THE PLANT ECOLOGY OF THE FARM GROOTHOEK, THABAZIMBI DISTRICT

by

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Co-supervisor: PROF. DR. G.K. THERON

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Reproduction of "Kransberg"

by Amie Grobler (1980)

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ABSTRACT

The purpose of this study was to classify the vegetation of the farm Groothoek, Thabazimbi district and to establish procedural guidelines for the application of the veld condition assessment technique (Foran, Tainton and Booysen, 1978) in Acocks's (1975) Sour Bushveld.

The vegetation was classified into eighteen communities, by means of the Braun-Blanquet method using the Domin-Krajina cover-abundance scale, under five main vegetation types which follow temperature/ moisture and soil depth gradients according to a detrended correspondence analysis (DCA) ordination of communities. Layer diagrams are used to illustrate community structure.

Suggestions for the application of the veld condition assessment in respect of grazing potential in bushveld vegetation include the use of the quadrat method with the Domin-Krajina cover-abundance scale for estimating canopy cover.

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DIE PLANTEKOLOGIE VAN DIE PLAAS GROOTHOEK, THABAZIMBI-DISTRIK

deur

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SAMEVATTING

Die doel van hierdie ondersoek was om die plantegroei van die plaas Groothoek, Thabazimbi-distrik te klassifiseer en om riglyne vir die toepassing van die veldtoestandsbepaling (Foran, Tainton en Booysen, 1978) in Acocks (1975) se Suur Bosveld vas te stel.

Die plantegroei is in vyf hoof plantegroeitipes en agtien plantgemeenskappe volgens die Braun-Blanquet metode, waarin die Domin-Krajina bedekking-getalsterkteskaal gebruik is, geklassifiseer. Volgens 'n neigingsverwydering ooreenstemmingsanalise (DCA) volg die gemeenskappe 'n temperatuur/vogtigheid en gronddiepte gradiënt. Laagdiagramme is gebruik om gemeenskapstruktuur uit te beeld.

Voorstelle vir die toepassing van die veldtoestandsbepaling met betrekking tot weidingspotensiaal, in bosveldplantegroei, sluit die gebruik van die kwadraatmetode tesame met die gebruik van die Domin-Krajina bedekking-getalsterkteskaal, vir die skatting van kruinbedekking in.

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(Tables 5.2 and 5.3 are in the back pocket)

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1. INTRODUCTION

According to Edwards (1972), 73,9 percent of the area of South Africa is covered by natural pastures, an area for which an adequate natural plant cover must be maintained for the livestock industry and for the maintenance of soil and water resources. For agriculture and land use a vegetation or ecosystem classification is a necessity for its predictive value, from the ordering of the various concrete examples of ecological systems with similar ecological properties, into abstract classificatory units (Edwards, 1972). Vegetation classification together with soil and other resource surveys, should provide the primary classification of ecosystems needed for the planned use of resources (Edwards, 1972). The classification of vegetation is required for the resources inventory of the Department of Agriculture and Fisheries to provide basic information on the vegetation for agricultural and environmental planning and management. A classification also serves as a reference for more detailed research work. A map of the vegetation units classified in this study forms a part of the classification. Habitat factors recorded at each sample site also form part of the classification and allow correlation between vegetation and environment, which should provide an understanding of vegetation-environmental relationships. The classification will, furthermore, facilitate later extrapolation and interpolation of data for the Waterberg area where similar vegetation units occur.

Vegetation can be classified by various characteristics. Some of the best known systems for classifying vegetation, according to Mueller-Dombois and Ellenberg (1974), are:

i physiognomic classifications;
ii environmentally orientated classifications;
iii physiognomic-ecological classifications;
iv areal-geographic-floristic classifications;
v dynamic-floristic classifications; and
vi floristic classifications.

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According to Westhoff and van der Maarel (1973) plant communities are types of vegetation recognized by their floristic composition and the full species composition of communities express their relationship to one another and to the environment better than any other characteristic.

Floristic data are, furthermore, regarded as one of the important types of information about vegetation (Braun-Blanquet, 1951; Fosberg, 1967; Werger, 1977). The Braun-Blanquet method of vegetation classification (Westhoff and van der Maarel, 1973; Mueller-Dombois and Ellenberg, 1974; Werger, 1974) which is a floristic classification, is used by the Botanical Research Institute, Private Bag X101, Pretoria, 0001, as a standard method for vegetation classification in South Africa. The Braun-Blanquet method is accordingly used in this study together with the Domin-Krajina cover-abundance scale (Mueller-Dombois and Ellenberg, 1974) for estimating cover-abundance, which is a more detailed scale than the Braun-Blanquet scale.

Ordination of vegetation will show any discontinuities present in vegetation and hence the need for classification (Whittaker, 1978). Ordination, furthermore, aids in the classification by indicating environmental gradients (van der Maarel, 1980). The communities described in this study were ordinated to indicate the main environmental gradients influencing the vegetation.

The condition of vegetation with respect to grazing is of considerable importance to livestock farmers who use natural pastures for livestock grazing. A classification of vegetation and description of plant communities should, therefore, take the condition of the vegetation with respect to grazing into account because almost three quarters of South Africa is covered by natural pastures (Edwards, 1972) and the grazing practices employed by farmers can affect the vegetation considerably. Foran, Tainton and Booysen (1978) have described a method, used in Natal for assessing veld condition, by determining if the vegetation is underutilized or overutilized by livestock or factors such as fire, and whether the vegetation is in a good condition with respect to grazing or whether the vegetation is

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selectively grazed. This method has, however, only been applied to the grasslands of Natal and not, prior to this study, to the bushveld of the Transvaal.

A veld type is defined by Acocks (1975) as "a unit of vegetation whose range is small enough to permit the whole of it to have the same farming potentialities".

The study area is mapped as Sour Bushveld (Acocks 1975) with the exception of a remnant of North-Eastern Mountain Sourveld (Acocks, 1975) occurring on the Kransberg massif. The borders of this remnant mapped at 1: 1 500 000 scale are, however, difficult to establish. The Sour Bushveld is a veld type described by Acocks (1975) as "the veld of the bushveld mountains. The Waterberg having the biggest area of it. It is an open savanna of tall straight *Faurea saligna* trees in a tall, tufted, wiry sour grassveld in the less rocky parts, a dense, mixed bushveld in the rugged parts". Booysen (1967) defines sourveld as a "veld in which the grazeable plants become unpalatable on reaching maturity or in which different plants retain their palatability after maturity or in which different plants are palatable at different times of the year so that the veld can be utilized by stock at all times of the year". The term Sour Bushveld (Acocks, 1975) is used in the sense of palatability to grazing stock and although the term is relative because a species may be both palatable and unpalatable depending on the locality and age of the plant, it is used extensively in pasture science. Furthermore, where veld consists only of unpalatable species grazing can, nevertheless, still take place. Sourveld tends to appear in wetter, cooler regions at higher altitudes than sweetveld which tends to appear in drier, warmer, lowerlying areas (van der Meulen, 1979).

Acock's (1975) veld types, of which the Sour Bushveld is an example, furnish useful information at the scale of broad landscape types. However, in present regional planning attention becomes focussed on sections of these landscapes and the veld types prove to be insufficiently detailed units to serve as a basis (van der Meulen and Scheepers, 1978). Because Sour Bushveld (Acocks, 1975) is only used

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for grazing part of the year, cattle farming is more productive in surrounding areas where Acocks's (1975) Mixed Bushveld and Sourish Mixed Bushveld occurs. The area has consequently received little attention in the study of its farming potential in the past.

It is expected that in the future parts of the western Transvaal Bushveld will accommodate an overflow of activities from the nearby Pretoria-Witwatersrand-Vereeniging complex, one of the Republic of South Africa's most densely populated industrial areas, because of the development of the Bronkhorstspruit-Pretoria-Rustenburg industrial axis (Department of Planning and the Environment, 1975). This overflow of activities will probably have an influence on the vegetation of the Sour Bushveld (Acocks, 1975) of the Transvaal Waterberg because the industrial development will be accompanied by an increase in population. A population increase in the Pretoria-Rustenburg area, which is less than 200 km from the Waterberg, can be expected to lead to an increased number of visitors to the Waterberg area with consequent increased environmental degradation.

Understanding the ecology and potential of Sour Bushveld (Acocks, 1975) is now becoming imperative. The primary aim of this study is to classify the vegetation of a part of Acocks's (1975) Sour Bushveld in the Waterberg of the Transvaal. The purpose of the classification can best be described by Greig-Smith's (1980) summary of the aims of classification, which are:

i to form a basis for inventory and mapping, either as an objective in itself, or as a basis of management;
ii classification may aim to identify "real" entities with clear discontinuities between them; and
iii classification may be a tool in the exploration of correlations between vegetation and environment.

The secondary aim of this study is to obtain a basis for comparison of Foran, Tainton and Booysen's (1978) technique of veld condition assessment, with the quadrat method used in this study and to establish

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procedural guidelines for the application of veld condition assessments in Sour Bushveld (Acocks, 1975) vegetation. A preliminary list of Increaser and Decreaser species, used for the veld condition assessment, will provide a better understanding of the ecology and behaviour of individual species recorded in each classification unit and will serve an important basis in veld use and management.

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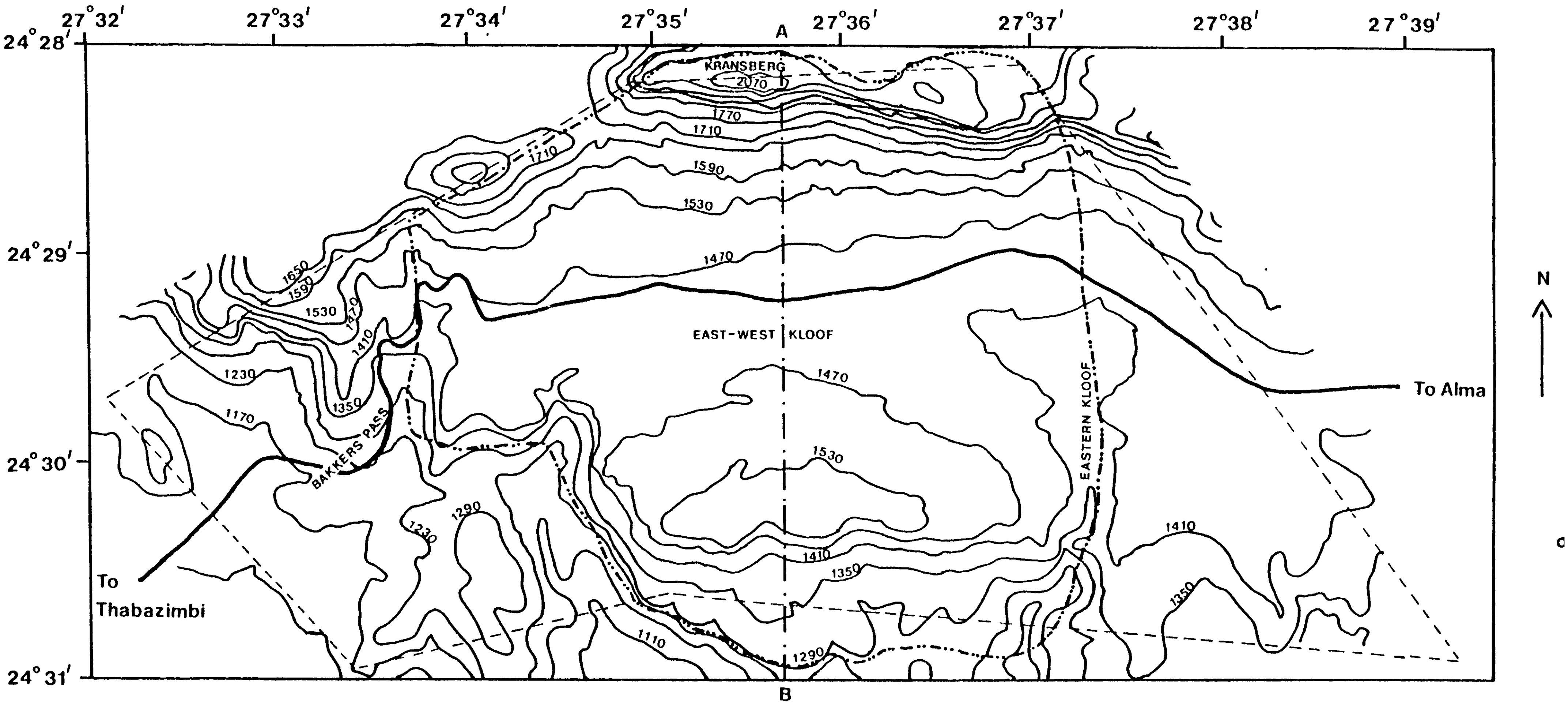

IG. 2.1 Topographic map of the farm Groothoek, Thabazimbi district.   Contour Interval 60 m   Scale 1:50 000

EGEND

- - - -	Boundary of the original farm Groothoek
—··—	Boundary of area sampled
━━	Road
—·—	Profile line of study area (FIG. 2.2)

Drawn from 1:50 000 S.A. TOPO SERIES
2427 BC Kransberg & 2427 DA Sandriviersspoort

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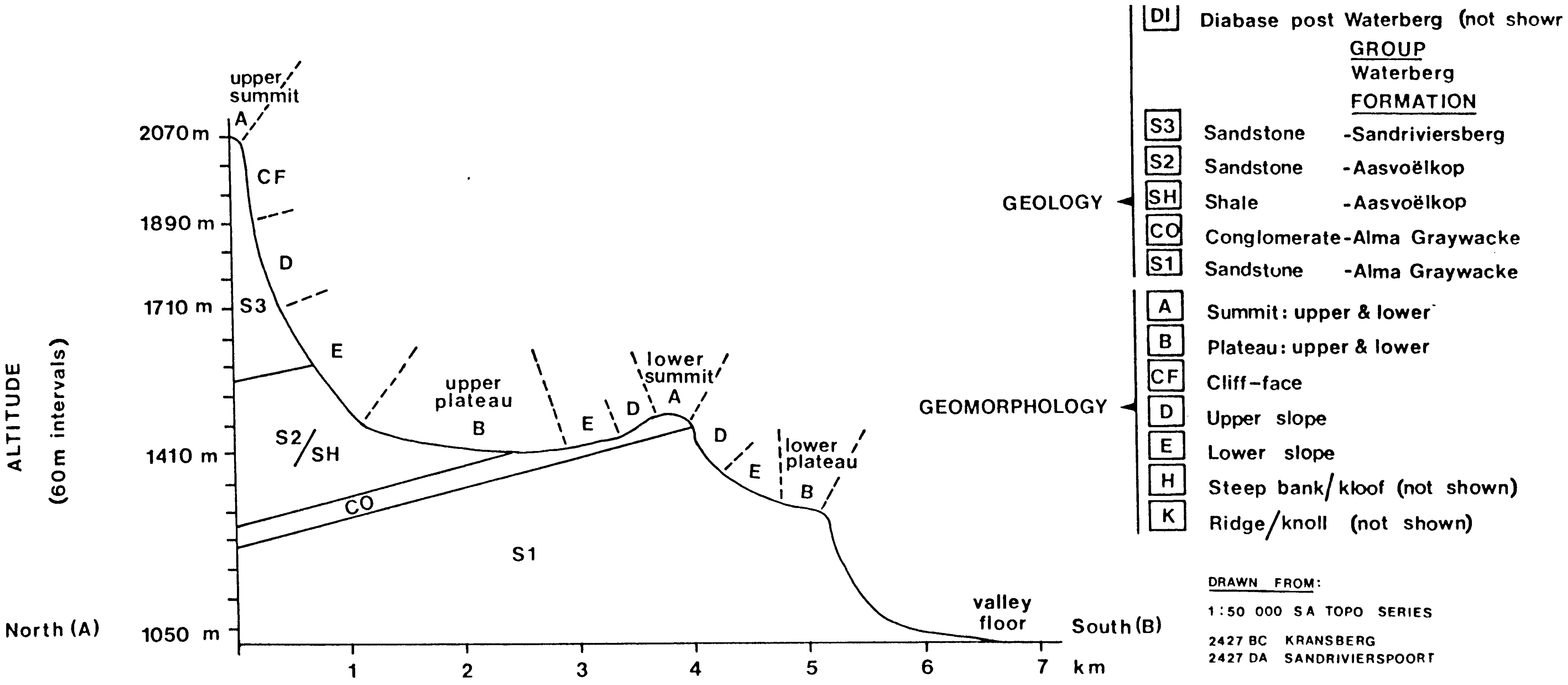

DRAWN FROM:

1:50 000 SA TOPO SERIES

2427 BC KRANSBERG
2427 DA SANDRIVIERSPOORT

1:250 000 SA GEOLOGICAL SERIES

2426 THABAZIMBI

FIG.2.2 North - South profile of the farm Groothoek, Thabazimbi district

Horizontal Scale: 1:50 000 Vertical Scale: 1:12 000

2. THE STUDY AREA

2.1 LOCALITY

The study area consists of parts of the farm Groothoek 278 KQ situated in the south-western Transvaal Waterberg between southern latitudes 24° 28' and 24° 31' and eastern longitudes 27° 32' and 27° 39'. The original farm Groothoek, which has subsequently been subdivided into a number of smaller farms, covers approximately 4 000 ha. The boundaries of the original farm Groothoek, are arbitrary and are not formed by physiographic features (Fig. 2.1). The boundaries of the area surveyed were, for convenience, taken from physiographic features (Fig. 2.1). The northern boundary is formed by the summit and plateau of Kransberg; the southern boundary by the edge of a sloping plateau at about 1 300 m altitude; the eastern boundary by a kloof incised by a stream that starts on the summit of Kransberg and flows roughly due south; and the western boundary is formed by the upper reaches of the western escarpment. The upper summit (Fig. 2.2) is taken to include the plateau on top of Kransberg, while the upper plateau refers to the plateau at about 1 400 m (Fig. 2.2). Bakker's pass allows vehicular access to the upper plateau. Thabazimbi, noted for the mining of iron ore in the banded ironstone of the Pretoria series, is the nearest town 20 km to the south west of the study area.

2.2 PHYSIOGRAPHY

2.2.1 Topography

Three main topographic features, in a north-south profile can be recognized in the study area (Fig. 2.2):

i The Kransberg massif, with the summit at 2 100 m altitude forming the northern boundary, with sheer cliffs of up to 150 m and slopes to the south;

ii The upper plateau at approximately 1 400 m altitude is to the south of the Kransberg massif. To the south of the upper plateau is a north facing, gentle slope. The crest of the north facing slope gives way to cliffs and slopes above the lower plateau, further south; and

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iii The lower plateau at 1 300 m altitude is about 300 m above the valley floor. The southern edge of the lower plateau forms the southern boundary of the study area.

The western escarpment which rises from 1 000 m altitude on the valley floor, to 1 400 m altitude on the upper plateau is not shown on the north-south profile (Fig. 2.2), but is discernable from the plan of the farm Groothoek, Thabazimbi district (Fig. 2.1). Bakker's Pass traverses the western escarpment, which is incised by numerous streams, forming kloofs. The slopes and plateaux are also cut by many streams, mostly flowing from north to south, forming kloofs with the eastern kloof most prominent.

2.2.2 Drainage

Two main drainage lines occur in the study area. The one stream flowing from north to south originates on the Kransberg summit and follows the kloof near the eastern border in the study area (Fig. 2.1). The second stream originates in a kloof incised in an east-west direction on the upper plateau (Fig. 2.1). The stream flows to the east for half its course on the upper plateau, where it discharges into the first kloof and for the other half on the upper plateau, flows to the west towards Bakker's Pass. Numerous smaller streams in kloofs on the Kransberg massif flow southwards onto the upper plateau from where they drain into the east-west kloof. None of the streams are, however, perennial. During the rainy period water oozes from the lower slopes, while the watertable on portions of the upper plateau is on or very near the soil surface (Table 5.2). The local inhabitants attribute the naming of the Waterberg to the oozing of water from the soil and from rocky outcrops during the rainy season. In the study area this phenomenon is caused by impermeable shale underlying the porous sandstone (Fig. 2.2).

2.3 GEOLOGY

The revision of the South African stratigraphic classification according to the recommendations of the International Subcommission

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TABLE 2.1 A stratigraphic comparison of rock outcrops of the Mokolian Erathem, Waterberg Group (previously Waterberg system) on the farm Groothoek, Thabazimbi district between the South African Committee for Stratigraphy (SACS, 1980) and the De Vries (1968-1969) classifications

OUTCROP	SYMBOL USED IN THIS STUDY	SACS 1980			DE VRIES 1968-1969		
		SUBGROUP	FORMATION	MEMBER	SERIES	STAGE	SUBSTAGE
Sandstone	S3	Kransberg	Sandriviersberg		Kransberg	Sandriviersberg	
Sandstone Shale	S2 SH	Matlabas	Aasvoëlkop		Nylstroom	Langkloof	Upper Langkloof
				Groothoek Mudstone			
Conglomerate Sandstone	CO S1	Nylstroom	Alma Graywacke			Alma	

Diabase (DI) classified as post-Waterberg diabase, an intrusive of Mokolian age (SACS, 1980) and as post-Waterberg diabase (De Vries, 1968-1969).

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on Stratigraphic Classification was started with the inception of the South African Committee for Stratigraphy (SACS) on 14 June 1971. A new stratigraphic classification for South Africa was published according to these recommendations in 1980 (SACS, 1980). The classification of rocky outcrops in the study area is, therefore, given in terms of the new classification (SACS, 1980) and is compared with the classification of de Vries (1968 - 1969) in Table 2.1.

Sedimentary deposits of the Waterberg Group of the Mokolian Erathem (1 080 - 2 070 Ma *) are found in the study area (Fig. 2.2). The Kransberg massif consists of sandstone of the Kransberg Subgroup, Sandriviersberg Formation (Fig. 2.1). The lower slopes of Kransberg and northern half of the upper plateau consist of sandstone of the Matlabas Subgroup, Aasvoëlkop Formation overlying shale and mudstone of the Matlabas Subgroup, Aasvoëlkop Formation, Groothoek Mudstone Member. Shale outcrops occur where the overlying sandstone has been completely eroded. The gentle, north-facing slopes to the south of the upper plateau consist of conglomerate outcrop of the Nylstroom Subgroup, Alma Graywacke Formation (Table 2.1, Fig. 2.2). The lower plateau and adjacent slopes north of the lower plateau consist of sandstone outcrops of the Nylstroom Subgroup, Alma Graywacke Formation (Table 2.1). It is here where the eastern kloof reaches its greatest depth in cutting through the sandstone. A post-Waterberg diabase dyke of Mokolian age is exposed in Bakker's Pass. During the course of fieldwork pieces of vein quartz with tin ore attached were found in the Aasvoëlkop Formation.

2.4 SOILS

The first soil classifications in South Africa provided good outlines of the general nature of soils at a small scale such as Republic of South Africa - Soils (1962) where the Waterberg area is classified as AcBdJa, with,

- Ac representing rock and rock debris not differentiated;

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* Ma (Mega annum) = 10^6 years.

- Bd representing lithosols and litholic soils with chrystelline basic rock; and
- Ja representing fersiallitic soils with sandy parent material.

In a later soil map, Republic of South Africa - soils (1973), the Waterberg area forms a part of the red-yellow-grey latosol plinthic catena. These systems proved inadequate for detailed studies and management at farm planning scale. A system of soil classification for South Africa was developed by MacVicar, Loxton & Van der Eyk (1965); Van der Eyk, MacVicar & de Villiers (1969); and MacVicar, de Villiers, Loxton, Verster, Lambrechts, Merryweather, Le Roux, van Rooyen & Harmse (1977), to meet these needs. However, no classification, according to this system, has yet been attempted in the study area. A correlation of lithosols with the new soil classification system (MacVicar, et al., 1977) shows that the Mispah soil form should be dominant in the study area. A Mispah soil form is characterized by a generally shallow orthic A horizon overlying hard rock or hardpan (MacVicar, et al., 1977). As the soils at each sample site were classified during the course of this study a soil description of the study area is given in chapter 5.

2.5 CLIMATE

According to Köppens classification (Schulze, 1947) the Waterberg, including the study area, is classified as a Cwa climate, where

- Cw is a warm temperate climate with summer rainfall; and
- a is a January mean temperature, exceeding 22° C.

As no full climatological station has ever been maintained in the area, this is not supported by direct evidence but is based on rainfall statistics and the high probability that the January mean temperature exceeds 22° C (Schulze, 1947).

Rainfall but not temperature records have been kept by the South African Iron and Steel Industrial Corporation Ltd., (ISCOR) at Thabazimbi (0 24° 38' S, 27° 24' E; altitude 945 m) since 1947

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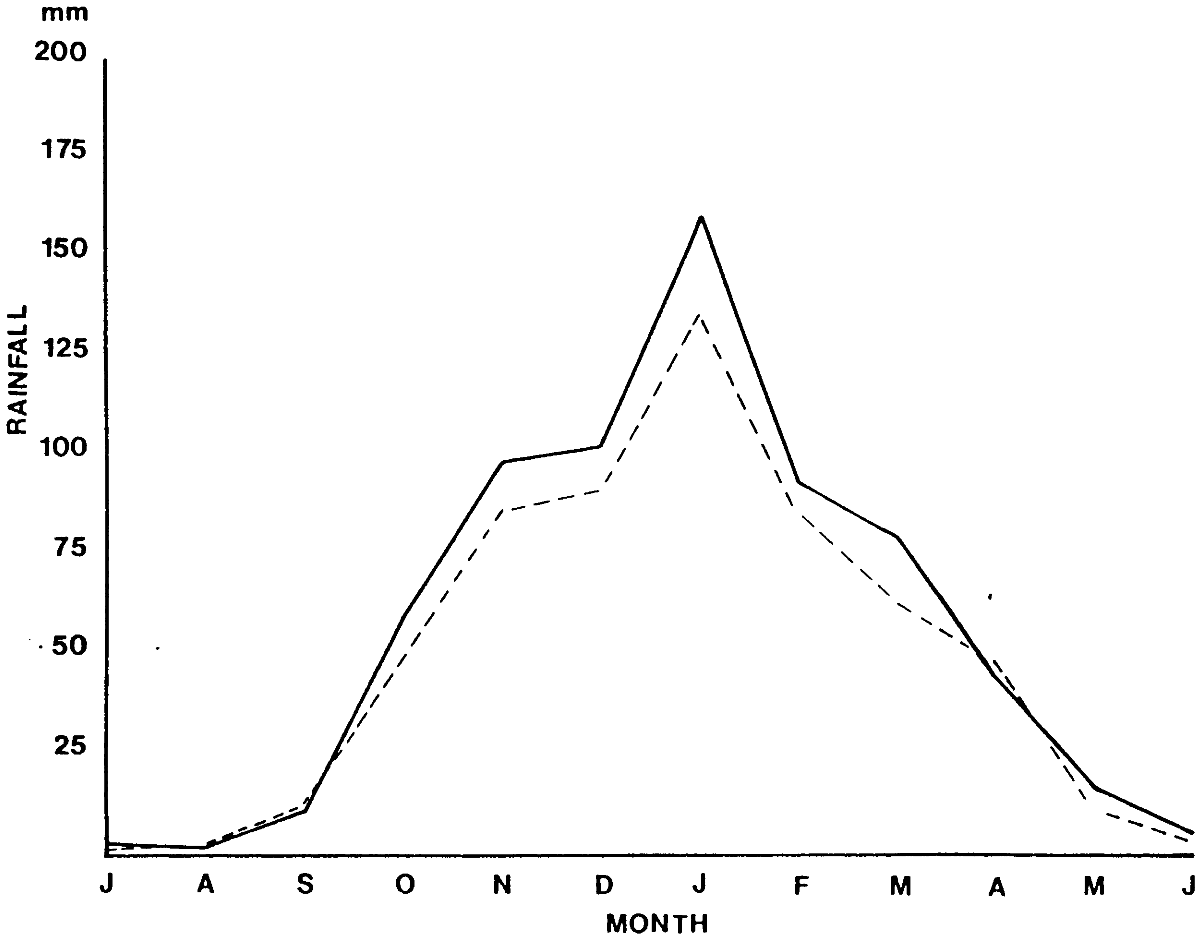

FIG.2.3 Mean monthly rainfall for Thabazimbi and the farm Bergrus in the study area (July 1963 - June 1973)

BERGRUS ———

THABAZIMBI - - - - - -

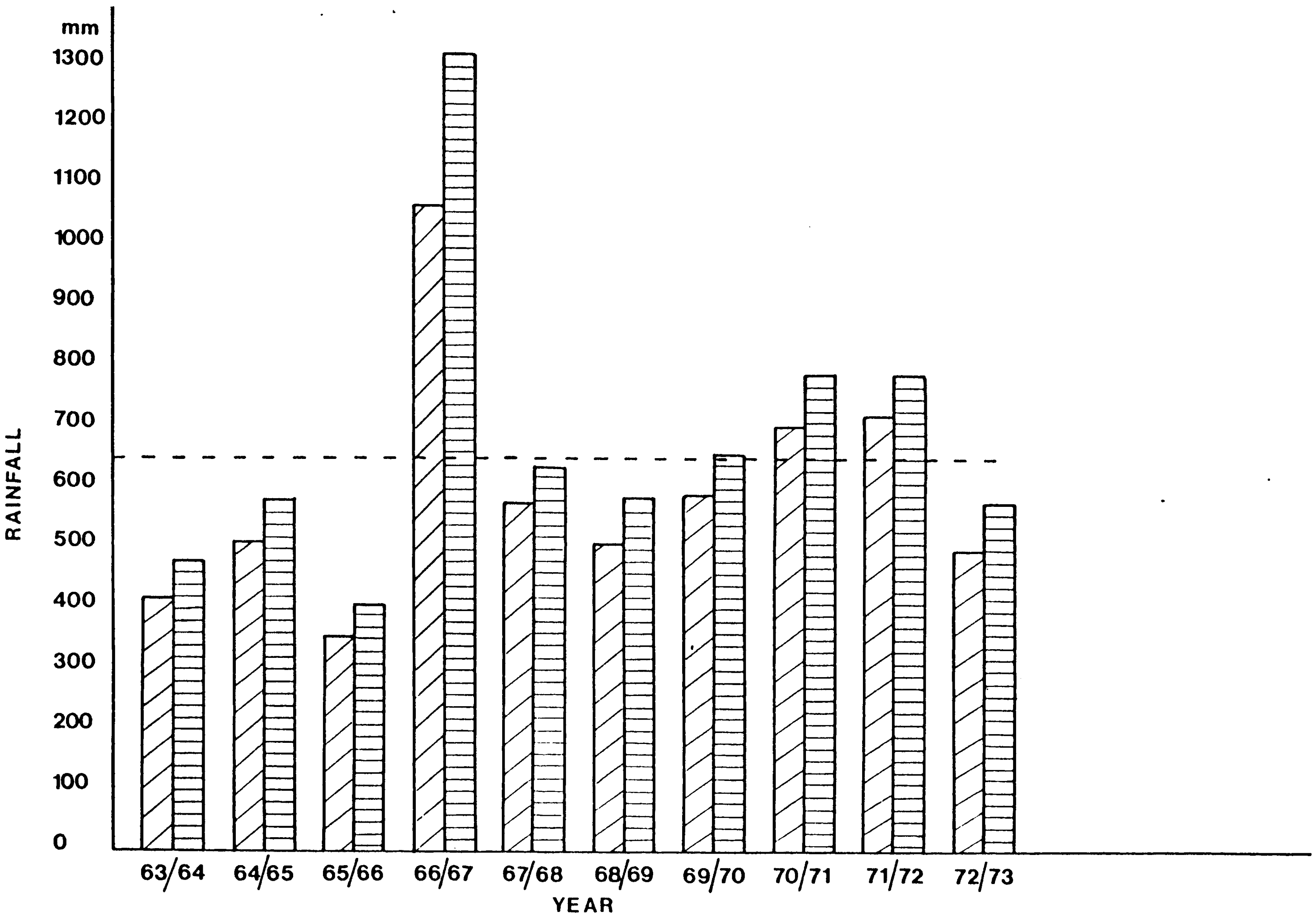

FIG. 2.4 Mean anual rainfall for Thabazimbi and the farm Bergrus in the study area (July 1963)– June 1973 . Dotted line indicates lower limit for Sour Bushveld (Acocks 1975)

BERGRUS ▤
THABAZIMBI ▨

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(Groenewald, * pers. comm.). The late Mr. C.C.A. Groenewald of the farm Bergrus, one of the subdivisions of the original farm Groothoek, kept rainfall records during the period July 1963 to June 1973. The mean monthly rainfall for the last mentioned ten year period for Thabazimbi and Bergrus is illustrated graphically in Fig. 2.3 and the mean annual rainfall for the ten year period is illustrated graphically in Fig. 2.4 The mean annual rainfall for Thabazimbi is 594 mm per annum and for Bergrus 680 mm per annum for this period. Both figures show Bergrus to have an almost consistently higher rainfall for the period than that recorded for Thabazimbi.

Acocks (1975) describes Sour Bushveld as having a rainfall range of 650 mm to 900 mm per annum. Although the mean annual rainfall for the ten year period at Thabazimbi, which is mapped on the border of Acocks's (1975) Sour Bushveld and Sourish Mixed Bushveld, is less than this range, the mean annual rainfall at Bergrus is within this range. However, both stations recorded six years with a mean annual rainfall of less than 650 mm (Fig. 2.4). This is in accordance with the local view that the period under consideration received less than the average rainfall. On the basis of the rainfall figures only, as no temperature data exists for the study area and immediate vicinity, Schultze's (1947) classification of Cwa for the Waterberg, is valid for the study area.

However, a variation in topography, such as found in the study area (Fig. 2.2) can cause considerable variation in the microclimate (Geiger, 1966), the upper reaches of the Kransberg massif, for example, being frequently subjected to mist.

2.6 BIOTIC FACTORS

The role of fire as a major factor in southern African ecology has long been recognized and research in this field has an extended history in South Africa (Schirge and Penderis, 1978). Fire is widely used in agricultural practice to stimulate out of season growth by burning grass in winter or autumn (Tainton, 1978). This use of fire

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* The late Mr. C.C.A. Groenewald, farm Bergrus, Thabazimbi, formerly Manager, South African Iron and Steel Industrial Corporation Ltd., Thabazimbi. 0380

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is not recommended because the recovery growth is usually subjected to heavy grazing with harmful effects on the grass composition and cover (Tainton, 1978). Burning is, however, useful for removing old grass to prevent the new growth from becoming moribund in sourveld as well as preventing bush encroachment in thornveld (Scott, 1972). Under grazing conditions there should be no need to burn in sweet=veld except to control seedlings of encroaching undesirable plants (Scott, 1966). Spring burning is generally recommended provided it is applied before active spring growth of grass (Tainton, 1978).

Burning in the south-western Waterberg area is generally not recom=mended (du Plooy, pers. comm.*) mainly because of the effects of stimulating out of season growth. The local farmers agree that pre=vious burning practices out of season were detrimental to the veld. It would appear that a uniform burning policy in sourveld and sweet=veld is also easier to apply as a large proportion of the farms in the south-western Waterberg area are in sweeter veld where burning is not essential (Scott, 1966), but this practice could be detri=mental to the sourveld areas.

Agriculture and veld grazing by livestock were and still are the main land use practices in savanna woodland (van der Meulen, 1979). The farms in the study area all have cattle. Some farmers use the sweeter veld, in the valley region outside the study area, for cattle grazing in winter while others use the sourveld of the study area, for cattle grazing throughout the year, to the detriment of the cattle's condi=tion.

Peaches are cultivated successfully on several farms on the upper pla=teau where the soils are deeper. A regrettable feature of the farming practice in the study area is the lack of fulltime farmers, as most of the farmers work in Thabazimbi. This leads to doubt about the econo=mic viability of the farms.

The seasonally high watertable on portions of the upper plateau causes

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* G.J. du Plooy, Extension Officer, Dept. Agriculture and Fisheries.
2nd Ave., Thabazimbi, 0380

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Fig. 2.5 Some of the remains of an extensive system of kraals on the southern slopes of Kransberg, as evidence of previous black inhabitants

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water to lie near or on the soil surface during the rainy period. Several farms in the study area have blue-gum trees (*Eucalyptus* sp.) planted on the upper plateau. These were originally planted in order to drain the soil (Groenewald, pers. comm.*) but with little success. The farm Bergrus, in the study area, has an orchard of *Opuntia* sp. cultivated for fruit. Only isolated escape plants have been observed in the study area but the potential for increasing encroachment of this species exists. These two species are the only aliens observed in the study area which pose a potential threat.

Stoebe vulgaris occurs on the upper plateau and dominates large portions of the grassland. This is detrimental to the grazing potential of the grassland in the study area as it is not utilized by stock. Scott (1979) has found much *Stoebe* sp. fossil pollen in the vicinity of the Waterberg dating between minumum periods of 11 000 and 9 500 years B.P.** *Stoebe vulgaris* can, therefore, not be regarded as an alien in the study area but according to Roux.(1969) will increase in abundance when the veld is selectively grazed.

The remains of an extensive system of kraals (Fig. 2.5) on the southern slopes of Kransberg, above the upper plateau and below the current tree-line, is the only evidence of previous black inhabitants. The tree-line must have moved upslope since the building of the kraals as it is unlikely that they were erected in the midst of trees. The high-lying position of the kraals may be attributed to the occurrence of malaria which was endemic in the low-lying parts (Küstner, 1980). According to local opinion there has been little influence by black populations on the vegetation of the study area, since the kraals were abandoned. The current absence of black populations is possibly as a result of poor winter grazing and previous endemic malaria.

The Kransberg massif is often frequented by mountain climbers, who consider it to be amongst the best of rock climbing facilities in the Transvaal. Visitors are also attracted by the spectacular view from the summit of Kransberg. The local farmers attribute the disappearance of the tree fern, *Alsophila dregei*, from the upper reaches of the eastern kloof, which allows access to the Kransberg summit, to visitors to the area.

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* The late Mr. C.C.A. Groenewald, farm Bergrus, Thabazimbi, 0380.

** B.P. - Before Present.

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3. REVIEW OF PREVIOUS VEGETATION RESEARCH RELATED TO SOUR BUSHVELD

Scientific interest in the vegetation of South Africa originated during the beginning of the colonial era. Showy plants and plants of medicinal and nutritional value first attracted the attention of researchers. *Protea neriifolia*, one of the first plants described and illustrated from the Cape, was published by Clussius in 1605 (Werger, 1978).

Interest in the geographic distribution of plants, in South Africa and world-wide, developed during the nineteenth century because of the descriptions of travellers such as Lichtenstein (1811;1812) and Burchell (1822; 1824) who described the interior of southern Africa (Werger, 1978). The Transvaal Waterberg formed part of the *Regnum Mesembryanthemorum et Stapeliarum*, one of the 22 world-wide floristic kingdoms, described by Schouw (1823). This kingdom covered the whole of extra-tropical southern Africa. In subsequent phytogeographic divisions of southern Africa the Transvaal Waterberg was placed in the Kalahari Region (Grisebach, 1872), Highveld Region (Rehmann, 1880), Palaeotropic Dry Region (Engler, 1882), Kalahari Region (Bolus, 1886; 1905) and the Highveld Region (Marloth, 1908). These early botanists based their delimitations of phytogeographic regions on observation and experience. Their accounts were, therefore, purely descriptive.

During the first two decades of the twentieth century botanists such as S. Schonland, R. Marloth, E.P. Phillips, J. Burtt-Davy and J.W. Bews published checklists of plant species and ecological notes on various areas in South Africa (Schonland 1922). Bews who worked mainly in Natal also studied the succession of plants in South Africa (Bews, 1916) and described the grasslands of South Africa in 1918. The Transvaal formed part of the Eastern Grassland Region (Bews, 1918). As a member of the Advisory Committee of the Botanical Survey of South Africa, Bews (1922) suggested guidelines for future surveys. Codes were proposed for habitat factors and plant physiognomy. Checklists were recommended and plant succession was emphasized. The influence of Bews (1916) and Clements (1916) with special reference to succession, henceforth played an important role in vegetation surveys in South Africa for the next four decades.

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Pole Evans (1922) in his first account of the vegetation of South Africa described the Transvaal Waterberg as part of the Kalahari Park and Bush Province, one of the four physiognomic regions of South Africa, excluding the Cape Region. The vegetation is described as "trees, scattered bush and grass". In a later classification of the vegetation of South Africa, Pole Evans (1936) describes the Waterberg area as the Evergreen and Deciduous Tree and Bush variation of Park=land with species such as *Faurea saligna* and *Burkea africana* dominant.

According to Adamson (1938) the Waterberg area is included in the Small Tree Savanna variation of the Bush Veld Savanna where genera such as *Faurea, Combretum, Burkea* and *Terminalia* are to be found.

Vegetation surveys, with the purpose of improving agriculture in South Africa, subsequently played a greater role. Irvine (1941) classified the vegetation of the northern Transvaal into veld types, based on grazing potential. According to Irvine (1941) two veld types are found in the study area namely: Firstly, the *Faurea saligna* veld variation of Sourveld with grasses that are only palatable during the growing season and woody species, such as *Faurea saligna, Dombeya rotundifolia, Lannea discolor* and *Vangueria infausta* dominant on the south facing slopes, and secondly, the *Terminalia sericea* veld and *Combretum apiculatum* veld variations with a mixture of sour and sweeter grasses and woody species such as *Terminalia sericea, Combretum apiculatum, Ochna pulchra* and *Burkea africana* dominant on gentle north-facing slopes.

Acocks (1953; 1975) classified the vegetation of South Africa into 70 veld types. This was a considerable improvement on previous veg=etation surveys of South Africa and laid the basis for more inten=sive surveys in the future.

Acocks (1975) relied largely on Irvine's (1941) data for the classifi=cation of Sour Bushveld (Veld Type 20). This veld type covers the Waterberg area with the exception of isolated high-lying areas, such as the Kransberg massif, where remnants of North-Eastern Mountain Sourveld (Veld Type 8) occurs (Acocks, 1975). However, Acocks (1975)

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only describes typical Sour Bushveld with kloof and grassland varia= tions. It is obvious from a reconnaisance of the Waterberg that the area mapped by Acocks (1975) as Sour Bushveld includes Mixed Bushveld (Veld Type 18) and Sourish Mixed Bushveld (Veld Type 19) in the exten= sive valley regions. It is, however, not practical to map these dif= ferences at the scale used by Acocks (1975) although the veld manage= ment practices differ considerably.

Plant ecological work on the Magaliesberg, including a strip of Acocks's (1975) Sour Bushveld, was done by Collet (1956), van Vuuren (1961), van Vuuren & van der Schijff (1979) and Coetzee (1975). Differences in topography and methodology preclude extrapolation of these data to the Waterberg area, where the greatest area of this veld type is to be found.

