobotrys capensis* and *Tapiphyllum parvifolium* (species group A).

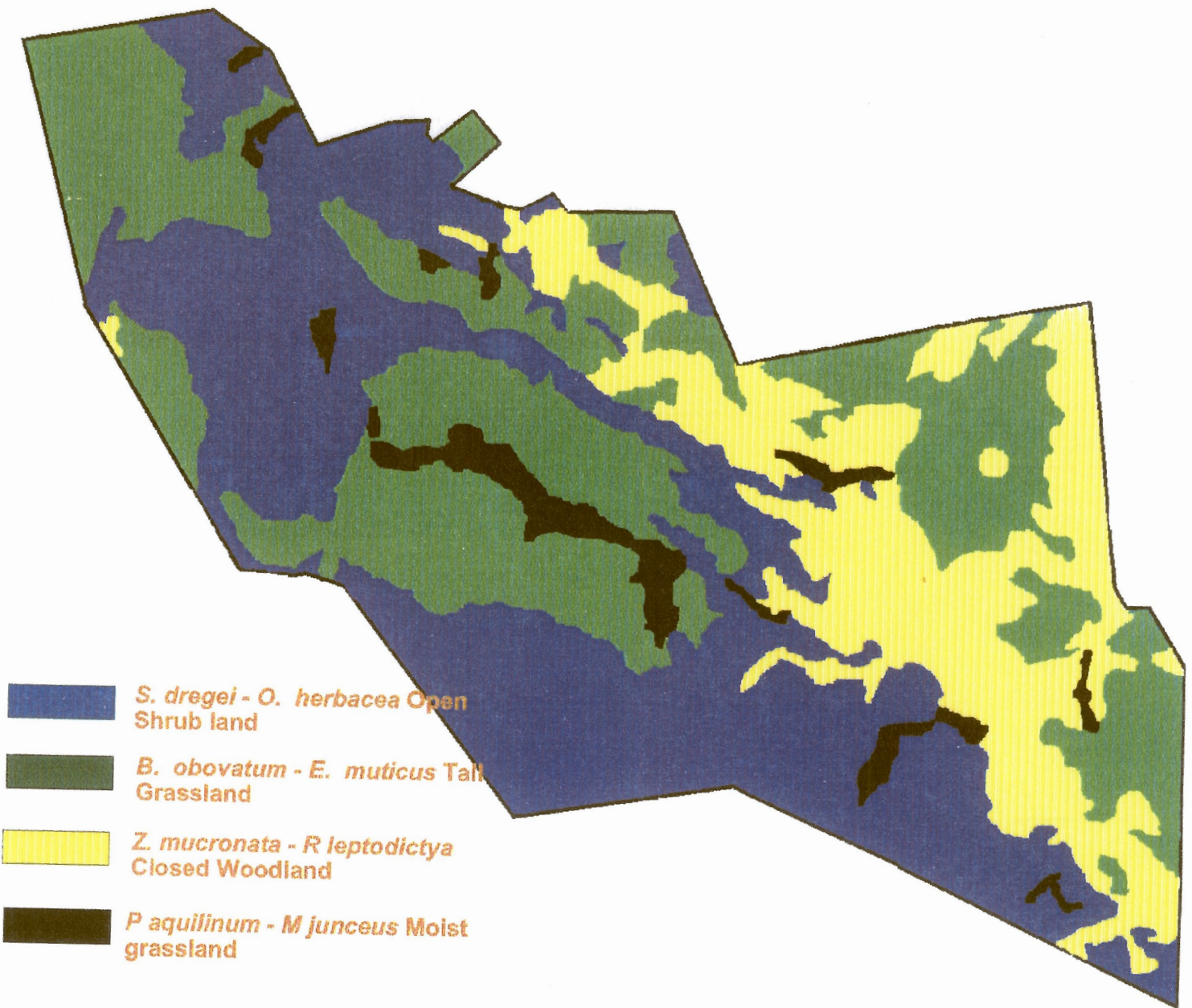


Figure 23: Vegetation map of Rustenburg Nature Reserve illustrating four management units

