

The phytosociology of the grasslands of the Ba and Ib land types in the Pretoria–Witbank–Heidelberg area

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An analysis of the plant communities of the grasslands of the Pretoria–Witbank–Heidelberg area is presented. Relevés were compiled in 148 stratified random sample plots. A TWINSpan classification, refined by Braun-Blanquet procedures, revealed fourteen plant communities, and a hierarchical classification, description and ecological interpretation of these plant communities are presented. Each of these plant communities may be regarded as an entity with a unique species composition, and with specific environmental relationships and an inherent forage production potential. The identification, classification and description of these plant communities are not only important for management purposes, but also for the preservation of biotic diversity.

'n Analise van die plantgemeenskappe van die grasveld binne die Pretoria–Witbank–Heidelberg studiegebied, word aangebied. Relevés is in 148 gestratifiseerde, ewekansig gekose monsterpersele saamgestel. 'n TWINSpan klassifikasie is op die floristiese data uitgevoer, waarna die resultaat deur middel van Braun-Blanquet prosedures verder verfyn is. Veertien plantgemeenskappe, elk met 'n unieke floristiese samestelling, habitateienskappe en weidingsproduksiepotensiaal, is sodoende onderskei. Hierdie gemeenskappe toon elk verwantskappe met sekere omgewingsfaktore en kan dus as aparte ekologiese eenhede beskou word. 'n Hiërargiese klassifikasie, beskrywing en ekologiese interpretasie van die plantgemeenskappe word aangebied. Die identifisering, klassifisering en beskrywing van hierdie plantgemeenskappe is nie net belangrik vir bestuursdoeleindes nie, maar ook vir die bewaring van biologiese diversiteit.

Keywords: Bankenveld, Braun-Blanquet, classification, Grassland Biome, synecology, veld management.

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Introduction

Natural vegetation, being a composite result of several factors such as climate, soil and topography, serves as one of the clear indicators for the determination of agricultural regions, and hence for a better understanding of problems of pasture management and soil conservation. Therefore, the basis for scientific veld management is the plant community. Each plant community has its own species composition with an own inherent production potential. Each plant community will react differently to certain management practices, for example, grazing pressure and burning. Pentz (1983) produced evidence to show that, in a country such as South Africa, any farming system not in accord with the natural vegetation must be regarded as artificial and a threat to the permanent occupation of the land.

The necessity to identify and describe plant communities not only for agricultural purposes but also in conservational management, was further well documented by Mentis and Huntley (1982) and Scheepers (1986). In order to provide an ecologically sound identification, description and interpretation of the grassland plant communities in the Pretoria–Witbank–Heidelberg area, an extensive survey, using the Zurich–Montpellier approach, was undertaken. In an overview of the vegetation of this area, Coetzee *et al.* (1994) recognized two distinct, though related major grassland communities in the area concerned, namely the *Bewsia biflora* – *Digitaria brazzae* Grassland, of rocky areas, representing the Bankenveld of Acocks (1953, 1988) and Moist Cool Temperate Grassland of Werger and Coetzee (1978), and the *Helichrysum rugulosum* – *Conyza podoccephala* Grassland, representing *Cymbopogon* – *Themeda* Veld of Acocks (1953, 1988) and Moist Cold Temperate Grassland of Werger and Coetzee (1978). Very little is known about the phytosociology of the grasslands of the Pretoria–Witbank–Heidelberg area and therefore this report aims to identify, describe and

interpret ecologically the different plant communities of the grassland in this area.

Study area

The study area is situated within the Grassland Biome of South Africa (Rutherford & Westfall 1986), in the Pretoria–Witbank–Heidelberg area (Figure 1). Characteristic of this area is the undulating landscape with flat plains and localized quartzite ridges. The quartzite ridges are mainly restricted to the Ib land type, characterized by rocky areas with miscellaneous soils. In contrast, the undulating and flat plains are found on the Ba land type, characterized by dystrophic and mesotrophic red soils occurring on various geological formations (Land Type Survey Staff 1985, 1987). Most parts of the study area are situated at altitudes above 1450 m, while restricted localized areas may be situated from 1400 to 1450 m above sea level. Due to the deep red soils, much of the Ba land type is utilized for intensive crop production. Thus, together with the increasing mining activities, rural and urban development, encroachment of foreign plant species and veld mismanagement, little of the natural vegetation remains, and the plant communities represented in these remnants are poorly conserved. A detailed description of the physical environment of the study area was presented by Coetzee *et al.* (1994), and is not repeated here.

Methods

Relevés were compiled in 265 stratified random sample plots in vegetation taken to be in fair condition, i.e. not severely degraded. Stratification was based on land type (Land Type Survey Staff 1985, 1987) and within land types on terrain units, namely, 1 – crests, 2 – escarpes, 3 – midslopes, 4 – footslopes, and 5 – floodplain or water courses. The use of land types and terrain units within land types as

