

A synecological account of the Suikerbosrand Nature Reserve.

I. The phytosociology of the Witwatersrand geological system*

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ABSTRACT

The vegetation of the Witwatersrand System of the Suikerbosrand Nature Reserve is analysed and classified according to the Braun-Blanquet table method. Descriptions of the plant communities include habitat features, differentiating species groups, as well as prominent and less conspicuous species for the tree, shrub and herbaceous layers. The habitat factors that are associated with differences in vegetation are mainly altitude, aspect and rockiness of the soil surface, but soil depth, soil texture and slope are also factors of considerable importance. The classification results in very natural communities which represent different ecosystems.

RÉSUMÉ

ANALYSE SYNÉCOLOGIQUE DE LA RÉSERVE NATURELLE DU SUIKERBOSRAND. I. PHYTO-SOCIOLOGIE DU SYSTÈME GÉOLOGIQUE DU WITWATERSRAND

La végétation du Système du Witwatersrand dans la réserve naturelle du Suikerbosrand est analysée et classée d'après la méthode tabulaire de Braun-Blanquet. Les descriptions des communautés végétales incluent les caractéristiques de l'habitat, les groupes distinctifs d'espèces aussi bien que les espèces dominantes et moins visibles pour les strates arborées, arbustives et herbacées. Les facteurs d'habitat associés à des différences de végétation sont principalement l'altitude, l'aspect et la composante rocheuse de la surface du sol; mais la profondeur du sol, sa texture et la pente sont aussi des facteurs d'importance considérable. La classification mène à des communautés très naturelles qui représentent divers écosystèmes.

INTRODUCTION

In order to distinguish areas of uniform potential for management purposes, the classification of vegetation into ecological units which can be correlated with stable habitat conditions, is essential (Daubenmire, 1968; Edwards, 1972). For this reason, and as part of a survey programme for conservation areas in South Africa, a study of the vegetation of the Suikerbosrand Nature Reserve was undertaken.

The hills, mountains, plateaux and flats represented in the Reserve result in numerous topographic units, each of which constitutes a potentially different habitat type. Both topography and vegetation are closely related to the two geological formations represented on the Reserve. In the text that follows an account is given of the vegetation of the Witwatersrand geological system.

THE STUDY AREA

The Suikerbosrand Nature Reserve is the first and, at present, the only nature reserve in the Bankenveld Veld Type (Acocks, 1953) under provincial authority. The Reserve covers approximately 13 336 hectares and is located 40 kilometres south-east of Johannesburg, between 26° 27' and 26° 34' S and 28° 09' and 28° 21' E (Fig. 1). The Witwatersrand System is found in the eastern part of the Reserve and covers approximately 40% of the Reserve (Fig. 2).

Topography

The Witwatersrand System was subjected to considerable folding, faulting and erosion (Du Toit, 1954), which has resulted in the present broken and very rugged appearance of the area (Fig. 3).

The study area is situated between 1 524–1 790 m and includes a chain of very rocky quartzite hills, oriented in a more or less north-east to south-west direction. The elevation of these hills gradually decreases to the south-west, with the result that the slightly undulating plateaux eventually decrease and merge into the lower-lying flats in the south-east. The

plateaux and the flats cover a relatively small area, bounded to the north and north-west by the Ventersdorp System (Fig. 2).

The soils of the area are usually sandy loams or sandy clay loams, very shallow on the hills, but may be as deep as 1 m on the plateaux and flats.

Climate

The climate of the area according to Köppen's system is a Cwb-climate (Trewartha, 1954), that is, a summer rainfall area with temperate summers and cold frosty winters.

The direct monthly average radiation as measured in Pretoria, reaches a maximum which exceeds 1 548,6 J/cm²/day (370 cal/cm²/day) during September to January, with 1134,3 J/cm²/day (271 cal/cm²/day) during June (Schulze, 1965). Due to the complex topography, local differences in direct radiation and thus, also temperature, are obvious.

Data obtained from the nearby weather stations, Zwartkoppies, Heidelberg I and Vereeniging (Weather Bureau, 1954) show average monthly maximum temperatures for January of between 32,6°C and 33,6°C. At Johannesburg (U.Obs.), situated at more or less the same altitude as the plateaux on the Reserve, a slightly lower average monthly maximum temperature of 29,8°C was recorded. Although the average monthly minimum temperature at Johannesburg during January is also lower (5,4°C) than the 5,7–7,1°C recorded at the other three stations, this difference is not so pronounced as in the case of the average monthly temperature. The average monthly maximum temperature for July at Johannesburg is 20,2°C, and at the three other stations between 22,6–23,3°C. It is interesting that the average monthly minimum temperature for July at Johannesburg is higher (–1,3°C) than the –6,7°C to –7,4°C measured at the three lower altitude stations.

Although these data are not directly applicable to the Reserve, they provide a general impression of the temperatures that may be expected. During summer it is probably cooler on the plateaux than on the relatively low altitude flats, while during winter lower maximum and higher minimum temperatures may be expected on the plateaux than on the flats.

Regular frosts occur from May to September, and occasional frosts from as early as March to as late as November (Schulze, 1965).

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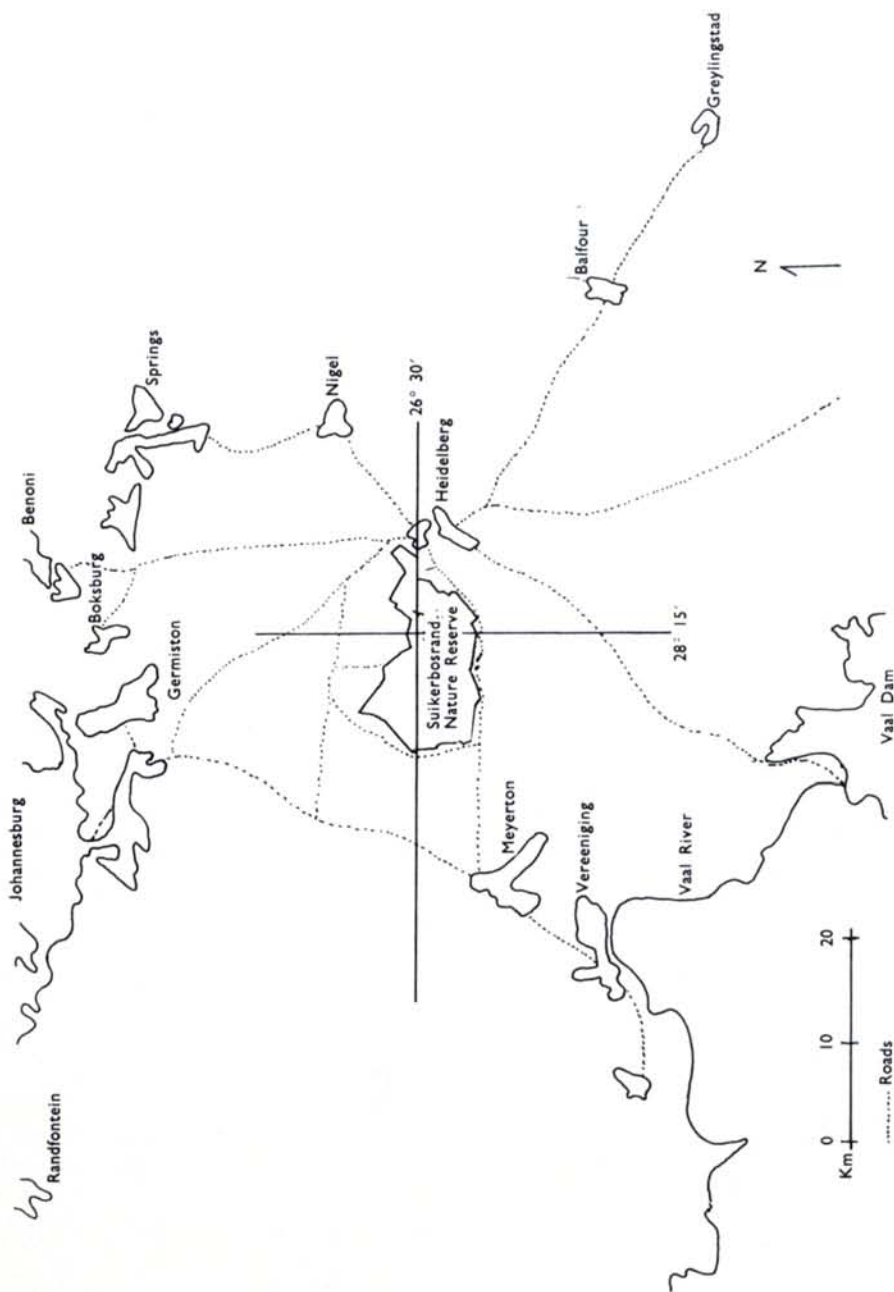


FIG. 1.—Map indicating the position of the Suikerbosrand Nature Reserve.

