

The vegetation and identification of management units of the Imberbe Game Lodge in the mixed bushveld of the north-western Transvaal

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An analysis of the vegetation of the Imberbe Game Lodge in the mixed bushveld of the north-western Transvaal is presented. Relevés were compiled in 39 stratified random sample plots. Four distinct plant communities were identified by means of Braun-Blanquet procedures. The data were ordinated using detrended correspondence analysis (DECORANA) to investigate possible relationships and gradients in and between the plant communities. Three management units were determined by means of a vegetation ordination. A hierarchical classification, description and ecological interpretation of the plant communities as well as a description of the management units are presented.

'n Analise van die plantegroei van die Imberbe Game Lodge in die gemengde bosveld van die Noordwes-Transvaal word gegee. Opnames is in 39 monsterpersele, wat op 'n gestratifiseerd ewekansige wyse uitgeplaas is, uitgevoer. Vier plantgemeenskappe is deur middel van Braun-Blanquet-prosedures geïdentifiseer. Die data is met behulp van die ontneigde ooreenstemmingsanalise (DECORANA) georden om moontlike verwantskappe en gradiënte binne en tussen die onderskeide plantgemeenskappe te ondersoek. Drie bestuurseenhede is deur middel van die plantegroei-ordening geïdentifiseer. 'n Hierargiese klassifikasie, beskrywing en ekologiese interpretasie van die plantgemeenskappe sowel as 'n beskrywing van die bestuurseenhede word gegee.

Keywords: Braun-Blanquet classification, DECORANA, management units, mixed bushveld, ordination, plant communities.

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Introduction

The north-western Transvaal is an important agricultural region of southern Africa in terms of extensive stock ranching and since the early 1970s in terms of game ranching (Schmidt 1992). Droughts and intensive overgrazing have resulted in veld deterioration and it is also suggested that bush encroachment may have taken place over the years (Grossman 1988). Furthermore, since the broad vegetation classification and map presented by Acocks in 1953 (Acocks 1953; 1988), very few intensive studies regarding the classification and description of the vegetation of the north-western Transvaal bushveld have been undertaken (Pauw 1988; Van Staden 1992; Schmidt 1992). In view of the lack of information concerning the natural vegetation and the veld condition of the area, an ecological study of the area is necessary. It is clear that future land-use planning, management and conservation strategies must be based on sound plant ecological principles. To facilitate optimal resource utilization in general, and to assess the conservation status of the vegetation in particular, a detailed identification, classification and mapping of the vegetation of a region should be undertaken (Fuls *et al.* 1992).

Since plant associations commonly reflect a particular range of uniform environmental variables (Mueller-Dombois & Ellenberg 1974), the description and classification of homogeneous vegetation units forms the primary basis for delineation of homogeneous physiographic units for management purposes (Shackleton *et al.* 1991). The aim of this study was therefore to identify, describe and map the plant communities of the Imberbe Game Lodge, to correlate these with selected environmental factors, and to delineate management units.

Study area

The Imberbe Game Lodge (1943 ha) is situated between 28°13' and 28°16' E longitude and 23°25' and 23°30' S latitude, north-west of Marken, along the Jemima road, in the north-western Transvaal. The topography comprises a flat to slightly undulating terrain with a few isolated ridges and a small, non-perennial stream which drains from the Imberbe Game Lodge westwards into the Palala River.

The study area is characterized by warm summers and mild winters with the daily mean maximum temperature being 30.8°C in summer (January) and 22.5°C in winter (July), and the daily mean minimum temperature being 19°C in summer and 5.8°C in winter. Frost seldom occurs, but a light frost occasionally occurs in July or August (Weather Bureau 1986). The long-term mean annual rainfall is 409 mm of which 80% falls between November and March. The wet season peaks in January when a minimum of 90 mm is expected. The rainfall is erratic and mostly occurs in the form of thunderstorms (Weather Bureau 1986).

More than 90% of the Imberbe Game Lodge is underlain by Villa Nora Gabbro and Nebo Granite belonging to the Bushveld Complex. The Villa Nora Gabbro has weathered to form relatively shallow, clayey soils, whereas the Nebo Granite has weathered to form deep, red, sandy soils (Van der Walt 1978). The soils mostly belong to the Hutton, Glenrosa, Mispah and Clovelly soil forms (MacVicar *et al.* 1977) which are characterized by a weak structure, high water infiltration rate and low water holding capacity, and to the Arcadia soil form which is characterized by a high clay content, slow water infiltration rate and high water holding capacity (Coetzee 1971).