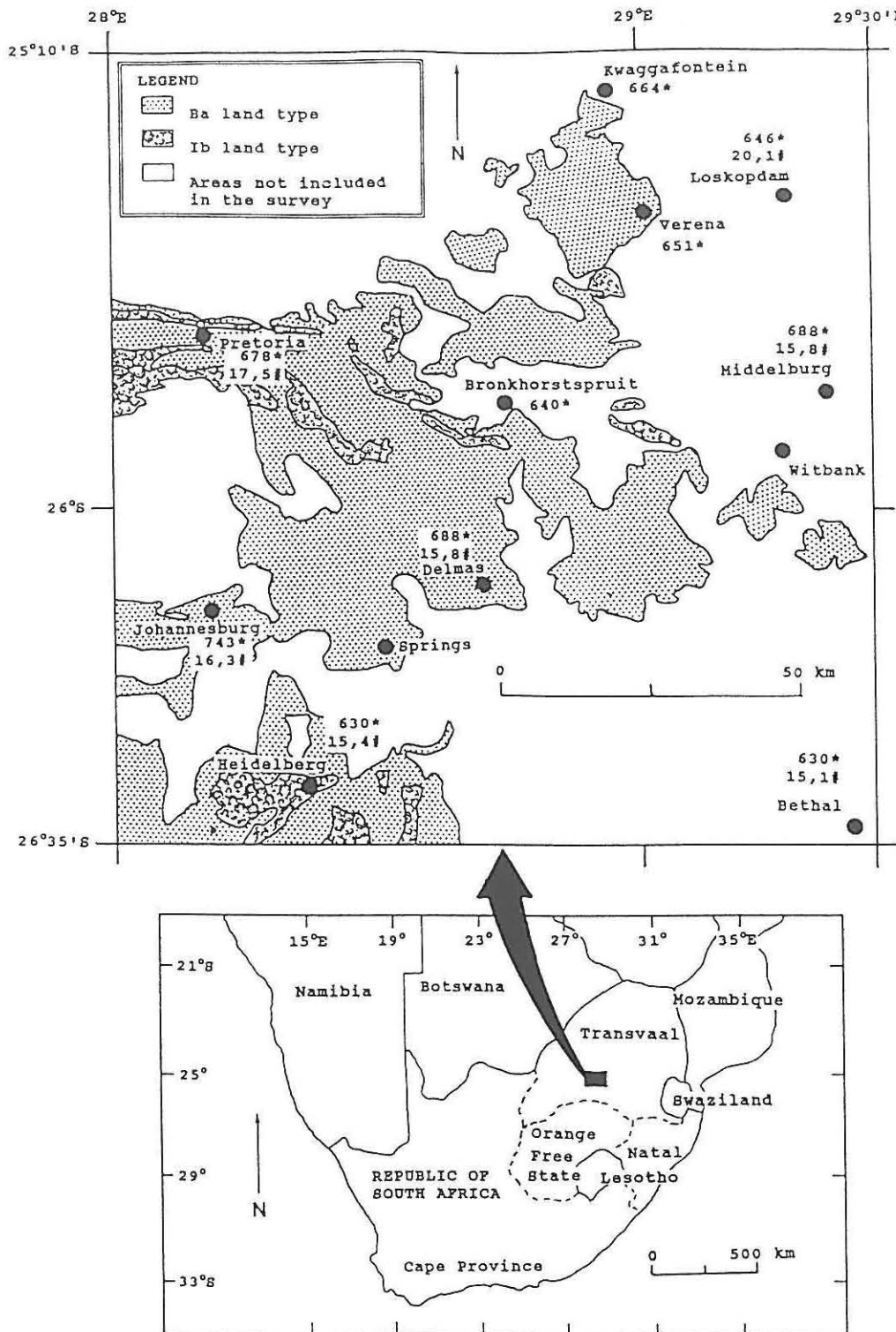


Figure 1 The Ba and Ib land types within the Pretoria–Witbank–Heidelberg area (adapted from Land Type Survey Staff 1987) and mean annual rainfall (*) and temperatures (#) for several weather stations (Weather Bureau 1986).

stratification units was applied for the first time, and with great success, in the classification of the grasslands of the North-West province by Bezuidenhout (1988). Subsequent studies by Bezuidenhout (1993) emphasized the usefulness of this way of stratification, especially as this procedure enabled the successful identification of plant community types on both regional and farm scales. This procedure was also followed by Kooij (1990) in the north-western Free State, Breytenbach (1991) in the southern parts of Eastern Transvaal and Smit (1992) in the grasslands of north-western KwaZulu-Natal.

Plot sizes varied from 200 m² in woody areas to 16 m² in grassland vegetation, in accordance with Bredenkamp and Theron (1978). In each sample plot the floristic composition, using the Braun-Blanquet cover-abundance scale (Mueller-Dombois & Ellenberg 1974) was recorded. Taxon and author names conform to those of Arnold and De Wet (1993). The environmental information included land type, geology, terrain unit, aspect, slope, rockiness of the soil surface, soil type and depth, percentage clay, erosion, soil moistness and degree of utilization by herbivores.

The two-step classification methodology developed by Bezuiden-

hout (1993) and successfully applied by Behr and Bredenkamp (1988) and Bredenkamp *et al.* (1989) was followed. Firstly, major vegetation types were identified by using TWINSpan (Hill 1979), refining the results by Braun-Blanquet procedures, and the subsequent construction of a synoptic table (Coetzee *et al.* 1994). Secondly, individual relevés of the two distinct, though related major grassland communities identified, namely the *Bewsia biflora* – *Digitaria brazzae* Grassland of rocky areas and the *Helichrysum rugulosum* – *Conyza podocephala* Grassland, were classified separately, again using TWINSpan as a first approximation, and refining the results by Braun-Blanquet procedures. These grasslands are represented by 148 relevés and are presented in two phytosociological tables (Tables 1 & 2).

From the final phytosociological tables, fourteen plant communities were identified (Tables 1 & 2). Schematic diagrams of the habitat interpretation of each major plant community are presented in Figures 2 and 3.

Results

The *Bewsia biflora* – *Digitaria brazzae* Grassland is divided into eight distinct plant communities (Table 1), while the *Helichrysum rugulosum* – *Conyza podocephala* Grassland (Table 2) is divided into six distinct plant communities.

Classification

- 1. The *Bewsia biflora* – *Digitaria brazzae* Major Grassland
 - 1.1 *Bewsia biflora* – *Monocymbium cerasiiforme* Grassland
 - 1.1.1 *Eragrostis racemosa* – *Digitaria tricholaenoides* Grassland
 - 1.1.2 *Themeda triandra* – *Ledebouria ovatifolia* Grassland
 - 1.1.3 *Loudetia simplex* – *Rhus magalismontana* Grassland
 - 1.1.4 *Aristida junciformis* – *Stoebe vulgaris* Grassland
 - 1.1.5 *Loudetia simplex* – *Monocymbium cerasiiforme* Grassland
 - 1.2 *Bewsia biflora* – *Tristachya biseriata* Grassland.
 - 1.2.1 *Themeda triandra* – *Tristachya biseriata* Grassland
 - 1.2.2 *Hyparrhenia hirta* – *Aristida congesta* Grassland
 - 1.2.3 *Trachypogon spicatus* – *Bewsia biflora* Grassland
- 2 The *Helichrysum rugulosum* – *Conyza podocephala* Major Grassland
 - 2.1 *Themeda triandra* – *Setaria sphacelata* Grassland
 - 2.1.1 *Themeda triandra* – *Brachiaria serrata* Grassland
 - 2.1.2 *Themeda triandra* – *Heteropogon contortus* Grassland
 - 2.1.3 *Themeda triandra* – *Hyparrhenia hirta* Grassland
 - 2.1.4 *Themeda triandra* – *Ledebouria revoluta* Grassland

- 2.2 *Eragrostis gummiflua* – *Cynodon dactylon* Grassland
 - 2.2.1 *Eragrostis gummiflua* – *Pogonarthria squarrosa* Grassland
 - 2.2.2 *Eragrostis gummiflua* – *Aristida congesta* Grassland

Description of the plant communities

1. The *Bewsia biflora* – *Digitaria brazzae* Grassland (Coetzee *et al.* 1994)

The *Bewsia biflora* – *Digitaria brazzae* Grassland occurs on shallow, rocky soils of the quartzite ridges, representing the Ib land type. It is characterized by the diagnostic species *Tristachya rehmannii*, *Panicum natalense*, *Digitaria brazzae*, *Bewsia biflora* and *Monocymbium cerasiiforme* (Coetzee *et al.* 1994). Werger and Coetzee (1978) described this type of grassland as the Moist Cool-Temperate Grassland, and it represents Bankenveld (Acocks 1988).

The plant communities within this grassland are presented in Table 1.

1.1 *Bewsia biflora* – *Monocymbium cerasiiforme* Grassland (Coetzee *et al.* 1994)

This grassland community occurs on the rocky and stony slopes above an altitude of 1450 m with a mean percentage rockiness of 30% and an inclination of 8–20°. The soils are shallow (mean depth is 100 mm) with Mispah and Glenrosa soil forms. Rocky outcrops are conspicuous in this area. The higher percentage rockiness and outcrops in this grassland provides a micro-habitat that prevents excessive evaporation of water (Theron 1973; Bezuidenhout *et al.* 1994). Thus this grassland is moister than the not-rocky communities.

Diagnostic species are the graminoids *Loudetia simplex*, *Sporobolus pectinatus*, *Monocymbium cerasiiforme*, *Brachiaria nigropedata* and *Ctenium concinnum*, the xerophytic sedge *Bulbostylis burchellii*, the xerophytic fern *Cheilanthes hirta* and the forbs *Indigofera comosa*, *Xerophyta retinervis* and *Acalypha angustata* (species group E, Table 1). The most conspicuous species are *Loudetia simplex*, *Monocymbium cerasiiforme* and *Themeda triandra*. Five plant communities were recognized in this grassland.

