

## The vegetation of the Kroonstad area: A description of the grassland communities

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A phytosociological analysis of the grassland vegetation data from the Kroonstad area is presented. The data set (193 relevés) was initially classified by using TWINSpan, and the results refined by applying Braun-Blanquet procedures. Ten communities, grouped into four major communities, were identified and described.

'n Fitososiologiese analise van grasvelddata uit die Kroonstad-omgewing word gegee. Die datastel, bestaande uit 193 relevés, is aanvanklik geklassifiseer deur gebruik te maak van die TWINSpan metode. Die resultaat is daarna verfyn deur gebruik te maak van die Braun-Blanquet tegniek. Tien plantgemeenskappe, wat in vier hoofgemeenskappe gegroepeer is, is geïdentifiseer en beskryf.

**Keywords:** Braun-Blanquet method, classification, grassland biome, phytosociology, plant communities.

### Introduction

Association analysis, a monothetic divisive classification technique (Gauch 1982), was used by Scheepers (1975) to classify the vegetation of the Kroonstad area. This technique is based on the subdivision of vegetation samples into two groups according to the significant presence or absence of a single species. This procedure is repeated a number of times in order to yield a hierarchy. The division species chosen is that species with the maximum ability to separate one group or association of species from another, defined on the criterion that it is characterized by the maximum sum of chi-squared values with all other species (Williams & Lambert, 1959, 1960, 1961 a & b).

Vegetation classes derived from association analysis are often not reconcilable with classes obtained from polythetic or Braun-Blanquet techniques, and inclusion of these classes in comprehensive phytosociological and syntaxonomic studies is difficult or impossible. Coetzee and Werger (1975) showed that polythetic Braun-Blanquet analyses of floristic data result in ecologically more reliable vegetation classes than those derived from monothetic techniques. Although the association analysis algorithm utilizes only presence-absence data, Scheepers's original data set comprised total floristic composition with Braun-Blanquet cover-abundance values for all identified species.

The aim of this paper is to reclassify the floristic data from the Kroonstad area by means of polythetic techniques and Braun-Blanquet procedures, to contribute towards a synthesis of all vegetation data from the north-western Orange Free State (Kooij *et al.* 1990a – d, Kooij *et al.* 1991).

Taxa referred to in this paper conform to those of Gibbs Russell *et al.* (1985, 1987), but the binomial *Setaria flabellata* is used to indicate *Setaria sphacelata* subsp. *flabellata*.

Soil taxonomy in this paper is according to MacVicar *et al.* (1977).

### Study area

The study area is situated between 27°30' and 27°45' S

latitude and 27°00' and 27°15'E longitude, in the north-western Orange Free State in the grassland biome (Figure 1). This area comprises approximately 625 000 ha. A detailed description of the physical environment of the area was given by Scheepers (1975).

### Methods

A semi-detailed ecological survey of the vegetation of the Kroonstad area was undertaken by Scheepers (1975). This ecological survey was intended to provide a basis for rational land use, large-scale planning and realization of the agricultural potential of the Highveld region (Scheepers 1975). The vegetation was sampled by means of 235 relevés, each relevé being a 16 m<sup>2</sup> quadrat. All species present were recorded and the data were analysed by means of association analysis (Scheepers 1975). In the present study this data set was reclassified by using two-way indicator species analysis (TWINSpan) (Hill 1979) and the resulting classification was refined by means of Braun-Blanquet procedures (see also Behr & Bredenkamp 1988; Bredenkamp *et al.* 1989; Kooij *et al.* 1990a – d, 1991). Based on the major division obtained by this procedure, the entire phytosociological table was subdivided into two smaller phytosociological tables. The one table, representing the vlei and bottomland communities, was published elsewhere (Kooij *et al.* 1991). The other table, representing grassland communities, is presented here (Table 1) and a description of the grassland communities is given in this paper.

### Results

A comparison of the classification of relevés by association analysis and the present classification is given in Table 2. From Table 2 and Figure 2 it can be derived that the grassland communities are represented by association analysis community group / combinations 1 and 3 – 9. Vlei and bottomland communities are represented by association analysis groups 2 and 10 – 13 (Kooij *et al.* 1991). The allocation of relevés from the grassland communities to association analysis groups is given in Figure 2.