As previously mentioned, Acocks's (1975) Mixed Bushveld (veld type 18) and Sourish Mixed Bushveld (veld type 19) also occur in the Waterberg area. Cognizance of these two veld types will have to be taken in any study of the Waterberg vegetation. Acocks (1975) describes Mixed Bushveld as a "Daedalian maze of variations and transitions" and Sourish Mixed Bushveld as "occupying an irregular belt on the gentle slopes to the mountains between the sour types (both grassveld and bushveld) and the mixed types of the plains and valleys". Plant eco= logical work in these vegetation types include van der Meulen (1979) who described the vegetation of the western Transvaal Bushveld south of the Waterberg and Theron (1973) who described the vegetation of the Loskopdam Nature Reserve.

Apart form Acocks's (1975) general description of the Waterberg area, based on Irvine's (1941) broad classification of the northern Trans= vaal little is known of the vegetation and ecology of the Sour Bush= veld.

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4. METHODS

The Braun-Blanquet method of analysis and synthesis, based on floristic compositions and canopy cover-abundance, as described by Westhoff and van der Maarel (1973), Mueller-Dombois and Ellenberg (1974) and Werger (1974), together with the Domin-Krajina cover-abundance scale for estimating canopy cover-abundance (Mueller-Dombois and Ellenberg, 1974) was applied in this study to obtain a phytosociological classification of the vegetation. The communities thus classified were subjected to a detrended correspondence analysis (DCA) ordination (Hill and Gauch, 1980) to help confirm discontinuities found in the classification and assist in identifying the main ecological gradients (van der Maarel, 1980).

The condition of the vegetation was assessed by the veld condition assessment technique described by Foran, Tainton and Booysen (1978) using basal cover-abundance estimates in the sample sites selected for the Braun-Blanquet method of analysis.

The alpha and beta diversities for the communities were determined, according to the method described by Whittaker (1972) and Whittaker, Niering and Crisp (1979).

4.1 THE PHYTOSOCIOLOGICAL CLASSIFICATION

4.1.1 Analysis

The reconnaissance of the study area was carried out from October to December 1979 for ground assessment of aerial photograph interpretation and familiarization of the terrain, vegetation and plant species. Unknown plant species were collected and later identified by the National Herbarium, Private Bag X101, Pretoria, 0001. A reconnaissance is regarded as a prerequisite for effective sampling (Mueller-Dombois and Ellenberg, 1974). Sampling of the vegetation began in January 1980 and was completed in May of the same year. Species unknown at the time of sampling were numbered and later identified by the National Herbarium, Private Bag X101, Pretoria, 0001.

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4.1.1.1 Quadrat sampling

4.1.1.1(a) Quadrat location

The quadrat location was determined by means of random sampling. Physiognomic-physiographic units were delineated on aerial photographs of the study area by means of stereoscope viewing. Random co-ordinates (Fisher and Yates, 1949) were used to select each quadrat within the study area. Ecotones and obvious habitat and vegetation heterogeneity were avoided as homogeneous vegetation is 'n prerequisite for quadrat location (Werger, 1977). This method allows for improved quadrat distribution among plant communities that coincide with the physiognomic-physio-graphic units and facilitates mapping of such communities. A further advantage is that the quadrats, being randomly located, provide data that may be subjected to statistical tests (Mueller-Dombois and Ellenberg 1974). The procedure is also easily accommodated within the flexible Braun-Blanquet approach (Coetzee, 1975).

4.1.1.1(b) Quadrat size

Although the smallest sampling unit, commensurate with adequate sampling, should be used to avoid heterogeneity (Edward, pers. comm.*), a standard quadrat size of 10 m x 20 m was used throughout the study area. This size is considered adequate for Bushveld vegetation in the western Transvaal by Coetzee, van der Meulen, Zwanziger, Gonsalves & Weisser (1976) who worked in Acocks's (1975) Mixed Bushveld and van der Meulen (1979) who worked in Acocks's (1975) Mixed Bushveld and Sourish Mixed Bushveld. Coetzee (1975) who worked in Acocks's (1975) Sour Bushveld on the Magaliesberg found a quadrat size of 10 m x 10 m (100 m^2) to be adequate as did Bredenkamp and Theron (1978; 1980) who worked in Acocks's (1975) Bankenveld. Although the Bankenveld is a False Grassland veld type, Sour Bushveld regularly occurs on rocky outcrops and hills (Acocks, 1975). A standard size was also preferred in this study because the application of different quadrat sizes

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*D. Edwards, Botanical Reseach Institute, Private Bag X101,
Pretoria, 0001.

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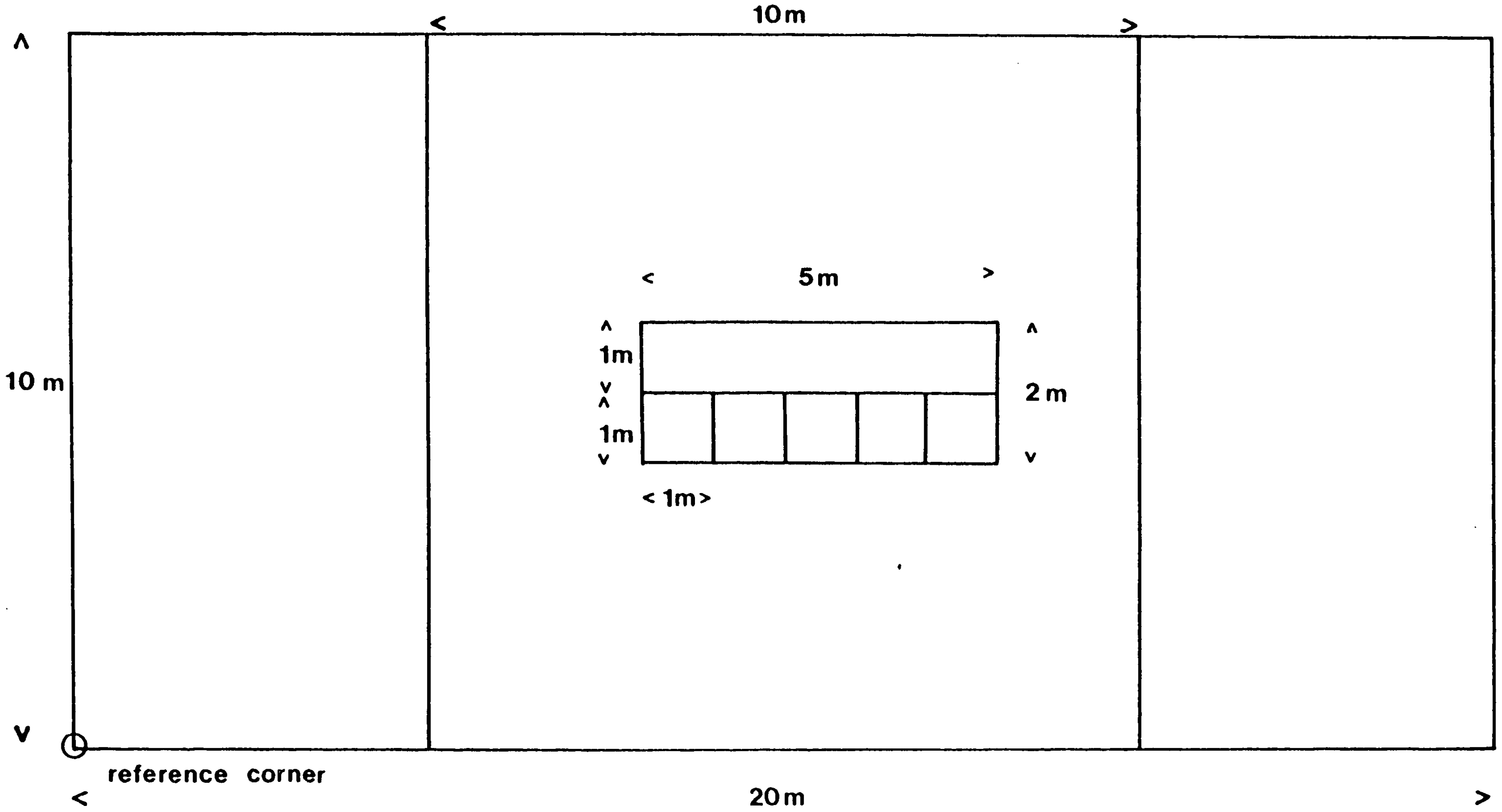

FIG. 4.1 Nested quadrats: 5 x 1m²; 1 x 10m²; 1 x 100m² & 1 x 200m² for species-area determinations

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might affect the results obtained with the veld condition assessment technique (see paragraph 4.2). However, to determine the efficacy of the quadrat size, species were recorded in nested quadrats (Fig. 4.1) within each 200 m^2 quadrat for species-area determinations. Five 1 m x 1 m, one 2 m x 5 m, one 10 m x 10 m and one 10 m x 20 m quadrats were used (Fig 4.1). This also allows a comparison between quadrats of alpha (intra community) and beta (inter community) species diversity (Whittaker, Niering and Crisp, 1979) (see paragraph 4.4).

4.1.1.1.(c) Quadrat number

A total of 170 quadrats were surveyed throughout the study area so that each delineated physiognomic-physiographic unit could contain a mini=mum of ten quadats. This is regarded as the minimum number of relevés required for an original diagnosis of an association or sub-association (Barkman, Moravec and Rauschert 1976). The number of randomly selected sites, however, exceeded 200. This was to facilitate on-site quadrat location where vegetation or habitat heterogeneity, not apparent from aerial photographs, was present. Such a site was then ignored and a quadrat was situated at the following site.

4.1.1.2 Data recorded

Use was made of the field data form, Ec. 2, compiled by the Botanical Research Institute, Private Bag X101, Pretoria, 0001 for field data recording. A form was completed for each quadrat sampled. The com=pleted forms were lodged with the Botanical Research Institute, Private Bag X101, Pretoria, 0001 after completion of the study, for safe-keeping and to ensure permanent access to raw field data.

4.1.1.2(a) Floristic data

Plant species identifiable at the time of sampling were recorded, without collecting voucher specimens. Voucher specimens were collec=ted of doubtful species which were not identifiable at the time of sampling for identification by the National Herbarium, Private Bag X101, Pretoria, 0001 where they were lodged. Species not perma=

TABLE 4.1 A simplified life form code showing life forms and their definitions in different strata

Code	STRATUM* (Edwards, 1976)	Life Form**	Definition
T	Tree	Tree	Any single stemmed woody plant over 2 m high, sometimes with a few definite trunks, seldom including shrubs over 5 m high and thick woody lianas (Edwards, 1976).
S	Shrub	Shrub	Any multi-stemmed low branching woody plant, 1-5 m high with stems from at or near ground level (Edwards, 1976)
DS	Dwarf Shrub	Dwarf shrub	Any woody plant less than 1 m high, usually about 0,5 m high (Edwards, 1976)
SUC	Tree, Shrub or Herb	Succulent	Plants with enlarged tissues that hold water or sugar (Allaby, 1977)
Geo	Herb or grass	Geophyte	Plants in which perennating parts are below ground level (Raunkiaer, 1937)
F		Forb	Herbaceous plant other than a member of the Poaceae or Cyperaceae (Timberlake & van der Poel, 1979)
C		Sedge	Member of the Cyperaceae (Timberlake & van der Poel, 1979)
G		Grass	Member of the Poaceae (Timberlake & van der Poel, 1979)
P		Fern	Member of the Pteridophyta (Allaby, 1977)

*Stratum, a layer of vegetation which represents herbs, shrubs or trees (Jackson, 1971)

**Life form, the characteristic form of a plant species at maturity (Allaby, 1977).

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TABLE 4.2 Percentage cover and class midpoints in terms of canopy or basal diameters apart of species for the Domin-Krajina and Braun-Blanquet cover-abundance scales

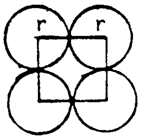
Percentage Cover	Abundance	Percentage Class Midpoint	Diameters Apart*	Domin-Krajina Scale	Braun-Blanquet Scale
91-100	Any number, complete cover	95,50	Overlapping/ Interlocking	0	5
76- 90	Any number	83,00	0,00-0,06	9	
51- 75	Any number	63,00	> 0,06-0,25	8	4
34- 50	Any number	42,00	> 0,25-0,50	7	3
26- 33	Any number	29,50	> 0,50-0,75	6	
11- 25	Any number	18,00	> 0,75-1,75	5	2
6- 10	Any number	7,50	> 1,75-3,00	4	
1- 5	Scattered	2,50	> 3,00-8,00	3	1
0,1- 1	Very scattered Small cover	0,50	> 8,00-27,00	2	
0,1	Seldom, insignificant cover	0,05	> 27,00	1	+
	Solitary insignificant cover	0,00	solitary	+	r

* Percentage cover in terms of diameters apart may be expressed as:

$$C\% = \frac{80}{(n+1)^2}$$

where n = the positive number of diameters apart,*
C = percent cover, and

the value 80 is an approximation of the percentage cover of 78,53975% obtained when circular canopies are just touching and are arranged on a square grid formation, e.g.



Area of square $= 2r \times 2r$

$= 4r^2$ (where r = radius of canopy)

Area covered by canopies within square

$$= \frac{Ti\ r^2 \times 4}{4}$$

% cover $= \frac{\text{crown area}}{\text{square area}} \times 100$

$$= \frac{Ti\ r^2}{4r^2} \times 100$$

$$= \frac{3,14159}{4} \times 100$$

$= 78,53975\%$

(n = 0 when crowns are touching) (Edwards, 1979)

* the value 1 is added to n so that the distance apart may be estimated from canopy to canopy rather than from stem to stem.

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nently recognizable, such as annuals and geophytes, were ignored when they were not identifiable without special effort, such as nursery cultivation. Nursery cultivation was not possible within the time-scale allowed for this study.

4.1.1.2(b) Life Form

A simplified life form code, adapted for this study, is given in Table 4.1 and was recorded next to each plant species recorded. The simplified code was used to cover the main life form types found in the study area, to enable non-professional botanists, to assess trends in veld condition by identifying only grass species (see paragraph 4.2). The majority of forbs and trees are classified as Increaser II species (Appendix II) and the identification of these are not necessary for trend assessments.

4.1.1.2(c) Cover-abundance

The canopy cover-abundance for each species recorded within a quadrat was estimated according to the Domin-Krajina cover-abundance scale (Mueller-Dombois and Ellenberg, 1974). Basal cover was also estimated for each species according to the Domin-Krajina cover-abundance scale for the veld condition assessment (see paragraph 4.2). The Domin-Krajina cover-abundance scale was considered more suitable for the veld condition assessment because of its greater detail (Table 4.2). Estimative errors with the more detailed scale were minimized by estimating percentage cover in terms of the average distance between plant canopies. This distance is expressed as the average number of the average canopy diameters for a species and is given as "canopy diameters apart" in Table 4.2 (Edwards 1979). For example, if the average canopy diameter of a species is x, and the average distance apart of plant canopies of the species is 2x (in terms of the average canopy diameter for the species) then the canopies of the individual plant species are on average two crown diameters apart. In Table 4.2, two canopy diameters apart represents a cover of 6 to 10 percent. This is equivalent to the value 4 on the Domin-Krajina scale. The same method was employed for basal cover estimates, using "basal diameters apart"

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TABLE 4.3 Formation classes and canopy cover of the vegetation, in terms of tree, shrub, dwarf shrub and grass strata, of the farm Groothoek, Thabazimbi district (Edwards, 1976)

STRATUM**	FORMATION CLASS	CANOPY COVER IN STRATA*			
		TREE	SHRUB	DWARF SHRUB	GRASS
Tree	Forest	≥ 80% 0Ø	< 9% >2Ø		
	Closed woodland	9-79% > 0-2Ø	< 9% > 2Ø		
	Open woodland	1-8 % > 2-8Ø	< 9% > 2Ø		
	Sparse woodland	<1 % >8-27Ø	< 9% > 2Ø		
Shrub	Closed shrubland	<1% > 8Ø	≥ 9% ≤ 2Ø		
	Open shrubland	seldom to absent	1-8% >2-8Ø		
	Sparse shrubland		< 1% >8-27Ø		
Dwarf Shrub	Closed dwarf shrubland	> 27Ø	seldom to absent	≥ 9% ≤ 2Ø	less than dwarf shrub
	Open dwarf shrubland	> 27Ø		1-8% > 2-8Ø	
	Sparse dwarf shrubland	> 27Ø		< 1% >8-27Ø	
Grass or Herb	Closed grassland		> 27Ø	less than grass or herb	≥ 9% ≤ 2Ø
	Open grassland		> 27Ø		1-8% >2-8Ø
	Sparse grassland		> 27Ø		< 1% >3-27Ø

* The symbol Ø is used to denote "number of canopy diameters apart" (Edwards, 1976)

**See Table 4.1 for definitions of life forms instead of "canopy diameters apart".

An advantage of cover-estimates using this technique is that the average canopy or basal diameter of a species can be determined by direct measurement. In this study use was made of the "Potch boom=meter" (van Wyk and du Plessis, 1971) to determine average canopy diameter of trees and the distance of the canopies apart from each other in terms of the average canopy diameters. For this purpose the in=strument was held horizontally instead of vertically and measurements taken were used to determine the relationship between canopy spacing and canopy diameters. This enabled verification of visual estimates.

4.1.1.2.(d) Vegetation formation

A stratum is used in the sense of Jackson (1971) in which a stratum is defined as a layer of vegetation representing herbs, shrubs or trees. The canopy cover of vegetation in four strata and corresponding formation classes (Edwards, 1976) is given in Table 4.3. The total canopy cover for each stratum of the vegetation was estimated at each sample quadrat by means of the method described in paragraph 4.1.1.2(c). The vegetation for each quadrat was then classified into formation classes according to the dominant stratum and canopy cover. (Table Table 4.3).

4.1.1.2(e) Vegetation structure

The total canopy cover for each of the following eight height classes was estimated at each sample quadrat by means of the method described in paragraph 4.1.1.2(c):

>12,0 m
> 8,0 - 12,0 m
> 5,0 - 8,0 m
> 3,0 - 5,0 m
>2,0 - 3,0 m
>1,0 - 2,0 m
>0,5 - 1,0 m
0,0 - 0,5 m

These classes were selected as the most meaningful for the bushveld vegetation of the western Transvaal (van der Meulen and Westfall, 1980),

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and are used to describe the vertical distribution of aboveground phytomass, or vegetation structure. The class limits are independent of vegetation height and were estimated at each sample quadrat by means of an optimal clinometer in which heights are read directly (Phillips, 1959).

4.1.1.2(f) Tree density

The total number of stems for each tree species, within a quadrat was recorded for tree density values so that tree density could be expressed per hectare. The term "tree" used here is defined in Table 4.1.

4.1.1.2(g) Habitat data

It is not always the aim of causal-analytical vegetation research to study the reaction of plants to individual site factors, but to analyse their reaction to the combination of all factors. In particular, it is important to recognize the factors that are primarily responsible for the control of the species combination of the plant community under study (Mueller-Dombois and Ellenberg, 1974). In this study each habitat factor was grouped into classes (Appendix I), so that a single class symbol above a relevé, would convey information about a particular habitat factor (Table 5.2). In this way, visual habitat-vegetation correlation is possible.

The following habitat information was recorded at each sample site:

i <u>Geomorphology</u>

The position of each quadrat in the study area, according to geomorphology classes devised by Scheepers (1975), was recorded. The following geomorphology classes, illustrated in Fig. 2.2., were used:

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Symbol	Class	Symbol	Class
A	upper Summit lower	E	Lower slope
B	upper Plateau lower	H	Steep bank or kloof
CF	Cliff face	K	Ridge or knoll
D	Upper slope		

ii Altitude

The altitude of each sample quadrat was recorded from 1:50 000 topo series maps of the study area. Each of the following classes used, has a 100 m range, except for the 1 901-2 100 m class which has a 200 m range, because of the altitudinal variation of the summit of Kransberg which is classified as a single community (Table 5.2):

Symbol	Class		Symbol	Class	
1	1 001 - 1 100 m	low	6	1 501 - 1 600 m	moderate
2	1 101 1 200 m	low			
3	1 201 - 1 300 m	low	7	1 601 - 1 700 m	high
4	1 301 - 1 400 m	moderate	8	1 701 - 1 800 m	high
5	1 401 - 1 500 m	moderate	9	1 801 - 1 900 m	high
			0	1 901 - 2 100 m	high

iii Slope

The slope of each sample quadrat was measured in degrees, using an optical clinometer (Phillips, 1959). The following classification of slope units is that used by the Botanical Research Institute, Private Bag X101, Pretoria, 0001:

Symbol	Description	Class (to the nearest 0,10°)
L	level	0,00 - 3,49°
G	gentle	3,50 - 17,62°
M	moderate	17,63 - 36,39°
S	steep	≥36,40°

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iv Aspect

The aspect of each sample quadrat, where the slope was greater than 0°, was measured in degrees using a magnetic compass, with allowance being made for a magnetic declination of 16° west. The following eight point scale was used to indicate the aspect of each relevé:

Symbol	Description	Class (to the nearest 1°)
1	North	338 - 360; 0 - 22°
2	North-east	23 - 67°
3	East	68 - 112°
4	South-east	113 - 157°
5	South	158 - 202°
6	South-west	203 - 247°
7	West	248 - 292°
8	North-west	293 - 337°

v Geology

The lithological classification of rocky outcrops within or near each sample quadrat was made at the time of sampling with the aid of the classifications of De Vries (1968 - 69) and SACS (1980). The following outcrops were identified:

Symbol	Outcrop	Group	Subgroup	Formation
D1	diabase	Post-Waterberg		
S3	sandstone	Waterberg	Kransberg	Sandriviersberg
S2	sandstone	Waterberg	Matlabas	Aasvoëlkop
SH	shale	Waterberg	Matlabas	Aasvoëlkop
CO	conglomerate	Waterberg	Nylstroom	Alma Graywacke
S1	sandstone	Waterberg	Nylstroom	Alma Graywacke

The above classification is according to SACS (1980) and a corre= lation is given with the system of De Vries (1968 - 69) in Table 2.1.

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vi Surface rock cover

The surface rock cover was estimated as a percentage of stones larger than 20 mm diameter, boulders and rock outcrop within each sample quadrat. The following five classes were distinguished, based on potential mechanical use (van der Meulen, 1979):

Symbol	Class (to the nearest 1%)	Description
0	<1%	No limitation on mechanical utilization
L	1 - 4%	Low limitation on mechanical utilization
M	5 - 34%	Moderate limitation on mechanical utilization
H	35 - 84%	High limitation on mechanical utilization
V	85 - 100%	No mechanical utilization possible

vii Soil depth

The average soil depth to bedrock, of five holes bored with an Eykelkamp* soil auger, within each quadrat, was determined. Soil depths were determined to a depth of one meter and soil depths exceeding one meter were regarded as deep soils. The following five classes were selected on the basis of the floristic classification (Table 5.2) as being most meaningful:

Symbol	Soil depth (to the nearest 10 mm)	
A	0 - 120 mm	shallow
B	130 - 240 mm	moderate
C	250 - 480 mm	moderate
D	490 - 1 000 mm	moderate
E	> 1 000 mm	deep

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*H.J. Eykelkamp & Sons, 1 Rivierweg, Lathum, The Netherlands

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viii Soil classification

Five soil samples were taken from each quadrat at the time of boring soil depth holes. The different horizons were separated on the basis of colour and texture and similar horizons from the five samples were mixed. A subsample of the mixed A-horizon was then taken and tested for pH by means of selective pH strips, with the soil at field capacity in distilled water. The soil colour of the subsample was then determined with the aid of a soil colour chart (Munsell Soil Color Charts, 1954). A further subsample of the mixed A-horizon was tested for calcium content by means of soil reaction with 10 N hydrochloric acid. A final subsample was tested for soil texture by means of field testing the pliability of moist, rolled soil (F.S.S.A., 1974). These field tests were conducted to aid classification of the soil and to indicate local soil descrepancies that could be investigated whilst recording at the site. The remaining soil samples were then forwarded to Mr. J. Schoeman of the Soil and Irrigation Research Institute, Private Bag X79, Pretoria, 0001 for classification. The following soils were classified in the study area:

Symbol	Soil Form	Soil Series
MM	Mispah	Mispah
SB	Shortlands	Bokuil
HM	Hutton	Middelburg
WS	Westleigh	Sibasa
KS	Kroonstad	Slangkop

Mr J Schoeman of the Soil and Irrigation Research Institute, Private Bag X79, Pretoria, 0001 selected twenty six samples of those submitted, as being representative of the variations of the soils in the study area, for chemical analysis of the A horizons. These included samples of each community and variations within communities. The chemical analysis was done by the Soil and Irrigation Research Institute, Private Bag X79, Pretoria, 0001.

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ix Chemical analysis of the A-horizon

The soil samples of the A-horizon forwarded for chemical analysis by the Soil and Irrigation Research Institute, Private Bag X79, Pretoria, 0001 were tested for the following factors which were classified into arbitrary classes where they are summarized in Table 5.2. The high, moderate and low rankings are relative and pertain to the study area:

Factor	Symbol	Class	
Carbon	1	0 - 1%	low
	2	> 1 - 2%	low
	3	> 2 - 3%	moderate
	4	> 3 - 4%	moderate
	5	10,4%	high (only one sample)
Titratable acidity	1	≤ 2,9	low (to the nearest 0,1 me/100 g soil)
	2	3,0 - 3,9	low
	3	4,0 - 4,9	low
	4	5,0 - 5,9	moderate
	5	6,0 - 6,9	moderate
	6	7,0 - 7,9	moderate
	7	8,0 - 8,9	moderate
	8	9,0 - 11,9	moderate
	9	12,0 - 14,9	high
	0	15,0 - 29,9	high
Aluminium	0	0,0 me%	low (to the nearest 0,1 me% soil)
	1	0,1 me%	low
	2	0,2 me%	low
	3	0,3 me%	low
	4	0,4 - 0,5 me%	low

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Aluminium	5	0,6 - 0,7 me% moderate
	6	0,8 - 0,9 me% moderate
	7	1,0 - 1,1 me% moderate
	8	1,2 - 1,4 me% high
	9	1,5 - 2,0 me% high
Electrical Resistance	1	$\leq$ 1 900 ohms low (to the nearest 100 ohms)
	2	2 000 - 2 900 ohms low
	3	3 000 - 3 900 ohms moderate
	4	4 000 - 4 900 ohms moderate
	5	5 000 - 5 900 ohms moderate
	6	6 000 - 6 900 ohms high
	7	7 000 - 7 900 ohms high
	8	8 000 - 8 900 ohms high
Soil pH (in distilled water solution) (MacVicar, *et al*., 1977)	M	pH 5,5 - 6,5 (moderately acid)
	S	pH $<$ 5,5 (strongly acid)
Soil pH (in $CaC\ell_2$ solution)		(not classified, because the difference in pH in distilled water and $CaC\ell_2$ is reflected as the Buffer capacity (Russell, (1961).
Buffer capacity (Russell, 1961)	1	0,1 low (being the difference in pH between distilled water solution and $CaC\ell_2$, solution to the nearest 0,1 pH)
	2	0,2 low
	3	0,3 low
	4	0,4 moderate
	5	0,5 moderate
	6	0,6 moderate
	7	0,7 high
	8	0,8 high
	9	0,9 high

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Sodium Potassium Calcium Magnesium	The values of these elements are expressed to the nearest 0,1 me/100 g soil in the results, and are not classified.
S-value (The sum of the values for Na, K, Ca and Mg) (MacVicar, et al., 1977)	The S-values are expressed to the nearest 0,1 me/100 g soil in the results and are not classified.

T-value (Cation exchange capacity expressed as me/100 g soil) (MacVicar, et al., 1977)	1	≤4,9 me%	low (to the nearest 0,1 me/100 g soil)
	2	5,0 - 5,9 me%	low
	3	6,0 - 6,9 me%	low
	4	7,0 - 7,9 me%	moderate
	5	8,0 - 8,9 me%	moderate
	6	9,0 - 9,9 me%	moderate
	7	10,0 - 11,9 me%	high
	8	12,0 - 14,9 me%	high
	9	15,0 - 22,0 me%	high

x Watertable depth

Although the watertable fluctuates with the rainy season, the average depth of the watertable, where observable from the five soil depth holes, was noted. The following four, arbitrarily chosen classes were used:

Symbol	Class (to the nearest 10 mm)
H	0 - 259 mm high
M	260 - 500 mm moderate
L	510 - 1 000 mm low
O	not observable

xi Biotic factors

Factors such as recent fire, grazing status, exotic plants, cultivated lands, roads and the influence of insects were noted where observed. Such factors were not classified but were used mainly to help explain inconsistencies in the floristic classification.

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4.1.2 Synthesis

A provisional classification was attempted in the field in order to gain an understanding of the vegetation as the fieldwork progressed and to facilitate the final classification.

As the entire fieldwork period was spent almost uninterruptedly in the field, a small "Tabellemacher" (Muller, Werger, Coetzee, Edwards and Jarman, 1972) was made to sequence 25 relevés and 25 species in the field. This did not prove practical, however, because of its small capacity.

4.1.2.1 Floristic classification

A floristic classification of the vegetation was made according to the Braun-Blanquet method as described by Westhoff and van der Maarel (1973), Mueller-Dombois and Ellenberg (1974) and Werger (1974). Together with Mr G. Dednam, Computer Services Division, University of Pretoria, 0002, a computer package (PHYTOTAB) was developed to assist in the data manipulation for the classification. The PHYTOTAB package consists of six programs that are named Plant10 to Plant60.

Plant10: This is the first program which prints a raw data table and a raw data matrix with relevés arranged numerically and species arranged alphabetically or numerically where the species have code numbers. This arrangement allows for easier checking of data that where species are arranged in order of occurrence as in van der Meulen, Morris and Westfall (1978). The program also determines if the number of relevés is correct and if species or cover-abundance values have been omitted.

Plant20: This program produces a preliminary classification and is optional. The printout is a relevé-species matrix based on relevé and species similarity. The relevé and species with the highest frequency is printed with the relevés and species in descending order of similarity, following, until a predetermined, lowest level of similarity required, is reached. A new group, based on the relevé and species, is then started and the process is repeated. The user

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defines the lowest percentage similarity required for relevés and species based on test runs to obtain the best groupings. The best groupings of relevés and species, in this study, was obtained by using a 35 percent species similarity and a 45 percent relevé similarity. This program allows for an objective preliminary classification, saves much time and overcomes the need for provisional classification of large data matrices during the analysis phase.

Plant30: This program allows for user sequencing of relevés and species. Time spent sequencing was considerably reduced because of the preliminary classification provided by Plant20. The small "Tabellemacher" (Muller, et al., 1972) has proved of value in this phase of classification as small groups could be manipulated before resequencing.

Plant40: This program produces the final table (Table 5.2) with title, relevé-linked habitat data, community names, full species names and species-linked data in a form acceptable for photographic reproduction. The program is flexible, by design, to suit most user's requirements for matrix tables.

Plant50: This program, which is optional, determines constancy values for the production of a synoptic table (Table 5.3), via Plant40.

Plant60: This program, which is optional, arranges the raw data in Plant10 in a format acceptable for input to DECORANA (Hill, 1979), a program that ordinates species, relevés and communities by means of detrended correspondence analysis (DCA)(Hill, 1979). Ordination is discussed in paragraph 4.3.

The species recorded in the study area were divided into two groups, namely, diagnostic and non-diagnostic species. The latter group consists of the general and infrequent species that are not diagnostic for communities or syntaxa within the study area at the scale of this study (Table 5.2). The diagnostic species consist of the differential species of which character species are characteristic of one specific syntaxon when compared with other syntaxa in the study area. Diffe=

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rential species differentiate syntaxa that are within floristically related groups and are not confined to one specific syntaxon (Westhoff and van der Maarel, 1973; Werger, 1974). Three types of character spe= cies were recognized according to Werger (1974):

Symbol	Type	Description
E	Exclusive	A species which occurs in only one syntaxon
S	Selective	A species which occurs in one syntaxon but is sparsely present in others
P	Preferential	A species which has optimum cover-abundance in one syntaxon but occurs with less cover-abundance in other syntaxa.

The syntaxonomic nomenclature is according to the proposed recommenda= tions by the Botanical Research Institute, Private Bag X101, Pretoria, 0001 for a standardized South African syntaxonomic nomenclature. It is proposed that the syntaxonomic nomenclature should be descriptive and should include:

i A binomial specific connotation where the first name should be that of a dominant or conspicious species and the second that of a selected differential or character species, and
ii A physiognomic structural term.

No attempt has been made to rank the syntaxa described in the study area because of the lack of data for these syntaxa outside the study area. The species-groups, therefore, cannot be expected to have any coherence outside the context of the syntaxa types for which they were derived (Wheeler, 1980). The proposed recommendations for a standardized South African syntaxonomic nomenclature, furthermore, advise caution in ranking syntaxa, which should not be obligatory until a consistent hierarchical terminology for South Africa is accep= ted.

After the syntaxa were distinguished and named the communities were mapped from aerial photographs of the study area onto a 1: 30 000

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scale base, using a radial line plotter.

The relative importance of species within a plant community as a whole, is not readily apparent from a Braun-Blanquet table. A certain species, with a high cover value, may, e.g. occur throughout the plant community but not in every relevé representing the community whereas a different plant species may occur in every relevé representing the community with a low cover value. The summation of Domin-Krajina cover-abundance percentage class midpoints (Table 4.2) for a species within a plant community, divided by the total number of relevés for the community gives the mean percentage cover for the community and was calculated for all species recorded in sample quadrats. This is a useful indicator of the relative importance of a species within a community and is referred to by Mueller-Dombois and Ellenberg (1974) as mean cover degree. However, mean percentage cover does not show the frequency with which a species occurs throughout the relevés representing the community. A species with a high mean percentage cover may occur in fewer relevés than a species with a low mean percentage cover. The percentage constancy for species within a community indicates the frequency with which a species occurs throughout the relevés representing the community or how representative the mean percentage cover is for the community (Mueller-Dombois and Ellenberg, 1974). Percentage constancy is calculated as follows for each species within a community (Mueller-Dombois and Ellenberg, 1974):

$$\frac{\text{Number of relevés in a community in which a species is present}}{\text{Total number of relevés for the community}} \times 100$$

In order to ascertain the adequacy of the quadrat size, species area curves for each quadrat, were drawn, using the H.P. 45 computer and plotter at the Botanical Research Institute, Private Bag X101, Pretoria, 0001. with a program developed for this purpose by Dr. J.W. Morris.* The species numbers are shown on the ordinate with the area in square metres on the abscissa. Because of the nested quadrat configuration (Fig. 4.1), the areas plotted are 1;2;3;4;5;10;100 and 200 m^2.

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* Dr J W Morris, Dept. Agriculture and Fisheries, Private Bag X116, Pretoria, 0001.

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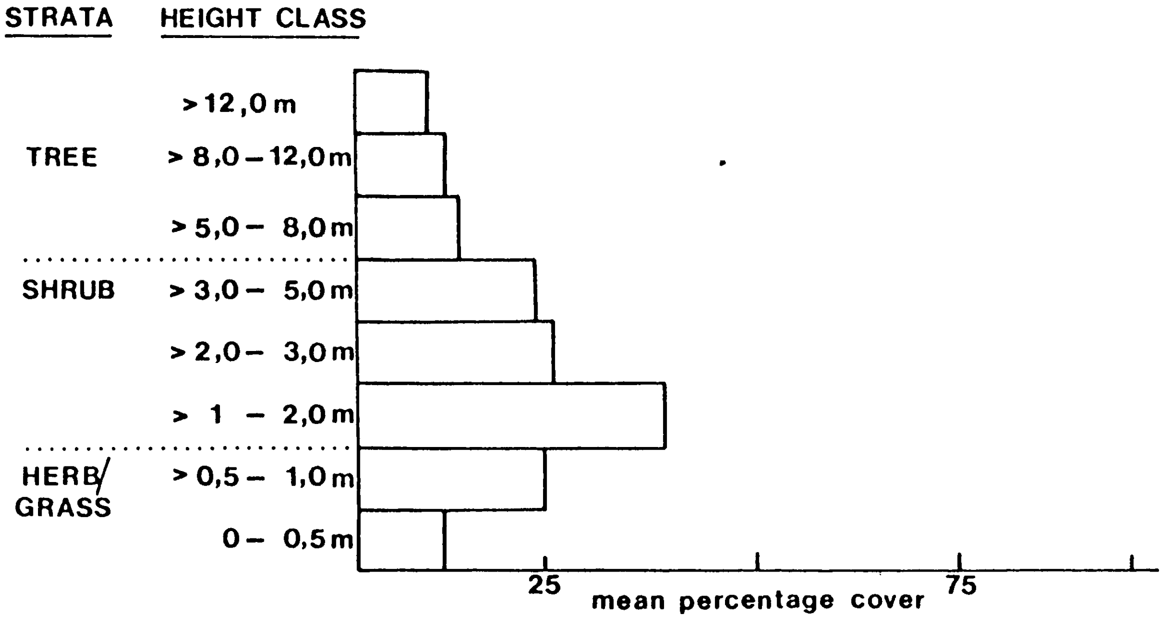

FIG. 4.2 An example of a structural diagram showing height classes, strata and mean percentage cover (Ito, 1979)

4.1.2.2 Structural classification

Vegetation structure refers to the spacing and height of plants forming the matrix of a vegetation cover (Mueller-Dombois and Ellenberg, 1974). This can be illustrated by means of layer or structural diagrams with mean percentage cover on the horizontal scale and height classes (see paragraph 4.1.1.2(e) on the vertical scale (Mueller-Dombois and Ellenberg, 1974; Ito, 1979). An example of a structural diagram is shown in Fig. 4.2. The cover in each height class is obtained by calculating the average cover of the height class for all the relevés representing the community. The average structure of the vegetation in a community and not a representative sample is thus depicted (van der Meulen and Westfall, 1980). Ito (1979) has classified structural diagrams according to synusia based on life form and height. He distinguished herb, shrub, subtree and tree synusia. As the strata used in this study (Table 4.1) are also based on life form and height, classification by means of strata is also possible. However, as a dwarf shrubland was only recorded for one relevé (relevé number 1) the dwarf shrub stratum has been included in the herb stratum. The following strata are therefore used for the structural diagrams based on Ito (1979) which differ from those of Edwards (1976) used for determining vegetation formation:

Stratum	Height Class	Description
Tree	>5 m	woody plants
Shrub	>1 - 5 m	woody plants
Herb	0 - 1 m	herbs and woody plants (includes woody dwarf shrubs)

The structural classification is determined by the highest mean percentage cover of the height classes within a stratum as follows (Ito, 1979):

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Diagram Type	Cover of Strata
L - type	herb > shrub > tree
rL - type	herb < shrub < tree
D - type	herb < shrub > tree
C - type	herb > shrub < tree
I - type	herb = shrub = tree

The use of these structural diagrams allows an easy visual assessment of cover to be made. Furthermore, classification of the diagrams affords a method of summarizing the main structural features of the study area.

4.2 THE VELD CONDITION ASSESSMENT

The veld condition assessment described by Foran, Tainton and Booysen (1978) and adapted from Dyksterhuis (1949) is based on a benchmark site for a particular plant community. The benchmark is an example of vegetation in good condition and is a practically attainable con= dition, by veld management practices, for other sites within the plant community (Foran, Tainton and Booysen, 1978). All other sites within the community are compared with the benchmark. Comparisons are based on species composition and basal cover. Species are classified into the following categories (Foran, Tainton and Booysen, 1978):

a) Decreaser species - those with a high basal cover, in veld which is in good condition and which decline in basal cover when veld deteriorates;

b) Increaser I species - those that have a low basal cover in veld which is in good condition, but which increase in basal cover when veld is underutilized;

c) Increaser II species - those that have a low basal cover in veld which is in good condition, but which increase in basal cover when veld is overutilized; and

d) Increaser III species - those that have a low basal cover in veld which is in good condition, but which increase in basal cover when veld in selectively grazed.

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For the veld condition assessment described by Foran, Tainton and Booysen (1978) the wheelpoint method is used to determine basal cover. However, in this study the quadrat method (Westhoff and van der Maarel, 1973; Mueller-Dombois and Ellenberg, 1974 and Werger 1974) was used to estimate cover-abundance, according to the Domin-Krajina scale (Table 4.2). A control assessment of basal cover employing the line intercept method (Canfield, 1941) with four transects of 20 m each were made in six quadrats, representative of the following formation classes in the study area, with geomorphology class in parenthesis:

Quadrat number	Formation class (Edwards, 1976)
1	Closed dwarf shrubland (upper plateau)
2	Closed grassland (upper plateau)
3	Closed grassland (upper plateau)
19	Open woodland (lower slope, north of upper plateau)
74	Closed grassland (upper summit)
119	Open woodland (upper slope, north of upper plateau)

The control assessments were conducted immediately after recording quadrat data in the same quadrats used for the phytosociological clas= sification. The line intercept method (Brown, 1954 and Canfield, 1941) was decided upon as a control method because it utilizes less bulky equipment and is recommended by Walker (1970) as the best method for determining basal cover on the basis of precision and efficiency, in grassland. Although basal cover-abundance estimates using the Domin-Krajina scale is considerably less precise that the line intercept method, nevertheless, the line intercept method was employed as a con= trol, because basal cover of woody vegetation can also be determined by this method.

The veld condition assessment is then calculated as follows (Foran, Tainton and Booysen, 1978):

a) The relative percentage composition for each species within a quadrat is calculated as

$$\frac{\text{percentage basal cover of a species within a quadrat}}{\text{percentage basal cover for all species within a quadrat}} \times 100$$

b) The composition score is the summation of relative percentage composition values for all species in a quadrat except for Decreaser species where the lowest relative percentage composition of the

  i sample quadrat or
  ii benchmark site or
  iii maximum limit (that is the maximum relative percentage composition allowed for a species where a very high relative percentage composition would reduce the cover of associated species)

is taken.

c) The final score is calculated as the composition score less basal cover deduction, where basal cover deduction (BCD) is:

$$\frac{\text{(Basal cover of benchmark - Basal cover of sample site)}}{\text{Basal cover of benchmark}} \times 50$$

Where the basal cover of the sample site is higher than that of the benchmark site then both scores remain the same. The value: $\frac{50}{\text{basal cover of benchmark}}$ is used to relate the BCD to the benchmark basal cover (Tainton, Foran and Booysen, 1978).

Mr. G. du Plooy* assisted with the classification of the grass species into Decreasers, Increaser I, Increaser II and Increaser III species (Appendix II). This generally conforms to the classification of Foran, Tainton and Booysen (1978), except for *Themeda triandra* which has been given a maximum limit of 20 percent with respect to the composition score as it is not considered a very good grazing grass in Sour Bushveld whereas in Natal the maximum limit is 60 percent (Foran, Tainton and Booysen, 1978). All forbs and woody species in a woodland situation were regarded as Increaser II species because they would tend to increase if the grass were overutilized. Trees normally found in forests were regarded as Increaser I species because if not subjected to fire or other use these species would tend to increase. *Stoebe*

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* G. du Plooy, Extension Officer, Department of Agriculture and Fisheries, Second Avenue, Thabazimbi, 0380

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vulgaris, an encroacher due to selective grazing, (Roux, 1969) is regarded as an Increaser III species. *Selaginella dregei* could not be classified into one of the existing categories and because it was recorded during fieldwork it is shown separately in the veld condition presentation. The list of Decreaser/Increaser species (Appendix II) is provisional for the Sour Bushveld and may be modified as more experience is gained.

