

AN OVERVIEW OF THE MAJOR PLANT COMMUNITIES OF THE MANYELETI GAME RESERVE GAZANKULU, SOUTH AFRICA

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Abstract: As part of a vegetation survey programme for conserved areas a survey of the Manyeleti Game Reserve was undertaken. From a Braun-Blanquet analysis of the vegetation, seven major plant communities were identified. As this survey forms the basis for further more detailed phytosociological research, an overview of these communities is presented. Descriptions of the communities include habitat characterization, diagnostic species, as well as prominent taxa in the woody and herbaceous strata.

Introduction

The Manyeleti Game Reserve is presently the only nature reserve in the Gazankulu state in Southern Africa. This conservation area and tourist attraction has greatly been utilized as a recreation and holiday resort. The great potential to serve as a centre for education in environmental conservation and wildlife management in this region was emphasized by Hancock (1980), and vegetation and general ecological surveys were considered to have high priority (Nakor 1979). Furthermore, for the establishment of efficient wildlife management programmes and conservation policies, a sound knowledge of the ecology of the area is essential (Edwards 1972, Bredenkamp and Theron 1978). For the reasons mentioned above, and as part of survey programme for conservation areas in South Africa, a study of the vegetation of the Reserve was undertaken. A classification of the vegetation and description of the major plant communities is given in this report.

The study area

The Manyeleti Game Reserve, which covers approximately 22,700 hectares, is situated in the Arid Lowveld Veld Type (Acocks, 1975), adjacent to the Kruger National Park, between 24°29' and 24°42'S and 31°23' and 31°36'E. The gently undulating plains are situated at an altitude of 350-450 m, with a slight rise towards the west. Numerous dry drainage lines dissect the area. Archaean granite covers most of the Reserve, but great portions of a large gabbro dyke are exposed in the western parts. Weakly developed fersiallitic soils are dominant on most of the granitic landscape. The soils of the upland sites are coarse, sandy, acid and leached, whereas soils of the bottomland sites are often solonchic and planosolic, fine textured, pH neutral or alkaline and often calcareous or sodic. On areas where the gabbro dyke is exposed, marginalitic, vertic soils are commonly found. The climate of the area is, according to the Köppen index, a BShw climate, where BS = arid steppe climate, h = hot and dry with mean annual temperatures exceeding 18°C, and w = dry winter. The average annual rainfall is about 600 mm.

Temperatures recorded for the nearby Skukuza range from mean daily maximum temperatures of 32,3°C in December and January, to mean daily minimum temperatures of 5,6°C in July (Weather Bureau 1954).

The vegetation represents Bushveld, consisting of a woody component of low-branching, small to medium sized trees and shrubs, and a herbaceous component of grasses and herbs (Van Wyk 1971; Werger and Coetzee 1978, Van der Meulen 1979). Bushveld belongs to the Zambezi Domain of the Sudano-Zambezi Region (Werger and Coetzee, 1978, Coetzee 1983). Two of the four major physiognomic types distinguished by Werger and Coetzee (1978), occur within the study area, namely Broad-orthophyll mesophytic Bushveld on well aerated moist sandy soils and Microphyllous Thorny Bushveld on relatively dry, clayey soils.

Methods

By using 1:30 000 black and white areal photographs, the entire study area was stratified into relatively homogeneous physiographic-physiognomic units. Sample plots were randomly located within each. The number of plots per unit was determined *pro rata*, on an area-size basis. In this way 264 sample plots were effectively distributed, and all variations in the vegetation were considered as well sampled. Relevés were compiled for each sample plot. The vegetation survey included the following:

(a) Cover/abundance values were estimated for all herbaceous species in a 10 m × 20 m sample plot, by using the Braun-Blanquet cover/abundance scale (Westhoff and Van der Maarel 1978).

(b) Quantitative cover and density data for all woody species were obtained by using the variable plot size method of Coetzee and Gertenbach (1977). The quantitative cover values were converted to Braun-Blanquet cover/abundance values for the purpose of the data. Quantitative values were used in an analysis of the structure of the woody component (Bredenkamp and Theron, 1985).

The habitat survey included geology, topography,

altitude, aspect, slope, surface rock and various soil properties, including physical and chemical analysis as well as a soil classification according to the system of MacVicar *et al.* (1977).

Final data processing was based on Braun-Blanquet procedures. However, the relatively large data set, including 264 relevés and 516 species was difficult to interpret. A preliminary classification of relevés on basis of species composition, and of species on basis of distribution within the relevés, was completed by agglomerative cluster analysis (Orlóci 1967). The results of these classifications were used to produce a fairly ordered two-way table, which was refined by rearrangement of relevés and species. Rearrangement was done electronically, and printouts of newly arranged tables were obtained after the rearrangements.