Methods

Relevés were compiled in 39 stratified random sample plots. The stratification units were structural-floristic homogeneous units subjectively identified with the aid of aerial photographs. Plot sizes in which the herbaceous layer was sampled were fixed at 200 m² (Coetzee *et al.* 1976; Westfall 1981; Pauw 1988). In each sample plot all herbaceous species were recorded, and Braun-Blanquet cover-abundance values were accorded to each species (Mueller-Dombois & Ellenberg 1974). The woody species composition and the cover-abundance values for each species were determined by the Variable Quadrant Plot method (Coetzee & Gertenbach 1977). Taxa names conform to those of Gibbs Russell *et al.* (1985; 1987). Environmental data recorded include soil type and depth, soil texture, rockiness of the soil surface, erosion and utilization by herbivores. Braun-Blanquet procedures (see also Bredenkamp *et al.* 1989; Kooi *et al.* 1990) were applied to the floristic data matrix to derive the vegetation classification, the result of which is presented in a phytosociological or differential table (Table 1). An ordination algorithm, Detrended Correspondence Analysis (DECORANA) (Hill 1979), was applied to the floristic data to determine a probable vegetation gradient.

Results and Discussion

The vegetation of the Imberbe Game Lodge can broadly be classified as a *Grewia flava* – *Aristida congesta* Open Woodland. Graminoids with a high constancy in all communities include *Tragus berteronianus*, *Eragrostis rigidior* (Species Group Q — Table 1) and *Digitaria eriantha* (Species Group S — Table 1). The numerous forb species often encountered, such as *Pavonia burchellii*, *Hibiscus micranthus*, *Tephrosia semiglabra*, *Phyllanthus parvulus* and *Blepharis subvolubilis*, may be the result of disturbance. The most conspicuous tree

species found in the Imberbe Game Lodge are *Acacia nigrescens*, *Boscia albitrunca*, *Acacia tortilis* and *Dichrostachys cinerea* (Species Groups I, O and P — Table 1). *Dichrostachys cinerea* often invades disturbed places, presenting a serious bush encroachment problem (Grossman 1988). Shrub species often encountered include various *Grewia* and *Commiphora* species of which *Grewia flava* and *Commiphora pyracanthoides* are the most abundant (Species Groups O and Q — Table 1). A total of 152 species were recorded in the 39 sample plots, with the average number of species per sample plot being 33. The vegetation was divided into four distinct plant communities, two sub-communities and four variants (Table 1).

Classification

A hierarchical classification of the plant communities recognized in the Imberbe Game Lodge (Table 1) is as follows:

1. The *Peltophorum africanum* – *Stipagrostis uniplumis* Open Woodland
2. The *Grewia flava* – *Pupalia lappacea* Open Shrubland
3. The *Acacia nigrescens* – *Aristida rhiniochloa* Open Woodland
 - 3.1 The *Aristida rhiniochloa* – *Aristida scabrivalvis* Sub-community
 - 3.1.1 The *Solanum panduriforme* Variant
 - 3.1.2 The *Dicoma capensis* Variant
 - 3.2 The *Aristida rhiniochloa* – *Heteropogon contortus* Sub-community
 - 3.2.1 The *Panicum maximum* Variant
 - 3.2.2 The *Enneapogon desvauxii* Variant
4. The *Acacia grandicornuta* – *Acacia senegal* Closed Woodland

Table 1 Phytosociological table of the Imberbe Nature Reserve, north-western Transvaal

COMMUNITY NUMBER	1		2		3		4	
					3.1	3.2		
V _i = variant	1a	1b	V	V	V	V		
RELEVÉ NUMBER	1 6171	1 324890	1111 5243	222 132	21111 08679	32232 07846	33232333 92589376	33 51
SPECIES GROUP A								
<i>Neorautanenia amboensis</i>	1 +1	+R +A			R+			
<i>Tephrosia lupinifolia</i>	1 B	3AA +						
<i>Cleome maculata</i>	AA+1	1R	+				+ R	
<i>Cassia mimosoides</i>	AA11	R						
<i>Indigofera melanadenia</i>	11	1+R						
<i>Peltophorum africanum</i>	1 +	+ 1						
<i>Terminalia sericea</i>	11	+ +						
<i>Hibiscus calyphyllus</i>	AA	R		1			1	
<i>Maytenus heterophylla</i>	1	11						
<i>Combretum apiculatum</i>	1	11+						
<i>Fimbristylis hispidula</i>	A	A A	1					
<i>Solanum capense</i>	A	+ R	R					
<i>Solanum nigrum</i>	R	R						
<i>Harpagophytum procumbens</i>		RR						
<i>Waltheria indica</i>	+ +							
SPECIES GROUP B								
<i>Pupalia lappacea</i>			3BA1			B		A+
<i>Heliotropium ciliatum</i>			11					
<i>Achyranthes aspera</i>			RA				1	+
<i>Grewia flavescens</i>			A	1	1			
<i>Albizia anthelmintica</i>			A					
SPECIES GROUP C								
<i>Limeum viscosum</i>	BAB1	R 1RBA	+11	A11	A1R+1	+		
<i>Convolvulus sagittatus</i>	B +A	A1 31A	A14B	++	A 11		R	
<i>Stipagrostis uniplumis</i>	1A44	AB+++1	AB	4B	3+	1		

