

The phytosociology of the De Rust section of the Mountain Zebra National Park, Eastern Cape

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Brown, L.R. and H. Bezuidenhout. 2000. The phytosociology of the De Rust section of the Mountain Zebra National Park, Eastern Cape. *Koedoe* 43(1): 1-18. Pretoria. ISSN 0075-6458.

As part of a vegetation survey programme for conservation areas in South Africa, the plant communities of the De Rust section of the Mountain Zebra National Park were investigated. From a TWINSpan classification, refined by Braun-Blanquet procedures, 14 plant communities, which can be placed into six major groups, were identified. A classification and description of these communities, as well as a vegetation map are presented. Associated gradients in habitat were identified by using an ordination algorithm (DECORANA). The diagnostic species as well as the prominent and less conspicuous species of the tree, shrub, herb and grass strata are outlined.

Keywords: Braun-Blanquet procedures, conservation area, plant communities, TWINSpan, vegetation classification.

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Introduction

Since having been proclaimed a protected area in 1937 (Wahl & Naude 1996), the park has become an important preserve for the Cape Mountain Zebra (*Equus zebra zebra*). The Park is visited by more than 14 000 tourists annually from all over the world and South Africa, and serves as an important education centre for environmental education and wildlife management.

From 1996 various farms adjacent to the park have been procured or are in the process of being bought and incorporated into the Park. These new areas will result in the park more than doubling its size from its current 6 536 ha, to approximately 18 000 ha. Although extensive studies on various aspects of the vegetation of the current Park have been conducted by Van der Walt (1980), Novellie (1990a; 1990b) and Novellie & Bezuidenhout (1994), little is known about the vegetation and habitat status of these newly acquired areas.

Because ecosystems react differently to different management practices (Bredenkamp

1982; Bezuidenhout 1993), it is important that a description and classification of the vegetation of an area is done (Van Rooyen *et al.* 1981). It is widely recognised that a detailed description, identification, classification and mapping of the vegetation, form the basis for sound land-use planning and management (Tueller 1988; Fuls *et al.* 1992; Fuls 1993; Bezuidenhout 1996; Brown 1997). The main aim of this study was therefore to describe and map the plant communities of the De Rust section, which has already been acquired by the South African National Parks.

This study forms part of a larger and long-term research project undertaken by South African National Parks and Technikon SA. The aim of this project is to describe and map the vegetation of each of the new farms and assessing the habitats of these areas for the establishment of large herbivores. This will enable management of the Mountain Zebra National Park (MZNP) to take scientifically based decisions on the management of each of these areas before incorporating it into the larger MZNP area. All the data will then be

incorporated into the existing management plan for the MZNP.

The study area

The MZNP is situated approximately 25 km northeast from the town of Cradock in the Eastern Cape Province. It extends from latitude 32°05'–32°20'S and longitude 25°23'–25°32'E (Fig. 1). The De Rust section com-

prises 1712 ha and lies approximately 8 km north of MZNP. The vegetation consists of a mixture of dwarf shrubs and grasses with *Acacia karroo* trees in the lower lying areas and riverbeds (Van der Walt 1980). According to Acocks (1988), the area can be classified as False Karroid Broken Veld (37), while Hoffman (1996) classifies it as Eastern Mixed Nama Karoo (52). Some isolated patches of the South-eastern Mountain Grassland (Grassland Biome) are also found in the study area (Lubke *et al.* 1996). The terrain is mountainous and comprises lower lying valleys and riverbeds, together with

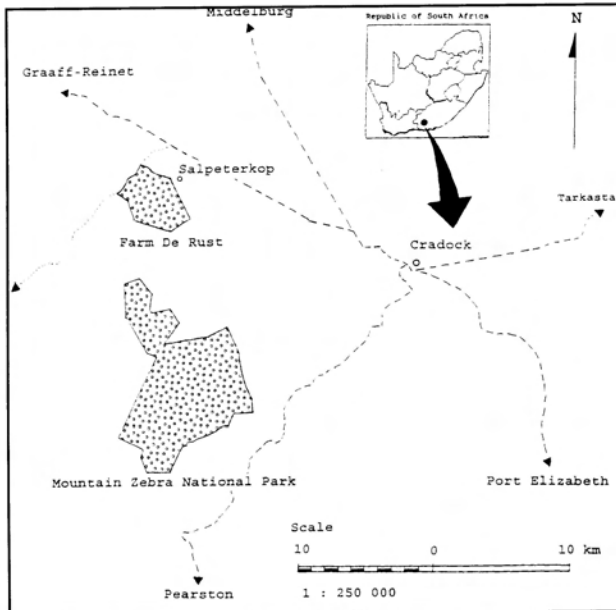


Fig. 1. Location of the study area.

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Land types with references to the physiography, geology and soil

Four land types, namely Ag, Da, Ib, and Fc, occur in the De Rust section of the MZNP as indicated in the terrain form sketch (Fig. 2). According to the Land Type Survey Staff (1986) "A land type denotes an area that can be shown at 1:250 000 scale and that displays a marked degree of uniformity with respect to terrain form, soil pattern and climate". A remarkable association between the major plant communities and the different land types has been observed in other studies (Kooij *et al.* 1990; Bezuidenhout 1993; Eckhardt 1993; Brown 1997).

