

# New azonal syntaxa from the hills and river banks of the Manyeleti Game Reserve, Northern Transvaal Province, South Africa

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As part of a vegetation survey programme for nature conservation areas in South Africa, surveys of the plant communities of the rocky outcrops and river banks in the Manyeleti Game Reserve were undertaken. The *Cardiospermo corindii-Acacietalia nigriventis* are restricted to quartz and gabbro hills, mainly on shallow, soils, whereas the *Spirostachyo africanae-Diospyretalia mespiliformis* occur on the banks of small dry rivers. From a Braun-Blanquet analysis of the vegetation of the rocky outcrops and the riparian vegetation, two new orders, two new alliances and six new associations were identified and described. Additionally a quantitative assessment of the woody component of each association is presented. Ordinations based on floristic data revealed the position of the syntaxa on an environmental gradient.

Key words: Braun-Blanquet analysis, Classification, conservation area, new syntaxa, Northern Transvaal Lowveld.

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## Introduction

Vegetation and general ecological surveys of conserved areas are essential for the establishment of efficient wildlife management programmes and conservation policies (Bredenkamp & Theron 1978). For this reason, and as part of a vegetation survey programme for conservation areas in South Africa, a study of the vegetation of the Manyeleti Game Reserve was undertaken.

In a general overview of the vegetation of the reserve, Bredenkamp (1987) distinguished seven major plant communities. Two of these represent the dense bushes on the rocky outcrops and the riparian vegetation along the dry rivulets. Phytosociological information about azonal vegetation in the Transvaal Lowveld are rare, as this vegetation has been avoided in

general vegetation surveys (Coetsee 1983; Gertenbach 1987; Van Rooyen 1978). Although Bredenkamp (1987) suggested that these two plant communities represent associations they have never been described formally. A subsequent detailed phytosociological analysis revealed six new associations and one plant community which cannot be ranked at this stage. Four new alliances and two new orders were also identified. In this report these syntaxa are described.

## Study area

The reserve is situated in the Arid Lowveld Veld Type (Acocks 1988) in the Northern Transvaal Province, adjacent to the Kruger National Park, between 24°29'—24°42'S and 31°23'—31°36'E. The climate,

topography and soils of the area have been described by Bredenkamp *et al.* (1983) and Bredenkamp (1987).

## Methods

The entire area of the reserve was stratified into relatively homogeneous physiographic-physiognomic units, using 1:30 000 scale aerial photographs. Sample plots were randomly located within these units. The number of plots per unit was determined pro rata, on an area-size basis. The vegetation of the hills is limited and is represented by seven sample plots and the riverine vegetation by 27 sample plots. Relevés were compiled for each sample plot. The vegetation survey included the following (Bredenkamp & Theron 1990, 1991):

(a) Cover/abundance values were estimated for all herbaceous species in 10 m x 20 m sample plots, using the Braun-Blanquet cover/abundance scale (Westhoff & Van der Maarel 1978), except that, following Werger (1973), scale-unit 2 was divided into the following categories:

- 2A: covering > 5 - 12% and
- 2B: covering > 12 - 25% of the sample plot area.

(b) Quantitative cover and density data for all woody species were obtained by using the variable plot method of Coetzee & Gertenbach (1977). These cover values were converted to Braun-Blanquet cover/abundance values for the compilation of the phytosociological table. The quantitative data were used to analyse and describe the structure of the woody component (Van Rooyen *et al.* 1981; Bredenkamp & Theron 1985).

A habitat survey of the relevés included geology, topography, altitude, aspect, slope,

soil surface rock, soil type (MacVicar *et al.* 1977) soil depth and various soil properties including physical and chemical analyses (Bredenkamp *et al.* 1983; Bredenkamp & Theron 1988). The soil properties analysed from the A and B horizons in each sample plot, include (MacVicar *et al.* 1977):

- percentage gravel (>2–75 mm diameter),
- percentage sand (0.02–2 mm diameter) and clay (<0.002 mm diameter) after the gravel has been removed,
- exchangeable K<sup>+</sup>, Na<sup>+</sup>, Mg<sup>2+</sup> and Ca<sup>2+</sup> (mg 100g<sup>-1</sup> soil),
- S-Value as sum of exchangeable K<sup>+</sup>, Na<sup>+</sup>, Mg<sup>2+</sup> and Ca<sup>2+</sup>,
- soil conductivity (mS/m) and
- soil pH (H<sub>2</sub>O).

The results of a preliminary classification of relevés and species from an agglomerative cluster analysis (Orloci 1967) produced a fairly ordered two-way table. This table was refined by application of Braun-Blanquet procedures. The results are given in a phytosociological table (Table 1). On the basis of the distribution of the species within the reserve, diagnostic species were distinguished (Bredenkamp 1987). Local character species (marked C in Table 1) are more or less restricted to specific syntaxa, while differential species (marked D) have a wider distribution, but may be used to characterise specific syntaxa (Westhoff & Van der Maarel 1978). Names and authors of taxa are in accordance with Arnold & De Wet (1993). Names of syntaxa are constructed in accordance with Barkman *et al.* (1986).

From the quantitative cover and density data, and derived constancy values calculated from the phytosociological table, Importance Values were calculated for all woody species in each of the recognised communities. Importance Value is the sum

Table 1

*Phytosociological table of the Cariospermo corindii-Acacieta nigracentis and Spirostacho africanae-Diospyretum mespiliformis (C = local character species, D = differential species)*

Order	1			2			
	1	2	3	1	2	3	4
Association	11	222	22	101021011001	1100110	2222	211
Relevés	44	111	11	631351311771	7133763	6655	699
	97	756	48	806398275524	0945191	1087	267

Species group A: Diagnostic species of *Cardiospermo corindii*-*Bridelietum mollis*

C	<i>Bridelia mollis</i>	43			A		
D	<i>Melinis repens</i>	4B					
C	<i>Diheteropogon amplexans</i>	11			1		
C	<i>Kalanchoe rotundifolia</i>	++					
C	<i>Momordica boivinii</i>	++		+			
C	<i>Pouzolzia hypoleuca</i>	++			1		
C	<i>Rhinacantha xerophilus</i>	++	1				
C	<i>Allophylus melanocarpus</i>	++					
C	<i>Protasparagus falcatus</i>	++					
C	<i>Dioscoria cotinifolia</i>	++					
C	<i>Dyschoriste fisheri</i>	++					
C	<i>Xerophyta retinervis</i>	++					
D	<i>Sporobolus fimbriatus</i>	++					
D	<i>Melhania prostrata</i>	++	+				
D	<i>Mariscus indecorus</i>	++					

Species group B: Diagnostic species of the *Tylosemo fassoglensis*-*Dalechampion galpinii*

C	<i>Tylosema fassoglensis</i>		111				
C	<i>Dolichos trilobos</i>	+	111		+		+
C	<i>Clerodendrum ternatum</i>		+11				
D	<i>Schmidtia pappophoroides</i>		+++				
C	<i>Cyperus species</i>		+++		+	+	
D	<i>Ficus abutilifolia</i>	+	+++				
D	<i>Talinum tenuissimum</i>		+++				
D	<i>Kalanchoe sp.</i>	+	++				
D	<i>Helichrysum miconiifolium</i>		++				
C	<i>Cymbopogon excavatus</i>		1+				
D	<i>Thesium gracilarioides</i>		++				
D	<i>Thunbergia neglecta</i>		++				+
D	<i>Hibiscus pusillus</i>		++				