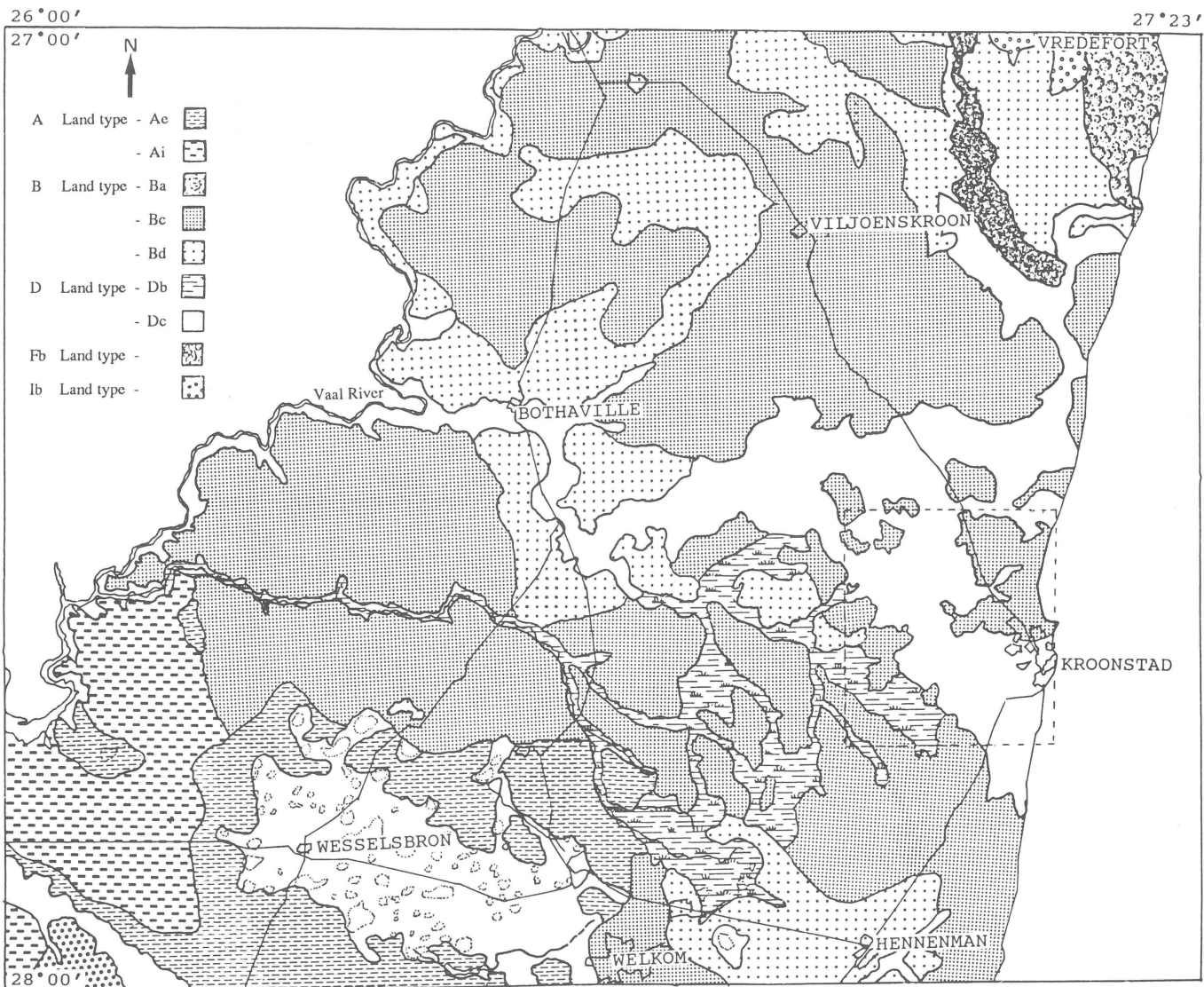


Figure 1 A map indicating the location of the study area in the north-western Orange Free State.