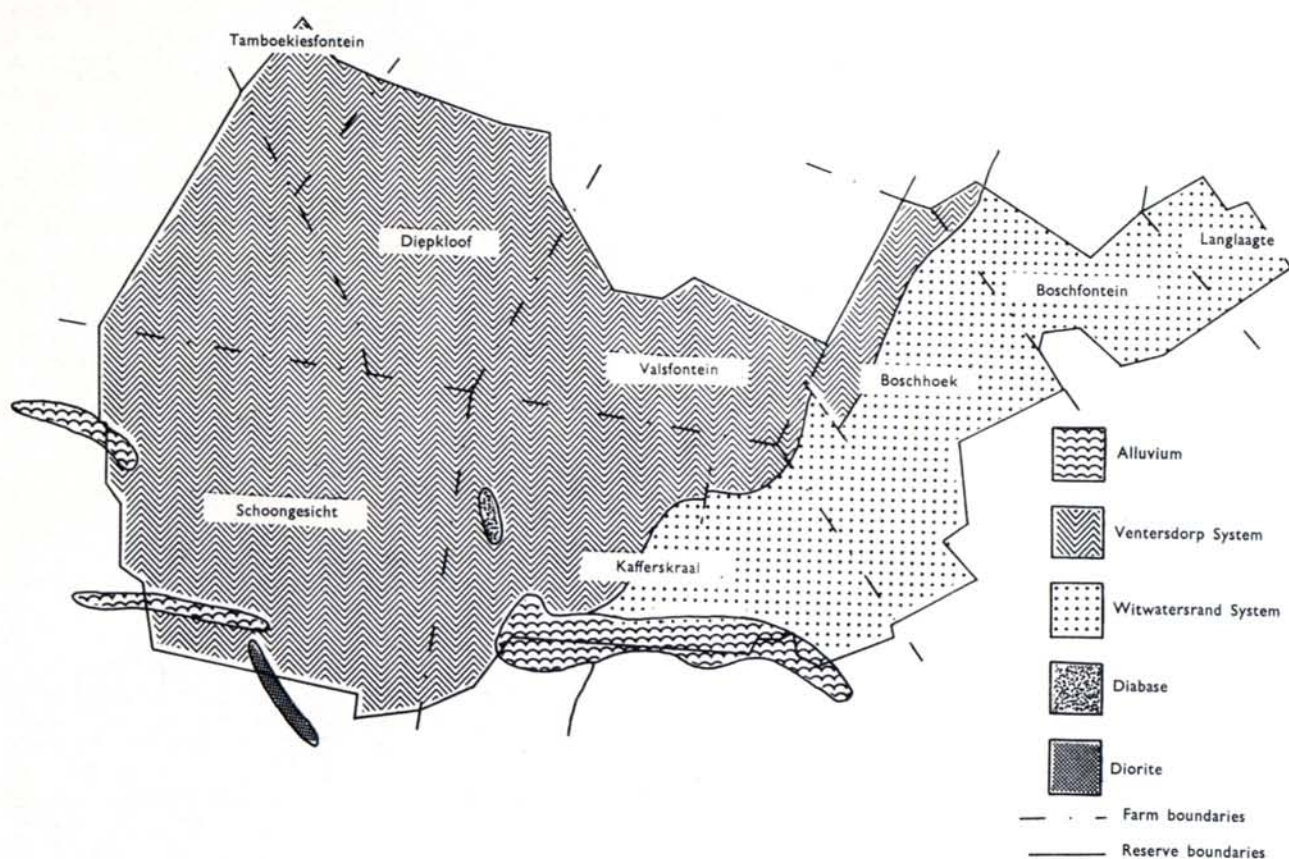


FIG. 2.—A geological map of the Suikerbosrand Nature Reserve.

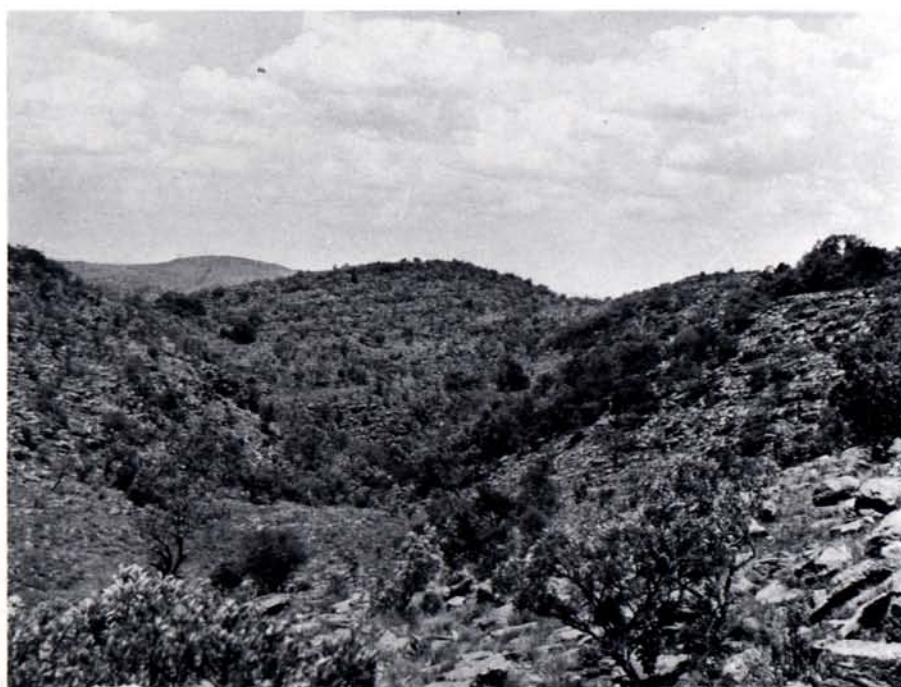


FIG. 3.—The rugged, rocky quartzite hills of the Witwatersrand system.

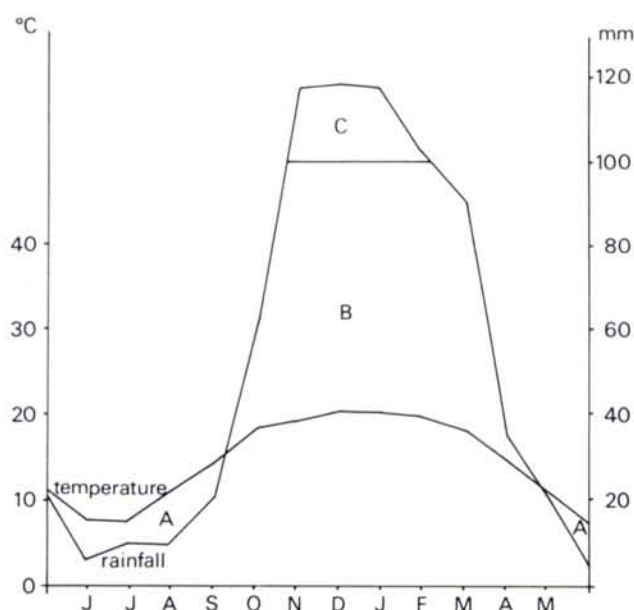


FIG. 4.—A climatic diagram for Heidelberg. A—dry, B—wet, C—very wet period.

The average rainfall for the Reserve, based on data from weather stations Heidelberg I, Heidelberg S.A.R., Heidelberg III, Glen Roy, Schickfontein and Tamboekiesfontein, is probably between 652–732 mm per annum, with 68% falling during the period October to March (Weather Bureau, 1965). During this period rain can be expected on 8–15 days per month (Schulze, 1965).

Because of great variations in topography and vegetation structure, considerable variation can be expected in micro and mesoclimate.

A climate diagram for Heidelberg is presented in Fig. 4. The dry period extends through the months where the rainfall curve is lower than the temperature curve, and the wet period, when the rainfall curve is higher than the temperature curve.

METHODS

Nine different physiographic and physiognomic units represented in the study area were delineated on aerial photographs. Ninety-five sample plots were

divided *pro rata* on an area basis among the nine units (Table 1) and were placed at random within these units*. Minimum sample plot sizes were determined by means of the species-area curve (Mueller-Dombois & Ellenberg, 1974) in each structural vegetation type, and finally fixed at 100 m² for woody vegetation types and 16 m² for grasslands.

Physiographic and soil data recorded in each sample plot included altitude, aspect, slope, surface stones, soil textures, and soil depth. Percentage total canopy cover and percentage canopy cover and height for each stratum were recorded in each sample plot. Trees were designated as woody plants taller than 2 m, and shrubs as woody plants up to 2 m tall. Braun-Blanquet (1964) cover-abundance values were estimated for each species occurring in every sample plot, and additional species occurring within 2 m of each sample plot were noted.

Phytosociological tables were compiled in order to describe the plant communities (Tables 2 and 4).

Syntaxa are not classified into ranks, as information from a wider area is desirable to ensure correct ranking and naming of syntaxa (Tüxen, 1970; Werger et al, 1972; Coetzee, 1974). Naming of the communities is, wherever possible, based on a combination of prominent, constant and differential species and on vegetation structure. Communities are also classified structurally according to the system of Fosberg (1967), and the code for each formation is given in brackets. Lists of species are given in sequence of constancy for each stratum in every community, and the constancy value of each species is indicated as a percentage in brackets.

Tables indicating prominent species for each community are included (Tables 3 and 5). Here "P" indicates species covering at least 5% of the area represented in the relevés in at least 20% of the relevés representing a community, while "p" indicates species covering at least 1% of the area represented in the relevés, in at least 50% of the relevés representing a community.

* Care was taken that the habitat within each plot was, as far as could be determined, uniform and the plant cover as homogeneous as possible.

TABLE 1.—The distribution of the 95 sample plots into the 9 physiographic-physiognomic units

physiographic-physiognomic units	bush and savanna					grassland				total
	kloof vegetation	slope vegetation				plateaux		lowlands		
		*N	S	E	W	rocky areas	not rocky areas	rocky areas	not rocky areas	
		14	15	15	9	8	9	10	9	
sample plots	6	53				17		19		95

* N=north-facing, etc.