In this study a benchmark site was selected for each community on the basis of the quadrat that had the highest relative precentage composition for Increaser I species for each forest community, and the highest relative percentage composition for Decreaser species for all other communities.

The presentation of veld condition scores (Foran, Tainton and Booysen, 1978) together with symbols and classes used in this study for scores and basal cover (Table 5.2), are as follows:

	Benchmark*	Sample Site
Final score	100%	final score
Composition score	100%	composition score
Basal cover	% basal cover	% basal cover
Decreasers	% composition	% composition
Increaser I	% composition	% composition
Increaser II	% composition	% composition
Increaser III	% composition	% composition
Selaginella dregei	% composition	% composition

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* Benchmark is indicated by the symbol "0" for both final score and composition score in Table 5.2.

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Symbol	Final score, composition score, Decreasers, Increaser I, Increaser II, Increaser III, and *Selaginella dregei* (to the nearest 1%)	Basal cover (to the nearest 1%
Blank	%	%
1	1 - 10%	1 - 3%
2	11 - 20%	4 - 6%
3	21 - 30%	7 - 9%
4	31 - 40%	10 - 12%
5	41 - 50%	13 - 15%
6	51 - 60%	16 - 18%
7	61 - 70%	19 - 21%
8	71 - 80%	22 - 24%
9	81 - 90%	25 - 27%
0	91 - 100%	28 - 30%

4.3 THE ORDINATION OF COMMUNITIES

Whittaker (1978) suggests the use of ordination techniques for deter= mining discontinuities in vegetation which may then be classified. Van der Maarel (1980) recommends ordination as an aid to classifica= tion and to help explain environmental influences. In this study classification of the vegetation was completed before ordination tech= niques were applied, because of the development of the PHYTOTAB pro= gram package (see paragraph 4.1.2.1). Ordination techniques, used in this study, therefore, can confirm rather than determine discontinui= ties in vegetation and hence the need for classification. They can also help explain environmental gradients.

The detrended correspondence analysis (DCA) method of ordination (Hill and Gauch 1980) was used for this study as it overcomes the problem of the 'arch effect' produced by the principle component analysis (PCA) and reciprocal averaging (RA) methods of ordination (Greig-Smith, 1980; Hill and Gauch, 1980; van der Maarel, 1980). The communities were ordinated on florisitic data using the DECORANA program written by Hill (1979).

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4.4 SPECIES DIVERSITY

Species diversity refers to the richness of species in vegetation (Whittaker, 1972) or the number of species in relation to area (Whittaker, Niering and Crisp, 1979) and can be given simply as the number of species per unit area (Whittaker, 1972). However, the rate at which species increase, as area is increased is not taken into account. This rate of increase and number of species for a given area can be illustrated graphically by showing species diversity area curve (Whittaker, Niering and Crisp, 1979) where the rate of increase is indicated by the angle of the linear regression.

Species diversity may, furthermore, be subdivided into alpha and beta diversities where alpha diversity refers to the intra or within community species diversity and beta diversity refers to the inter or between communities species diversity (Whittaker, 1972).

The nested quadrat method of sampling vegetation (see paragraph 4.1.1.1(b) allowed the recording of plant species in areas of 1 m², 10 m², 100 m² and 200 m², the latter being the full size of the 10 m x 20 m quadrat. All plant species were recorded in the first 1 m² quadrat and their occurrence in the remaining four 1 m² quadrats were noted together with species not recorded in the previous 1 m² quadrats. In this way the average number of species/m² over five square metres could be determined (Whittaker, Niering and Crisp, 1979), which illustrates the number of species per unit area for each quadrat. Only species not recorded for previous quadrats were recorded for the 10 m² (5 m x 5 m), 100 m² (10 m x 10 m) and 200 m² (10 m x 20 m) quadrats.

The alpha diversity for each community was determined by the linear regression of the species area curve, for each quadrat within a community, on a linear species number and log scale. Species number is plotted on the ordinate with the log of the area, in square metres on the abscissa. The log area scale, therefore, reads 0 (1 m²); 1 (10 m²; 2 (100 m²) and 2,3 (200 m²) to the nearest 0,1.

The beta diversity was calculated as the average number of plant species in each 1 m², 10 m², 100 m² and 200 m² nested quadrat for each

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quadrat in the community. A linear regression of the species area curve was then plotted for each community in the study area, in the same manner as that used for the alpha diversity.

The alpha and beta diversities were plotted graphically using the H.P. 45 computer and plotter at the Botanical Research Institute, Private Bag X101, Pretoria, 0001 with a program developed for this purpose by Dr. J.W. Morris*.

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*Dr. J.W. Morris, Department of Agriculture and Fisheries, Private Bag X116, Pretoria, 0001.

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Table 5.1 A classification of the plant communities of the farm Groothoek, Thabazimbi district

A. Kloof forest communities on moderately deep soil in moist, sheltered habitats.

5.1 *Celtis africana* — *Erythrina lysistemon* kloof forest
5.2 *Celtis africana* — *Osyris lanceolata* kloof forest
5.3 *Celtis africana* — *Asplenium splendens* kloof forest

B. Woodland, representative of Acocks's (1975) Sour Bushveld, on moderately deep to deep soils, in moderately exposed habitats.

5.4 *Combretum molle* — *Panicum maximum* closed woodland
5.5 *Combretum molle* — *Euclea crispa* closed woodland
5.6 *Combretum molle* — *Setaria megaphylla* closed woodland
5.7 *Combretum molle* — *Terminalia sericea* closed woodland
5.8 *Combretum molle* — *Aristida diffusa* open woodland
5.8.1 *Combretum molle* — *Aristida diffusa* — *Strychnos madagascariensis* variation
5.8.2 *Combretum molle* — *Aristida diffusa* — *Vitex rehmannii* variation
5.9 *Combretum molle* — *Landolphia capensis* closed woodland
5.9.1 *Combretum molle* — *Landolphia capensis* — *Burkea africana* variation
5.9.2 *Combretum molle* — *Landolphia capensis* — *Tapiphyllum parvifolium* variation
5.10 *Combretum molle* — *Coleochloa setifera* open woodland
5.11 *Combretum molle* — *Heteropogon contortus* closed and open woodlands
5.11.1 *Combretum molle* — *Heteropogon contortus* — *Rhus dentata* closed woodland variation
5.11.2 *Combretum molle* — *Heteropogon contortus* — *Chaetacanthus costatus* open woodland variation
5.12 *Combretum molle* — *Themeda triandra* open woodland
5.13 *Combretum molle* — *Argyrolobium transvaalense* open woodland
5.14 *Combretum molle* — *Pachycarpus schinzianus* open woodland
5.15 *Combretum molle* — *Protea caffra* open woodland

C. Grassland, representative of Acocks's (1975) Sour Bushveld on moderately deep soils in exposed, dry habitats.

5.16 *Andropogon appendiculatus* — *Eragrostis pallens* grassland

D. Woodland, representative of Acocks's (1975) North-Eastern Mountain Sourveld on moderately shallow soils in moderately exposed habitats.

5.17 *Protea roupelliae* — *Helichrysum nudifolium* sparse woodland

E. Grassland, representative of Acocks's (1975) North-Eastern Mountain Sourveld on shallow, rocky soils in exposed habitats.

5.18 *Trachypogon spicatus* — *Eragrostis racemosa* grassland.

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5. THE PHYTOSOCIOLOGICAL CLASSIFICATION OF THE VEGETATION AND DESCRIPTION OF THE PLANT COMMUNITIES

INTRODUCTION

The results of the phytosociological classification and description of the plant communities given in this chapter include the results of the species-area determinations so that cognizance of relevés, where minimum area was inadequate, could be taken in the description of plant communities. Similarly, the results in this chapter include the results of the structural classification because plant community descriptions would be incomplete without reference to vegetation structure. Although the results of the ordination of communities are given in Chapter 7, reference is made to the main vegetation types determined by the ordination because the main vegetation types form part of the community descriptions.

In the community descriptions, character species are listed alphabetically and the following symbols are used:

- E exclusive character species;
- S selective character species; and
- P preferential character species.

Conspicuous woody and herb species are both listed in order of constancy followed by mean percentage cover, with the respective values indicated next to each species.

a. Differential and synoptic tables

The phytosociological classification of the vegetation in the study area resulted in the identification of eighteen communities with three of the communities having two variations each (Table 5.1). The floristic composition of the communities according to sample plots are given in Table 5.2 and are summarized in Table 5.3. A simplified life form code (see Table 4.1) is indicated next to

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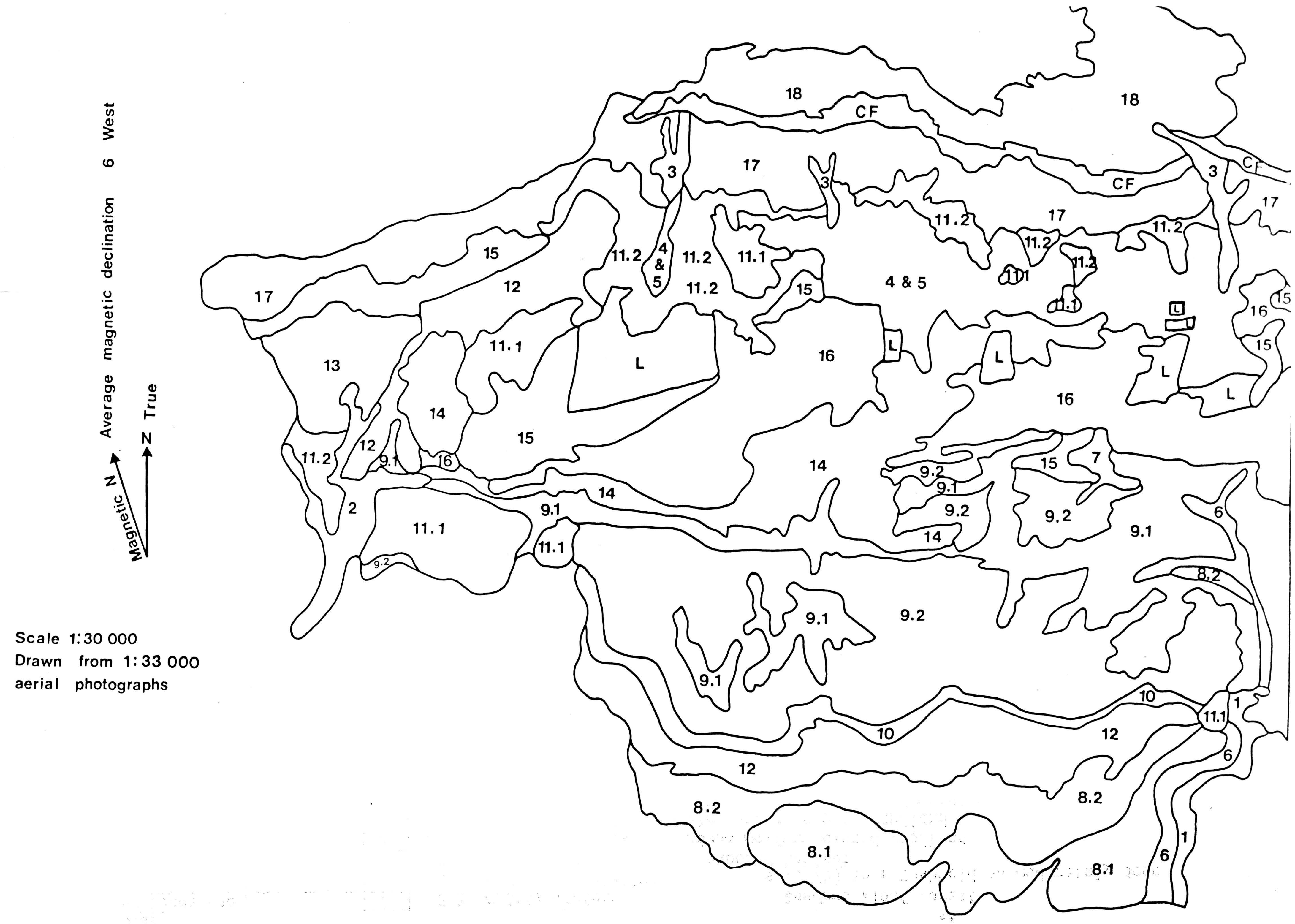

LEGEND

Soil Form	PREVAILING Geology*	Topography		
				Kloof forest communities on moderately deep soils in moist, sheltered habitats
Mispah	S1 Sandstone	Kloofs	1	5.1 *Celtis africana* — *Erythrina lysistemon* kloof forest
Shortlands	Diabase		2	5.2 *Celtis africana* — *Osyris lanceolata* kloof forest
Mispah	S3 Sandstone		3	5.3 *Celtis africana* — *Asplenium splendens* kloof forest
				Woodland representative of Acocks's (1975) Sour Bushveld on moderately deep to deep soils in moderately exposed habitats
	S2 Sandstone	Lower Slopes	4	5.4 *Combretum molle* — *Panicum maximum* closed woodland
			5	5.5 *Combretum molle* — *Euclea crispa* closed woodland
Hutton	Conglomerate	Kloof	6	5.6 *Combretum molle* — *Setaria megaphylla* closed woodland
		Plateau	7	5.7 *Combretum molle* — *Terminalia sericea* closed woodland
Mispah	S1 Sandstone	Lower Slopes	8.1	5.8.1 *Combretum molle* — *Aristida diffusa* — *Strychnos madagascariensis* open woodland variation
			8.2	5.8.2 *Combretum molle* — *Aristida diffusa* - *Vitex rehmannii* open woodland variation
	Conglomerate	Upper and Lower Slopes	9.1	5.9.1 *Combretum molle* — *Landolphia capensis* - *Burkei africana* closed woodland variation
			9.2	5.9.2 *Combretum molle* — *Landolphia capensis* - *Tapiphyllum parvifolium* closed woodland variation
		Summit	10	5.10 *Combretum molle* — *Coleochloa setifera* open woodland
	S2 Sandstone	Lower Slopes	11.1	5.11.1 *Combretum molle* — *Heteropogon contortus* - *Rhus dentata* closed woodland variation
			11.2	5.11.2 *Combretum molle* — *Heteropogon contortus* - *Chaetacanthus costatus* open woodland variation
	S1 & S2 Sandstone		12	5.12 *Combretum molle* — *Themeda triandra* open woodland
			13	5.13 *Combretum molle* — *Argyrolobium transvaalense* open woodland
			14	5.14 *Combretum molle* — *Pachycarpus schinzianus* open woodland
			15	5.15 *Combretum molle* — *Protea caffra* open woodland
	Shale	Plateau		Grassland representative of Acocks's (1975) Sour Bushveld on moderately deep soils in exposed dry habitats
			16	5.16 *Andropogon appendiculatus* — *Eragrostis pallens* grassland
	S2 & S3 Sandstone	Upper Slopes		Woodland representative of Acocks's (1975) North-Eastern Mountain Sourveld on moderately shallow soils in moderately exposed habitats
			17	5.17 *Protea roupelliae* - *Helichrysum nudifolium* sparse woodland
	S3 Sandstone	Summit		Grassland representative of Acocks's (1975) North-Eastern Mountain Sourveld on shallow, rocky soil in exposed habitats
			18	5.18 *Trachypogon spicatus* — *Eragrostis racemosa* grassland
			L	Cultivated lands
			CF	Cliff face

Fig. 5.1 A vegetation map of the farm Groothoek, Thabazimbi district (* diabase - post-Waterberg Group. Waterberg Group: S3, Sandriviersberg Formation; S2 & shale, Aasvoëlkop Formation; S1 & Conglomerate, Alma Graywacke Formation).

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each species on the differential species section of Table 5.2 and the species on the non-diagnostic section, or general and infrequent species, are grouped into simplified life forms. This allows physiognomically dominant species, such as some trees, to be taken into account more easily when interpreting the table. Similarly, the grouping of ferns, geophytes, sedges and grasses (Table 4.1) allow easier interpretation for later veld condition assessments (see chapter 6) than an ungrouped table. The matrix values in Table 5.2 are according to the Domin-Krajina cover-abundance scale for canopy cover (see Table 4.2). The species-groups were extracted without reference to other classification schemes to avoid the possibility of inappropriate bias (Wheeler, 1980). Percentage constancy and mean percentage cover are given for each species within species-groups on the differential species section of Table 5.2 and for each species within the study area, on the non-diagnostic section. Similarly tree density is given as the number of stems of a species per relevé and per hectare within species-groups on the differential species section of Table 5.2 and within the study area on the non-diagnostic section.

The habitat data for each relevé are shown in Tables 5.4 to 5.24 and are summarized in Table 5.2. Class symbols for the summarized habitat data are explained in paragraph 4.1.1.2(g) and are summarized in Appendix I. As all sampling took place in 1980 only the month and day of sampling are included in Table 5.2 for phenological interpretation. Geophytes, for example, were only recorded when identifiable, that is, when flowering. The veld condition assessment presentations are included with the habitat data, although discussed in chapter 6, because reference to veld condition forms a part of the community descriptions.

A synopsis of the phytosociological classification is given in Table 5.3 in which the species-groups are the same as in Table 5.2. The matrix values in Table 5.3 are calculated as the percentage constancy for each species within a community (see paragraph 4.2.1) and expressed as algebraic numerals instead of Roman numerals as described by Mueller-Dombois and Ellenberg (1974). A vegetation map of the study area showing the distribution of the communities is given in Fig. 5.1.

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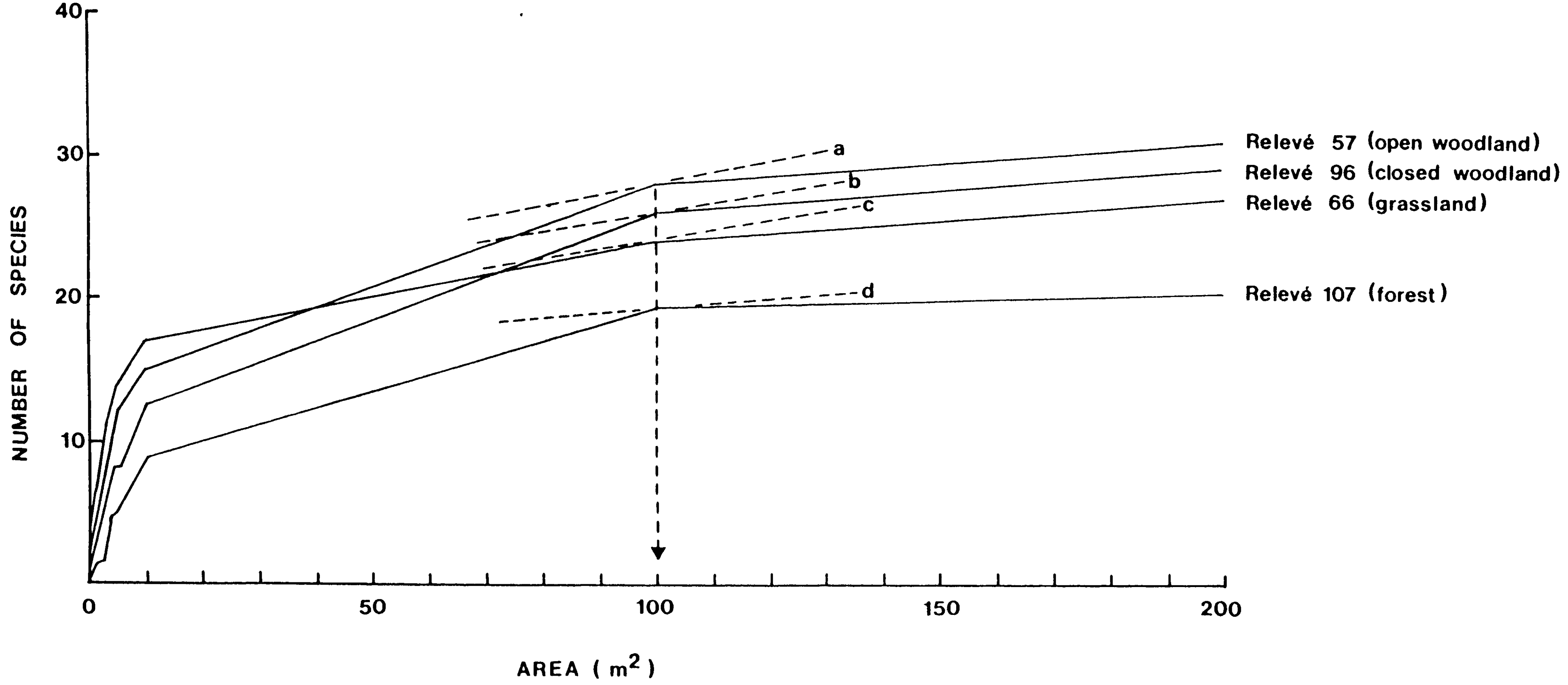

FIG. 5.2 Representative species area curves for forest, closed woodland, open woodland and grassland on the farm Groothoek, Thabazimbi district. Lines a, b, c and d represent the slope $y = A + 0,5x$. The tangential intersection of these lines and respective species-area curves is the minimum quadrat area. A = intersect on y-axis, y = dependant variable & x = independent variable

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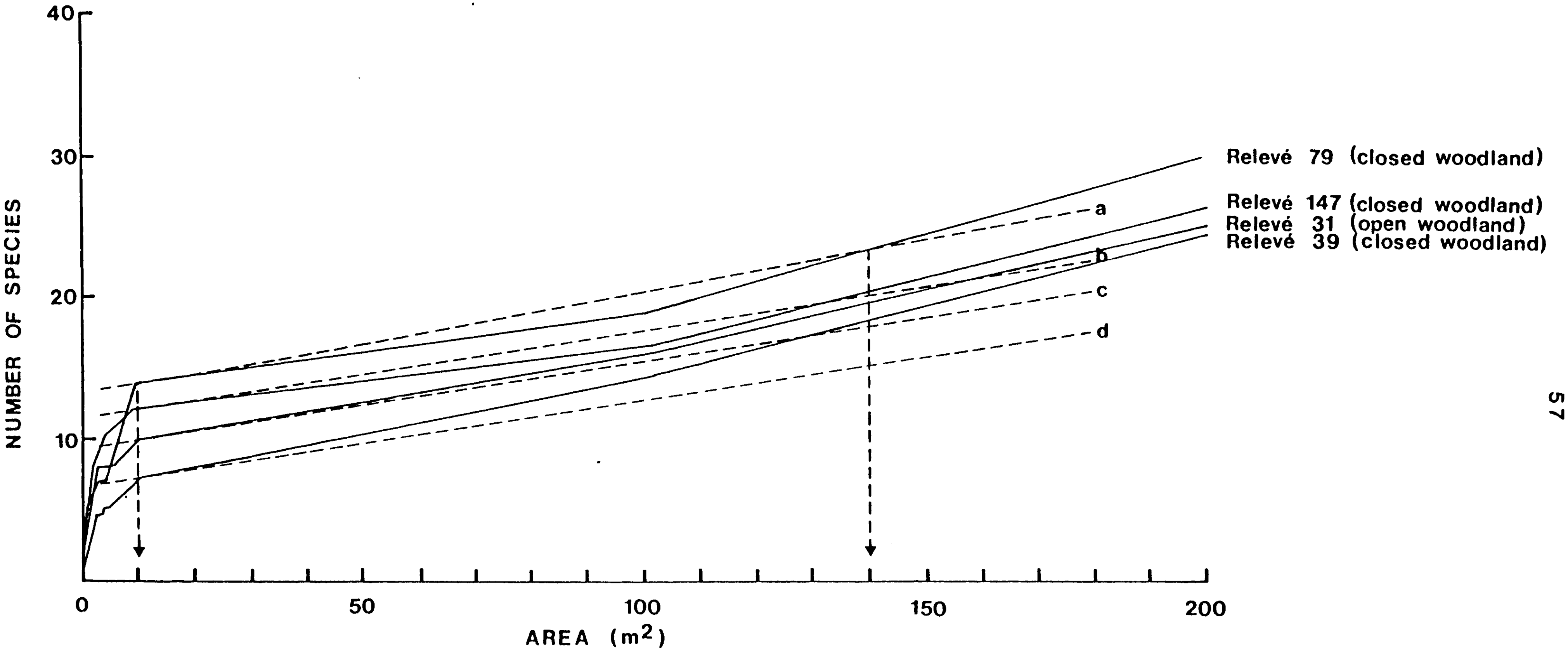

FIG.5.3 Species area curves for open and closed woodland sample quadrats, on the farm Groothoek, Thabazimbi district, where quadrat size is $10m^2$ and $140m^2$ (a and b) and greater than $200m^2$ (c and d). Lines a, b, c and d represent the slope of $y = A + 0{,}5x$ where A= intersect on y-axis, x= independant variable and y= dependant variable

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Communities 5.4 and 5.5 are mapped as a single unit because they could not be differentiated on aerial photographs (see paragraphs 5.4 and 5.5).

b. Species-area

Although species-area curves were drawn for each relevé only four, namely relevé numbers 107, 96, 57 and 66 representing forest, closed woodland, open woodland and grassland respectively are shown (Fig. 5.2) as they are representative of the species-area curves for these formation classes in the study area. Mueller-Dombois and Ellenberg (1974) suggest a conservative minimum sample area where a 10 percent increase in sample size gives a 5 percent or less increase in species numbers. This is represented by the slope where $y = A + 0,5\ x$ and A is the intersection on the y-axis, x is the independent variable and y the dependent variable. In Fig. 5.2 the intersection of these slopes and the species-area curves projected on the x - axis is the minimum sample size required. However, the minimum sample size for the vegetation represented by relevé numbers 31 (open woodland) and 39 (closed woodland) is greater than 200 m^2 while relevé numbers 79 and 147 have two minimum sample size intersection points at 10 m^2 and 140 m^2 (Fig. 5.3).

As two tangential intersections for normal species-area curves are not possible (Mueller-Dombois and Ellenberg, 1974) the recorded data are possibly contrary to that expected of normal species-area curves for relevé numbers 79 and 147. A higher number of species at 100 m^2 for these relevés could have produced normal curves with minimum areas in the vicinity of 100 m^2. The fewer species recorded for 100 m^2 for these relevés may be attributed to local heterogeneity not apparent at the time of sampling. Because the rate of increase for species exceeds 5 percent for an increase in 10 percent area, for relevés numbers 31 and 39 up to the quadrat size of 200 m^2 (Fig. 5.3) a minimum sample size of greater than 200 m^2 is indicated. But, because these two relevés represent only 1,2 percent of the samples, it is likely that these relevés also represent quadrats in which heterogeneity, not apparent at the time of sampling, was present.

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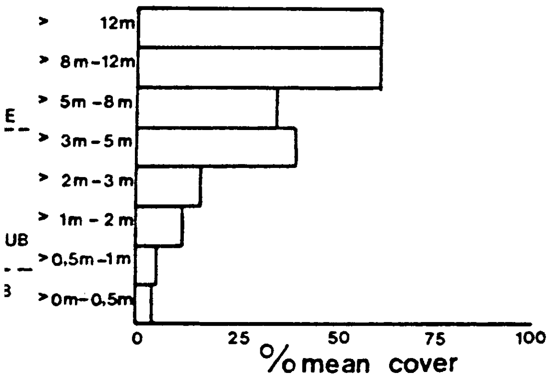
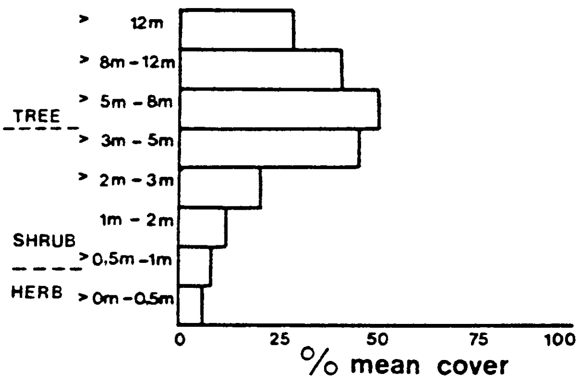
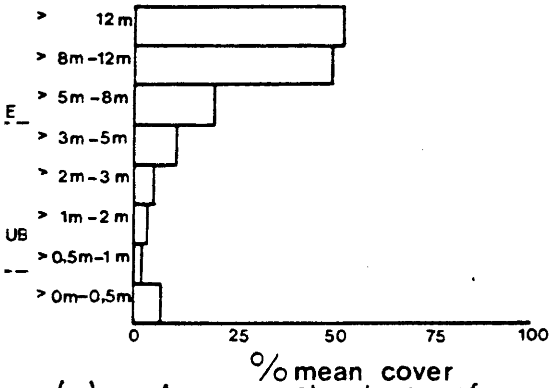


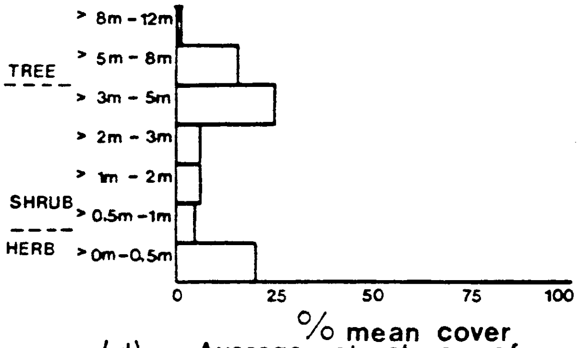
(a) Average structure of community 5.1. Type rL



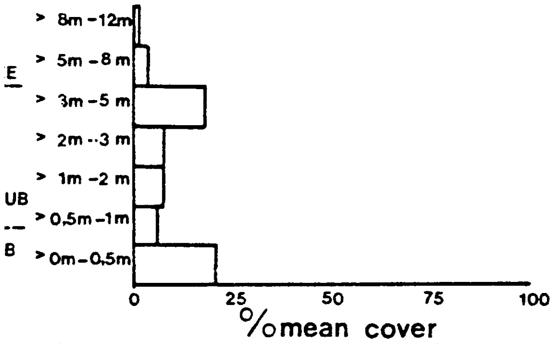
(b) Average structure of community 5.2.Type rL



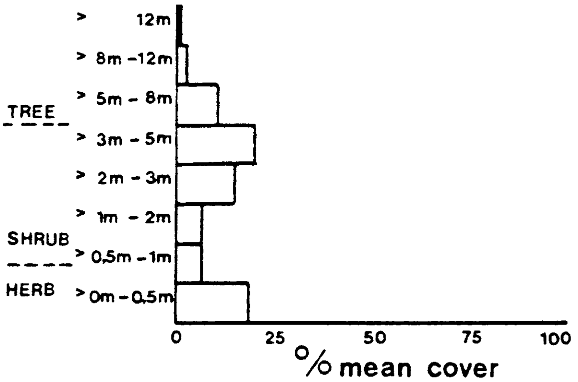
(c) Average structure of community 5.3. Type rL



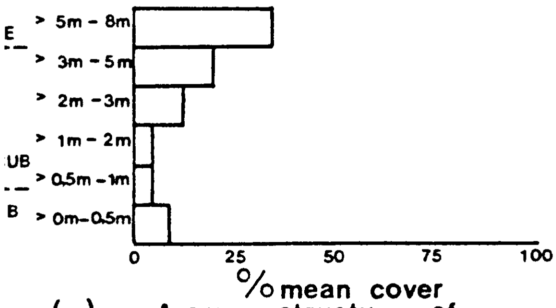
(d) Average structure of community 5.4. Type D



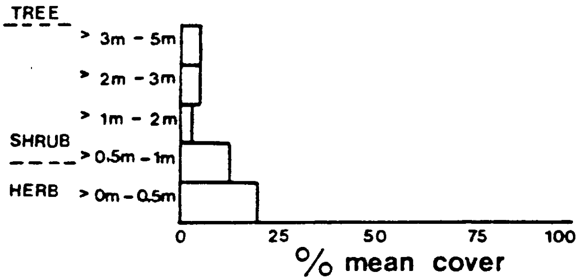
(e) Average structure of community 5.5.Type L



(f) Average structure of community 5.6.Type D



(g) Average structure of community 5. 7. Type rL



(h) Average structure of community 5.8.Type L

5.4 Average structure of the vegetation of the farm Groothoek, Thabazimbi district, showing height classes, strata and percentage mean cover

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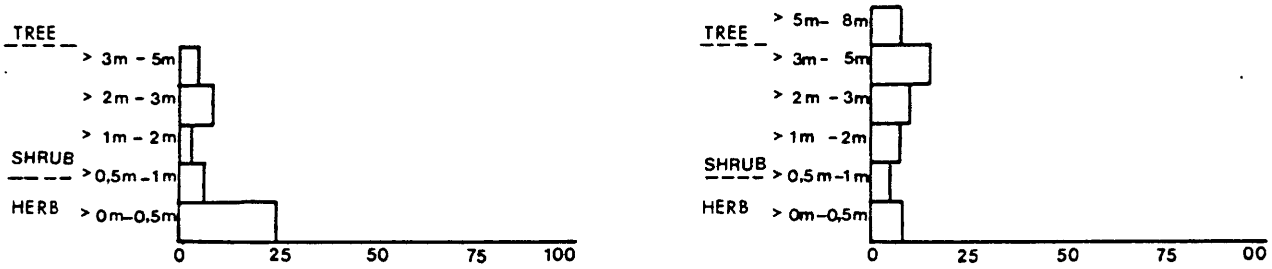
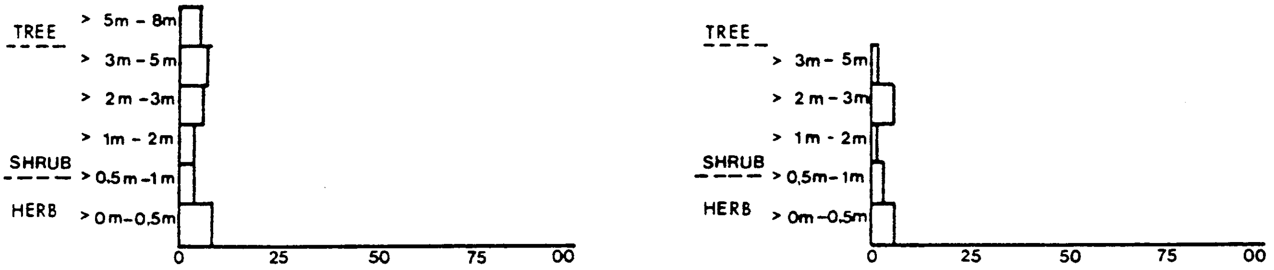


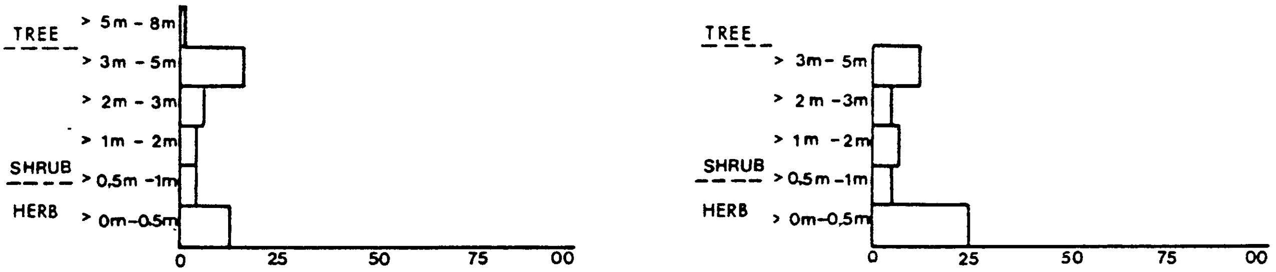
(i) Average structure of community 5.8.2 Type L

(j) Average structure of community 5.9.1 Type D



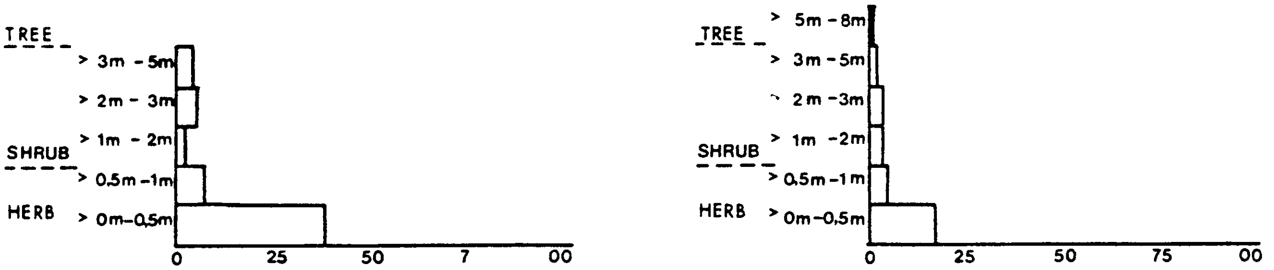
(k) Average structure of community 5.9.2 Type D

(l) Average structure of community 5.10 Type L



(m) Average structure of community 5.11.1 Type D

(n) Average structure of community 5.11.2 Type L



(o) Average structure of community 5.12 Type L

(p) Average structure of community 5.13 Type L

FIG. 5.4 (continued) Average structure of the vegetation of the farm Groothoek, Thabazimbi district, showing height classes, strata and percentage mean cover

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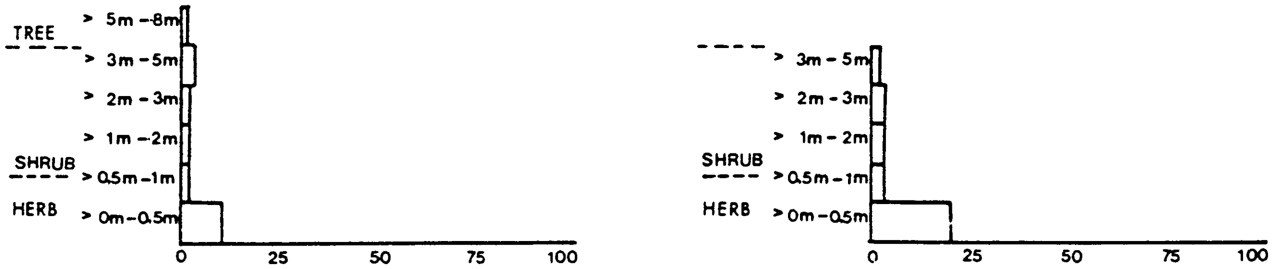
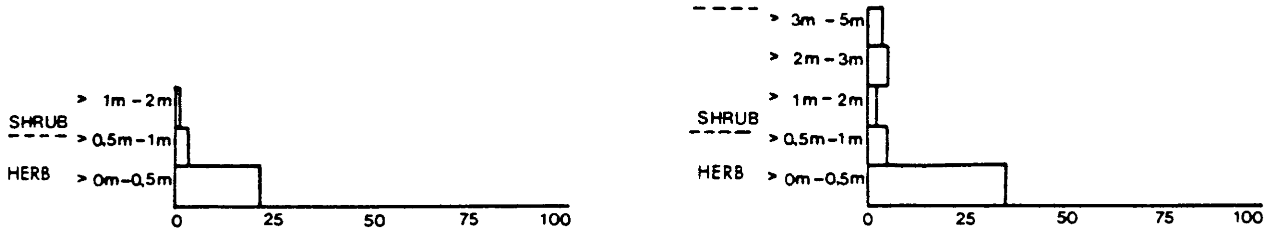


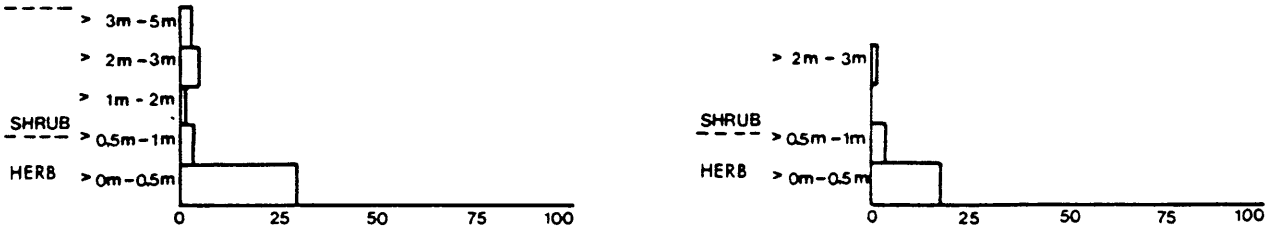
(q) Average structure of community 5.14 Type L

(r) Average structure of community 5.15 Type L



(s) Average structure of community 5.16 Type L

(t) Average structure of community 5.17 a Type L



(u) Average structure of community 5.17 b Type L

(v) Average structure of community 5.18 Type L

FIG. 5.4 (continued) Average structure of the vegetation of the farm Groothoek, Thabazimbi district, showing height classes, strata and percentage mean cover.

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The sample size of 200 m^2 used in this study may be considered adequate as it is larger than the minimum size indicated (Mueller-Dombois and Ellenberg, 1974) for 98,8 percent of the quadrats in the study area.

c. Vegetation structure

The average structure of the vegetation in each community is illustrated by means of layer diagrams in Fig. 5.4. The classification of structure by diagram types (Ito, 1979) in the study area is as follows:

Diagram type	Number	Percent frequency
rL	4	18,18
D	6	27,27
L	12	54,55
Total	22	100,00

The classification of these structural types is similar to that for Edwards's (1976) formation classes:

Formation class	Number of communities	Percent frequency
Forest	3	13,64
Closed woodland	7	31,81
Open and sparse woodlands and grasslands	12	54,55
Total	22	100,00

Community 5.7, structural diagram (g) of Fig. 5.4 has a low cover in the herb stratum due to heavy grazing (see paragraph 5.7). This has led to the rL structural classification. A higher cover in the herb stratum and corresponding decrease in the tree stratum, could have led to a D structural classification for this community. The high percentage (54,55) frequency for the L structural classification

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indicates a predominantly open to sparse woodland vegetation which confirms Acocks's (1975) description of Sour Bushveld as an "open savanna". The use of these structural diagrams allows an easy visual assessment of cover to be made and classification of the structural types affords a method of summarizing the main structural features of the study area.

d. Affinities

The detrended correspondence analysis (DCA) (Hill and Gauch, 1980) method of ordinating communities (see chapter 7) shows the following main vegetation types in the study area, according to a temperature/ moisture gradient and a maximum soil depth gradient, namely:

- A kloof forest on moderately deep soils in moist, sheltered habitats;
- B woodland, representative of Acocks's (1975) Sour Bushveld on moderately deep to deep soils in moderately exposed habitats;
- C grassland, representative of Acocks's (1975) Sour Bushveld on moderately deep soils in exposed dry habitats;
- C woodland, representative of Acocks's (1975) North-Eastern Mountain Sourveld on moderately shallow soils in moderately exposed habitats; and
- E grassland, representative of Acocks's (1975) North-Eastern Mountain Sourveld on shallow, rocky soil in exposed habitats.