#### Classification

In general, the vegetation of the area can be considered to be a *Themeda triandra* – *Panicum coloratum* Grassland. A hierarchical classification of the grassland communities is the following:

1. *Themeda triandra* – *Aristida bipartita* Grassland
  - 1.1 *Aristida bipartita* – *Trichoneura grandiglumis* Variant
2. *Nananthus transvaalensis* – *Panicum coloratum* Grassland
  - 2.1 *Panicum coloratum* – *Euphorbia pseudotuberosa* Variant
3. *Felicia muricata* – *Eragrostis chloromelas* Disturbed Grassland
  - 3.1 *Felicia muricata* – *Pentzia globosa* Disturbed Grassland
    - 3.1.1 *Felicia muricata* – *Eragrostis barbinodis* Variant
    - 3.1.2 *Felicia muricata* – *Eragrostis obtusa* Variant
    - 3.1.3 *Felicia muricata* – *Pentzia globosa* Variant
  - 3.2 *Felicia muricata* – *Setaria flabellata* Disturbed Grassland
    - 3.2.1 *Felicia muricata* – *Elionurus muticus* Variant
    - 3.2.2 *Felicia muricata* – *Eragrostis trichophora* Variant

4. *Themeda triandra* – *Eragrostis chloromelas* Valley Grassland

#### Description of the communities

##### 1. The *Themeda triandra* – *Aristida bipartita* Grassland

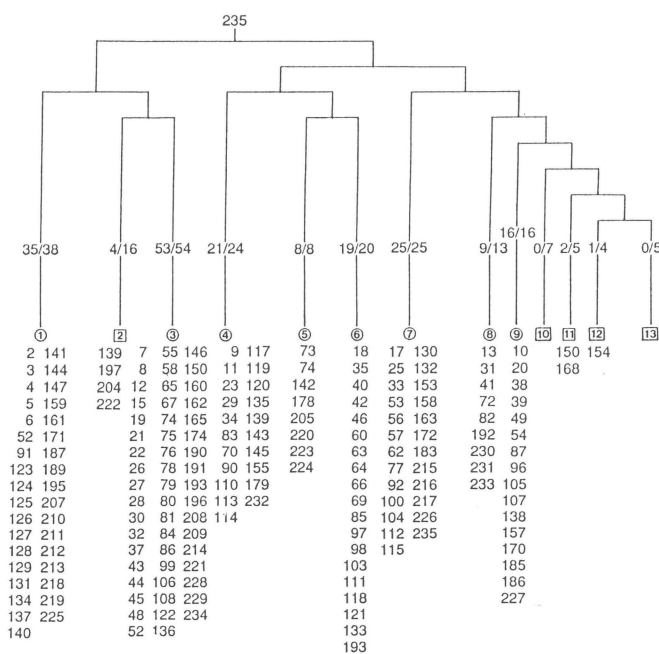
This community relates in part to community 3 of Scheepers (1975) (*Corchorus asplenifolius* – *Panicum coloratum* Grassland) and especially community 3.2 *Corchorus asplenifolius* – *Salvia burchellii* (minor community) (Table 2). However, this community of Scheepers is floristically heterogeneous, owing to heterogeneous habitat conditions. The 54 relevés of his community 3 are dispersed among several communities identified by Braun-Blanquet procedures (Table 2).

The *Themeda triandra* – *Aristida bipartita* Grassland is associated with the dry plateau edges. These sites are usually situated on shallow, deeply cracking, blocky structured, black vertic, droughty soils of the Arcadia Form (Arcadia Series) often associated with dolerite (MacVicar *et al.* 1977). The veld is usually selectively and patchily overgrazed and trampled. The diagnostic species for this community are *Hermannia depressa*, *Aristida bipartita*, *Osteospermum muricatum*, *Scabiosa columbaria*, *Anthospermum*

**Table 1** Please see pages 158 – 161.

**Table 2** A comparison of the classification of the relevés by association analysis (Scheepers 1975) and the present classification method

	Community numbers	Association analysis													Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	
Braun-	1	1	*	9	3	*	3	1	1	*	*	*	*	*	18
Blanquet	1.1	1	*	1	2	5	1	3	*	*	*	*	*	*	14
	2	12	1	8	2	*	*	4	5	1	*	*	*	*	33
	2.1	19	2	12	5	1	1	6	*	1	*	*	*	*	47
	3.1.1	*	1	8	5	*	2	3	2	1	*	*	*	*	22
	3.1.2	*	*	7	1	*	*	1	1	*	*	*	*	*	10
	3.1.3	1	*	8	*	*	3	*	*	1	*	*	*	*	13
	3.2.1	*	*	*	1	2	5	4	*	3	*	*	*	*	15
	3.2.2	1	*	*	2	*	4	3	*	4	*	1	*	*	15
	4	*	*	*	*	*	*	*	*	4	*	1	1	*	6
Total for the Grassland communities		35	4	53	21	8	19	25	9	16	0	2	1	0	193
Vlei and Bottomland communities (Kooij <i>et al.</i> 1991)		3	12	1	3	0	1	0	4	0	7	3	3	5	42
Total relevés		38	16	54	24	8	20	25	13	16	7	5	4	5	235



**Figure 2** A dendrogram of the association analysis of the Kroonstad area vegetation described by Scheepers (1975). □: Vlei and Bottomland communities (Kooij *et al.* 1991). ○: Grassland communities.