Species group C: Diagnostic species of the *Commiphora africanae*-*Euphorbietum ingentis*

C	<i>Euphorbia ingens</i>			11			
C	<i>Aneilema aequinoctiale</i>			++			
C	<i>Cyphostemma natalitium</i>			++			
C	<i>Enteropogon macrostachyus</i>			+1			

Species group D: Diagnostic species of *Cardiospermo corindii*-*Dalechampion galpinii*

C	<i>Dalechampia galpinii</i>		111	++			
C	<i>Erythrina humeana</i>		+++	++			
D	<i>Acalypha segetalis</i>		+++	++	+	+	+
D	<i>Protasparagus retinervis</i>		+++	++		++	
C	<i>Cenchrus ciliaris</i>		+11	+			+
C	<i>Ochna natalitia</i>		1+	11			
C	<i>Diospyros lycioides</i>		++1	1			
D	<i>Ehretia amoena</i>		+	++		+	
D	<i>Sphedamnocarpus pruriens</i>		++	+		+	
D	<i>Commiphora edulis</i>		1+	1			
C	<i>Maytenus polyacantha</i>		++	+			
C	<i>Orthosiphon suffrutescens</i>		++	+			
C	<i>Enneapogon cenchroides</i>		1	+			

Table 1  
(continued)

C	<i>Fockea angustifolia</i>			+	+				
C	<i>Hibiscus sidiformis</i>			+	+				

Species group E: Diagnostic species of *Cardiospermo corindii*-*Acacietaalia nigriventris*

C	<i>Cardiospermum corindum</i>	1+	131	A1					
D	<i>Rhynchosia venulosa</i>	++	1A1	1+			+		
C	<i>Pellaea viridis</i>	++	+++	++		+			
D	<i>Commiphora africana</i>	++	+1	AB				+	
D	<i>Digitaria eriantha</i>	++	111	+					
C	<i>Pupalia lapacea</i>	++	+	++			1		+
C	<i>Priva meyeri</i>	++	+	+					
C	<i>Sansevieria hyacinthoides</i>	++	++	+					
C	<i>Stylochiton natalensis</i>	+	+++	+				+	
C	<i>Pappea capensis</i>	++	++	1		1	+	B1	
C	<i>Commiphora mollis</i>	+	+1	+					
D	<i>Strychnos madagascariensis</i>	++	+A						
D	<i>Kyllinga alba</i>	+	+	+					

Species group F: Diagnostic species of the *Schotia brachypetalae*-*Diospyretum mespiliformis*

C	<i>Grewia flavescens</i>					+111+1B1A1			+1	
D	<i>Schotia brachypetala</i>	1+	+			++ A++B1+1A1				+
D	<i>Bridelia catharica</i>			1+		++11 +++ A		++		
C	<i>Secamone parviflora</i>					+++++ ++ A				
D	<i>Cassine aethiopica</i>	++				A11A+A		A	++	1
D	<i>Acacia burkei</i>					A ++ +13 3			+	1
D	<i>Cassine transvaalensis</i>		+			+++1 1 B				1
C	<i>Carissa edulis</i>					++ ++ 1 A+			A	
D	<i>Hibiscus calyphyllus</i>		+			1 ++ 1 +				+
C	<i>Manilkara mochisia</i>					1 A 11				
D	<i>Berchemia zeyheri</i>		+			+ 1 A A				
C	<i>Ficus thonningii</i>					T 3 55				
C	<i>Pavetta gardenifolia</i>					1 ++ +				
C	<i>Cissampelos mucronata</i>					+ ++				
C	<i>Crotalaria sp.</i>					++ +				+

Species group G: Diagnostic species for the *Spirostacho africanae*-*Phoenicetum reclinatae*

D	<i>Phoenix reclinata</i>					+		+	+++11+1		A3
D	<i>Eriochloa holubii</i>					++	1 1		++1 3++		+
D	<i>Peltophorum africanum</i>							+	+++1++		1 1
C	<i>Kraussia floribunda</i>								++		
C	<i>Vernonia colorata</i>								++		
D	<i>Scolopia zeyheri</i>								++		
C	<i>Heteropixis natalensis</i>					1			++		

Species group H: Diagnostic species for *Euclea natalensis*-*Diospyrion mespiliformis*

D	<i>Euclea natalensis</i>	++	++			++ ++1A1 +1+		++ ++1A		1
D	<i>Achyranthes aspera</i>	++				111 +B1+ A		111+ 13		
C	<i>Rhus pyroides</i>					+A A 1		+++3		
C	<i>Ficus sycomoros</i>					B 3		B3B		
C	<i>Capparis tomentosa</i>					+ ++		++		
D	<i>Rhus guenzii</i>					+ B A		+		

Species group I: Diagnostic species for *Albizia harveyi*-*Diospyretum mespiliformis*

D	<i>Cyperus fastigiatus</i>					+		+	++	++++	
D	<i>Albizia harveyi</i>					+		1	1	+++4	1+
D	<i>Cyperus sexangularis</i>					+				++	
D	<i>Crinum moorii</i>								+	++	+1
D	<i>Waltheria indica</i>		+							+	

Species group J: Diagnostic species for *Phoenix reclinata*-*Setaria incrassata* community

Table 1  
(continued)

D	<i>Setaria incrassata</i>								+B1			11
D	<i>Themeda triandra</i>	++	+1	1								BB
D	<i>Solanum panduraeforme</i>			+								++
D	<i>Leucas glabrata</i>											++

Species group K: Diagnostic species for *Spirostachyo africanae*-*Diospyretalia mespiliformis*

C	<i>Diospyros mespiliformis</i>		+		1BBBA44BB4+4				++11355			+3+
D	<i>Ruellia patula</i>	11			11+AA111+1B+				11+1+1+			++1 +
C	<i>Acacia robusta</i>				1+1B1 A AB B				+ +A1A1			+ 1
D	<i>Euclea divinorum</i>	+			+11 131B131				++ 1 1B			1+ +
D	<i>Combretum hereroense</i>		+		AA A1				+1+1			A1 +
D	<i>Lonchocarpus capassa</i>			1					+1+1			A1+
D	<i>Jasminum fluminense</i>		+	+	+++1 1+1++				+1 +			++
D	<i>Sida dregei</i>		++		++ +				+++++			++
D	<i>Pavonia burchellii</i>	+			+ + + +				++++ ++			++
D	<i>Combretum imberbe</i>				B+1				+ +			1 +
C	<i>Phyllanthus nummulariaefolius</i>				+ 1 1				++A 1			1 +
D	<i>Justicia protracta</i>				1 +A+ + + +				+1 + + +			1 +
D	<i>Bolusanthus speciosus</i>				A + + + +				1			+ 1
C	<i>Barleria elegans</i>				+ + 1 + +				++			+1
D	<i>Ipomoea obscura</i>		+		+ + + +				++			++
C	<i>Allophylus decipiens</i>				1 1				1 +			++
C	<i>Clerodendrum glabrum</i>				1				++ +			++
C	<i>Psydrax obovata</i>				11 +							++ ++