The land type unit Ag refers to red apedal, freely drained, high base status soil which is

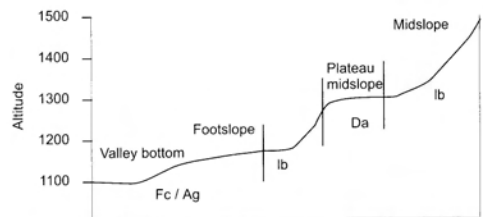


Fig. 2. Terrain form sketch indicating the different land types of the study area.

shallower than 400 mm. The predominant geology of this land type is mudstone, shale and sandstone of the Balfour Formation, Beaufort Group of the Karoo Supergroup (Toerien 1972). A dense subdendritic drainage and dissection pattern occurs in this land type with some dolerite intrusions. The slightly undulating plains are dominated by the valley bottom terrain unit with the dominant soil form Hutton (Soil Classification Working Group 1991). This soil is shallow (150–400 mm), rocky and the sand grade is fine (Land Type Survey Staff 1999).

According to the Land Type Survey Staff (1986) the D land type refers to a soil pattern where duplex soils such as Swartland and Valsrivier forms are dominant. Without exposed rocks, stones or boulders, more than half of the remaining land consists of duplex soils. Unit Da refers to land where duplex soils with red B horizons comprise more than half of the area covered by duplex soils. These plains are dominated by the plateau midslopes. The geology of this land type is mudstone, shale and sandstone of the Balfour Formation, Beaufort Group of the Karoo Supergroup.

The F land type refers to pedologically young landscapes which are predominantly rocky and not alluvial or aeolian. The Fc unit refers to land where lime occurs regularly in upland and valley bottom soils (Land Type Survey Staff 1986). Soil forms that epitomise this land type are Glenrosa and Oakleaf. The geology consists of mudstone, shale and sandstone of the Beaufort Group of the Karoo Sequence with rare dolerite intrusions (Land Type Survey Staff 1999). Two topographical positions are prominent in this terraced landscape, namely the footslopes and valley bottoms.

The Ib land type unit refers to exposed rocks that cover 60–80 % of the area. The rocky portions of Ib may be underlain by soil which has qualified the unit for inclusion in another broad soil pattern had it not been for the surface rockiness. The midslopes are the most prominent topographical position in this mountainous landscape and the domi-

nant soil-rock complex consists of rock while the Glenrosa soil form is subdominant. The geology consists of dolerite with mudstone, shale and sandstone of the Balfour Formation, Beaufort Group of the Karoo Supergroup (Land Type Survey Staff 1999).

Climate

The average annual rainfall for the area, as measured at the MZNP weather station from July 1962 to December 1998, is 381.9 mm with the highest rainfall of 651 mm and lowest rainfall of 153 mm being recorded in 1977 and 1966 respectively. In the last 10 years the lowest rainfall recorded was 213.4 mm (1992) and the highest 565.5 mm (1991). The average monthly rainfall varies from 11.3 mm in the dry winter season to 60.8 mm in the wet summer season (Fig. 3). The average maximum temperature varies between 23.1–28.4 °C in summer (September–March) and 16.2–22.7 °C in winter (April–August), while the average minimum temperature varies between 5.6–13.6 °C in summer and 0.05–7.8 °C in winter. The average maximum and minimum temperatures are also indicated in Fig. 3.

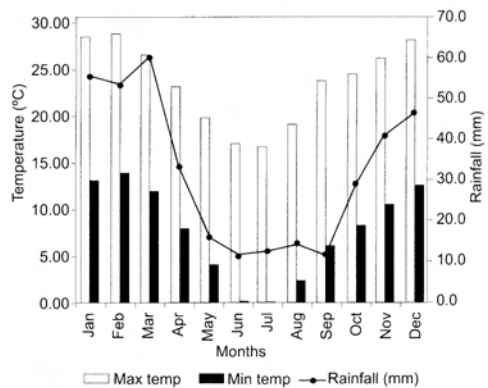


Fig. 3. The average monthly rainfall and the mean average minimum and maximum temperatures for Mountain Zebra National Park

Methods

By using 1:50 000 stereo aerial photographs, the study area was stratified into physiognomic-physiographic units. A total of 76 sample plots were randomly located within these units to ensure that all variations in the vegetation were considered and sampled. Plot sizes were fixed at approximately 400 m² according to Brown (1997). In each sample plot all species were recorded and the cover-abundance of each species was assessed according to the Braun-Blanquet cover-abundance scale (Mueller-Dombois & Ellenberg 1974). Fieldwork was done during February and March 1999. Although certain taxon names have changed, the taxon names of this publication conform to those of Arnold & De Wet (1993). Structural terminology is according to Edwards (1983). The percentage open (grasses and herbaceous plants), shrub (woody species varying in height between >0–3 m) and tree veld (woody species higher than 3 m) were also estimated.

Environmental data included soil type, altitude, an estimation of aspect, slope and rockiness of the soil surface. The floristic data was analysed according to Braun-Blanquet procedures using the BBPC suite (Bezuidenhout *et al.* 1996). By applying the Two-way indicator species analysis (TWINSPAN) (Hill 1979b) to the floristic data, a first approximation of the main plant communities was derived. Further refinement of the classification was achieved by Braun-Blanquet procedures (Bredenkamp *et al.* 1989; Kooij *et al.* 1990; Bezuidenhout 1993; Eckhardt 1993; Brown & Bredenkamp 1994). An ordination technique, DECORANA (Hill 1979a), was also applied to the floristic data to illustrate floristic relationships between plant communities, to detect possible gradients associated in and between communities and to detect possible habitat gradients associated with vegetation gradients. Soil nomenclature follows the classification of the Soil Classification Working Group (1991). No attempt was made to formally fix syntaxa names as this is normally avoided in detailed local studies (Coetsee 1983).

Results

Classification

The analysis resulted in the following fourteen plant communities (Fig. 4), which may be grouped into six major community types (Table 1):

1. *Atriplex semibaccata-Cynodon incompletus* Grassland.

