CHAPTER 6
HERBACEOUS SPECIES COMPOSITION AND VELD CONDITION ASSESSMENT

INTRODUCTION

Possible methods for use in determining the species composition of the herbaceous layer are the Levy bridge method (Levy and Madden 1933, *In*: Walker 1970), the line intercept method (Canfield 1941, *In*: Floyd and Anderson 1987), the loop method (Parker 1951, *In*: Johnston 1957), the wheel-point method (Tidmarsh and Havenga 1955), the variable plot method (Hyder and Sneva 1960, *In*: Walker 1970), the descending point method (Roux 1963, *In*: Vorster 1982), the dry-weight rank method ('t Mannetjie and Haydock 1963), the belt transect method (Mueller-Dombois and Ellenberg 1974), the comparative yield method (Haydock and Shaw 1975), the step-point method (Mentis 1981); the metric belt transect method (Everson and Clarke 1987), the line transect method (Snyman 1989), a combination of the dry-weight rank method and the comparative method (Snyman, Grossman and Rethman 1990; Schmidt 1992), and near infrared reflectance spectroscopy (García-Criado, García-Criado and Perez-Corona 1991). However, estimates of species composition are most commonly determined with the wheel-point apparatus (Tidmarsh and Havenga 1955) or modifications thereof (Mentis 1981). The step-point method (Mentis 1981) has also been used extensively in savanna vegetation (Du Plessis 1992; Orban 1995; Swart 1995). A sample size of 200 points is commonly used (Hardy and Walker 1991). The step-point and wheel-point methods are commonly used in conjunction with the nearest-plant method (Mentis, Collinson and Wright 1980; Everson and Clarke 1987; Everson, Clarke and Everson 1990; Snyman *et al.* 1990; Hardy and Walker 1991). However, criticism has been levelled at the nearest-plant method (Snyman *et al.* 1990). Moreover, Snyman *et al.* (1990) regard the technique as unsuitable for use in arid areas where annual species dominate and the ecological status of grass species varies from year to year.

The various techniques used for determining species composition have been evaluated by various authors (Johnston 1957; Walker 1970; Becker and Crockett 1973; Mentis 1981; Barnes, Odendaal and Beukes 1982; Gillen and Smith 1986; Everson and Clarke 1987; Floyd and Anderson 1987; Friedel and Shaw 1987; Novellie and Strydom 1987; Everson *et al.* 1990; García-Criado *et al.* 1991) and the general consensus is that not one technique alone is completely accurate. Each author recommends a different technique and this is of course dependent on the conditions that prevailed when the methods were tested. It seems as if their

suggestions are best followed to obtain an idea of the best method for the conditions under which the survey will be carried out. Considerations include the type of grass, the cover, the terrain, the researcher's objectives, expertise and enthusiasm and the finances available.

Veld condition is defined by Trollope, Trollope, and Bosch (1990) as the condition of the vegetation in relation to some or other functional characteristic, usually maximum forage production and resistance to soil erosion. The veld is thus described in terms of its state of health (Tainton 1981). Stuart-Hill (1989b) gives three reasons for conducting veld condition assessments. The first is to determine the species composition of the veld. The second is to establish a reference point for predictions of grazing capacity or runoff from a particular piece of veld. The third is to monitor vegetation change to determine the effect of management practices on the veld. Once the species composition and condition of a piece of veld is known then objectives can be defined on the basis of its potential for forage production and resistance to soil erosion. The wildlife manager then has a scientific basis upon which to base his management decisions. By monitoring the veld condition over a certain period the researcher or manager can obtain information on the effect of rainfall, fire and grazing on that particular veld (Tainton 1981). Trends observed will then indicate to the manager whether his past and current management practices have had any success or whether modifications should be brought about.

The objectives of the veld condition assessment are to:

- Determine the proportional species composition of the herbaceous layer.
- Determine a grazing gradient.
- Attempt an objective allocation of grass species to ecological categories.
- Assess the condition of the veld using two different methods.
- Compare the results of the two methods and select the simplest yet most reliable method to be used during monitoring.
- Attempt an explanation of the ecological factors contributing to the current veld condition.
- Use these data to determine the grazing capacity of an area.