TABLE 2.- Phytosociological table of Rhus pyroides Forest and Canthium gilfillanii-Aristida transvaalensis-Cymbopogon marginatus Savanna Communities

Community number	1.1	1.2	2.1	2.2.1	2.2.2	2.3.1	2.3.2	2.3.3
Relevé number	188 1715 189	186 1645 190	191 1660 191 1645 204 1645 202 1660 206 1660 207 1660 203	1615 215 1630 215 1660 225 1660 231 1660 228 1660 229 1660 239 1660 195 1690 212	1645 240 1690 211 1680 213 1680 214 1630 214 1715 193 1645 234 1670 192 1615 194 1630 208 1660 216 1580 209 1670 238 1630 233	1615 210 1680 187 1645 197 1660 185 1610 236 1645 232 1680 222 1600 198	1590 199 1660 226 1600 225 1590 200 1660 223 1615 201	1740 218 1660 219 1740 217 1700 220 1645 237 1680 224 1680 241 1740 205 1630 221 1680 280
Altitude (m)	1680 1715 189	1645 186 190	1660 191 1645 204 1645 202 1660 206 1660 207 1660 203	1615 215 1630 215 1660 225 1660 231 1660 228 1660 229 1660 239 1660 195 1690 212	1645 240 1690 211 1680 213 1680 214 1630 214 1715 193 1645 234 1670 192 1615 194 1630 208 1660 216 1580 209 1670 238 1630 233	1615 210 1680 187 1645 197 1660 185 1610 236 1645 232 1680 222 1600 198	1590 199 1660 226 1600 225 1590 200 1660 223 1615 201	1740 218 1660 219 1740 217 1700 220 1645 237 1680 224 1680 241 1740 205 1630 221 1680 280
Aspect/Kloof (K) N = North, O = East S = South, W = West	K K K	K K K	NO SO O O O O O O O	NO W O SO NO NO NO NO SW SW N	W N N W W O N N W N N NW W O	W S S S SW O S S	S S S SW S S S	P SO SW S S W S SO S S
Slope	- 30 -	30 -	150 300 370 300 150 400 300 150 500	150 200 300 370 200 320 150 200 350 240 130	110 390 250 140 200 120 110 350 330 200 180 300 400 290	250 - 280 200 230 200 150 300 200 150	180 150 160 290 160 300 150	50 150 50 110 150 70 100 150 110 60
Soil depth (mm)	1000 1000 1000	1000 1000 1000	300 600 370 300 150 400 300 150 500	150 200 300 370 200 320 150 200 350 240 130	110 390 250 140 200 120 110 350 330 200 180 300 400 290	250 - 280 200 230 200 150 300 200 150	180 150 160 290 160 300 150	50 150 50 110 150 70 100 150 110 60
Rockiness (5 point scale, 20% intervals)	0 0 0	3 4 4	3 3 3 3 3 3 3 3 3	3 3 3 3 3 3 3 3 3	4 5 4 5 4 5 4 5 4 5 4 5 4 5	4 5 4 5 4 5 4 5 4 5 4 5 4 5	4 4 4 4 4 4 4 4 4	4 4 4 4 4 4 4 4 4
Species per relevé	15 16 18	18 24 24	29 22 22 23 11 17 19 28	23 16 23 23 12 24 19 22 23 14	21 15 22 19 17 19 24 19 23 26 22 23 23	22 22 16 24 29 19 18 21	27 25 29 25 20 25	24 31 36 28 20 19 22 21 24
Average canopy cover (%) - c and height (m) - h	100 100 13 55 2 7,5 0,6	100 180 7,5 60 2 10,5 0,2	84 54 6,1 27 2 12 0,4	76 26 3,8 45 2 27 4,4	66 28 4 27 2 36 0,6	68 25 5 16 2 38 0,7	78 29 4,8 13 2 67 0,9	64 21 3,6 7 2 53 0,8
Differentiating species of 1	BUDDLEIA SALVIFOLIA EHRHARTIA ERECTA ASPLENIUM AETHIOPICUM RHUS PYROIDES RUBUS RIGIDUS	1 3 + 1 t t 3 4 + +	3 2 + t 1 t 3 2 1			+ 1		
Differentiating species of 1.1	CELTIS AFRICANA RIOCREUXIA POLYANTHA BROMUS LEPTOCLADOS	2 1 + 1 1 1	t					
Differentiating species of 2.1	DOMBEYA ROTUNDIFOLIA RHOICISSUS TRIDENTATA SOLANUM RIGESCENS ZIZIPHUS MUCRONATA MAYTENUS POLYACANTHA OPUNTIA SP. ACACIA KARROO PAPPEA CAPENSIS HIBISCUS CALLYPHYLLUS	2 + + + + + + + +	+ 1 + 2 t + 1 t 2 1 1 + + + t t t + 1 t + + t 3 t t + 1 + t t t t 1 t + 1 t	1 + + + + + + + +	1 + + + + + + + +	t 2 1 1 + + + + +		
Differentiating species of 2.2	LANDOLPHIA CAPENSIS BEQUARTIODENDRON MAGALISMONTANUM TAPIPHYLLUM PARVIFOLIUM RHYNCHELYTRUM SETIFOLIUM	1 1 1 1 1 1	+ + 1 1	1 3 3 + + 1 1 2 2 3 2 2 3 1 2 2 t + 2 1 1 + 2 1 3 2 1 t + + + 1	1 2 2 3 2 1 4 1 1 1 1 2 1 3 3 1 + 1 1 1 1 1 1 2 1 2 3 1 1 t 1 1 + + + + 1 + +	2 + 2 1	1 1 + 1	+ + + +
Differentiating species of 2.2.1	CRASSULA ARGYROPHYLLA ALOE DAVYANA KALANCHOE PANICULATA	t	+ t t t t + 1 + 1 + + + t t t t +		1 + +	+ + +		t + +
Species common to 2.1 and 2.2.2	FAGARA CAPENSIS BRACHYLAENA ROTUNDATA EUCLEA CRISPA PAVETTA ASSIMILIS MAERUA CAFRA	+ 1 1 1 1	t 1 t + 1 4 1 1 t 3 1 2 2 + 2 + 1 + + +	+ 1 + + 1 1 2 1 1 1 t + + 2 + 1 + 1 t + 1	+ + + + t	+ 1 + 2 + + t	2 + + + +	1 1 + 1 +
Differentiating species of 2.2.2	VANGUERIA INFAUSTA CANTHIUM MUNDIANUM	1 1	+ 1	+ 1 + + 1 +	t + + + 1 1 + + t + 2 3 t 2 t	+ 1 1		1 + 1 1 + +
Differentiating species of 2.3	PROTEA CAPFRA HELICHRYSUM SETOSUM KOELERIA CRISTATA HYPOXIS RIGIDULA LEONOTIS MICROPHYLLUM BERKHEYA SEMINIVEA FESTUCA SCABRA	1	+ 1 + 1	2 + 1	2 + 1 1 1 2 + 1 1 1 1 + + 1 t	3 2 3 3 2 + 2 2 1 1 1 1 + + 1 t 1 t t t + t	1 + + 2 2 2 3 2 2 3 1 t + + 1 1 1 1 + + + + t t t + t	1 + + 2 2 2 3 2 2 3 1 t + + 1 1 1 1 + + + + t t t + t
Differentiating species of 2.3.2	HELICHRYSUM LEPIDISSIMUM SENECIO VENOSUS ATHRIXIA ELATA STREPTOCARPUS VANDELEURII NIDORELLA HOTTENTOTTICA			t	+ + + + +	+ + + + +	+ 1 1 + + t t t t t + + + + t t t t t t t t	+ + + + +
Differentiating species of 2.3.3	ERAGROSTIS RACEMOSA PTERIDIUM AQUILINUM VERNONIA STAEHELINOIDES INDIGOFEA SANGUINEA RHYNCHELYTRUM REPENS BULBOSTYLIS BURCHELLII TEPHROSIA LONGIPES CHRYSOCOMA TENUIFOLIA HEBENSTREITIA ELONGATA				+ + + + + + + + +	3 3 + + + + + + + +	1 1 + 1 + 1 + 1 + 1 + 1 + 1 2 1 3 2 1 2 1 + t + 1 1 1 1 + + + 1 + + + + + + t	1 1 + 1 + 1 + 1 + 1 + 1 + 1 2 1 3 2 1 2 1 + t + 1 1 1 1 + + + 1 + + + + + + t
Common species absent in 1.1 and 2.3.3	CLUTIA PULCHELLA NUXIA CONGESTA	+ 1 + 3 t 2 1 1 1 2	+ t + 1 + 1 + + 1 2 1 + 2 2 t 2 +	2 + + 1 1 1 2 +				

TABLE 3.—Prominent species in *Rhus pyroides* Forest and *Canthium gilfillanii*—*Aristida transvaalensis*—*Cymbopogon marginatus* Savanna Communities

Community number	1.1	1.2	2.1	2.2.1	2.2.2	2.3.1	2.3.2	2.3.3
<i>Buddleia salviifolia</i>	P	P						
<i>Rhus pyroides</i>	P	P						
<i>Diospyros lycioides</i>	P	P						
<i>Celtis africana</i>	P							
<i>Heteromorpha arborescens</i>	P							
<i>Riocreuxia polyantha</i>	P							
<i>Ehrharta erecta</i>	P							
<i>Bromus leptoclados</i>	P							
<i>Myrsine africana</i>		P				P		
<i>Halleria lucida</i>		P						
<i>Dioscorea retusa</i>		P						
<i>Pavetta assimilis</i>		P						
<i>Rubus rigidus</i>		P						
<i>Asplenium aethiopicum</i>		P						
<i>Cyperus albobistriatus</i>		P	P					
<i>Rhus leptodictya</i>			P					
<i>Rhoicissus tridentata</i>			P					
<i>Euclea crispa</i>	P	P	P					
<i>Landolphia capensis</i>				P	P			
<i>Bequaertiodendron magalismontanum</i>				P	P			
<i>Tapiphyllum parvifolium</i>				P	P			
<i>Mundulea sericea</i>				P		P		
<i>Canthium mundianum</i>					P			
<i>Clutia pulchella</i>					P	P		
<i>Protea caffra</i>						P	P	P
<i>Themeda triandra</i>						P	P	P
<i>Pteridium aquilinum</i>						P		P
<i>Eragrostis curvula</i>						P		P
<i>Helichrysum setosum</i>						P		P
<i>Eragrostis racemosa</i>								P
<i>Loudetia simplex</i>								P
<i>Canthium gilfillanii</i>		P	P	P		P	P	P
<i>Aristida transvaalensis</i>				P	P	P	P	P
<i>Nuxia congesta</i>		P	P	P	P			
<i>Indigofera comosa</i>		P		P	P		P	
<i>Cymbopogon marginatus</i>				P		P	P	P

Explanation of "P" and "p" in text.