In the phytosociological classification the kloof forest communities (main vegetation type A) have little affinity, based on species-groups, with the other main vegetation types in the study area (Table 5.2). The *Heteropogon contortus* species-group (Table 5.2 AD) shows affinities between the main vegetation types B and D. The *Bulbostylis burchellii* species-group (Table 5.2 AE) shows affinities between the main vegetation types B, D and E while the *Eragrostis racemosa* species-group (Table 5.2 AF) shows affinities between the main vegetation types B, C, D and E.

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e. Community descriptions

A. KLOOF FOREST COMMUNITIES ON MODERATELY DEEP SOILS IN MOIST, SHELTERED HABITATS

The kloof forest communities are found in kloofs in the east (communities 5.1 and 5.3) and in the west (community 5.2) of the study area (Fig. 5.1) at altitudes of 1 050 m to 1 850 m (Table 5.2). The vegetation is represented by three communities, namely communities 5.1 to 5.3 (Table 5.2).

Habitat

The soils are mainly of the Mispah Form, Mispah Series and Shortlands Form, Bokuil Series, derived from sandstone and diabase respectively. The soil depth varies from 140 mm to 470 mm. The kloofs are the least exposed of the geomorphology classes (Appendix I) found in the study area and as a result probably have the lowest temperature range and highest humidity of the communities in the study area. Streamflow in the kloof communities is seasonal.

Floristics

Although the kloof vegetation is physiognomically homogeneous, the communities have few species in common, namely, the species of the *Diospyros whyteana* species-group (Table 5.2 F). The *Olea europaea* species-group (Table 5.2 C) is common to the first and second communities (communities 5.1 and 5.2) and the *Myrsine africana* species-group (Table 5.2 E) is common to the second and third communities (communities 5.2 and 5.3) (Table 5.2). The *Cyperus albostriatus* species-group (Table 5.2 H) is the only species-group the kloof communities (communities 5.2 and 5.3) have in common with the other main vegetation types in the study area. This species-group contains only two shrubs, namely, *Secamone alpinii*, a shrubby climber, and *Pterocelastrus rostratus* whose ecological amplitude suggest that they occur on forest margins. *Celtis africana* is diagnostic and physiognomically conspicuous in the kloof

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Fig. 5.5 An example of kloof forest vegetation in the west of the study area with the *Combretum molle* — *Faurea saligna* open woodland in the foreground.

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TABLE 5.4 Habitat factors recorded for the *Celtis africana* - *Erythrina lysistemon* kloof forest (community 5.1)

Relevé number	98	100
Vegetation		
Canopy cover (%)	≥80	≥80
Formation*	F	F
Species diversity (per m²)	3	5
Species per relevé	17	21
Veld condition		
Final score (%)	100	32
Composition score (%)	100	44
Basal cover (%)	5	4
Decreasers (%)	1	1
Increaser I (%)	70	44
Increaser II (%)	29	55
Increaser III (%)	0	0
Selaginella dregei (%)	0	0
Topography		
Geomorphology*	H	H
Altitude (m)	1 050	1 100
Slope (°)	3	6
Aspect	S	SW
Geology		
Formation*	Sl	Sl
Surface rock cover (%)	60	60
Soil		
Form*	M	M
Series*	M	M
Depth (mm)	450	190
Watertable depth (mm)**	N/O	N/O
Carbon (%)	1,3	
Titratable acidity (me/100g)	8,2	
Aluminium (me%)	1,2	
Electrical resistance (ohms)	4 300	
pH (H_2O)	4,8	
pH ($CaCl_2$)	4,1	
Sodium (me/100g)	0,0	
Potassium (me/100g)	0,2	
Calcium (me/100g)	0,5	
Magnesium (me/100g)	0,2	
S - value (me/100g)	0,9	
T - value (me/100g)	9,3	

*Symbols used:	Formation (Vegetation)	F - forest
	Geomorphology	H - kloof
	Formation (Geology)	Sl - sandstone (Formation Alma Graywacke)
	Form	M - Mispah
	Series	M - Mispah
** N/O:	Not observable	

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communities. *Podocarpus latifolius* is non-diagnostic (general) and infrequent section of Table 5.2) but physiognomically conspicuous in all the kloof communities and also in portions of the main vegetation types B and occasionally in D and E (Table 5.2). An example of kloof forest vegetation in the west of the study area (community 5.2) is shown in Fig. 5.5.

In the phytosociological classification, the kloof forest communities are classified as follows (Tables 5.1 and 5.2):

5.1 *Celtis africana* — *Erythrina lysistemon* kloof forest, found below 1 101 m altitude on sandstone.
5.2 *Celtis africana* — *Osyris lanceolata* kloof forest, found at altitudes of 1 300 m to 1 400 m on diabase.
5.3 *Celtis africana* — *Asplenium splendens* kloof forest, found at altitudes of 1 600 m and 1 850 m on sandstone.

5.1 *Celtis africana* — *Erythrina lysistemon* kloof forest

The *Celtis africana* — *Erythrina lysistemon* kloof forest is found below 1 101 m in a deep kloof in the south east of the study area (Fig. 5.1). It is represented by relevés 98 and 100 with 17 and 21 species per relevé respectively. This forest community (Edwards, 1976) has an rL structure (Ito, 1979; Fig. 5.4 a) with the greatest average cover of 65 percent in the upper height classes higher than eight metres. The kloof is subjected to cold air drainage (Coetzee, 1975) and being situated lower than the other two kloof forest communities, is not only cooler at night but can probably reach higher day temperatures resulting in a greater temperature range than the other kloof forest communities in the study area.

Habitat

The habitat factors recorded for the community are shown in Table 5.4 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series, derived from sandstone of the Alma Graywacke Formation.

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The average soil depth varies from 190 mm to 450 mm and the surface rock cover averages 60 percent. The kloof slopes from 3° to 6° in a south to south-west direction. The electrical resistance of the soil is the highest in relation to the other kloof communities and the T-value is the lowest (Table 5.2), indicating nutrient poor soils. This may be attributed to the low altitude with consequent greater streamflow than the high-lying kloofs. The nutrient poor soils may also be attributed to periodic flooding as the quadrats were placed below the observable floodline when sampling. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 4,8 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the *Plectranthus verticillatus* species-group (Table 5.2 A). The following are character species for the community:

- *Erythrina lysistemon* (shrub), E
- *Glycine wightii* (forb), E
- *Plectranthus verticillatus* (forb), S

The species diversity per unit area is low for the study area with an average of 4 species/m² for the community (Table 5.4).

Trees and shrubs

Conspicuous woody species with more than 5 percent mean cover and occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Podocarpus latifolius* (tree)	100%	53%
- *Celtis africana* (tree)	100%	46%
- *Buxus macowani* (shrub)	100%	18%
- *Diospyros whyteana* (shrub)	100%	6%
- *Ficus capensis* (tree)	100%	6%

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Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Plectranthus verticillatus* (forb)	100%	0,50%
- *Glycine wightii* (forb)	100%	0,28%
- *Mohria caffrorum* (fern)	100%	0,05%

General

Communities 5.1 and 5.2 are related to each other through the mutual presence of the *Olea europaea* species-group (Table 5.2 C) and communities 5.1, 5.2 and 5.3 are related to each other through the mutual presence of the *Diospyros whyteana* species-group (Table 5.2 F). Community 5.1 has no species-groups in common with the other main vegetation types found in the study area, which may be attributed to the low altitude of community 5.1 and the surrounding vegetation not having been sampled. It is, therefore, suggested that this community could have a higher occurrence of species in common with the low-lying, valley vegetation.

The veld condition assessment (see chapter 6) shows a similar trend to the other kloof communities (Table 5.2), namely, with few Decreaser species and a high proportion of Increaser I species. The latter are species that increase when the vegetation is underutilized (Foran, Tainton and Booysen, 1978) . The higher proportion of Increaser II species in relevé number 100 (Table 5.4) may be attributed to the disturbance caused by seasonal flooding. A higher proportion of Increaser II species could also be expected where fire causes disturbance (Tainton,* pers. comm.), however, no signs of fire were observed in relevé number 100.

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TABLE 5.5 Habitat factors recorded for the *Celtis africana - Osyris lanceolata* kloof forest (community 5.2)

Relevé number	166	163	169	168	162	167	161	170
Vegetation								
Canopy cover (%)	≥ 80	≥80	≥80	≥80	≥80	≥80	≥80	≥80
Formation*	F	F	F	F	F	F	F	F
Species diversity (per m^2)	3	3	3	2	2	3	3	2
Species per relevé	22	13	18	21	21	23	21	11
Veld condition								
Final score (%)	21	9	11	11	61	21	100	5
Composition score (%)	21	29	13	13	63	25	100	9
Basal cover (%)	4	1	2	4	2	4	2	4
Decreasers (%)	0	0	0	0	33	11	31	0
Increaser I (%)	64	64	41	78	24	55	33	79
Increaser II (%)	36	36	59	22	43	34	36	21
Increaser III (%)	0	0	0	0	0	0	0	0
Selaginella dregei (%)	0	0	0	0	0	0	0	0
Topography								
Geomorphology*	H	H	H	H	H	H	H	H
Altitude (m)	1 350	1 400	1 325	1 350	1 400	1 350	1 400	1 300
Slope (°)	13	3	23	17	3	17	10	8
Aspect	W	S	W	W	SW	W	SW	S
Geology								
Formation*	DI	DI	DI	DI	DI	DI	DI	DI
Surface rock cover (%)	15	15	20	20	15	15	40	15
Soil								
Form*	S	S	S	S	S	S	S	S
Series*	B	B	B	B	B	B	B	B
Depth (mm)	140	470	140	150	280	150	320	160
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	2,6							
Titratable acidity (me/100g)	3,7							
Aluminium (me %)	0,2							
Electrical resistance (ohms)	880							
pH (H_2O)	6,5							
pH ($CaCl_2$)	5,9							
Sodium (me/100g)	0,0							
Potassium (me/100g)	0,9							
Calcium (me/100g)	6,4							
Magnesium (me/100g)	3,4							
S - value (me/100g)	10,7							
T - value (me/100g)	16,5							

*Symbols used:	Formation (Vegetation)	F - forest
	Geomorphology	H - kloof
	Formation (Geology)	DI - diabase (post - Waterberg Group)
	Form	S - shortlands
	Series	B - bokuil
** N/O:	Not observable	

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5.2 *Celtis africana* — *Osyris lanceolata* kloof forest

The *Celtis africana* — *Osyris lanceolata* kloof forest is found at altitudes of 1 300 m to 1 400 m in Bakker's Pass, on the escarpment in the west of the study area (Fig. 5.1). It is represented by eight relevés (Table 5.2) with 13 to 23 species per relevé. This forest community (Edwards, 1976) has an rL structure (Ito, 1979; Fig. 5.4 b) with the greatest average cover of 50 percent in the >5 - 8 metre height class. There are several non-perennial streams in the community which, in area, is the largest of the kloof communities (Fig. 5.1). The community is sheltered and is situated at an altitude between that of the other kloof communities (Table 5.2), probably resulting in the lowest temperature range and highest humidity of the kloof forest communities.

Habitat

The habitat factors recorded for the community are shown in Table 5.5 and summarized in Table 5.2. The soils are of the Shortlands Form, Bokuil Series, derived from diabase of the post-Waterberg Group. The average soil depth varies from 140 mm to 470 mm and the surface rock cover varies from 15 to 40 percent. The kloof slopes from 3° to 17° in a southerly to westerly direction. The electrical resistance of the soil is the lowest recorded for all the communities in the study area, while the T-value is amongst the highest (Table 5.2), indicating nutrient rich soils. The soils are moderately acid (MacVicar, et al., 1977) with a pH of 6,5 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the *Osyris lanceolata* species-group (Table 5.2 B). The following are character species for the community:

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- *Acokanthera oppositifolia* (shrub), E
- *Calpurnia* cf *aurea* (tree/shrub), E
- *Clerodendrum glabrum* (tree), E
- *Ehretia rigida* (shrub), E
- *Euphorbia ingens* (tree), E
- *Ficus burkei* (tree), E
- *Osyris lanceolata* (shrub), E
- *Sphedamnocarpus pruriens* var. *pruriens* (shrub), E
- *Tricalysia lanceolata* (tree), E
- *Vepris lanceolata* (shrub), E

The species diversity per unit area is the lowest for the kloof communities with an average of 2,6 species /m² for the eight relevés (Table 5.5).

Trees and shrubs

Conspicuous woody species with more than 5 percent mean cover and occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Osyris lanceolata* (shrub)	100%	35%
- *Maytenus undata* (shrub)	88%	16%
- *Olea europaea* subsp. *africana* (shrub)	88%	9%
- *Tricalysia lanceolata* (shrub)	45%	12%

Herbs

The only herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) is:

- *Cyperus albostriatus* (sedge)	63%	0,8%

The presence of a sedge as the most conspicuous species in the herb stratum is indicative of the mesic conditions in this community.

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General

Communities 5.1 and 5.2 are related to each other through the mutual presence of the *Olea europaea* species-group (Table 5.2 C) and communities 5.2 and 5.3 are related to each other through the mutual presence of the *Myrsine africana* species-group (Table 5.2 E) while the *Diospyros whyteana* species-group (Table 5.2 F) is common to communities 5.1, 5.2 and 5.3. The *Cyperus albostriatus* species-group (Table 5.2 H) shows affinities with the main vegetation type B but as the affinity is limited to communities 5.4 and 5.5 this species-group may be regarded as being representative of forest margin species.

The veld condition assessment (see chapter 6) of this community is generally similar to that of the other kloof forest communities with the exception of relevé numbers 161, 162 and 167 (Table 5.5) which have a relatively higher proportion of Decreaser species. The community is accessible to grazing in places and the areas represented by these relevés contain grass patches as forest incursors.

5.3 *Celtis africana* — *Asplenium splendens* kloof forest

The *Celtis africana* — *Asplenium splendens* kloof forest is found at altitudes of 1 600 m to 1 850 m (Table 5.6) in two kloofs in the north and north-east of the study area (Fig. 5.1). It is represented by six relevés (Table 5.6) with 13 to 24 species per relevé. This forest community (Edwards, 1976) has an rL structure (Ito, 1979; Fig. 5.4 c) with the greatest average cover of over 50 percent in the higher than twelve metres height class. This kloof forest community is found at the highest altitude for the kloof forest communities in the study area and is consequently influenced by mist which occurs frequently on the Kransberg massif, but because the kloofs are generally shallow the community is more exposed than the other kloof communities and should, therefore, experience a greater amplitude in temperature.

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TABLE 5.6 Habitat factors recorded for the *Celtis africana* - *Asplenium splendens* kloof forest (community 5.3)

Relevé number	106	76	105	108	113	107
Vegetation						
Canopy cover (%)	≥80	≥80	≥80	≥80	≥80	≥80
Formation*	F	F	F	F	F	F
Species diversity (per m²)	3	5	1	3	2	3
Species per relevé	19	24	13	16	18	16
Veld condition						
Final score (%)	100	82	8	7	9	28
Composition score (%)	100	84	40	34	21	40
Basal cover (%)	2	2	1	1	2	1
Decreasers (%)	0	0	0	0	0	0
Increaser I (%)	82	71	64	66	26	70
Increaser II (%)	18	29	36	34	74	30
Increaser III (%)	0	0	0	0	0	0
Selaginella dregei (%)	0	0	0	0	0	0
Topography						
Geomorphology	H	H	H	H	H	H
Altitude (m)	1 750	1 850	1 850	1 600	1 675	1 700
Slope (°)	30	25	30	22	17	27
Aspect	S	SE	S	S	S	S
Geology						
Formation*	S3	S3	S3	S3	S3	S3
Surface rock cover (%)	80	80	95	75	40	80
Soil						
Form*	M	M	M	M	M	M
Series*	M	M	M	M	M	M
Depth (mm)	180	350	200	170	390	180
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	10,4					
Titratable acidity (me/100g)	27,7					
Aluminium (me%)	2,0					
Electrical resistance (ohms)	2 200					
pH (H_2O)	4,1					
pH ($CaCl_2$)	3,8					
Sodium (me/100g)	0,1					
Potassium (me/100g)	0,5					
Calcium (me/100g)	1,2					
Magnesium (me/100g)	0,5					
S - value (me/100g)	2,3					
T - value (me/100g)	22,0					

*Symbols used:	Formation (Vegetation)	F - forest
	Geomorphology	H - kloof
	Formation (Geology)	S3 - sandstone (Formation Sandriviersberg)
	Form	M - Mispah
	Series	M - Mispah
** N/O:	Not observable	

Habitat

The habitat factors recorded for the community are shown in Table 5.6 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series, derived from sandstone of the Sandriviersberg Formation. The average soil depth varies from 170 mm to 390 mm and the surface rock cover varies from 40 to 95 percent.

The kloofs slope from 17° to 30° in a southerly to south-easterly direction. The electrical resistance of the soil is low at 2 200 ohms with a high T-value of 22,0 me/100 g indicating a richer nutrient status than for community 5.1. This may be attributed to the protection afforded to the soil, which is found mostly in pockets between boulders, by the large rocks and boulders found in this community. The effect of streamflow on the leaching of nutrients from the soil should thus be minimized. Furthermore, the streamflow in these two kloofs is considerably less than in the other kloofs because these two kloofs are situated at a high altitude and do not have feeder streams. It is also suggested that this community is not subjected to as severe flooding as the other kloof communities. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 4,1 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the *Asplenium splendens* species-group (Table 5.2 D). The following are character species for the community:

- *Asplenium splendens* (fern), E
- *Carex spicato-paniculata* (sedge), E
- *Cyathula cylindrica* (forb), E
- *Pterocelastrus echinatus* (shrub), E

The species diversity per unit area averages 2,8 species/m^2 for the six relevés (Table 5.6).

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Fig. 5.6 *Alsophila dregei* in the *Celtis africana* — *Asplenium splendens* kloof forest

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Trees and shrubs

Conspicuous woody species, with more than 5 percent mean cover and occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Celtis africana* (tree)	100%	52%
- *Podocarpus latifolius* (tree)	83%	47%

Myrsine africana and *Diospyros whyteana* both occur with 100 percent constancy but with 2,5 percent and 2,2 percent mean cover respectively. *Widdringtonia nodiflora* occurs with 33 percent constancy and 1,3 percent cover but also occurs in the grassland community 5.18 as a forest element.

The smaller kloof represented by relevé number 113 has a high cover-abundance (11% - 25%) of the tree fern *Alsophila dregei* (Fig. 5.6; Table 5.2). This smaller kloof is relatively inaccessible, while the larger kloof is more accessible, being the most used route to the top of Kransberg. There are, however, isolated stumps of *Alsophila dregei* in the larger kloof, suggesting that the habitat is suitable for growth of the tree fern. It is suggested, therefore, that were it not for the removal of*Alsophila dregei* this species would be a character species for community 5.3 with a high cover-abundance.

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Plectranthus fruticosus* (forb)	100%	2,3%
- *Cyperus albostriatus* (sedge)	100%	8 %
- *Pteridium aquilinum* (fern)	83%	0,4%
- *Asplenium splendens* (fern)	83%	0,2%
- *Pellaea calomelanos* (fern)	83%	0,4%
- *Carex spicato-paniculata* (sedge)	67%	0,7%

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General

Communities 5.2 and 5.3 are related to each other through the mutual presence of the *Myrsine africana* species-group (Table 5.2 E) and the *Diospyros whyteana* species-group (Table 5.2 F) is common to the three kloof forest communities. The *Cyperus albostriatus* species-group (Table 5.2 H) shows affinities with the main vegetation type B but only as regards forest margin species. Community 5.3 is similar to community 5.2 in respect of common species-groups, however, unlike community 5.2, community 5.3 does not have the *Olea europaea* species-group (Table 5.2 C) in common with community 5.1. This difference may be attributed to the higher altitude in which community 5.3 occurs indicating that the *Olea europaea* species-group (Table 5.2 C) does not occur above 1 400 m altitude.

The veld condition assessment (see chapter 6) is similar to that of the other kloof communities, except for relevé 113 which has a higher proportion of Increaser II species. This is because *Cymbopogon validus*, an Increaser II species, is present on the margins of the smaller kloof with a high (6% - 10%) percentage cover (Table 5.2).

B. WOODLAND, REPRESENTATIVE OF ACOCKS'S (1975) SOUR BUSHVELD, ON MODERATELY DEEP TO DEEP SOILS IN MODERATELY EXPOSED HABITATS

The woodland communities, representative of Acocks's (1975) Sour Bushveld are found south of the Kransberg massif in the study area (Fig. 5.1) below 1 600 m altitude.

Habitat

The soils are mainly of the Mispah Form, Mispah Series with the Hutton Form, Middelburg Series, Shortlands Form, Bokuil Series and the Westleigh Form, Sibasa Series also occurring. Soil depth varies from 40 mm to more than 1 000 mm with 57 percent of the soil depths recorded being greater than 130 mm. The communities are more exposed than the kloof communities but more sheltered than the communities on the upper slopes of the Kransberg massif and on the upper summit (Fig. 2.2), being sheltered by the Kransberg massif.

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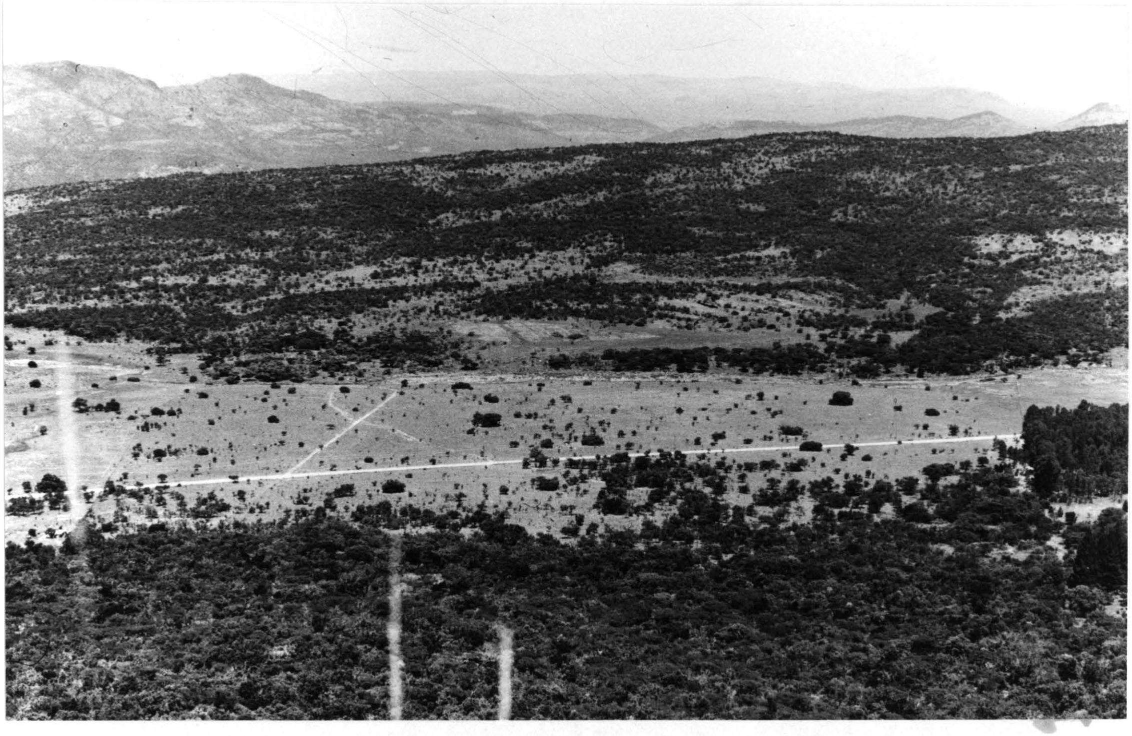

Fig. 5.7 Woodland representative of Acocks's (1975) Sour Bushveld with the *Combretum molle* — *Panicum maximum* and *Combretum molle* — *Euclea crispa* closed woodlands in the foreground and the *Combretum molle* — *Landolphia capensis* closed woodland in the background.

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Floristics

The vegetation is structurally heterogeneous, varying from closed woodland to open woodland and occasionally sparse woodland (Table 5.2). An example of closed woodland communities is shown in Fig. 5.7.

The *Combretum molle* species-group (Table 5.2 AC) is differentiating for the woodland communities representing Acocks's (1975) Sour Bushveld (main vegetation type B). The grasslands representative of Acocks's (1975) Sour Bushveld (main vegetation type C) are related to the main vegetation type B through the mutual presence of the *Schizachyrium sanguineum* species-group (Table 5.2 W). The *Aristida aequiglumis* species-group (Table 5.2 Q) which contains species such as *Burkea africana* and *Ochna pulchra* has a narrower ecological amplitude than the *Combretum molle* species-group (Table 5.2 AC) and is common to communities 5.5 to 5.11.

In the phytosociological classification the communities of the main vegetation type B are classified as follows (Tables 5.1 and 5.2):

5.4 *Combretum molle* — *Panicum maximum* closed woodland
5.5 *Combretum molle* — *Euclea crispa* closed woodland
5.6 *Combretum molle* — *Setaria megaphylla* closed woodland
5.7 *Combretum molle* — *Terminalia sericea* closed woodland
5.8 *Combretum molle* — *Aristida diffusa* open woodland
5.8.1 *Combretum molle* — *Artisda diffusa* — *Strychnos madagascariensis* variation
5.8.2 *Combretum molle* — *Artistida diffusa* — *Vitex rehmannii* variation
5.9 *Combretum molle* — *Landolphia capensis* closed woodland
5.9.1 *Combretum molle* — *Landolphia capensis* — *Burkea africana* variation
5.9.2 *Combretum molle* — *Landolphia capensis* — *Tapiphyllum parvifolium* variation
5.10 *Combretum molle* — *Coleochloa setifera* open woodland
5.11 *Combretum molle* — *Heteropogon contortus* closed and open woodlands
5.11.1 *Combretum molle* — *Heteropogon contortus* — *Rhus dentata* closed woodland variation
5.11.2 *Combretum molle* -- *Heteropogon contortus* — *Chaetacanthus costatus* open woodland variation

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TABLE 5.7 Habitat factors recorded for the *Combretum molle* — *Panicum maximum* closed woodland (community 5.4)

Relevé number	148	136	133	137	155	135	142	144	138	141
Vegetation										
Canopy cover (%)	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	1-8
Formation*	W	W	W	W	W	W	W	W	W	W
Species diversity (per m²)	6	6	8	6	6	6	5	7	2	6
Species per relevé	21	32	28	24	26	33	26	22	24	24
Veld condition										
Final score (%)	100	15	17	13	9	9	13	15	13	1
Composition score (%)	100	17	19	15	9	12	16	18	17	5
Basal cover (%)	3	5	1	6	5	2	2	2	1	3
Decreasers (%)	70	10	14	27	5	9	0	3	4	20
Increaser I (%)	6	1	3	0	4	6	8	13	8	4
Increaser II (%)	24	88	83	73	91	85	92	84	88	76
Increaser III (%)	0	1	0	0	0	0	0	0	0	0
Selaginella dregei (%)	0	0	0	0	0	0	0	0	0	0
Topography										
Geomorphology*	E	E	E	E	E	E	E	E	E	E
Altitude (m)	1 475	1 450	1 500	1 450	1 600	1 500	1 475	1 500	1 450	1 550
Slope (°)	6	8	8	5	8	25	8	4	3	12
Aspect	S	S	S	S	S	S	S	S	S	S
Geology										
Formation*	S2	S2	S2	S2	S2	S2	S2	S2	S2	S2
Surface rock cover (%)	1	1	1	1	10	25	15	1	10	40
Soil										
Form*	M	M	M	M	M	M	M	M	M	M
Series*	M	M	M	M	M	M	M	M	M	M
Depth (mm)	360	200	370	200	150	150	250	500	260	190
Watertable depth (mm)	N/0	N/0	N/0	N/0	N/0	N/0	N/0	N/0	N/0	N/0
Carbon (%)	1,3									
Titratable acidity (me/100g)	7,8									
Aluminium (me %)	0,5									
Electrical resistance (ohms)	4 700									
pH (H_2O)	4,8									
pH ($CaCl_2$)	4,4									
Sodium (me/100g)	0,0									
Potassium (me/100g)	0,2									
Calcium (me/100g)	0,4									
Magnesium (me/100g)	0,2									
S - value (me/100g)	0,8									
T - value (me/100g)	8,5									

*Symbols used:	Formation (vegetation)	W - woodland
	Geomorphology	E - lower slopes
	Formation (Geology)	S2 - sandstone (Formation Aasvoëlkop)
	Form	M - Mispah
	Series	M - Mispah
** N/0	Not observable	

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5.12 *Combretum molle* — *Themeda triandra* open woodland
5.13 *Combretum molle* — *Arbyrolobium transvaalense* open woodland
5.14 *Combretum molle* — *Pachycarpus schinzianus* open woodland
5.15 *Combretum molle* — *Protea caffra* open woodland

5.4 *Combretum molle* — *Panicum maximum* closed woodland

The *Combretum molle* — *Panicum maximum* closed woodland is found at altitudes of 1 450 m - 1 600 m on the lower slopes of the Kransberg massif in the north of the study area (Fig. 5.1). It is represented by ten relevés (Table 5.7) with 21 to 33 species per relevé. This closed woodland community (Edwards, 1976) has a D structure (Ito, 1979; Fig. 5.4 d) with the greatest average cover of about 27 percent in the >3 m - 5 m height class. Because the slopes on which this community is found are south facing, the temperature is likely to be lower than that of the north facing slopes (Theron, 1973) and should, therefore, have a smaller temperature amplitude, if night temperatures are equal, than that of the north facing slopes.

Habitat

The habitat factors recorded for the community are shown in Table 5.7 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series, derived from sandstone of the Aasvoëlkop Formation. The average soil depth varies from 150 mm to 500 mm and the surface rock cover varies from 1 percent to 40 percent. The terrain slopes from 3° to 25° in a southerly direction. The electrical resistance of the soil is 4 700 ohms and the T-value is 8,5 me/100 g which is moderate for a study area indicating a moderate nutrient status. As the community is situated on the lower slopes, nutrient accumulation from runoff is greater than for the upper slopes (Russell, 1961), where greater leaching can be expected. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 4,8 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the

Achyranthes aspera species-group (Table 5.2 G). The following are differential species for the community:

- *Achyranthes aspera* (forb), E
- *Bidens pilosa* (forb), E
- *Clematis* sp. (shrub), P
- *Panicum maximum* (grass), S
- *Tagetes minuta* (forb), S

The species diversity per unit area averages 5,8 species/m² for the community (Table 5.7). The character species for the species-group are mainly pioneer forbs, which could have a wider presence than that indicated on Table 5.2. However, at the time of sampling they were characteristic of community 5.4 in the study area and are, therefore, classified accordingly.

Trees and shrubs

Conspicuous woody species with more than 5 percent mean cover and occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Combretum molle* (tree/shrub)	90%	7,1%
- *Rhus leptodictya* (tree/shrub)	80%	5,1%
- *Faurea saligna* (tree/shrub)	60%	6,2%

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Achyranthes aspera* (forb)	100%	1,2%
- *Tagetes minuta* (forb)	80%	2,8%
- *Oxalis depressa* (forb)	70%	0,2%
- *Cymbopogon validus* (grass)	60%	0,9%
- *Bidens pilosa* (forb)	60%	0,3%

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General

Communities 5.2, 5.3, 5.4 and 5.5 are related to each other through the mutual presence of the *Cyperus albostriatus* species-group (Table 5.2 H). Communities 5.4 and 5.5 are structurally similar (Figs. 5.4 d and 5.4 e) and because they occur next to each other in the study area cannot be separated on aerial photographs. They are, therefore, mapped as a single unit in Fig. 5.1. The two communities represent a transitional vegetation zone between the main vegetation types A and B because they do not have perennial character species which are at present apparent (Table 5.2).

The final score for the veld condition assessment (Table 5.2) is the lowest in the study area for community 5.4 as a whole. Increaser II species have the highest proportion basal cover (Table 5.7) which indicates overutilization due to severe grazing pressure (Foran, Tainton and Booysen, 1978). The community is, furthermore, characterized by pioneer forbs with a high mean percentage cover for the herb stratum (Table 5.2 G) which indicates disturbance. Community 5.4 can, therefore, be said to be severely overgrazed. However, in the absence of the *Achyranthes aspera* species-group (Table 5.2 G) which could possibly be brought about by reduced grazing pressure, this community could be floristically more similar to community 5.5 than is indicated on Table 5.2.

5.5 *Combretum molle* — *Euclea crispa* closed woodland

The *Combretum molle* — *Euclea crispa* closed woodland is found at altitudes of 1 500 m to 1 550 m on the lower slopes of the Kransberg massif in the north of the study area (Fig. 5.1). It is represented by relevés 145, 153 and 134 with 25, 30 and 34 species per relevé respectively. This closed woodland community (Edwards, 1976) has a D structure (Ito, 1979; Fig. 5.4 e) with the greatest average cover of 23 percent in the >3 m - 5 m height class. Because the community is adjacent to community 5.4 the temperature and moisture regimes should be similar to that of community 5.4.

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TABLE 5.8 Habitat, factors recorded for the *Combretum molle - Euclea crispa* closed woodland (community 5.5)

Relevé number	145	153	134
Vegetation			
Canopy cover (%)	9-79	9-79	9-79
Formation*	W	W	W
Species diversity (per m²)	4	5	5
Species per relevé	25	30	34
Veld condition			
Final score (%)	100	32	8
Composition score (%)	100	34	14
Basal cover (%)	4	8	2
Decreasers (%)	44	30	12
Increaser I (%)	6	3	9
Increaser II (%)	36	37	79
Increaser III (%)	14	30	0
Selaginella dregei (%)	0	0	0
Topography			
Geomorphology*	E	E	E
Altitude (m)	1 550	1 550	1 500
Slope (°)	16	12	8
Aspect	S	S	SE
Geology			
Formation*	S2	S2	S2
Surface rock cover (%)	60	30	20
Soil			
Form*	M	M	M
Series*	M	M	M
Depth (mm)	150	240	160
Watertable depth (mm)**	N/O	N/O	N/O
Carbon (%)	1,3		
Titratable acidity (me/100g)	7,8		
Aluminium (me%)	0,5		
Electrical resistance (ohms)	4 700		
pH (H_2O)	4,8		
pH ($CaCl_2$)	4,4		
Sodium (me/100g)	0,0		
Potassium (me/100g)	0,2		
Calcium (me/100g)	0,4		
Magnesium (me/100g)	0,2		
S - value (me/100g)	0,8		
T - value (me/100g)	8,5		

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	E - lower slopes
	Formation (Geology)	S2 - sandstone (Formation Aasvoëlkop)
	Form	M - Mispah
	Series	M - Mispah
** N/O:	Not observable	

Habitat

The habitat factors recorded for the community are shown in Table 5.8 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series, derived from sandstone of the Aasvoëlkop Formation. The average soil depth varies from 150 mm to 240 mm and the surface rock cover varies from 20 percent to 60 percent. The terrain slopes from 8° to 16° in a southerly to south-easterly direction. The electrical resistance of the soil is 4 700 ohms and the T-value is 8,5 me/100 g which is similar to that of community 5.4. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 4,8 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the absence of character species, as well as the absence of the *Achyranthes aspera* species-group (Table 5.2 G), and the presence of the *Aristida aequiglumis* species-group (Table 5.2 Q) and *Cyperus albostriatus* species-group (Table 5.2 H). The species diversity per unit area averages 4,7 species /m^2 for the community (Table 5.8) which is less than for community 5.4 possibly as a result of the high surface rock cover in community 5.5 with consequently less soil area for vegetation as well as fewer annual and pioneer species.

Trees and shrubs

Conspicuous woody species with more than 5 percent mean cover and occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Combretum molle* (tree/shrub)	100%	5,8%
- *Burkea africana* (tree/shrub)	67%	6,8%

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Heteropogon contortus* (grass)	100%	4,2%
- *Andropogon schirensis* (grass)	100%	1,8%
- *Cyperus leptocladus* (sedge)	100%	0,5%
- *Pellaea calomelanos* (fern)	100%	0,05%
- *Eragrostis racemosa* (grass)	67%	1,7%
- *Loudetia simplex* (grass)	67%	1,7%
- *Rhynchosia spectabilis* (forb)	67%	1,0%
- *Bulbostylis burchellii* (sedge)	67%	0,1%
- *Commelina africana* (forb)	67%	0,05%
- *Oxalis depressa* (forb)	67%	0,03%

General

Communities 5.2, 5.3, 5.4 and 5.5 are related to each other through the mutual presence of the *Cyperus albostriatus* species-group (Table 5.2 H) and communities 5.5 to 5.11 are related to each other through the mutual presence of the *Aristida aequiglumis* species-group (Table 5.2 Q). As mentioned in paragraph 5.4, community 5.5 together with community 5.4 forms a transitional vegetation zone between the main vegetation types A and B.

The veld condition assessment (Table 5.2) indicates that this community, although subjected to heavy grazing is in a better condition with respect to grazing than community 5.4. This is shown by the final scores and relatively fewer Increaser II species for community 5.5 than for community 5.4 (Tables 5.7 and 5.8). The pioneer forbs present in community 5.4 (Table 5.2 G) are absent in community 5.5. *Selaginella dregei* is present in two of the three relevés representing community 5.5 indicating the high surface rock cover found in this community. Although the community is accessible to cattle, the high surface rock cover may possibly cause a grazing preference for community 5.4.

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TABLE 5.9 Habitat, factors recorded for the *Combretum molle* - *Setaria megaphylla* closed woodland (community 5.6)

Relevé number	103	101	102	99
Vegetation				
Canopy cover (%)	9-79	9-79	9-79	9-79
Formation*	W	W	W	W
Species diversity (per m²)	6	4	6	5
Species per relevé	27	26	27	21
Veld condition				
Final score (%)	5	9	100	40
Composition score (%)	7	27	100	40
Basal cover (%)	5	3	7	13
Decreasers (%)	48	22	68	58
Increaser I (%)	3	27	9	5
Increaser II (%)	49	51	23	37
Increaser III (%)	0	0	0	0
Selaginella dregei (%)	0	0	0	0
Topography				
Geomorphology*	H	H	H	H
Altitude (m)	1 375	1 325	1 350	1 075
Slope (°)	5	3	4	4
Aspect	S	S	S	SW
Geology				
Formation*	CO	CO	CO	Sl
Surface rock cover (%)	30	70	60	40
Soil				
Form*	M	M	M	M
Series*	M	M	M	M
Depth (mm)	150	190	200	210
Watertable depth (mm)**	N/O	N/O	N/O	N/O
Carbon (%)	1,3			
Titratable acidity (me/100g)	8,2			
Aluminium (me%)	1,2			
Electrical resistance (ohms)	4 300			
pH (H_2O)	4,8			
pH ($CaCl_2$)	4,1			
Sodium (me/100g)	0,0			
Potassium (me/100g)	0,2			
Calcium (me/100g)	0,5			
Magnesium (me/100g)	0,2			
S - value (me/100g)	0,9			
T - value (me/100g)	9,3			

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	H - kloof
	Formation (Geology)	CO - conglomerate (Formation Alma Graywacke)
		Sl - sandstone (Formation Alma Graywacke)
	Form	M - Mispah
	Series	M - Mispah
** N/O	Not observable	

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5.6 *Combretum molle* — *Setaria megaphylla* closed woodland

The *Combretum molle* — *Setaria megaphylla* closed woodland is found at altitudes of 1 075 m to 1 375 m in an open kloof in the east of the study area (Fig. 5.1). It is represented by relevés 103, 101, 102 and 99 with 27, 26, 27 and 21 species per relevé respectively. This closed woodland community (Edwards, 1976) has a D structure (Ito, 1979; Fig. 5.4 f) with the greatest average cover of about 22 percent in the >3 m - 5 m height class. Although the community is situated in a kloof, the kloof is very broad and shallow so that the vegetation is more exposed with a consequently greater temperature amplitude and is less moist than the other kloof forest communities. The vegetation is, therefore, a closed woodland and not forest as could be expected from the geomorphology class H (Table 5.2).

Habitat

The habitat factors recorded for the community are shown in Table 5.9 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series derived from conglomerate of the Alma Graywacke Formation in the case of relevés 103, 101 and 102 and sandstone of the Alma Graywacke Formation in the case of relevé 99. The average soil depth varies from 150 mm to 210 mm and the surface rock cover varies from 30 percent to 70 percent. The kloof slopes from 3° to 5° in a southerly to south-westerly direction. The electrical resistance of the soil is 4 300 ohms with a T-value of 9,3 me/100 g indicating soils of a moderate nutrient status for the study area. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 4,8 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the *Setaria megaphylla* species-group (Table 5.2 I). The following are character species for the community:

- *Hypoestes verticillaris* (forb), E
- *Senecio barbertonicus* (shrub), E
- *Setaria megaphylla* (grass), P

Setaria megaphylla is also found in community 5.1 with 100 percent constancy but with a lower mean percentage cover (Table 5.2) hence the classification of preferential character species. The species diversity per unit area averages 5,3 species/m², for the community (Table 5.9).

Trees and Shrubs

The only conspicuous woody species with more than 5 percent mean cover and occurring in more than 50 percent of the relevés representing the community (Table 5.2) is:

- *Elephantorrhiza burkei* (shrub)	75%	7%

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Setaria megaphylla* (grass)	100%	13,1%
- *Cyperus leptocladus* (sedge)	75%	0,9%
- *Hypoestes verticillaris* (forb)	75%	0,9%
- *Cheilanthes hirta* (fern)	75%	0,01%
- *Commelina africana* (forb)	75%	0,01%

General

Communities 5.5 to 5.11 are related to each other through the mutual presence of the *Aristida aequiglumis* species-group (Table 5.2 Q).