1.1.1 The *Eragrostis racemosa* – *Digitaria tricholaenoides* Grassland

This plant community is restricted to the Witpoort area, north-east of Delmas, within the Ba land type. It occurs on a localized geological feature of quartzitic ridges, with minor hornfels from the Magaliesberg Formation within the Pretoria Group. This

Table 1 Phytosociological table of the *Bewsia biflora* – *Digitaria brazzae* Grassland

Community number	1.1.1	1.1.2	1.1.3	1.1.4	1.1.5	1.2.1	1.2.2	1.2.3
Species Group A								
<i>Digitaria tricholaenoides</i>	11+		+				+	
<i>Aristida aequiglumis</i>	+1				+	+		
<i>Oldenlandia herbacea</i>	+++							
<i>Pollichia campestris</i>	+++			+++				
<i>Melinis nerviglume</i>	A+	+	+		+			+
<i>Landolphia capensis</i>	++						1	
<i>Kalanchoe thyrsiflora</i>	++							
Species Group B								
<i>Ledebouria ovatifolia</i>	+	+++	+		+		+	
<i>Ipomoea bathycolpos</i>	+	+++R			+	++		+
<i>Indigofera sordida</i>		++						
<i>Dianthus mooiensis</i>		++		+				
<i>Senecio lydenburgensis</i>		++						
<i>Hypoxis iridifolia</i>		++						
<i>Graderia subintegra</i>		++						
<i>Striga elegans</i>	+	++			+		+	+
<i>Ipomoea crassipes</i>		++						

Table 1 Continued

	000	000	11101111021	112222222	2111021122201200112210212	111111010221	200222222202122202	121222202122	
	223	100	66746677103	990001115	6795756504075589766327745	451435438357	284425233315934573	460330676556	
	890	087	14365240178	763121453	0287399858429837104526021	925750995746	142770890637210552	036846245121	
Community number	1.1-1	1.1-2	1.1-3	1.1-4	1.1-5	1.2-1	1.2-2	1.2-3	
Species Group C									
<i>Rhus magalismontana</i>	++		+++ + ++ +	++					
<i>Fadogia homblei</i>	+		++ + + ++		+				
<i>Aloe davyana</i>			++ + ++			+	++	+	
<i>Aristida canescens</i>			++ A1						
<i>Lopholaena coriifolia</i>	1+		++ + A	+	A +	+			
<i>Pellaea calomelanos</i>	+		+++ +		+	+			
<i>Chaetacanthus setiger</i>			+++ +		+				
<i>Lapeirousia sandersonii</i>	R		+ + +						
<i>Euphorbia clavarioides</i>			++ +			+			
Species Group D									
<i>Aristida junciformis</i>				33AA1A1++	+	1	1		
<i>Stoebe vulgaris</i>			++	+1++++1++	+	+	1+	+	
Species Group E									
<i>Loudetia simplex</i>	1+		A1+1AA11 11	+++1 BB	A11 +AA11 + 1A3 11	A	+	1	
<i>Bulbostylis burchellii</i>	+++		++ 1++++	+	+	+	+	+	
<i>Monocymbium cerasiiforme</i>			+11 +1+1	1+	+++1++ 1 +++11 + 1B+ ++ +				
<i>Sporobolus pectinatus</i>	1	+++	+ + + ++	++ + ++	++ + ++ + 1+				
<i>Indigofera comosa</i>	+		++ + ++	+++ + ++	++ + ++				
<i>Xerophyta retinervis</i>			++ + ++ +	++ + ++	++ + ++				
<i>Brachiaria nigropedata</i>			1+ +	+++ +	++ + ++ +	1			
<i>Acalypha angustata</i>		+++	+ + ++ ++	+	+	+			
<i>Ctenium concinnum</i>	++	+	+		++ + ++ + + 1				
<i>Cheilanthes hirta</i>			++	++	++ +				
Species Group F									
<i>Panicum natalense</i>	+	+++	++ ++ ++	+	+	+	+	+	
<i>Andropogon schrensis</i>			+ + + + +	+	+	+	+	+	
<i>Senecio venosus</i>	+	+	+	+	+	+	+	+	
<i>Thesium sp.</i>	+	+++	+ + +	+	+	+	+	+	
<i>Pentstemon angustifolia</i>			+	+	+	+	+	+	
Species Group G									
<i>Hyparrhenia hirta</i>				++					
<i>Aristida congesta</i>	+			+		+			
<i>Melinis repens</i>	+++	+		+++					
<i>Hypoxis hemerocallidea</i>	+			+					
<i>Trichoneura grandiglumis</i>	+			+		+			
<i>Pogonarthria squarrosa</i>	+		1			+			
<i>Heteropogon contortus</i>	+	++							
<i>Pygmaeothamnus zeyheri</i>	++								
<i>Eragrostis gummiflua</i>				+	+	++			
Species Group H									
<i>Tristachya biseriata</i>			111 11		1	1 AA	1	1A A B B	
<i>Sphenostylis angustifolia</i>				++	+	+	++	B A A 1+	
<i>Brachiaria serrata</i>	+	+	+	+	+	+	++	1 1A A 1	
<i>Cymbopogon excavatus</i>							+	+++ + + +	
<i>Vernonia oligocephala</i>							+	+++ + +	
Species Group I									
<i>Digitaria brazzae</i>			+1 1++ + +	+ B+1	++ + ++ 1 ++1+1	A	+1+++ + +	+++ 1 +	
<i>Schizachyrium sanguineum</i>			+ + + 1+	++ +	+ 1++ 1+++ 1 +	+++1	++A 1 +	A+ ++ ++ +	
<i>Trachypogon spicatus</i>			1	+++ +	++ ++ + + + +	1++1	1 + 1+A+	1 11B+ +++ +	
<i>Helichrysum coriaceum</i>				+	++ + ++	+	++ + ++ +	++ + ++ +	
<i>Urelytrum agropyroides</i>	+	+	+	++	++ + ++ + +	+	+1++ +	+ + + + +	
Species Group J									
<i>Themeda triandra</i>	11+	BBB	++ + +B +	+1 A+1 B	AA +AA11AA1BA1 B1A 13A1+1	3A3+B31ABAB	+111 1++11A +1+1	3AA113A+ ++A	
<i>Eragrostis racemosa</i>	+1+	1A+	+11+++++1	+111+++1	++++1+ 11++1+1+1+++1 1+++	+++++11+1 11	+1 1 + 1+ + + +	1+ +++++	
<i>Diheteropogon amplexens</i>	++		1 ++++++1 ++	+1 +	++ +++++1+1+1+++ 1+++1	+11+ + + + +	1+ + 1 +++++	+++ + + A+	
<i>Tristachya rehmannii</i>	11	BB	1B+++A1A1	+A +1+++	A 1A A11+AA1 ++A1+ AB B	1 A 1 + B	1 B 1 1	++ + + 1 +	
<i>Eragrostis curvula</i>	+		+ + 1+1	+3B1 3A3+	1 1+A+ 1 +1 +	1 3	A11BA111 +B 1A1A1A	+ 1+A+ 1A 1	
<i>Setaria sphacelata</i>	11 +		1 A	+	1+ 1 A1 +	1 1+ 11 A1+	1A++ A 111A1+A1B11	BA11 ++ 1	
<i>Elionurus muticus</i>	+A1	+11	+ + 1	+	+	+	1 + ++ ++ ++	+ + +1 + 1 +	
<i>Parinari capensis</i>	1+		++ + + + + ++	+++	+	+	+ + + + + + +	+++ +	
<i>Bewsia biflora</i>	+++	++		++ ++	+	+	++ + ++	+ + + + + + +	
<i>Helichrysum cephaloidium</i>	+		+	+	+	+	++ + ++	+++ + + +	
<i>Digitaria monodactyla</i>	++		+	+++ +	++ + + + + +	+	++ + ++ + + +	+++ + + 1	
<i>Hypoxis obtusa</i>	+++	+	+	+	++ + + + + + + +	++	+++ +	+++ + + +	
<i>Justisia anagaloides</i>	+	+++	+	++	+	+	++ + ++	+++ + + +	
<i>Elephantorrhiza elephantina</i>	+++	+	+	+	+	+	++ + ++	+ + + + + +	
<i>Ipomoea ommaneyi</i>	+		+	++ +	+	+	++ +	+ + + + + +	
<i>Hypoxis rigidula</i>	+	+++	+	++	+	+	++ + ++	++ + + + +	
<i>Rhynchosia monophylla</i>	+		++ ++ +	+	+	+	+	+ + + + + +	
<i>Eragrostis nindensis</i>	+		+ 1 +				11	++ + + + +	
<i>Pearsonia sessilifolia</i>	+				+	+	+	++ + + + +	
<i>Senecio coronatus</i>	+				+	+	+	+ + + + + +	
<i>Vernonia natalensis</i>	+				+	+	+	+ + + + + +	
<i>Dicoma anomala</i>	+			+	++	+	+	+ + + + + +	
<i>Eriosema burkei</i>				+	++ +		+	+ + + + + +	
<i>Boophae disticha</i>	+				+	+	+	+ + + + + +	
<i>Burkea africana</i>					1 1 1	1	1	+ + + + + +	
<i>Cleome maculata</i>	+		++ +	+	+	+	+	+ + + + + +	
<i>Cassia comosa</i>					+	++		+ + + + + +	
<i>Helichrysum dasymalum</i>			+	+	+	+	+	+ + + + + +	
<i>Eragrostis plana</i>	14	+				A		+ + + + + +	
<i>Ledebouria revoluta</i>			+	+				+ + + + + +	
<i>Cymbopogon plurinodis</i>	+	+			+	+	+	+ + + + + +	
<i>Indigofera aleoides</i>			+		+	+	+	+ + + + + +	
<i>Protasparagus suaveolens</i>	++		+					+ + + + + +	