Species group L: Species restricted to koppies and rivers banks

	<i>Aspilia mossambicensis</i>	++	334	B1	+ +B11 1 + +				111 A++			+11 ++
	<i>Spirostachys africana</i>		1	11	+1 +B AA13+				++ 1++			11
	<i>Protasparagus africanus</i>	++	+++	+	+++++				+++			++
	<i>Rhoicissus tridentata</i>		111	1	+ + + + 1 +				1+			+++ ++
	<i>Cocculus hirsutus</i>		++1	+1	+ +1 ++ 1+				+			++ ++
	<i>Dombeya rotundifolia</i>	1A	1		++ + +				+ +			1 A
	<i>Panicum infestum</i>		1+1	1	+1				++ +			+
	<i>Tragia dioica</i>	+	+++	+	++				++ +			++
	<i>Combretum molle</i>	+	+						+ +			+

Species group M: General species

	<i>Panicum maximum</i>	34	A1B	43	444333BB3B1B				BB444B+			4BB 4B
	<i>Maytenus senegalensis</i>		A	A+	11+11AAA B				++1A1++			A1A A1
	<i>Lannea schweinfurthii</i>		B +1	A+	AA B B +1				+++++ +			+ ++
	<i>Securinega virosa</i>	++	+1+	++	1 + + 3				1 ++			++ ++
	<i>Acacia nigrescens</i>	+4	1AA	11	31 + + 14				++ +			1
	<i>Ziziphus mucronata</i>	++	+1A	+	+3 + 3 +				++			+ B
	<i>Commelina erecta</i>	+		++	++++				++ +			+++
	<i>Dalbergia melanoxylon</i>		B1		A 1				1+ +B			+
	<i>Phyllanthus burchellii</i>		+++	++					+			++
	<i>Combretum apiculatum</i>	33	+1+	1	B A				A			+ B
	<i>Sclerocarya birrea</i>		1+	+	A A3				A 1			+B
	<i>Grewia bicolor</i>	BA		A					++ ++			
	<i>Maytenus heterophylla</i>	11			A AB				+			1
	<i>Dichrostachys cinerea</i>	++	+	+					++ +			+
	<i>Ormocarpum trichocarpum</i>	++			++				+			+
	<i>Grewia retinervis</i>	11	+	B	+				+			+
	<i>Achyranthes sicala</i>	++	+		+							+
	<i>Terminalia sericea</i>								1 1			++
	<i>Combretum zeyheri</i>	1A										++
	<i>Heteropogon contortus</i>	+1	1	+1					+			+
	<i>Cassia abbreviata</i>		+		1				B			+
	<i>Lantana rugosa</i>		+		+				+			+
	<i>Gardenia volkensii</i>	+1		+								+
	<i>Urochloa mosambicensis</i>		1						+			+
	<i>Acalypha glabrata</i>	++							1 1			+
	<i>Brachiaria deflexa</i>		+	+	+							+
	<i>Commelina africana</i>			+					++			+

of the relative cover, relative density and relative constancy, expressed as a percentage.

Gradients within the vegetation were determined by the application of Principal Components Analysis (Orloci 1978) to the floristic data set. Corresponding gradients in individual habitat factors were obtained by super-imposing the quantitative values of these factors onto the scatter diagram.

## Results

### Classification

The analysis resulted in the following hierarchical classification:

Order 1 *Cardiospermo corindii-Acacietaalia nigriscentis* of the hills and ridges, with three associations and two alliances:

Alliance 1 *Bridelion mollis* nom. prov.,

Association 1 *Cardiospermo corindii-Bridelietum mollis* on the quartz ridges,

Alliance 2 *Cardiospermo corindii-Dalechampion galpinii* on the gabbro ridges,

Association 2 *Tylosemo fassoglensis-Dalechampietum galpinii* on the south-facing slopes,

Association 3 *Commiphoro africanae-Euphorbietum ingentis* on the north facing slopes.

Order 2 *Spirostachyo africanae-Diospyretalia mespiliformis* riparian vegetation, with three associations, two alliances and one plant community without rank:

Alliance 1 *Eucleo natalensis-Diospyrion mespiliformis* on the banks of relatively big and intermediate dry rivulets,

Association 1 *Schotio brachypetalae-Diospyretum mespiliformis* representing dense riparian thickets along the dry rivulet banks on sandy, leached alluvial soils of the Dundee soil form,

Association 2 *Spirostachyo africanae-Phoenicetum reclinatae* representing the more open riparian thickets along rivulet banks on clayey soils of the Estcourt- and Arcadia soil forms,

Alliance 2 *Mayteno-Diospyrion mespiliformis* nom. prov.,

Association 3 *Albizio harveyi-Diospyretum mespiliformis* along the relatively smaller rivulets on sandy soils, *Phoenix reclinata-Setaria incrassata* Riparian Thicket along river courses on clayey soils (no syntaxonomical rank).

### Description of the syntaxa

Order 1. The *Cardiospermo corindii-Acacietaalia nigriscentis* ord. nov., hoc loco.

Nomenclatural type: *Cardiospermo corindii-Dalechampion galpinii*

Within the Manyeleti Game Reserve the *Cardiospermo corindii-Acacietaalia nigriscentis* are restricted to the rocky quartz and gabbro hills and ridges. The shallow Mispah soil form (Orthic A-horizon on rock) is predominant. An analysis of the soil characteristics of the associations in the order is given in Table 3. The soils of the quartz ridges are sandier (84% sand) than those of the gabbro ridges (66% sand) (Table 3). Furthermore, the conductivity of the soils on the quartz ridges is relatively low and the S-values of the gabbroic soils are more than 3 000 mg per 100 g soil.

The position of these syntaxa along a vegetation gradient, as well as associated habitat gradients are given in Fig. 1.

In general, the vegetation is dense bush, with many shade tolerant species in the lower strata.

Diagnostic species for this order were identified by Bredenkamp (1987). Constantly present local character species (species group E, Table 1), restricted to the hills and ridges, are the vigorous and conspicuous liane, *Cardiospermum corindum*, the lithophytic trees, *Pappea capensis* and *Commiphora mollis*, the sciophytic semi-herbaceous chamophytes, *Priva meyeri* and *Pupalia lapacea*, the xerophytic tough leafy succulent, *Sansevieria hyacinthoides* and the xerophytic fern, *Pellaea viridis*.

The woody species with the highest Importance Value in the associations of the order are given in Table 2.

The most prominent herbaceous species include the grass, *Panicum maximum* and the forb, *Aspilia mossambicensis*.

The floristic affinity between the *Cardiospermum corindii*-*Acacietaalia nigriscentis* of the hills and ridges with the *Spirostachyo africanae*-*Diospyretalia mespiliformis* along the dry river banks is indicated by species group L (Table 1).

Three floristically and ecologically distinct associations are recognized:

Alliance 1. *Bridelion mollis* nom. prov.