The final scores for the veld condition assessment are low for relevés 103 and 101 whereas the veld condition represented by relevés 102 and 99 is better with respect to grazing (Table 5.9). Relevé number 99

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TABLE 5.10 Habitat factors recorded for the *Combretum molle* - *Terminalia sericea* closed woodland (community 5.7)

Relevé number	79	80	77
Vegetation			
Canopy cover (%)	9-79	9-79	1-8
Formation*	W	W	W
Species diversity (per m²)	6	9	6
Species per relevé	30	30	22
Veld condition			
Final score (%)	5	7	100
Composition score (%)	7	11	100
Basal cover (%)	1	1	4
Decreasers (%)	10	10	2
Increaser I (%)	0	0	0
Increaser II (%)	90	90	36
Increaser III (%)	0	0	62
Selaginella dregei (%)	0	0	0
Topography			
Geomorphology*	B	B	B
Altitude (m)	1 415	1 415	1 425
Slope (°)	1	1	2
Aspect	N	N	N
Geology			
Formation*	CO	CO	CO
Surface rock cover (%)	1	1	2
Soil			
Form*	H	H	H
Series*	M	M	M
Depth (mm)	400	650	150
Watertable depth (mm)**	N/O	N/O	N/O
Carbon (%)	0,8		
Titratable acidity (me/100g)	6,0		
Aluminium (me%)	0,7		
Electrical resistance (ohms)	6 400		
pH (H_2O)	4,1		
pH ($CaCl_2$)	4,0		
Sodium (me/100g)	0,0		
Potassium (me/100g)	0,1		
Calcium (me/100g)	0,2		
Magnesium (me/100g)	0,2		
S - value (me/100g)	0,5		
T - value (me/100g)	5,9		

*Symbols used:
Formation (Vegetation) W - woodland
Geomorphology B - plateau
Formation (Geology) CO - conglomerate (Formation Alma Graywacke)
Form H - Hutton
Series M - Middelburg

** N/O: Not observable

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represents vegetation in an inaccessible habitat on the lower plateau while relevé number 102 represents vegetation on the opposite bank of a stream, to which cattle come to drink. The vegetation represented by relevé numbers 103 and 101 is on the same side of the stream as that used by cattle for drinking and the grazing pressure on the vegetation, represented by relevé numbers 103 and 101 is consequently high, resulting in the low final scores for these relevés. The low cover-abundance values (Table 5.2) for *Setaria megaphylla*, which is a good grazing species (G. du Plooy*, pers. comm.) is also indicative of the grazing pressure, to which the vegetation, represented by relevé numbers 103 and 101, is subjected.

5.7 *Combretum molle* — *Terminalia sericea* closed woodland

The *Combretum molle* — *Terminalia sericea* closed woodland is found at altutudes of 1 415 m to 1 425 m in the eastern central part of the study area on the upper plateau (Fig. 5.1). It is represented by relevés 79, 80 and 77 with 30, 30 and 22 species per relevé respectively. This closed woodland community (Edwards, 1976) has an rL structure (Ito, 1979; Fig. 5.4 g) with the greatest average cover of about 37 percent in the upper height class of >5 m - 8 m. The community is probably subjected to temperature inversion at night because it is situated near a stream in a depression. The temperature amplitude should, therefore, be high for the study area.

Habitat

The habitat factors recorded for the community are shown in Table 5.10 and summarized in Table 5.2. The soils are of the Hutton Form, Middelburg Series, derived from conglomerate of the Alma Graywacke Formation. The average soil depth varies from 150 mm to 650 mm and the surface rock cover varies from one percent to two percent. The terrain slopes from 1° to 2° in a northerly direction . The electrical resistance of the soil is 6 400 ohms and the T-value is 5,9 me/100 g

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indicating a poor nutrient status for the soils, which may be attributed to leaching. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 4,1 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the *Terminalia sericea* species-group (Table 5.2 J). The following are character species for the community:

- *Indigofera filipes* (forb), E
- *Rhus pyroides* (shrub), P
- *Terminalia sericea* (tree), S

The species diversity per unit area averages 7 species/m^2 for the community (Table 5.10) which is relatively high for the study area.

Trees and shrubs

Conspicuous woody species with more than 5 percent mean cover and occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Terminalia sericea* (tree)	100%	28,0%
Burkea africana (tree/shrub)	67%	8,5%

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Aristida aequiglumis* (grass)	100%	0,5%
- *Digitaria eriantha* subspecies *transvaalensis* (grass)	67%	1,0%
- *Perotis patens* (grass)	67%	1,0%
- *Rhynchelytrum repens* (grass)	67%	1,0%
- *Richardia brasiliensis* (forb)	67%	1,0%

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Fig. 5.8 *Combretum molle* — *Terminalia sericea* closed woodland with the grass layer grazed short.

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- *Anthospermum rigidum* (forb)	67%	0,3%
- *Bulbostylis burchellii* (sedge)	67%	0,3%
- *Cyperus denudatus* (sedge)	67%	0,3%
- *Heteropogon contortus* (grass)	67%	0,3%
- *Indigofera filipes* (forb)	67%	0,3%

General

Communities 5.5 to 5.11 are related to each other through the mutual presence of the *Aristida aequiglumis* species-group (Table 5.2 Q). The community is restricted to the moderately deep soils of the upper plateau which are well drained, but as these soils are limited in extent, the community is consequently small in area. On the northern side of the stream, opposite community 5.7, there is much cultivated land on moderately deep soils, which could have had the same vegetation as that of community 5.7.

The final score of the veld condition assessment (Table 5.10) is very low with a generally high proportion of Increaser II species compared with Decreaser species for relevé numbers 79 and 80 which indicates overgrazing. The vegetation represented by these two relevés is heavily overgrazed, as observed at the time of sampling, (Fig. 5.8) probably because the quadrats which the relevés represent, were placed near a kraal which is situated near the stream used for drinking by cattle. In contrast, the vegetation represented by relevé number 77, is subjected to selective grazing as is indicated by the high proportion of Increaser III species (Table 5.10). The vegetation represented by relevé number 77 is further away from the kraal and stream and personal observations have shown that the cattle only graze here while on their way to and from the kraal and stream.

5.8 *Comtretum molle — Aristida diffusa* open woodland

The *Combretum molle — Aristida diffusa* open woodland is found at altitudes of 1 250 m to 1 400 m on the lower slopes of the lower plateau in the south of the study area with an outlier of the community above the eastern kloof on the upper plateau (Fig. 5.1).

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The community is differentiated by the *Artistida diffusa* species-group (Table 5.2 K) which only has one character species, namely *Aristida diffusa* a grass that is a selective character species. The community is separated into the following two variations, based on floristics:

5.8.1 *Combretum molle* — *Aristida diffusa* — *Strychnos madagascariensis* variation found at,or below 1 325 m altitude.

5.8.2 *Combretum molle* — *Aristida diffusa* — *Vitex rehmannii* variation found at, or above 1 325 m altitude.

5.8.1 *Combretum molle* — *Aristida diffusa* — *Strychnos madagascariensis* variation found at, or below 1 325 m altitude

The *Combretum molle* — *Aristida diffusa* — *Strychnos madagascariensis* variation is found at altitudes of 1 250 m to 1 325 m, being the lowest altitude of the communities on the lower plateau in the south of the study area (Fig. 5.1). It is represented by six relevés (Table 5.11) with 23 to 38 species per relevé. This open woodland variation (Edwards, 1976) has an L structure (Ito, 1979; Fig. 5.4 h) with the greatest average cover of about 20 percent in the lowest height class of 0,0 m - 0,5 m. The lower plateau is exposed and a high temperature amplitude could be expected, while the open vegetation indicates a low moisture status for the variation.

Habitat

The habitat factors recorded for the variation are shown in Table 5.11 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series, derived from sandstone of the Alma Graywacke Formation. The average soil depth varies from 120 mm to 170 mm and the surface rock cover varies from 50 percent to 70 percent. The terrain slopes from 1° to 9° in a southerly to south-westerly direction. The electrical resistance of the soil is 3 500 ohms and the T-value is 7,1 me/100 g indicating a moderate nutrient status. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 5,4 when saturated with water.

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TABLE 5.11 Habitat factors recorded for the *Combretum molle - Aristida diffusa - Strychnos madagascariensis* variation (community 5.8.1)

Relevé number	82	85	84	83	88	81
Vegetation						
Canopy cover (%)	1-8	1-8	1-8	1-8	1-8	1-8
Formation*	W	W	W	W	W	W
Species diversity (per m²)	6	6	6	4	6	5
Species per relevé	38	31	30	23	33	32
Veld condition						
Final score (%)	9	32	100	8	14	17
Composition score (%)	31	42	100	24	19	24
Basal cover (%)	3	7	7	4	10	5
Decreasers (%)	6	18	53	3	12	3
Increaser I (%)	0	1	1	2	0	0
Increaser II (%)	91	73	46	93	82	96
Increaser III (%)	3	8	0	2	6	1
Selaginella dregei (%)	0	0	0	0	0	0
Topography						
Geomorphology*	E	E	E	E	E	E
Altitude (m)	1 260	1 300	1 250	1 275	1 325	1 275
Slope (°)	6	9	1	5	1	3
Aspect	SW	S	S	S	S	S
Geology						
Formation*	Sl	Sl	Sl	Sl	Sl	Sl
Surface rock cover (%)	60	60	60	50	70	60
Soil						
Form*	M	M	M	M	M	M
Series*	M	M	M	M	M	M
Depth (mm)	120	140	120	150	130	170
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	1,8					
Titratable acidity (me/100g)	3,6					
Aluminium (me%)	0,0					
Electrical resistance (ohms)	3 500					
pH (H_2O)	5,4					
pH ($CaCl_2$)	5,0					
Sodium (me/100g)	0,0					
Potassium (me/100g)	0,4					
Calcium (me/100g)	1,4					
Magnesium (me/100g)	0,7					
S - value (me/100g)	2,5					
T - value (me/100g)	7,1					

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	E - lower slopes
	Formation (Geology)	Sl - sandstone (Formation Alma Graywacke)
	Form	M - Mispah
	Series	M - Mispah
** N/O:	Not observable	

Floristics

The floristic composition of the variation is shown in Table 5.2 and summarized in Table 5.3. The variation is differantiated by the *Schrebera alata* species group (Table 5.2 L). The following are character species for the variation:

- *Blepharis subvolubilis* (forb), E
- *Enneapogon pretoriensis* (grass), E
- *Rhynchosia totta* (forb), E
- *Schrebera alata* (tree/shrub), E
- *Strychnos madagascariensis* (tree), E

The species diversity per unit area averages 5,5 species/m² for the variation (Table 5.11).

Trees and shrubs

Conspicuous woody species with a 2,5 percent or more mean cover and occurring in more than 50 percent of the relevés representing the variation (Table 5.2) are:

- *Pseudolachnostylis maprouneifolia* (tree/shrub)	100%	2,6%
- *Diplorhynchus condylocarpon* (tree/shrub)	100%	2,5%

The value of 2,5 percent or more, mean cover for the conspicuous woody plants has been reduced from the arbitrarily selected 5 percent used for the previous communities because community 5.8 is the first community with an open formation class. The 5 percent mean cover value is too high for open formation and no woody species would be detected.

Herbs

Herb species occurring in more than 50 percent of the relevés representing the variation (Table 5.2) are:

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- *Aristida diffusa* (grass)	100%	5,0%
- *Schizachyrium sanguineum* (grass)	100%	2,2%
- *Commelina africana*(forb)	100%	0,2%
- *Diheteropogon amplectens* (grass)	83%	2,9%
- *Aristida aequiglumis* (grass)	83%	1,8%
- *Heteropogon contortus* (grass)	67%	3,0%
- *Brachiaria nigropedata* (grass)	67%	1,0%
- *Elionurus muticus* (grass)	67%	1,0%
- *Rhynchelytrum setifolium* (grass)	67%	0,7%
- *Loudetia simplex* (grass)	67%	0,5%
- *Vernonia staehelinoides* (forb)	67%	0,3%
- *Tephrosia longipes* (forb)	67%	0,03%

General

Communities 5.8 and 5.9 are related to each other through the mutual presence of the *Diplorhynchus condylocarpon* species-group (Table 5.2 N) and communities 5.5 to 5.11 are related to each other through the mutual presence of the *Aristida aequiglumis* species-group (Table 5.2 Q), while communities 5.8 to 5.16 are related to each other through the mutual presence of the *Schizachyrium sanguineum* species-group (Table 5.2 W).

The condition of the vegetation in variation 5.8.1 is overgrazed as is indicated by the low final scores and high proportion of Increaser II species. Relevé number 84 represents vegetation in the extreme south of the variation which has a higher proportion of Decreaser species (Table 5.11). The vegetation in relevé 84 is less accessible because it is separated by a gully from the rest of the variation and hence the higher proportion of Decreaser species.

5.8.2 The *Combretum molle* — *Aristida diffusa* — *Vitex rehmannii* variation

The *Combretum molle* — *Aristida diffusa* — *Vitex rehmannii* variation is found at altitudes of 1 325 m to 1 400 m upslope of variation 5.8.1 on the lower plateau in the south of the study area and on the slopes leading to a kloof on the upper plateau in the east of the study area (Fig. 5.1). It is represented by six relevés (Table 5.12) with 20

TABLE 5.12 Habitat factors recorded for the *Combretum molle* - *Aristida diffusa* — *Vitex rehmannii* variation (community 5.8.2)

Relevé number	86	89	90	87	96	104
Vegetation						
Canopy cover (%)	1-8	1-8	1-8	1-8	9-79	9-79
Formation*	W	W	W	W	W	W
Species diversity (per m²)	5	5	5	5	5	4
Species per relevé	25	23	29	33	29	20
Veld condition						
Final score (%)	3	23	19	21	100	9
Composition score (%)	9	31	33	25	100	28
Basal cover (%)	4	7	5	10	10	4
Decreasers (%)	1	0	3	11	17	16
Increaser I (%)	0	0	0	0	1	4
Increaser II (%)	99	100	96	88	82	64
Increaser III (%)	0	0	1	1	0	0
Selaginella dregei (%)	0	0	0	0	0	16
Topography						
Geomorphology*	E	E	E	E	E	H
Altitude (m)	1 350	1 325	1 360	1 360	1 400	1 375
Slope (°)	1	1	1	0	28	20
Aspect	S	S	S		SE	N
Geology						
Formation*	Sl	Sl	Sl	Sl	Sl	CO
Surface rock cover (%)	60	70	60	60	60	60
Soil						
Form*	M	M	M	M	M	M
Series*	M	M	M	M	M	M
Depth (mm)	120	160	100	140	170	190
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	1,8				1,4	1,4
Titratable acidity (me/100g)	3,6				5,8	10,2
Aluminium (me%)	0,0				0,5	1,7
Electrical resistance (ohms)	3 500				6 000	6 700
pH (H_2O)	5,4				5,0	4,5
pH ($CaCl_2$)	5,0				4,3	3,8
Sodium (me/100g)	0,0				0,0	0,0
Potassium (me/100g)	0,4				0,2	0,1
Calcium (me/100g)	1,4				0,7	0,2
Magnesium (me/100g)	0,7				0,2	0,3
S - value (me/100g)	2,5				0,9	0,6
T - value (me/100g)	7,1				7,4	10,5

*Symbols used: Formation (Vegetation) W - woodland
Geomorphology E - lower slopes, H - kloof
Formation (Geology) Sl - sandstone (Formation Alma Graywacke)
CO - conglomerate (Formation Alma Graywacke)
Form M - Mispah
Seires M - Mispah

**N/O Not observable

to 33 species per relevé. This open woodland variation (Edwards, 1976) has an L structure (Ito, 1979; Fig. 5.4 i) with the greatest average cover of 25 percent in the lowest height class of 0,0 m - 0,5 m, which is greater than that for variation 5.8.1. The temperature and moisture regimes should be similar to that of variation 5.8.1.

Habitat

The habitat factors recorded for the variation are shown in Table 5.12 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series derived from sandstone in the case of relevés 86, 89, 90, 87 and 96 and conglomerate in the case of relevé 104, both of the Alma Graywacke Formation. The average soil depth varies from 100 mm to 190 mm and the surface rock cover varies from 60 percent to 70 percent. The terrain slopes up to 28° in a southerly to south easterly direction in the case of relevés 86, 89, 90, 87 and 96 and in a northerly direction in the case of relevé 104. The electrical resistance varies from 3 500 ohms to 6 700 ohms and the T-value varies from 7,1 me/100 g to 10,5 me/100 g, indicating soils of a moderate nutrient status. The soils are strongly acid (MacVicar, et al., 1977) with a pH range of 4,5 to 5,4 when saturated with water.

The difference in the soil factors found in this variation may be attributed to the difference in parent materials in the case of relevé 104 and possibly to the leaching effect of a seasonal stream which causes periodic flooding in the vicinity of relevé 96, with increased runoff and consequent leaching.

Floristics

The floristic composition of the variation is shown in Table 5.2 and summarized in Table 5.3 The variation is differentiated by the absence of character species and notably the absence of the species of the *Schrebera alata* species-group (Table 5.2 L) which differentiates this variation from the *Combretum molle* — *Aristida diffusa* — *Strychos madagascariensis* variation. The species diversity per unit area averages 4,8 species/m² for the variation (Table 5.12) which is lower than for variation 5.8.1.

Trees and shrubs

Conspicuous woody species with 2,5 percent or more mean cover and occurring in more than 50 percent of the relevés representing the variation (Table 5.2) are:

- *Combretum molle* (tree/shrub)	100%	2,9%
- *Diplorhynchus condylocarpon* (tree/shrub)	83%	4,6%

Vitex rehmannii is present with 83 percent constancy and 1,4 percent mean cover.

Herbs

Herb species occurring in more than 50 percent of the relevés representing the variation (Table 5.2) are:

- *Aristida diffusa* (grass)	83%	3,8%
- *Andropogon schirensis* (grass)	83%	2,9%
- *Aristida aequiglumis* (grass)	83%	1,4%
- *Commelina africana* (forb)	83%	0,4%
- *Tristachya biserriata* (grass)	67%	4,2%
- *Diheteropogon amplectens* (grass)	67%	1,7%
- *Bulbostylis burchellii* (sedge)	67%	1,0%

General

Variation 5.8.2 has the same affinities with other communities as that described for variation 5.8.1.

Vegetation in variation 5.8.2 is in an overgrazed condition as is indicated by the low final scores and high proportion of Increaser II species (Table 5.12). However, there are marginally more Increaser

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II species in variation 5.8.2 compared to variation 5.8.1 (compare Tables 5.11 and 5.12). As cattle move to the lower plateau from the upper plateau, variation 5.8.2. is encountered first (Fig. 5.1), which may account for the difference in Increaser II species.

5.9 *Combretum molle* — *Landolphia capensis* closed woodland

The *Combretum molle* — *Landolphia capensis* closed woodland is found at altitudes of 1 425 m to 1 550 m south of the upper plateau in the southern half of the study area (Fig. 5.1). The community is differentiated by the *Landolphia capensis* species-group (Table 5.2 M) which has the following character species:

- *Cyperus margaritaceus* (sedge), E
- *Hexalobus monopetalus* (shrub), E
- *Landolphia capensis* (shrub), P
- *Lannea discolor* (shrub), P

The community is separated into the following two variations, based on floristics:

5.9.1 *Combretum molle* — *Landolphia capensis* — *Burkea africana* variation found on soils with a moderate surface rock cover.

5.9.2 *Combretum molle* — *Landolphia capensis* — *Tapiphyllum parvifolium* variation found on soils with a moderate to high surface rock cover.

5.9.1 *Combretum molle* — *Landolphia capensis* — *Burkea africana* variation

The *Combretum molle* — *Landolphia capensis* variation is found at altitudes of 1 425 m to 1 550 m south of the upper plateau in the southern half of the study area (Fig. 5.1). It is represented by eight relevés (Table 5.13) with 19 to 31 species per relevé. This closed woodland variation (Edwards, 1976) has a D structure (Ito, 1979; Fig. 5.4 j) with the greatest average cover of 15

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TABLE 5.13 Habitat factors recorded for the *Combretum molle* — *Landolphia capensis* — *Burkei africana* variation (community 5.9.1)

Relevé number	48	44	39	32	41	45	97	40
Vegetation								
Canopy cover (%)	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79
Formation*	W	W	W	W	W	W	W	W
Species diversity (m^2)	8	4	4	4	5	4	5	6
Species per relevé	31	21	24	21	29	20	19	25
Veld condition								
Final score (%)	23	22	11	21	21	27	100	13
Composition score (%)	26	27	13	25	21	30	100	13
Basal cover (%)	10	10	8	7	18	7	23	8
Decreasers (%)	6	0	0	15	12	0	20	7
Increaser I (%)	0	0	0	0	0	0	0	0
Increaser II (%)	88	100	99	77	88	91	80	86
Increaser III (%)	6	0	1	8	0	9	0	7
Selaginella dregei (%)	0	0	0	0	0	0	0	0
Topography								
Geomorphology*	E	D	D	E	E	D	E	E
Altitude (m)	1 450	1 500	1 450	1 425	1 450	1 550	1 450	1 425
Slope (°)	3	6	6	6	3	0	2	6
Aspect	N	N	N	N	NE		E	N
Geology								
Formation*	CO	CO	CO	CO	CO	CO	CO	CO
Surface rock cover (%)	10	25	20	5	10	10	20	10
Soil								
Form*	M	M	M	M	M	M	M	M
Series*	M	M	M	M	M	M	M	M
Depth (mm)	200	250	250	150	150	170	130	40
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	1,4							
Titratable acidity (me/100g)	10,2							
Aluminium (me %)	1,7							
Electrical resistance (ohms)	6 700							
pH (H_2O)	4,5							
pH ($CaCl_2$)	3,8							
Sodium (me/100g)	0,0							
Potassium (me/100g)	0,1							
Calcium (me/100g)	0,2							
Magnesium (me/100g)	0,3							
S - value (me/100g)	0,6							
T - value (me/100g)	10,5							

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	E - lower slopes, D - upper slopes
	Formation (Geology)	CO - conglomerate (Formation Alma Graywacke)
	Form	M - Mispah
	Series	M - Mispah
** N/O:	Not observable	

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percent in the >3 m - 5 m height class. The variation occurs on north facing slopes and should therefore have a greater temperature amplitude than the south facing slopes (Theron, 1973), if night temperatures are the same.

Habitat

The habitat factors recorded for the variation are shown in Table 5.13 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series, derived from conglomerate of the Alma Graywacke Formation. The average soil depth varies from 40 mm to 250 mm and the surface rock cover varies from 5 percent to 25 percent. The terrain slopes up to 6° in a northerly to easterly direction. The electrical resistance is 6 700 ohms and the T-value is 10,5 me/100 g indicating soils of a moderate nutrient status for the study area. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 4,5 when saturated with water.

Floristics

The floristic composition of the variation is shown in Table 5.2 and summarized in Table 5.3. The variation is differentiated by the absence of character species as well as the absence of the *Selaginella dregei* species-group (Table 5.2 P) which differentiates the variation from the *Combretum molle* — *Landolphia capensis* — *Tapiphyllum parvifolium* variation. The species diversity per unit area averages 5 species/m^2 for the variation.

Trees and Shrubs

Conspicuous woody species with more than 5 percent mean cover and occurring in more than 50 percent of the relevés representing the variation (Table 5.2) are:

- *Burkea africana* (tree/shrub)	100%	15,9%
- *Combretum molle* (tree/shrub)	100%	6,0%
- *Ochna pulchra* (tree/shrub)	88%	7,6%

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Fig. 5.9 The *Combretum molle* — *Landolphia capensis* — *Burkea africana* variation with *Burkea africana* in the foreground and the grass layer grazed short.

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Burkea africana has the highest constancy value in the study area in variation 5.9.1.

Herbs

Herb species occurring in more than 50 percent of the relevés representing the variation (Table 5.2) are:

- *Bulbostylis burchellii* (sedge)	100%	1,0%
- *Schizachyrium sanguineum* (grass)	88%	2,1%
- *Aristida aequiglumis* (grass)	88%	1,4%
- *Andropogon schirensis* (grass)	75%	2,5%
- *Elionurus muticus* (grass)	63%	0,8%

General

Communities 5.8 and 5.9 are related to each other through the mutual presence of the *Diplorhynchus condylocarpon* species-group (Table 5.2 N) and communities 5.5 to 5.11 are related to each other through the mutual presence of the *Aristida aequiglumis* species-group (Table 5.2 Q) while communities 5.8 to 5.16 are related to each other through the mutual presence of the *Schizachyrium sanguineum* species-group (Table 5.2 W).

The vegetation is overgrazed, which is indicated by the high proportion of Increaser II species (Table 5.13) and confirmed by personal observation as the grass was grazed very short (see Figs. 5.4 j and 5.9) by cattle on the gentle north facing slopes.

5.9.2 *Combretum molle* — *Landolphia capensis* — *Tapiphyllum parvifolium* variation

The *Combretum molle* — *Landolphia capensis* — *Tapiphyllum parvifolium* variation is found at altitudes 1 425 m to 1 525 m south of the upper plateau in the southern half of the study area (Fig. 5.1). It is represented by twelve relevés (Table 5.14) with 21 to 34 species per relevé. This closed woodland variation (Edwards, 1976) has a

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TABLE 5.14 Habitat factors recorded for the *Combretum molle* — *Landolphia capensis* — *Tapiphyllum parvifolium* variation (community 5.9.2)

Relevé number	60	35	36	37	47	43	38	42	31	33	34	46
Vegetation												
Canopy cover (%)	9-79	9-79	9-79	9-79	9-79	9-79	9-79	1-8	1-8	9-79	1-8	1-8
Formation*	W	W	W	W	W	W	W	W	W	W	W	W
Species diversity (per m^2)	3	5	3	5	4	6	4	4	4	5	6	4
Species per relevé	21	26	21	30	25	34	24	24	25	34	26	27
Veld condition												
Final score (%)	7	27	36	18	33	22	44	34	7	100	8	15
Composition score (%)	16	43	41	28	38	22	50	38	26	100	23	26
Basal cover (%)	2	7	9	8	13	26	10	11	3	11	5	9
Decreasers (%)	2	7	0	8	2	2	6	5	0	11	0	6
Increaser I (%)	0	1	0	0	0	0	0	1	2	0	0	1
Increaser II (%)	68	85	71	55	71	88	88	66	96	89	99	53
Increaser III (%)	4	7	0	6	4	0	6	6	1	0	1	13
Selaginella dregei (%)	26	0	29	31	23	10	0	22	1	0	0	27
Topography												
Geomorphology*	E	E	E	E	D	D	D	D	D	D	D	D
Altitude (m)	1 450	1 450	1 425	1 450	1 450	1 500	1 475	1 450	1 525	1 450	1 525	1 500
Slope (°)	1	7	6	7	6	8	7	6	7	2	6	6
Aspect	N	NE	NE	N	N	N	N	N	NE	NE	NE	N
Geology												
Formation*	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO
Surface rock cover (%)	60	60	5	60	10	10	30	40	80	10	60	20
Soil												
Form*	M	M	M	M	M	M	M	M	M	M	M	M
Series*	M	M	M	M	M	M	M	M	M	M	M	M
Depth (mm)	50	130	180	60	230	200	200	50	60	150	80	80
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	1,4											
Titratable acidity (me/100g)	10,2											
Aluminium (me %)	1,7											
Electrical resistance (ohms)	6 700											
pH (H_2O)	4,5											
pH ($CaCl_2$)	3,8											
Sodium (me/100g)	0,0											
Potassium (me/100g)	0,1											
Calcium (me/100g)	0,2											
Magnesium (me/100g)	0,3											
S - value (me/100g)	0,6											
T - value (me/100g)	10,5											

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	E - lower slopes, D - upper slopes
	Formation (Geology)	CO - conglomerate (Formation Alma Graywacke)
	Form	M - Mispah
	Series	M - Mispah
** N/O	Not observable	

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D structure (Ito, 1979; Fig. 5.4 k) with the greatest average cover of 10 percent in the > 3 m - 5 m height class. The variation can, therefore, be considered to be more open than variation 5.9.1 which could indicate a drier moisture regime than for variation 5.9.1. The temperature regime should be similar to that of variation 5.9.1.

Habitat

The habitat factors recorded for the variation are shown in Table 5.14 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series, derived from conglomerate of the Alma Graywacke Formation. The average soil depth varies from 50 mm to 230 mm and the surface rock cover varies from 5 percent to 80 percent. The terrain slopes from 1° to 8° in a northerly to north easterly direction. The electrical resistance of the soil is 6 700 ohms and the T-value is 10,5 me/100 g indicating a moderate nutrient status for the study area. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 4,5 when saturated with water.

Floristics

The floristic composition of the variation is shown in Table 5.2 and summarized in Table 5.3. The variation is differentiated by the absence of character species and is differentiated from the *Combretum molle* — *Landolphia capensis* — *Burkea africana* variation by the presence of the *Selaginella dregei* species-group (Table 5.2 P). The species diversity per unit area averages 4,4 species/m² for the variation, which is lower than for variation 5.9.1.

Trees and shrubs

The only conspicuous woody species with more than 5 percent mean cover and occurring in more than 50 percent of the relevé representing the variation (Table 5.2) is:

- *Burkea africana* (tree/shrub)	67%	7,3%

Combretum molle has a 100 percent constancy in variation 5.9.2 but only 4,4 percent mean cover while *Ochna pulchra* has 83% constancy and only 4,1 percent mean cover indicating the lesser cover of these two species in this variation compared with variation 5.9.1.

Herbs

Herb species occurring in more than 50 percent of the relevé representing the variation (Table 5.2) are:

- *Bulbostylis burchellii* (sedge)	100%	1,1%
- *Aristida aequiglumis* (grass)	83%	1,4%
- *Selaginella dregei* (fern)	75%	1,3%
- *Eragrostis curvula* (grass)	75%	1,0%
- *Andropogon schirensis* (grass)	67%	1,3%
- *Indigofera egens* (forb)	67%	0,1%

General

Communities 5.8 to 5.9, 5.5 to 5.11 and 5.8 to 5.16 are related to each other through the mutual presence of the *Diplorhynchus condylocarpon* species-group (Table 5.2 N), the *Aristida aequiglumis* species-group (Table 5.2 Q) and the *Schizachyrium sanguineum* species-group (Table 5.2 W) respectively which is the same as that for the *Combretum molle* — *Landolphia capensis* — *Burkea africana* variation. The *Selaginella dregei* species-group (Table 5.2 P) is common to community 5.10 and variation 5.9.2 but is absent in variation 5.9.1.

The vegetation is overgrazed, which is indicated by the high proportion of Increaser II species (Table 5.14). *Selaginella dregei* has a 75 percent constancy which is high for the study area and is indicative of the high surface rock cover for variation 5.9.2. because *Selaginella dregei* only occurs where there are sheet outcrops. The high surface rock cover is a possible reason for the structural differences between the two variations of community 5.9 and can also contribute to the floristic differences between the two variations.

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Fig. 5.10 The lower summit in the south of the study area, on the left with the *Combretum molle* — *Themeda triandra* open woodland on the slopes in the foreground.

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TABLE 5.15 Habitat factors recorded for the *Combretum molle - Coleochloa setifera* open woodland (community 5.10)

Relevé number	55	56	51	57	54	52	53	58
Vegetation								
Canopy cover (%)	1-8	1-8	1-8	1-8	1-8	1-8	1-8	1-8
Formation*	W	W	W	W	W	W	W	W
Species diversity (per m^2)	5	6	5	5	6	5	5	5
Species per relevé	31	33	30	30	33	26	31	30
Veld condition								
Final score (%)	42	43	42	52	32	24	41	100
Composition score (%)	48	45	44	59	51	35	41	100
Basal cover (%)	5	8	7	7	5	4	8	6
Decreasers (%)	10	18	2	17	12	14	14	28
Increaser I (%)	1	1	1	1	2	1	1	2
Increaser II (%)	80	46	57	74	62	25	47	61
Increaser III (%)	9	28	1	0	12	1	7	1
Selaginella dregei (%)	0	7	39	8	12	59	31	8
Topography								
Geomorphology*	A	A	A	A	A	A	A	A
Altitude (m)	1 540	1 550	1 500	1 540	1 535	1 500	1 525	1 540
Slope (°)	18	23	25	18	22	18	18	22
Aspect	S	S	S	S	S	S	S	S
Geology								
Formation*	CO	CO	CO	CO	CO	CO	CO	CO
Surface rock cover (%)	60	70	65	65	65	60	60	80
Soil								
Form*	M	M	M	M	M	M	M	M
Series*	M	M	M	M	M	M	M	M
Depth (mm)	50	60	80	40	70	50	40	50
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	1,4							
Titratable acidity (me/100g)	10,2							
Aluminium (me %)	1,7							
Electrical resistance (ohms)	6 700							
pH (H_2O)	4,5							
pH ($CaCl_2$)	3,8							
Sodium (me/100g)	0,0							
Potassium (me/100g)	0,1							
Calcium (me/100g)	0,2							
Magnesium (me/100g)	0,3							
S - value (me/100g)	0,6							
T - value (me/100g)	10,5							

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	A - summit
	Formation (Geology)	CO - conglomerate (Formation Alma Graywacke)
	Form	M - Mispah
	Series	M - Mispah
** N/O:	Not observable	

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5.10 *Combretum molle* — *Coleochloa setifera* open woodland

The *Combretum molle* — *Coleochloa setifera* open woodland is found at altitudes of 1 525 m to 1 550 m south of the upper plateau in the southern half of the study area (Fig. 5.1). It is represented by eight relevés (Table 5.15) with 26 to 33 species per relevé. This open woodland community (Edwards, 1976) has an L structure (Ito, 1979; Fig. 5.4 1) with the greatest average cover of 5 percent in the lowest height class of 0,0 m - 0,5 m. Because the vegetation occurs on the lower summit (Fig. 5.10) the community is more exposed than the adjacent communities (communities 5.8 and 5.9) and a greater temperature amplitude and a drier moisture regime than in communities 5.8 and 5.9, could be expected.

Habitat

The habitat factors recorded for the community are shown in Table 5.15 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series, derived from conglomerate of the Alma Graywacke Formation. The average soil depth varies from 40 mm to 80 mm and the surface rock cover varies from 60 percent to 80 percent. The terrain slopes from 18° to 25° in a southerly direction. The electrical resistance is 6 700 ohms and the T-value is 10,5 me/100 g indicating soils of a moderate nutrient status for the study area. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 4,5 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the *Coleochloa setifera* species-group (Table 5.2 0). The following are character species for the community:

- *Becium obovatum* (forb), S
- *Coleochloa setifera* (sedge), S
- *Combretum moggii* (shrub), S
- *Mimusops zeyheri* (shrub), E
- *Plectranthus* sp. (shrub), E

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The species diversity per unit area averages 5,3 species/m² for the community (Table 5.15).

Trees and shrubs

The only conspicuous woody species with 2,5 percent or more mean cover and occurring in more than 50 percent of the relevés representing the community (Table 5.2) is:

- *Heteropyxis natalensis* (shrub)	100%	2,5%

Combretum molle, *Vitex rehmannii*, *Bequaertiodendron magalismontanum* and *Brachylaena rotundata* occur in all the relevés representing the community but have a mean cover of less than 2,5 percent.

Herbs

Herb species occurring in 50 percent of the relevés representing the community (Table 5.2) are:

- *Bulbostylis burchellii* (sedge)	100%	2,0%
- *Coleochloa setifera* (sedge)	100%	1,8%
- *Pellaea calomelanos* (fern)	100%	0,05%
- *Selaginella dregei* (fern)	88%	1,2%
- *Elionurus muticus* (grass)	75%	1,4%
- *Andropogon schirensis* (grass)	75%	0,9%
- *Indigofera comosa* (forb)	75%	0,2%
- *Stachys natalensis* var. *natalensis* (forb)	75%	0,04%
- *Aristida aequiglumis* (grass)	63%	0,8%
- *Digitaria eriantha* subspecies *transvaalensis* (grass)	63%	0,6%
- *Xerophyta retinervis* (forb)	63%	0,09%
- *Cheilanthes hirta* (fern)	63%	0,03%

General

Variation 5.9.2 and community 5.10 are related to each other through the mutual presence of the *Selaginella dregei* species-group (Table 5.2 P) while communities 5.5 to 5.11 and 5.8 to 5.16 are related

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to each other through the mutual presence of the *Aristida aequiglumis* species-group (Table 5.2 Q) and the *Schizachyrium sanguineum* species-group (Table 5.2 W) respectively.

The condition of the grass layer is poor with respect to cover (Fig. 5.4 1) and overgrazing is indicated by the high proportion of Increaser II species (Table 5.15), and the low cover-abundance values for the grass species (Table 5.2). The high surface rock cover, caused by conglomerate sheet outcrop, is reflected in the relatively high proportion of *Selaginella dregei* in Table 5.15.

5.11 *Combretum molle* — *Heteropogon contortus* clossed and open woodlands

The *Combretum molle* — *Heteropogon contortus* closed and open woodlands are found at altitudes of 1 400 m to 1 600 m in the north, south east and south west of the study area (Fig. 5.1). The community is differentiated by the absence of character species as well as the absence of the *Cyperus albostriatus* species-group (Table 5.2 H), the *Setaria megaphylla* species-group (Table 5.2. I) the *Terminalia sericea* species-group (Table 5.2 J), the *Diplorhynchus condylocarpon* species-group (Table 5.2 N), the *Selaginella dregei* species-group (Table 5.2 P), the *Stoebe vulgaris* species-group (Table 5.2 U) and the *Senecio erubescens* species-group (Table 5.2 V) in the main vegetation type B, as well as the presence of the *Aristida aequiglumis* species-group (Table 5.2 Q). The community is separated into the following two variations, based on floristics:

5.11.1 *Combretum molle* — *Heteropogon contortus* — *Rhus dentata* closed woodland variation on predominantly nutrient rich soils

5.11.2 *Combretum molle* — *Heteropogon contortus* — *Chaetacanthus costatus* open woodland variation on predominantly nutrient poor soils

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TABLE 5.16 Habitat factors recorded for the *Combretum molle - Heteropogon contortus - Rhus dentata* closed woodland variation (community 5.11.1)

Relevé number	154	151	143	139	146	147	24	59	49	50
Vegetation										
Canopy cover (%)	9-79	9-79	9-79	9-79	9-79	9-79	1-8	1-8	1-8	9-79
Formation*	W	W	W	W	W	W	W	W	W	W
Species diversity (per m^2)	4	6	6	4	5	6	5	4	4	4
Species per relevé	30	25	24	19	19	26	32	24	26	30
Veld condition										
Final score (%)	100	65	61	22	23	25	5	4	1	1
Composition score (%)	100	65	61	61	53	44	27	19	7	7
Basal cover (%)	13	13	13	10	5	8	8	6	8	7
Decreasers (%)	71	57	79	81	51	33	37	27	14	9
Increaser I (%)	0	1	1	1	5	3	7	0	1	1
Increaser II (%)	29	23	16	12	33	32	49	56	78	82
Increaser III (%)	0	19	4	6	11	32	7	17	7	8
Selaginella dregei (%)	0	0	0	0	0	0	0	0	0	0
Topography										
Geomorphology*	E	E	E	E	E	E	E	B	A	A
Altitude (m)	1 575	1 500	1 500	1 500	1 500	1 475	1 480	1 450	1 400	1 450
Slope (°)	5	9	8	8	16	5	5	0	25	18
Aspect	S	S	S	S	S	S	S		S	S
Geology										
Formation*	S2	S2	S2	S2	S2	S2	S2	CO	CO	CO
Surface rock cover (%)	20	40	40	40	60	25	20	20	40	55
Soil										
Form*	M	M	M	M	M	M	M	M	M	M
Series*	M	M	M	M	M	M	M	M	M	M
Depth (mm)	230	140	130	120	130	190	40	90	100	130
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	1,2		2,6	1,2	2,6		1,2	1,4		
Titratable acidity (me/100g)	7,4		14,5	7,4	14,5		4,2	10,2		
Aluminium (me %)	0,9		1,9	0,9	1,9		0,0	1,7		
Electrical resistance (ohms)	4 400		3 400	4 400	3 400		2 100	6 700		
pH (H_2O)	4,5		4,1	4,5	4,1		6,0	4,5		
pH ($CaCl_2$)	4,2		3,8	4,2	3,8		5,4	3,8		
Sodium (me/100g)	0,0		0,1	0,0	0,1		0,1	0,0		
Potassium (me/100g)	0,1		0,4	0,1	0,4		0,6	0,1		
Calcium (me/100g)	0,6		0,4	0,6	0,4		1,6	0,2		
Magnesium (me/100g)	0,1		0,2	0,1	0,2		1,3	0,3		
S - value (me/100g)	0,8		1,1	0,8	1,1		3,6	0,6		
T - value (me/100g)	7,4		15,8	7,4	15,8		9,3	10,5		

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	E - lower slopes
	Formation (Geology)	S2 - sandstone (Formation Aasvoëlkop)
		CO - conglomerate (Formation Alma Graywacke)
	Form	M - Mispah
	Series	M - Mispah
** N/O	Not observable	

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5.11.1 *Combretum molle* — *Heteropogon contortus* — *Rhus dentata* closed woodland variation

The *Combretum molle* — *Heteropogon contortus* — *Rhus dentata* closed woodland variation is found at altitudes of 1 400 m to 1 575 m on the lower slopes of the Kransberg massif in the north as well as in the south west and south east of the study area (Fig. 5.1). It is represented by ten relevés (Table 5.16) with 19 to 32 species per relevé. This closed woodland variation (Edwards, 1976) has a D structure (Ito, 1979; Fig. 5.4 m) with the greatest average cover of 20 percent in the >3 m - 5 m height class. Because the variation has a closed woodland formation, the temperature is likely to have a smaller amplitude and the moisture regime is likely to be higher than variation 5.11.2.

Habitat

The habitat factors recorded for the variation are shown in Table 5.16 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series derived from sandstone of the Aasvoëlkop Formation, in the case of relevés 154, 151, 143, 139, 146, 147 and 24 and conglomerate of the Alma Graywacke Formation in the case of relevés 59, 49 and 50. The average soil depth varies from 40 mm to 230 mm and the surface rock cover varies from 20 percent to 60 percent. The terrain slopes up to 25° in a southerly direction. The electrical resistance of the soils varies from 2 100 ohms to 6 700 ohms. The T-value varies from 7,4 me/100 g to 15,8 me/100 g indicating soils of a predominantly high nutrient status. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 4,1 to 4,5 except for relevé 24 which has a pH of 6,0 when saturated with water and is, therefore, moderatly acid. The habitat factors for this variation have a wide range which may be attributed to the distribution of this variation which occurs as small areas, widely dispersed through the study area (Fig. 5.1).

Floristics

The floristic composition of the variation is shown in Table 5.2 and summarized in Table 5.3. The variation is differentiated by

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the absence of character species as well as the absence of the *Helichrysum* sp. species-group (Table 5.2 AB), which differentiates it from the *Combretum molle* — *Heteropogon contortus* — *Chaetachanthus costatus* variation. The species diversity per unit area averages 4,8 species/m² for the variation (Table 5.16).

Trees and shrubs

The only conspicuous woody species with more than 5 percent mean cover and occurring in more than 50 percent of the relevés represen= ting the variation (Table 5.2) is:

- *Burkea africana* (tree/shrub)	70%	13%

Rhus dentata (shrub) occurs in 70 percent of the relevés and has a mean cover of 1,4 percent.