2. *Aristida congesta* subsp. *barbicollis-Pentzia globosa* Grassland.
 - 2.1 *Walafrida geniculata-Eragrostis obtusa* Grassland.
 - 2.2 *Psilocaloun junceum-Eragrostis lehmanniana* Grassland.
 - 2.3 *Monsonia angustifolia-Heteropogon contortus* Grassland.
3. *Tragus koelerioides-Becium burchellianum* Grassland.
 - 3.1 *Oropetium capense-Becium burchellianum* Grassland.
 - 3.2 *Asparagus striatus-Becium burchellianum* Grassland.
 - 3.3 *Becium burchellianum-Acacia karroo* Woodland.
4. *Setaria neglecta-Cadaba aphylla* Shrubland.
 - 4.1 *Enneapogon scoparius-Ehretia rigida* Shrubland.
 - 4.2 *Sporobolus africanus-Acacia karroo* Shrubland
 - 4.2.1 *Pollichia campestris* Variant.
 - 4.2.2 *Solanum supinum* Variant.
5. *Carissa macrocarpa-Euclea undulata* Shrubland.
6. *Rhus lucida-Buddleja glomerata* Shrubland.
 - 6.1 *Themeda triandra-Rhus lucida* Shrubland.
 - 6.2 *Melica decumbens-Gymnosporia heterophylla* Shrubland
 - 6.2.1 *Cussonia paniculata* Variant.
 - 6.2.2 *Buddleja glomerata* Variant.

Description of the plant communities

1. *Atriplex semibaccata-Cynodon incompletus* Grassland.

This plant community consists of two small sections found in the western part of the study area (Fig. 4). Relevé 74 is located on a seasonally dry dam, and relevé 75 on an old cultivated field. The area is relatively flat with little to no rock cover, while clayish soils are found in certain parts. The vegetation of this community is heavily utilised by animals, especially on the old cultivated land resulting in an unstable plant community.

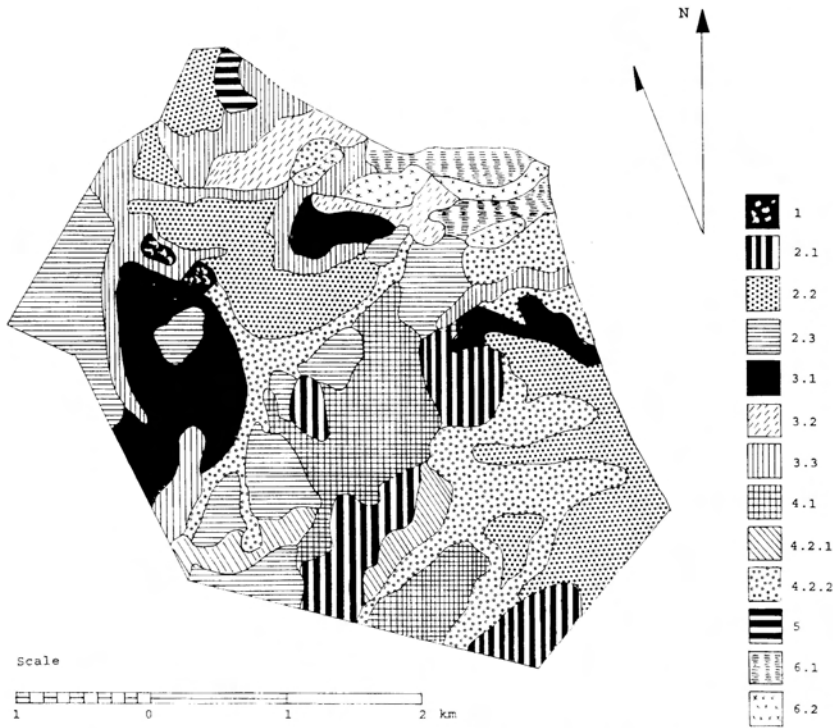


Fig. 4. Vegetation map of the De Rust section of the Mountain Zebra National Park.

The altitude of these low-lying areas varies between 1 058 m and 1 079 m above sea level.

No woody species are found and the diagnostic species include the forbs *Atriplex semibaccata* and *Schkuhria pinnata* (species group A - Table 1). The herbaceous layer, with a 80% canopy cover at the dam and a 20% canopy cover on the old land, is dominated by the grasses *Cynodon incompletus* and *Chloris virgata* (species group D - Table 1). The pioneer grass *Tragus koelerioides* (species group CC - Table 1) is also prominent. The pioneer grasses *Chloris virgata* and *Cynodon incompletus* are relatively good pasture grasses (Van Oudtshoorn 1999), which explains the high degree of animal utilisation in this community.

This community shows affinity with the *Cynodon incompletus* Community described by Van der Walt (1980).

2. *Aristida congesta* subsp. *barbicollis*-*Pentzia globosa* Grassland.

This grassland is found scattered throughout the study area on plateau midslopes and valley bottoms. The terrain is generally flat, while the altitude varies between 1040–1200 m above sea level. The soils are shallow and rocky. Diagnostic species are the grasses *Aristida congesta* subsp. *barbicollis* and *Urochloa panicoides*. This community can be subdivided into the following three sub-communities:

2.1 *Walafrida geniculata*-*Eragrostis obtusa* Grassland.

This sub-community is restricted to the central and southern parts of the study area on the higher lying plateau areas and gentle sloping valley bottoms (Fig. 4) and is associated with the Da land type. Areas belonging

to this grassland are relatively flat with a slight gradient that varies between 1-3°. Altitude varies between 1100 m and 1300 m above sea level. The dominant soil forms are Mispah, Swartland and Valsrivier, while the rock cover varies between 10-50 % with little to no rocks present in certain localities.