*pumilum*, *Helichrysum rugulosum* and *Barleria macrostegia* (species group A, Table 1). Prominent species are *Themeda triandra*, *Panicum coloratum*, *Eragrostis chloromelas* and *Heteropogon contortus* (species group J). Other prominent species, constantly present, are the species *Elionurus muticus* (species group H), *Digitaria argyrograpta*, *Aristida congesta*, *Setaria flabellata*, *Cymbopogon plurinodis*, *Eragrostis superba* and *Eragrostis lehmanniana* and the karroid shrub *Felicia muricata* (species group I).

Other species are listed mainly in species group G – J (Table 1).

This veld evidently should be dominated by *Themeda triandra* with a high basal cover (Scheepers 1975). However, under a régime of light to selective overgrazing the basal cover has been lowered. *Themeda triandra* has yielded dominance to *Cymbopogon plurinodis*, *Eragrostis chloromelas*, *Setaria flabellata* and *Aristida congesta* and eventually to karroid species such as *Pentzia globosa* and *Felicia muricata*.

One variant of this community can be distinguished.

### 1.1 The *Aristida bipartita* – *Trichoneura grandiglumis* Variant

This variant is akin to the community 5 (*Eragrostis superba* – *Trichoneura grandiglumis* Grassland) concept of Scheepers (1975) (Table 2). It occurs on moderately deep, leached, loose sandy soils of the Kroonstad Form, but it may also occur on reddish apedal soils of the Hutton Form as well as red structured soils of the Shortlands Form. Chimney-building termite species typical of sandy soils are commonly found in this habitat (Scheepers 1975).

The diagnostic species for this community are *Tolpis capensis*, *Thesium* species, *Trichoneura grandiglumis*, *Hibiscus microcarpus* and *Mariscus capensis* (Table 1, species group B). Dominant species constantly present are the grass species *Elionurus muticus*, *Setaria flabellata*, *Cymbopogon plurinodis*, *Eragrostis superba*, *Themeda triandra*, *Eragrostis chloromelas* and *Heteropogon contortus*.

Other species are listed in species groups H – J (Table 1).

Owing to the sandier leached soils, the grazing is less sweet than that of the *Themeda triandra* – *Aristida bipartita* Grassland and there is less overstocking (Scheepers 1975).

### 2. The *Nananthus transvaalensis* – *Panicum coloratum* Grassland

This grassland community relates mainly to community 1 (*Corchorus asplenifolius* – *Nananthus transvaalensis* Grass-