From the final phytosociological table, seven major plant communities were identified. A synoptic table (Table 1) was compiled for the communities. In this table the entries represent the constancy of the species in the communities as follows:

- 5 = 81 - 100% presence
- 4 = 61 - 80% presence
- 3 = 41 - 60% presence
- 2 = 21 - 40% presence.

Species with a constancy of lower than 21% were omitted from the table. Author names of species are not given, as these are found in Bredekamp (1985). The structure of

the woody component of the vegetation is described according to the structural classification of Bredekamp and Theron (1985).

Results

A diagrammatic presentation of a hierarchical classification and broad ecological interpretation of the seven major communities is given in Figure 1. The vegetation is divided into two broad types, namely

1. Zonal bushveld of the semi-arid undulating plains; and
2. Azonal bushveld of the sub-humid river banks, hills and outcrops.

1. *Zonal vegetation: Bushveld and grassland of the semi-arid undulating plains*

This vegetation type covers >90% of the study area, and includes Broad-orthophyll Plains Bushveld and Microphyllous Thorny Plains Bushveld on granite (Werger and Coetzee 1978), as well as grassland on gabbroic plains. Species with a wide distribution type, are listed in Species Group H (Table 1). This Bushveld vegetation comprises a mosaic of many different communities, and is therefore quite heterogeneous. However, *Combretum zeyheri*, *C. apiculatum*, *Terminalia sericea* and *Sclerocarya birrea* are often dominants or subdominants in vast areas, while *Acacia nigrescens* or *Albizia harveyi* or *Combretum collinum* and *Pterocarpus rotundifolius* may be dominants

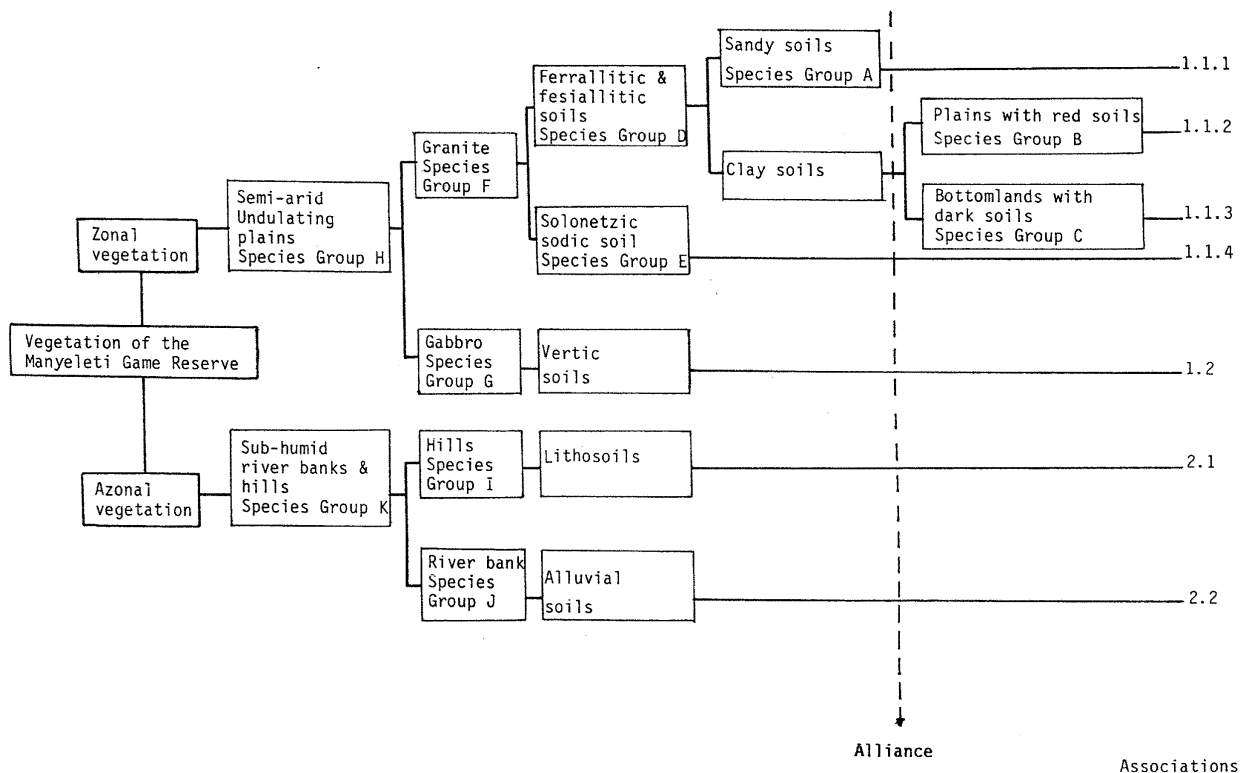


Fig. 1. A broad hierarchical habitat interpretation of the seven major plant communities of the Manyeleti Game Reserve. Number code on right margin identify sections in the main text.