Diagnostic species include the dwarf shrubs *Walafrida geniculata*, *Pentzia incana* and *Hermannia spinosa* together with the forbs *Gazania krebsiana* and *Protasparagus thunbergianus* (species group C - Table 1). The herbaceous layer has a canopy coverage that varies between 30-50 %. This grassland is dominated by the dwarf shrub *Pentzia globosa* (species group CC - Table 1) together with the grasses *Eragrostis obtusa* and *Enneapogon scoparius* (species group CC - Table 1). The tree *Acacia karroo* (species group CC - Table 1), is prominent locally. Other prominent species include the dwarf shrubs *Talinum cafrum* and *Lycium cinereum* (species group F - Table 1) together with the grasses *Cynodon incompletus* (species group D - Table 1), *Eragrostis lehmanniana*, *Tragus koelerioides*, *Eragrostis chloromelas*, *Heteropogon contortus*, *Eragrostis curvula* and the forb *Protasparagus suaveolens* (species group CC - Table 1). The perennial tufted grass *Heteropogon contortus* (Van Oudtshoorn 1999) (species group CC - Table 1) has a mosaic distribution pattern within this community and forms dense clumps in localised areas. The grasses *Urochloa panicoides* (species group B - Table 1) and *Cynodon incompletus* (species group D - Table 1) are heavily utilised by animals in certain parts of this grassland while smaller patches consisting of *Cynodon incompletus* only, are found scattered throughout the grassland.

2.2 *Psilocalon junceum-Eragrostis lehmanniana* Grassland.

The *Psilocalon junceum-Eragrostis lehmanniana* Sub-community is mainly found in the eastern and central part of the study area with a small section in the north western part of De Rust (Fig. 4). This open

grassland sub-community is found in the lower lying valley bottoms, associated with the Ag land type, at altitudes between 1061 m and 1100 m above sea level. Rock cover varies between 1-20 %, although a high rock cover, estimated at up to 60 %, was recorded in localised areas. Dominant soil forms are Hutton, Mispah and Oakleaf.

The spreading shrub *Psilocalon junceum*, together with the grass *Panicum maximum* and the forbs *Delosperma frutescens*, *Blepharis capensis* and the invader *Opuntia aurantiaca* (species group E - Table 1) are diagnostic for this grassland. The herbaceous layer has a 40 % coverage and is totally dominated by the dwarf shrub *Pentzia globosa* and the grass *Eragrostis lehmanniana* (species group CC - Table 1). Other prominent species include the dwarf shrub *Eriocephalus ericoides* and the grasses *Eragrostis obtusa*, *Tragus koelerioides* (species group CC - Table 1), *Aristida congesta* subsp. *barbicollis* (species group B - Table 1) and *Aristida congesta* subsp. *congesta* (species group F - Table 1).

Isolated *Acacia karroo* trees, found closer to the drainage lines, and the grass *Enneapogon scoparius* (species group CC - Table 1), are locally dominant. Slight erosion, estimated at 5 % is evident in certain localities near the drainage lines, while various antelopes utilise the area. Termite activity was also noted at certain localities in this grassland.

2.3 *Monsonia angustifolia-Heteropogon contortus* Grassland.

Although present in the northern part, this grassland is mainly found in the southern and western sections of the study area (Fig. 4). This sub-community is characteristic for the lower-lying plateaux and foot-slopes with the altitude varying between 1040-1200 m above sea level and is associated with the Da land type. The area is relatively flat with a slight gradient of 1-3°. Dominant soil forms are Mispah and Swartland. Rock cover varies between 3-20 %.

The forb *Monsonia angustifolia* (species group G - Table 1) is diagnostic for this sub-community. The dwarf shrub *Pentzia globosa* and the grasses *Heteropogon contortus*, *Enneapogon scoparius* and *Eragrostis curvula* (species group CC - Table 1) dominate this grassland and have a 40 % canopy coverage. Other prominent species include the grasses *Eragrostis obtusa*, *Tragus koelerioides*, *Aristida meridionalis* (species group CC - Table 1) and the forbs *Indigofera alternans*, *Thesium lineatum*, *Blepharis* spp., *Helichrysum zeyheri* and *Commelina africana* (species groups J and K - Table 1).

The tree *Acacia karroo* which was locally dominant in the previous two sub-communities, was only recorded in one section of this grassland. The dominant grass *Heteropogon contortus* forms dense stands that are evenly dispersed throughout this sub-community.

3. *Tragus koelerioides*-*Becium burchellianum* Grassland.

The *Tragus koelerioides*-*Becium burchellianum* Grassland is confined to the northern and western parts of the study area. This community, which is divided into three sub-communities, is associated with mountain midslopes and footslopes, and also valley bottoms. In certain parts the gradient is mild to steep, while the mountain footslopes are generally flat with a slight gradient. The altitude varies between 1070–1280 m above sea level.

The presence of the dwarf shrub *Becium burchellianum* (species group H - Table 1), which totally dominates this community, is diagnostic.

3.1 *Oropetium capense*-*Becium burchellianum* Grassland.

Characteristic for mountain midslopes and footslopes, this sub-community is found in the south-western, northern and eastern part of the study area (Fig. 4). The altitude varies between 1070–1230 m above sea level. Rock cover varies between 15–35 % and the dominant soil forms are Glenrosa and Oakleaf.

The area is relatively flat with a gradient of 20° and is associated with the Fc land type.