Table 1 Continued

COMMUNITY NUMBER	1		2		3		4	
	1a		1b		3.1		3.2	
V = variant			V	V	V	V		
RELEVE NUMBER	1	1	1111	222	21111	32232	33232333	33
	6171	324890	5243	132	08679	07846	92589376	51
SPECIES GROUP D								
<i>Aristida stipitata</i>	A 1+	RA B	+AB	R+R	+R			
<i>Eragrostis lehmanniana</i>	A+	RR +	1 +	1+1	B11	+		1
<i>Hermannia modesta</i>	+	R+ +		A	1+	++1		
<i>Elephantorrhiza elephantina</i>	R++	++		A	R+ +	+A		
SPECIES GROUP E								
<i>Limeum fenestratum</i>	43A	A+B4A	1+ 1	A+1	1	1	+	
<i>Gisekia africana</i>	A +	+3+RA+	3+1A	R+	B		+	+
<i>Merremia tridentata</i>	B1AA	+ARAB	33	11				
<i>Crotalaria sphaerocarpa</i>	R R	1R	+ +	R+R	R		+	
<i>Urochloa panicoides</i>	R 1	11 A	+ 1	1+				
<i>Acrotome inflata</i>	111	1 A	+		1		+	+
<i>Indigofera filipes</i>	3	1	3A	+	1 +			+
<i>Merremia palmata</i>	R	+	+	B				
SPECIES GROUP F								
<i>Commelina benghalensis</i>	+ +	+ A	++		+			
<i>Tribulus terrestris</i>		++R+	+ 31		1		1	+
<i>Eragrostis biflora</i>		+RR+	++		R			1+
<i>Cucumis myriocarpus</i>	1	B	+1		+			
<i>Acacia erioloba</i>		1	1					
SPECIES GROUP G								
<i>Solanum panduriforme</i>			+1	+1+	R1			R
<i>Phyllanthus maderaspatensis</i>				A1	A 1 +			
SPECIES GROUP H								
<i>Dicoma capensis</i>		+	A		+131+	+	R	
<i>Conyza sumatrensis</i>					ARR+R		1 R	
<i>Aristida scabrivalvis</i>					AR A			
<i>Indigofera rhytidocarpa</i>					33			
SPECIES GROUP I								
<i>Terminalia prunioides</i>		1+	+	AAA1	AA++A	A1B1AB1A	+	+
<i>Ipomoea obscura</i>		R	A 1	A+ 1	A+11R	1A+11R A	+	+
<i>Acacia nigrescens</i>	+		1+A	1BABB	AAA A	1 31ABB	1	1
<i>Aristida congesta</i> subsp. <i>barbicollis</i>		+	1	AA1	+ A1	A+3	1 1	+
<i>Aristida rhiniochloa</i>				A	1A 54	14+ B	A+ 5 +	R
<i>Heteropogon contortus</i>				+	+1AAA	113A	AB+B+B	
SPECIES GROUP J								
<i>Indigofera spinescens</i>					+ ++	1+11	A1RA1+1	
<i>Clerodendrum ternatum</i>					RAA A	A1+ 1R	1 +	
<i>Evolvulus alsinoides</i>					R1	A	1 1R	+R
<i>Kyphocarpa angustifolia</i>		+			31		1 1	
<i>Bothriochloa insculpta</i>					+ +	1A +	+	R
SPECIES GROUP K								
<i>Cenchrus ciliaris</i>		+	+	+		R 1	B R+	+
<i>Grewia monticola</i>			+	+		+1	+ +	+
<i>Geigeria burkei</i>			R			1 R	A 1	
SPECIES GROUP L								
<i>Eragrostis superba</i>						+R		
<i>Cymbopogon marginatus</i>						R+		
<i>Monsonia angustifolia</i>		1		RR		RR +		
SPECIES GROUP M								
<i>Enneapogon desvauxii</i>						3+A	5	
<i>Aristida bipartita</i>						A1 A11	B	
<i>Tribulus zeyheri</i>						111 1	1	
<i>Aptosimum lineare</i>					R	R++	R	
<i>Jatropha species</i>						R +		

Description of the communities

1. The *Peltophorum africanum* – *Stipagrostis uniplumis* Open Woodland

This plant community is restricted to well-drained, red, sandy soils with a low water-holding capacity (Hutton soil form — Table 2) along the southern boundary of the Imberbe Game Lodge. Previously cultivated fields in different stages of succession (1a — Table 1) as well as patches of natural vegetation (1b — Table 1) are found in this unit. This community is characterized by the diagnostic forb and woody species in species group A (Table 1). Diagnostic forbs include *Tephrosia lupinifolia*, *Cleome maculata*, *Cassia mimosoides*, *Indigofera melanadenia* and *Fimbristylis hispidula*. *Peltophorum africanum*, *Terminalia sericea*, *Maytenus heterophylla* and *Combretum apiculatum* are diagnostic tree species in this community. The vegetation of the natural veld is dominated by *Grewia flava* and *Schmidtia pappophoroides* while *Stipagrostis uniplumis*, *Tephrosia semiglabra* and *Dichrostachys cinerea* are dominant in the previously cultivated fields, which are also characterized by the absence of *Grewia flava* and *Commiphora pyracanthoides*. From 22 to 39 species were recorded in the ten sample plots surveyed in this community.