THE PLANT COMMUNITIES

The vegetation consists of three major groups of communities:

- (1) Kloof communities,
- (2) Communities of the rocky quartzite hills and
- (3) Communities of the flat areas.

1. Kloof communities: *Rhus pyroides* Forests

These forests are found at an altitude of 1 645–1 715 m along seasonal streams in kloofs that are well sheltered by steep slopes. The soils are usually deeper than 1 m and rich in humus.

A mosaic of evergreen broad sclerophyll forest (1A1/6; see Fosberg, 1967) and dry season deciduous forest (1A2/3) represents this vegetation which is characterized by the *Buddleia salviifolia* species group (Table 2) and the prominence of *Diospyros lycioides*. Two types of *Rhus pyroides* Forests are recognized:

1.1 *Rhus pyroides*—*Buddleia salviifolia*—*Celtis africana* Forest

These forests occur where little or no rock is found on the soil surface and are characterized by the presence of the differential species *Celtis africana*, *Riocreuxia polyantha* and *Bromus leptoclados* of the *Celtis africana* species group (Table 2). This community is negatively associated with the *Clutia pulchella* and *Pellaea calomelanos* species groups (Table 2)

which are characteristic of rocky areas. A relatively low average of 16 species is recorded per relevé, but the total canopy cover is nearly 100%.

The tree stratum is 12–15 m tall, with a canopy cover of nearly 100%. The most prominent trees include *Rhus pyroides* (100%), often with a canopy cover of more than 25%, *Buddleia salviifolia* (100%) and *Celtis africana* (100%). The trees *Euclea crispa* (50%) and *Heteromorpha arborescens* (50%) occur less constantly, but are locally very prominent (see Table 3).

The shrub canopy cover varies from 40–70% and shrubs include *Diospyros lycioides* (100%) and *Fagara capensis* (50%). *Riocreuxia polyantha* (100%) and *Rubus rigidus* (100%) locally form impenetrable thickets. The lianas *Rhoicissus tridentata* (50%) and *Clematis brachiata* (50%) are frequently found in the tree and shrub strata.

The herbaceous layer is poorly represented, but *Bromus leptoclados* (100%), *Ehrharta erecta* (100%) and *Asplenium aethiopicum* (100%) are constantly present.

1.2 *Rhus pyroides*—*Buddleia salviifolia* Forests.

These forests are found in kloofs where rocks cover more than 60% of the soil surface. Although it seems that no differential species occur in this community,

it can be distinguished from *Rhus pyroides*—*Buddleia salviifolia*—*Celtis africana* Forest by the absence of the *Celtis africana* species group (Table 2), and a positive association with the *Clutia pulchella* and *Pellaea calomelanos* species groups (Table 2). Furthermore, *Pittosporum viridiflorum*, *Halleria lucida* and *Ilex mitis* seem to be fairly faithful to this community.

An average of 21 species is recorded per relevé and the total canopy cover is nearly 100%.

The tree stratum is 5–15 m tall with a canopy cover of 80%. The most prominent trees are *Rhus pyroides* (100%) and *Buddleia salviifolia* (100%) (Table 3), both locally covering up to 50% of the soil surface. Other conspicuous trees include *Nuxia congesta* (100%), *Pittosporum viridifolium* (100%), *Canthium gilfillanii* (100%), *Pavetta assimilis* (100%), *Euclea crispa* (100%), *Ilex mitis* (50%), *Halleria lucida* (50%) and *Cussonia paniculata* (100%).

The total canopy cover of the shrub stratum is 60% and the most prominent shrubs are *Diospyros lycioides* (100%) and *Myrsine africana* (100%), but young individuals of *Euclea crispa* (100%) and *Buddleia salviifolia* (100%) are also very conspicuous in the shrub stratum (Table 3). Other shrubs, which are locally abundant, include *Pavetta assimilis* (100%) *Rubus rigidus* (50%) and *Lippia javanica* (50%).

The liane, *Dioscorea retusa* (50%), is found locally scrambling among the trees and shrubs.

The herbaceous layer is better developed than in the *Rhus pyroides*—*Buddleia salviifolia*—*Celtis africana* Forest, but does not exceed 20% canopy coverage. The most conspicuous herbs are *Ehrharta erecta* (100%), *Asplenium aethiopicum* (100%), *Commelina africana* (100%), *Oxalis sp.* (100%) and *Cyperus albostratus* (50%).

2. Communities of the rocky quartzite hills: *Canthium gilfillanii*—*Aristida transvaalensis*—*Cymbopogon marginatus* Savannas (Table 2).

This vegetation includes open savanna communities that are restricted to the shallow coarse sandy soils of the rocky quartzite hills. With the exception of the *Protea caffra*—*Pteridium aquilinum* Savanna (2.3.3), which occurs on fairly rocky and fairly steep (5–16°) slopes mostly at an altitude of 1648–1740 m above sea level, all the other communities of this vegetation type are found on very rocky and very steep (11–40°) slopes, at an altitude of 1580–1690 m above sea level.

The *Canthium gilfillanii*—*Aristida transvaalensis*—*Cymbopogon marginatus* Savannas are characterized by the *Pellaea calomelanos* species group (Table 2), with *Canthium gilfillanii*, *Aristida transvaalensis*, *Nuxia congesta*, *Indigofera comosa* and *Cymbopogon marginatus* prominent in most communities (Table 3). Three major communities are recognized:

Dombeya rotundifolia—*Ziziphus mucronata* Savanna, *Landolphia capensis*—*Bequaertiodendron magalismontanum* Savanna and

Protea caffra—*Helichrysum setosum* Savanna

2.1 *Dombeya rotundifolia*—*Ziziphus mucronata* Savanna

This community is found in well sheltered valleys on steep east-facing slopes of the rocky quartzite hills. Structurally, the community represents an evergreen sclerophyllous steppe savanna (2D1/2) characterized by the *Dombeya rotundifolia* species group (Table 2). Species from the *Fagara capensis* species group (Table 2), as well as constant high canopy cover values of *Rhus leptodictya*, are also characteristic of this community. An average of 23 species per relevé

is recorded and the total canopy cover of the vegetation is 60–95%.

The trees of this community are 5–8 m tall, with a canopy cover value of 40–90%. Prominent trees are *Rhus leptodictya* (86%), *Canthium gilfillanii* (86%), *Euclea crispa* (57%) and *Nuxia congesta* (57%) (Table 3). Other conspicuous trees include:

<i>Dombeya rotundifolia</i>	86%	<i>Pavetta capensis</i>	43%
<i>Euclea crispa</i>	57%	<i>Pavetta assimilis</i>	43%
<i>Brachylaena rotundata</i>	57%	<i>Maerua cafra</i>	43%
<i>Ziziphus mucronata</i>	57%	<i>Cussonia paniculata</i>	43%
<i>Nuxia congesta</i>	57%	<i>Osyris lanceolata</i>	29%
<i>Acacia karroo</i>	43%	<i>Maytenus heterophylla</i>	29%

The shrub stratum is 1–2 m tall and is fairly open, its canopy covering from 10–50%. The most conspicuous shrubs include:

<i>Canthium gilfillanii</i>	86%	<i>Euclea crispa</i>	57%
<i>Fagara capensis</i>	71%	<i>Diospyros lycioides</i>	57%
<i>Maytenus polyacantha</i>	57%	<i>Opuntia sp.</i>	57%
<i>Bequaertiodendron magalismontanum</i>	57%	<i>Hibiscus callyphyllus</i>	43%
		<i>Indigofera comosa</i>	29%
		<i>Mundulea sericea</i>	29%
		<i>Myrsine africana</i>	29%

The liane, *Rhoicissus tridentata* (100%), is very abundant in the tree and shrub strata and *Asparagus aethiopicus* (29%) occurs locally. The herbaceous layer is poorly represented, often with a total cover value of less than 5%. *Cyperus albostratus* (71%) is well represented, with scattered individuals of the following species: *Solanum rubetorum* (71%), *Pellaea calomelanos* (71%), *Cyperus albostratus* (71%), *Aristida transvaalensis* (57%), *Cymbopogon marginatus* (57%), *Cheilanthes hirta* (57%), *Clutia pulchella* (43%), *Ruellia cordata* (29%) and *Commelina africana* (29%).

2.2 *Landolphia capensis*—*Bequaertiodendron magalismontanum* Savanna

This Savanna is found on the steep north, east and west facing slopes of the rocky quartzite hills. The community includes Fosberg's (1967) open evergreen broad sclerophyll shrub savanna (1G1/2) and evergreen broad sclerophyll shrub savanna (1K1/2). The community is characterized by the *Landolphia capensis* species group (Table 2) and constantly high cover-abundance values for *Aristida transvaalensis*.

Two variations of this community, which are distributed in a complex mosaic pattern, are recognized:

Landolphia capensis—*Crassula argyrophylla* Savanna and

Landolphia capensis—*Canthium mundianum* Savanna
2.2.1 *Landolphia capensis*—*Crassula argyrophylla* Savanna Variant

Large quartzite rocks covering more than 80% of the soil surface are very conspicuous in this community, which is characterized by the *Crassula argyrophylla* species group (Table 2) and which is positively associated with the *Fagara capensis* species group and more or less negatively associated with the *Loudetia simplex* species group (Table 2).

An average of 22 species is recorded per relevé and the total canopy cover of this community varies from 60–90%.

The canopy cover of the tree stratum from 2–8 m tall, is 50%, but may be as high as 70% in prominent bush thickets. *Bequaertiodendron magalismontanum* (90%), *Canthium gilfillanii* (90%), *Nuxia congesta* (80%) and *Tapiphyllum parvifolium* (70%) are the most prominent trees (Table 3), often with canopy cover values of 25% and sometimes even 50%.



FIG. 5.—*Landolphia capensis*—*Crassula argyrophylla* Savanna with the succule its *Crassula argyrophylla*, *Aloe davyana* and *Kalanchoe paniculata*.