METHODS

SPECIES COMPOSITION OF THE HERBACEOUS LAYER

An adaptation of the wheel-point method (Tidmarsh and Havenga 1955) and the step-point method (Mentis 1981) was used to determine the species composition

of the herbaceous layer. The adaptation consisted of a thin rod and the technique is therefore called the rod method (Du Plessis 1992). Du Plessis (1992) tentatively suggested that the rod method might give more accurate results than either the step-point or wheel-point method. The rod method was used in a survey consisting of line transects placed in a north-south direction commencing from each point used for the Braun-Blanquet survey. Because of the difficult terrain no herbaceous surveys were conducted on koppies. At each site 200 point observations were made at 2 m intervals that were stepped out in four parallel line transects of 100 m in length. The plots were placed in such a way that sub-habitats both under and in-between trees were included (Snyman 1989). The nearest plant to the point was recorded according to the nearest plant method (Snyman *et al.* 1990). The maximum radius to the nearest plant was determined during a survey of 2 000 point observations placed in a stratified manner in each of the homogeneous plant communities (Snyman *et al.* 1990). A maximum radius of 150 mm was used and was taken as the distance in which plant species were present in 90 percent of the observations. Only plants rooted within this maximum radius were recorded. Grass plants were identified to species level and all other herbaceous plants were recorded as forbs. The grass canopy cover was estimated visually by using the Braun-Blanqet cover-abundance scale (Chapter 5).

VELD CONDITION

The condition of the herbaceous component of the vegetation was assessed using the method of Vorster (1982). However, because this original method has been criticised for its subjective allocation of grasses to ecological status groups, a more objective method of determining ecological status was applied. Van Rooyen, Bredenkamp and Theron (1991) and Cauldwell, Zieger, Bredenkamp and Bothma (1999) have both used this latter method.

Identification of a degradation gradient

The methods of Bosch and Janse Van Rensburg (1987), Bosch, Janse Van Rensburg and Truter (1987), Bosch (1989), Janse Van Rensburg and Bosch (1990), Bosch and Gauch (1991), Van Rooyen *et al.* (1991), Bosch and Kellner (1991), and Cauldwell *et al.* (1999) were used to identify a grazing gradient. Only the Braun-Blanquet data (Chapter 5) for the grass species were used for the identification of the degradation gradient (Cauldwell *et al.* 1999). A separate survey was conducted in areas that represented varying degrees of degradation, for example near water points, protected areas and grazing areas. The data were subjected to a DECORANA ordination (Hill 1975a). The axis representing a grazing gradient was identified after refinement by the ordinated positions of the

stands that were surveyed at increasing distances from watering points, next to fenced areas, at points of animal concentration and at protected areas.

Classification of plant species into ecological categories

Species frequency curves were fitted to the degradation gradient by means of a polynomial regression technique to identify decreaser and increaser species (Van Rooyen *et al.* 1991; Cauldwell *et al.* 1999). These were then compared with the theoretical curves from Figure 87 for each of the ecological status groups (Van Rooyen *et al.* 1991). The herbaceous species were categorised into one of the following categories according to their response to grazing intensity (Vorster 1982):

- Decreasers : Species decreasing when the veld is over-utilised but that dominate in good veld.
- Increasers 1 : Species rare in good veld but increasing when the veld is underutilised.
- Increasers 2 a : Grass species rare in good veld but increasing when the veld is moderately overutilised.
- Increasers 2 b : Species rare in good veld but increasing when the veld is heavily overutilised.
- Increasers 2 c : Species rare in good veld but increasing when the veld is excessively overutilised.

Veld condition assessment

Relative index values are assigned to each ecological status category, to reflect various stages of degradation, and the value of an ecological class as a grazing resource (Barnes, Rethman and Kotze 1984). The following relative index values are widely used in southern Africa (Van Rooyen *et al.* 1996), and were used here too: Decreasers: 10; Increasers 1: 7; Increasers 2a: 5; Increasers 2b: 4; Increasers 2c: 1.

The mean percentage frequency of grass species of each ecological class were calculated for each management unit, and were then multiplied by the appropriate relative index values. The total score then represents the veld condition index (Foran, Tainton and Booysen 1978; Vorster 1982). The veld condition possesses a maximum theoretical value of 1000 and a minimum theoretical value of 100. The veld condition index score obtained is then divided by 10 to render a veld condition score on a scale from 10 to 100.