2. The *Grewia flava* – *Pupalia lappacea* Open Shrubland

This community is encountered on well-drained, sandy soils of the Hutton soil form, with a medium water-holding capacity (Table 2). It is characterized by the forbs *Pupalia lappacea*, *Heliotropium ciliatum* and *Achyranthes aspera*, as well as by the woody species *Grewia flavescens* and *Albizia anthelmintica* (Species Group B — Table 1). Other species generally present are the graminoids *Schmidtia pappophoroides*, *Aristida congesta* subsp. *congesta* and *Eragrostis rigidior*, the forbs *Convolvulus sagittatus* and *Gisekia africana*, the shrubs *Grewia flava* and *Commiphora pyracanthoides* and the trees *Boscia albitrunca* and *Acacia tortilis*. From 29 to 38 species were recorded in four sample plots surveyed in this community.

3. The *Acacia nigrescens* – *Aristida rhiniochloa* Open Woodland

This plant community occurs on well-drained, sandy soils of the Hutton and Clovelly forms as well as on well-drained, shallow soils of the Mispah soil form (Table 2). The most conspicuous diagnostic graminoid is *Aristida rhiniochloa* (Species Group I — Table 1). Other diagnostic grass species are *Aristida congesta* subsp. *barbicollis* and *Heteropogon contortus*, the forb *Ipomoea obscura* and the tree species *Terminalia prunioides* and *Acacia nigrescens* (Species Group I — Table 1). From 20 to 46 species were recorded in 21 sample plots. This community can be divided into two sub-communities and each sub-community into two variants according to species composition and habitat differences.

Table 2 Selected soil characteristics of the soil forms and soil series of the Imberbe Game Lodge

Soil form	Soil series	Soil depth	% Clay
		(mm)	A-horison
Hutton	Shorrock(-)	500	15 – 25
	Zwartfontein	>1200	6 – 15
Glenrosa	Dunvegan	100	6 – 15
	Trevanian	300	15 – 35
Clovelly	Torquay	400	6 – 15
Mispah	Mispah	<100	0 – 10
	Muden	150	20 – 30
Arcadia	Arcadia	600	40 – 60

3.1 The *Aristida rhiniochloa* – *Aristida scabrivalvis* Sub-community

This sub-community is almost totally restricted to well-drained soils of the Hutton and Glenrosa soil forms with an average clay percentage of 6 – 25% (Table 2), found along a slight slope. This sub-community does not contain species with a strong diagnostic value (Table 1), but is characterized by species such as *Phyllanthus maderaspatensis*, *Dicoma capensis* and *Aristida scabrivalvis* found in species groups G and H (Table 1). Conspicuous species encountered in this sub-community include the woody species *Dichrostachys cinerea*, *Commiphora* species, *Acacia nigrescens*, *Terminalia prunioides* and *Acacia tortilis* as well as the graminoids *Aristida rhiniochloa*, *Melinis repens*, *Aristida congesta* and *Schmidtia pappophoroides*. From 26 to 46 species were recorded in eight sample plots representing this sub-community. This sub-community is divided into two variants: the *Solanum panduriforme* variant and the *Dicoma capensis* variant, which are mainly distinguished by differences in the constancy of certain subordinate species.

The *Solanum panduriforme* variant is found in and near previously cultivated fields in the *Aristida rhiniochloa* – *Aristida scabrivalvis* sub-community. Species often encountered in this variant include *Limeum viscosum*, *Stipagrostis uniplumis*, *Eragrostis lehmanniana*, *Acacia nigrescens*, *Acacia tortilis* and *Dichrostachys cinerea*. The *Dicoma capensis* variant is found along a slight slope in the central part of the study area. Species often encountered in this variant include *Dicoma capensis*, *Clerodendrum ternatum*, *Schmidtia pappophoroides*, *Eragrostis rigidior*, *Terminalia prunioides*, *Commiphora pyracanthoides*, *Acacia tortilis* and *Grewia flava*.

3.2 The *Aristida rhiniochloa* – *Heteropogon contortus* Sub-community

This sub-community is encountered on a variety of soils of the Glenrosa, Mispah and Clovelly soil forms which vary from well-drained, sandy soils with a low water-holding capacity to shallow, rocky soils with a low water infiltration and low water-holding capacity (Table 2). This sub-community is characterized by the diagnostic species *Cenchrus ciliaris*, *Grewia monticola* and *Geigeria burkei* (Species Group K — Table 1). The most conspicuous species occurring in this sub-community are *Terminalia prunioides*, *Acacia nigrescens*, *Grewia flava* and *Enneapogon scoparius*. From 20 to 30 species were recorded in 13 sample plots surveyed in this sub-community.

This sub-community is divided into two variants: the *Panicum maximum* variant and the *Enneapogon desvauxii* variant. The *Panicum maximum* variant which is associated with deep, sandy soils is characterized by the diagnostic species *Eragrostis superba*, *Cymbopogon marginatus* and *Monsonia angustifolia* (Species Group L — Table 1). The *Enneapogon desvauxii* variant associated with shallow, calcareous soils is characterized by the diagnostic species *Enneapogon desvauxii*, *Aristida bipartita*, *Tribulus zeyheri* and *Aptosimum lineare* (Species Group M — Table 1).