Nomenclatural type: *Cardiospermum corindii*-*Bridelietosum mollis*

This alliance contains only the type association and its characteristics are therefore similar to those of the association.

Association 1. *Cardiospermo corindii*-*Bridelietosum mollis* ass. nov., hoc loco.

Nomenclatural type: Relevé 147

This association is restricted to isolated quartz ridges surrounded by granite. More than 5% of the soil surface is covered by quartz gravel, stones and boulders. Locally, large quartz boulders cover up to 60% of the soil surface.

The A-horizon of the Mispah soil form (A horizon on rock), found on these hills, is structureless with a loose consistence. The S-value of the soils is moderate (688 mg per 100 g), with a low pH (5.8) and an electrical conductivity of 20.5 mS/m (Table 3).

The vegetation is a dense tall tree veld, (Bredenkamp & Theron 1985) but locally, where big quartz boulders occur, it is less dense and shorter.

This association is characterized by many diagnostic, mostly local, character species (species group A, Table 1). The woody stratum is dominated by the small shrubby diagnostic tree, *Bridelia mollis*, while other prominent woody species include the trees, *Schotia brachypetala*, *Dombeya rotundifolia*, *Acacia nigrescens*, *Combretum apiculatum* and *C. zeyheri*. Shrubby species with a high canopy cover include the diagnostic *Pouzolzia hypoleuca* and also *Cassia aethiopica*, *Maytenus heterophylla*, *Grewia bicolor*, *Grewia retinervis* and *Gardenia volkensii*.

The Importance Values of the woody species are given in Table 2. The tall character species, *Bridelia mollis* is the most important with an Importance Value of 49.7.

Table 2

Analysis of the Importance Values of the woody species of *Cardiospermo corindii*-*Acacietaalia nigriscentis* (A) and *Spirostachyo africana*-*Diospyretalia mespiliformis* (B)

Species	A			B			
	1	2	3	1	2	3	4
<i>Bridelia mollis</i>	54.4	-	-	-	-	-	-
<i>Combretum apiculatum</i>	41.0	20.7	-	-	-	3.8	-
<i>Acacia nigrescens</i>	31.9	32.5	20.0	9.7	2.5	-	-
<i>Grewia retinervis</i>	21.7	-	-	-	-	-	-
<i>Grewia bicolor</i>	13.5	-	-	-	-1.9	-	-
<i>Combretum zeyheri</i>	13.2	-	-	-	-	6.9	-
<i>Commiphora africana</i>	10.7	29.1	60.5	-	-	-	-
<i>Dombeya rotundifolia</i>	10.0	-	-	2.7	7.9	10.8	-
<i>Ziziphus mucronata</i>	9.3	21.6	-	5.9	4.2	15.0	-
<i>Combretum molle</i>	8.9	-	-	-	2.2	3.8	-
<i>Maytenus heterophylla</i>	8.2	-	-	7.6	-	-	-
<i>Securinea virosa</i>	7.8	13.3	17.9	7.3	4.9	5.3	19.1
<i>Schotia brachypetala</i>	7.8	-	-	10.7	-	-	-
<i>Cardiospermum corindum</i>	7.5	-	-	-	-	-	-
<i>Strychnos madagascariensis</i>	7.4	14.8	-	-	-	-	-
<i>Euclea natalensis</i>	7.2	8.7	-	16.0	11.6	-	-
<i>Pappea capensis</i>	7.1	7.0	-	5.2	-	-	-
<i>Gardenia volkensii</i>	5.7	-	-	-	-	-	-
<i>Allophylus melanocarpus</i>	5.7	-	-	-	-	-	-
<i>Dioscorea cotinifolia</i>	5.5	-	-	-	-	-	-
<i>Ormocarpum trichocarpum</i>	5.1	-	-	-	-	-	-
<i>Pouzolzia hypoleuca</i>	4.8	-	-	-	-	-	-
<i>Cassine aethiopica</i>	4.7	-	-	9.3	3.7	-	-
<i>Dalbergia melanoxylon</i>	-	54.4	-	3.4	12.6	-	-
<i>Commiphora mollis</i>	-	14.8	-	-	-	-	-
<i>Ochna natalitia</i>	-	13.4	17.1	-	-	-	-
<i>Lannea schweinfurthii</i>	-	13.4	35.2	8.2	7.3	-	13.9
<i>Ficus abutilifolia</i>	-	11.7	-	-	-	-	-
<i>Sclerocarya birrea</i>	-	10.3	-	4.9	3.8	11.8	-
<i>Erythrina humeana</i>	-	9.9	21.8	-	-	-	-
<i>Commiphora edulis</i>	-	8.1	-	-	-	-	-
<i>Dichrostachys cinerea</i>	-	8.0	-	-	4.7	-	-
<i>Diospyros lycioides</i>	-	7.7	-	-	-	-	-
<i>Maytenus polyacantha</i>	-	5.3	-	-	-	-	-
<i>Maytenus senegalensis</i>	-	-	33.7	15.5	22.2	65.4	66.1
<i>Ehretia amoena</i>	-	-	27.7	-	-	-	-
<i>Bridelia cathartica</i>	-	-	23.7	8.4	3.0	-	-
<i>Euphorbia ingens</i>	-	-	22.9	-	-	-	-
<i>Spirostachys africana</i>	-	-	19.0	21.7	18.7	14.9	-
<i>Diospyros mespiliformis</i>	-	-	-	39.0	53.2	17.6	-
<i>Euclea divinorum</i>	-	-	-	18.0	8.9	5.5	-
<i>Ficus thonningii</i>	-	-	-	11.5	-	-	-
<i>Acacia robusta</i>	-	-	-	10.2	11.5	9.4	-
<i>Acacia burkei</i>	-	-	-	10.0	2.5	-	-
<i>Grewia flavescens</i>	-	-	-	9.9	3.3	-	-
<i>Combretum hereroense</i>	-	-	-	7.0	14.1	13.8	-
<i>Secamone parviflora</i>	-	-	-	6.2	-	-	-
<i>Cassine transvaalensis</i>	-	-	-	6.1	-	-	-
<i>Carissa edulis</i>	-	-	-	5.1	-	-	-
<i>Phyllanthus nummulariaefolius</i>	-	-	-	4.9	11.7	13.1	44.6
<i>Berchemia zeyherii</i>	-	-	-	4.6	-	-	-
<i>Bolusanthus speciosus</i>	-	-	-	4.3	2.0	3.6	-
<i>Combretum imberbe</i>	-	-	-	4.1	6.1	11.6	25.5
<i>Lonchocarpus capassa</i>	-	-	-	3.9	8.1	23.5	-



Table 2  
(continued)