Other conspicuous trees include *Brachylaena rotundata* (50%), *Euclea crispa* (50%), *Maerua caffra* (30%) and *Rhus leptodictya* (30%).

The well-defined shrub stratum is 1–2 m tall and its canopy covers 20–70%. Impenetrable shrub thickets occur locally. The most prominent and conspicuous species include:

<i>Landolphia capensis</i> 100%	<i>Euclea crispa</i> 50%
<i>Bequaertiodendron magalismsontanum</i> 90%	<i>Mundulea sericea</i> 50%
<i>Canthium gilfillanii</i> .. 90%	<i>Pavetta assimilis</i> 30%
<i>Indigofera comosa</i> .. 90%	<i>Diospyros lycioides</i> .. 30%
<i>Nuxia congesta</i> 80%	<i>Myrsine africana</i> 30%
<i>Tapiphyllum parvifolium</i> 70%	<i>Vangueria infausta</i> .. 30%
<i>Fagara capensis</i> 50%	<i>Sphedamnocarpus galphimifolius</i> ... 30%

The herbaceous layer attains a height of 0.7 m and its canopy cover varies from 5% in bush thickets to 60% in open areas.

Aristida transvaalensis (100%) and *Cymbopogon marginatus* (100%) are prominent grasses (Table 3) and *Rhynchelytrum setifolium* (100%) is also very common. Succulents such as *Crassula argyrophylla* (90%), *Aloe davyana* (80%) and *Kalanchoe paniculata* (50%), occur constantly in this community (Fig. 5). Other herbs include *Pellaea calomelanos* (90%), *Clutia pulchella* (90%), *Cheilanthes hirta* (80%), *Themeda triandra* (40%), *Commelina africana* (30%), *Pavonia burchellii* (30%) and *Loudetia simplex* (30%).

2.2.2 *Landolphia capensis*—*Canthium mundianum* Savanna Variant

This community occurs on more or less similar but slightly less rocky areas than the *Landolphia capensis*—*Crassula argyrophylla* Savanna Variant, but rocks still cover 60–80% of the soil surface.

The vegetation is characterized by the *Vangueria infausta* species group (Table 2) and is negatively

associated with the *Fagara capensis* species group and positively associated with the *Loudetia simplex* species group (Table 2). The species *Cyperus albobistriatus* and *Themeda triandra*, are fairly constantly represented in the *Landolphia capensis*—*Canthium mundianum* Savanna Variant, but are rather scarce in the *Landolphia capensis*—*Crassula argyrophylla* Savanna Variant.

An average of 21 species is recorded per relevé and the total canopy cover varies from 40–90%, depending on the amount of rock locally present.

The tree stratum is 2–6 m tall and has a canopy cover of 10–50%. *Bequaertiodendron magalismsontanum* (85%) is the most prominent tree and its canopy cover is locally as high as 50% (Fig. 6). *Nuxia congesta* (77%) and *Tapiphyllum parvifolium* (62%) are locally very conspicuous. *Canthium gilfillanii* (54%) and *C. mundianum* (54%) are very abundant in some areas and form nearly impenetrable thickets. Other trees found scattered in this community include *Protea caffra* (47%), *Osyris lanceolata* (23%), *Pittosporum viridiflorum* (23%) and *Euclea crispa* (23%).

The shrubs in this community are up to 2 m tall with a total canopy cover from 10–50%. *Landolphia capensis* (92%), *Bequaertiodendron magalismsontanum* (85%), *Tapiphyllum parvifolium* (85%), *Canthium gilfillanii* (54%) and *C. mundianum* (54%) are the most prominent shrubs. Other shrubs include *Vangueria infausta* (84%), *Nuxia congesta* (77%), *Indigofera comosa* (69%), *Mundulea sericea* (54%), *Rhus magalismsontanum* (54%), *Lopholaela coriifolia* (38%) and *Myrsine africana* (23%).

The total canopy cover of the herbs are mostly less than 40%, but are locally as high as 70%, depending on the canopy cover of the trees and shrubs present. Prominent grasses are *Aristida transvaalensis* (92%) and *Cymbopogon marginatus* (77%), while the forb *Clutia pulchella* (85%) is also well represented (Table 3). Other herbs present include:

<i>Pellaea calomelanos</i> 85%	<i>Eragrostis curvula</i> ... 38%
<i>Themeda triandra</i> ... 69%	<i>Sphenostylis angustifolia</i> 31%
<i>Cheilanthes hirta</i> 69%	<i>Brachiaria serrata</i> ... 23%
<i>Loudetia simplex</i> 54%	<i>Hypoxis rigidula</i> ... 23%
<i>Rhynchelytrum setifolium</i> 54%	<i>Vernonia sutherlandii</i> 23%
<i>Cyperus albobistriatus</i> 46%	

2.3 *Protea caffra*—*Helichrysum setosum* Savanna

This community (Fig. 7) is usually found on steep rocky south-facing slopes, but occasionally also on steep rocky east and west-facing slopes. Structurally the vegetation represents an evergreen broad sclerophyll shrub savanna (1K1/2) with *Protea caffra* as the most prominent species (Table 3). The community is characterized by the *Protea caffra* species group (Table 2).

Three variations of this community may be distinguished:

Protea caffra—*Clutia pulchella* Savanna Variant

Protea caffra—*Helichrysum lepidissimum* Savanna Variant and

Protea caffra—*Pteridium aquilinum* Savanna Variant

Due to the complex topography of the area where these three communities are found, their distribution patterns are a complex irregular mosaic.

2.3.1 *Protea caffra*—*Clutia pulchella* Savanna Variant

This community is situated between 1 600–1 680 m usually on steep (10° to 28°) south-facing slopes, and occasionally on east and west-facing slopes. Large quartzite rocks cover more than 60% of the soil surface. Although it seems as if no differential species occur in this community, it can be distinguished from



FIG. 6.—*Landolphia capensis*—*Canthium mundianum* Savanna.



FIG. 7.—*Protea caffra*—*Helichrysum setosum* Savanna.

the *Protea caffra*—*Helichrysum lepidissimum* Savanna Variant and the *Protea caffra*—*Pteridium aquilinum* Savanna Variant by the absence respectively of the *Helichrysum lepidissimum* and *Eragrostis racemosa* species groups (Table 2).

An average of 21 species is recorded per relevé and the total canopy cover of the vegetation is from 60–90%.

The tree stratum which is 3–6 m tall is fairly open with a canopy cover of 10–40%. *Protea caffra* is the tallest and most conspicuous tree, but *Canthium*

gilfillanii (63%), *Nuxia congesta* (50%), *Mundulea sericea* (50%), *Rhus leptodictya* (38%) and *R. pyroides* (25%) are also common.

The shrub stratum has a canopy cover of 5–40%. The shrubs are usually widely scattered and are mostly represented by young plants of the tree species, although *Indigofera comosa* (50%), *Myrsine africana* (50%), *Diospyros lycioides* (38%), *Vangueria infausta* (25%) and *Lippia javanica* (25%) are also locally present.

TABLE 4.— Phytosociological table of *Eragrostis racemosa*-
Digitaria monodactyla Grassland Communities