Herbs

Herb species occurring in more than 50 percent of the relevés representing the variation (Table 5.2) are:

- *Indigofera comosa* (forb)	90%	0,9%
- *Heteropogon contortus* (grass)	80%	4,9%
- *Loudetia simplex* (grass)	80%	1,6%
- *Schizachyrium sanguineum* (grass)	80%	0,8%
- *Cyperus leptocladus* (sedge)	80%	0,3%
- *Pellaea calomelanos* (fern)	70%	0,03%
- *Aristida aequiglumis* (grass)	60%	1,2%
- *Bulbostylis burchellii* (sedge)	60%	0,3%

General

Communities 5.5 to 5.11 are related to each other through the mutual presence of the *Aristida diffusa* species-group (Table 5.2 Q) and communities 5.8 to 5.16 are related to each other through the mutual presence of the *Schizachyrium sanguineum* species-group (Table 5.2 W).

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The condition of the vegetation with respect to grazing, represented by relevé numbers 154, 151, 143, 139 and 146 is better than that represented by relevé numbers 147, 24, 59, 49 and 50 because the former group of relevés has a high proportion of Decreaser species and the latter group has a high proportion of Increaser II species. Relevé number 147 has an approximately equal amount of Decreaser and Increaser II species. The vegetation represented by the last group of relevés is, therefore, subjected to overgrazing, which may be attributed to the vegetation being situated on the upper plateau, lower summit and lower slopes adjoining the upper plateau which is more accessible to cattle than the first group of relevés which are further upslope on the Kransberg massif.

5.11.2 *Combretum molle* — *Heteropogon contortus* — *Chaetacanthus costatus* open woodland variation

The *Combretum molle* — *Heteropogon contortus* — *Chaetacanthus costatus* open woodland variation is found at altitudes of 1 500 m to 1 600 m on the lower slopes of the Kransberg massif in the northern half of the study area (Fig. 5.1). It is represented by eight relevés (Table 5.17) with 20 to 27 species per relevé. This open woodland variation (Edwards, 1976) has an L structure (Ito, 1979; Fig. 5.4 n) with the greatest cover of 25 percent in the 0,0m - 0,5 m height class. Because the variation is generally situated upslope of variation 5.11.1, it is probably more exposed with a consequently greater temperature amplitude and a drier moisture regime than variation 5.11.1.

Habitat

The habitat factors recorded for the variation are shown in Table 5.17 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series derived from sandstone of the Aasvoëlkop Formation. The average soil depth varies from 110 mm to 210 mm and the surface rock cover varies from 15 percent to 60 percent. The terrain slopes from 3° to 21° in a southerly direction. The

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TABLE 5.17 Habitat factors recorded for the *Combretum molle - Heteropogon contortus - Chaetacanthus costatus* open woodland variation (community 5.11.2)

Relevé number	152	150	157	159	160	156	140	149
Vegetation								
Canopy cover (%)	1-8	1-8	1-8	9-79	9-79	1-8	1-8	9-79
Formation*	W	W	W	W	W	W	W	W
Species diversity (per m²)	6	5	5	5	5	5	7	5
Species per relevé	26	21	20	26	22	22	27	26
Veld condition								
Final score (%)	100	53	43	45	42	23	21	14
Composition score (%)	100	53	59	59	51	56	48	33
Basal cover (%)	16	23	11	11	12	7	10	8
Decreasers (%)	67	81	79	75	63	36	32	21
Increaser I (%)	0	0	0	0	0	3	1	0
Increaser II (%)	33	8	17	1	37	53	42	79
Increaser III (%)	0	11	4	24	0	8	25	0
Selaginella dregei (%)	0	0	0	0	0	0	0	0
Topography								
Geomorphology*	E	E	E	E	E	E	E	E
Altitude (m)	1 525	1 500	1 600	1 575	1 550	1 600	1 550	1 500
Slope (°)	5	5	21	6	3	12	12	4
Aspect	S	S	S	S	S	S	S	S
Geology								
Formation*	S2	S2	S2	S2	S2	S2	S2	S2
Surface rock cover (%)	40	15	40	40	15	40	60	40
Soil								
Form*	M	M	M	M	M	M	M	M
Series*	M	M	M	M	M	M	M	M
Depth (mm)	190	200	130	140	150	160	110	210
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	1,2	1,2					1,3	1,0
Titratable acidity (me/100g)	6,6	7,4					7,8	6,4
Aluminium (me %)	0,6	0,9					0,5	1,4
Electrical resistance (ohms)	4 500	4 400					4 700	5 100
pH (H_2O)	4,7	4,5					4,8	4,3
pH ($CaCl_2$)	4,4	4,2					4,4	4,0
Sodium (me/100g)	0,0	0,0					0,0	0,0
Potassium (me/100g)	0,4	0,1					0,2	0,2
Calcium (me/100g)	0,6	0,6					0,4	0,8
Magnesium (me/100g)	0,5	0,1					0,2	0,2
S - value (me/100g)	1,5	0,8					0,8	1,2
T - value (me/100g)	8,2	7,4					8,5	6,3

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	E - lower slopes
	Formation (Geology)	S2 - sandstone (Formation Aasvoëlkop)
	Form	M - Mispah
	Series	M - Mispah
** N/O:	Not observable	

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electrical resistance is 4 400 ohms to 5 100 ohms for the soils and the T-value varies from 6,3 me/100 g to 8.5 me/100 g which is generally lower than that for variation 5.11.1 indicating soils of a lower nutrient status. This may be as a result of variation 5.11.2 being generally upslope of variation 5.11.1 with nutrients lost by runoff from variation 5.11.2 to 5.11.1. The soils are strongly acid (MacVicar, et al., 1977) with a pH range of 4,3 to 4,8 when saturated with water.

Floristics

The floristic composition of the variation is shown in Table 5.2 and summarized in Table 5.3. The variation is differentiated by the absence of character species and is differentiated from variation 5.11.1 in community 5.11 by the presence of the *Helichrysum* sp. species-group (Table 5.2 AB). The species diversity per unit area averages 5,4 species/m^2 for the variation (Table 5.17) which is higher than that for variation 5.11.1.

Trees and shrubs

Conspicuous woody species with 2,5 percent or more mean cover and occurring in more than 50 percent of the relevés representing the variation (Table 5.2) are:

- *Combretum molle* (tree/shrub)	88%	2,9%
- *Burkea africana* (tree/shrub)	75%	7,1%
- *Protea caffra* (tree/shrub)	63%	2,8%

Bequaertiodendron magalismontanum has 100% constancy in variation 5.11.2 but only 2,1 percent mean cover.

Herbs

Herb species occurring in more than 50 percent of the relevés representing the variation (Table 5.2) are:

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- *Heteropogon contortus* (grass)	100%	15,0%
- *Chaetacanthus costatus* (forb)	88%	0,1%
- *Bulbostylis burchellii* (sedge)	75%	0,4%
- *Commelina africana* (forb)	75%	0,4%
- *Schizachyrium sanguineum* (grass)	63%	1,6%
- *Loudetia simplex* (grass)	63%	1,4%
- *Indigofera comosa* (forb)	63%	0,3%
- *Sphenostylis angustifolia* (forb)	63%	0,4%
- *Vernonia staehelinoides* (forb)	63%	0,3%

General

Communities 5.5 to 5.11 and 5.8 to 5.16 are related to each other through the mutual presence of the *Aristida aequiglumis* species-group (Table 5.2 Q) and the *Schizachyrium sanguineum* species-group (Table 5.2 W) respectively. Variation 5.11.2 and communities 5.12, 5.17 and 5.18 are related to each other through the mutual presence of the *Helichrysum* sp. species-group (Table 5.2 AB).

The condition of the vegetation with respect to grazing is intermediate to the two extremes described for variation 5.11.1 as is shown by the final scores for variations 5.11.1 and 5.11.2. Relevé numbers 156, 140 and 149, however, have a higher proportion of Increaser II species than the other relevés representing variation 5.11.2 which indicates overgrazing. These three relevés represent vegetation which is more accessible to cattle or closer to a farmstead, in the case of relevé number 149, than the other relevés representing the variation, and are consequently overgrazed.

5.12 *Combretum molle* — *Themeda triandra* open woodland

The *Combretum molle* — *Themeda triandra* open woodland is found at altitudes of 1 400 m to 1 600 m in the south (Fig. 5.10), north and west (Fig. 5.2) of the study area (Fig. 5.1). It is represented by thirteen relevés (Table 5.18) with 21 to 29 species per relevé. This open woodland community (Edwards, 1976) has an L structure (Ito, 1979; Fig. 5.4 o) with the greatest average cover of

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TABLE 5.18 Habitat factors recorded for the *Combretum molle — Themeda triandra* open woodland (community 5.12)

Relevé number	130	158	132	127	128	129	95	93	92	94	91	165	164
Vegetation													
Canopy cover (%)	9-79	1-8	1-8	1-8	1-8	9-79	9-79	1-8	<1	1-8	< 1	9-79	9-79
Formation*	W	W	W	W	W	W	W	W	W	W	W	W	W
Species diversity (per m²)	6	5	6	6	5	3	6	7	5	7	6	7	6
Species per relevé	24	24	22	24	21	23	26	28	28	28	24	29	26
Veld condition													
Final score (%)	100	32	24	17	14	12	47	44	31	31	9	18	5
Composition score (%)	100	59	47	45	42	42	47	44	31	31	9	31	27
Basal cover (%)	19	11	11	10	7	5	30	22	20	24	25	15	7
Decreasers (%)	61	53	51	55	59	43	67	39	43	46	13	19	56
Increaser I (%)	0	1	0	0	0	0	26	0	40	0	30	0	1
Increaser II (%)	39	46	49	17	41	35	7	59	17	52	57	81	43
Increaser III (%)	0	0	0	28	0	11	0	2	0	2	0	0	0
Selaginella dregei (%)	0	0	0	0	0	11	0	0	0	0	0	0	0
Topography													
Geomorphology*	E	E	E	E	E	E	E	E	E	E	E	E	E
Altitude (m)	1 500	1 600	1 475	1 525	1 525	1 500	1 400	1 400	1 400	1 400	1 400	1 425	1 425
Slope (°)	7	12	2	4	3	4	24	23	18	23	22	8	8
Aspect	S	S	S	S	S	S	S	S	S	S	S	SE	W
Geology													
Formation*	S2	S2	S2	S2	S2	SH	S1	S1	S1	S1	S1	DI	DI
Surface rock cover (%)	15	20	10	10	5	60	50	50	45	45	40	5	10
Soil													
Form*	M	M	M	M	M	M	M	M	M	M	M	S	S
Series*	M	M	M	M	M	M	M	M	M	M	M	B	B
Depth (mm)	160	150	300	220	170	70	160	150	170	140	120	80	80
Watertable depth (mm)	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	0,5	1,2	0,5			1,0	1,4					1,2	
Titratable acidity (me/100g)	3,0	7,4	3,0			4,6	5,8					7,4	
Aluminium (me %)	0,2	0,9	0,2			0,2	0,5					0,9	
Electrical resistance (ohms)	3 200	4 400	3 200			4 800	6 000					4 400	
pH (H_2O)	5,0	4,5	5,0			4,9	5,0					4,5	
pH ($CaCl_2$)	4,9	4,2	4,9			4,7	4,3					4,2	
Sodium (me/100g)	0,0	0,0	0,0			0,0	0,0					0,0	
Potassium (me/100g)	0,2	0,1	0,2			0,2	0,2					0,1	
Calcium (me/100g)	0,8	0,6	0,8			1,2	0,7					0,6	
Magnesium (me/100g)	0,0	0,1	0,0			0,3	0,2					0,1	
S - value (me/100g)	1,0	0,8	1,0			1,7	0,9					0,8	
T - value (me/100g)	4,4	7,4	4,4			6,3	7,4					7,4	

*Symbols used: Formation (vegetation) W - woodland
Geomorphology E - lower slopes
Formation (geology) S2 - sandstone (Formation Aasvoëlkop)
SH - shale (Formation Aasvoëlkop)
S1 - sandstone (Formation Alma Graywacke)
Form M - Mispah
Series M - Mispah
** N/O Not observable

Formation (geology) DI - diabase (post-Waterberg Group)
Form S - shortlands
Series B - Bokuil

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38 percent in the 0,0 m - 0,5 m height class. The temperature should have a large amplitude and the moisture regime should be dry, because of the relatively exposed situation of the community.

Habitat

The habitat factors recorded for the community are shown in Table 5.18 and summarized in Table 5.2. The soils are mainly of the Mispah Form, Mispah Series, derived from sandstone of Aasvoëlkop and Alma Graywacke Formations and shale of the Aasvoëlkop Formation. Soils of Shortlands Form, Bokuil Series, derived from diabase of the post-Waterberg Group, are also found in the community (relevés 165 and 164). The limits set for the soil classification used in this study (MacVicar, et al., 1977) are not necessarily the same as the limits influencing the vegetation (D. Edwards*, pers. comm.), hence the variation of soil within the community. The Shortlands Form recorded for this community can, furthermore, be regarded as atypical because of the shallow soil depth of 80 mm recorded (Table 5.18). The average soil depth varies from 80 mm to 300 mm and the surface rock cover varies from 5 percent to 60 percent. The terrain slopes from 3° to 24° in a south easterly to westerly direction. The electrical resistance of the soils varies from 3 200 ohms to 6 000 ohms and the T-value varies from 4,4 me/100 g to 7,4 me/100 g, indicating soils with a moderate nutrient status. The soils are strongly acid (MacVicar, et al., 1977)with a pH range of 4,5 to 5,0 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the absence of character species as well as the absence of the *Aristida aequiglumis* species-group (Table 5.2Q) and the *Senecio erubescens* species-group (Table 5.2 V) and the presence of the *Helichrysum* sp. species-group (Table 5.2 AB) in the main vegetation type B,

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differentiated by the *Combretum molle* species-group (Table 5.2 AC). The species diversity per unit area averages 5,8 species/m^2 for the community (Table 5.18).

Trees and shrubs

Conspicuous woody species with 2,5 percent or more, mean cover and occurring in 50 percent of the relevés representing the community (Table 5.2) are:

-	*Protea caffra* (tree/shrub)	69%	2,5%
-	*Faurea saligna* (tree/shrub)	62%	3,4%

Faurea saligna occurs in eleven of the twelve communities of the main vegetation type B represented by species-group AC but has the highest mean percentage cover of its range in the study area in community 5.12.

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

-	*Heteropogon contortus* (grass)	92%	9,8%
-	*Themeda triandra* (grass)	85%	4,4%
-	*Setaria perennis* (grass)	85%	1,3%
-	*Diheteropogon amplectens* (grass)	62%	1,1%
-	*Rhynchelytrum setifolium* (grass)	62%	1,0%
-	*Eragrostis racemosa* (grass)	62%	0,9%
-	*Indigofera egens* (forb)	62%	0,2%
-	*Helichrysum* sp. (forb)	54%	0,2%
-	*Senecio conrathii* (forb)	54%	0,06%

General

Communities 5.8 to 5.16 are related to each other through the mutual presence of the *Schizachyrium sanguineum* species-group (Table 5.2 W) and variation 5.11.2 and communities 5.12, 5.17 and 5.18 are related

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TABLE 5.19 Habitat factors recorded for the *Combretum molle - Argyrolobium transvaalense* open woodland (community 5.13)

Relevé number	29	26	30	25	28
Vegetation					
Canopy cover (%)	1-8	1-8	1-8	1-8	1-8
Formation*	W	W	W	W	W
Species diversity (per m²)	9	7	6	8	9
Species per relevé	31	29	22	26	25
Veld condition					
Final score (%)	51	4	25	46	100
Composition score (%)	52	40	32	53	100
Basal cover (%)	11	7	8	8	13
Decreasers (%)	34	21	14	46	68
Increaser I (%)	5	1	7	7	4
Increaser II (%)	55	69	71	39	24
Increaser III (%)	6	9	8	8	4
Selaginella dregei (%)	0	0	0	0	0
Topography					
Geomorphology*	E	E	E	E	E
Altitude (m)	1 450	1 500	1 435	1 450	1 575
Slope (°)	0	9	15	9	27
Aspect		SW	SE	SW	S
Geology					
Formation*	S2	S2	S2	S2	S2
Surface rock cover (%)	7	15	12	10	12
Soil					
Form*	M	M	M	M	M
Series*	M	M	M	M	M
Depth (mm)	150	120	120	150	150
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O
Carbon (%)	1,2				
Titratable acidity (me/100g)	4,2				
Aluminium (me%)	0,0				
Electrical resistance (ohms)	2 100				
pH (H_2O)	6,0				
pH ($CaCl_2$)	5,4				
Sodium (me/100g)	0,1				
Potassium (me/100g)	0,6				
Calcium (me/100g)	1,6				
Magnesium (me/100g)	1,3				
S - value (me/100g)	3,6				
T - value (me/100g)	9,3				

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	E - lower slopes
	Formation (Geology)	S2 - sandstone (Formation Aasvoëlkop)
	Form	M - Mispah
	Series	M - Mispah
** N/O:	Not observable	

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to each other through the mutual presence of the *Helichrysum* sp. species-group (Table 5.2 AB).

The proportion of Decreaser species is generally higher than Increaser II species except for relevé numbers 93, 94, 91 and 165. These last four relevés represent vegetation at generally lower altitudes than the other relevés in the community and are more accessible to cattle. However, the proportion of Decreaser species to Increaser II species indicates that the vegetation for the community as a whole is subjected to heavy grazing pressure because the difference between Decreaser and Increaser II species is not great and the generally low final scores indicate veld that is not of good grazing potential, with respect to species composition.

5.13 *Combretum molle* — *Argyrolobium transvaalense* open woodland

The *Combretum molle* — *Argyrolobium transvaalense* open woodland is found at altitudes of 1 435 m to 1 575 m on the lower slopes of the Kransberg massif in the north west of the study area (Fig. 5.1). It is represented by five relevés (Table 5.19) with 22 to 31 species per relevé. This open woodland community (Edwards, 1976) has an L structure (Ito, 1979; Fig. 5.4 p) with the greatest average cover of 20 percent in the 0,0 m - 0,5 m height class. The community is more exposed, as a result of its situation on prominent ridges, than the other communities of the lower slopes and large temperature fluctuations and a dry moisture regime can consequently be expected.

Habitat

The habitat factors recorded for the community are shown in Table 5.19 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series, derived from sandstone of the Aasvoëlkop Formation. The average soil depth varies from 120 mm to 150 mm and the surface rock cover varies from 7 percent to 15 percent. The terrain slopes up to 27° in a south easterly to south westerly direction. The electrical resistance of the soils is 2 100 ohms and the T-value is 9,3 me/100 g indicating a moderate nutrient status. The soils are moderately acid (MacVicar, et al., 1977) with a pH of 6,0 when saturated with water.

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Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the *Vernonia oligocephala* species-group (Table 5.2 R). The following are character species for the community:

- *Argyrolobium transvaalense* (shrub), E
- *Ruellia cordata* (forb), E
- *Vernonia oligocephala* (forb), P

The species diversity per unit area averages 7,8 species/m² for the community (Table 5.19) which is relatively high for the study area.

Trees and shrubs

There are no woody species with a mean cover of 2,5 percent or more. Woody species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Argyrolobium transvaalense* (shrub)	100%	0,2%
- *Faurea saligna* (tree/shrub)	80%	2,6%
- *Acacia caffra* (tree/shrub)	80%	1,2%
- *Protea caffra* (tree/shrub)	60%	1,2%
- *Vitex rehmannii* (tree/shrub)	60%	1,2%
- *Combretum molle* (tree/shrub)	60%	1,1%

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2), are:

- *Themeda triandra* (grass)	100%	13,0%
- *Setaria perennis* (grass)	100%	2,5%
- *Elionurus muticus* (grass)	100%	2,1%
- *Eragrostis racemosa* (grass)	100%	2,1%
- *Cymbopogon* sp. (grass)	100%	1,7%
- *Vernonia oligocephala* (forb)	100%	0,2%

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- *Ruellia cordata* (forb)	100%	0,05%
- *Senecio erubescens* (forb)	100%	0,05%
- *Eragrostis capensis* (grass)	80%	1,6%
- *Diheteropogon amplectens* (grass)	80%	0,8%
- *Scabiosa columbaria* (forb)	80%	0,4%
- *Hypericum aethiopicum* (forb)	80%	0,04%
- *Tristachya biseriata* (grass)	60%	0,7%
- *Bulbostylis boeckeleriana* (sedge)	60%	0,2%
- *Senecio venosus* (forb)	60%	0,2%
- *Indigofera comosa* (forb)	60%	0,1%
- *Hypoxis angustifolia* (geophyte)	60%	0,03%
- *Gazania krebsiana* (forb)	60%	0,03%

General

Communities 5.13 to 5.16 are related to each other through the mutual presence of the *Senecio erubescens* species-group (Table 5.2 V) and communities 5.8 to 5.16 are related to each other through the mutual presence of the *Schizachyrium sanguineum* species-group (Table 5.2 W).

The proportion of Increaser II species is generally higher than the Decreaser species for the community as a whole, indicating overgrazing.

5.14 *Combretum molle* — *Pachycarpus schinzianus* open woodland

The *Combretum molle* — *Pachycarpus schinzianus* open woodland is found at altitudes of 1 425 m to 1 465 m on the upper plateau and adjacent south facing lower slopes in the centre of the study area (Fig. 5.1). It is represented by six relevés (Table 5.20) with 24 to 27 species per relevé. This open woodland variation (Edwards, 1976) has an L structure (Ito, 1979; Fig. 5.4 q) with the greatest average cover of 10 percent in the 0,0m - 0,5 m height class. Being situated adjacent to the upper plateau, which probably is subjected to temperature inversion at night, the community can be expected to have a wide temperature amplitude and corresponding dry moisture status.

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TABLE 5.20 Habitat factors recorded for the *Combretum molle* - *Pachycarpus schinzianus* open woodland (community 5.14)

Relevé number	12	13	17	18	22	23
Vegetation						
Canopy cover (%)	1-8	1-8	1-8	1-8	1-8	1-8
Formation*	W	W	W	W	W	W
Species diversity (per m²)	8	7	7	7	7	8
Species per relevé	24	26	25	26	26	27
Veld condition						
Final score (%)	5	28	4	1	76	100
Composition score (%)	22	29	25	14	76	100
Basal cover (%)	7	10	7	2	14	10
Decreasers (%)	21	16	15	6	49	65
Increaser I (%)	1	0	0	2	4	1
Increaser II (%)	78	78	78	91	43	29
Increaser III (%)	0	6	7	1	4	5
Selaginella dregei (%)	0	0	0	0	0	0
Topography						
Geomorphology*	E	E	B	B	E	E
Altitude (m)	1 450	1 425	1 450	1 465	1 450	1 465
Slope (°)	5	3	2	0	4	2
Aspect	S	S	N		S	S
Geology						
Formation*	S2	S2	S2	S2	S2	S2
Surface rock cover (%)	4	2	1	1	0	0
Soil						
Form*	M	M	M	M	W	W
Series*	M	M	M	M	S	S
Depth (mm)	220	200	90	80	>1 000	800
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	1,2				0,4	
Titratable acidity (me/100g)	4,2				1,0	
Aluminium (me%)	0,0				0,1	
Electrical resistance (ohms)	2 100				2 800	
pH (H_2O)	6,0				6,0	
pH ($CaCl_2$)	5,4				5,5	
Sodium (me/100g)	0,1				0,1	
Potassium (me/100g)	0,6				0,2	
Calcium (me/100g)	1,6				0,8	
Magnesium (me/100g)	1,3				0,3	
S - value (me/100g)	3,6				1,4	
T - value (me/100g)	9,3				3,4	

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	E - lower slopes, B - plateau
	Formation (Geology)	S2 - sandstone (Formation
	Form	M - Mispah
	Series	M - Mispah
	Form	W - Westleigh
	Series	S - Sibasa
** N/O	Not observable	

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Habitat

The habitat factors recorded for the community are shown in Table 5.20 and summarized in Table 5.2. The soils are mainly of the Mispah Form, Mispah Series, derived from sandstone of the Aasvoëlkop Formation but relevés 22 and 23 represent soils of the Westleigh Form, Sibasa Series also derived from sandstone of the Aasvoëlkop Formation. The soils of the Westleigh Form appear in isolated pockets and are not large in extent, resulting in no apparent vegetation change at the scale of this study. The average soil depth varies from 80 mm to deeper than 1 000 mm and the surface rock cover is 4 percent or less. The terrain slopes up to 5° in a southerly direction with one relevé (17) representing a 2° slope in a northerly direction. The electrical resistance of the soils is 2 100 ohms to 2 800 ohms and the T-value varies from 3,4 me/100 g to 9,3 me/100 g indicating a moderate nutrient status for the Mispah Form soils and a low nutrient status for the Westleigh Form soils. The soils are moderately acid (MacVicar, et al., 1977) with a pH of 6,0 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the *Pachycarpus schinzianus* species-group (Table 5.2 S). The following are character species for the community:

- *Pachycarpus schinzianus* (forb), P
- *Talinum caffrum* (forb), E
- *Triumfetta sonderi* (forb), E

The species diversity per unit area averages 7,3 species/m^2 for the community (Table 5.20).

Trees and shrubs

The only conspicuous woody species with 2,5 percent or more mean cover and occurring in 50 percent of the relevés representing the community (Table 5.2) is:

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Fig. 5.11 The *Combretum molle* — *Protea caffra* open woodland with *Protea caffra* in the left foreground.

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- *Combretum molle* (tree/shrub)	67%	2,5%

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Eragrostis racemosa* (grass)	100%	5,8%
- *Setaria perennis* (grass)	100%	4,2%
- *Indigofera comosa* (forb)	100%	0,7%
- *Pachycarpus schinzianus* (forb)	83%	0,1%
- *Eragrostis pallens* (grass)	67%	7,5%
- *Elionurus muticus* (grass)	67%	1,7%
- *Scabiosa columbaria* (forb)	67%	0,7%
- *Hypericum aethiopicum* (forb)	67%	0,03%

General

Communities 5.13 to 5.16 are related to each other through the mutual presence of the *Senecio erubescens* species-group (Table 5.2 V) and communities 5.8 to 5.16 are related to each other through the mutual presence of the *Schizachyrium sanguineum* species-group (Table 5.2 W).

The condition of the vegetation with respect to grazing is poor as is indicated by the generally low final scores and generally higher proportion of Increaser II species than Decreaser species for the community (Table 5.2).

5.15 *Combretum molle* — *Protea caffra* open woodland

The *Combretum molle* — *Protea caffra* open woodland (Fig. 5.11) is found at altitudes of 1 425 m to 1 575 m on the upper plateau and the adjacent south facing lower slopes in the northern half of the study area (Fig. 5.1). It is represented by eight relevés (Table 5.21) with 18 to 30 species per relevé. This open woodland community (Edwards, 1976) has an L structure (Ito, 1979; Fig. 5.4 r) with the greatest cover of 20 percent in the 0,0m - 0,5 m height

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TABLE 5.21 Habitat factors recorded for the *Combretum molle* - *Protea caffra* open woodland (community 5.15)

Relevé number	78	11	16	27	131	19	15	14
Vegetation								
Canopy cover (%)	<1	1-8	1-8	1-8	1-8	1-8	1-8	1-8
Formation*	W	W	W	W	W	W	W	W
Species diversity (per m²)	6	7	5	8	6	6	7	7
Species per relevé	18	25	23	22	24	27	30	26
Veld condition								
Final score (%)	1	14	100	27	16	28	36	13
Composition score (%)	4	16	100	27	16	28	36	13
Basal cover (%)	2	7	8	12	14	13	8	8
Decreasers (%)	2	22	71	21	78	24	21	17
Increaser I (%)	0	0	1	0	0	1	1	29
Increaser II (%)	96	78	28	79	21	71	64	53
Increaser III (%)	0	0	0	0	1	4	14	1
Selaginella dregei (%)	2	0	0	0	0	0	0	0
Topography								
Geomorphology*	B	B	B	E	B	E	B	B
Altitude (m)	1 425	1 435	1 450	1 575	1 450	1 475	1 475	1 480
Slope (°)	2	3	2	19	4	5	1	3
Aspect	N	S	S	SE	SE	S	S	S
Geology								
Formation*	CO	S2	S2	S2	S2	S2	S2	S2
Surface rock cover (%)	3	4	1	15	10	1	2	1
Soil								
Form*	M	M	M	M	M	M	M	W
Series*	M	M	M	M	M	M	M	S
Depth (mm)	80	150	400	110	150	400	170	>1 000
Watertable depth (mm)**	800	N/O	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	0,9	1,2			0,5	1,2		0,4
Titratable acidity (me/100g)	4,8	4,2			3,0	4,2		1,0
Aluminium (me %)	0,3	0,0			0,2	0,0		0,1
Electrical resistance (ohms)	4 700	2 100			3 200	2 100		2 800
pH (H_2O)	5,3	6,0			5,0	6,0		6,0
pH ($CaCl_2$)	4,4	5,4			4,9	5,4		5,5
Sodium (me/100g)	0,0	0,1			0,0	0,1		0,1
Potassium (me/100g)	0,2	0,6			0,2	0,6		0,2
Calcium (me/100g)	0,2	1,6			0,8	1,6		0,8
Magnesium (me/100g)	0,1	1,3			0,0	1,3		0,3
S - value (me/100g)	0,5	3,6			1,0	3,6		1,4
T - value (me/100g)	5,2	9,3			4,4	9,3		3,4

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	B - plateau, E - lower slopes
	Formation (Geology)	SO - conglomerate (Formation Alma Graywache)
		S2 - sandstone (Formation Aasvoëlkop)
	Form	M - Mispah
	Series	M - Mispah
	Form	W - Westleigh
	Series	S - Sibasa
** N/O:	Not observable	

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class. Being situated adjacent to the upper plateau the community can be expected to have a wide temperature amplitude and dry moisture status.

Habitat

The habitat factors recorded for the community are shown in Table 5.21 and summarized in Table 5.2. The soils are mainly of the Mispah Form, Mispah Series, derived mainly from sandstone of the Aasvoëlkop Formation but also conglomerate, in the case of relevé 78, of the Alma Graywacke Formation. Relevé 14 represents soils of the Westleigh Form,Sibasa Series, derived from sandstone of the Aasvoëlkop Formation. The average soil depth varies from 80 mm to deeper than 1 000 mm and the surface rock cover varies from 1 percent to 15 percent. The terrain slopes from 1° to 19° in a south to south easterly direction with relevé 78 on the upper plateau representing a slope of 2° in a northerly direction. The electrical resistance of the soils varies from 2 100 ohms to 4 700 ohms and the T-value varies from 3,4 me/100g to 9,3 me/100 g, indicating soils with a low to moderate nutrient status. The soils are moderately to strongly acid (MacVicar, et al., 1977) with a pH range of 5,0 to 6,0, when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the absence of character species and the absence of the *Vernonia oligocephala* species-group (Table 5.2 R), the *Pachycarpus schinzianus* species-group (Table 5.2 S) and the *Cyperus denudatus* species-group (Table 5.2 T) together with the presence of the *Senecio erubescens* species-group (Table 5.2 V). The species diversity per unit area averages 6,5 species/m^2 for the community (Table 5.21).

Trees and shrubs

All woody species have less that 2,5 percent mean cover. Woody species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

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Protea caffra (tree/shrub)	75%	1,9%
Rhus dentata (shrub)	63%	0,5%

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

Eragrostis racemosa (grass)	100%	4,3%
Setaria perennis (grass)	75%	2,9%
Indigofera comosa (forb)	63%	0,2%
Bulbostylis boeckeleriana (sedge)	63%	0,09%

General

Communities 5.13 to 5.16 are related to each other through the mutual presence of the *Senecio erubescens* species-group (Table 5.2V) and communities 5.8 to 5.16 are related to each other through the mutual presence of the *Schizachyrium sanguineum* species-group (Table 5.2 W). The *Stoebe vulgaris* species-group (Table 5.2 U) indicates a partial affinity between communities 5.15 and 5.16. *Stoebe vulgaris* is an Increaser III species (Appendix II) which indicates that the condition responsible for its high cover-abundance in community 5.16 (Table 5.2) is causing encroachment in community 5.15.

The condition of the vegetation with respect to grazing is poor as is indicated by the low final scores and high proportion of Increaser II species to Decreaser species (Table 5.21), which indicates overgrazing. However, the proportion of Decreaser species to Increaser II species is higher for the vegetation represented by relevé numbers 16 and 131. The vegetation represented by the last two relevés is situated within fenced camps, apart from the rest of the community. It would appear, therefore, that the vegetation represented by the last two relevés is not subjected to heavy grazing pressure as is the rest of the community.

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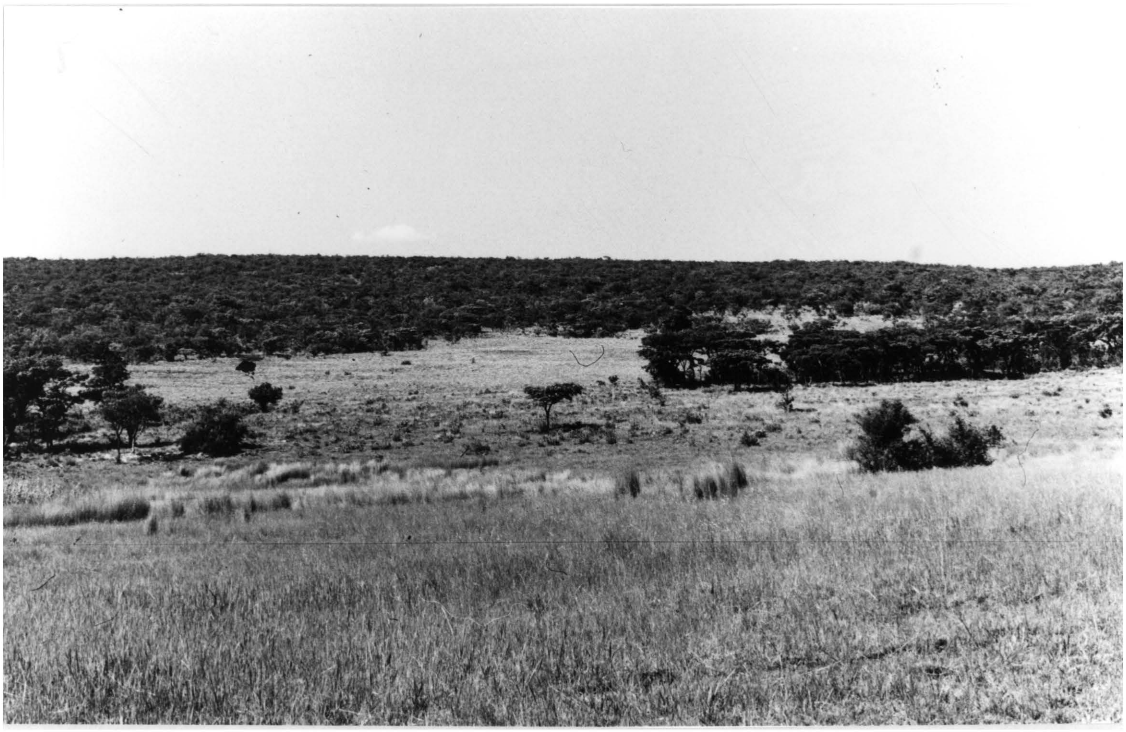

Fig. 5.12 The *Andropogon appendiculatus* — *Eragrostis pallens* grassland in the foreground with the north facing slopes in the background.

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Fig. 5.13 *Stoebe vulgaris* closed dwarf shrubland in the foreground, represented by relevé 1.

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TABLE 5.22 Habitat factors recorded for the *Andropogon appendiculatus* - *Eragrostis pallens* grassland (community 5.16)

Relevé number	7	9	10	6	5	3	4	8	20	2	1	21
Vegetation												
Canopy cover (%)	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79
Formation*	G	G	G	G	G	G	G	G	G	G	D	G
Species diversity (per m²)	7	6	4	6	7	6	5	7	8	6	4	7
Species per relevé	23	18	15	23	25	22	14	17	28	20	12	17
Veld condition												
Final score (%)	23	31	4	1	23	100	1	5	5	51	1	3
Composition score (%)	23	36	17	23	48	100	23	22	16	51	6	22
Basal cover (%)	21	19	17	6	4	21	4	16	13	22	28	11
Decreasers (%)	23	45	17	41	63	67	1	0	18	34	0	14
Increaser I (%)	12	0	1	9	0	0	0	16	4	1	0	1
Increaser II (%)	51	49	80	41	33	28	98	84	77	63	36	81
Increaser III (%)	14	6	2	9	4	5	1	0	1	2	64	4
Selaginella dregei (%)	0	0	0	0	0	0	0	0	0	0	0	0
Topography												
Geomorphology*	B	B	B	B	B	B	B	B	B	B	B	B
Altitude (m)	1 450	1 435	1 465	1 465	1 440	1 420	1 435	1 450	1 400	1 435	1 450	1 425
Slope (°)	3	2	3	3	2	2	0	3	2	0	1	2
Aspect	S	S	SE	S	SW	SW		N	S		SE	S
Geology												
Formation*	SH	SH	SH	SH	SH	SH	SH	SH	CO	SH	SH	SH
Surface rock cover (%)	0	0	0	0	0	0	0	0	0	0	0	0
Soil												
Form*	M	M	M	M	M	K	M	M	K	M	M	K
Series*	M	M	M	M	M	S	M	M	S	M	M	S
Depth (mm)	800	800	600	750	200	>1 000	250	150	>1 000	400	240	850
Watertable depth (mm)**	800	N/O	N/O	750	N/O	1 000	250	150	1 000	N/O	N/O	250
Carbon (%)	2,3					1,0	2,3		1,0	2,3		1,0
Titratable acidity (me/100g)	10,4					5,4	10,4		5,4	10,4		5,4
Aluminium (me %)	0,7					0,7	0,7		0,7	0,7		0,7
Electrical resistance (ohms)	3 100					4 800	3 100		4 800	3 100		4 800
pH (H_2O)	4,7					4,5	4,7		4,5	4,7		4,5
pH ($CaCl_2$)	4,4					4,3	4,4		4,3	4,4		4,3
Sodium (me/100g)	0,1					0,1	0,1		0,1	0,1		0,1
Potassium (me/100g)	0,5					0,2	0,5		0,2	0,5		0,2
Calcium (me/100g)	0,7					0,5	0,7		0,5	0,7		0,5
Magnesium (me/100g)	0,2					0,1	0,2		0,1	0,2		0,1
S - value (me/100g)	1,5					0,9	1,5		0,9	1,5		0,9
T - value (me/100g)	11,8					5,9	11,8		5,9	11,8		5,9

*Symbols used:	Formation (Vegetation)	G - grassland
	Geomorphology	B - plateau
	Formation (Geology)	SH - shale (Formation Aasvoëlkop)
		CO - conglomerate (Formation Alma Graywacke)
	Form	M - Mispah
	Series	M - Mispah
	Form	K - Kroonstad
	Series	S - Slangkop
**N/O	Not observable	

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C. GRASSLAND, REPRESENTATIVE OF ACOCKS'S (1975) SOUR BUSHVELD ON MODERATELY DEEP SOILS, IN EXPOSED, DRY HABITATS

The grassland, representative of Acocks's (1975) Sour Bushveld is represented by one community in the study area, namely:

5.16 *Andropogon appendiculatus* — *Eragrostis pallens* grassland

5.16 *Andropogon appendiculatus* — *Eragrostis pallens* grassland

The *Andropogon appendiculatus* — *Eragrostis pallens* grassland (Fig. 5.12) is found at altitudes of 1 400 m to 1 465 m on the upper plateau in the central part of the study area (Fig. 5.1). It is represented by twelve relevés (Table 5.22) with 12 to 28 species per relevé. This grassland community (Edwards, 1976) has an L structure (Ito, 1979; Fig. 5.4 s) with the greatest average cover of 23 percent in the 0,0 m - 0,5 m height class. However, relevé 1 represents vegetation classified as dwarf shrubland (Edwards, 1976) because of the presence of *Stoebe vulgaris* which has a mean cover of 42 percent in this relevé (Fig. 5.13). The upper plateau is possibly subjected to temperature inversion at night because of the slopes to the north and south, resulting in wide temperature amplitudes. Except for the rainy season, when the watertable is high or at the soil surface for large areas of the upper plateau, the community is very dry, possibly because of the exposed nature of the habitat and lack of high vegetation cover.

Habitat

The habitat factors recorded for the community are shown in Table 5.22 and summarized in Table 5.2. The soils are mainly of the Mispah Form, Mispah Series, derived from shale of the Aasvoëlkop Formation and the Kroonstad Form, Sibasa Series derived from shale of the Aasvoëlkop Formation and conglomerate of the Alma Graywacke Formation. The average soil depth varies from 150 mm to deeper than 1 000 mm but the impermeable shale causes a high watertable, which varied from

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150 mm to deeper than 1 000 mm at the time of sampling, that could have a limiting effect on maximum root depth. No surface rocks were recorded for the community. The terrain slopes up to 3° mainly in a south easterly to south westerly direction but also northerly in the case of relevé 8. The electrical resistance varies from 3 100 ohms to 4 800 ohms and the T-value varies from 5,9 me/100 g to 11,8 me/100 g indicating soils of a predominantly high nutrient status, possibly because of poor drainage due to the impermeable shale. The soils are strongly acid (MacVicar, et al., 1977) with a pH of 4,5 to 4,7 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the *Cyperus denudatus* species-group (Table 5.2 T). The following are character species for the community:

- *Andropogon appendiculatus* (grass), P
- *Asclepias* sp. (forb), S
- *Cyperus denudatus* (sedge), P
- *Eragrostis gummiflua* (grass), E
- *Eragrostis lappula* (grass), S
- *Setaria sphacelata* (grass), E
- *Trichoneura grandiglumis* (grass), E

The species diversity per unit area averages 6,1 species/m^2 for the community (Table 5.22).

Trees and shrubs

Only an isolated *Protea caffra* tree was recorded for this community. The dwarf shrub, *Stoebe vulgaris* with a constancy of 53 percent has a mean cover of 4 percent for the relevés representing the community. However, in relevé number 1, *Stoebe vulgaris* has a mean cover of 42 percent, resulting in this relevé being classified as closed dwarf shrubland (Fig. 5.13). If relevé number 1 is not taken into account, the mean cover of *Stoebe vulgaris* is less than 1 percent for the community as a whole, hence the community is classified as grassland. The floristic composition of relevé number 1 is such that it forms a part of community 5.16 (Table 5.2). *Stoebe vulgaris* can be regarded as an invader species, without which relevé number 1 would have potentially closer floristic affinities with community 5.16. The presence of *Stoebe vulgaris* causes much concern amongst the local farmers because of its encroachment upon grassland used for grazing.