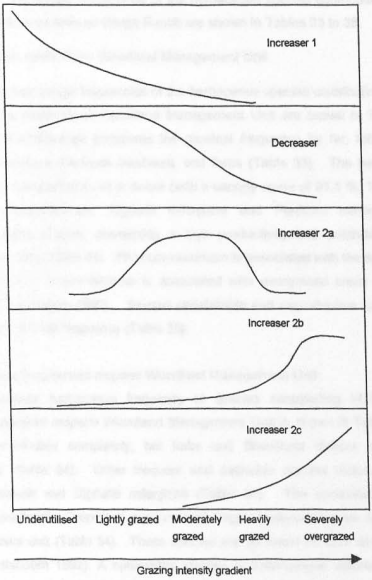

Figure 87. Schematic representation of the five general ecological status classes as defined along a grazing intensity gradient (Van Rooyen *et al.* 1991).

RESULTS AND DISCUSSION

GRASS SPECIES COMPOSITION

The relative percentage frequencies of the herbaceous species contributing >0.5% to the management units on Sango Ranch are shown in Tables 33 to 38.

1. The *Acacia tortilis* Open Woodland Management Unit

The relative percentage frequencies of the herbaceous species contributing >0.5% to the *Acacia tortilis* Open Woodland Management Unit are shown in Table 33. *Urochloa mosambicensis* possesses the greatest frequency by far, followed by *Digitaria milanjiana, Panicum maximum,* and forbs (Table 33). The herbaceous layer in this management unit is dense (with a canopy cover of 91.1 %, Table 33). *Urochloa mosambicensis, Digitaria milanjiana* and *Panicum maximum* are desirable grass species, possessing a high productivity and palatability (Van Oudtshoorn 1992, Table 39). *Panicum maximum* is associated with the subcanopy habitat, while *U. mosambicensis* is associated with overgrazed areas on fertile soils (Van Oudtshoorn 1992). Several unpalatable and unproductive species are present, but at a low frequency (Table 33).

2. The *Colophospermum mopane* Woodland Management Unit

The percentage herbaceous frequency of species contributing >0.5% to the *Colophospermum mopane* Woodland Management Unit is shown in Table 34. No species dominates completely, but forbs and *Brachiaria deflexa* occur most frequently (Table 34). Other frequent and desirable species include *Urochloa mosambicensis* and *Digitaria milanjiana* (Table 34). The undesirable annuals *Aristida junciformis, Oropetium capense* and *Tragus berterorianus* are found in this management unit (Table 34). These species are all found on bare denuded soils (Van Oudtshoorn 1992). A noteworthy species is *Enteropogon macrostachys.* It grows on sandy soils in the shade of trees (Van Oudtshoorn 1992). *Sporobolus nitens* indicates the presence of saline-sodic soils where it occurs (Van Oudtshoorn 1992). The canopy cover is high at 93.8 % (Table 34).

3. *Combretum apiculatum* Woodland Management Unit

The percentage frequencies of the herbaceous species of the *Combretum apiculatum* Woodland Management unit are shown in Table 35. Forbs are most frequent in this management unit, followed by *Urochloa mosambicensis, Digitaria milanjiana,*

Table 33. The species composition of the herbaceous layer as a relative percentage frequency in the *Acacia tortilis* Open Woodland Management Unit. Canopy cover 91.1 %.

SPECIES	*RELATIVE PERCENTAGE FREQUENCY*
Urochloa mosambicensis	63.4
Digitaria milanjiana	16.1
Panicum maximum	7.7
Forbs	6.4
Sporobolus nitens	1.9
Eragrostis rigidior	1.6
Chloris virgata	0.9
Dactyloctenium giganteum	0.8
Eragrostis curvula	0.6
Tragus berterorianus	0.6

Table 34. The species composition of the herbaceous layer as a relative percentage frequency in the *Colophospermum mopane* Woodland Management Unit. Canopy cover is 92.1 %.

SPECIES	*RELATIVE PERCENTAGE FREQUENCY*
Forbs	25.2
Brachiaria deflexa	18.2
Urochloa mosambicensis	12.6
Aristida junciformis	9.7
Oropetium capense	9.6
Digitaria milanjiana	8.2
Tragus berterorianus	5.6
Eragrostis rigidior	3.8
Sporobolus nitens	1.6
Panicum maximum	1.4
Chloris virgata	1.2
Panicum coloratum	0.7
Enteropogon macrostachys	0.6

Brachiaria deflexa and *Panicum maximum.* Several other palatable and productive species occur here, namely *Setaria pumila* and *S. sagittifolia* (Van Oudtshoorn 1992). On the other hand, several unproductive species are also present, namely *Eragrostis rigidior, Heteropogon contortus, Aristida junciformis, Pogonarthria squarrosa, Oropetium capense, Tricholaena monachne* and *Tragus berterorianus.* Many of these unproductive species have a preference for sandy or stony soils (Van Oudtshoorn 1992). The grass layer is dense, with a canopy cover of 95.6 %.