Species	A			B			
	1	2	3	1	2	3	4
<i>Combretum imberbe</i>	-	-	-	4.1	6.1	11.6	25.5
<i>Lonchocarpus capassa</i>	-	-	-	3.9	8.1	23.5	-
<i>Rhus guenzii</i>	-	-	-	3.5	-	-	-
<i>Rhus pyroides</i>	-	-	-	3.3	9.3	-	-
<i>Manilkara mochisia</i>	-	-	-	3.1	-	-	-
<i>Pavetta assimilis</i>	-	-	-	2.8	-	-	-
<i>Capparis tomentosa</i>	-	-	-	2.5	1.8	-	-
<i>Psyrdrax obovata</i>	-	-	-	2.4	-	4.3	-
<i>Ficus sycomorus</i>	-	-	-	-	17.0	-	-
<i>Phoenix reclinata</i>	-	-	-	-	12.8	-	86.2
<i>Peltophorum africanum</i>	-	-	-	-	5.7	-	-
<i>Albizia harveyi</i>	-	-	-	-	5.0	44.5	25.2
<i>Terminalia sericea</i>	-	-	-	-	2.9	5.0	-
<i>Clerodendrum glabrum</i>	-	-	-	-	2.8	4.9	-
<i>Cassia abbreviata</i>	-	-	-	-	2.1	-	-
<i>Kraussia floribunda</i>	-	-	-	-	1.9	-	-
<i>Vernonia colorata</i>	-	-	-	-	1.9	-	-
<i>Scolopia zeyheri</i>	-	-	-	-	1.9	-	-
<i>Heteropyxis natalensis</i>	-	-	-	-	1.8	-	-
<i>Allophylus decipiens</i>	-	-	-	-	-	4.6	-

*Combretum apiculatum* and *Acacia nigrescens* are also conspicuous, with *Grewia retinervis* relatively dense, having a density of 394 individuals per hectare. The lianae, *Dioscorea cotinifolia* and *Cardiospermum corindum* are also important in the woody component.

The herbaceous layer is approximately one metre tall, with a relatively low canopy cover of 65%. *Panicum maximum*, *Melinis repens*, *Heteropogon contortus* and *Diheteropogon amplexans* are the most prominent grass species in this layer.

Alliance 2. *Cardiospermo corindii-Dalechampion galpinii* all. nov., hoc loco.

Nomenclatural type: *Tylosemo fassoglensis-Dalechampion galpinii*

This alliance is restricted to the gabbro hills. Gabbro boulders cover 50% to 70% of the soil surface.

A floristic analysis of the vegetation of this alliance is given in Table 1. Diagnostic species include the woody *Erythrina humeana*, *Ochna natalitia*, *Commiphora edulis*, *Protasparagus retinervis* and *Maytenus polyacantha*, the grasses, *Cenchrus ciliaris* and *Enneapogon cenchroides* the forbs, *Acalypha segetalis* and *Hibiscus sidiformis* as well as the lianae, *Dalechampia galpinii* and *Sphedamnocarpus pruriens* var. *latifolius* (species group D, Table 1).

Association 2. *Tylosemo fassoglensis-Dalechampion galpinii* ass. nov., hoc loco.

Nomenclatural type: Relevé 215

Table 3  
Soil characteristics of the A and B horizon of the associations of the  
*Cardiospermo corindii-Acacietaalia nigricentis*

Soil characteristic	Associations		
	1	2	3
Soil depth (m)	0,015	0,01	0,01
Gravel A (%)	55	4	4
Sand A (%)	84	66	66
Clay A (%)	16	25	29
Potassium A (mg/100g)	200	125	213
Sodium A (mg/100g)	50	125	188
Magnesium A (mg/100g)	188	1708	1286
Calcium A (mg/100g)	250	2292	1572
S-Value A	688	4250	3963
Conductivity A (mS/m)	205	217	363
pH A	5,9	7,4	5,9

Soil characteristics of the A and B horizon of the associations of the *Spirostachyo africanae-Diospyretalia mespiliformis*

Soil characteristic	Associations			
	1	2	3	no rank
Soil depth (m)	0,12	0,12	0,12	0,12
Gravel A (%)	1	1	9	0
Gravel B (%)	6	2	6	0
Sand A (%)	12	13	32	8
Sand B (%)	25	13	44	12
Clay A (%)	27	29	32	29
Clay B (%)	31	24	30	35
Potassium A (mg/100g)	393	275	217	325
Potassium B (mg/100g)	118	110	50	125
Sodium A (mg/100g)	105	70	50	100
Sodium B (mg/100g)	105	420	100	75
Magnesium A (mg/100g)	1011	600	375	1250
Magnesium B (mg/100g)	955	1445	417	561
Calcium A (mg/100g)	1398	750	500	1063
Calcium B (mg/100g)	693	850	375	563
S-Value A	2889	1695	1142	2738
S-Value B	1873	2665	942	1325
Conductivity A (mS/m)	27,4	19,8	11,5	16,8
Conductivity B (mS/m)	16,7	24,1	7,7	7,5
pH A	6,9	6,9	6,4	6,4
pH B	7,5	7,7	7,0	7,1

This association is situated on the south-facing slopes of the gabbro hills, exclusively on slopes with an inclination of 25° to 30°, and represents the typical association of the alliance.

The soils of the south and north-facing slopes are physically and chemically similar,

the soils of the south-facing slopes, however, have a somewhat harder consistency and are more alkaline. The shallow soils of the Mispah soil form are clayey (25-29% clay), containing only 4% gravel. The soil consistence is loose, with a crumbly texture. These dark red-brown soils are rich in magnesium (1 625 mg per 100 g

soil) and calcium (2 500 mg per 100 g soil), with high S-Values (4 000 mg per 100g soil). The soil pH is 6.7 (Table 3).

The structure of the woody component varies considerably, from only 0.5 m tall, up to 3 m tall. The average canopy cover is 7.5%. An analysis of the Importance Values of the woody species is given in Table 2. *Dalbergia melanoxylon* is the most important species, with the highest Importance Value (54.4), highest average canopy cover (8.1%) and density (666 individuals per hectare). These high values are ascribed to local bush encroachment. Other conspicuous woody species are *Acacia nigrescens*, *Ziziphus mucronata* and *Combretum apiculatum*. The lianae, *Rhoicissus tridentata*, *Sphedamnocarpus pruriens* and *Grewia retinervis* are often found in the woody component.

The herbaceous stratum is 0.8 m high with a canopy cover of 85%. *Panicum maximum* and *Digitaria eriantha* subsp. *eriantha* are the most prominent species, but the creepers, *Tylosema fassoglensis*, *Dolichos trilobos* and *Rhynchosia venulosa* are often also conspicuous. The *Tylosemo fassoglensis-Dalechampietum galpinii* are distinguished from the *Commiphora africanae-Euphorbietum ingentis* association by the presence of species group B, including the diagnostic creeper species, *Tylosema fassoglensis*, *Dolichos trilobos* subsp. *transvaalicus* and *Thunbergia neglecta*, the lithophytic tree, *Ficus abutilifolia* in rock crevices and the xerophytic succulents, *Talinum tenuissimum* and *Kalanchoe rotundifolia*.

Association 3. The *Commiphora africanae-Euphorbietum ingentis* ass nov., hoc loco.

Nomenclatural Type: Relevé 218

This association is located on the north-facing slopes of the gabbro hills with an inclination of between 20° and 30°. The soils of the north-facing slopes are more acidic and have a softer consistency than those of the south-facing slopes.

The vegetation is a dense brush or tall tree veld (Bredenkamp & Theron 1985). Species group C (Table 1) characterises this association, with the diagnostic large succulent tree, *Euphorbia ingens*, the forb, *Aneilema aequinoctiale*, succulent creeper, *Cyphostemma natalitium* and the grass *Enteropogon macrostachyus*.