Community number	3.1	3.2.1	3.2.2	3.3	3.4
Relevé number	260 262 267 268 261 265 266 263	277 276 287 272 273 271 275 249 274	269 278	245 252 244 259 247 257 248 264	254 251 250 253 246 243 255 258 242
Altitude (m)	1600 1590 1560 1570 1615 1615 1350 1600	1690 1615 1570 1570 1570 1550 1615 1700 1630	1660 1660	1740 1700 1710 1690 1740 1690 1740 1615	1660 1680 1690 1650 1750 1715 1680 1660 1740
Rockiness (5-point scale, 20% intervals)	4 1 1 1 1 1 1 1	0 0 0 0 0 1 0 1	0 0	5 5 5 5 5 5 5 5	1 0 0 0 0 0 0 0
Soil depth (mm)	500 250 500 1000 200 1000 1000 500	1000 1000 1000 400 500 500 1000 1000	1000 1000	250 100 100 150 100 150 500 500	100 1000 1000 1000 1000 200 1000 1000
Average canopy cover (%)	71	73	93	48	63
Average height (m)	0,7	0,7	1	0,7	0,5
Species per relevé	19 17 20 12 14 15 19 10	29 21 24 31 15 29 24 19 23	22 25	19 23 26 11 14 15 24 26	9 15 17 14 25 23 19 23 16
Differentiating species of 3.1					
INDIGOFERA COMOSA	+ t t t + + +			+ t	
DIOSPYROS LYCIOIDES	t t t t + t				
RHUS PYROIDES	t t t t t				
POGONARTHRIA SQUARROSA	+ + + +	t 1			
Differentiating species of 3.2					
ERAGROSTIS CHLOROMELAS		4 + + 2 1 + 1	1 2		
TRICHONEURA GRANDIGLUMIS	+	t + t + + + + t	+ t		
CYNODON DACTYLON	+	2 2	2 1		+
HELICHRYSUM RUGULOSUM		++	++		
Differentiating species of 3.2.1					
PANICUM NATALENSE	+	+ + + + + +		+	
ERAGROSTIS CAPENSIS		t + + + t +			
INDIGOFERA SANGUINEA	1 +	t + + + +		+	
GEIGERIA BURKEI		+ t t t			
SCHIZACHYRIUM SANGUINEUM	1	1 + t + t			
AJUGA OPHRYDIS		+ t + t			t
Differentiating species of 3.2.2					
POLYGALA AMATYMBICA			tt		
RHYNCHOSIA TOTTA			tt		
HERMANNIA DEPRESSA			tt		
SIDA DREGEI			tt		
ARISTIDA CONGESTA			+ 1		
Differentiating species of 3.3					
LOPHOLAENA CORIIFOLIA	+			1 t 1 t + 1 1	
ARISTIDA TRANSVAALENSIS				1 1 t 3 1 1 2	
SENECIO VENOSUS		+		1 t t + t 1 t	
RHUS MAGALISMONTANA		+		1 t + + + 1	
SPOROBOLUS PECTINATUS		+		+ 1 + 1 1 +	
TEPHROSIA LONGIPES		+		t + + +	+
CYPERUS RUPESTRIS		t		t t t t	
HELICHRYSUM CHIONOSPHERUM				tt t	
SELAGINELLA DREGEI				1 1 1	
URSINIA NANA SUBSP. LEPTOPHYLLA				+ + +	
Common species					
ERAGROSTIS RACEMOSA	+ 3 2 2 1 1 +	+ 1 2 1 1 1	2 2	2 2 1 1 1 1 +	1 + 1 1 3 2
HETEROPOGON CONTORTUS	1 + 2 + 1	1 + 2 2 3 2 2 + 1	+ 1	1 1 1 1 +	1 1 1 2 + 1
ERAGROSTIS CURVULA	1 + + 1 1 3 + 4	1 t + 1	+ 1	1 1	3 4 3 1 1 1 2 1
THEMEDA TRIANDRA	1 + t 1	t + 1 + 1 +	+ 2	+ + 1 + 1	+ 1 1 3 2
BRACHIARIA SERRATA	++ 1	++ t 1 +		1 + 1 1 +	+ t 1 1 1 + + +
STOEBE VULGARIS	t t + 3 t 1	1 t t + +	1 1	t t t t	+ 1 1 1 1
ELIONURUS ARGENTEUS	+ + + +	3 1 1 1 1	+	2	+ 3 2 1
BULBOSTYLIS BURCHELLII	t + 1 t	+ 1 1 t		t 1 1 t + t	1 1 +
CYANOTIS SPECIOSA	t t t t	t t		tt t t + t	tt t t
ARISTIDA JUNCIFORMIS	1 2 1 + + 1	+ + t + 1 2		1 1 +	+ +
LOUDETIA SIMPLEX	1 + + + +	2		2 1 1 1 + 1 +	1 1
DIGITARIA MONODACTYLA	1 1 + +	+ 1 1		1 1 1 1	1 + 1 1 1 +
HYPARRHENIA HIRTA	+ + 1 2	1 2 + 1 + t	3 2	1	+ +
HERMANNIA LANCIFOLIA	t + + +	+ t t t			t t 1 1 1 + 1
INDIGOFERA HILARIS	+ +	+		t + +	1 t 1 + 1
RHYNCHELYTRUM SETIFOLIUM	1 +	t +	+	1 1 + t +	+
LEDEBOURIA MARGINATA	t t t	t t	t		t t +
DIHETEROPOGON FILIFOLIUS	1 + +	3 3 1		1	1 1 1 2
ELEPHANTORRHIZA ELEPHANTINA	+			t 1 1 +	+ 1 1 1 3 1
ACALYPHA PUNCTATA		t	t	t	+ + 1 t + 1
TRISTACHYA REHMANNII	1 +	+ 1		+ + 1	+ 1 1
VERNONIA GALPINII	t	t +		t t + + t	t
TRACHYPOGON SPICATUS	+	2 1 1 +		1	+ + 1
TRISTACHYA HISPIDA		2 2		1	1 1 1
MONOCYMBIUM CERESIFORME	+ +	+ t		+	+ 2
DIGITARIA TRICHOLOENOIDES		+ + 1 1	+	1	1 1
PENTANISIA ANGUSTIFOLIA	t	+		+	1 + +
DIHETEROPOGON AMPLECTENS		+ + + +		+	+ 1
CASSIA BIENSIS	t +	t t		t	t
CHAETACANTHUS BURCHELLII		t +		t	t t t
HYPOXIS RIGIDULA		t	tt		tt t
SCABIOSA COLUMBARIA		++		t	t t
HYPOXIS ROOPERI	t t	t		t	t t
CYPERUS OBTUSIFLORUS	+	tt			t 1
HELICHRYSUM MICONIAEFOLIUM		t			+ t + t
CLERODENDRUM TRIPHYLLUM		t			+ t t t
CYMBOPOGON MARGINATUS	+	t +		1 1	

The well developed herbaceous layer is up to 1 m tall and its canopy cover is mostly from 40–60%, but may be occasionally lower. Prominent species (Table 3) include *Cymbopogon marginatus* (100%), *Aristida transvaalensis* (88%), *Helichrysum setosum* (88%) and *Clutia pulchella* (88%). *Eragrostis curvula* and *Themeda triandra* (63%), which is less constantly present, are locally very abundant, often with a canopy cover of 50%. Other species represented in the herbaceous layer include:

<i>Pellaea calomelanos</i> 100%	<i>Commelina africana</i> 38%
<i>Cheilanthes hirta</i> ... 100%	<i>Anthospermum hispidulum</i> ... 25%
<i>Koeleria cristata</i> ... 75%	<i>Festuca scabra</i> ... 25%
<i>Hypoxis rigidula</i> ... 75%	<i>Athrixia elata</i> ... 25%
<i>Themeda triandra</i> ... 63%	<i>Loudetia simplex</i> ... 25%
<i>Berkheya seminivea</i> 50%	<i>Pteridium aquilinum</i> 25%
<i>Cyperus albostratus</i> 50%	<i>Brachiaria serrata</i> ... 25%
<i>Leonotis microphyllum</i> ... 38%	<i>Acalypha punctata</i> ... 25%
<i>Vernonia sutherlandii</i> 38%	<i>Oxalis sp.</i> ... 25%

2.3.2 *Protea caffra*—*Helichrysum lepidissimum* Savanna Variant

This community is situated between 1 590–1 660 m on steep (16–30°) south-facing slopes, which are less rocky than the slopes on which the *Protea caffra*—*Clutia pulchella* Savanna Variant occurs.

The community is differentiated by the *Helichrysum lepidissimum* species group (Table 2).

There is an average of 25 species per relevé and the vegetation has a total canopy cover of 70–90%. As in the case of the *Protea caffra*—*Clutia pulchella* Savanna Variant *Protea caffra* is most conspicuous in the tree stratum, which is up to 4 m tall and has a canopy cover of 10–40%. *Nuxia congesta* (67%) and *Canthium gilfillanii* (67%) are locally conspicuous (Table 3).

The shrub stratum is usually inconspicuous with a total canopy cover of less than 20%. Shrubs represented in this community include *Indigofera comosa* (83%), *Nuxia congesta* (67%), *Canthium gilfillanii* (67%), *Diospyros lycioides* (67%), *Lopholaena coriifolia* (67%), *Mundulea sericea* (33%), *Myrsine africana* (33%), *Rhus magalismontana* (33%) and *Lippia javanica* (33%).

The herbaceous layer is well developed, up to 1 m tall and with a canopy cover of 50–80%. *Themeda triandra* (100%), *Aristida transvaalensis* (100%) and *Cymbopogon marginatus* (100%) are the most prominent and conspicuous grasses (Table 3). Other herbs in this community include:

<i>Pellaea calomelanos</i> 100%	<i>Koeleria cristata</i> ... 50%
<i>Cheilanthes hirta</i> ... 100%	<i>Leonotis microphyllum</i> ... 50%
<i>Loudetia simplex</i> ... 100%	<i>Hypoxis rigidula</i> ... 50%
<i>Helichrysum lepidissimum</i> ... 83%	<i>Commelina africana</i> 50%
<i>Senecio venosus</i> ... 83%	<i>Berkheya seminivea</i> 33%
<i>Helichrysum setosum</i> 83%	<i>Vernonia sutherlandii</i> 33%
<i>Athrixia elata</i> ... 66%	<i>Vernonia staehelinoides</i> ... 33%
<i>Streptocarpus vanderlurii</i> ... 66%	<i>Sphenostylis angustifolia</i> ... 33%
<i>Nidorella hottentotica</i> ... 66%	<i>Scirpus burkei</i> ... 33%
<i>Clutia pulchella</i> ... 66%	<i>Oxalis sp.</i> ... 33%
<i>Eragrostis curvula</i> ... 66%	

2.3.3 *Protea caffra*—*Pteridium aquilinum* Savanna Variant

This community (Fig. 8) is situated at higher altitudes (1 630–1 740 m) than the other *Protea caffra*—*Helichrysum setosum* Savanna communities, usually

on less steep (5–16°) south-facing slopes. The community is characterized by the *Eragrostis racemosa* species group (Table 2) and is, furthermore, negatively associated with the *Clutia pulchella* species group (Table 2). Another feature of this community is the presence, though with low vitality, of species from the *Landolphia capensis* species group (Table 2), which are more generally found on north-facing slopes.

Total canopy cover of this vegetation is from 40–95% with an average of 26 species per relevé.

Trees in this community are up to 4 m tall and have a total canopy cover of 5–30%. *Protea caffra*, (100%) the prominent tree, *Mundulea sericea* (53%) and *Canthium gilfillanii* (45%) are also present in the tree stratum.

Shrubs found in this community have a total canopy cover of less than 10%. Scattered shrubs include *Protea caffra* (90%), *Rhus magalismontana* (73%), *Indigofera comosa* (64%), *Lopholaena coriifolia* (64%), *Mundulea sericea* (55%), *Diospyros lycioides* (55%) and *Canthium gilfillanii* (45%). The species *Landolphia capensis* (45%), *Bequaertiodendron magalismontanum* (45%), *Tapiphyllum parvifolium* (27%) and *Vangueria infausta* (27%), which are differential species for the communities on north-facing slopes are sometimes present, though usually in locally sheltered areas and with a marked low vitality.