Table 1. Synoptic table of the major plant communities of the Manyeleti Game Reserve. See explanations in the main text.

Community number	1	1	1	1	1	2	2

	1	1	1	1	2	1	2

	1	2	3	4			
Species group A							
Character species of the							
Perotis patens-Terminalia sericea							
Woodland							
w=woody; g=graminoid; f=forb							
w Terminalia sericea	5						
g Perotis patens	4						
f Cassia absus	4						
f Rhynchosia venulosa	4					5	
g Schmidtia pappophoroides	3					3	
f Merremia tridentata	3						
f Triliceras lacerata	3						
g Trichoneura grandiglumis	3						
f Indigofera filipes	3						
f Macrotyloma maranguense	2						
w Acacia burkei	2						2
f Melhania prostrata	2					2	
g Elionurus muticus	2						
g Rhynchelytrum repens	2					2	
f Heliotropium strigosum	2						
f Harpagophytum zeyheri	2						
f Chascanum adenostachyum	2						
w Strychnos madagascariensis	2					3	
g Eragrostis gummiflua	2						
g Sporobolus fimbriatus	2					2	
g Microchloa caffra	2						
f Monsonia angustifolia	2						
f Jatropha zeyheri	2						
f Clerodendrum ternatum	2					3	
f Cleome monophylla	3	2					
Species group B							
Character species of the							
Combretum collinum-Pterocarpus rotundi-							
folius Woodland							
w Combretum collinum		5					
w Pterocarpus rotundifolius	3	4				2	
f Vernonia oligocephala		3				2	
w Lannea discolor		2					
f Barleria oxyphylla		2				2	
g Cymbopogon plurinodis		2	2				
g Setaria sphacelata	2	2					
f Chascanum hederaceum		2				2	
Species group C							
Character species of the							
Euclea divinorum-Acacia nigrescens							
Woodland							
w Euclea divinorum			4		2		4
f Tephrosia uniflora			3				
f Ocimum canum		2	3				
f Stylochiton natalensis		2	3		2		
f Justicia flava			3				
g Sporobolus pectinatus			2				
g Cyperus holostigma			2				
f Becium knyanum			2				

g	<i>Chloris virgata</i>			2
f	<i>Albica setosa</i>			2
g	<i>Dactyloctenium australe</i>			2
w	<i>Grewia retinervis</i>			2
g	<i>Aristida stipitata</i>	2		3

Species group D

Species limited to communities 1,2 and 3

w	<i>Acacia exuvialis</i>	3	3	3	2
g	<i>Aristida congesta</i>	3	2	2	
f	<i>Stylosanthes fruticosa</i>	3	2	2	
f	<i>Thunbergia neglecta</i>	3	2	2	2
w	<i>Grewia monticola</i>	2	2	2	
f	<i>Urginia altissima</i>	2	2	2	
f	<i>Melhania forbesii</i>	2	2	2	
f	<i>Indigofera lupatana</i>	2	2		
f	<i>Polygala sphenoptera</i>	2	2		
f	<i>Dolichos junodii</i>	2	2		
g	<i>Eustachys paspaloides</i>	2	2		

Species group E

Character species of the
Euclea divinorum-Albizia
harveyi Woodland

f	<i>Epaltes gariepina</i>			2	3
f	<i>Justicia cheiranthifolia</i>				3
g	<i>Eragrostis stapfii</i>				2
f	<i>Kyphocarpa angustifolia</i>		2	2	3
f	<i>Gomphrena celocioides</i>		2	2	
f	<i>Abutilon austro-africanum</i>			2	2
g	<i>Dactyloctenium geminatum</i>				2
f	<i>Tulbachia leucantha</i>				2

Species group F

Species on granite

(communities 1,2,3 and 4)

g	<i>Urochloa mosambicensis</i>	4	5	5	5
f	<i>Agathisanthemum bojeri</i>	5	4	4	3
w	<i>Combretum zeyheri</i>	5	3	4	2
w	<i>Cissus cornifolia</i>	4	3	4	3
f	<i>Waltheria indica</i>	5	3	2	2
g	<i>Eragrostis rigidior</i>	4	3	4	4
g	<i>Pogonarthria squarrosa</i>	4	2	2	3
f	<i>Boopane disticha</i>	2	3	3	2
g	<i>Eragrostis superba</i>	2	3	4	4
f	<i>Achyranthes sicula</i>	2	3	4	3
f	<i>Chaetacanthus burchelli</i>	2	3	2	2
f	<i>Anthericum galpinii</i>	3	2	3	2
f	<i>Kohautia virgata</i>	4	4	4	4
f	<i>Aeschynomene indica</i>	3	3		2
f	<i>Evolvulus alsinoides</i>	2		2	2
f	<i>Blepharis integrifolius</i>	2		4	3
f	<i>Hermbstaedia odorata</i>	3		3	2
g	<i>Brachiaria nigropedata</i>	4	2	2	
f	<i>Oxalis obliquifolia</i>		2	2	2
g	<i>Kyllinga alba</i>	4		3	2
g	<i>Mariscus indecorus</i>	3		4	2