Table 9 : Synoptic table of the vegetation on Rustenburg Nature Reserve

Species	MANAGEMENT UNIT 1				MANAGEMENT UNIT 2				MANAGEMENT UNIT 3				MANAGEMENT UNIT 4			
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<p>MANAGEMENT UNIT 1: Seligella dregei - Ombinania herbacea Open Shrubland</p> <p>Species group A</p> <p>Zieritium capense Anycobryum capense Tappetyum parvifolium Commelina erecta Crasula species Nuxia congesta Asparagus krebbsianus Calaie puchella Cenchrus piliferus Anthospermum hepaticum Cyperus sphaerocarpus Ochna pukeia Plectranthus madagascariensis Ficus ingens</p>																
<p>Species group B</p> <p>Cyperus rupestris Eragrostis ruscoides Xerophyllum viscosum Microchloa caflra</p>																
<p>Species group C</p> <p>Klaudia acutepala Laportea andersonii Eragrostis albiglra Ledebouria revoluta Euphorbia clevelandensis Fitzingia pukeia Anacampses subvelatum Helichysum cerasoides Bracharia nigropedata</p>																
<p>Species group D</p> <p>Seligella dregei Ombinania herbacea Cochlosia setifera Cymbopogon veldii Rhus magnamontanum Euphorbia revoluta Euphorbia schimperii Aloe peglerae Aster ellipticus Indigofera melitoides Kalanchoe thyrsiflora</p>																
<p>Species group E</p> <p>Pennisetum aristatum Vernonia subcylindrica</p>																
<p>Species group F</p> <p>Pygmaea thymoides Raphanoclinon hirsutum Trientalis reticulata Diplazium laevigatum Panicum echinatum Sida bartholomaei Cytisus oblongifolius</p>																
<p>Species group G</p> <p>Dicoma anomala Raphanoclinon burkei Panicum capensis Dichapetalum cymosum Thesium cymoides</p>																
<p>Species group H</p> <p>Anthospermum rigidum Aster angulatus Abaca setosa Luzula striplax Cyanus speciosa Thesium transvaalense Indigofera comosa</p>																
<p>Species group I</p> <p>Indigofera hedyntha Helichysum concavum Nolite rariflora Cypripedium oblongifolium Senecio erubescens Rhyssoloma monophyllum Bubostylis antephe</p>																
<p>Species group J</p> <p>Rubia petiolata Gentiana pilosellulata Conyza egyptica Hyperthymus bipinnatus var. pilosa</p>																
<p>Species group K</p> <p>Acalypha angustifolia Crabbea hirsuta Ledebouria marginata Rhyssoloma nervosa Felicla muricata Burkea africana</p>																
<p>MANAGEMENT UNIT 2: Beemum obovatum - Eleonurus muricosa Tall Grassland</p> <p>Species group L</p> <p>Beemum obovatum Eilonurus muricosa Vernonia galeata Pennisetum angustifolium Kohoula emalymbica Urelytrum angustifolium Aloe greatheadii Ipomoea omanensis Protea caflra Ruellia patula Sida nervosa</p>																
<p>Species group M</p> <p>Eragrostis racemosa Muhra calliflora Nidorella kollentiaica Panicum natalense</p>																
<p>Species group N</p> <p>Trinilachys bismalensis Trachypogon spicatus</p>																
<p>Species group O</p> <p>Eustachys paspalioides Ipomoea bathylobos var. bathylobos Asparagus laticarpus Clematis oweniana Thunbergia alpicollis Setaria nigropunctata Turberia oblongata Cuscuta panicoides Nidorella reedii</p>																
<p>Species group P</p> <p>Schizanthus sanguineum Andropogon schrenkii Tephrosia elongata Pellaea calomeles Melinis nervipennis Oralis oblongifolia</p>																
<p>Species group Q</p> <p>Chaetacharitus setiger Altrixia elata Blumea alata Conyza abida Cymbopogon excelsus Diplazium dipterocarpum Helichysum nudifolium Indigofera burkeana Vernonia natalensis Hypoxis rigida Helichysum setifolium</p>																
<p>Species group R</p> <p>Setaria sphaerocarpa Heteropogon confertus Elephantorrhiza elephantiina Ledebouria species Eragrostis curvula Asparagus suavelens Rhyssoloma folia Lippia javanica Vernonia oligophylla</p>																
<p>Species group S</p> <p>Solanum panicoides Teucrium tridatum Hyperthymus latis Asida poiretii</p>																
<p>Species group T</p> <p>Themelia triandra Veronica infusata Senecio venosus Heteropogon amplicaudus Bracharia serrata Chamaecrista minuscula Setaria lindenbergiana Combrum zeyheri Sphenodytes angustifolia Faurea salsigne</p>																
<p>Species group U</p> <p>Solanum maurianum Setaria megaphylla Maytenus polycantha Asparagus cooperi</p>																
<p>Species group V</p> <p>Acacia caflra Meyenhus heterophylla Rhus lancea Rhus ripida Larrea discober Larrea rugosa</p>																
<p>Species group W</p> <p>Cela africana Grewia occidentalis Panicum maximum Aloe transvaalensis Berchemia zeyheri Cynodon dactylon Diospyros whyteana</p>																
<p>MANAGEMENT UNIT 3: Zephys mucronata - Rhus leptodictya Closed Woodland</p> <p>Species group X</p> <p>Dombeya rotundifolia Euclea crispata Pappus capensis Achyrocline aspera Hypochoeris forskualli</p>																
<p>Species group Y</p> <p>Zephys mucronata Rhus leptodictya Tagetes minuta Diospyros lycoides Melissa repens Hemaranthe depressa Rhus pyricoides Sida dregei Acacia karoo</p>																
<p>Species group Z</p> <p>Commelina africana Combrum mole</p>																
<p>MANAGEMENT UNIT 4: Pteridium equinum - Miscanthus junceus Moist Grassland</p> <p>Species group AA</p> <p>Pteridium equinum Miscanthus junceus Panicum alternatum Nidorella auriculata Buddleja saligna Arundinella repens Pycnostachya reticulata Gunnera perpense Commelina species</p>																