In the herbaceous layer, which is up to 1 m tall and has a canopy cover of 30–90%, the fern *Pteridium aquilinum* (82%) is very prominent (Fig. 8). Prominent and abundant grasses (Table 3) include *Cymbopogon marginatus* (100%), *Eragrostis racemosa* (100%), *Aristida transvaalensis* (82%), *Eragrostis curvula* (82%), *Loudetia simplex* (73%) and *Themeda triandra* (73%). Other herbs include:

<i>Eragrostis racemosa</i> 100%	<i>Bulbostylis burchellii</i> ... 45%
<i>Pellaea calomelanos</i> 91%	<i>Brachiaria serrata</i> ... 45%
<i>Eragrostis curvula</i> ... 82%	<i>Leonotis microphyllum</i> ... 36%
<i>Cheilanthes hirta</i> ... 82%	<i>Berkheya seminivea</i> 36%
<i>Helichrysum setosum</i> 73%	<i>Sphenostylis angustifolia</i> ... 36%
<i>Vernonia staehelinoides</i> ... 73%	<i>Hebenstreitia elongata</i> ... 27%
<i>Loudetia simplex</i> ... 73%	<i>Festuca scabra</i> ... 27%
<i>Themeda triandra</i> ... 73%	<i>Chrysocoma tenuifolia</i> ... 27%
<i>Indigofera sanguinea</i> 64%	<i>Rhynchelytrum setifolium</i> ... 27%
<i>Vernonia sutherlandii</i> 55%	<i>Senecio venosus</i> ... 27%
<i>Rhynchelytrum repens</i> ... 45%	
<i>Tephrosia longipes</i> ... 45%	
<i>Koeleria cristata</i> ... 45%	

3. Communities of the flat: *Eragrostis racemosa*—*Digitaria monodactyla* Grassland Communities (Tables 4 and 5).

This vegetation, characterized by the *Eragrostis racemosa* species group, includes the grassland communities occurring on the flat or gently undulating areas at the foot of the hills as well as on the plateaux on top of these hills.

The coarse sandy loam soils of these communities are usually deeper than 1 m, but are occasionally, especially on rocky outcrops, more shallow.

Eragrostis racemosa—*Digitaria monodactyla* grasslands include the following communities (Table 4):



FIG. 8.—*Protea caffra*—*Pteridium aquilinum* Savanna.

TABLE 5.—Prominent species in *Eragrostis racemosa*—*Digitaria monodactyla* Grassland Communities

Community number	3.1	3.2.1	3.2.2	3.3	3.4
<i>Aristida junciformis</i>	P		P		
<i>Eragrostis chloromelas</i> ...		P	P		
<i>Cynodon dactylon</i>		P	P		
<i>Tristachya hispida</i>		P			
<i>Hyparrhenia hirta</i>			P		
<i>Aristida congesta</i>			P		
<i>Stoebe vulgaris</i>			P		
<i>Aristida transvaalensis</i> ...				P	
<i>Lopholaena coriifolia</i> ...				P	
<i>Loudetia simplex</i>				P	
<i>Digitaria monodactyla</i> ...				P	
<i>Elionurus argenteus</i>		P			P
<i>Themeda triandra</i>			P		P
<i>Elephantorrhiza elephantina</i>					P
<i>Eragrostis racemosa</i>	P	P	P	P	P
<i>Heteropogon contortus</i> ...		P	P	P	P
<i>Eragrostis curvula</i>	P	P	P	P	P

Indigofera comosa—*Aristida junciformis* Grassland
Eragrostis chloromelas—*Trichoneura grandiglumis* Grassland, *Lopholaena coriifolia*—*Aristida transvaalensis*—*Sporobolus pectinatus* Grassland and *Eragrostis curvula*—*Hermannia lancifolia* Grassland.

3.1 *Indigofera comosa*—*Aristida junciformis* Grassland

This community occurs between 1 550–1 615 m, and is situated at the foot of the south-facing slopes of the rocky quartzite hills. Stones generally cover from 1–20% of the soil surface.

Structurally this community falls into Fosberg's (1967) seasonal grass steppe (2G2/1) but, due to the small scattered shrubs of *Indigofera comosa* (88%), *Diospyros lycioides* (75%) *Stoebe vulgaris* (75%) and *Rhus pyroides* (63%) which occur in this community, it can locally be classified as a deciduous orthophyll shrub steppe savanna (2E2/1).

An average of 17 species is recorded per relevé. The total canopy cover of the vegetation is usually

70–95%, but is sometimes, due to local overgrazing, as low as 40%.

The *Indigofera comosa* species group (Table 4) characterizes this community.

Eragrostis curvula (100%), *E. racemosa* (86%) and *Aristida junciformis* (86%) are the most prominent herbaceous species, (Table 5) each with a local canopy cover of about 25%. *Hyparrhenia hirta* (50%) is often locally very conspicuous. Other species constantly present or locally abundant, include:

<i>Loudetia simplex</i>	63%	<i>Hermannia lancifolia</i>	38%
<i>Heteropogon contortus</i>	63%	<i>Ledebouria marginata</i>	38%
<i>Pogonarthria squarrosa</i>	50%	<i>Tristachya rehmannii</i>	25%
<i>Elionurus argenteus</i> ...	50%	<i>Rhynchelytrum setifolium</i>	25%
<i>Digitaria monodactyla</i>	50%	<i>Monocymbium cereciiforme</i>	25%
<i>Themeda triandra</i> ...	50%	<i>Indigofera hiliaris</i> ...	25%
<i>Cyanotis speciosas</i> ...	50%	<i>Cassia biensis</i>	25%
<i>Bulbostylis burchellii</i>	50%	<i>Indigofera sanguinea</i>	25%
<i>Diheteropogon filifolius</i>	38%	<i>Hypoxis rooperi</i>	25%
<i>Brachiaria serrata</i> ...	38%	<i>Silene burchellii</i>	25%

This community probably represents an ecotone between *Eragrostis racemosa*—*Digitaria monodactyla* Grassland of the flats and the *Canthium gilfillanii*—*Aristida transvaalensis*—*Cymbopogon marginatus* Savanna on the rocky hills.

3.2 *Eragrostis chloromelas*—*Trichoneura grandiglumis* Grassland

This Grassland (Fig. 9) occurs on the flats between 1 550–1 700 m, on sandy loam soils with little or no rock on the soil surface. Various abandoned farmlands in different stages of succession occur in this community. The vegetation generally represents seasonal orthophyll meadow (short grass) (1M2/1), but seasonal orthophyll tall grass (1L2/1) is often locally very conspicuous.

The *Eragrostis chloromelas* species group (Table 4) characterizes this community.

Two variations of this community were sampled:

Trichoneura grandiglumis — *Panicum natalense* Grassland Variant and *Trichoneura grandiglumis*—*Hermannia depressa* Grassland Variant

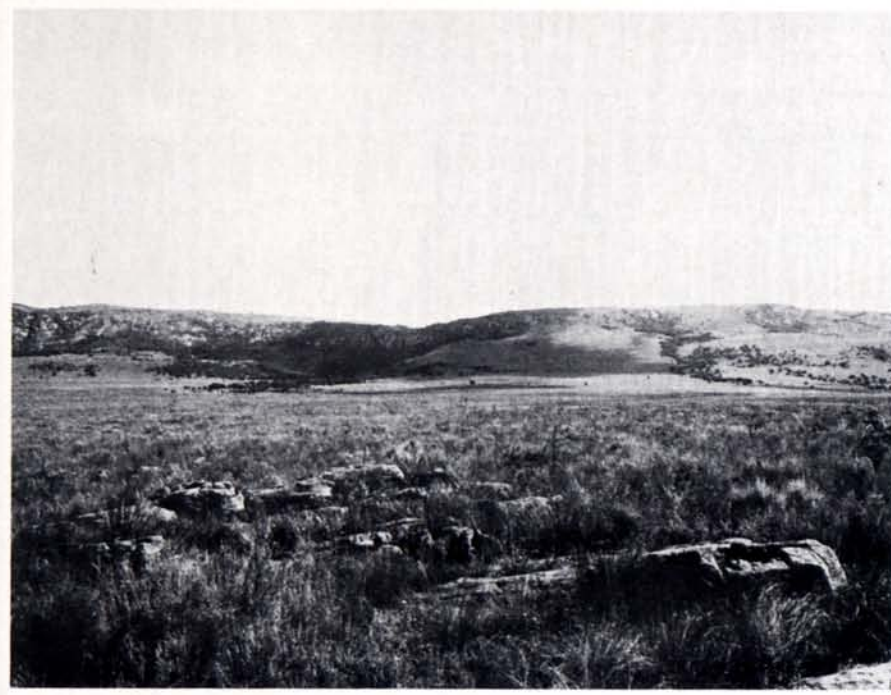


FIG. 9.—*Eragrostis chloromelas*—*Trichoneura grandiglumis* Grassland.

3.2.1. *Trichoneura grandiglumis*—*Panicum natalense* Grassland Variant

Most of the *Eragrostis chloromelas*—*Trichoneura grandiglumis* Grassland is represented by this community. An average of 23 species is recorded per relevé and the vegetation has a canopy cover of 60–95%. The vegetation is mostly shorter than 1 m, due to regular grazing.