Table 2 Phytosociological table of the *Helichrysum rugulosum* – *Conyza podocephala* Grassland

	00000000000002	000000000	112001000010	12111	11222222	2202220
	02036614063564	534526225	882558396395	71349	88024441	0444430
	10444671236416	088912426	780856540713	50119	45991942	8542335
Community number	2.1.1	2.1.2	2.1.3	2.1.4	2.2.1	2.2.2
Species Group A						
<i>Polygala hottentotta</i>	+++++++ ++		+			
<i>Conyza podocephala</i>	+++++ R++		+			
<i>Brachiaria serrata</i>	1++ + + ++ +	+				
<i>Peucedanum magalismontanum</i>	R ++ + R +					
<i>Cyperus obtusiflorus</i>	R++ + ++					+
<i>Ipomoea crassipes</i>	R+++ ++					
<i>Rhynchosia monophylla</i>	+ +++ +		+			+
<i>Senecio affinis</i>	+ + + +			+		
<i>Microchloa caffra</i>	+ ++ +	+				
Species Group B						
<i>Heteropogon contortus</i>	+++ + + + 1+	+11+ ++				
<i>Eragrostis capensis</i>	+A ++ +++++	+ 1 +1+				
<i>Helichrysum nudifolium</i>	+ +++++++ ++	++ +				
<i>Hypoxis rigidula</i>	+ ++ +1+++ +	++ +	++		+	+
<i>Tolpis capensis</i>	++ ++ R	+ +++++				
<i>Justicia anagalloides</i>	+ + + + +	+++ +			+	
<i>Bewisia biflora</i>	+ + + ++	+++				
<i>Ledebouria ovatifolia</i>	+ R + ++	+	+			
<i>Panicum natalense</i>	+ + +	1+				
<i>Ipomoea bathycolpos</i>	+ + + ++					+
<i>Hypoxis obtusa</i>	+ + + +	+ +				+
<i>Gladiolus sp.</i>	+ + + +	R ++				
<i>Abildgaardia ovata</i>	++ R	+ +				
Species Group C						
<i>Helichrysum rugulosum</i>	+++1++++ +++++	+++1+	+++++ ++++++	+		+
<i>Eilonurus muticus</i>	1AA+ +AA+1+	1+1A++1A+	+ 11++ 1 A	+	+	
<i>Hermannia depressa</i>	+++ ++ +++ +	+++	++ + + +++		+	
<i>Acalypha angustata</i>	+ + +++++++ ++	+	++ + + +			
<i>Anthospermum hispidulum</i>	++++ +R+++	+ +	+ ++ + +			
<i>Vernonia oligocephala</i>	++ + +++ ++	+ +	+++ + +		+	
<i>Pentanisia angustifolia</i>	+ + + + +++	+ +	++ + + ++		+	
<i>Cymbopogon excavatus</i>	+ + + A ++ ++	1 + + +	++ + + +			
<i>Senecio inornatus</i>	+ + ++ +	+	++ + ++			
<i>Cucumis zeyheri</i>	R+ + +	++ +	+ + ++			+
<i>Crabbea angustifolia</i>	+ + + ++		++ ++ +			
<i>Ziziphus zeyheriana</i>	+ + +	+ +	+ + +			+
<i>Berkheya radula</i>	+ + +	+ +	+ +			+
<i>Verbena bonariensis</i>	+ + +	+	+ ++			
Species Group D						
<i>Themeda triandra</i>	BAB114+ 1B3A13	B+AB A+BB	1111B1+3B113	A1+A	1+	1 1
<i>Setaria sphacelata</i>	+1 11 +++++1B1B	1+1 A41	11 1	A14 3		
<i>Helichrysum coriaceum</i>	++ + +++		++ +	++ +		+
Species Group E						
<i>Melinis repens</i>		+	+ ++		1+++1++	+
<i>Pogonarthria squarrosa</i>					+++++ +	
<i>Trichoneura grandiglumis</i>					+++ ++	
Species Group F						
<i>Cynodon dactylon</i>			+1+ + +	+	+111+1+	A1+
<i>Aristida congesta</i>		++	+ ++		+++ + 1+	++ ++
<i>Eragrostis gummiflua</i>		++		+	+ B +	++ +
Species Group G						
<i>Eragrostis curvula</i>	ABAB1 3B1A11	AAB A1B3B	3+ BB3A1A+BA	31AA	1AA3A33	B+A 3 3
<i>Eragrostis racemosa</i>	A+1+++ 1+A+1+	111+ A1	11 1 A1+ +	1+ 1	+ 1	+ 1
<i>Hyparrhenia hirta</i>	A +AA A +	13A14	A B3AA4 3 A	1	34 1 +1+	+A +5
<i>Eragrostis plana</i>	A AA	A A 1	+ B 4B+	1	B +B+	14+A+
<i>Stoebe vulgaris</i>	+ + + +	1+ +R +	+ + +	1	+ ++ A	A +
<i>Thesium sp.</i>	++ ++	+		++		
<i>Hermannia transvaalensis</i>	+ + +			++		
<i>Cymbopogon plurinodes</i>	+ + +			++ +		
<i>Ledebouria revoluta</i>		R +		+++		
<i>Lippia javanica</i>		+ +		+		
<i>Helichrysum cephaloideum</i>	+ + +			+		++
<i>Hypoxis hemerocallidea</i>		+ + ++		+		
<i>Solanum incanum</i>	R		+	+		+
<i>Digitaria monodactyla</i>		+ +		1		R
<i>Trachypogon spicatus</i>		++ + ++				+
<i>Senecio coronatus</i>	+ + +	+				

community is situated from 1450 to 1500 m above sea level. The soils are shallow (>100 mm) with the Mispah and Glenrosa soil forms predominant. The clay content of the soil is <15%. Many

rock sheets and rocky outcrops are found, with rocks covering 50–60% of the soil surface. This community is not restricted to a specific aspect, and occurs on both north- and south-facing