An analysis of the Importance Value of the woody component is given in Table 2. *Commiphora africana* has the highest Importance Value (60.5) followed by *Lannea schweinfurthii* (35.2) and *Maytenus senegalensis* (33.2). Other conspicuous tree species are *Balanites maughamii*, *Sterculia africana*, *Sclerocarya birrea*, *Pappea capensis*, *Lonchocarpus capassa*, *Grewia bicolor*, *Commiphora mollis*, *Combretum molle*, *Combretum apiculatum*, *Commiphora edulis*, *Dinocanthium hystrix*, *Grewia retinervis* and *Ziziphus mucronata*.

The herbaceous layer is 0.5 m tall with a canopy cover of 75%. *Panicum maximum* and *Aspilia mossambicensis* are by far the dominant species.

Order 2. The *Spirostachyo africanae-Diospyretalia mespiliformis* ord. nov., hoc loco.

Nomenclatural type: *Eucleo natalensis-Diospyrion mespiliformis*

The *Spirostachyo africanae-Diospyretalia mespiliformis* occur along the seasonally dry river banks, forming the riparian thickets.

The vegetation on deep alluvial soils (Dundee soil form, with an Orthic A-horizon on stratified alluvium) along the major river courses is a dense, tall, forest-like woodland. The vegetation is less dense, forming open to dense woodlands on the more clayey soils of the Estcourt soil form (Orthic A-horizon over an eluviated E-horizon on a Prismaeutanic B-horizon) and the vertic Arcadia soil form, found along small and intermediate rivulets. Along the smaller rivulets, the riparian vegetation grades into the adjacent bushveld, giving rise to brush.

Characteristic of these soils are the high magnesium and calcium content, as well as a high S-value in the A horizon, usually exceeding that of the B horizon.

The diagnostic floristic feature of this order is the presence of species group K (Table 1). Diagnostic species for this order include the woody trees, *Diospyros mespiliformis*, *Acacia robusta*, *Clerodendrum glabrum*, *Allophyllus decipiens*, *Canthium obovatum*, *Euclea divinorum*, *Lonchocarpus capassa*, *Combretum imberbe*, *Bolusanthus speciosus* and *Phyllanthus numulariaefolius*, as well as the the liana, *Jasminum fluminense* and forbs, *Justicia protracta* and *Barleria elegans* (Table 1).

Alliance 1. *Euclea natalensis-Diospyrion mespiliformis* all. nov., hoc loco.

Nomenclatural type: *Schotia brachypetalae-Diospyretum mespiliformis*

This alliance is situated along small and intermediate rivulets and is characterised by species group H (Table 1). Diagnostic species include the woody, *Euclea natalensis*, *Rhus pyroides*, *Ficus sycomorus*, *Rhus guenzii* and *Capparis tomentosa*, and the forb, *Achyranthes aspera* (Table 1).

Association 1. '*Schotia brachypetalae-Diospyretum mespiliformis* ass. nov., hoc loco.

Nomenclatural Type: Relevé 33

This dense riparian thicket is dispersed throughout the study area along the dry rivulet banks on sandy, alluvial soils. The sand content of the alluvial B-horizon is 80%, the clay content and base status vary considerably due to the alluvial character.

This is the type association of the alliance. Species group F characterises the association, including the woody *Grewia flavescens*, *Schotia brachypetala*, *Cassine aethiopica*, *Acacia burkei*, *Cassine transvaalensis*, *Carissa edulis*, *Manilka mochisia*, *Berchemia zeyheri*, *Ficus thonningii* and *Pavetta gardenifolia*. The shrubs, *Crotalaria* species and *Hibiscus calyphyllus*, as well as the lianae, *Secamone parviflora* and *Cissampelos mucronata*, are also present.

An analysis of the woody component of the association is given in Table 2. The woody *Diospyros mespiliformis* has the highest constancy (100 %) and canopy cover and is the most important species with an Importance Value of 39. Other notable species are *Spirostachys africana*, *Euclea divinorum*, *Euclea natalensis* and *Maytenus senegalensis*. The lianae, *Rhoicissus tridentata* and *Jasminum fluminense*, are also conspicuous.

The height (0.5 - 1.0 m) and canopy cover (30 - 60 %) of the herbaceous layer under the dense woody component vary considerably. Prominent herbaceous species are the graminoid, *Panicum maximum*, *Eriochloa holubii* and *Panicum infestum*, the forbs *Aspilia mossambicensis*, *Ruellia patula*, *Hibiscus calyphyllus* and *Achyranthes aspera*.

Table 4  
Species with the highest eigen values in the first, second and third principal components  
(Orlaci 1967)

Principal components	Eigen values		
	1	2	3
<i>Cardiospermum corindum</i>	1000	-	-
<i>Rhynchosia venulosa</i>	930	-	-
<i>Pellaea viridis</i>	925	-	-
<i>Sansevieria hyacinthoides</i>	921	-	-
<i>Strychnos madagascariensis</i>	881	-	-
<i>Digitaria eriantha</i>	868	-	-
<i>Ficus abutilifolia</i>	856	-	-
<i>Privia meyeri</i>	825	-	-
<i>Dalechampia galpinii</i>	785	-629	-
<i>Dolichos trilobos</i>	769	-	-
<i>Clerodendrum ternatum</i>	764	-603	-
<i>Tylosema fassoglensis</i>	764	-603	-
<i>Schmidtia pappophoriodes</i>	764	-603	-
<i>Diospyros lycioides</i>	764	-	-
<i>Rhinacanthus xerophilus</i>	742	-	-
<i>Melhania prostrata</i>	742	-	-
<i>Cenchrus ciliaris</i>	732	-	-
<i>Heteropogon contortus</i>	731	-	-
<i>Commiphora mollis</i>	729	-	-
<i>Kalanchoe species</i>	729	-	-
<i>Stylochiton natalensis</i>	710	-	-
<i>Ruellia patula</i>	-651	-	-
<i>Diospyros mespiliformis</i>	-631	-	-
<i>Acacia robusta</i>	-624	-	-
<i>Combretum imberbe</i>	-513	-	-509
<i>Allophylus melanocarpus</i>	-	1000	-
<i>Protasparagus falcatus</i>	-	1000	-
<i>Dioscorea coriifolia</i>	-	1000	-
<i>Dyschoriste fischeri</i>	-	1000	-
<i>Xerophyta retinervis</i>	-	1000	-
<i>Kalanchoe rotundifolia</i>	-	1000	-
<i>Bridelia mollis</i>	-	857	-
<i>Momordica boivinii</i>	-	857	-
<i>Pouzolzia hypoleuca</i>	-	857	-
<i>Acalypha glabrata</i>	-	751	-
<i>Combretum zeyheri</i>	-	717	-
<i>Erythrina humeana</i>	-	633	-
<i>Secamone parviflora</i>	-	-	1000
<i>Protasparagus africanus</i>	-	-	863
<i>Cassine transvaalensis</i>	-	-	857
<i>Schottia brachypetala</i>	-	-	820
<i>Carissa edulis</i>	-	-	746
<i>Grewia flavescens</i>	-	-	742
<i>Acacia burkei</i>	-	-	704
<i>Vernonia colorata</i>	-	-	-563
<i>Setaria incrassata</i>	-	-	-553
<i>Phoenix reclinata</i>	-	-	-548
<i>Albizia harveyi</i>	-	-	-547
<i>Heteropyxis natalensis</i>	-	-	-525
<i>Terminalia sericea</i>	-	-	-505
<i>Kraussia floribunda</i>	-	-	-503

Association 2. *Spirostachyo africanae-Phoenixetum reclinatae* ass. nov., hoc loco.