Species group G

Character species of the
Themeda triandra-Setaria
incrassata Grassland

g	<i>Setaria incrassata</i>				5	2
f	<i>Indigofera spicata</i>				5	

f	<i>Tragia incisifolia</i>					4	
f	<i>Rhynchosia minima</i>					4	
f	<i>Vernonia fastigiata</i>					4	
f	<i>Hybanthus ennaespermus</i>					4	
f	<i>Merremia palmata</i>					3	
f	<i>Turbina robertsiana</i>					3	
f	<i>Abutilon guineense</i>					3	
g	<i>Eragrostis curvula</i>					3	
w	<i>Commiphora edulis</i>					3	
f	<i>Acalypha segetalis</i>					3	4
f	<i>Leucas glabrata</i>					3	
f	<i>Teramnus labialis</i>					2	
f	<i>Alysicarpus glumaceus</i>					2	
g	<i>Aristida bipartita</i>					2	
f	<i>Ipomoea lapathifolia</i>					2	
f	<i>Tephrosia polystachya</i>					2	
g	<i>Trachypogon spicatus</i>					2	
f	<i>Ipomoea coscinosperma</i>					2	
f	<i>Neorautanemia amboense</i>					2	

Species group H

Species of the plains

f	<i>Solanum panduraeforme</i>	3	4	5	3	3	
f	<i>Phyllanthus maderaspatensis</i>	4	5	4	3	2	
f	<i>Solanum incanum</i>	2	2	2	2	4	
f	<i>Lantana rugosa</i>	2	4	4	3	3	
f	<i>Corchorus asplenifolius</i>	2	3	3	4	5	
g	<i>Digitaria eriantha</i>	4	4	4	3	2	5
w	<i>Acacia gerrardii</i>	2	4	4	3	2	
f	<i>Commelina africana</i>	2	3	3	2	4	
f	<i>Ipomoea crassipes</i>	3	3	2	2	2	
g	<i>Bothriochloa radicans</i>		3	2	2	5	
f	<i>Talinum tenuissimum</i>	2		3		2	3
f	<i>Hibiscus pusillus</i>		2	2	2	2	2

Species group I

Character species of the

Cardiospermum corindum corindum-*Acacia nigrescens* Bush

w	<i>Cardiospermum corindum</i>					5
f	<i>Pellaea viridis</i>					5
w	<i>Commiphora africana</i>	2	2			5
f	<i>Pupalia lapacea</i>					4
f	<i>Priva meyeri</i>					4
f	<i>Sansevieria hyacinthoides</i>					4
w	<i>Papea capensis</i>					4
f	<i>Dalechampia galpinii</i>					4
w	<i>Erythrina humeana</i>					4
w	<i>Commiphora mollis</i>					3
g	<i>Cenchrus ciliaris</i>					3
f	<i>Rhinacanthus xerophilus</i>					3
w	<i>Ochna natalitia</i>					3
w	<i>Diospyros lycioides</i>					3
f	<i>Sphedamnocarpus pruriens</i>					3
w	<i>Bridelia mollis</i>					2
g	<i>Diheteropogon amplexans</i>					2
f	<i>Kalanchoe rotundifolia</i>					2
f	<i>Momordica boivinii</i>					2
w	<i>Pouzolzia hypoleuca</i>					2
w	<i>Allophylus melanocarpus</i>					2
w	<i>Protasparagus falcatus</i>					2
w	<i>Dioscorea cotonifolia</i>					2
f	<i>Dyschoriste fisheri</i>					2
f	<i>Xerophyta retinervis</i>					2