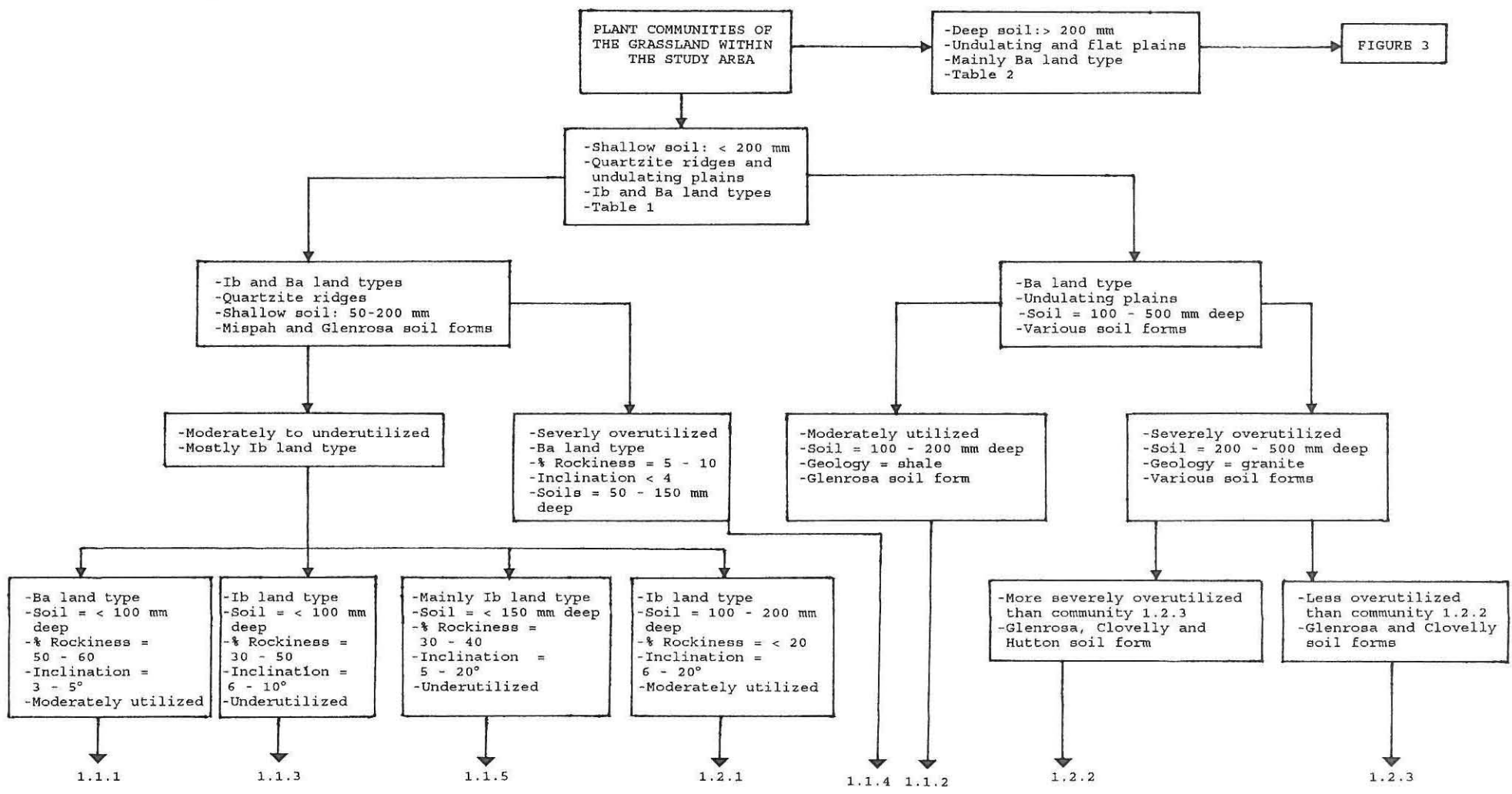


Figure 2 A hierarchical habitat interpretation of the *Bewsia biflora* – *Digitaria brazzae* Grassland (Table 1). Community numbers correspond with descriptions in text.

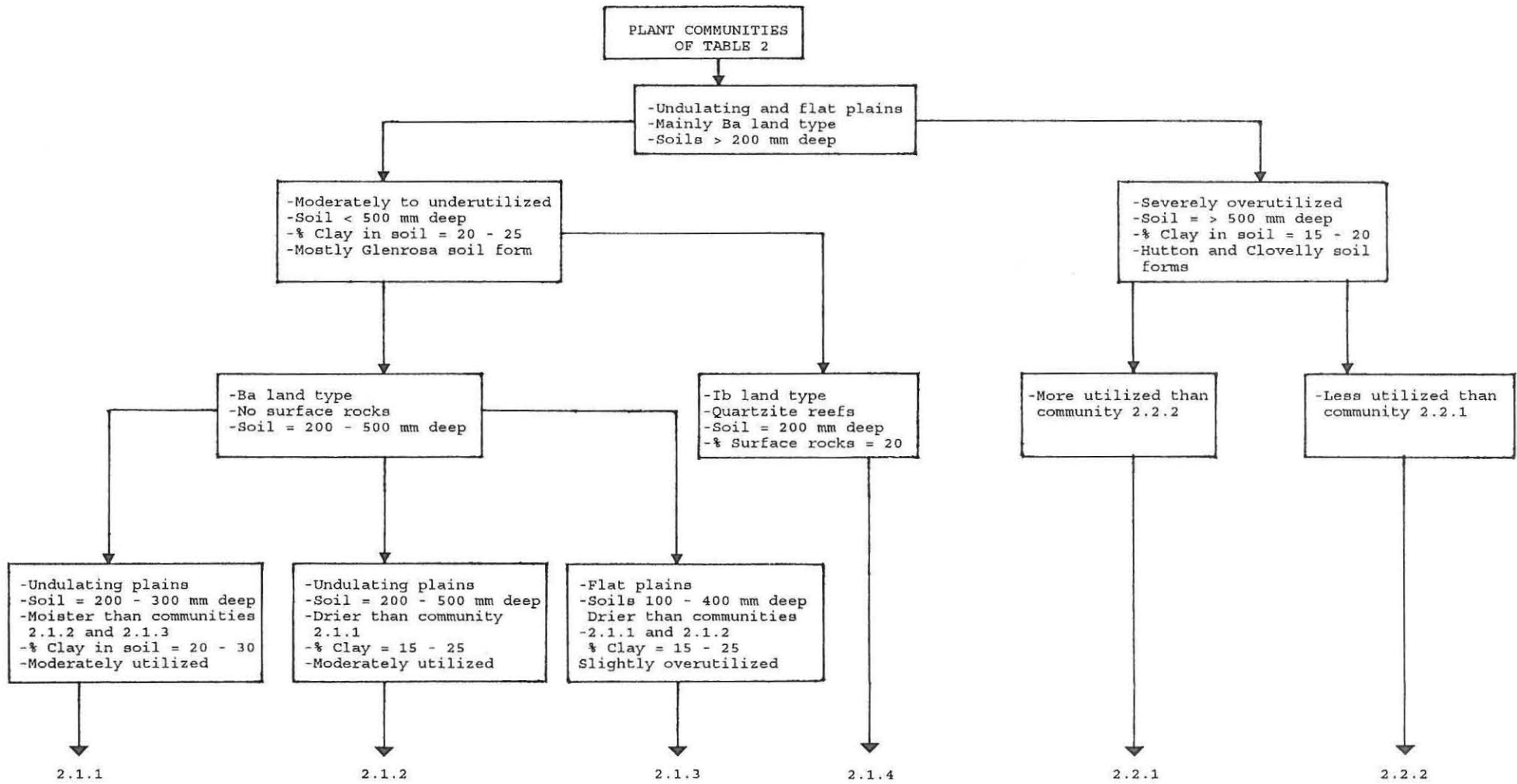


Figure 3 A hierarchical habitat interpretation of the *Helichrysum rugulosum* – *Conyza podocephala* Grassland (Table 2). Community numbers correspond with descriptions in text.

slopes with an inclination of 3–5°, and also on the crests.