The *Selaginella dregei* - *Oldenlandia herbacea* Open Shrubland occurs on shallow Mispah soils and exposed quartzite sheets on the high lying areas of the reserve. Soils are shallow litholitic, confined to Mispah and Glenrosa soil forms. A lithosol-rock complex of sheetlike to broken quartzite occurs on the steep upper slopes (Coetzee 1975) in this management unit. The areas of exposed rock and shallow Mispah soils are mainly limited to the crest of the Magaliesberg, although a mosaic of these exposed areas is interspersed among the deeper soils on the middle and foot slopes. The deeper Glenrosa soils are found further down the slope where an accumulation of eroded material occur. Characteristic of the soils of the Mispah form on the reserve is the high content of decomposed organic matter (Coetzee 1975), the result of a high occurrence of pioneer plant roots in the top layer (% carbon > 3.04%).

Management Unit II:

***Becium obovatum* - *Elionurus muticus* Tall Grassland**

The *Becium obovatum* - *Elionurus muticus* Tall Grassland consist of the *Tristachya biseriata* - *Protea caffra* Short Sparse Woodland, the *Protea gaugedi* - *Monocymbium ceresiiforme* Short Open Shrub land, *Indigofera comosa* - *Schizachyrium sanguineum* Tall Closed Grassland, *Plexipus hederaceus* - *Cymbopogon excavatus* Tall Closed Grassland, the *Tristachya leucotrix* - *Setaria sphacelata* Tall Sparse Woodland and the *Becium obovatum* - *Protea caffra* Tall Closed Woodland sub-community of the *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland community (Table 9).

The *Becium obovatum* - *Elionurus muticus* Tall Grassland represents the vegetation associated with the medium deep Glenrosa to deep Hutton soils on the foot slopes and in the central basin area of the reserve. This management unit is spread over the study area on the slopes of the valley between the summit and the eastern range of quartzite ridges running through the reserve and the deeper soils on the slopes surrounding the central basin area and the central basin area. The soil texture are sandloam to sandclayloam (Soil Classification Working Group

1991), consisting of coarse to finely-grained sand. This management unit is situated on fairly mild gradients (3° - 6°), except for one community situated on a gradient of 3° - 30°. Conspicuous species in this management unit are the forbs *Becium obovatum*, *Pentharidium angustifolia*, *Vernonia galpinii*, *Kohoutia amatymbica* (species group L), *Pellaea calomelanos*, *Oxalis oblongifolia* (species group P), *Senecio venosus*, *Chamaecrista mimosoides* (species group T) and *Commelina africana* (species group Z). *Elionurus muticus* (species group L), *Schizachyrium sanguineum* (species group P), *Eragrostis racemosa* (species group M), *Melinis nerviglumis*, *Trachypogon spicatus* (species group N), *Themeda triandra*, *Loudetia simplex* (species group H), *Brachiaria serrata* (species group T) represent the dominant grass species in this management unit. The tree layer is relatively inconspicuous and confined to open stands of *Protea caffra* (species group L), *Ziziphus mucronata*, *Rhus leptodictya*, *Dombeya rotundifolia* (species group Y), *Acacia caffra* (species group V) and *Faurea saligna* (species group T).