f	<i>Orthosiphon suffrutescens</i>						2
g	<i>Enneapogon cenchroides</i>						2
f	<i>Fockea angustifolia</i>						2
f	<i>Hibiscus sidiformis</i>						2
g	<i>Cymbopogon excavatus</i>						2
w	<i>Euphorbia ingens</i>						2
f	<i>Aneilema aequinoctiale</i>						2
f	<i>Cyphostemma natalitium</i>						2
g	<i>Enteropogon macrostachyus</i>						2
w	<i>Maytenus heterophylla</i>						2
w	<i>Combretum molle</i>						2
Species group J							
Character species of the							
<i>Spirostachys africana</i> - <i>Diospyros</i>							
<i>mespiliformis</i> Bush							
	<i>Diospyros mespiliformis</i>						5
w	<i>Acacia robusta</i>						4
w	<i>Phyllanthus nummulariaefolius</i>						3
w	<i>Phoenix reclinata</i>						3
f	<i>Justicia protracta</i>						3
w	<i>Alphyllus decipiens</i>						3
g	<i>Eriochloa holubii</i>						3
f	<i>Achyranthes aspera</i>				2		3
w	<i>Grewia flavescens</i>						3
x	<i>Clérodendrum glabrum</i>						2
w	<i>Canthium obovatum</i>						2
f	<i>Hybiscus calyphyllus</i>						2
g	<i>Cyperus fastigiatus</i>						2
f	<i>Barleria elegans</i>						2
f	<i>Crinum moorii</i>						2
w	<i>Rhus pyroides</i>						2
w	<i>Secamone parviflora</i>						2
w	<i>Carissa edulis</i>						2
w	<i>Bolusanthus speciosus</i>						3
f	<i>Pavonia burchellii</i>						3
f	<i>Ruellia patula</i>						5
Species group K							
Species limited to hills and							
river banks							
f	<i>Aspilia mossambicensis</i>					5	4
w	<i>Rhoicissus tridentata</i>					3	3
w	<i>Jasminum fluminense</i>					2	3
g	<i>Panicum infestum</i>					3	2
w	<i>Dombeya rotundifolia</i>					3	2
w	<i>Protasparagus africanus</i>					5	3
w	<i>Spyrostachys africana</i>					3	4
f	<i>Cocculus hirsutus</i>					4	2
w	<i>Schotia brachypetala</i>					3	3
w	<i>Bridelia cathartica</i>					2	2
w	<i>Cassine aethiopica</i>					2	2
Species group L							
Species of general occurrence							
g	<i>Panicum maximum</i>	5	5	5	5	5	5
w	<i>Ziziphus mucronata</i>	2	3	5	2	4	5
f	<i>Phyllanthus burchellii</i>	3	2	2	2	4	4
w	<i>Dalbergia melanoxylon</i>	4	4	2	2	5	2
w	<i>Maytenus senegalensis</i>	3	3	2	2	2	3
w	<i>Acacia nigrescens</i>	2	2	5		4	5
w	<i>Albizia harveyi</i>	4	5	5	5	4	
w	<i>Dichrostachys cinerea</i>	4	5	4	3	5	2
w	<i>Combretum hereroense</i>	2	4	4	3	5	
w	<i>Ormocarpum trichocarpum</i>	2	2	3	2	5	2

g	<i>Themeda triandra</i>	2	5	4	4	5	4	
w	<i>Lonchocarpus capassa</i>	4	2	2	2	2		3
w	<i>Sclerocarya birrea</i>	5	3	2		3	3	2
f	<i>Ipomoea obscura</i>		3	2	2	3		2
w	<i>Lannea schweinfurthii</i>	3	2	2			4	4
f	<i>Sida dregei</i>		2	2	2	4		3
g	<i>Heteropogon contortus</i>	3	3		2	2	4	
f	<i>Commelina livingstonii</i>	3	2	3			3	3
w	<i>Peltophorum africanum</i>	2	2	2				2
w	<i>Grewia bicolor</i>	2	2	2			3	
w	<i>Combretum apiculatum</i>	4	2	4			5	
w	<i>Securinega virosa</i>					2	5	3
w	<i>Combretum imberbe</i>			2	3			4
f	<i>Tragia dioica</i>			2			4	2
w	<i>Ehretia amoena</i>					2	2	
w	<i>Protasparagus retinervis</i>	2					4	

locally, depending on the geology topography and soil type. More detailed discussions are given under the relevant subheadings that follow.

1.1. Bushveld and grassland on granite

Within the gently undulating granitic landscape, dissected with numerous dry rivers, soil types are strongly correlated with topography. The strong correlation between soil types and plant communities in this area was shown by Bredenkamp, Theron & Van Vuuren (1983) and in other Lowveld Bushveld areas by Van der Schijff (1957), Gertenbach (1978) and Coetzee (1983). Four distinct major communities are distinguished.

1.1.1. *The Perotis patens-Terminalia sericea Woodland on deep, sandy, mesic fersiallitic soils of upland sites.* This community clearly belongs to the *Perotido patensis-Terminalietum sericeae* described by Coetzee (1983) from the Kruger National Park. The vegetation is mostly an open to dense low to tall tree veld (Bredenkamp and Theron 1985), representing the Board Orthophyll Plains Bushveld of Werger and Coetzee (1978). The areal distribution is restricted to deep acid, dystrophic, leached, sandy soils of upland sites on the gently undulating granite plains (See also Bredenkamp, Theron and Van Vuuren 1983). Soil forms (MacVicar *et al.* 1977) represented in these areas include the Glenrosa, Cartref, and Fernwood forms. The habitat features of this community are summarised in Table 2.