4. *Acacia tortilis* Closed Woodland Management Unit

The percentage frequencies of the herbaceous species of the *Acacia tortilis* Closed Woodland Management Unit are presented in Table 36. The very productive and palatable *Panicum maximum* is most frequent in this community. Forbs are also very frequent, followed by *Urochloa mosambicensis* and *Dactyloctenium giganteum.* Very few unproductive grass species are found in this very rank herbaceous layer (the canopy cover is 96.8 %).

5. The *Diospyros mespiliformes* Riverine Management Unit

Table 37 shows the percentage frequencies of the herbaceous species of the *Diospyros mespiliformes* Riverine Management Unit. *Panicum maximum* is most frequent in this closed canopy management unit. *Eriochloa meyeriana* and forbs are also frequent, with the productive species *Setaria sagittifolia* growing in the shade. Because of the closed woody layer canopy (Chapter 5), the herbaceous canopy cover is a low 68 %.

7. The *Echinochloa colona* Wetland Management Unit

Table 38 shows the percentage frequencies of the herbaceous species of the *Echinochloa colona* Wetland Management Unit. The tall herbaceous layer is dominated by *Echinochloa colona,* with a canopy cover of 80.5 %. Apart from the few forbs present, the grasses are all palatable and productive (Van Oudtshoorn 1992).

DEGRADATION GRADIENT

A scatter diagram showing a general degradation gradient for Sango Ranch based on the DECORANA ordination is shown in Figure 88. A degradation gradient is evident on the first axis. The gradient was divided into four equal sections, which roughly correspond to the utilisation levels found on Sango Ranch. It is clear that

Table 35. The species composition of the herbaceous layer as a relative percentage frequency in the *Combretum apiculatum* Woodland Management Unit. Canopy cover is 95.6 %.

SPECIES	*RELATIVE PERCENTAGE FREQUENCY*
Forbs	28.1
Digitaria milanjiana	17.9
Urochloa mosambicensis	16.3
Brachiaria deflexa	14.8
Panicum maximum	10.3
Setaria pumila	2.9
Eragrostis cylindriflora	1.1
Eragrostis rigidior	1.1
Tricholaena monachne	0.8
Aristida junciformis	0.7
Setaria sagittifolia	0.7
Heteropogon contortus	0.6
Oropetium capense	0.1

Table 36. The species composition of the herbaceous layer as a relative percentage frequency in the *Acacia tortilis* Closed Woodland Management Unit. Canopy cover is 96.8 %.

SPECIES	*RELATIVE PERCENTAGE FREQUENCY*
Panicum maximum	49.3
Forbs	37.4
Urochloa mosambicensis	9.3
Dactyloctenium giganteum	2.4
Eragrostis rigidior	1.1
Chloris virgata	0.5

Table 37. The species composition of the herbaceous layer as a relative percentage frequency in the *Diospyros mespiliformes* Riverine Management Unit. Canopy cover is 68 %.

SPECIES	*RELATIVE PERCENTAGE FREQUENCY*
Panicum maximum	58.3
Forbs	29.2
Eriochloa meyeriana	*20.8*
Setaria sagittifolia	4.2

Table 38. The species composition of the herbaceous layer as a relative percentage frequency in the *Echinochloa colona* Wetland Management Unit. Canopy cover 80 percent.

SPECIES	*RELATIVE PERCENTAGE FREQUENCY*
Paspalidium obtusifolium	79.8
Forbs	12.3
Eragrostis curvula	4.9
Echinochloa colona	3.1

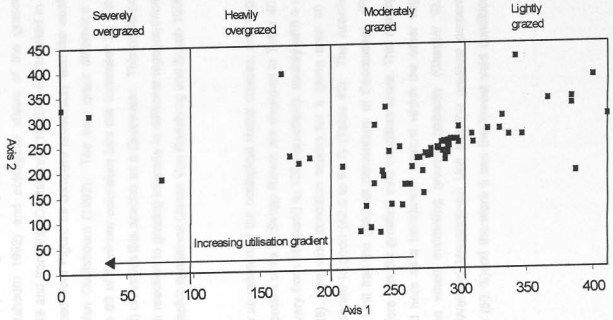

Figure 88. Scatter diagram to show the degradation gradient present in the DECORANA ordination (Hill 1979a) of the herbaceous species on Sango Ranch, Save Valley Conservancy, Zimbabwe.

the majority of sites are moderately grazed and only three sites are severely overgrazed.