Prominent species (Table 5) include *Heteropogon contortus* (100%), *Eragrostis chloromelas* (78%), *E. racemosa* (67%), *Elionurus argenteus* (56%), *Tristachya hispida* (22%) and *Cynodon dactylon*, which is locally abundant. Species present in 20% of the relevés representing this community are:

<i>Trichoneura grandiglumis</i>	89%	<i>Tristachya rehmannii</i>	22%
<i>Panicum natalense</i>	67%	<i>T. hispida</i>	22%
<i>Themeda triandra</i> ...	67%	<i>Cymbopogon marginatus</i>	22%
<i>Eragrostis racemosa</i> ...	67%	<i>Rhynchelytrum setifolium</i>	22%
<i>Aristida junciformis</i> ...	67%	<i>Helichrysum rugulosum</i>	22%
<i>Hyparrhenia hirta</i> ...	67%	<i>Cyanotis speciosa</i> ...	20%
<i>Eragrostis capensis</i> ...	56%	<i>Ledebouria marginalata</i>	20%
<i>Schizachyrium sanguineum</i>	56%	<i>Cassia biensis</i>	22%
<i>Brachiaria serrata</i> ...	56%	<i>Chaetacanthus burchellii</i>	22%
<i>Indigofera sanguinea</i> ...	56%	<i>Vernonia monocephala</i>	22%
<i>Geigeria burkei</i>	56%	<i>Scabiosa columbaria</i> ...	22%
<i>Stoebe vulgaris</i>	56%	<i>Cyperus obtusiflorus</i> ...	22%
<i>Trachypogon spicatus</i>	44%	<i>Gerbera plantaginea</i> ...	22%
<i>Digitaria tricholaela</i>	44%	<i>Vernonia oligocephala</i>	22%
<i>Eragrostis curvula</i> ...	44%	<i>Commelina africana</i> ...	22%
<i>Hermannia lancifolia</i> ...	44%	<i>Becium obovatum</i> ...	22%
<i>Bulbostylis burchellii</i> ...	44%	<i>Senecio affinis</i>	22%
<i>Diheteropogon filifolius</i>	33%	<i>Nidorella anomala</i> ...	22%
<i>D. amplexans</i>	33%		
<i>Cynodon dactylon</i> ...	33%		
<i>Digitaria monodactyla</i>	33%		

3.2.2 *Trichoneura grandiglumis*—*Hermannia depressa* Grassland Variant

This community probably represents a late seral community in the *Eragrostis chloromelas*—*Trichoneura grandiglumis* Grassland. It is differentiated by the *Polygala amatymbica* species group (Table 4). The canopy cover of the vegetation is from 90–95% and an average of 24 species is recorded per relevé.

Prominent species include (Table 5) *Hyparrhenia hirta* (100%), *Eragrostis chloromelas* (100%), *Cynodon*

dactylon (100%), *Aristida congesta* (100%), *Themeda triandra* (100%), *Heteropogon contortus* (100%), *Eragrostis curvula* (100%) and *E. racemosa* (100%). Other species which occur in both relevés representing this community are:

<i>Hyparrhenia hirta</i> ...	100%	<i>Polygala amatymbica</i>	100%
<i>Eragrostis chloromelas</i>	100%	<i>Rhynchosia totta</i> ...	100%
<i>Cynodon dactylon</i> ...	100%	<i>Hermannia depressa</i> ...	100%
<i>Heteropogon contortus</i>	100%	<i>Sida dregei</i>	100%
<i>Eragrostis racemosa</i> ...	100%	<i>Hypoxis rigidula</i> ...	100%
<i>Stoebe vulgaris</i>	100%	<i>Trichoneura grandiglumis</i>	100%
<i>Eragrostis curvula</i> ...	100%	<i>Helichrysum rugulosum</i>	100%
<i>Themeda triandra</i> ...	100%		
<i>Aristida congesta</i> ...	100%		

3.3 *Lopholaena coriifolia*—*Aristida transvaalensis*—*Sporobolus pectinatus* Grassland

This community is restricted to rocky outcrops in *Eragrostis racemosa*—*Digitaria monodactyla* Grassland. The very shallow sandy loam soil is restricted to cracks and hollow places between rocks (Fig. 10).

The vegetation represents a seasonal orthophyll meadow (short grass) (1M2/1), but short stunted shrubs of *Lopholaena coriifolia* (88%), *Rhus magalis-montana* (75%), *Elephantorrhiza elephantina* (50%), *Stoebe vulgaris* (50%) and *Indigofera comosa* (50%) are found scattered about. *Aristida transvaalensis* (88%), *Loudetia simplex* (88%), *Eragrostis racemosa* (88%), *Heteropogon contortus* (63%) and *Digitaria monodactyla* (50%) are conspicuous grasses (Table 5). Other species present include:

<i>Senecio venosus</i>	88%	<i>Tephrosia longipes</i> ...	50%
<i>Sporobolus pectinatus</i>	75%	<i>Cyperus rupestris</i> ...	50%
<i>Bulbostylis burchellii</i> ...	75%	<i>Digitaria monodactyla</i>	50%
<i>Cyanotis speciosa</i> ...	75%	<i>Selaginella dregei</i> ...	38%
<i>Heteropogon contortus</i>	63%	<i>Helichrysum chionosphaerum</i>	38%
<i>Themeda triandra</i> ...	63%	<i>Ursinia nana</i> subsp. leptophylla.....	38%
<i>Brachiaria serrata</i> ...	63%	<i>Tristachya rehmannii</i> ...	38%
<i>Rhynchelytrum setifolium</i>	63%	<i>Aristida junciformis</i> ...	38%
<i>Vernonia monocephala</i>	63%	<i>Indigofera hilaris</i> ...	38%

3.4 *Eragrostis curvula*—*Hermannia lancifolia* Grassland

This trampled seasonal orthophyll meadow (short grass) (1M2/1) and seasonal orthophyll tall grass



FIG. 10.—Rocky outcrops, the habitat of the *Lopholaena coriifolia*—*Aristida transvaalensis*—*Sporobolus pectinatus* Grassland.

(1L2/1) are found at an altitude of 1 650–1 750 m on the plateaux, on sandy loam to sandy clay loam soils.

An average of 18 species is recorded per relevé and the canopy cover of the vegetation is from 40–90%.

It seems as if this grassland does not include differential species, but is nevertheless differentiated from the other *Eragrostis raemosa*—*Digitaria monodactyla* Grassland Communities by a negative association with the *Indigofera comosa*, *Eragrostis chloromelas*, *Panicum natalense*, *Polygala amatymbica* and *Lopholaena coriifolia* species groups (Table 4). Another feature of this community is the fairly constant presence of *Hermannia lancifolia* (78%), *Acalypha punctata* (67%), *Elephantorrhiza elephantina* (67%) and *Digitaria monodactyla* (67%). *Eragrostis curvula* (88%) occurs fairly constantly with high cover-abundance values, while *E. racemosa* (67%), *Heteropogon contortus* (67%), *Themeda triandra* (56%) and *Elionurus argenteus* (44%) are locally also prominent species (Table 5). Other species include:

<i>Brachiaria serrata</i> ...	89%	<i>Digitaria tricholae-</i>	
<i>Stoebe vulgaris</i>	56%	<i>noides</i>	22%
<i>Indigofera hilaris</i>	56%	<i>Diheteropogon am-</i>	
<i>Clerodendrum triph-</i>		<i>plectens</i>	22%
<i>hyllum</i>	44%	<i>Scabiosa columbaria</i>	22%
<i>Diheteropogon filifo-</i>		<i>Vernonia oligoceph-</i>	
<i>lius</i>	44%	<i>ala</i>	22%
<i>Cyanotis speciosa</i> ...	44%	<i>Aristida junciformis</i>	22%
<i>Helichrysum micon-</i>		<i>Loudetia simplex</i> ...	22%
<i>iaefolium</i>	44%	<i>Monocymbium cere-</i>	
<i>Bulbostylis burchellii</i>	33%	<i>siiforme</i>	22%
<i>Ledebouria marginata</i>	33%	<i>Hypoxis rooperi</i> ...	22%
<i>Pentanisia angustifolia</i>	33%	<i>Cyperus obtusiflorus</i>	22%
<i>Chaetacanthus burchellii</i>	33%	<i>Commelina africana</i>	22%
<i>Hypoxis rigidula</i> ...	33%	<i>Alectra sessiliflora</i> ...	22%
<i>Tristachya rehmannii</i>	33%	<i>Sphenostylis angustifolius</i>	22%
<i>T. hispida</i>	33%	<i>Hyparrhenia hirta</i> ...	22%
<i>Trachypogon spicatus</i>	33%	<i>Cynodon dactylon</i> ...	22%
		<i>Polygala rehmannii</i> ...	22%
		<i>Solanum panduraeforme</i>	22%

DISCUSSION AND CONCLUSIONS

Adequate sampling of the variety of vegetation types represented in the study area was obtained by the use of stratified random sampling, the strata used

being the different physiographic-physiognomic units distinguished on aerial photographs.

The final plant communities distinguished coincide to a large extent with the previously determined physiographic-physiognomic units.

The polythetic nature of the Braun-Blanquet method provides a very natural classification of vegetation into units which are separable on the basis of presence and absence of groups of associated species related to specific sets of environmental factors. This results in good species-cum-habitat units, and thus into ecosystems that are definitely different.

The habitat conditions, which are strongly associated with differences in vegetation, are mainly altitude, aspect and rockiness of the soil surface, but slope, soil depth and soil texture are also of considerable importance.

The Braun-Blanquet tables can be a great help to management planners. From these tables the following information can be extracted:

- the main habitat features,
- the total floristic component,
- the cover-abundance of all species present in the relevés,
- the differentiating species of each community,
- the distribution of species over the communities, and
- the habitat preferences of some of the species.

Furthermore, the method facilitates the grouping of closely related communities into larger units, which may be of great practical value in a management programme. Another advantage of this method is that without much extra effort an unrestricted amount of new relevé data can be added and compared with the existing data. In this way it is possible to determine true differentiating species (character species) of different communities over a wide area, which could result in a hierarchical classification of the vegetation of the area (Werger, 1973).

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UITTREKSEL

Die plantegroei van die Witwatersrandstelsel van die Suikerbosrandnatuurreseervaat wat in die Bankenveld geleë is, is volgens die Braun-Blanquet tabel-metode geklassifiseer en ge-analiseer. Beskrywings van die plantgemeenskappe sluit habitateienskappe, totale floristiese samestelling, differensiërende spesiegroepe asook prominente en opvallende spesies in die boom- struik- en kruidstratums, in. Habitat-eienskappe wat met verskille in die plantegroei geassosieer is, is hoofsaaklik hoogte bo seespieël, aspek en klipperigheid van grondoppervlak, maar gronddiepte, grondtekstuur en helling is ook besonder belangrik. Natuurlike gemeenskappe wat definitiewe verskillende ekosisteme verteenwoordig is die resultaat van die klassifikasie.

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