The grass *Oropetium capense* (species group I - Table 1), is diagnostic for this sub-community. This grassland consists mainly of a herbaceous layer which covers between 25–40 % of the area and is dominated by the dwarf shrub *Becium burchellianum* (species group H - Table 1) together with the grasses *Heteropogon contortus*, *Enneapogon scoparius* and *Oropetium capense* (species groups I and CC - Table 1). Other species also prominent include the dwarf shrub *Pentzia globosa*, the grasses *Tragus koelerioides*, *Aristida meridionalis* (species group CC - Table 1), and the forbs *Helichrysum zeyheri*, *Helichrysum dregeanum* and *Cyperus usitatus* (species groups K and CC - Table 1).

In areas where the soil is more rocky, the dwarf shrub *Pentzia globosa* together with the grass *Enneapogon scoparius*, becomes more dominant. The trees *Acacia karroo*, *Rhus spinosum* and the forb *Lycium oxycarpon* are found in clumps in certain parts within this grassland. Rocky midslopes, dominated by the shrub *Rhigozum obovatum*, are found within this sub-community in the south-western section of the study area. Black wildebeest is resident in this section.

3.2 *Protasparagus striatus*-*Becium burchellianum* Grassland.

This sub-community is restricted to the midslopes of the Salpeterkop mountain in the northern part of the study area (Fig. 4) and is associated with the Ib land type. The dominant soil-rock complex consists of rock with a 30–55 % cover, while the Mispah soil form is subdominant. The aspect is south with a gradient that varies between 10–19°. Altitude varies between 1100–1280 m above sea level.

Diagnostic species are the grass *Aristida difflusa* together with the forbs *Asparagus striatus* and *Crassula dependens* from species group L (Table 1). The dwarf shrub *Becium burchellianum* (species group H - Table 1)

Table 1.
Phytosociological table of the vegetation of the Mountain Zebra National Park

Community number	1	2	3	4	5	6
	2.1	2.2	3.1	4.1	4.2	6.1
			3.2	4.2	4.2.2	6.2
				4.2.1	4.2.2	6.2.1
						6.2.2
Relévé numbers	1 1 2 3 3 5 7	5 5	4 4 5 5 6	2 3 7 6 7 5	3 4 5 6 6 6	2 2 2 7
	1 4 5	1 0 1 4 0 1 4 3	2 4 1 2 5 7 3 9 0 0 3 9	3 9 1 2 3 6 5	2 1 7 2 8	0 2 5 6
				8 7 8 9 1 4 8	7 8 3 4 5 6 7 0	1 9 5 6 9 0
					6 8 2 4 6	5 6 7
						3 5 6 9 1
						4 7
						8 2 3
Species Group A						
<i>Atriplex semibaccata</i>	+				+	
<i>Schulhria pinnata</i>	+				+	
Species Group B						
<i>Aristida congesta</i> ssp. <i>barbicollis</i>	+	+	+	+	+	+
<i>Urochloa panicoides</i>	+	+	+	+	+	+
Species Group C						
<i>Walafria geniculata</i>	+	+				
<i>Penzlia incana</i>	A		+			
<i>Hermannia spinosa</i>	+					
<i>Gazania krebsiana</i>	+					
<i>Protasparagus Ithumbianus</i>	+			+		
Species Group D						
<i>Cynodon incompletus</i>	B	+			+	
<i>Chloris virgata</i>	B	+			+	
Species Group E						
<i>Psilocaulon junceum</i>						
<i>Panicum maximum</i>						
<i>Opuntia aurantiaca</i>						
<i>Delosperma frutescens</i>						
<i>Blepharis capensis</i>						

Table 1
(continued)

Species Group F											
<i>Aristida congesta</i> ssp. <i>congesta</i>	+	+	+	+	+	+	+	+	+	+	+
<i>Limnium viscosum</i>	+	+	+	+	+	+	+	+	+	+	+
<i>Felicia muricata</i>	+	+	+	+	+	+	+	+	+	+	+
<i>Talinum californicum</i>	+	+	+	+	+	+	+	+	+	+	+
<i>Ledebouria</i> spp.	+	+	+	+	+	+	+	+	+	+	+
<i>Lycium cinereum</i>	+	+	+	+	+	+	+	+	+	+	+
Species Group G											
<i>Monsonia angustifolia</i>	+	+	+	+	+	+	+	+	+	+	+
Species Group H											
<i>Becium burchellianum</i>	+	+	+	+	+	+	+	+	+	+	+
Species Group I											
<i>Oropetium capense</i>	+	+	+	+	+	+	+	+	+	+	+
Species Group J											
<i>Indigofera alternans</i>	+	+	+	+	+	+	+	+	+	+	+
<i>Thesium lineatum</i>	+	+	+	+	+	+	+	+	+	+	+
<i>Blepharis</i> spp.	+	+	+	+	+	+	+	+	+	+	+
Species Group K											
<i>Helichrysum zeyheri</i>	+	+	+	+	+	+	+	+	+	+	+
<i>Commelina africana</i>	+	+	+	+	+	+	+	+	+	+	+
<i>Cyperus usitatus</i>	+	+	+	+	+	+	+	+	+	+	+
Species Group L											
<i>Protasparagus striatus</i>	+	+	+	+	+	+	+	+	+	+	+
<i>Crassula dependens</i>	+	+	+	+	+	+	+	+	+	+	+
<i>Aristida diffusa</i>	+	+	+	+	+	+	+	+	+	+	+

Table I
(continued)

Species Group M									
<i>Setaria sphacelata</i>	+	+	+	+	+	+	+	+	+
<i>Cadaba aphylla</i>									
Species Group N									
<i>Ehretia rigida</i>									
<i>Pegolella retrofracta</i>									
<i>Phyllanthus parvulus</i>									
<i>Aristida canescens</i> spp. <i>canescens</i>									
Species Group O									
<i>Cymbopogon plurinodis</i>									
Species Group P									
<i>Tephrosia</i> spp.									
Species Group Q									
<i>Lycium oxycarpum</i>									
<i>Sporobolus africanus</i>									
Species Group R									
<i>Pollichia campestris</i>									
Species Group S									
<i>Panicum coloratum</i>									
<i>Solanum supinum</i>									
<i>Teucrium trifidum</i>									
Species Group T									
<i>Euclea undulata</i>									
<i>Fingerhuthia africana</i>									

and the grass *Themeda triandra* (species group BB - Table 1) dominate this sub-community. Within this grassland bush clumps occur where the trees *Acacia karroo* (species group CC - Table 1) and *Rhus lucida* (species group BB - Table 1), together with the grass *Digitaria eriantha* (species group CC - Table 1) are prominent.