ECOLOGICAL STATUS CATEGORIES

The changes in percentage frequency of the common grass species along the degradation gradient are depicted in Figure 89. No Increaser 1 category could be found for Sango Ranch, possibly indicating that no areas are underutilised. The palatability (Van Oudtshoorn 1992) and ecological status of the grasses as determined in Figure 89 and from Van Oudtshoorn (1992) are presented in Table 39. The results obtained from Figure 89 compare favourably with the ecological status categories of Van Oudtshoorn (1992). The only great difference is the classification in Figure 89 of *Panicum coloratum* into the Increaser 2a category. Van Oudtshoorn (1992) classifies this species as a Decreaser. This could possibly be due to a variation in reaction to grazing intensity in different topographical units and under different edaphic conditions (Janse Van Rensburg and Bosch 1990).

VELD CONDITION

The mean percentage abundance of the ecological status classes, and vegetation scores for the management units of Sango Ranch are depicted in Table 40. Veld condition scores can vary from 10 (poor) to 100 (excellent), usually with a median of 55 (Cauldwell 1998). The veld condition scores for a given area on Sango Ranch vary from moderate to good (42.5 to 61.7) (Table 40). The *Acacia tortilis* Closed Management Unit has the greatest percentage of Decreasers *(Panicum maximum)* and therefore has the greatest veld condition score. This management unit is therefore used here as a benchmark against which the other vegetation units were compared when estimating grazing capacity (Chapter 9). The *Echinochloa colona* Wetland Management Unit has the greatest percentage of Increaser 2c species (50 %)and therefore it has the lowest veld condition score (42.5).

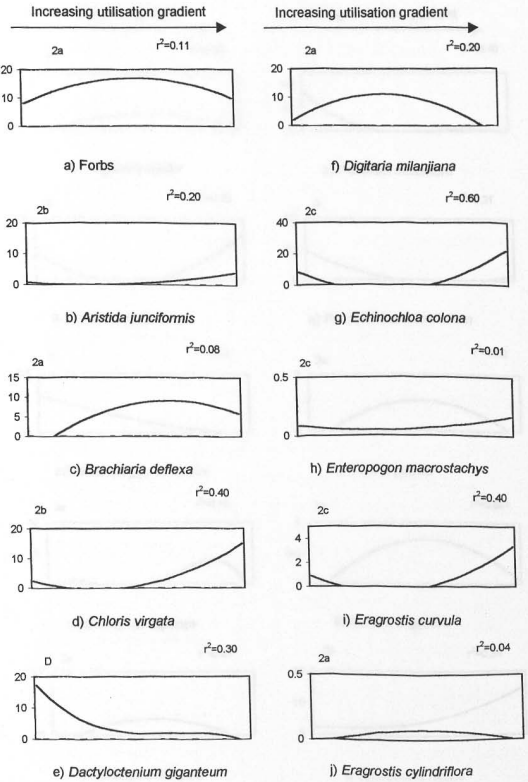

Figure 89. Changes in percentage frequency of 22 common grass species along a grazing gradient on Sango Ranch, Save Valley Conservancy, Zimbabwe.