Nomenclatural Type: relevé 171

The association represents an open riparian vegetation on clayey soils of the Estcourt and Arcadia soil forms. The high clay content of the B-horizon is associated with a high sodium, magnesium and calcium content as well as a high S-Value. The high sodium content (450 mg per 100g soil) and high conductivity (24.1 mS/m) are characteristic for this habitat (Table 4). The vegetation on these clayey soils is an open, tall to low woodland or an open grassland with scattered trees (Bredenkamp & Theron 1985). The canopy cover and density of the *Spirostachyo africanae* - *Phoenixetum reclinatae* are lower than those of the *Schotio brachypetalae-Diospyretum mespiliformis*.

This association is characterised by species group G (Table 1). Diagnostic species include the palm, *Phoenix reclinata*, the grass, *Eriochloa holubii*, the tree *Peltophorum africana*, the shrubs, *Kraussia floribunda*, *Scolopia zeyheri* and *Heteropyxis natalensis* and the forb, *Vernonia colorata*.

An analysis of the Importance Values of the woody component is represented in Table 2. *Diospyros mespiliformis* is the most important species. The high Importance Values for *Maytenus senegalensis*, *Combretum hereroense*, *Phoenix reclinata*, *Dalbergia melanoxylon* and *Phyllanthus nummulariaefolius* are characteristic of this association. Lianae, often found in the woody component, are *Rhoicissus tridentata* and *Jasminum fluminense*.

The height of the herbaceous layer varies between 0.4 m–1.0 m and the canopy cover range from open (40%) to dense (95%). *Panicum maximum*, *Eriochloa holubii*, *Achyranthes aspera*, *Ruellia patula* and *Aspilia mossambicensis* are the most

conspicuous species in the herbaceous layer. Other species which are also notable include the grasses *Panicum infestum* and *Setaria incrassata*.

Alliance 2. *Mayteno-Diospyrion mespiliformis* nom. prov.

Nomenclatural type: *Albizia harveyi-Diospyretum mespiliformis*.

This alliance only contains the type association and its characteristics are therefore similar to those of the association.

Association 3. *Albizia harveyi-Diospyretum mespiliformis* ass. nov., hoc loco.

Nomenclatural Type: Relevé 258

This association is restricted to small dry rivulets meandering through the coarse sandy granite hills in the north eastern parts of the reserve. The soils usually belongs to the Dundee form (Orthic A-horizon on a deep alluvial B-horizon). The A and B horizons are very sandy (87.5%). The soils have a loose, soft, apedal consistency. The coarse, sandy texture of the soils causes high eluviation, resulting in the low base status, S-value and conductivity.

The vegetation is a dense low or tall woodland, occasionally the brush is well developed, forming an open low-growing thicket. The association is characterised by species group I, including the diagnostic tree, *Albizia harveyi*, the sedges, *Cyperus fastigiatus* and *C. sexangularis*, the geophyte, *Crinum moorii* and forb, *Walteria indica* (Table 1).

*Maytenus senegalensis* is the most important species with an Importance Value of 65.4%. The liana, *Rhoicissus tridentata*, is often

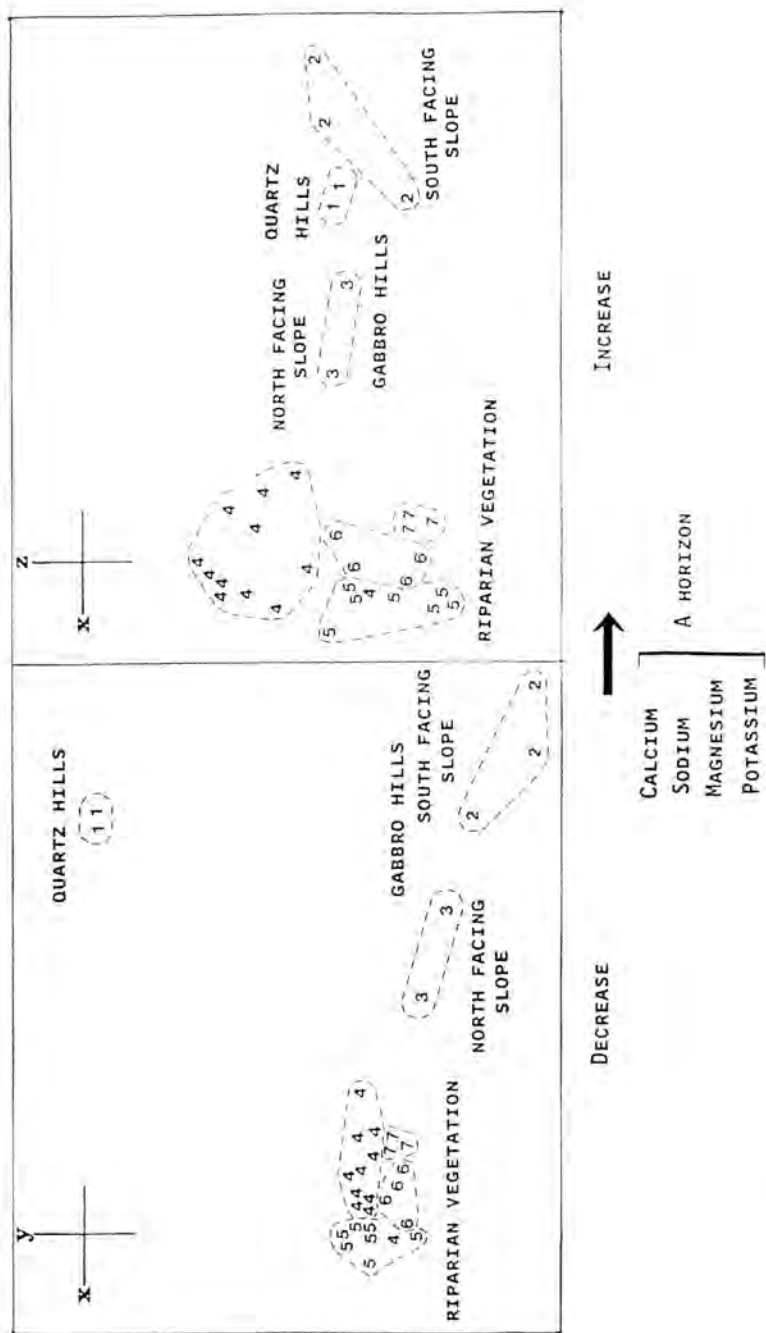


Fig. 1: The distribution of relevés along the first and second and the first and third axes of the ordination based on floristic data. 1. *Cardiospermo corindii-Bridelietum mollis*. 2. *Tylosamo fassoslenis-Dalechampietum galpinii*. 3. *Commiphora africanae-Euphorbietum ingentis*. 4. *Schottia brachypetalae-Diospyretum mespiliformis*. 5 - *Spirostachyo africanae-Phoenicetum reclinatae*. 6. *Albizia harveyi-Diospyretum mespiliformis*. 7. *Phoenix reclinata-Setaria microassata* riparian thicket.

associated with the woody component. The canopy cover of the herbaceous layer can vary from open (50%) to closed (90%), the average height of this layer is between 0.5 - 1.0 m. The graminoid, *Panicum maximum* is the most prominent species, with the sedges, *Cyperus fastigiatus*, *C. sexangularis* and Composite, *Aspilia mossambicensis* also conspicuous.