3.3 *Becium burchellianum*-*Acacia karroo* Woodland.

This woodland is strongly associated with the drainage lines of the Fc and Ag land types and is found in the eastern and western section of De Rust (Fig. 4). The altitude varies between 1090–1150 m above sea level, with an average rock cover of 40 %. The Oakleaf and Mispah soil forms are dominant and the slope varies from 8° up to 18° in certain localities.

This community is distinguished from the previous two sub-communities by the absence of species from species groups I and L (Table 1). The woody layer, which covers between 10–20 % of the area, is dominated by the tree *Acacia karroo* (species group CC - Table 1). The grass *Enneapogon scoparius* (species group CC - Table 1) dominates the herbaceous layer, which has a 20–40 % coverage. Prominent species include the tree *Rhus longispina* (species group V - Table 1), the shrubs *Carissa macrocarpa* (species group U - Table 1), *Diospyros lycioides* (species group AA - Table 1) and the grasses *Cymbopogon plurinodis*, *Tragus koelerioides*, *Heteropogon contortus*, *Eragrostis curvula*, *Digitaria eriantha* and *Aristida adscensionis* (species groups O and CC - Table 1). The forbs *Tephrosia* spp. and *Protasparagus suaveolens* (species groups P and CC - Table 1) are also prominent.

This sub-community has affinity with the *Diospyros lycioides*-*Acacia karroo* Community of the old section of the park as described by Van der Walt (1980). Within the study area, this sub-community has similarities with the *Setaria sphacelata* - *Cadaba aphylla* Shrubland (4) in that both the tree *Acacia karroo* and the grass *Enneapogon*

scoparius (species group CC - Table 1) are also dominant in the latter community.

4. *Setaria sphacelata*-*Cadaba aphylla* Shrubland.

This community is found on rocky ridges and seasonally dry riverbeds in the central, southern and eastern parts of the study area. The habitat consists mainly of relatively steep slopes with a high rock cover of up to 70 % in certain localities. Dominant soil forms are Mispah and Oakleaf. Altitude varies between 1050–1360 m above sea level.

Species diagnostic for this community include the leafless shrub *Cadaba aphylla* and the decreaser grass *Setaria sphacelata* (species group M - Table 1). This community can be divided into two sub-communities and two variants.

4.1 *Enneapogon scoparius*-*Ehretia rigida* Shrubland.

This shrubland, which is characteristic for plateau midslopes of the Da land type, with gradients that vary between 10–20°, is found in the central and south-eastern part of the study area (Fig. 4). The soil-rock complex consist of rock, which cover between 20–60 % of the habitat, while the dominant soil forms are Mispah and Swartland. Altitude varies between 1130–1220 m above sea level.

Species from species group N (Table 1) are diagnostic for this sub-community and include the shrub *Ehretia rigida*, the grass *Aristida canescens* subsp. *canescens* and the forbs *Pegolettia retrofracta* and *Phyllanthus parvulus*. The woody layer which has a 10–20 % coverage, is dominated by the tree *Acacia karroo* and the shrub *Rhus longispina* (species groups V and CC - Table 1). The shrubs *Carissa macrocarpa*, *Rhigozum obovatum*, *Diospyros lycioides*, *Grewia occidentalis* and the dwarf shrubs *Pentzia globosa* and *Eriocephalus ericoides* (species groups U, AA and CC - Table 1) are also prominent. The herbaceous layer is dominated by the

grasses *Enneapogon scoparius* and *Aristida meridionalis* (species group CC - Table 1), while *Tragus koelerioides*, *Eragrostis obtusa*, *Heteropogon contortus* and *Chrysopogon ciliata* together with the forbs *Helichrysum dregeanum*, *Protasparagus suaveolens* and *Felicia filifolia*, are also prominent.

In certain localities the area is disturbed due to previous farming practices, while bush clumps consisting of the shrubs *Rhus longispina*, *Carissa macrocarpa*, *Ehretia rigida* and *Maytenus heterophylla* are prominent on the plateau midslopes.

4.2 *Sporobolus africanus*-*Acacia karroo* Woodland.

This sub-community occurs in the central, southern and eastern parts of the study area in various habitats ranging from steep eastern and southern slopes to lower lying seasonally dry riverbeds of the Fc land type. The altitude varies between 1090–1353 m above sea level. Except for the seasonally dry riverbeds, the rock cover is high and varies between 40–70 %. The sub-dominant soil forms are Mispah, Swartland and Oakleaf while rock is dominant in the soil-rock complex of this sub-community.

The presence of species from species group Q (Table 1) is characteristic for this woodland. Diagnostic species include the grass *Sporobolus africanus* and the forb *Lycium oxycarpon*. The tree *Acacia karroo* together with the grasses *Enneapogon scoparius* and *Digitaria eriantha* (species group CC - Table 1) is dominant within this woodland.