Table 1 Continued

	1										2										
Community number	1.1																				
Releve number	000000111100000010	21102111101121	111201111112210001	222222010201121	2111111112212122111	433368001628776899	20530147061823	99920783225234317	1112233030224213	3745936231060332644	017454030536567511	08535228437344	0266617769810405245629	13285523496	4450750034417258267						
<b>SPECIES GROUP J</b>																					
<i>Themeda triandra</i>	+31	2+312313333+12	33123433222+33	32222 23+ + 22	12+2 3 313332	23432 3232332+23232															
<i>Panicum coloratum</i>	+1+2+	++2+3+ 3211	+2+ + 2 3	3+232323322+	3++ 3332312212+ 322	233333232332322333															
<i>Eragrostis chloromelas</i>	+12+2122	222+2321+	22+13221222133	2 32 3233 +1 321 2 ++	+3 2+ 224	3 23 3 32323133233															
<i>Heteropogon contortus</i>	+ + 131+11+21+	2+2	12 ++2+ 211+13	1 2 32 +	+3+13+1 2 2+13 2	+23 11221+1+ 3+21															
<i>Cyperus usitatus</i>		++ ++	+ ++1+ ++ +1	+1 2+++++113+++	131+ 1 1 2+1	+1+ ++ 1113 1+1+															
<i>Cynodon dactylon</i>	+2 + + 32 +		1+ + 1	+2 + 2 2 33++1151 2	1++++	1 1 2 + ++1															
<i>Eragrostis plana</i>		+ 2+		2 + +1 12+3	2 2 1	+ 1 1 +1															
<b>SPECIES GROUP K</b>																					
<i>Walafrida densiflora</i>																					
<i>Chrysocoma ciliata</i>	+ ++ +		++ +	+ ++	2 ++1 ++																
<i>Seddera suffruticosa</i>																					
<i>Sutera aurantiaca</i>	+ +		2																		
<i>Solanum supinum</i>		++ +																			
<i>Deverra burchellii</i>		1 +																			
<i>Kyllinga erecta</i>																					
<i>Epaltes gariepina</i>																					
<i>Digitaria eriantha</i>																					
<i>Portulaca quadrifida</i>																					
<i>Lippia rehmannii</i>	+ 1		2																		
<i>Salvia namaensis</i>	+ + +																				
<i>Acacia karroo</i>																					
<i>Stachys spatula</i>																					
<i>Convolvulus boedeckerianus</i>		++ +																			
<i>Indigofera candicans</i>																					
<i>Dipcadi ciliare</i>																					
<i>Tulbaghia alliacea</i>																					
<i>Sutera atrocaerulea</i>																					
<i>Cynodon hirsutus</i>																					
<i>Senecio burchellii</i>																					
<i>Delospermum herbeum</i>																					
<i>Asclepias meyeriana</i>																					
<i>Kyllinga alba</i>																					
<i>Dicoma macrocephala</i>																					
<i>Bulbine abyssinica</i>																					
<i>Dolichos linearis</i>																					
<i>Moraea species</i>																					
<i>Crabba hirsuta</i>																					
<i>Helichrysum zeyheri</i>																					
<i>Aristida diffusa</i>																					
<i>Monsonia angustifolia</i>																					
<i>Berkheya radula</i>																					
<i>Turbina oenotheroides</i>																					
<i>Commelina africana</i>																					
<i>Cordylogyne globosa</i>																					
<i>Eragrostis gummiflora</i>																					
<i>Sporobolus species</i>																					
<i>Talinum caffrum</i>																					
<i>Ziziphus zeyheriana</i>																					
<i>Ipomoea simplex</i>																					
<i>Eragrostis racemosus</i>																					
<i>Lessertia prostata</i>																					
<i>Dianthus micropetalus</i>																					
<i>Delosperma herbeum</i>																					
<i>Protasparagus laricinus</i>																					
<i>Sporobolus fimbriatus</i>																					
<i>Tristachya hispida</i>																					
<i>Chaetacanthus setiger</i>																					
<i>Ruschia hamata</i>																					
<i>Tephrosia semiglabra</i>																					
<i>Cyperus fulgens</i>																					
<i>Menodora africana</i>																					
<i>Crinum bulbispermum</i>																					
<i>Solanum panduriforme</i>																					
<i>Aristida canescens</i>																					
<i>Rhynchosia confusa</i>																					
<i>Helichrysum asperum</i>																					
<i>Berkheya pinnatifida</i>																					
<i>Salsola glabra</i>																					

Continued on next page

Species with an occurrence of <2 have been omitted.

land) of Scheepers (1975). Some of the relevés classified under Scheepers's communities 3, 7 and 8 are also included in the *Nananthus transvaalensis* - *Panicum coloratum* Grassland.

This community covers extensive areas, occurring on the flat to slightly sloping peniplains and adjacent pedi-plains and lower pediment slopes within the study area. On upland areas the soils vary from the Arcadia Form (Gelykvlakte Series) via the Estcourt to the Kroonstad Form. The Rens-

burg Form dominates in bottomland situations. In general, the soil environment is typified by droughty, calcareous dark, vertic clays, commonly poorly drained (Scheepers 1975). Serious problems with veld deterioration on soils of Arcadia Form (Gelykvlakte Series) arise from the crusting properties of these soils. Compaction of Gelykvlakte Series soils under denudation and trampling causes serious deterioration once this crust formation has passed beyond a certain threshold of severity. However, if degradation continues



*Geigeria aspera*. Further species are listed mainly under species groups E – J (Table 1).