The only woody species found in this community are the small (0.5–1.5 m) evergreen semi-succulent shrub *Lopholaena coriifolia*, the scandent diagnostic *Landolphia capensis* and the dwarf shrub *Rhus magalismsontana*. The most abundant perennial grass species are the densely tufted *Elionurus muticus*, *Eragrostis racemosa*, *E. plana* and *Themeda triandra* and the rhizomatous, tufted *Bewisia biflora*. A conspicuous xerophytic sedge is the thread-like *Bulbostylis burchellii*. The following perennial graminoids are diagnostic (species group A, Table 1) for this community: the rhizomatous and tufted *Digitaria tricholae-noides*, the stout rhizomatous and densely tufted *Aristida aequi-glumis* and the tufted *Melinis nerviglume*. The diagnostic forbs are the very slender *Oldenlandia herbacea* and the perennial, low-growing shrublet *Pollichia campestris*. An average of 49 species per sample plot was recorded. Most of these species are restricted to rocky areas.

1.1.2 The *Themeda triandra* – *Ledebouria ovatifolia* Grassland

This community was sampled on a localized area north-east of Delmas on the farm Groenfontein on diamictite and shale of the Dwyka Formation from the Karoo Sequence. This community is situated on the east- and west-facing slopes with an inclination of 3° and at an altitude of 1550 m. The soil contains about 15% clay and represents the Glenrosa soil form. Surface rock cover varies from 0 to 10%. This community is moderately utilized by livestock with little erosion present.

The most abundant graminoid species with a canopy cover of 12–25% are *Themeda triandra*, *Tristachya rehmannii* and the wiry, perennial and densely tufted *Eragrostis curvula*. Grass species with a smaller canopy cover, but still abundantly present, are *Elionurus muticus*, *Panicum natalense* and the rhizomatous *Sporobolus pectinatus*. No woody species occur in this community. All diagnostic species (species group B, Table 1) are forbs, including the geophyte *Ledebouria ovatifolia*, the scandent creeper *Ipomoea bathycolpos*, the shrublet *Indigofera sordida* and *Dianthus mooiensis*. An average of 41 species per sample plot was recorded.

1.1.3 The *Loudetia simplex* – *Rhus magalismsontana* Grassland

This community is found on quartzite and minor hornfels ridges representing the Ib land type on the Magaliesberg Formation from the Pretoria Group, situated 1500–1580 m above sea level. These areas lie north and north-west of the Bronkhorstspuit Dam with a few sample plots south-west of Pretoria. The community is situated mainly on the north-facing slopes with an inclination of 6–10°, and also on the crests of the ridges. The soil is shallow, from the Glenrosa soil form, with 30–50% surface rocks. The clay content of the soil is <15%. Most of the sample plots are undisturbed or underutilized, probably as a result of the unpalatable (sour) nature of the vegetation and the inaccessibility of the area.

Conspicuous species are the dwarf shrub *Rhus magalismsontana*, the tufted grasses *Loudetia simplex* and *Tristachya rehmannii* which are indicators of sour veld (Van Wyk & Malan 1988), the loosely tufted perennial grass *Monocymbium ceresiiforme* and also *Eragrostis racemosa*. The diagnostic woody species are the shrublets *Fadogia homblei*, *Lopholaena coriifolia* and *Rhus magalismsontana* (species group C, Table 1). The only diagnostic graminoid is the slender tufted perennial *Aristida canescens* subsp. *canescens*. Although *Aristida canescens* subsp. *canescens* is often an indicator of eroded and disturbed soil (Van Oudtshoorn 1991), it is not the case in this community, but rather of the naturally harsh, rocky environmental conditions. Only one sam-

ple plot was recorded that was slightly disturbed and eroded. Diagnostic succulent species are leaf succulent *Aloe davyana* and semi-succulent *Euphorbia clavarioides* with *Pellaea calomelanos* as diagnostic xerophytic fern and *Chaetacanthus setiger* and *Lapeirousia sandersonii* as diagnostic forbs (species group C, Table 1). An average of 27 species per sample plot was recorded.

1.1.4 The *Aristida junciformis* – *Stoebe vulgaris* Grassland

This community is restricted to rocky outcrops consisting of partly ferruginous shale, quartzite and banded ironstone of the Hospital Hill Formation of the West Rand Group and ferruginous shale of the Timeball Hill Formation of the Pretoria Group around Heidelberg. This community is not restricted to a specific aspect, but more than 50% of the sample plots were situated on north-facing slopes. The inclination is not more than 4°. A few rock sheets and outcrops (5–10% surface rocks) are prominent. The soils are shallow (50–150 mm deep) representing the Mispah and Glenrosa soil forms. The clay content in the soil is <15%. This community is severely overgrazed as indicated by the presence of *Aristida junciformis* subsp. *junciformis* (Gibbs Russell *et al.* 1991) and *Stoebe vulgaris* (Van Wyk & Malan 1988), both diagnostic species (species group D, Table 1). Species that can be regarded as relatively abundant are *Loudetia simplex*, *Sporobolus pectinatus*, *Bulbostylis burchellii* and *Indigofera comosa*. An average of 22 species per sample plot was recorded.

1.1.5 The *Loudetia simplex* – *Monocymbium ceresiiforme* Grassland

This community is found on rocky outcrops consisting of quartzite and minor hornfels from the Magaliesberg Formation of the Pretoria Group and shale, sandstone, conglomerate and volcanic rocks from the Loskop Formation of the Bushveld Complex south of Verena. This community is situated mainly in the Ib land type on altitudes varying from 1500 to 1690 m above sea level. The soil is shallow (<150 mm deep) representing the Glenrosa and Mispah soil forms. The clay content in the soil is about 15%. The surface rock cover varies from 30 to 40%. This community is not restricted to a specific aspect but occurs mainly on the south- and east-facing slopes and crests. The inclination varies mainly from 5 to 20° but extreme cases are recorded of up to 30°. Most of the sample plots were underutilized by livestock.

No diagnostic species is found and this community is characterized by the presence of species group E (Table 1) and the absence of species groups A, B, C and D (Table 1). There are no specific dominant species to be found, but the most abundant species are *Ctenium concinnum*, *Loudetia simplex*, *Monocymbium ceresiiforme*, *Panicum natalense*, *Andropogon schirensis*, *Sporobolus pectinatus* and *Bulbostylis burchellii*, all indicators of rocky habitats. This area was mapped by Acocks (1953, 1988) as Mixed Bushveld and/or Sourish Mixed Bushveld, but this vegetation clearly represents typical Bankenveld grassland (Coetzee *et al.* 1994). An average of 23 species per sample plot was recorded.