4. The *Acacia grandicornuta* – *Acacia senegal* Closed Woodland

This is a very distinctive community that is restricted to the Arcadia soil form, which has a high water holding-capacity but a low water infiltration rate (Table 2). This soil form is found along the dry stream-bed and water drainage lines in the northern part of the Imberbe Game Lodge. This community is dominated by woody species such as *Acacia senegal*, *Acacia grandicornuta*, *Boscia foetida*, *Euclea undulata* and *Lycium schizocalyx* (Species Group N — Table 1). The herbaceous layer is severely disturbed and degraded and is dominated by

species that are indicators of disturbance and/or retrogression, such as *Enneapogon scoparius*, *Tragus berteronianus*, *Blepharis subvolubilis* and *Aristida congesta* subsp. *congesta*. Respectively, 28 and 32 species were recorded in the two sample plots representing this community.

Ordination

The distribution of relevés along the first and second axes of a DECORANA ordination diagram is presented in Figure 1. A definite gradient in soil type, and therefore soil properties, is illustrated along the first axis. Communities situated to the left of the diagram are associated with sandy soils with an average clay content of 6 – 25%, a high water infiltration capacity and a low water-holding capacity, while the communities to the right are associated with clayey soils with an average clay content of 40 – 60%, a light water-holding capacity and a low water infiltration capacity. A weaker gradient in soil depth is illustrated along the second axis. Communities situated to the bottom of the axis are associated with deep soils whereas

communities to the top are associated with shallow soils.

In the scatter diagram (Figure 1), a distinct discontinuity can be observed among communities 1, 3 and 4, while communities 1 and 2 seem to be closely related.

Management units

Three management units that were identified on the basis of discontinuity and floristic affinity are mapped (Figure 2) and described in terms of the structure and canopy spread of the woody vegetation.

I. The *Terminalia sericea* management unit

This management unit consists of the *Peltophorum africanum* – *Stipagrostis uniplumis* Open Woodland and the *Grewia flava* – *Pupalia lappacea* Open Shrubland and occurs on deep, red, sandy soils of the Hutton soil form (Figure 1). The density of woody species in this management unit is 1041 individuals per hectare (Table 3) which renders it the management unit with the lowest density of woody species. The most abundant