It would seem that with continued overgrazing and harvester termite infestation, especially on the more clayey soils of Arcadia Form (Gelykvlakte Series), dominance shifts successively from *Themeda triandra* to *Panicum coloratum*, and to *Eragrostis chloromelas* and then to *Sporobolus ioclados* var. *usitatus*. These stages in the retrogression of originally good stands of *Themeda* veld are not, at first, accompanied by marked reduction in basal cover as prominence is assumed by one grass at the expense of another. However, the productivity and palatability of the pasture drops steadily with retrogression. Despite its high basal cover and palatability, *Panicum coloratum* produces a smaller mass of herbage than *Themeda triandra*. *Eragrostis chloromelas* produce relatively small quantities of forage of indifferent to poor quality. *Sporobolus ioclados* var. *usitatus* may have a high basal cover, but it produces little herbage. Together with species of *Cynodon* and *Aristida*, dominance by *Sporobolus ioclados* var. *usitatus* represents the last perennial grass stage before the veld commences to break down to a critical level of denudation and degradation. This critical threshold level is heralded by the incursion of short-lived grasses, karoo bushes and weeds, such as *Aristida* species, *Chloris virgata*, *Tragus racemosus*, *Pentzia globosa*, *Chrysocoma ciliata*, *Chamaesyces inequilatera* and *Nidorella resedifolia*. If site degradation continues beyond this critical threshold, it may be extremely difficult or impossible to reverse the trend, except by applying costly measures.

### 2.1 The *Panicum coloratum* – *Euphorbia pseudotuberosa* Variant

This Variant represents a less degraded stage of the *Nananthus transvaalensis* – *Panicum coloratum* Grassland. Although degradation of the vegetation is also evident, *Themeda triandra* has high cover-abundance and constancy values, and karoo bush encroachment is less conspicuous. The diagnostic species for this variant are the grass species *Sporobolus discosporus*, the forbs *Euphorbia pseudotuberosa*, *Hermannia coccocarpa*, *Pterodiscus speciosus*, *Oxalis depressa* and *Hypoxis argenteus* (species group D). Other species constantly present are the grass species *Eragrostis barbinodis*, *Eragrostis obiusa* and the dominant grass species *Themeda triandra*, *Panicum coloratum*, *Eragrostis chloromelas* and *Heteropogon contortus* (species group E, F and J).

### 3. *Felicia muricata* – *Eragrostis chloromelas* Disturbed Grassland

This community shows affinities with communities 3, 4, 6, 7 and 9 of Scheepers (1975) (Table 2).

This major grassland community represents various stages of degradation of the grasslands in the north-western Orange Free State. It is widespread, on summits, plateaux and pediment slopes. The soils vary from the red structured Shortlands to the vertic Arcadia Forms. The community is recognized by the presence of species group I and simultaneous absence of species groups A – D (Table 1). The dominant species of this major community are the grass species *Themeda triandra*, *Panicum coloratum* and *Eragros-*

*tis chloromelas*, but *Digitaria agyrogapta*, *Aristida congesta*, *Setaria flabellata*, *Cymbopogon plurinodis*, *Eragrostis superba*, *Elionurus muticus* and *Cynodon dactylon* and the forbs *Hibiscus pusillus* and *Blepharis integrifolia* as well as the karroid shrubs *Felicia muricata* and *Pentzia globosa* are conspicuously present.

### 3.1 *Felicia muricata* – *Pentzia globosa* Disturbed Grassland

This community relates mainly to communities 3 (*Corchorus asplenifolius* – *Panicum coloratum* Grassland) and 4 (*Eragrostis superba* – *Cynodon dactylon* Grassland) of Scheepers (1975). It is found over a wide range of habitat situations varying from pediment slopes, plains, structural terraces and plateaux. The vegetation of this community is usually lightly to selectively overgrazed, and is distinguished from other communities by the absence of species groups A – D and the presence of species group G (Table 1). Three variants can be recognized.

#### 3.1.1 *Felicia muricata* – *Eragrostis barbinodis* Variant

This variant is related partially to community 3 (*Corchorus asplenifolius* – *Panicum coloratum* Grassland) and especially to community 4 (*Eragrostis superba* – *Cynodon dactylon* Grassland) of Scheepers (1975).

This community typically occurs on shallow, somewhat sandy soils of the Kroonstad Form (shallow phase of the Kroonstad Series), Hutton Form (Shorrocks Series) and Oakleaf Form (Jozini Series). It may also be present on the Arcadia Form (Gelykvlakte Series) where a sandy topsoil is present. Although variations do occur, the typical sites appear to lie in minor topographic depressions in the depositional sandy plain landscape. Particularly characteristic are sites where the sandy overburden is partially stripped by erosion, and the underlying rock, stones or hard clayey subsoil is near the surface. The continued existence of grassland on these sites is due to their being non-arable, because of the shallow stony soils.