Differential taxa are listed under Species Group A in Table 1. Dominant and subdominant woody species regularly include *Combretum zeyheri*, *Sclerocarya birrea* and *Terminalia sericea*. On shallower soils is *Combretum apiculatum* among the dominants, while *Strychnos madagascariensis* becomes prominent on deeper soils. Other species which may be locally prominent include *Acacia burkei*, *A. exuvialis*, *A. nigrescens*, *Lonchocarpus capassa*, *Lannea schweinfurthii*, *Peltophorum africanum*, *Dalbergia melanoxylon*, *Pterocarpus rotundifolius* and *Dichrostachys cinerea*. Dominant grasses include *Panicum maximum*, *Digitaria eriantha*, *Pogonarthria squarrosa*,

Schmidtia pappophoroides, *Brachiaria nigropedata*, *Eragrostis rigidior*, *Urochloa mosambicensis* and *Sporobolus fimbriatus*. The forb *Agathisanthemum bojeri* is often conspicuously present in the herbaceous layer. Locally where the sandy soils are wet and often saturated with percolating water, the grass *Eragrostis gummiflua* and the forbs *Murdannia simplex*, *Cyperus holostigma*, *Wahlenbergia caledonica* and *Epaltes gariepina* become prominent.

1.1.2. *The Combretum collinum-Pterocarpus rotundifolius Woodland on red mesic clay soils on flat plains.* This community is related to certain sub-communities of the *Themeda triandrae - Acacietum gerrardii*, a complex and heterogeneous community described by Coetzee (1983) from the Kruger National Park. The *Combretum collinum - Pterocarpus rotundifolius* Woodland is however more mesic than any of the subcommunities of the above association. A major difference is the dominance of *Combretum collinum* and the presence of *Lannea discolor* in the *Combretum collinum - Pterocarpus rotundifolius* Woodland, while both these species are absent in Coetzee's association. In the Manyeleti Game Reserve the *Combretum collinum - Pterocarpus rotundifolius* Woodland merges into the more mesic *Perotis patens - Terminalia sericea* Woodland on mesic sands, described above, and the floristic relationships between these two communities are demonstrated by species groups D, F and H in Table 1.

This community occurs in a wide transitional area between Archaean granite and the exposed gabbro. The terrain is fairly flat or slightly undulating and the influence of the basic igneous gabbro can clearly be seen in the properties and the soils in this region. Where the influence of granite dominates, red structureless fersialitic soils, representing the Hutton Soil form (MacVicar *et al.* 1977), are formed. In contrast, red structured fersialitic clay soils of the Shortlands Form are found on sites where gabbro dominates. The major habitat features are summarized in Table 2.

Sparse to open low shrub veld, dense brush and very dense low tree veld represent this Broad orthophyll Plains

Bushveld. The *Combretum collinum* - *Pterocarpus rotundifolius* Woodland is characterised by the taxa listed in species group B in Table 1. The differential taxa *Combretum collinum*, *Pterocarpus rotundifolius* and *Lannea discolor* are regularly amongst the dominants or subdominants of the woody component. Other prominent trees and shrubs include *Dichrostachys cinerea*, *Albizia harveyi*, *Combretum hereroense*, *Dalbergia melanoxylon* and *Acacia gerrardii*. The most conspicuous grasses include *Urochloa mosambicensis*, *Panicum maximum*, *Themeda triandra*, *Digitaria eriantha* and *Heteropogon contortus*.

1.1.3. The *Euclea divinorum* - *Acacia nigrescens* Woodland

on mesic calcareous bottomland clays. Coetzee (1983) classifies fairly similar vegetation on similar but somewhat dryer habitats under a subcommunity of his *Themeda triandrae* - *Acacietum gerrardii* of an unspecified Alliance. However the presence of several diagnostic species, such as *Euclea divinorum*, *Justicea flava*, *Ipomoea coptica*, *Dactyloctenium australe*, *Kyphocarpa angustifolia* and *Pupalea lapacea* in the *Euclea divinorum* - *Acacia nigrescens* - Woodland, are also diagnostic species for Coetzee's *Chlorico virgatae* - *Justiceion flavae* on sodic soils. The floristic composition, as well as the sodic nature of especially the B horizon of the soils, suggests that the *Euclea divinorum* - *Acacia nigrescens* Woodland should be classified under the *Chlorico virgatae* - *Justiceion flavae*.

Table 2. Habitat features and soil characteristics for the major plant communities of the Manyeleti Game Reserve. See explanations in the main text.