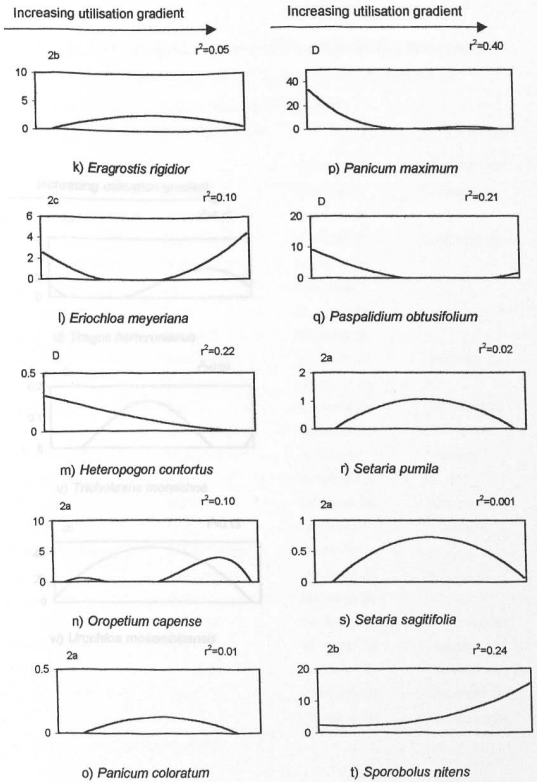

Figure 89. Changes in percentage frequency of 22 common grass species along a grazing gradient on Sango Ranch, Save Valley Conservancy, Zimbabwe.

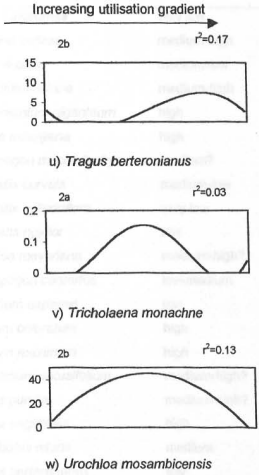

Figure 89. Changes in percentage frequency of 22 common grass species along a grazing gradient on Sango Ranch, Save Valley Conservancy, Zimbabwe.

Table 39. The palatability and ecological status of 23 grass species in Sango Ranch, Save Valley Conservancy, Zimbabwe as determined from Figure 89.

SPECIES	*PALATABILITY**	*ECOLOGICAL STATUS*	
		Figure 6.3	*Van Oudsthoorn (1992)*
Aristida junciformis	very low	Increaser 2b	Increaser 2c
Brachiaria deflexa	medium-high	Increaser 2a	-
Chloris virgata	medium-low	Increaser 2b	Increaser 2c
Echinochloa colona	medium-high	Increaser 2c	-
Dactyloctenium giganteum	high	Decreaser	-
Digitaria milanjiana	high	Increaser 2a	-
Enteropogon macrostachys	medium?	Increaser 2b	-
Eragrostis curvula	medium-low	Increaser 2c	Increaser 2b
Eragrostis cylindriflora	very low	Increaser 2a	-
Eragrostis rigidior	low	Increaser 2b	Increaser 2b
Eriochloa meyeriana	medium-high?	Increaser 2c	-
Heteropogon contortus	low-medium	Decreaser	Variable
Oropetium capense	low	Increaser 2a	-
Panicum coloratum	high	Increaser 2a	Decreaser
Panicum maximum	high	Decreaser	Decreaser
Paspalidium obtusifolium	medium-high?	Decreaser	-
Setaria pumila	medium-high?	Increaser 2a	-
Setaria sagittifolia	high	Increaser 2a	-
Sporobolus nitens	medium	Increaser 2b	Increaser 2c
Tragus berterorianus	low	Increaser 2b	Increaser 2c
Tricholaena monachne	medium	Increaser 2a	Increaser 2b/2c
Urochloa mosambicensis	high	Increaser 2b	Increaser 2c
Forbs	-	Increaser 2a	Increaser 2a

* Source: Van Oudtshoorn (1992)

Table 40. The mean percentage abundance of the ecological status classes, and veld condition scores for the management units of Sango Ranch, Save Valley Conservancy, Zimbabwe.

MANAGEMENT UNIT	PERCENTAGE FREQUENCY				VELD CONDITION SCORE	VELD CONDITION CLASS
	Decreasers	Increasers 2a	Increasers 2b	Increasers 2c		
1	20	20	50	10	51.0	Moderate
2	15	31	54	0	52.3	Moderate
3	15	62	23	0	55.4	Moderate
4	33	17	50	0	61.7	Good
5	25	50	0	25	52.5	Moderate
6	25	25	0	50	42.5	Moderate
Mean	22.2	34.2	29.5	14.2	52.6	Moderate

1. The *Acacia tortilis* Open Woodland Management Unit
2. The *Colophospermum mopane* Woodland Management Unit.
3. The *Combretum apiculatum* Woodland Management Unit
4. The *Acacia tortilis* Closed Woodland Management Unit
5. The *Diospyros mespiliformes* Riverine Management Unit
6. The *Echinochloa colona* Wetland Management Unit