The *Turbina oblongata* - *Phyllanthus glaucophyllus* High Closed Shrub land, the *Diospyros lycioides* - *Rhus rigida* Tall Closed Woodland and the *Hypericum aethopicum* - *Acacia karroo* variations of the *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland community are regarded as a transitional group between the *Becium obovatum* - *Elionurus muticus* Tall Grassland and the *Ziziphus mucronata* - *Rhus leptodictya* Closed Woodland management unit. This group contains a variety of species conspicuous to both management units. Species from species groups R and T (Table 9) dominate the vegetation composition in this group, which are well represented in both management units.

Management Unit III:

***Ziziphus mucronata* - *Rhus leptodictya* Closed Woodland**

The *Ziziphus mucronata* - *Rhus leptodictya* Closed Woodland consists of the woodland and forest communities in the reserve. This management unit contains the *Heteropogon contortus* - *Faurea saligna* Tall Open Woodland, *Senecio venosus* - *Heteropogon contortus* Tall Closed Woodland, *Setaria sphacelata* - *Themeda triandra* Tall Closed Woodland, *Euclea crispa* - *Panicum maximum* Tall

Closed Woodland, the *Asparagus virgata* - *Celtis africana* and *Olea europaea* - *Grewia occidentalis* Tall Closed Woodland sub-communities of the *Acacia caffra* - *Ziziphus mucronata* Tall Closed Woodland community, the *Mimusops zeyheri* - *Hypoestes forskaoli* Tall Forest and *Cynodon dactylon* - *Panicum maximum* Tall Sparse Woodland communities (Table 9) .

The *Ziziphus mucronata* - *Rhus leptodictya* Closed Woodland is found on the low-lying slopes and low-lying areas of the eastern valleys in the study area. The soil has a coarse-grained texture and large rocks and boulders occur frequently throughout this management unit. The soils varies from medium-deep Glenrosa soil forms on the slopes to deep alluvial soils on the pediments of the valleys. The slopes vary from gentle to relative-steep with gradients of up to 37°.

The tree and shrub layer are very prominent and are characterises by the trees and shrubs *Ziziphus mucronata*, *Rhus leptodictya*, *Diospyros lycioides*, *Rhus pyroides* (Species group Y), *Pappea capensis*, *Euclea crispa*, *Dombeya rotundifolia*, (species group X), *Celtis africana*, *Grewia occidentalis* (species group W), *Acacia caffra*, *Maytenus heterophylla*, *Rhus lancea*, *Rhus rigida*, *Lannea discolor*, *Lantana rugosa* (species group V), *Combretum zeyheri* (species group T) and *Combretum molle* (species group Z). Dominant grass species in this management unit are *Melinis repens* (species group Y), *Panicum maximum* (species group W), *Setaria sphacelata*, *Heteropogon contortus* (Species group R), *Themeda triandra*, *Brachiaria serrata* and *Setaria lindenbergiana* (species group Y). Noticeable forbs include *Tagetes minuta* (Species group Y), *Hypoestes forskaoli* (species group X) and *Commelina africana* (species group Z).

Disturbed areas, orchards and old lands are also included in this management unit.

Management Unit IV:

***Pteridium aquilinum* - *Miscanthus junceus* Moist Grassland**

The *Pteridium aquilinum* - *Miscanthus junceus* Moist Grassland management unit

represents the moist habitats on the reserve, consisting of the *Pteridium aquilinum* - *Miscanthus junceus* Tall Closed Grassland, including the *Phragmites mauritanus* - *Cyperus* species Reedswamp, the *Vernonia hirsuta* - *Pteridium aquilinum* Tall Closed Grassland and *Pycnostachys reticulata* - *Buddleja salviifolia* Tall closed Shrub land, and the *Aristida junciformis* - *Arundinella nepalensis* Tall Closed Grassland communities.

The soils in this management unit vary from deep, black clay soils of the Willowbrook and Kroonstad soil forms underlying the reed swamp to deep Hutton soils adjacent to the streams in the southern section of the central basin. This management unit occurs on a high water table and certain communities in this management unit are submerged.

Species diversity is low and confined to species associated with moist conditions. Species group AA contains the dominant species occurring in this management unit. Conspicuous species are *Pteridium aquilinum*, *Miscanthus junceus*, *Panicum attenuatum*, *Nidorella auriculata*, *Buddleja salviifolia*, *Arundinella nepalensis* and *Pycnostachys reticulata*. The unique reedswamp in this management unit consists of a homogenous stand of *Phragmites mauritanus* (Table 9).