Community number (see text)	1.1.1	1.1.2	1.1.3	1.1.4	1.2	2.1	2.2
Geology	Granite	Granite/Gabbro	Granite/dolerite	Granite	Gabbro	Quartz/Gabbro	Alluvium
Topography	Upland	flat areas	bottomland	bottomland	upland & bottomland	hills	riverbanks
Soil Forms (MacVicar, <i>et al.</i> 1977)	Glenrosa Cartref Fernwood	Shortlands Hutton Mayo	Bonheim Willowbrook Valsrivier	Estcourt Sterkspruit Katspruit Willowbrook Valsrivier	Arcadia Rensburg	Mispah	Dundee Oakleaf Clovelly
Gravel A* %	10	5	7	4	2	18	2
Gravel B %	46	20	28	11	14	—	4
Sand A %	85	69	78	71	43	71	77
Sand B %	83	55	62	56	57	—	77
Clay A %	12	28	18	24	51	24	22
Clay B %	14	38	33	38	38	—	21
Texture class A	Loamy sand	Sandy clay loam	Sandy loam	Sandy clay loam	Sandy clay	Sandy clay loam	Sandy clay loam
Texture class B	Loamy sand	Sandy clay	Sandy clay loam	Sandy clay	Sandy clay	—	Sandy clay loam
Potassium A mg/100g	274	229	182	221	439	172	328
Potassium B mg/100g	233	101	104	123	241	—	116
Sodium A mg/100g	53	84	97	128	180	122	92
Sodium B mg/100g	108	198	360	409	294	—	171
Magnesium A mg/100g	215	641	411	437	3.516	1.286	731
Magnesium B mg/100g	238	1.060	1.034	1.186	3.406	—	744
Calcium A mg/100g	160	408	278	360	1.740	1.572	872
Calcium B mg/100g	73	505	360	662	2.737	—	582
S-value A mg/100g	685	1.353	974	1.196	6.011	3.150	1.904
S-value B mg/100g	643	1.865	1.820	2.280	6.757	—	1.605
Conductivity A µmho/cm	82	138	154	146	219	258	218
Conductivity B µmho/cm	45	209	693	1.295	582	—	159
pH (H ₂ O) A	5,6	5,9	5,7	6,0	7,3	6,5	6,7
pH (H ₂ O) B	6,2	6,9	7,1	7,6	8,1	—	7,4
HCl reaction	No	No	Yes	No	Yes	No	No

* A and B refer to the soil horizons

This woodland occurs in bottomlands of the undulating granitic plains. These bottomlands occur in a mosaic pattern with the sandy upland sites of the *Perotis patens* - *Terminalia sericea* Woodland, described above. These two communities often merge into another, and their floristic relationships are indicated by Species groups D, F and H. Dolerite dykes are commonly found in lower parts of granitic terrain, and the presence of dolerite might have been responsible for bottomland formation (Coetzee 1983). Under these conditions the soil forms Willowbrook, Bonheim, Valsrivier and Mayo (MacVicar, *et al.* 1977) are often found. The major habitat features are summarized in Table 2.

The *Euclea divinorum* - *Acacia nigrescens* Woodland represents Microphyllous Thorny Plains Bushveld (Werger and Coetzee 1978) and represents open to closed tall treeveld (Bredenkamp and Theron 1985). The characteristic taxa are listed in Species group B in Table 1. As already mentioned, many of these species are also differential species for the *Chlorico virgatae* - *Justiceion flavae*. Dominant and subdominant woody species include *Acacia nigrescens*, *Albizia harveyi*, *Ziziphus mucronata*, *Acacia gerrardii*, *Combretum hereroense*, *C. apiculatum* and *Euclea divinorum*. The most prominent grasses are *Panicum maximum*, *Digitaria eriantha* and *Themeda triandra*, with *Urochloa mosambicensis* and *Eragrostis rigidior* in overgrazed sites.

1.1.4. *The Albizia harveyi* - *Euclea divinorum* Woodland and grassland on bottomland granitic solonchic sodic soils of valley floors, pans and flood plains. This community represents the *Albizia harveyi* - *Euclea divinorum* described by Coetzee (1983). The following range of structural types (Bredenkamp and Theron 1985) are represented: grassland, sparse to very dense, dwarf to low shrub veld and open tall tree veld. Many granitic, bottomland sites, especially along larger drainage lines or on valley floors, are characterized by solonchic duplex soils, with prisma-cutanic, sodic B-horizons. These soils are classified as Estcourt or Sterkspruit Forms (MacVicar *et al.* 1977), but the Willowbrook, Katspruit and Valsrivier soil Forms may also occur in these situations. The sodic B-horizons of the soil usually contain >35% clay. The major habitat features of the community are summarized in Table 2.

The characteristic taxa are listed in Species Group E (Table 1). Although the grass *Eragrostis stapfii* and the forb *Epaltes gariiepina* may be prominent, locally, most of these differential taxa are inconspicuous forbs in the herbaceous layer. The woody plants are mostly dwarfed and only *Albizia harveyi* reaches tree height. Other woody plants represent dwarf or low shrubs of *Combretum hereroense*, *C. imberbe*, *Acacia gerrardii*, *Dichrostachys cinerea* and *Ormocarpum trichocarpum*, and these are often hidden in the herbaceous layer. *Panicum maximum* is abundantly present on many sites but on overgrazed sites *Urochloa mosambicensis* attains dominance. Grasses which are constantly present, include *Themeda triandra*, *Eragrostis rigidior* and *Digitaria eriantha*.