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Cyperus denudatus* (sedge)	100%	0,8%
- *Eragrostis racemosa* (grass)	92%	5,9%
- *Eragrostis pallens* (grass)	92%	4,6%
- *Bulbostylis boeckeleriana* (sedge)	92%	0,9%
- *Senecio erubescens* (forb)	92%	0,2%
- *Andropogon appendiculatus* (grass)	67%	1,7%
- *Alloteropsis semialata* (grass)	67%	0,2%
- *Bergia decumbens* (forb)	67%	0,2%
- *Panicum natalense* (grass)	58%	5,7%
- *Aristida junciformis* (grass)	58%	2,7%
- *Eragrostis capensis* (grass)	58%	2,2%

General

Communities 5.13 to 5.16 are related to each other through the mutual presence of the *Senecio erubescens* species-group (Table 5.2 V) and communities 5.8 to 5.16 are related to each other through the mutual presence of the *Schizachyrium sanguineum* species-group (Table 5.2 W). The *Stoebe vulgaris* species-group (Table 5.2 U) indicates a partial affinity between communities 5.15 and 5.16.

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Fig. 5.14 The *Protea roupelliae* — *Helichrysum nudifolium* sparse woodland on the upper slopes of the Kransberg massif.

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The vegetation is generally overgrazed as is indicated by the high proportion of Increaser II species to Decreaser species. The vegetation represented by relevé numbers 5 and 3, however, has a higher proportion of Decreaser to Increaser II species, indicating vegetation of better grazing potential. As the vegetation represented by these last two relevés is accessible to cattle and forms part of the camps where the vegetation is overgrazed, it is suggested that the seasonal waterlogging of the soils and surface water after rains could inhibit grazing as the vegetation represented by these two relevés is generally lower-lying than the rest of the vegetation in the community or in shallow depressions. The vegetation represented by relevé number 1 has a high poportion of Increaser III species, indicating selective grazing. As *Stoebe vulgaris* is classified as an Increaser II species (Roux, 1969) its presence is responsible for the high proportion of Increaser III species. Roux (1969) suggests that selective grazing of grass results in grass tufts often being left ungrazed, which provides essential shade for *Stoebe vulgaris* seed germination. Where grass is grazed short and species composition is not affected, that is, non-selective grazing (Acocks, 1966), *Stoebe vulgaris* will be unable to germinate for lack of shade.

D. WOODLAND, REPRESENTATIVE OF ACOCKS'S (1975) NORTH-EASTERN MOUNTAIN SOURVELD ON MODERATELY SHALLOW SOILS, IN MODERATELY EXPOSED HABITATS

The woodland, representative of Acocks's (1975) North-Eastern Mountain Sourveld is represented by one community in the study area, namely:

5.17 *Protea roupelliae — Helichrysum nudifolium* sparse woodland

5.17 *Protea roupelliae — Helichrysum nudifolium* sparse woodland

The *Protea roupelliae — Helichrysum nudifolium* sparse woodland (Fig. 5.14) is found at altitudes of 1 600 m to 1 900 m (Table 5.23) in the northern part of the study area (Fig. 5.1). It is represented by seventeen relevés (Table 5.23) with 17 to 32 species per relevé. Relevé 120 and 118, although floristically different to the rest

TABLE 5.23 Habitat factors recorded for the *Protea roupelliae — Helichrysum nudifolium* sparse woodland (community 5.17).

Relevé number	120	118	123	125	126	122	121	114	115	111	116	109	119	112	110	117	124
Vegetation																	
Canopy cover (%)	<1	<1	1-8	1-8	1-8	<1	1-8	<1	<1	<1	<1	<1	1-8	<1	<1	<1	<1
Formation*	· W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
Species diversity (per m²)	6	5	7	6	7	7	7	5	7	6	6	6	7	7	6	5	6
Species per relevé	27	21	32	23	23	20	24	30	23	27	23	21	28	26	24	17	23
Veld condition																	
Final score (%)	100	53	67	56	68	51	73	63	68	53	52	62	100	55	53	52	51
Composition score (%)	100	66	73	60	68	51	73	69	68	67	61	67	100	62	67	61	66
Basal cover (%)	16	11	14	13	16	20	30	13	17	11	11	14	16	11	11	11	12
Decreasers (%)	65	78	72	69	68	53	76	71	91	81	75	59	83	77	78	79	67
Increaser I (%)	1	1	0	1	0	0	0	1	1	1	0	0	1	1	1	1	0
Increaser II (%)	31	16	24	11	16	9	17	24	8	18	21	37	16	18	17	15	29
Increaser III (%)	3	5	4	19	16	38	7	4	0	0	4	4	0	4	4	5	4
Selaginella dregei (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Topography																	
Geomorphology*	D	D	D	D	D	A	D	D	D	D	D	D	D	D	D	D	D
Altitude (m)	1 700	1 700	1 800	1 700	1 600	1 750	1 700	1 700	1 850	1 875	1 625	1 900	1 700	1 850	1 850	1 650	1 800
Slope (°)	27	26	38	34	28	0	31	24	28	25	18	26	23	25	26	23	36
Aspect	SE	S	SE	SW	S		S	S	SW	S	S	W	SW	S	S	S	S
Geology																	
Formation*	S3	S3	S2	S2	S2	S2	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3	S2
Surface rock cover (%)	60	70	80	80	70	75	50	60	60	60	50	60	55	60	60	60	75
Soil																	
Form*	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Series*	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Depth (mm)	120	100	70	100	120	70	130	180	120	150	100	110	160	90	100	90	120
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	1,2	3,2	2,0	2,2		2,0		1,2			3,2	1,2	1,2	1,2		3,2	2,2
Titratable acidity (me/100g)	6,6	9,0	8,7	7,8		8,7		6,2			9,0	6,2	6,6	6,2		9,0	7,8
Aluminium (me %)	0,6	1,4	0,9	0,7		0,9		1,0			1,4	1,0	0,6	1,0		1,4	0,7
Electrical resistance (ohms)	4 500	8 200	4 600	4 300		4 600		5 200			8 200	5 200	4 500	5 200		8 200	4 300
pH (H_2O)	4,7	4,9	4,7	4,8		4,7		4,4			4,9	4,4	4,7	4,4		4,9	4,8
pH ($CaCl_2$)	4,4	4,2	4,4	4,4		4,4		4,1			4,2	4,1	4,4	4,1		4,2	4,4
Sodium (me/100g)	0,0	0,0	0,0	0,0		0,0		0,0			0,0	0,0	0,0	0,0		0,0	0,0
Potassium (me/100g)	0,4	0,1	0,2	0,2		0,2		0,2			0,2	0,2	0,4	0,2		0,0	0,2
Calcium (me/100g)	0,6	0,5	1,2	1,0		1,2		0,3			0,5	0,3	0,6	0,3		0,5	1,0
Magnesium (me/100g)	0,5	0,1	0,2	0,2		0,2		0,2			0,1	0,2	0,5	0,2		0,1	0,2
S - value (me/100g)	1,5	0,7	1,6	1,4		1,6		0,7			0,7	0,7	1,5	0,7		0,7	1,4
T - value (me/100g)	8,2	11,8	9,8	6,0		9,8		7,1			11,8	7,1	8,2	7,1		11,8	6,0

*Symbols used:	Formation (Vegetation)	W - woodland
	Geomorphology	D - upper slopes, A - summit
	Formation (Geology)	S3 - sandstone (Formation Sandriviersberg) S2 - sandstone (Formation Aasvoëlkop)
	Form	M - Mispah
	Series	M - Mispah
** N/O	Not observable	

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of the community, are not regarded as a separate variation because of the lack of character species and because only two relevés represent the difference. The difference in floristic composition for these two relevés is indicated by the dotted line in Table 5.2. In order to ascertain if structural differences existed, the two different floristic units were illustrated separately as Fig. 5.4 t, for relevés 120 and 118 (5.17 a)* and Fig. 5.4 u for the rest of the community (5.17 b)*. This sparse woodland community (Edwards, 1976) has an L structure (Ito, 1979; Figs 5.4 t and 5.4 u) with the greatest average cover of 36 percent for relevés 120 and 118, and 30 percent for the other relevés in the community, in the 0,0 m to 0,5 m height class. The community is exposed, being situated at a high altitude and a considerable temperature amplitude could be expected. The moisture regime, however, should not be the lowest in the study area, although the community is exposed, because of the occurence of frequent mists on the upper reaches of the Kransberg massif, which was observed during the course of fieldwork.

Habitat

The habitat factors recorded for the community are shown in Table 5.23 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series, derived from sandstone of the Aasvoëlkop and Sand=riviersberg Formations. The average soil depth varies from 70 mm to 180 mm and the surface rock cover varies from 50 percent to 80 percent. The terrain slopes up to 38° in a south-easterly to westerly direction. The relevé (number 122) representing the 0° slope is situated on a flat area at 1 750 m altitude. The electrical resistance of the soils varies from 4 300 ohms to 8 200 ohms and the T-value varies from 6,0 me/100 g to 11,8 me/100 g indicating a low to high nutrient status. It is suggested that the high nutrient status occurs in fluves, where runoff from the interfluves causes depletion of nutrients on the interfluves and accumulation of nutrients in the fluves. The soils are strongly acid (MacVicar, et al., 1977) with pH from 4,4 to 4,9 when saturated with water.

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*5.17 a and 5.17 b refer to Figs 5.4 and 8.2.

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Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the *Helichrysum nudifolium* species-group (Table 5.2 X) which does not occur in relevés 120 and 118. The following are character species for the community:

- *Brachymeris bolusii* (forb), P
- *Helichrysum nudifolium* (forb), P
- *Vernonia galpinii* (forb), P

The species diversity per unit area average 6,2 species/m² for the community (Table 5.23). It appears from aerial photographs of the study area that the vegetation represented by relevés 120 and 118 fall into an apparently permanent shadow caused by the Kransberg massif and with additional sampling could prove to be a variation of community 5.17.

Trees and shrubs

The only conspicuous woody species occurring in 50 percent of the relevés representing the community (Table 5.2) is:

- *Protea caffra* (tree/shrub)	71%	2,8%

The mean percentage cover for *Protea caffra* is higher than indicated for a sparse woodland (Edwards, 1976), however, the high cover can be attributed to individual plants, under 2 m high, as is also the case with *Protea roupelliae* which has a 47 percent constancy and 1,3 percent mean cover

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

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- *Heteropogon contortus* (grass)	100%	25,6%
- *Eragrostis racemosa* (grass)	94%	1,8%
- *Panicum natalense* (grass)	88%	2,6%
- *Bulbostylis burchellii* (sedge)	88%	0,2%
- *Loudetia simplex* (grass)	82%	2,9%
- *Monocymbium ceresiiforme* (grass)	82%	2,4%
- *Helichrysum* sp. (forb)	71%	0,1%
- *Indigofera hedyantha* (forb)	71%	0,1%
- *Helichrysum nudifolium* (forb)	65%	0,09%
- *Andropogon schirensis* (grass)	59%	1,1%
- *Brachymeris bolusii* (forb)	59%	0,8%
- *Chaetacanthus costatus* (forb)	59%	0,3%
- *Helichrysum kraussii* (forb)	59%	0,3%
- *Stachys natalensis* var. *natalensis* (forb)	59%	0,06%
- *Themeda triandra* (grass)	53%	3,2%
- *Dicoma anomala* (forb)	53%	0,03%

General

Communities 5.17 and 5.18 are related to each other through the mutual presence of the *Protea roupelliae* species-group (Table 5.2 Z) and the *Helichrysum kraussii* species-group (Table 5.2 AA) but the former species-group is not represented by relevés 120 and 118 while the latter is represented by these two relevés. Variation 5.11.2 and communities 5.12, 5.17 and 5.18 are related to each other through the mutual presence of the *Helichrysum* sp. species-group (Table 5.2 AB).

The condition of the vegetation, with respect to grazing potential, is for community 5.17, the best in the study area, as indicated by the high final scores and high proportion of Decreaser species compared to Increaser species. The high altitude and steep slope on which the community is found, together with the high surface rock cover make accessibility and hence grazing by cattle difficult. The grass is not moribund, however, probably due to periodic, accidental fires, and the species composition is consequently not high in Increaser I species, which indicates underutilization.

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Fig. 5.15 The *Trachypogon spicatus* — *Eragrostis racemosa* grassland with an isolated *Podocarpus latifolius* tree in the centre.

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TABLE 5.24 Habitat factors recorded for the *Trachypogon spicatus* — *Eragrostis racemosa* grassland (community 5.18)

Relevé number	68	69	66	70	73	65	75	67	62	63	61	71	64	74	72
Vegetation															
Canopy cover (%)	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79	9-79
Formation*	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Species diversity (per m²)	7	6	6	6	7	6	6	6	6	5	6	5	6	6	6
Species per relevé	29	24	26	24	33	27	35	20	25	22	19	23	23	23	28
Veld condition															
Final score (%)	51	58	58	100	53	53	51	61	45	45	51	49	51	50	44
Composition score (%)	51	67	58	100	53	53	51	61	45	45	51	49	51	50	44
Basal cover (%)	5	3	7	3	7	7	7	5	6	6	7	7	7	7	6
Decreasers (%)	2	0	8	17	2	0	1	11	1	2	1	8	0	2	4
Increaser I (%)	13	23	35	22	38	38	34	52	42	43	37	35	40	39	43
Increaser II (%)	34	57	23	44	24	25	32	26	16	14	26	23	22	21	14
Increaser III (%)	51	20	34	17	36	37	33	11	41	41.	36	34	38	38	39
Selaginella dregei (%)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Topography															
Geomorphology*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Altitude (m)	2 025	2 075	2 000	2 040	2 000	2 025	1 900	2 050	2 050	2 050	2 080	1 950	2 050	1 950	2 000
Slope (°)	12	0	0	0	10	14	12	0	6	0	0	0	5	13	8
Aspect	NE				NW	E	SE		N				N	SW	NE
Geology															
Formation*	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3	S3
Surface rock cover (%)	85	90	85	90	75	80	80	85	80	80	80	90	75	80	60
Soil															
Form*	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Series*	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Depth (mm)	90	40	50	70	70	50	40	50	80	90	100	70	70	60	80
Watertable depth (mm)**	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O
Carbon (%)	2,5														
Titratable acidity (me/100g)	10,0														
Aluminium (me %)	1,1														
Electrical resistance (ohms)	4 200														
pH (H_2O)	5,2														
pH ($CaCl_2$)	4,3														
Sodium (me/100g)	0,1														
Potassium (me/100g)	0,4														
Calcium (me/100g)	0,3														
Magnesium (me/100g)	0,2														
S - value (me/100g)	1,0														
T - value (me/100g)	11,0														

*Symbols used:	Formation (Vegetation)	G - grassland
	Geomorphology	A - summit
	Formation (Geology)	S3 - sandstone (Formation Sandriviersberg)
	Form	M - Mispah
	Series	M - Mispah
** N/O	Not observable	

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E. GRASSLAND, REPRESENTATIVE OF ACOCKS'S (1975) NORTH-EASTERN MOUNTAIN SOURVELD ON SHALLOW ROCKY SOILS IN EXPOSED HABITATS

The grassland, representative of Acocks's (1975) North-Eastern Mountain Sourveld is represented by one community in the study area, namely:

5.18 *Trachypogon spicatus* — *Eragrostis racemosa* grassland

5.18 *Trachypogon spicatus* — *Eragrostis racemosa* grassland

The *Trachypogon spicatus* — *Eragrostis racemosa* grassland (Fig. 5.15) is found at altitudes of 1 900 m to 2 080 m in the extreme north of the study area (Fig. 5.1). It is represented by fifteen relevés (Table 5.24) with 19 to 35 species per relevé. This grassland community (Edwards, 1976) has an L structure (Ito, 1979; Fig. 5.4 v) with the greatest average cover of 18 percent in the 0,0 m to 0,5 m height class. The community is exposed, being situated on the upper summit, and a considerable temperature amplitude could be expected. Similarly to community 5.17, the moisture regime should not be the lowest in the study area, although the community is exposed, because of the occurrence of frequent mists, which were observed during the course of fieldwork.

Habitat

The habitat factors recorded for the community are shown in Table 5.24 and summarized in Table 5.2. The soils are of the Mispah Form, Mispah Series, derived from sandstone of the Sandriviersberg Formation. The average soil depth varies from 40 mm to 100 mm and the surface rock cover varies from 60 percent to 90 percent. The terrain slopes up to 14° mainly in a south westerly through northerly to south easterly direction. The absence of a southerly aspect may be attributed to the cliff face to the south of the upper summit. The electrical resistance of the soils is 4 200 ohms and the T-value is 11,0 me/100 g indicating soils of a high nutrient status which may be attributed to the predominantly flat nature of the upper summit which inhibits runoff and consequent loss of nutrients. The soils are strongly acid

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(MacVicar, et al., 1977) with a pH of 5,2 when saturated with water.

Floristics

The floristic composition of the community is shown in Table 5.2 and summarized in Table 5.3. The community is differentiated by the *Trachypogon spicatus* species-group (Table 5.2 Y). The following are character species for the community:

- *Helichrysum uninervium* (forb), S
- *Polygala hottentotta* (forb), S
- *Selago capitellata* (forb), S
- *Tephrosia elongata* (forb), S
- *Trachypogon spicatus* (grass), P
- *Ursinia nana* (forb), E
- *Widdringtonia nodiflora* (shrub), S

The species diversity per unit area averages 6,0 species/m² for the community (Table 5.24).

Trees and shrubs

Isolated *Protea roupelliae* trees and shrubs occur in 60 percent of the relevés representing the community. The shrublet *Fadogia monticola* occurs with a 60 percent constancy in the community. Isolated *Podocarpus latifolius* trees are found in boulder clumps and the shrub *Widdringtonia nodiflora* occurs in 33 percent of the relevés. The canopy cover of the woody species is, however, less than 0,1 percent, resulting in the grassland classification (Edwards, 1976) for the community.

Herbs

Herb species occurring in more than 50 percent of the relevés representing the community (Table 5.2) are:

- *Trachypogon spicatus* (grass)	100%	8,6%
- *Loudetia simplex* (grass)	100%	7,2%
- *Andropogon schirensis* (grass)	100%	2,2%

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- *Acalypha angustata* (forb)	100%	0,3%
- *Bulbostylis burchellii* (sedge)	93%	0,9%
- *Helichrysum kraussii* (forb)	93%	0,4%
- *Helichrysum* sp. (forb)	93%	0,3%
- *Dicoma anomala* (forb)	93%	0,2%
- *Eragrostis racemosa* (grass)	80%	0,4%
- *Helichrysum mimetes* (forb)	73%	0,2%
- *Selago capitellata* (forb)	67%	1,0%
- *Helichrysum uninervium* (forb)	67%	0,2%
- *Helichrysum cephaloideum* (forb)	60%	0,2%
- *Indigofera hedyantha* (forb)	60%	0,06%
- *Senecio contrathii* (forb)	60%	0,06%
- *Mohria caffrorum* (fern)	60%	0,03%
- *Cyperus leptocladus* (sedge)	53%	0,2%
- *Berkheya carlinopsis* (forb)	53%	0,2%
- *Tephrosia elongata* (forb)	53%	0,09%
- *Xerophyta retinervis* (forb)	53%	0,06%

General

Communities 5.17 and 5.18 are related to each other through the mutual presence of the *Protea roupelliae* species-group (Table 5.2 Z) and the *Helichrysum kraussii* species-group (Table 5.2 AA). Variation 5.11.2 and communities 5.12, 5.17 and 5.18 are related to each other through the mutual presence of the *Helichrysum* sp. species-group (Table 5.2 AB).

The condition of the vegetation with respect to grazing potential is variable. There is a generally low proportion of Decreaser species with a high proportion of Increaser II species in relevés 69, 70 and 67, indicating overgrazing. The other relevés in the community have a generally high proportion of Increaser III species, indicating selective grazing. An access road to the summit of Kransberg approaches the mountain from the north. The end of the road at the summit is in vegetation represented by relevé numbers 69, 70 and 67 which are overgrazed. As cattle are driven up the mountain to graze and do not appear to be able to reach the summit of their own accord, possibly due to fences, the summit is only grazed periodically, hence the selective grazing tendency.

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TABLE 6.1 Percentage basal cover obtained with the one intercept and quadrat methods, showing the percentage difference between the two methods

Relevé number	Percentage Basal Cover		Percentage difference
	Line intercept method	Quadrat method*	
1	22,99	28,15	5,16
2	23,31	22,35	0,96
3	24,76	20,40	4,36
19	16,06	13,25	2,81
74	15,17	6,50	8,67
119	16,09	15,70	0,38

*The quadrat method using the Domin-Krajina cover-abundance scale for basal cover estimates

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TABLE 6.2 Comparison of basal cover determinations using the quadrat method and line intercept method for relevé number 74

Species recorded	Domin-Krajina basal cover-abundance value*	Percentage class midpoint*	Line intercept basal cover (percent)
Trachypogon spicatus	3	2,50	5,94
Loudetia simplex	3	2,50	5,36
Ursinia nana	1	0,05	
Protea roupelliae	1	0,05	0,13
Euryops pedunculatus	1	0,05	0,13
Helichrysum kraussii	1	0,05	
Indigofera hedyantha	1	0,05	0,03
Acalypha angustata	1	0,05	0,06
Helichrysum mimetes	1	0,05	
Aristea woodii	1	0,05	0,03
Psammotropha mucronata	1	0,05	
Helichrysum sp.	1	0,05	0,11
Dicoma anomala	1	0,05	0,24
Helichrysum cephaloideum	1	0,05	
Bulbostylis burchellii	1	0,05	0,18
Cyperus leptocladus	1	0,05	
Tristachya biseriata	1	0,05	0,60
Andropogon schirensis	2	0,50	1,29
Themeda triandra	1	0,05	0,64
Monocymbium ceresiiforme	1	0,05	0,43
Hypericum aethiopicum	1	0,05	
Lobelia aquaemontis	1	0,05	
Mohria caffrorum	1	0,05	
Total basal cover		6,50%	15,17%

*see Table 4.2

6. THE VELD CONDITION ASSESSMENT

The results of the veld condition assessment are presented in Tables 5.4 and 5.24 and the condition of the vegetation, with respect to grazing, is described in the description of communities in chapter 5. The results of the control assessment for determining basal cover with the line intercept method (paragraph 4.2) and with the quadrat method, using the Domin-Krajina cover-abundance scale, is given in Table 6.1, for the six quadrats in which the control assessment was made. The values obtained with the Domin-Krajina cover-abundance scale, for basal cover estimates, are within 5 percent of those obtained with the line intercept method for four of the six quadrats (Table 6.1). In the first quadrat (relevé number 1) the difference between the two methods is 5.16 percent. The high cover-abundance of *Stoebe vulgaris* in relevé number 1 caused difficulty in determining basal cover (see paragraph 5.16). *Stoebe vulgaris* branches low down, with the lower branches often touching the ground for up to half their length, before curving upwards. Basal cover determinations with both methods were likely to have been overestimated because the branching habit and large number of penicillate branches (Dyer, 1975) of *Stoebe vulgaris*, often led to branches forming part of the basal cover determinations. Difficulty in establishing the difference between low penicillate branches and stems, especially with the Domin-Krajina cover-abundance estimates was also experienced. The fifth comparison (relevé number 74) in grassland (paragraph 5.18) showed a difference of 8,67 percent between the two methods (Table 6.1).

Table 6.2 shows the actual Domin-Krajina basal cover-abundance values recorded for each species in relevé number 74 together with percentage class midpoints and the basal cover obtained by the line intercept method. The two grasses with the highest basal cover, *Trachypogon spicatus* and *Loudetia simplex* were estimated to have a basal cover value of under 5 percent, that is, a Domin-Krajina cover-abundance value of 3 (Table 4.2) whereas the line intercept method showed a basal cover of 5,94 percent and 5,36 percent for the two species respectively (Table 6.2). The basal cover of the two species was, therefore, according to the line intercept method, between the class limits of 5 percent and 6 percent for the Domin-Krajina cover-

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abundance scale (Table 4.2). Had a cover-abundance value of 4 been estimated for *Trachypogon spicatus*, 5,94 percent being closer to the 6 percent class limit than the 5 percent class limit (Table 4.2), the total basal cover estimated by means of the Domin-Krajina cover-abundance scale would have been 11,5 percent where the percentage class midpoint for the Domin-Krajina cover-abundance value of 4 is 7,5% (Table 4.2). This would have resulted in only a 3,67 percent difference between the two methods. Special care should, therefore, be exercised in estimating species cover-abundance when the basal cover is near the Domin-Krajina cover-abundance class limits, particularly when a species with dominant basal cover is involved.

Although the "+" symbol, for a solitary individual with insignificant cover (Table 4.2) is generally used for canopy cover, it could be used in estimating basal cover-abundance where there are several individuals with joint insignificant cover for which an appropriate symbol is lacking. This was not done in this study and an over=estimate of basal cover could have occurred where a number of species with insignificant basal cover were present.

It appears from the results of the six line intercept control determinations that basal cover estimates, using the Domin-Krajina cover-abundance scale, can give results within 5 percent of that obtained by the line intercept method. This will apply where the summation of the differences in basal cover for each species, obtained by the Domin-Krajina cover-abundance estimates, and that obtained by another method, such as the line intercept method, is less than 5 percent (Dunn, 1964).

The main vegetation type A has a final score class of 5 or less, with the greatest proportion of species in the Increaser I class (Table 5.2), indicating underutilization. As kloof forests are not usually used for grazing, the high proportion of Increaser I species could be expected, where fire or other factors have not caused an increase in Increaser II species. The main vegetation types B and C generally have a final score class of 5 or less, with the greatest proportion

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of species in the Increaser II class (Table 5.2) indicating overutilization. The main vegetation type D generally has a final score class of more than 5 with the greatest proportion of species in the Decreaser class (Table 5.2) indicating vegetation that is in good condition with respect to grazing. The main vegetation type E generally has a final score class of more than 5 but with the greatest proportion of species in the Increaser I and Increaser III classes (Table 5.2) indicating underutilization and selective grazing respectively.

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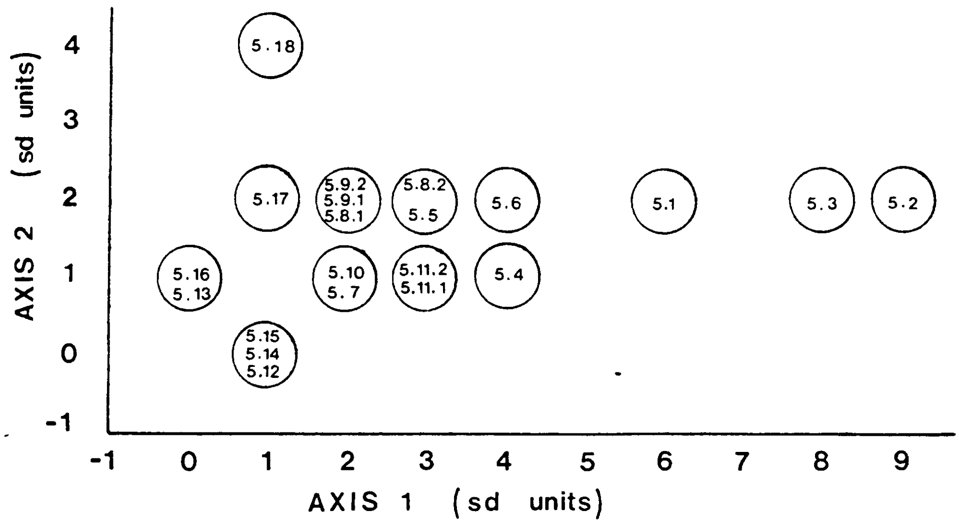

Fig.7.1 A detrended correspondence analysis (DCA) ordination of communities. Scatter diagram with communities grouped into cells along the first and second axes of the ordination.

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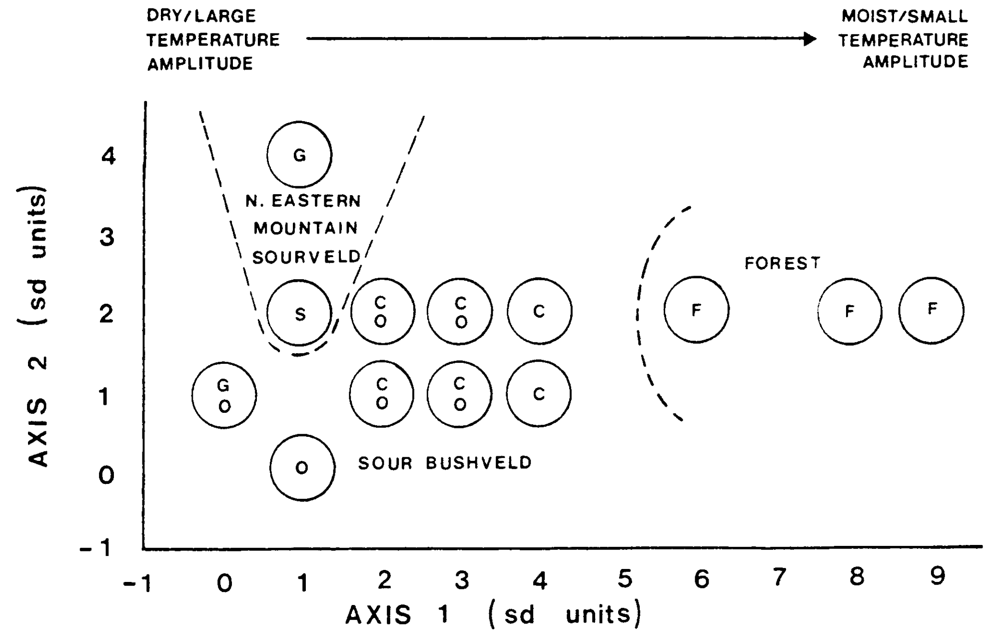

Fig. 7.2 - The position of the five major vegetation types along the first and second axes of ordination. The first axis represents a temperature/moisture gradient from grassland to forest.

G = grassland, S = sparse woodland, O = open woodland, C = closed woodland and F = forest.

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7. THE ORDINATION OF COMMUNITIES

The results of the detrended correspondence analysis (DCA) method of ordination of communities is given in Fig. 7.1 in the form of a scatter diagram representing the first (x-axis) and second (y-axis) axes of ordination. Communities are placed in cells, either alone, or with similar communities according to the first and second axes of the ordination. The gradient of length for the first axis (x-axis) is 9,25 sd and for the second axis (y-axis) 4,23 sd where the value sd is defined so that the root-mean-square, standard deviation (sd) is one (Hill, 1979).

Separation of cells along the first axis (x-axis) shows a gradient from grassland and open woodland (communities 5.16 and 5.13 respectively) on the left to closed woodland and forest (community 5.2) on the right of the scatter diagram (Figs 7.1 and 7.2). Although no data concerning the temperature or moisture status of the communities were recorded, this gradient probably corresponds with a temperature/moisture gradient similarly to that described by Theron (1973). This would range from the exposed areas of the plateau and summit grasslands, with wide temperature and moisture fluctuations, on the left of the scatter diagram to closed woodlands and forests of the sheltered slopes and kloofs with narrow temperature and moisture fluctuations, on the right of the scatter diagram (Fig. 7.2). Community 5.18 (summit grassland, paragraph 5.18) is more exposed than community 5.16 (plateau grassland, paragraph 5.16), but because of the occurrence of mist on the summit, more mist is received by community 5.18 than by community 5.16. The high watertable recorded for community 5.16 only occurs during the rainy season. Furthermore, community 5.16 is possibly subjected to inversion of temperature at night and probably experiences a greater temperature amplitude as a result thereof, than community 5.18 (see paragraphs 5.16 and 5.18). The communities are, therefore, separated on the x-axis with community 5.16 occupying the most extreme large temperature amplitude/dry position (Fig. 7.1).

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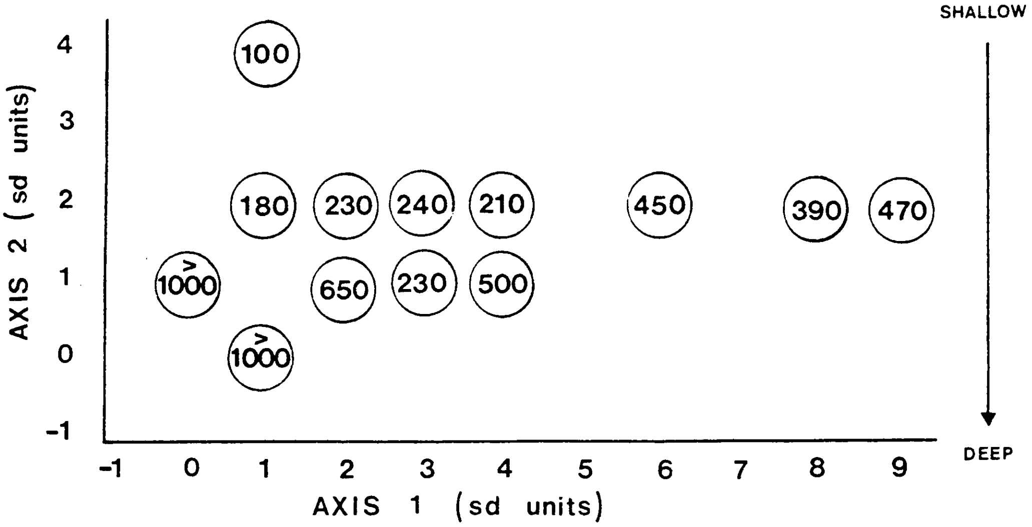

Fig.7.3 The position of the five main vegetation types along the first and second axes of ordination. The second axis represents a maximum soil depth gradient from shallow soils to deep soils. The figures represent the maximum recorded soil depth, in millimeters.

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Separation of cells along the second axis (y-axis) shows a general correlation with maximum recorded soil depth per cell (Fig. 7.3). This ranges from shallow soil (community 5.18 at the top of the scatter diagram) to deep soil (communities 5.12, 5.14 and 5.15) at the bottom. The occurrence of communities 5.13 (open woodland) and 5.16 (grassland) in one cell may be attributed to the underlying rock formation found within community 5.16 which is impermeable shale that causes a high watertable to form during the rainy season (paragraph 5.16). The soil is generally deep but where it is shallow water remains on the surface for long periods after rain. This seasonally high watertable could have the same limiting effect on root penetration as shallow soil by inhibiting growth of roots. The position of community 5.16 on the y-axis indicates that the effective, maximum soil depth for root penetration, is probably under 1 000 mm and not over 1 000 mm as recorded. The position of communities 5.10, 5.11.1, 5.11.2 and 5.13 at 1 sd unit on the y-axis and community 5.12 at 0 sd units on the y-axis (Figs 7.1 and 7.3) suggests that the possible, maximum soil depth for these communities was not sampled, although the separation of cells in the centre of the scatter diagram (Fig. 7.1) are not necessarily significant (Hill, 1979). The maximum recorded soil depths per cell on the y-axis (Fig. 7.3), for each sd unit, are similar to the soil depth classes described in paragraph 4.1.1.2(g) viii, a comparison of which follows:

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Position on y-axis (sd units) (Fig. 7.3)	Maximum soil depth range (Fig. 7.3)	Soil depth* range (paragraph 4.1.1.2 (g) viii)	Symbol for soil depth class
4	0 - 100 mm	0 - 120 mm	A
2	180 - 470 mm	130 - 480 mm	B & C
1	500 - 650 mm (excluding communities 5.11 and 5.16)	490 - 1 000 m	D
0	1 000 mm	1 000 mm	E

*to the nearest 10 mm

All recorded habitat data were compared with the first (x-axis) and second (y-axis) axes of the ordination. Apart from maximum recorded soil depth and the inferred temperature/moisture correlation, either none or only partial correlation could be found. As only the first (x-axis) and second (y-axis) axes were considered for the main environmental gradients, other, lesser factors could show correlation with the third and fourth axes. The better correlation obtained with maximum recorded soil depths, compared to minimum recorded soil depths and average soil depths, for which correlations were also attempted, indicates that maximum soil depth is possibly more limiting for vegetation in the study area, than minimum or average soil depths. This corresponds with effective soil depths described by Bosch (1974).

The five main vegetation types revealed in the classification (Figs 5.1 and 5.2) are also present in the ordination (Fig. 7.2). Forest communities are separated to the right of the scatter diagram, with grassland representative of Acocks's (1975) Sour Bushveld grassland to the left. The Sour Bushveld (Acocks, 1975) woodland vegetation is represented by the cells in the centre of the scatter diagram, ranging from open woodland on the left, to closed woodland on the right. Acocks's (1975) North-Eastern Mountain Sourveld vegetation is separated into two cells (Fig. 7.2) on the second axis (y-axis), with the grassland community above and the woodland community directly below, according to a soil depth gradient. Acocks's (1975) Sour Bushveld open woodland vegetation on deep soils is represented by the cell at the bottom of the y-axis. The ordination of communities has, furthermore, justified the need for a classification, in showing *a posteriori*, that discontinuities in the vegetation are present (Whittaker, 1978).

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TABLE 8.1 The ranges of species diversity, or alpha diversity, for the communities of the farm Groothoek, Thabazimbi district shown by the difference in minimum and maximum number of species at log 3 for the relevés representing the communities (Fig. 8.1)

Alpha diversity as the difference in minimum and maximum number of species at log 3 per community	Community number	Main vegetation type
3 - 4 species	5.1	A
	5.14	B
8 - 14 species	5.3	A
	5.4	B
	5.5	B
	5.6	B
	5.7	B
	5.8.2	B
	5.9.1	B
	5.9.2	B
	5.10	B
	5.11.1	B
	5.11.2	B
	5.12	B
	5.13	B
	5.15	B
	5.17(a)	D
18 - 20 species	5.2	A
	5.8.1	B
	5.16	C
	5.17(b)	D
	5.18	E

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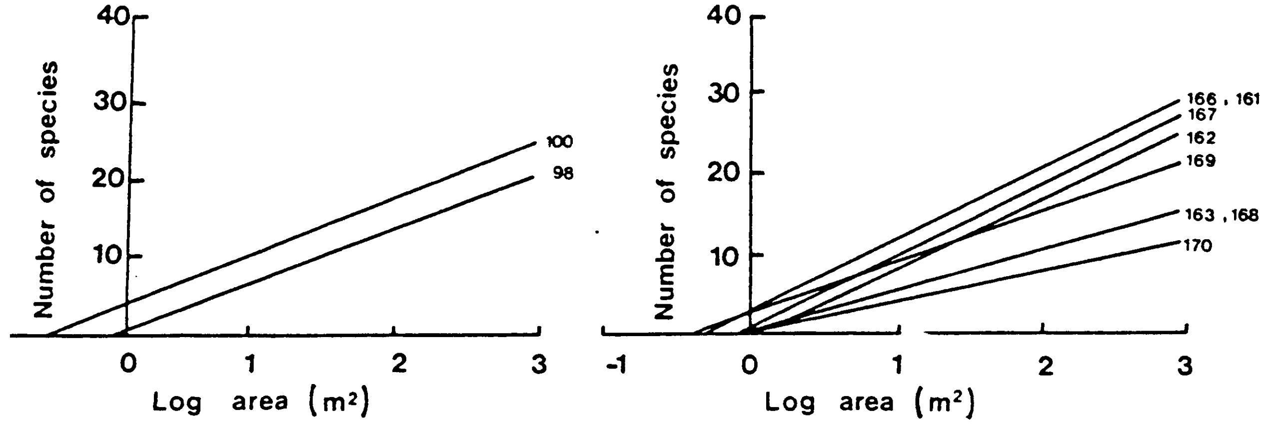
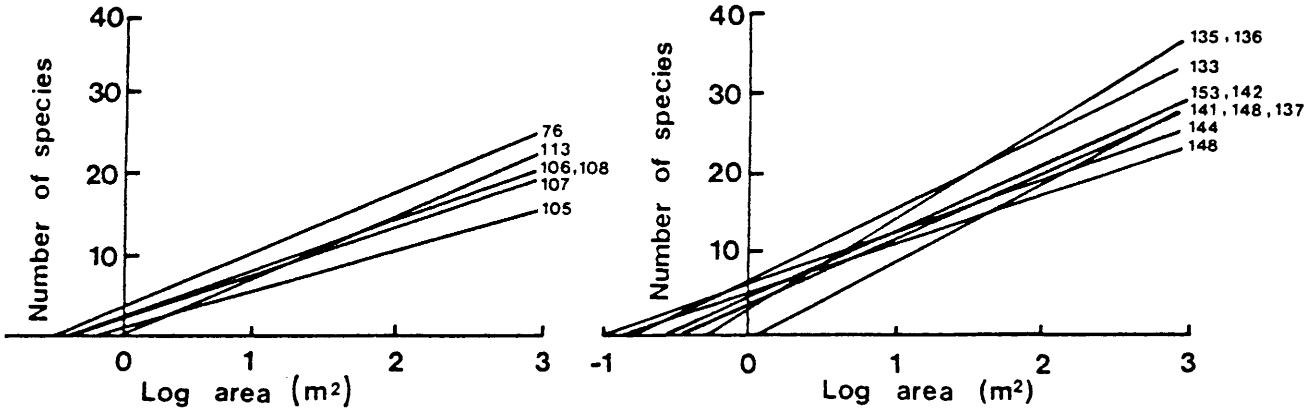


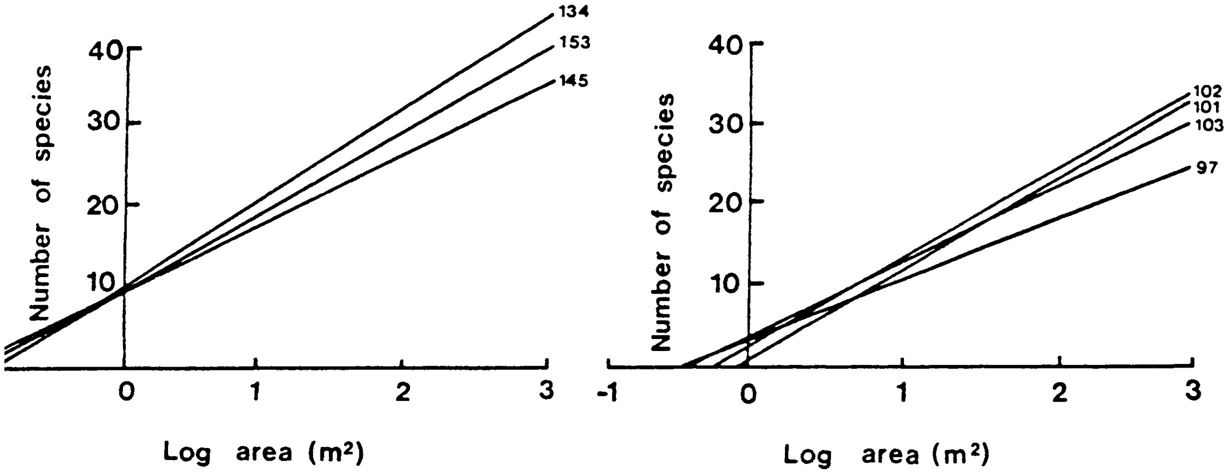
Community 5.1

(b) Community 5.2



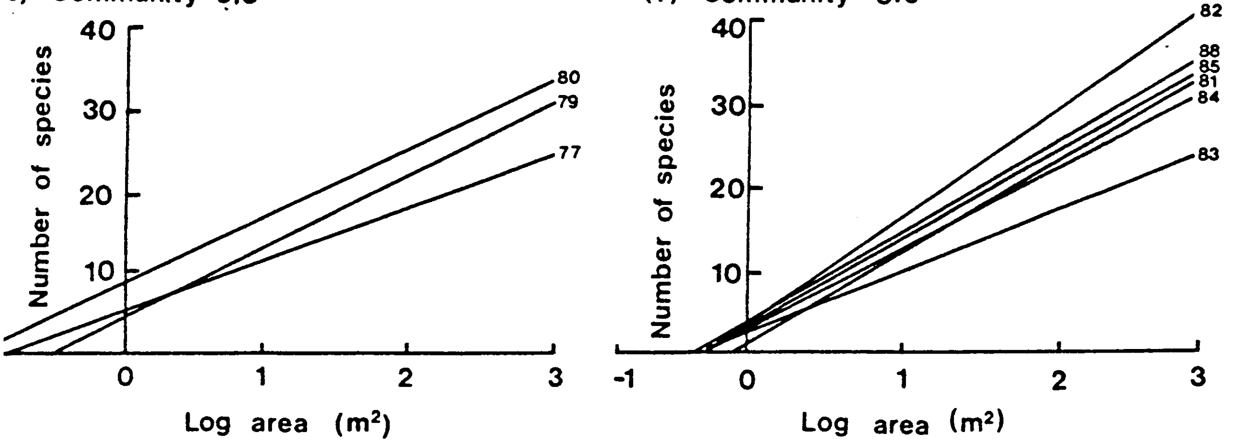
:) Community 5.3

(d) Community 5.4



e) Community 5.5

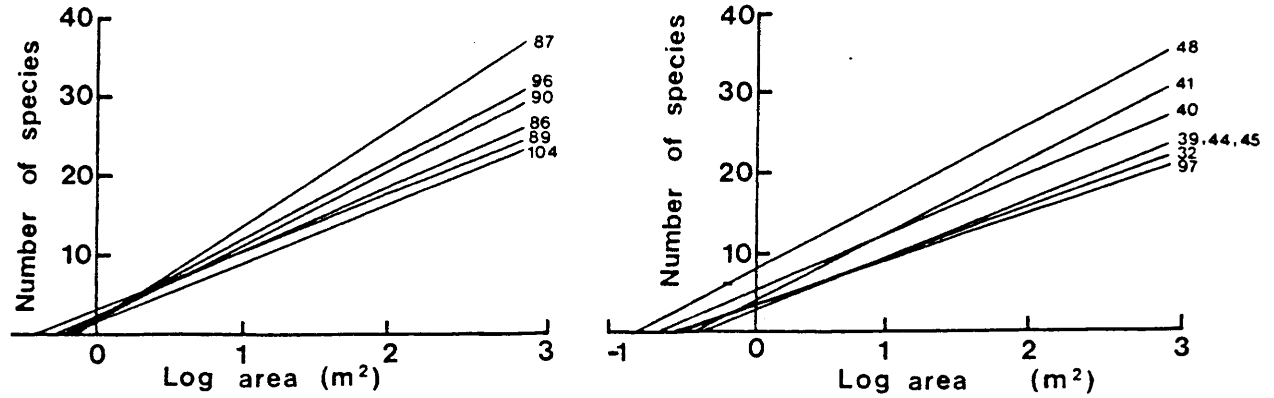
(f) Community 5.6



g) Community 5.7

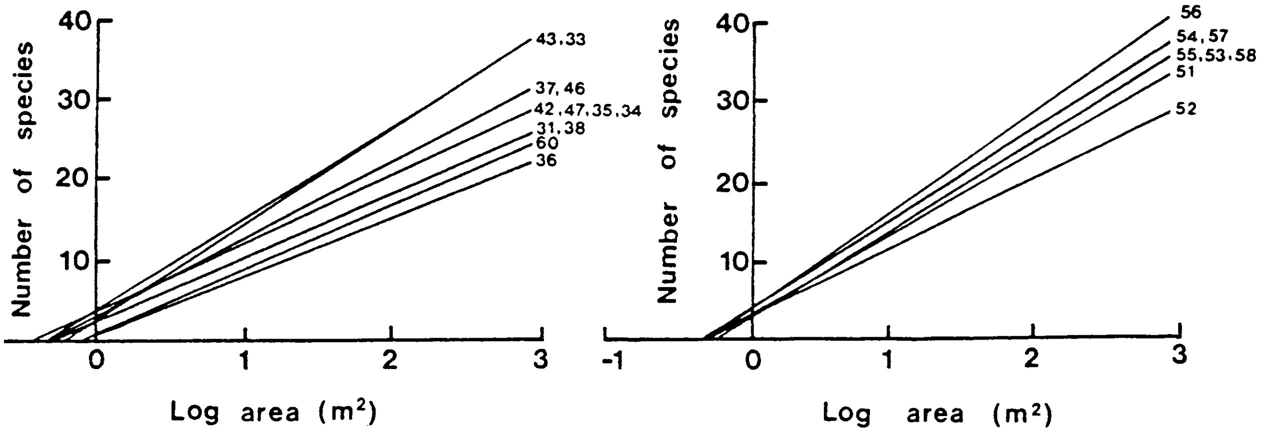
(h) Community 5.8.1

G 8.1 Alpha diversity for each community classified on the farm Groothoek, Thabazimbi district with linear regressions on a linear species number, log area scale, showing relevé numbers next to each linear regression.