Within the *Felicia muricata* – *Eragrostis chloromelas* Disturbed Grassland this variant is identified by the presence of species group E, the prominence of *Cynodon dactylon*, and the presence of *Chrysocoma tridentata* (Table 1). *Cynodon dactylon* is invariably present to dominant, suggesting enhanced nitrogen status owing to biotic factors, such as dung and urine effects and, possibly, termite infestation (Scheepers 1975; Breznak *et al.* 1973; Lee & Wood 1971; Murray 1938). Dominant species of this community are the grass species *Panicum coloratum*, *Eragrostis chloromelas*, with *Cynodon dactylon* and, locally in patches, *Themeda triandra* (species group J). Other prominent species include *Eragrostis barbinodis* (species group E), *Microchloa caffra*, *Eragrostis obtusa* and *Sporobolus ioclados* and the karroid shrubs *Pentzia incana* and *Atriplex semibaccata* as well as the geophyte *Bulbine narcissifolia* (species groups E, F & I). Other species constantly present are *Corchorus asplenifolius*, *Pentzia globosa*, *Geigeria aspera*, *Aptosimum depressum*, *Felicia muricata*, *Hibiscus pusillus*, *Blepharis integrifolia*, *Anthericum fasciculatum*, *Eragrostis superba* and *Eragrostis trichophora* (species groups G – I).

### 3.1.2 *Felicia muricata* – *Eragrostis obtusa* Variant

This variant relates partially to community 3 (*Corchorus asplenifolius* – *Panicum coloratum* Grassland) of Scheepers (1975). It is usually situated on the flat pediment slopes. The Arcadia Form predominates, often covered by a sandy layer. This variant is slightly to severely overgrazed in places as well as being infested by termites. It is distinguished from the other variants by the presence of species group F and the absence of species group E (Table 1). Dominant species of this variant are the grass species *Themeda triandra*, *Panicum coloratum* and *Eragrostis chloromelas* with *Eragrostis obtusa* and *Sporobolus ioclados* also prominent (species groups J & F). Other species constantly present are *Corchorus asplenifolius*, *Pentzia globosa*, *Geigeria aspera*, *Aptosimum depezzum*, *Gazania krebsiana*, *Felicia muricata*, *Hibiscus pusillus*, *Blepharis integrifolia* and *Digitaria argyrograpta* (species groups G – I).

### 3.1.3 *Felicia muricata* – *Pentzia globosa* Variant

This variant also relates mainly to community 3 (*Corchorus asplenifolius* – *Panicum coloratum* Grassland) of Scheepers (1975). It is also found over a wide range of habitat situations, varying from structural terraces and plateaux to pediment slopes. The black vertic soils of the Arcadia and Rensburg Forms are predominant. The veld is selectively and closely grazed to locally overgrazed and is sometimes subjected to heavy trampling. This variant is defined by the presence of *Corchorus asplenifolius* and *Pentzia globosa* (species group G) and the absence of species groups E and F. Dominant species are the grasses *Themeda triandra*, *Panicum coloratum*, *Eragrostis chloromelas* and *Heteropogon contortus* (species group J). Other conspicuous species constantly present are the grass species *Elionurus muticus*, *Digitaria argyrograpta*, *Aristida congesta*, *Setaria flabellata*, *Cymbopogon plurinodis*, *Eragrostis superba*, the forbs *Geigeria aspera*, *Aptosimum depezzum*, *Hibiscus pusillus* and *Blepharis integrifolia* as well as the karroid shrub *Felicia muricata* (species groups H & I).

## 3.2 *Felicia muricata* – *Setaria flabellata* Disturbed Grassland

This community relates mainly to communities 6 (*Eragrostis superba* – *Trichoneura grandiglumis* Grassland), 7 (*Anthericum fasciculatum* – *Geigeria aspera* Grassland) and 9 (*Eragrostis chloromelas* – *Eragrostis plana* Grassland) of Scheepers (1975). It is mainly situated on pediment slopes. The soils vary from black clayey soils of the Arcadia and Rensburg Forms to the Kroonstad Form as well as lithosols. Common physical factors of the environment are the shallowness, sandiness and relatively high base status of the surface soil. In respect of the physical factors, the habitats are similar to those of community 1.1 (*Aristida bipartita* – *Trichoneura grandiglumis* Variant, from which, in some cases, this community appears to be derived) and community 3.1.1 (*Felicia muricata* – *Eragrostis barbinodis* Variant). The veld condition of this community is poor owing to secondary disturbing factors. This community appears to have arisen on shallow or litholic soil sites unsuitable or marginal for cultivation and has, therefore, been used as grazing land for livestock. It is usually less overstocked, and

sometimes understocked and selectively grazed (Scheepers 1975).