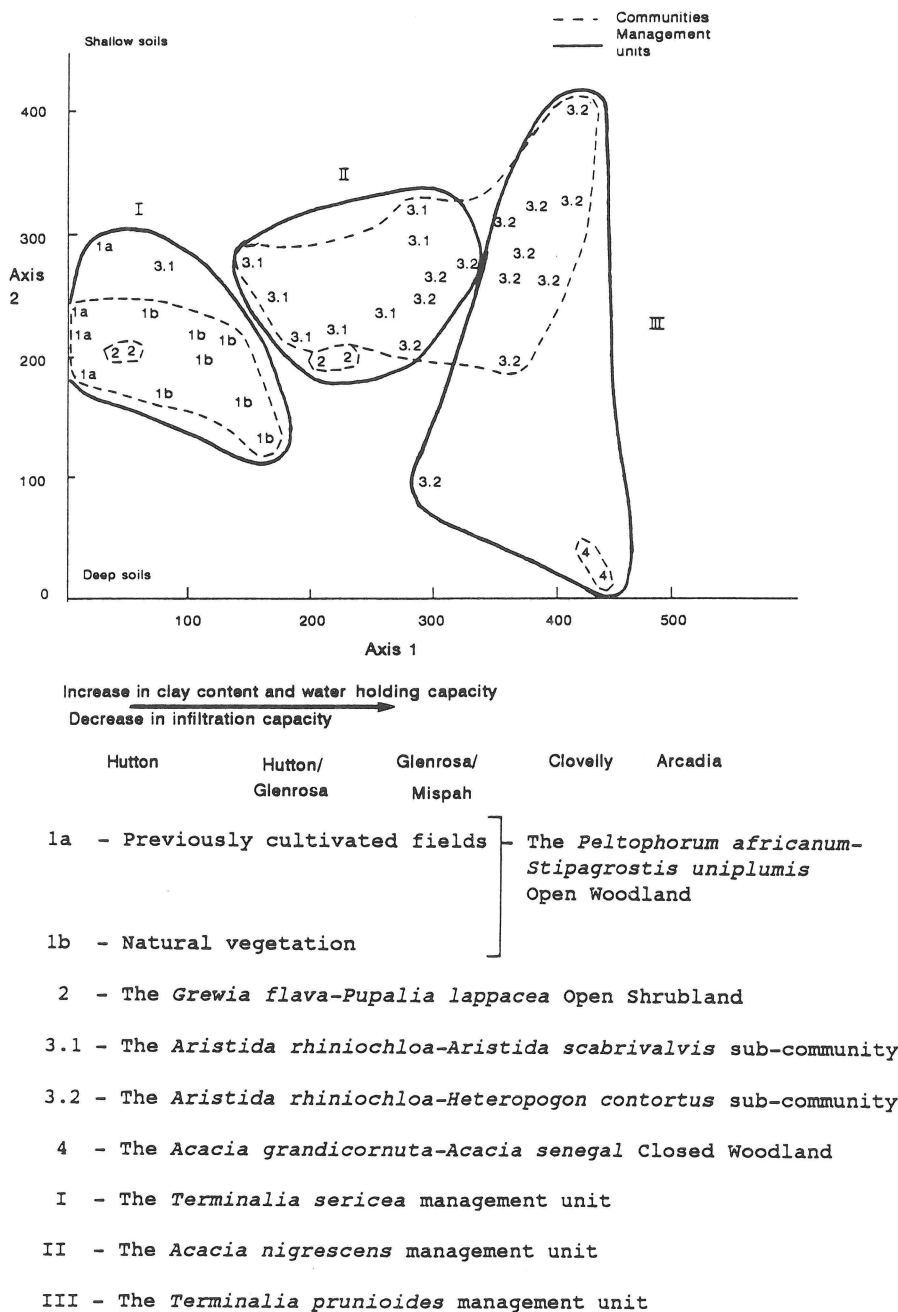


Figure 1 DECORANA ordination of the vegetation of the Imberbe Game Lodge (Eigen values: Axis 1 = 0.677; Axis 2 = 0.273).

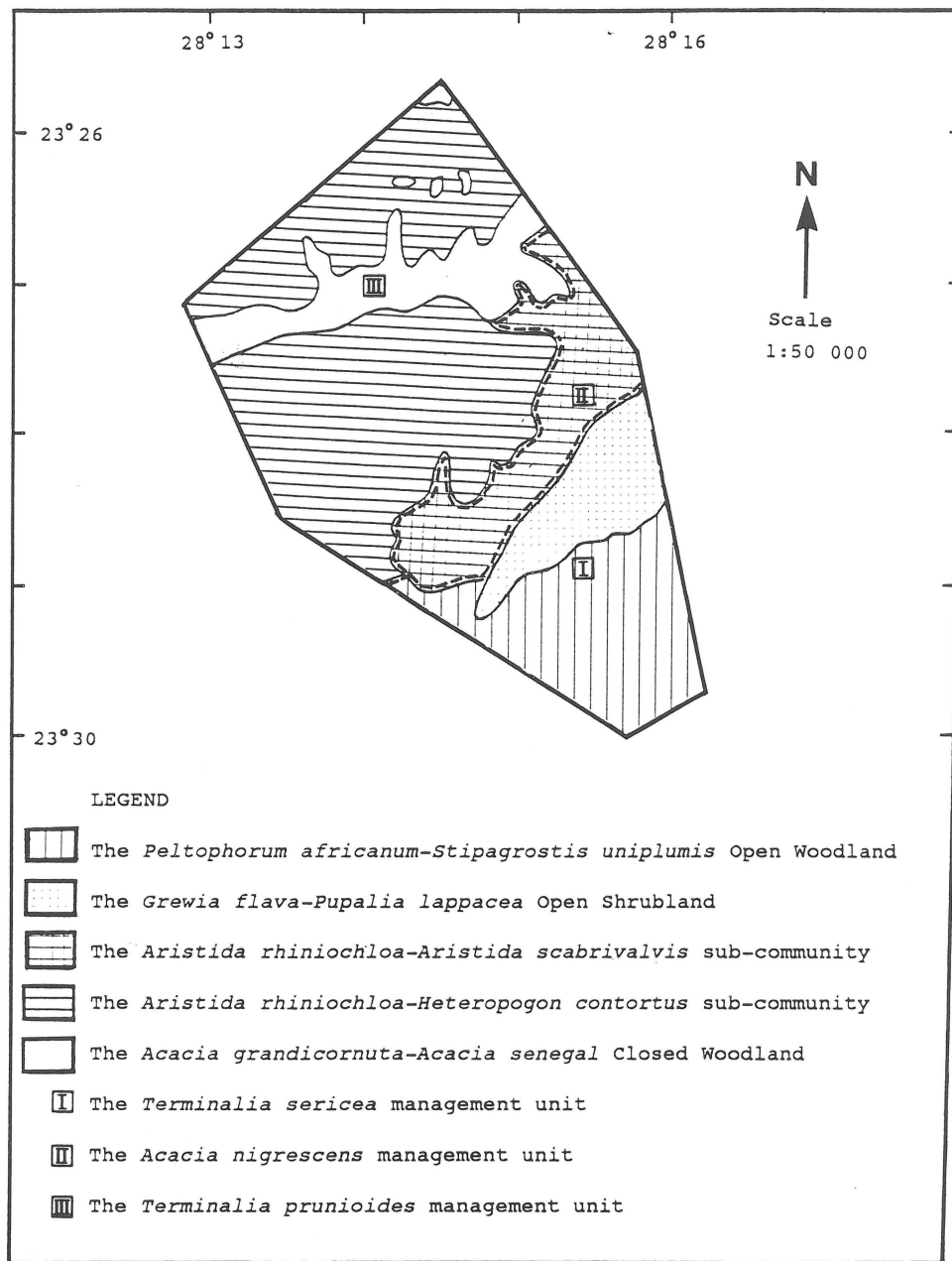


Figure 2 Vegetation and management map of the Imberbe Game Lodge.

woody species are *Dichrostachys cinerea*, *Grewia flava* and *Acacia tortilis* (Table 3). The percentage canopy spread, being the highest at the 0.5-m and 1-m height classes, correlates with the high number of shrubs found in this unit (Table 4).