This sub-community can be divided into the following two variants:

4.2.1 *Pollichia campestris* Variant.

The *Pollichia campestris* Variant is mainly found on steep slopes, with the altitude varying between 1125–1225 m above sea level, in the southern parts of the study area (Fig. 4). The gradient varies between 20–40° on eastern and south-eastern slopes. The soils are shallow and rock cover is high rang-

ing between 40–70 %. The soil-rock complex consists of rock and Mispah soil form.

The presence of the soft shrublet *Pollichia campestris* (species group R - Table 1) is diagnostic for this variant. The woody layer, which covers between 20–30 % of the area, is dominated by the tree *Acacia karroo* together with the shrub *Rhus longispina* (species groups V and CC - Table 1). Other woody species also prominent include the shrubs *Rhus lucida*, *Diospyros lycioides* and *Grewia occidentalis* (species groups AA and BB - Table 1). The leafless shrub *Cadaba aphylla* (species group M - Table 1) is also prominent locally. The herbaceous layer covers between 30–50 % of the area and is dominated by the grasses *Setaria sphacelata* and *Enneapogon scoparius* (species group M and CC - Table 1). Other prominent grass species include *Sporobolus africanus*, *Tragus koelerioides* and *Digitaria eriantha* (species groups Q and CC - Table 1). The absence of the grass *Themeda triandra* (species group BB - Table 1), which is in the *Solanum supinum* Variant (4.2.2), is also characteristic for this variant.

4.2.2 *Solanum supinum* Variant.

This variant is found on the cool and moist footslopes in the south-eastern and northern parts of the study area where the latter is closely associated with the footslopes of Salpeterkop Mountain. It also occurs in the seasonally dry riverbeds in the central part of De Rust (Fig. 4). The Oakleaf and Mispah soil forms are dominant in the seasonally dry riverbeds while the Mispah and Swartland soil forms are dominant on the mountain footslopes. Rock cover varies from 2 % in the seasonally dry riverbeds up to 70 % on the mountain midslopes. Altitude in the lower lying riverbeds is 1090 m above sea level with the highest altitude of 1353 m above sea level measured on the mountain footslopes.

The presence of the grass *Panicum coloratum* and the forbs *Solanum supinum* and *Teucrium trifidum* (species group S - Table 1), is diagnostic for this variant. The woody layer covers between 30–50 % of the

area and the herbaceous layer between 20–50 %. The tree *Acacia karroo* (species group CC - Table 1) and the grass *Sporobolus africanus* (species group Q - Table 1) dominate the woody and herbaceous layer respectively. Other species also prominent include the shrubs *Rhus longispina*, *Diospyros lycioides*, *Rhus lucida*, *Lycium oxycarpon*, and the grass *Digitaria eriantha* (species groups Q, V, AA, BB and CC - Table 1). The grasses *Eragrostis lehmanniana* and *E. chloromelas* and the forb *Protasparagus suaveolens* (species group CC - Table 1) are locally dominant.

5. *Carissa macrocarpa-Euclea undulata* Shrubland.

This shrubland is only found in one small locality in the north western section of the study area (Fig. 4) and is associated with the lb land type. The altitude varies between 1168–1208 m above sea level. This community is situated on a north-western midslope with a gradient of 13°. The soil-rock complex is dominated by medium sized rocks which covers approximately 40 % of the area.

Species diagnostic for this shrubland include the woody shrubs *Euclea undulata*, *Boscia oleoides*, the dwarf shrub *Zygophyllum* spp., the grass *Fingerhuthia africana* and the forb *Crassula muscosa*, (species group T - Table 1). The woody layer which has a 30 % coverage, is dominated by the shrubs *Euclea undulata* (species group T - Table 1) and *Carissa macrocarpa* (species group U - Table 1), while the shrubs *Rhigozum obovatum*, *Rhus longispina* (species groups U and V - Table 1) and *Maytenus heterophylla* (species group AA - Table 1) are very prominent. The grasses *Fingerhuthia africana* and *Enneapogon scoparius* (species groups T and CC - Table 1) dominate the herbaceous layer, which has a 5 % canopy cover.

6. *Rhus lucida-Buddleja glomerata* Shrubland.

This shrubland is found on the higher midslopes and mountain crest of Salpeterkop Mountain. Except for the mountain crest, it

is characterised by steep slopes with the gradient varying between 20–60°. Rock cover varies between 25–90 % on shallow, rocky soils, sometimes covered by sparse vegetation. This community is associated with the lb land type.

The presence of the large shrub *Buddleja glomerata* (species group W - Table 1) is diagnostic for this shrubland. This community is divided into two sub-communities, one with two variants.

6.1 *Themeda triandra-Rhus lucida* Shrubland.

This shrubland is found on the higher midslopes and mountain crest of the Salpeterkop Mountain (Fig. 4). The midslopes are very steep with the gradient varying between 50–58°. Approximately 25–30 % of the soils are covered by rocks which is dominant in the soil-rock complex of this community. The altitude varies between 1424–1514 m above sea level.

Diagnostic species include the shrub *Tarchonanthus camphoratus* and the dwarf shrub *Stachys linearis* (species group X - Table 1). This shrubland is dominated on the mountain crest by the shrub *Rhus lucida* and the grass *Themeda triandra* (species group BB - Table 1), while the dwarf shrub *Stachys linearis* (species group X - Table 1) together with the grass *Themeda triandra* is locally dominant on the higher midslopes. Other species also prominent, include the shrub *Buddleja glomerata*, the dwarf shrub *Pentzia globosa* and the grass *Eragrostis chloromelas* (species group W and CC - Table 1).