#### *Phoenix reclinata*-*Setaria incrassata* Riparian Thicket

No syntaxonomical rank

This plant community occurs in the south-eastern parts of the reserve. An analysis of the soils of this riparian thicket is presented in Table 3. This community is situated along banks of dry rivulets meandering through sandy clay-loam soils. The clayey soil belongs to the Arcadia form. The consistency of the soil is hard with a well-developed block structure. The calcium (1 063 mg per 100 g soil) and magnesium (1 250 mg per 100 g soil) contents, as well as the S-Value (2 738 mg per 100g soil) of the A-horizon, are high (Table 3).

Only a few woody species are found in this plant community, dominated by the palm, *Phoenix reclinata*. The vegetation is a low open-growing brush or dense thicket (Bredenkamp & Theron 1985).

This riparian thicket is characterised by species group J (Table 1), including the diagnostic grass species, *Setaria incrassata* and *Themeda triandra* as well as the forbs, *Solanum panduraeforme* and *Leucas glabrata*.

An analysis of the woody component is given in Table 2. *Phoenix reclinata* has the highest Importance Value (86%) followed by *Maytenus senegalensis* (66%) and

*Phyllanthus nummulariaefolius* (44%). The lianae *Rhoicissus tridentata* and *Jasminum fluminense* are often found scrambling in the trees. A few isolated specimens of the tree *Combretum imberbe* are found scattered about.

The herbaceous layer is dense with an average canopy cover of 96%. *Panicum maximum*, *Themeda triandra* and *Setaria incrassata* are the most prominent species in the herbaceous layer. Other notable species are the geophyte, *Crinum moorii*, the forbs, *Aspilia mossambicensis*, *Tragia dioica* and *Justicia cheiranthifolia*, and the liane *Cocculus hirsutus*.

#### *Ordination of vegetation relevés*

The distribution of relevés along the first (X) and second (Y), and second and third (Z) axes of the ordination of floristic data are given in Fig. 1.

According to the ordination along the X-Y axes the relevés of the riparian vegetation are grouped together, indicating a close relationship between the riparian communities. A distinct discontinuity indicates the difference between the *Cardiospermo corindii*-*Acacietaalia nigriscentis* and *Spirostachyo africanae*-*Diospyretalia mespiliformis*.

In the scatter diagram a distinct discontinuity in the distribution of the relevés belonging to the three associations of the *Cardiospermo corindii*-*Acacietaalia nigriscentis* can be observed (Fig. 1). The distribution along the Y-axis indicates the separation of the *Cardiospermo corindii*-*Bridelietum mollis* (1), on the quartz hills, to the top of the diagram, and the *Cardiospermo corindii*-*Dalechampion galpinii* (2&3), on the gabbro hills, to the bottom of the diagram. Along the X-axis a distinct discontinuity is observed between the *Tylosemo fassoglensis*-*Dalechampion galpinii* (2) situated on the



south-facing slopes and the *Commiphora africanae-Euphorbietum ingentis* (3) located on the north-facing slopes of the gabbro hills (Fig. 1). In the X-Z ordination approximately the same results were obtained, except that the discontinuity between the syntaxa on the hills is not as clear as in the X-Y ordination. The results also indicate a close relation between the *Commiphora africanae-Euphorbietum ingentis* (3) on the hills and the riparian vegetation (4-7).

Although the relevés of the *Spirostachyo africanae-Diospyretalia mespiliformis* are grouped together, the different syntaxa are separated in the scatter diagram (Fig. 1). The relevés of the two associations belonging to the *Eucleo natalensis-Diospyrion mespiliformis* namely the *Schotio brachypetalae-Diospyretum mespiliformis* (4) and *Spirostachyo africanae-Phoenicetum reclinatae* (5) are located to the top of the scatter diagram. The relevés of the *Spirostachyo africanae-Phoenicetum reclinatae* (5) occur on soils relatively rich in calcium, sodium, magnesium and potassium, and are situated to the right of the diagram, whereas the relevés of the *Spirostachyo africanae-Phoenicetum reclinatae* (5), on poorer soils, are situated to the left. The relevés of the *Albizia harveyi-Diospyretum mespiliformis* (6) and the *Phoenix reclinata-Setaria incrassata* (7) riparian thicket are situated to the bottom of the scatter diagram with the *Albizia harveyi-Diospyretum mespiliformis* on poorer soils to the left and the *Phoenix reclinata-Setaria incrassata* riparian thicket, on richer soils, to the right. A more or less similar trend can be observed in Fig. 1, but the two associations of the *Eucleo natalensis-Diospyrion mespiliformis* are separated on the Z-axis.

Species with the highest eigen values in the first, second and third principal components are given in Table 4. Species with high

positive eigen values in the first principal component, are diagnostic species of the *Cardiospermo corindii-Acacietaalia nigriscentis* situated to the right of the scatter diagram.

The four species with high negative eigen values are diagnostic of the *Spirostachyo africanae-Diospyretalia mespiliformis* situated to the left of the scatter diagram.

The species with high positive eigen values in the second principal component are diagnostic species for the *Cardiospermo corindii-Bridelietum mollis*, situated to the top of the Y-axis of the scatter diagram. Species with relative high negative eigen values in the second principal component are diagnostic for the *Cardiospermo corindii-Dalechampion galpinii*, particularly the *Tylosemo fassoglensis-Dalechampion galpinii*, situated to the bottom of the Y-axis in the scatter diagram.

Species with high positive eigen values in the third principal component are diagnostic for the *Schotio brachypetalae-Diospyretum mespiliformis*, whereas species with a high negative eigen value are diagnostic for species of the *Spirostachyo africanae-Phoenicetum reclinatae*, *Albizia harveyi - Diospyretum mespiliformis* and the *Phoenix reclinata-Setaria incrassata* riparian thicket.

## Concluding remarks

The classification obtained by agglomerative cluster analysis (Orloci 1967) refined by Braun-Blanquet procedures resulted in vegetation units that can be related to environmental factors and these should therefore be considered as ecologically interpretable communities for the area concerned. The classification is supported by the results of the floristic ordination, the latter providing an understanding of the vegetation gradients and associated habitat gradients within the orders. The description

of the syntaxa contributes to the scanty knowledge of the syntaxonomy and synecology of the Transvaal Lowveld region in South Africa.

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