II. The *Acacia nigrescens* management unit

This management unit consists of the *Aristida rhiniochloa – Aristida scabrivalvis* sub-community which is associated with shallow, rocky soils of the Glenrosa soil form and with a Glenrosa/Hutton and Glenrosa/Mispah complex (Figure 1). This management unit has the highest density of woody plants per hectare (2450 ind. ha⁻¹ — Table 3), with *Dichrostachys cinerea*, *Acacia nigrescens*, *Acacia tortilis*, *Commiphora africana* and *Commiphora pyracanthoides* occurring in the highest densities (Table 3). The high density of shrubs occurring in this management unit contributes to a high percentage canopy spread at the 0.5-m and 1-m height classes (Table 4).

III. The *Terminalia prunioides* management unit

This management unit includes the *Aristida rhiniochloa – Heteropogon contortus* sub-community which occurs on a

variety of soils of the Hutton, Glenrosa, Mispah and Clovelly soil forms, and the *Acacia grandicornuta – Acacia senegal* Closed Woodland which is associated with the Arcadia soil form (Figure 1). A mean density of 2085 woody individuals per hectare, with *Grewia flava*, *Acacia nigrescens*, *Dichrostachys cinerea*, *Terminalia prunioides* and *Acacia grandicornuta* being the most abundant species, is found in this management unit (Table 3). The percentage canopy spread at the 2-m to > 6-m height levels is noticeably higher in this management unit than in the other two units (Table 4). This can be attributed to the large number of tall trees with spreading canopies occurring on the Arcadia soil form.

Conclusion

The application of Braun-Blanquet procedures resulted in the successful delineation of plant communities which are related to specific environmental conditions; in this instance, soil forms and soil depth and clay content. Although the Imberbe Game Lodge is geographically situated in Acocks’s (1953; 1988) veld type number 18 — Mixed Bushveld, the vegetation of the *Acacia nigrescens – Aristida rhiniochloa* Open Wood-

Table 3 Mean density (ind. ha⁻¹) of the most conspicuous tree species in the Imberbe Game Lodge

Species	Density		
	Management unit		
	I	II	III
<i>Acacia grandicornuta</i>	0	14	205
<i>Acacia mellifera</i>	39	42	68
<i>Acacia nigrescens</i>	0	415	234
<i>Acacia senegal</i>	0	0	49
<i>Acacia tortilis</i>	162	345	69
<i>Boscia albitrunca</i>	11	5	44
<i>Boscia foetida</i> subsp. <i>rehmanniana</i>	7	1	45
<i>Boscia foetida</i> subsp. <i>minima</i>	107	13	154
<i>Commiphora africana</i>	14	294	7
<i>Commiphora mollis</i>	0	61	0
<i>Commiphora pyracanthoides</i>	133	279	53
<i>Grewia bicolor</i>	2	32	65
<i>Grewia flava</i>	186	240	413
<i>Grewia flavescens</i>	3	81	9
<i>Terminalia prunioides</i>	3	55	223
<i>Terminalia sericea</i>	17	0	0
<i>Dichrostachys cinerea</i>	236	470	232
<i>Ehretia rigida</i>	20	6	43
<i>Sclerocarya birrea</i>	0	38	0
Total	940	2391	1913

I — *Terminalia sericea* management unit.

II — *Acacia nigrescens* management unit.

III — *Terminalia prunioides* management unit.

Table 4 Mean density (ind. ha⁻¹) and percentage canopy spread of woody species found in three management units in the Imberbe Game Lodge

Management unit	Characteristic	Height levels (m)						Total
		>6	4-5	3	2	1	0.5	
I	Density	12	27	53	185	347	417	1041
	Canopy spread	1.95	3.75	6.77	10.56	14.41	16.01	53.45
II	Density	11	34	74	239	721	1371	2450
	Canopy spread	1.93	5.98	11.69	25.08	33.87	33.82	112.37
III	Density	23	68	96	249	373	1276	2085
	Canopy spread	3.92	9.92	18.76	24.5	22.55	22.46	102.11

I — *Terminalia sericea* management unit.

II — *Acacia nigrescens* management unit.

III — *Terminalia prunioides* management unit.

land found on shallow soils, corresponds to Acocks's veld type number 14 — the Arid Sweet Bushveld. The incidence of a large number of increaser species in the herbaceous layer, as well as the high densities of woody species, such as *Dichrostachys cinerea* and various *Acacia* species, reflect the degradation of the veld, and imply the possibility of bush encroachment. A large number of pioneer species and a low incidence of certain woody species which are common in the surrounding area delineates previously cultivated fields in different stages of succession. The results of the ordination suggested that some of the communities could be grouped together to form three management units. The delineation of management units and associated habitats of the Imberbe Game Lodge should be used as the basis for future management which should be aimed at the protection of the diverse vegetation through habitat protection and improvement.