1.2. *The Themeda triandra* - *Setaria incrassata* Shrub Veld and Grasslands on gabbro

Only this single community was identified on the vertic soils found on the gabbro. This community is more mesic than the related communities on dryer vertic or near vertic soils described by Gertenbach (1978) and Coetzee (1983) from the Kruger National Park. The vertic soils of the *Themeda triandra* - *Setaria incrassata* Shrub Veld and Grassland constantly represent the Arcadia Form or the more moist Rensburg Form (MacVicar *et al.* 1977). The vertic A-horizons have high pH-values, very high S-values and >50% clay. Montmorillonite is the predominant clay mineral, and when dry large cracks appear in the soil, due to the swelling and shrinking of the soil. Free carbonates are often present. The habitat features are listed in Table 2. The vegetation represents grassland or open to closed dwarf shrub veld to low shrub veld (Bredenkamp and Theron 1985).

The community is characterised by many differential taxa, including the dominant *Setaria incrassata* and also many inconspicuous forbs. These species are listed in Species Group G in Table 1. Woody species are almost always dwarfed, and these include *Dichrostachys cinerea*, *Combretum hereroense*, *Ormocarpum trichocarpum*, *Dalbergia melanoxylon*, *Albizia harveyi* and *Acacia nigrescens*. The herbaceous layer is strongly developed, and the tall grasses *Setaria incrassata* and *Themeda triandra* are dominant, while *Trachypogon spicatus* becomes dominant on poorly drained sites.

2. Azonal vegetation: Bushveld of the semi-humid river banks, hills and outcrops

Van der Schijff (1957) mentioned the relationships between the vegetation types of river banks and rocky hills in the Kruger National Park. These relationships are caused by the mesic conditions prevailing on these habitats. Within the Manyeleti Game Reserve the vegetation of the river banks and hills are floristically quite distinct, each containing many differential taxa (compare Species Groups I and J in Table 1). A number of mesic taxa are however exclusive to both these communities. These species are listed in Species Group K, Table 1.

2.1. *The Cardiospermum corindum* - *Acacia nigrescens* Bushveld of the rocky hills

Dense Brush or open to closed tall tree veld covers the low rocky quartz or gabbro hills, which occur within the area. The shallow lithosols belong to the Mispah Form (MacVicar *et al.* 1977). Habitat features are summarised in Table 2. Differential taxa are listed in Species Group I in Table 1. Almost all these species are exclusive to the rocky hills in the study area. Although *Acacia nigrescens* is locally prominent the woody layer consists of a mixture of many species, including *Cardiospermum corindum*, *Securinega virosa*, *Ziziphus mucronata*, *Combretum apiculatum*, *Commiphora africana*, *Pappea capensis*, *Lan-*

nea schweinfurthii, *Erythrina humeana*, *Strychnos madagascariensis*, *Grewia retinervis*, *Euclea natalensis*, *Commiphora mollis*, *Rhoicissus tridentata*, *Diospyros lycioides* and *Ochna natalitia*. The herbaceous layer is often poorly developed, but the grass *Panicum maximum* and the Asteraceous *Aspilia mosambicensis* are constantly present.

2.2. *The Spirostachys africana* - *Diospyros mespiliformis* Forest on river banks

Dense to closed tall tree veld (Bredenkamp and Theron 1985) occur on the sandy, often alluvial soils associated with the drainage lines. The alluvial Dundee Form predominates, but the Oakleaf and Clovelly Form (MacVicar *et al.* 1977) may be found on certain sites. Habitat features are summarised in Table 2.

The many differential taxa of this community are listed in Species Group J (Table 1). Many tree species occur in these dense bushes, but *Diospyros mespiliformis* and *Spirostachys africana* are often the most prominent. Other conspicuous trees include *Euclea divinorum*, *E. natalensis*, *Maytenus senegalensis*, *Schotia brachypetala*, *Acacia robusta*, *A. nigrescens* and *Grewia flavescens*. The herbaceous layer is poorly developed. The most conspicuous grasses include *Panicum maximum* and *Eriochloa holubii*, while *Aspilia mosambicensis*, *Ruellia patula* and *Achyranthes aspera* are locally prominent forbs.

Conclusion

The plant communities of the Manyeleti Game Reserve were identified, characterised and delimited by using standard Braun-Blanquet procedures, supplemented by automated clustering techniques. From the synoptic table and the descriptions of the various plant communities, the communities should easily be recognised in the field. Each community is furthermore restricted to a unique set of environmental conditions, which indicate that the delimitation is ecologically sound. This overview, together with surveys of Gertenbach (1978) and Coetzee (1983), can form a basis for further phytosociological investigation within the study area, the Arid Lowveld and other related vegetation types.

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