1.2 *Bewisia biflora* – *Tristachya biseriata* Grassland (Coetzee *et al.* 1994)

This vegetation unit can be found on slightly less stony undulating plains with a mean percentage rockiness on the soil surface of 5–10% and an inclination of 2–6°, and with drier and deeper soils (mean depth is 200 mm) than the *Bewisia biflora* – *Monocymbium ceresiiforme* Grassland.

Diagnostic species are the graminoids *Tristachya biseriata*, *Brachiaria serrata* and *Cymbopogon excavatus* and the forbs *Sphenostylis angustifolia* and *Vernonia oligocephala* (species group H, Table 1). Conspicuous species are *Eragrostis curvula*, *Setaria spbacelata*, *Elionurus muticus* and *Tristachya biseriata*.

1.2.1 The *Themeda triandra* – *Tristachya biseriata* Grassland

The hills, ridges and outcrops that consist of quartzite (Magaliesberg Formation), andesite (Hekpoort Formation) and dolomite (Malmani Subgroup), all of the Pretoria Group, represent the largest area of this community. Although this community occurs mainly on the Ib land type (Figure 1), a few sample plots are also situated in the Ba land type. This community is only found on south-facing slopes on the hills and ridges. The inclination does not exceed 6° on the hills but may be as steep as 20° on the quartzite ridges. The altitude varies from 1450 to 1550 m. The soil is shallow (100–200 mm), contains more or less 15% clay and represents the Glenrosa and Mispah soil forms. Rocky outcrops and rock sheets do not occur frequently and the surface rock cover does not exceed 20%. Most of the sample plots are moderately utilized to overutilized by livestock.

This grassland is characterized by the presence of species group F (Table 1) and the absence of species group E (Table 1). The presence of species group H (Table 1) indicates an environment that is less rocky with slightly deeper soils and a more undulating landscape. The most abundant graminoid species are the rhizomatous and densely tufted perennial *Panicum natalense* that is an indicator of sour veld (Van Wyk & Malan 1988; Van Oudtshoorn 1991), *Themeda triandra*, the perennial rhizomatous *Diheteropogon amplexans*, *Eragrostis racemosa* and the fairly robust, rhizomatous and tufted perennial *Setaria sphacelata*. An average of 25 species per sample plot was recorded.

1.2.2 The *Hyparrhenia hirta* – *Aristida congesta* Grassland

This grassland is mainly found on grey to pink coarse-grained granite from the Lebowa Granite Suite of the Bushveld Complex west and south-west of Verena. This community is situated at 1400–1500 m above sea level on the Ba land type. The landscape consists of slightly undulating plains with slopes of not more than 6°. The aspect is of no importance in this community. The soils are relatively deep (100–500 mm) representing the Glenrosa, Clovelly and Hutton soil forms. The clay content in the soil varies from 15 to 20%. In most of the sample plots no surface rocks were encountered. This community is severely overgrazed, with moderate to severely eroded areas. Termite mounds occur abundantly in some areas. As is the case with the *Loudetia simplex* – *Monocymbium ceresiiforme* Grassland (community 1.1.5), this community also represents Bankenveld grassland rather than Mixed or Sourish Mixed Bushveld as mapped by Acocks (1953, 1988).

The vegetation is mostly dominated by the rhizomatous and wiry perennial tall grass *Hyparrhenia hirta*, while the tufted perennials *Heteropogon contortus*, *Eragrostis curvula* and *Setaria sphacelata* are also abundantly present. The diagnostic graminoids are *Hyparrhenia hirta*, the annual pioneers *Aristida congesta* and *Trichoneura grandiglumis* and the perennial pioneers *Pogonarthria squarrosa*, *Eragrostis gummiflua* and *Heteropogon contortus*. The two diagnostic non-grassy species are the geophyte *Hypoxis hemerocallidea* and the erect, sparsely branched geophyte dwarf shrublet *Pygmaeothamnus zeyheri*. An average of 23 species per sample plot was recorded.

1.2.3 The *Trachypogon spicatus* – *Bewsia biflora* Grassland

The presence of species groups H, I and J, and the simultaneous absence of species groups F and G, are characteristic features of this community. This grassland is poor in species. It is closely related, environmentally and floristically, to the *Hyparrhenia hirta* – *Aristida congesta* Grassland (community 1.2.2), but the vegetation is less overgrazed, resulting in the absence of species group G (Table 1), which mostly contains pioneer species. It differs from the other communities of the *Bewsia biflora* – *Tristachya biseriata* Grassland in that the species of species

groups F and G (Table 1) are absent. The vegetation is dominated by *Themeda triandra*, with *Eragrostis curvula* and *Tristachya biseriata* also prominent. An average of 20 species per sample plot was recorded.

2. *Helichrysum rugulosum* – *Conyza podocephala* Grassland (Coetzee *et al.* 1994)

The *Helichrysum rugulosum* – *Conyza podocephala* Grassland is mainly restricted to moist, deep, not rocky soils and is mostly found on the undulating and flat plains within the Ba land type. Werger and Coetzee (1978) described this vegetation unit as the Moist Cold-Temperate Grassland, and it represents *Cymbopogon* – *Themeda* Veld (Acocks 1988).

Diagnostic species are *Cynodon dactylon*, *Eragrostis capensis*, *Helichrysum rugulosum*, *Anthospermum hispidulum*, *Hermannia depressa* and *Conyza podocephala* (Coetzee *et al.* 1994).

The plant communities of this grassland are presented in Table 2.

2.1 *Themeda triandra* – *Setaria sphacelata* Grassland

This grassland represents less disturbed or lightly to moderately grazed areas which are characterized by the prominence of *Themeda triandra* and *Setaria sphacelata* (species group D, Table 2).

2.1.1 The *Themeda triandra* – *Brachiaria serrata* Grassland

This community is found on carbonaceous shale from the Silverton Formation of the Pretoria Group and on diabase of the Waterberg Group. The landscape consists of very gentle undulating plains with flat areas. The inclination does not exceed 4° and the aspect is of no importance. The soils are 200–300 mm deep, mainly representing the Glenrosa and Clovelly soil forms. The clay content of the soil varies from 20 to 30%. Most of the sample plots in this community occur in depressions that are moister than the habitat of the other communities in Table 2. This community is moderately utilized by livestock with only a few sample plots that are overgrazed.

This community can easily be distinguished by the following diagnostic species: the slender forbs *Polygala hottentotta* and *Peucedanum magalimontanum*, the perennial sedge *Cyperus obtusiflorus* subsp. *obtusiflorus* and the perennial short graminoid *Microchloa caffra* (species group A, Table 2). Many of the diagnostic species are indicators of slightly moist conditions (Van Wyk & Malan 1988). Abundant species, with a total canopy cover of 5–25%, are the graminoids *Themeda triandra*, *Setaria sphacelata*, *Eragrostis curvula* and *Eragrostis racemosa*. An average of 35 species per sample plot was recorded.

2.1.2 The *Themeda triandra* – *Heteropogon contortus* Grassland

This community is mainly situated on shale from the Silverton Formation of the Pretoria Group. The landscape is similar to that in community 2.1.1 except for a few sample plots with a more steep inclination (6°). The soil depth varies from 200 to 500 mm with a clay content of 15–25%. The soil is mostly representative of the Glenrosa soil form. The vegetation in the sample plots is lightly or moderately utilized. The main difference between this community and community 2.1.1 is that the habitat of this community is drier (see community 1.1), resulting in the absence of species from species group A. The most abundant species are the grass species *Elionurus muticus*, *Themeda triandra*, *Setaria sphacelata*, *Eragrostis curvula*, *E. racemosa* and also *Hyparrhenia hirta* in some places. No diagnostic species were identified but the community can be recognized by the presence of species group B and the absence of species group A (Table 2). An average of 25 species per sample plot was recorded.