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Buckollia, a new genus in the Periplocaceae

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A new genus *Buckollia* is described. Two species, *Tacazzea tomentosa* E.A. Bruce and *Curroria volubilis* (Schltr.) Bullock are transferred to this new genus. *Buckollia* is distinguished by few-flowered monochasia, flowers with shallow corolla tubes, corolla lobes with adaxial glandular swellings, stamens and corona arising from the corolla mouth, glabrous anthers, exposed gynostegia, interstaminal discs and long cylindrical-ovoid, verrucose follicles. *Buckollia* most closely resembles *Tacazzea* Decne. and *Periploca* L. and comparisons are made between these three genera and *Curroria* Planch. ex Benth.

'n Nuwe genus, *Buckollia*, word beskryf. Twee spesies, *Tacazzea tomentosa* E.A. Bruce en *Curroria volubilis* (Schltr.) Bullock word na hierdie nuwe genus oorgeplaas. *Buckollia* word herken aan die min-blommige monogasi-ums, blomme met vlak kroonbuis, bykroon wat by die kroonmond ontspring, haarlose helmknoppe, blootgestelde ginostegiums, tussen-meeldraadse lobbe, en lang, silindries-eierronde kokervrugte. *Buckollia* stem die meeste met *Tacazzea* Decne. en *Periploca* L. ooreen en vergelykings word tussen hierdie drie genera en *Curroria* Planch. ex Benth. getref.

Keywords: *Buckollia*, genus nova, *Periploca*, Periplocaceae, *Tacazzea*, taxonomy.

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Introduction

Curroria volubilis (Schltr.) Bullock and *Tacazzea tomentosa* E.A. Bruce, two closely related species, differ to such an extent from the other species in their respective genera that they should be excluded from these genera. Both *Curroria volubilis* and *Tacazzea tomentosa* are from north-eastern Africa. *C. volubilis* is relatively common and was collected in northern Tanzania, Kenya, Ethiopia, Somalia and Uganda. *T. tomentosa* appears to be rare and was collected in southern Ethiopia and north-eastern Uganda (Figure 1).

Schlechter (1895) described *Raphionacme volubilis*. He regarded the filiform corona lobes and glandular globular swellings as similar to the tri-segmented or triparted corona lobes present in certain species of *Raphionacme*, such as *R. galpinii* Schltr. and *R. velutina* Schltr. This conclusion, however, was faulty. The swellings are part of the corolla lobes, similar to those found in *Periploca*. Furthermore, *Raphionacme* species have distinct corolla tubes while Schlechter's *R. volubilis* possesses a shallow, bowl-shaped corolla tube. Brown (1902) was quite correct in stating: 'this plant in no way resembles a *Raphionacme*'. Since its structure and habit coincide with those of *Tacazzea*, Brown (1902) consequently transferred *Raphionacme volubilis* to *Tacazzea*.

Bullock (1955) transferred the species to the genus *Curroria*. His reason for the transfer was: 'Both authors (Schlechter and Brown) depended entirely on flower structure, particularly the form of the corona. For his assessment of the habit character, Brown was certainly mistaken, there being no other *Tacazzea* with short flowering spurs'. Bullock (1955) was correct in his assessment that *Tacazzea* does not have short flowering spurs and that *Curroria volubilis* consequently does not belong in *Tacazzea*. Strangely, however, he left *T. tomentosa* in

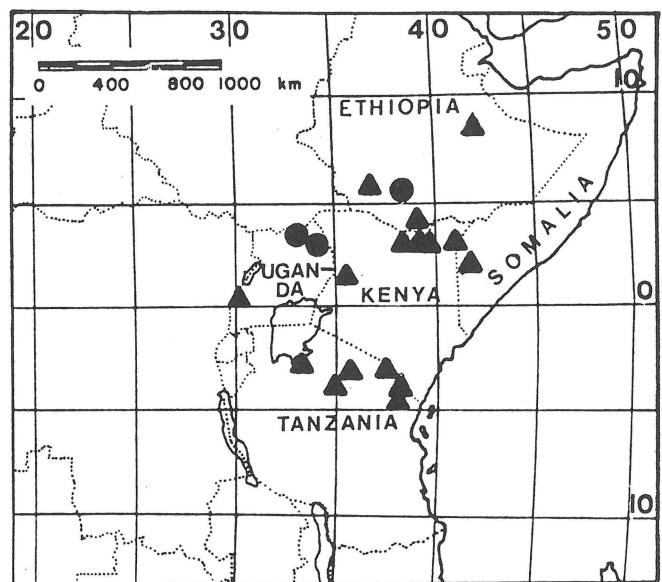


Figure 1 Known geographical distribution of *Buckollia volubilis* (▲) and *B. tomentosa* (●).

Tacazzea, even though this species obviously has short flowering spurs.

Bullock (1955) regarded the short shoot character, which he heavily depended on for his 'resuscitation' of *Curroria*, as 'extremely important, far more so than the relatively small differences in the corona described by Brown and almost invariably used by him (Brown) for the delimitation of genera'.