This community is characterized by the absence of species group G and the presence of species group I. Two variants are recognized.

### 3.2.1 *Felicia muricata* – *Elionurus muticus* Variant

This variant is mainly akin to communities 6 (*Eragrostis superba* – *Eragrostis chloromelas* Grassland) and 7 (*Anthericum fasciculatum* – *Geigeria aspera* Grassland) of Scheepers (1975). It is mainly situated on the upper pediment slopes. Common physical factors of the environment are the shallow sandy nature and relatively high base status of the surface soil, usually of the Kroonstad Form or lithosols. The poor condition of this variant is mainly caused by secondary disturbing factors, including compaction due to trampling by livestock and game as well as by machinery and implements. Within the *Felicia muricata* – *Setaria flabellata* Grassland this variant is recognized by the presence of species group H (Table 1), including the prominent grass *Elionurus muticus*, the forbs *Geigeria aspera* and *Aptosimum depezzum*. Other species prominently present are the grass species *Digitaria argyrograpta*, *Setaria flabellata*, *Cymbopogon plurinodis*, *Eragrostis superba*, *Panicum coloratum* and *Heteropogon contortus*, the forbs *Hibiscus pusillus* and *Blepharis integrifolia*, as well as the karroid shrub *Felicia muricata*.

### 3.2.2 *Felicia muricata* – *Eragrostis trichophora* Variant

This variant is related in part to communities 6 (*Eragrostis superba* – *Eragrostis chloromelas* Grassland), 7 (*Anthericum fasciculatum* – *Geigeria aspera* Grassland) and 9 (*Eragrostis chloromelas* – *Eragrostis plana* Grassland) of Scheepers (1975). It is situated mainly on pediment slopes and plains. The soils vary from the black clayey soils of the Arcadia and Rensburg Forms to the Kroonstad Form as well as lithosols. This variant is severely overgrazed and trampled owing to its distribution being restricted to the vicinity of watering points. Within the *Felicia muricata* – *Setaria flabellata* Grassland, this variant is recognized by the absence of species group H (Table 1). Only the widespread species of species groups I and J are present. Dominant species are *Themeda triandra* and *Eragrostis chloromelas*. Other prominent species for this variant are the grass species *Setaria flabellata*, *Cymbopogon plurinodis*, *Panicum coloratum*, *Heteropogon contortus*, *Cynodon dactylon*, *Eragrostis superba*, *Eragrostis trichophora* and *Eragrostis lehmanniana* and the forb *Hibiscus pusillus*.

## 4. The *Themeda triandra* – *Eragrostis chloromelas* Grassland

This community relates to community 9 (*Eragrostis chloromelas* – *Eragrostis plana* Grassland) of Scheepers (1975), and is associated with lower pediment slopes and valley flats. The habitats are relatively moist, disturbed bottomland situations along drainage lines, situated on black clayey soils of the Rensburg and Arcadia Forms. The soils are variously calcareous, to slightly saline or alkaline in places. Characteristic of this community is the low species richness as well as the absence of species group I (Table 1). Stands of *Themeda triandra* – *Eragrostis chloromelas*



Grassland generally show marked internal heterogeneity at a large scale of pattern. They are normally restricted to relatively small areas — commonly portions of paddocks near water where animals tend to concentrate and where patchy overgrazing and trampling effects are common. Prominent species of this community are *Themeda triandra*, *Panicum coloratum*, *Eragrostis chloromelas*, *Cyperus usitatus*, *Cynodon dactylon* and *Eragrostis plana*.

### Conclusion

With association analysis 13 major communities, divided into 25 sub-communities, were identified (Table 2). Eight of the 13 major communities are represented in Table 1. The remaining five communities are included in the vlei and bottomland vegetation (Kooij *et al.* 1991). In the present classification ten communities are grouped into four major communities. The results of this classification of the Kroonstad data (Scheepers 1975) can be arranged alongside those of Kooij *et al.* (1990a – d, 1991). This will permit a synthesis and formal syntaxonomic classification of the vegetation of the north-western Orange Free State.

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