2.1.3 The *Themeda triandra* – *Hyparrhenia hirta* Grassland

This community is found on various geological formations, namely shale and hornfels from the Silverton Formation of the Pretoria Group, diabase from the Waterberg Group, dolomite and chert from the Chuniespoort Group, all between Pretoria and Delmas, and also on basaltic lava, agglomerate and tuff from the Klipriviersberg Group around Heidelberg (Figure 1). This community occurs on flat plains and its habitat is drier than that of communities 2.1.1 and 2.1.2. The soil in most of the sample plots contains 15–25% clay. The soil is mainly of the Glenrosa and Hutton forms and the soil depth varies from 100 to 400 mm. This community shows signs of overutilization, as indicated by the presence of the pioneer graminoids *Cynodon dactylon* and *Aristida congesta* (species group F, Table 2).

This grassland is characterized by the presence of species group C and the absence of species group B (Table 2). Although the grass species *Eragrostis curvula* and *Themeda triandra* are the most prominent species, tall-growing *Hyparrhenia hirta* is locally the most conspicuous in overgrazed areas. Other species constantly present in this community are the grasses *Elionurus muticus* and *Eragrostis curvula* and the forbs *Helichrysum rugulosum*, *Hermannia depressa*, *Acalypha angustata* and *Senecio inornatus*. An average of 20 species per sample plot was recorded.

2.1.4 The *Themeda triandra* – *Ledebouria revoluta* Grassland

This grassland is restricted to the south-facing slopes (4–8°) and crests of quartzite ridges with soils about 200 mm deep, within the Ib land type. The soil is well drained and drier than that of communities 2.1.1, 2.1.2 and 2.1.3, with a clay content of less than 15%. Surface rocks are mostly rare, but may have a cover of 20% locally. All the sample plots in this community were undisturbed and underutilized.

This community is characterized by the presence of species group D and the absence of species group C (Table 2). The most conspicuous and dominant grass species are *Themeda triandra*, *Setaria sphacelata* and *Eragrostis curvula*. Species with a relatively high presence but of no diagnostic value, are the graminoid *Cymbopogon plurinodis* and the geophyte *Ledebouria revoluta* (species group G, Table 2). Species that can be regarded as locally common are *Hyparrhenia hirta*, *Eragrostis plana* and *Stoebe vulgaris* (species group G, Table 2). An average of 15 species per sample plot was recorded. This relatively low species richness is typical of areas where the vegetation is dominated by the tall-growing *Hyparrhenia hirta* which overshadows and excludes many other species.

2.2. *Eragrostis gummiflua* – *Cynodon dactylon* Grassland

This grassland represents overgrazed and trampled areas which are characterized by species group F (Table 2) and where *Themeda triandra* and *Setaria sphacelata* are almost entirely absent. This degraded community is situated on shale and tillite from the Dwyka Formation of the Karoo Sequence and basaltic lava, agglomerate and tuff from the Klipriviersberg Formation. These flat plains consist mainly of the deep (>500 mm) Hutton and Clovelly soil forms with a clay content of 15–20%. This grassland is severely overgrazed and disturbed and many areas were cultivated, resulting in pioneer vegetation.

2.2.1 The *Eragrostis gummiflua* – *Pogonarthria squarrosa* Grassland

The most conspicuous grass species are *Eragrostis curvula*, *Hyparrhenia hirta* and the perennial densely tufted *Eragrostis plana* (species group G, Table 2). The diagnostic species are the tufted, pioneer or sub-climax annual *Melinis repens* and *Trichoneura grandiglumis* and the tufted, pioneer perennial *Pogo-*

narthria squarrosa. The disturbed nature of this vegetation is further emphasized by the constant occurrence of the pioneer grasses *Cynodon dactylon*, *Aristida congesta* and *Eragrostis gummiflua* (species group F, Table 2). An average of 11 species per sample plot was recorded.

2.2.2 The *Eragrostis gummiflua* – *Aristida congesta* Grassland

The geographical distribution and environmental conditions of this community are similar to those of community 2.2.1, indicating that these communities may be regarded as floristically and ecologically related, but that they are in different stages of degradation due to different degrees of overgrazing. This community is characterized by the presence of species group F and the absence of species group E (Table 2), resulting in a poorer species composition. It is entirely dominated by pioneer species such as *Cynodon dactylon*, *Aristida congesta*, *Eragrostis gummiflua*, *Eragrostis curvula* and *Hyparrhenia hirta*, indicating that this community is more degraded than community 2.2.1. An average of 12 species per sample plot was recorded.

Concluding remarks

All plant communities are clearly related to specific environmental conditions and are therefore ecologically recognizable and interpretable. The delineation of the plant communities and associated habitats of the grassland of the Pretoria–Witbank–Heidelberg area should be used as the basis for future management and conservation of these areas.

Large parts of the study area that were mapped by Acocks (1953, 1988) as Bankenveld, should, according to Coetzee *et al.* (1994), be regarded as part of the Northern Variation of the *Cymbopogon* – *Themeda* Veld. These areas are classified within the *Helichrysum rugulosum* – *Conyza podocephala* which is based on the species composition, similar to the Northern Variation of the *Cymbopogon* – *Themeda* Veld. The Bankenveld, on the contrary, is represented by the *Bewsia biflora* – *Digitaria brazzae* Grassland (Coetzee *et al.* 1994). These findings are supported by the phytosociological tables (Tables 1 & 2) of the two vegetation units. Species that are typical of the *Cymbopogon* – *Themeda* Veld (Acocks 1953, 1988) are *Setaria sphacelata*, *Themeda triandra*, *Heteropogon contortus*, *Helichrysum rugulosum*, *Cynodon dactylon*, *Brachiaria serrata*, *Eragrostis plana*, *Cymbopogon plurinodis* and *Eragrostis* spp., and those of the Bankenveld, *Trachypogon spicatus*, *Digitaria tricholaenoides*, *Tristachya leucothrix*, *Loudetia simplex*, *Tristachya rehmannii*, *Monocymbium ceresiiforme*, *Urelytrum agropyroides*, *Diheteropogon amplexens*, *Digitaria monodactyla* and *Parinari capensis*. Some species with a wide ecological amplitude, for example *Setaria sphacelata*, *Themeda triandra* and *Eragrostis racemosa*, occur in both vegetation units (Tables 1 & 2) but are often more conspicuous in the one unit than in the other.

According to Coetzee *et al.* (1994), the part of the Ba land type that is situated in the Mixed Bushveld and/or Sourish Mixed Bushveld map units of Acocks (1953, 1988), to the north and south-west of Verena, should be regarded as Bankenveld. The plant communities found in those areas are classified within the *Loudetia simplex* – *Monocymbium ceresiiforme* and the *Hyparrhenia hirta* – *Aristida congesta* Grasslands which are both classified within the *Bewsia biflora* – *Digitaria brazzae* Grassland, typical of Bankenveld vegetation.

Although various grassland communities have already been described by various authors, for example Bredenkamp and Theron (1980), Kooij *et al.* (1990) and Bezuidenhout and Bredenkamp (1991), and although floristic and ecological similarities with some of the plant communities described in this report, may occur, a syntaxonomic comparison of the grassland

communities is at present not desirable because of the lack of phytosociological data in large parts of Eastern Transvaal. Studies are presently undertaken in these areas and a syntaxonomic synthesis should be done when these data are available.

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