The succulent invader *Opuntia ficus-indica* forms dense stands locally on the crest of Salpeterkop Mountain where it is dispersed by baboons.

6.2 *Melica decumbens-Maytenus heterophylla* Shrubland.

This sub-community is found on the higher lying areas and escarpment on the Salpeterkop Mountain (Fig. 4). The gradient

of the slope varies between 20–60° with the vegetation growing between rocky outcrops. The substratum that has a rock cover varying between 70–90 %, consists of rocks and stones of various sizes.

Diagnostic species include the grass *Melica decumbens* and the forbs *Abutilon austro-africanum* (species group Y - Table 1). Due to floristic variation it can be divided into two variants. These variants form a mosaic distribution pattern and are therefore not indicated on the vegetation map (Fig. 4).

6.2.1 *Cussonia paniculata* Variant.

This variant is found on the higher lying drainage lines and rocky outcrops on the Salpeterkop Mountain. The gradient of the steep southern slopes varies between 20–60°. This variant has a high rock cover that varies between 70–90 % on an altitude that varies between 1150–1226 m above sea level.

The presence of the tree *Cussonia paniculata*, the shrub *Maytenus undata* and the forbs *Stachys cymbalaria*, *Cheilanthes hirta*, *Solanum tomentosum* and *Cyphostemma*

quinatum (species group Z - Table 1), are diagnostic for this variant. The woody layer which covers between 20–65 %, is dominated by the shrub *Buddleja glomerata* (species group W - Table 1). The shrubs *Diospyros lycioides*, *Maytenus heterophylla* and *Grewia occidentalis* (species group AA - Table 1) are also present.

The presence of the shrubs *Rhus lucida* (species group BB - Table 1), *Diospyros lycioides*, *Maytenus heterophylla* and *Grewia occidentalis* (species group AA - Table 1) indicate an affinity with the *Grewia occidentalis-Rhus lucida* Community described by Van der Walt (1980). However, the habitat of this variant differs slightly from that described by Van der Walt, which is mainly associated with lower pediment slopes of less exposed smaller valleys.

6.2.2 *Buddleja glomerata* Variant.

The *Buddleja glomerata* Variant is found on the escarpment and cliffs at the top of the Salpeterkop Mountain where the altitude varies between 1359–1513 m above sea level. Rockiness is estimated at 90 % with the shrubs growing between rocky outcrops.

Both the woody and the herbaceous layers have a 10 % coverage which is low compared to the previous variant. This variant is characterised by the absence of species from species group Z (Table 1). This variant is totally dominated by the shrubs *Buddleja glomerata* and *Rhus lucida* (species groups W and BB - Table 1). Other species also prominent include the shrubs *Diospyros lycioides*, *Maytenus heterophylla* and *Grewia occidentalis* (species group AA - Table 1). There are no prominent grasses or forbs present.

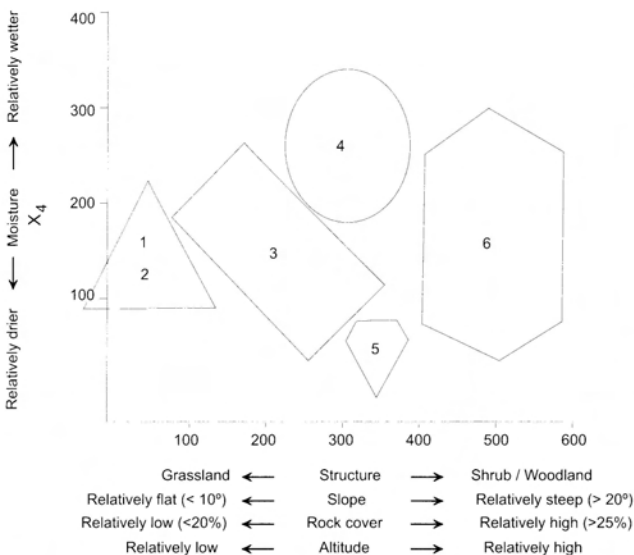


Fig. 5. Ordination.

Ordination

In the scatter diagram the distribution of the plant communities along the first and fourth axes of the DECORANA ordination is given (Hill 1979a)(Fig. 5). Although no distinct discontinuity can be observed, the plant communities are restricted to specific spatial areas in the diagram. Along the first axis the grassland communities are situated to the left side and centre of the diagram while the shrub- / woodland communities occur to the centre and right side of the diagram. Also illustrated on the first axis is a gradient which can be related to slope, rock cover and altitude. The fourth axis illustrates a moisture gradient (Fig. 5). This result confirms the result of the classification, and is not discussed further.

Discussion and conclusion

Although in some cases the variants form a mosaic pattern, there are clear distinctions between the different plant communities identified.

From the fourteen communities identified on the De Rust section of the Mountain Zebra National Park, three communities have similarities with those described by Van der Walt (1980). Results from this study indicate that the incorporation of the De Rust section into Mountain Zebra National Park, enhances the plant communities cum-habitat diversity of the park.

The data obtained from this study will be incorporated into the existing vegetation map (Van der Walt 1980) and management plan for the MZNP as part of a larger project undertaken by Technikon SA and South African National Parks.

The description of the plant communities, together with the vegetation map can serve as a basis to formulate a management programme for the De Rust section of the MZNP. An understanding of the plant communities and their associated habitats are of fundamental importance for devising sound management and conservation strategies.

Acknowledgements

South African National Parks, the park warden and staff of Mountain Zebra National Park is thanked for allowing and encouraging the research. Mrs Thea Bezuidenhout is thanked for the drawing of the figures and vegetation map. The Grahamstown Herbarium is thanked for the identification of plant species. This research was financially supported by the National Research Foundation.

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