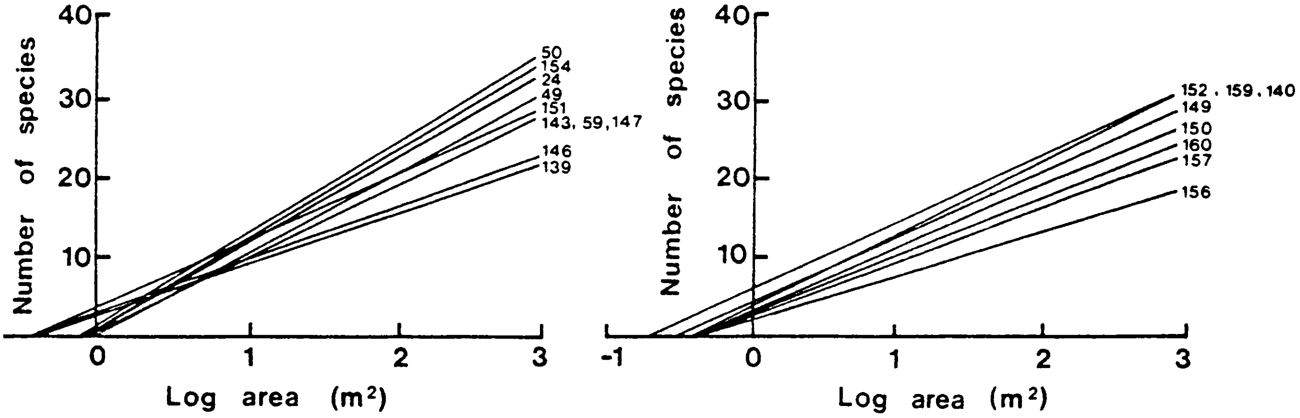
Community 5.8.2

(j) Community 5.9.1



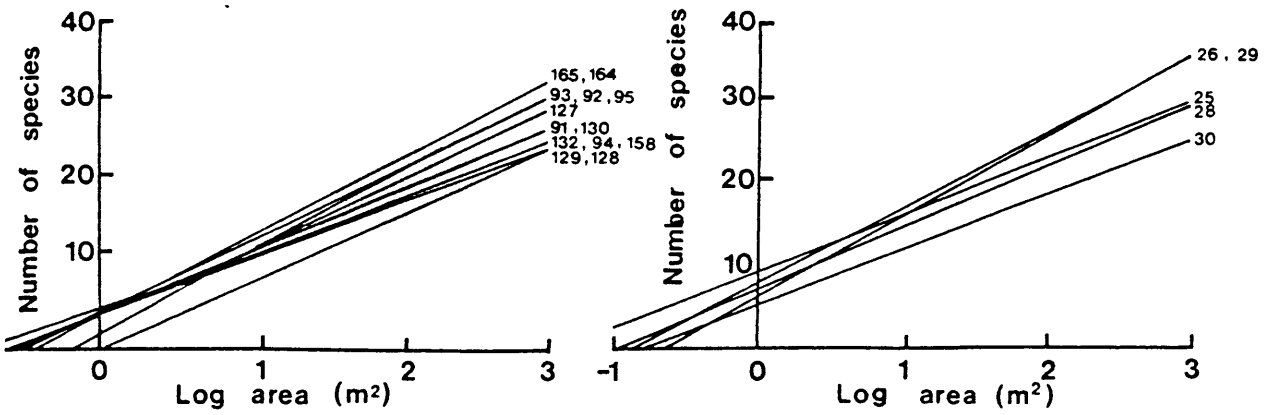
) Community 5.9.2

(l) Community 5.10



) Community 5.11.1

(n) Community 5.11.2



Community 5.12

(p) Community 5.13

8.1 (continued) Alpha diversity for each community classified on the farm Groothoek, Thabazimbi district with linear regressions on a linear species number, Log area scale showing relevé numbers next to each linear regressions.

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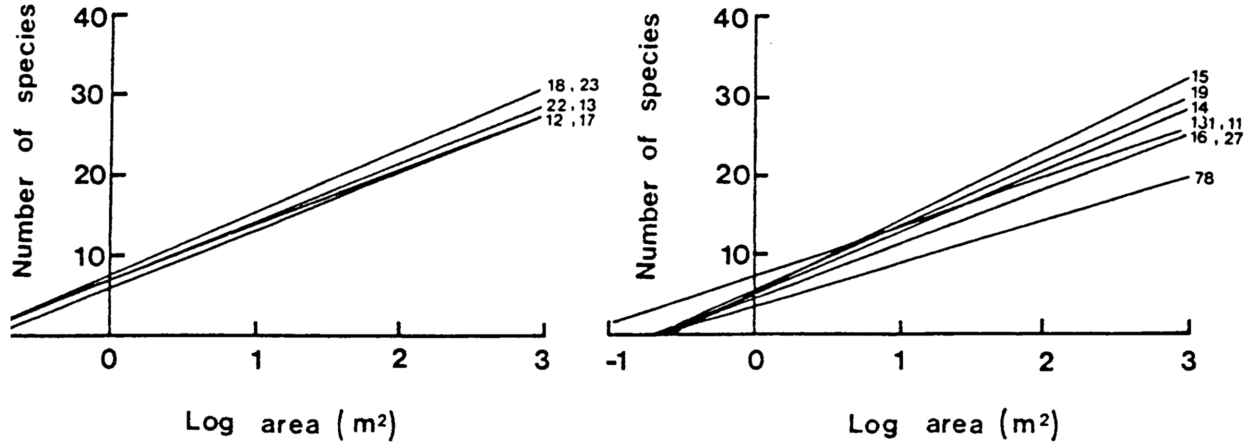
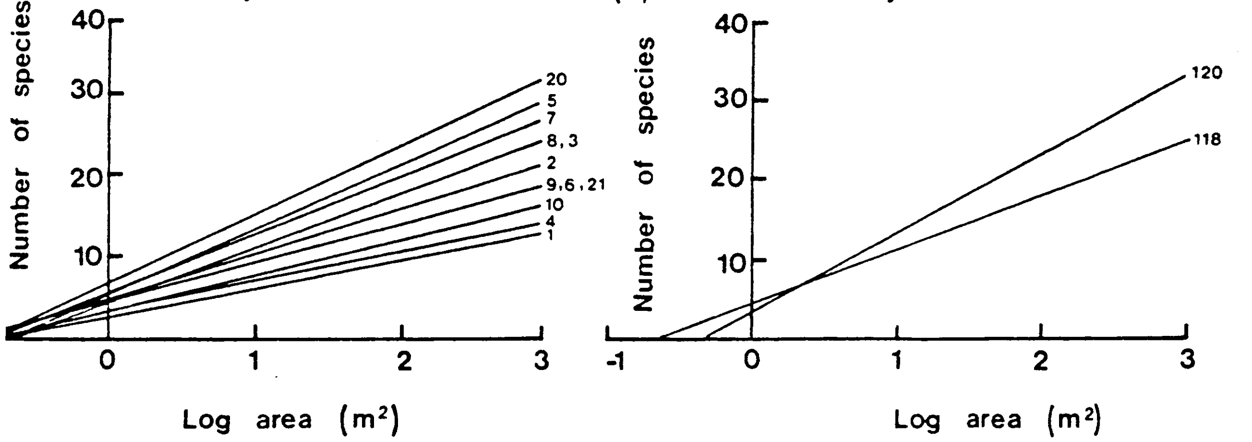


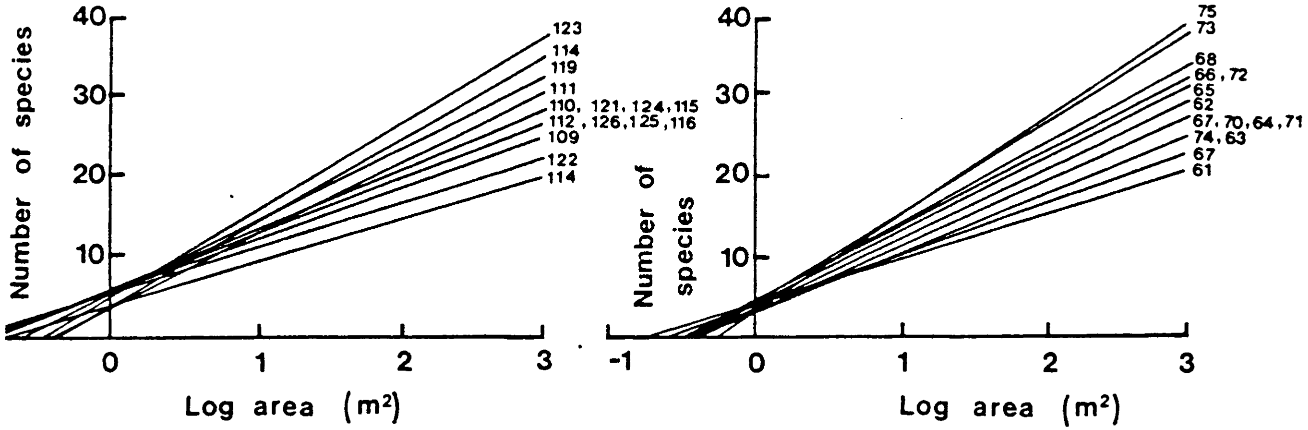
Community 5.14

(r) Community 5.15



) Community 5.16

(t) Community 5.17 a



) Community 5.17 b

(v) Community 5.18

.8.1 (continued) Alpha diversity for each community classified on the farm Groothoek, Thabazimbi district with linear regressions on a linear species number, Log area scale, showing relevé numbers next to each linear regression.

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8. SPECIES DIVERSITY

(a) Alpha diversity

The results of the alpha, or intra community species diversity are shown in Fig. 8.1 by means of a linear regression of the species-area curve, on a linear species number and log area scale, for each relevé within each community. If the vegetation is completely homogeneous and sampling is effective, in that all species within a community are recorded for each sample, then the linear regressions for each relevé of the community will fall on the same points (Whittaker,* pers. comm.). The linear regressions have all been extrapolated to log 3 or 1 000 m^2 (Fig. 8.1) so that the results may be more easily compared with other observations of alpha diversity, using the same method and because extrapolation is possible from 1 m^2 to 1 000 m^2 in homogeneous vegetation (Whittaker, Niering and Crisp, 1979). The difference in the minimum and maximum number of species at log 3, per community is indicative of the diversity within the community, or alpha diversity. Three distinct ranges of alpha diversity are distinguished for the communities in the study area, based on the difference in the minimum and maximum number of species at area log 3, per community (Fig. 8.1) which are shown in Table 8.1. In the lowest diversity range of 3 - 4 species difference between minimum and maximum number of species per community (Table 8.1), community 5.1 is only represented by two relevés which could account for the low alpha diversity of this community. Community 5.14 (Table 8.1) also has a low alpha diversity which indicates homogeneous vegetation. Homogeneous vegetation for community 5.14 substantiates the observation that no change in vegetation can be detected over the difference in soil forms for the community (paragraph 5.14).

The largest proportion of communities is found in the intermediate diversity range of 8 - 14 species difference between minimum and maximum number of species per community (Table 8.1). These include

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*The late R.H. Whittaker, formerly of Section of Ecology and Systematics, Division of Biological Sciences, Cornell University, Ithaca, New York.

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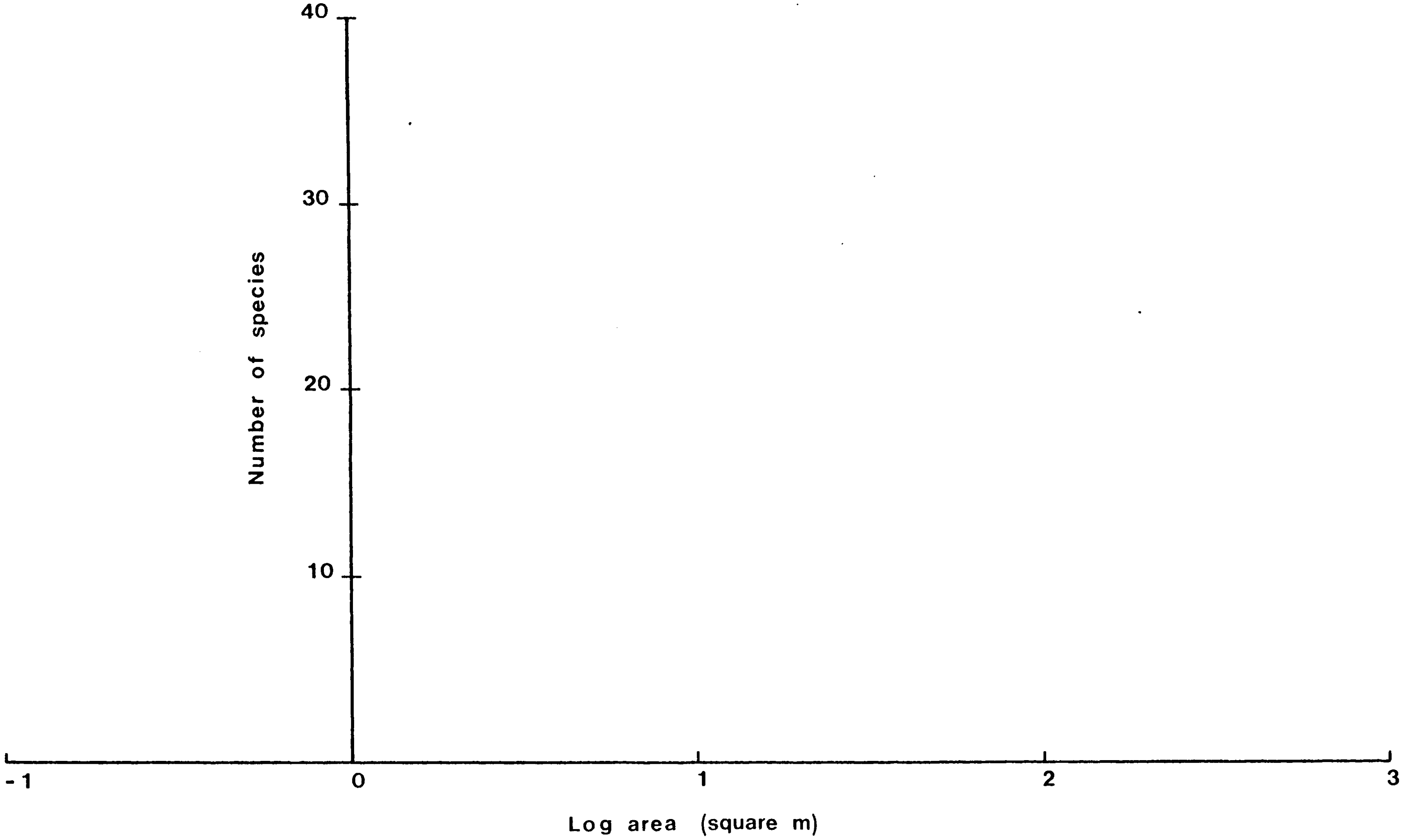

Fig. 8.2 Beta diversity for the communities in the study area with community numbers indicated

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one community from the main vegetation type A (community 5.3) and the two relevés of community 5.17 (a) (paragraph 5.17) of the main vegetation type D, as well as thirteen communities and variations of the main vegetation type B. Community 5.17 (a) can be regarded as under-sampled as only two relevés are represented which may account for the difference in alpha diversity between community 5.17 (a) and 5.17 (b).

The communities with the greatest alpha diversity in the study area are found in the 18 - 20 species difference between minimum and maximum number of species per community (Table 8.1). One community or variation represents each of the five main vegetation types in this range (Table 8.1). Community 5.2 has a variety of micro-habitats, because of the many kloofs found on the western escarpment (paragraph 5.2) and community 5.17 (b) also has a range of micro-habitats, ranging from ridges or interfluves to depressions or fluves (paragraph 5.17) which may account for the high alpha diversity. Communities 5.8.1, 5.16 and 5.18 all have a variation in veld condition with respect to grazing condition, ranging from overutilized to under=utilized veld conditions and also selectively grazed (see paragraphs 5.8.1, 5.16 and 5.18). As the grazing condition is determined by the floristic composition and basal cover (paragraph 4.2) the variation in condition with respect to grazing, could be responsible for the high alpha diversity.

It would, therefore, appear that the range of alpha diversity in the study area, is generally less than 14 species per 1 000 m² per community, providing that the topography is uniform and that the vegetation is uniformly but not excessively utilized. Alpha diversity does not indicate whether or not the vegetation is in good condition with respect to grazing but can indicate whether the vegetation is uniformly utilized.

(b) Beta diversity

The results of the beta, or inter community, diversity are shown in Fig. 8.2 by means of a linear regression of the species-area curve, on a linear species number and log area scale, for all the

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species recorded for each community (paragraph 4.4).

The communities 5.1, 5.2, 5.3 (main vegetation type A) and 5.16 (main vegetation type C) have the lowest beta diversity in the study area although the rate of increase in number of species for increase in area is less for community 5.16 as is indicated by the slopes of the linear regressions (Fig. 8.2). The low beta diversity of communities 5.1, 5.2 and 5.3 may be attributed to the nature of the vegetation which is forest. Whittaker (1960) considers that diversity is in large part an expression of herb stratum diversity and that conditions "favourable" for the development of maximum diversity in the herb stratum are not the conditions most "favourable" for development of the tree stratum. It may be expected, therefore, for the forest communities to have considerably less species in the herb stratum than woodland or grassland communities and hence a lower beta diversity in the forest communities.

Community 5.18 (main vegetation type E) has a higher beta diversity than community 5.16 (main vegetation type C) although both communities are grassland formations (Fig. 8.2). Community 5.10 has the highest beta diversity in the study area, followed by communities 5.8.1, 5.5, 5.13 and 5.6 (Fig. 8.2). No single factor recorded, can account for the high beta diversity of these last five communities, which confirms Whittaker's (1960) opinion that beta diversity does not fit into any simple pattern of interpretation in relation to the environment.

Odum (1971) suggests that beta diversity tends to peak during the early or middle stages of succession and to decline in the climax. The reverse should also be true if a climax community is subjected to severe stress or disturbance, such as overgrazing, then an initial increase in beta diversity, followed by a decline, could be expected. It is, therefore, postulated that communities 5.10, 5.8.1, 5.5, 5.13 and 5.16, which are severely overgrazed (see chapter 5), have the highest beta diversity in the study area because of the stress or disturbance caused by overgrazing and occupy

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a position of either approaching or receding from a beta diversity greater than that for the climax vegetation. Community 5.16, on the other hand has a low beta diversity caused by overgrazing which has resulted in an initial increase followed by a large decline in beta diversity. It is not possible to speculate on whether the communities (Fig. 8.2) are in the process of increasing or decreasing in beta diversity. However, communities 5.17 and 5.18 are not over=grazed (see chapter 5) so it can be assumed that they are in a more or less stable condition with respect to beta diversity, and possibly represent a climax.

In this study the beta diversity can possibly indicate trends in succession but follow up studies are essential to determine the direction of the trends.

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9. GENERAL DISCUSSION AND CONCLUSION

The present study has resulted in a classification of the vegetation and a correlation of the main environmental factors influencing the vegetation. The composition of the vegetation with respect to grazing condition has also been described. Although the vegetation is predominantly open woodland the formation classes found in the study area range from forests to grasslands, with a diversity of communities, along a temperature/moisture gradient. Soil depth also appears to play an important role in community differentiation. The kloof forest communities are differentiated by the species *Celtis africana* and *Diospyros whyteana* while the woodland communities representing Acocks's (1975) Sour Bushveld are differentiated by species such as *Combretum molle*, *Faurea saligna*, *Ozoroa paniculosa* and *Heteropyxis natalensis*. Species such as *Burkea africana*, *Ochna pulchra* and *Strychnos pungens* which represent the *Aristida aequiglumis* species-group (Table 5.2 Q) have a more restricted range than the species that differentiate the woodlands representative of Acocks's (1975) Sour Bushveld. The ordination of communities (Fig. 7.1) shows that the communities characterized by the *Aristida aequiglumis* species-group (Table 5.2 Q) occupy a central position on the temperature/moisture gradient. It can, therefore, be inferred that the extremes of the temperature/moisture gradient are limiting factors for the species of the *Aristida aequiglumis* species-group (Table 5.2 Q). The grassland representative of Acocks's (1975) Sour Bushveld, in the study area, appears to be influenced by the apparent maximum soil depth caused by seasonally high watertables (chapter 7). If the drainage could be improved it is possible that an open woodland formation could become established. Tinley (1977) similarly, attributes the occurrence of grasslands in dambos to seasonal waterlogging.

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Grass species such as, *Schizachyrium sanguineum*, *Elionurus muticus*, *Setaria perennis* and *Aristida junciformis*, which represent the *Schizachyrium sanguineum* species-group (Table 5.2 W) occur in both the grassland and woodland communities representing Acocks's (1975) Sour Bushveld although they do not occur in the communities 5.4, 5.5, 5.6 and 5.7) in which the cover, for any height class in the tree stratum, is greater than 20 percent (Fig. 5.4). Grass species such as *Eragrostis racemosa*, *Andropogon schirensis*, *Loudetia simplex*, *Themeda triandra*, *Panicum natalense*, *Diheteropogon amplectens* and *Rhynchelytrum setifolium* representing the *Eragrostis racemosa* species-group (Table 5.2 AF) occur throughout the study area, with the exception of the kloof forest communities and consequently have the widest ecological amplitude of the diagnostic species.

With the exception of *Acacia caffra* and occasionally *Acacia karroo*, no other *Acacia* spp. or *Dichrostachys cinerea* occur in Acocks's (1975) Sour Bushveld, in the study area. In an unpublished experiment conducted in a grassland and adjacent bare patch (G. du Plooy,* pers. comm.) counted *Acacia* spp. seedlings which were numerous in both the grassland and bare patch. Three years later a repeat count revealed few *Acacia* spp. plants in the grassland but the adjacent bare patch had approximately the same number of *Acacia* spp. seedlings, as during the original count, suggesting that grass cover could affect *Acacia* spp. establishment. However, no reason could be given for the occurrence of the bare patch. It is possible that when in the seedling stage, tree roots compete in the same area as grass roots for water and nutrients, (Walter, 1979) until the tap roots of the trees penetrate below the depth of the roots of the grasses, when the trees become established. Damage to grass roots by heavy grazing and trampling by cattle could, therefore, lead to a greater number of trees being

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established, than when a high grass cover is present because of the reduced competition from the grass roots. The effect of heavy grazing could possibly explain why certain woodland communities in the study area have a closed canopy cover (Table 5.2)) while others have an open canopy cover. The lack of *Acacia* spp. and *Dichrostachys cinerea* is not, however, explained by grazing pressure alone. Fourie (1981) found that soils, in which *Dichrostachys cinerea* encroachment was severe, had low nitrate and high ammonium concentrations with little evidence of nitrification while soils with *Acacia tortilis* encroachment had high nitrate and low ammonium concentrations. Free ammonia is toxic to most plants in more than trace amounts and is interconvertible with ammonium in water (Noggle and Fritz, 1976):

$$NH_3 \quad + \quad N_2O \longleftrightarrow NH_4^+ \quad + \quad OH^-$$

It is, therefore, possible that high ammonium and low nitrate concentrations favour the establishment of *Dichrostachys cinerea* and are detrimental to competitors while high nitrate and low ammonium concentrations favour the establishment of *Acacia* spp. such as *Acacia tortilis* to the detriment of competitors. High ammonium concentrations could be caused by cattle (Noggle and Fritz, 1976) in the absence of nitrification while high nitrate concentrations could be caused by the same source in the presence of nitrification. Although nitrate and ammonium concentrations were not tested in the soils of the study area it is suggested that the high rainfall and runoff could be responsible for the displacement of nitrate and ammonium ions to the valley region where *Dichrostachys cinerea* and *Acacia tortilis* occur with the consequent absence of these species from the study area.

The communities representing Acocks's (1975) North-Eastern Mountain Sourveld are found above 1 501 m altitude in the study area. Acocks (1975) describes North-Eastern Mountain Sourveld as having had a high

Fig. 9.1 An isolated *Podocarpus latifolius* tree in a boulder clump in the *Protea roupelliae* — *Helichrysum nudifolium* sparse woodland.

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forest climax. Isolated *Podocarpus latifolius* trees are found in community 5.17, amongst boulder clumps (Fig. 9.1). The boulders probably afford protection from fire. Edwards (1967) describes the occurrence of *Podocarpus latifolius* amongst boulder clumps in the *Protea* savanna in Natal as developing initial forest clumps. It is likely that *Podocarpus latifolius* could have a higher mean percentage cover, than at present, if protected from fire in community 5.17, with the possibility of a *Podocarpus latifolius* forest as a climax.

A comparison of communities described by Coetzee (1975), Coetzee, *et al.*, (1976) and van der Meulen (1979) shows that none of the communities are similar to communities described in this study, in terms of character species for the communities. A further comparison of communities described by Theron (1973), on the basis of dominant species in terms of importance values, and the communities in this study on the basis of dominant species in terms of percentage constancy and mean percentage cover, also shows none of the communities to be florisically similar. The difference in floristic composition of the communities described by Theron (1973), Coetzee (1975), Coetzee *et al.*, (1976) and van der Meulen (1979) and the communities described in this study, can be attributed partly to the geographic distances separating the various study sites from the area of this study, as well as geological differences. With the exception of Coetzee (1975) the study sites of the aforementioned are, furthermore, representative of veld types other than Acocks's (1975) Sour Bushveld as represented in this study. The terrain and geology described by Coetzee (1975) also differ from those in this study, in that the Rustenburg Nature Reserve is situated mainly on a plateau with north and west facing downslopes on soils derived mainly from quartzite and hornfels, unlike the topography in this study where the plateau has upslopes to the north and south on soils derived from sandstone, shale and conglomerate. A comlete floristic comparison of the communities described by the aforementioned authors and those in this study would entail joint synthesis of all the communities involved.

The vegetation in the study area is mostly overutilized where grass is accessible to cattle, indicating overgrazing. A grazing management program is therefore essential. The veld condition

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assessment used in this study can indicate whether vegetation is overutilized, underutilized, selectively grazed or in good condition with respect to grazing potential. The method used in this study in assessing veld condition was the quadrat method where all species are recorded, unlike the point method used by Foran, Tainton and Booysen (1978) where species dominant in basal cover are more likely to be recorded. For simplicity, and lacking data on the behaviour of forbs with respect to grazing, all forbs were classified as Increaser II species (Appendix II). However, certain forb species could prove sensitive indicators of different veld use and should, as more data about their behaviour becomes available, be classified as such. Although some grass species generally have a wide ecological amplitude (see the *Eragrostis racemosa* species-group (Table 5.2 AF) and the non-diagnostic section of Table 5.2) others appear to have more restricted ecological amplitudes (see Table 5.2 K, T and W). Veld condition should, therefore, be assessed for each community, with a benchmark representative of the community, especially in bushveld situations where woody species also play an important role. The approach used by Foran, Tainton and Booysen (1978) makes use of bioclimatic regions, encompassing a variety of communities, for which a benchmark is selected. It is doubtful, in bushveld situations where woody species also have to be taken into account, that a single grazing policy, covering several communities, can attain the condition of the benchmark for all the communities. If a benchmark is to be "a practically attainable condition for vegetation" (Foran, Tainton and Booysen, 1978) then the benchmark should represent a single community and not several communities.

Estimation of basal cover-abundance with the Domin-Krajina scale as used in this study is possible but because of the wide class intervals can be inaccurate (chapter 6). As percentage composition is required for the veld condition assessment, canopy cover estimations can also provide percentage composition and are far quicker and easier to apply than basal cover determinations. An advantage in estimating canopy cover is that if the basal cover for two species is the same, and one of the species is heavily grazed, the difference is reflected in canopy cover, but not basal cover. Canopy cover should, therefore, indicate

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TABLE 9.1 Percentage cover in terms of average canopy diameters of canopies apart on a scale with closer intervals than in the Domin-Krajina cover-abundance scale, calculated as in Table 4.2

Diameters apart	Percentage cover (to the nearest 1%)
0,00	80%
0,25	51%
0,50	34%
0,75	26%
1,00	20%
1,25	16%
1,50	13%
1,75	11%
2,00	9%
2,50	7%
3,00	5%
4,00	3%
5,00	2%
8,00	1%

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potential changes in floristic composition, which can be corrected by changing grazing pressure before they occur. Where a more precise estimate of basal and canopy cover is required, use can be made of Table 9.1 where cover in terms of "diameters of canopies apart" is given, as determined in Table 4.2.

It would appear from the community descriptions that in an open bushveld situation, woody species encroachment could become a problem for grazing management, when the canopy cover of the woody species is less than two crown diameters apart or more than 9 percent canopy cover (Table 4.2) forming a closed woodland. Although the floristic composition of the grass stratum appears different in Acocks's (1975) Sour Bushveld represented in the study area, when the canopy cover of the tree stratum is greater than 20 percent for any height class (Fig. 5.4), it is likely that floristic change could take place before a 20 percent canopy cover is achieved.

The removal of the tree ferns, *Alsophila dregei* from the larger kloof in which community 5.3 is found emphasizes the need for protection of the smaller kloof in which *Alsophila dregei* still occurs, if the species is to be conserved in its natural habitat in the study area. Although there is an abundance of streams in the study area none are perennial. The experience gained at the Thabamhlope Research Station, near Estcourt in Natal (Westfall, 1979) indicates that protection of kloofs from grazing and fire, should prolong the periods in which streams flow, which would be of benefit to the farms south of Kransberg.

Although burning in the study area is discouraged (see chapter 1) accidental fires still occur. Controlled burning can be used as a management tool where underutilization and selective grazing occur, so that all species are uniformly burnt which could have the same effect as utilizing Increaser I and Increaser III species. The disappearance of grass species due to moribundity if not grazed or burnt, is unlikely to occur in the study area, because of frequent accidental fires. No grass species was observed in a moribund state during the course of fieldwork.

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The agricultural potential of the study area appears to be limited because of the limited extent of deep soils, generally high surface rock cover and lack of perennial free water. Furthermore, the grass cover is not suited to year-round grazing because of its sour nature (Booysen, 1967). That agriculture appears limited, is supported by the many part-time farmers in the study area. Cattle enclosures generally do not follow natural community boundaries, which contributes to portions of camps being selected for grazing far more than others. Cattle enclosures should be erected so that the enclosed vegetation is as homogeneous as possible to encourage uniform grazing. Where communities, such as community 5.16 have local differences in veld condition with respect to grazing these could also be separated by fences to ensure uniform grazing.

In the study area the intra community or alpha diversity, is indicative of habitat differences and differences in grazing pressure within a community. Graphically illustrated, this is a simple method of highlighting the differences in habitat and grazing pressure which may not be otherwise readily apparent. Alpha diversity is also indicative of the homogeneity of heterogeneity of a community in the same way, and can be useful in determining the homogeneity of a cattle enclosure. The inter community of beta diversity, appears to be indicative of trends in succession, in the study area. This can be useful in determining areas where management priority should be the highest for improving vegetation composition with respect to grazing. Community 5.16 has the highest priority in the study area in this respect.

Recommendations based on this study may be summarized as follows:

A. Vegetation

1. Species requiring conservation in their natural habitats include *Alsophila dregei* as well as *Encephalartos eugene-maraisii* which has been reported in the Waterberg (Coates Palgrave, 1977) and on the upper north facing slopes of the

Kransberg massif by local farmers but not observed during the course of this study.

2. Protection of the catchment areas from grazing by means of fences and fire by means of firebreaks to improve the water supply.
3. Improve the species composition of the veld with respect to grazing and to overcome problems caused by invader species such as *Stoebe vulgaris* by ensuring that cattle enclosure fences coincide with community boundaries if practical and adjusting grazing pressure as the proportion of Increaser species and Decreaser species dictates.
4. Provide facilities for, and control the activities of sightseers, so that the landscape is not littered and species such as *Alsophila dregei* are not removed.

Conservation of the entire study area could achieve the abovementioned recommendations and might be feasible because of the apparently low agricultural potential of the study area. Furthermore, conservation would ensure that Acocks's (1975) Sour Bushveld, which is poorly conserved (Edwards, 1972), could be represented in the Waterberg where the greatest area of this veld type is found (Acocks, 1975). The study area includes the Kransberg massif, which is frequently visited by members of mountain clubs, as witnessed during the course of fieldwork, and is considered by mountain club members as probably the best rock climbing facility in the Transvaal. The study area is approximately 200 km from Pretoria which is an accessible range for visitors from Pretoria, Johannesburg and vicinity. Introduction of grazing game into the area would not improve the grass species composition without a grazing policy being implemented. Several private game reserves in the Waterberg area have a woody species canopy cover, including *Dichrostachys cinerea*, which, from passing observation appears impenetrable. A grazing policy in which the species composition is frequently monitored and grazing pressure adjusted accordingly is, therefore, essential. A further advantage of conservation of the study area is that the area could provide emergency grazing for farms in the Mixed and Sourish Mixed Bushveld (Acocks, 1975), in times of drought, but not on a permanent basis.

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B. Veld condition assessment

1. Permanent benchmark sites, while providing an example of veld with good grazing potential, are not essential when initiating a veld condition assessment. In the absence of permanent benchmark sites, the best example of good grazing potential, within a community, based on the cover ratio of Decreaser to Increaser species, may be used. Permanent benchmark sites may be selected when sufficient data on what constitutes good veld with respect to grazing potential, are obtained.
2. Grazing potential should be established for floristically homogeneous vegetation, such as a plant community at the scale used in this study. The benchmark should be representative of a community, so that the vegetation condition with respect to grazing, may be more easily influenced by grazing management. If a benchmark is representative of a plant community other than that of the vegetation being assessed, it is doubtful whether the floristic composition of the community being assessed, can be easily influenced by grazing management, to approach, floristically, that of the benchmark.
3. All species should be taken into account in a veld condition assessment and not just species dominant in basal cover so that changes in vegetation composition can be detected timeously, which will facilitate management policy in that less radical changes in grazing patterns will be required to improve vegetation composition than when detected after the species dominant in basal cover have changed in basal cover.
4. Estimates of canopy cover using the Domin-Krajina cover-abundance scale are more effective than the point method used by Foran, Tainton and Booysen (1978) in determining the total floristic composition because in the latter method species dominant in basal cover are more likely to be recorded than species with a low basal cover.
5. Estimation of canopy cover using the Domin-Krajina cover-abundance scale is possibly more effective in bushveld situations than the point method used by Foran, Tainton and Booysen (1978) which was used in grasslands as the woody component can be taken

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into account more easily. Basal cover estimates of the woody component are often difficult especially when shrubs with numerous coppicing stems, such as is often encountered with *Ochna pulchra*, cannot even be counted without marking. Canopy cover is, furthermore, of possibly greater importance with regard to species composition than basal cover, because of the shading effect of the canopies, in the case of the woody component.

6. A disadvantage of canopy cover estimates is that grass cover and hence apparent grass composition can vary with differences in grazing pressure, while the basal cover determinations should remain constant. However, a species percentage constancy over a number of quadrats should indicate whether or not the species is changing in constancy and hence whether the number of individuals is increasing or decreasing, irrespective of canopy cover. It is also possible to weight a species canopy cover-abundance value to that of what it should be if it had not been grazed. The estimation of canopy cover for grasses will, however, indicate which grasses are subject to greater grazing pressure, unlike the basal cover determinations. This is advantageous in that early management adjustments to grazing practice are possible before changes in species composition take place.

7. Canopy cover estimations using the Domin-Krajina cover-abundance scale, involve no expensive equipment such as a wheel-point apparatus, and can be used by a single individual for quick assessments of veld condition. This is of particular importance to agricultural extension services where time and manpower can prohibit extensive wheel-point surveys. Frequent assessments by farmers using the Domin-Krajina cover-abundance estimate scale should prove of greater value for management of vegetation with respect to grazing than an occasional wheel-point survey assessment so that grazing pressure can be adjusted as required.

Veld condition assessments are an essential part of any management program where grazing is involved. However, the recommendations

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outlined above should ensure easier and more widely used assessments of veld condition, both by those implementing grazing programs and in the course of vegetation surveys.

In conclusion, the classification of the farm Groothoek, Thabazimbi district has revealed a diversity of plant communities and habitats requiring continual surveillance by farmers or conservation authorities if the full potential of the area is to be realized.

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SUMMARY

The purpose of this study was to classify the vegetation of a portion of Acocks's (1975) Sour Bushveld, represented on the farm Groothoek, Thabazimbi district and to establish procedural guidelines for the application of the veld condition assessment technique (Foran, Tainton and Booysen, 1978) in Acocks's (1975) Sour Bushveld.

The vegetation was classified into eighteen communities, by means of the Braun-Blanquet method, using the Domin-Krajina cover-abundance scale, under five main vegetation types which follow temperature/ moisture and soil depth gradients, according to a detrended correspondence analysis (DCA) ordination of communities. The communities and variations, which were described in terms of floristics, habitat and condition of the vegetation with respect to grazing, are:

A. Kloof forest communities on moderately deep soils in moist, sheltered habitats.

- 5.1 *Celtis africana* — *Erythrina lysistemon* kloof forest
- 5.2 *Celtis africana* — *Osyris lanceolata* kloof forest
- 5.3 *Celtis africana* — *Asplenium splendens* kloof forest

B. Woodland, representative of Acocks's (1975) Sour Bushveld, on moderately deep to deep soils, in moderately exposed habitats.

- 5.4 *Combretum molle* — *Panicum maximum* closed woodland
- 5.5 *Combretum molle* — *Euclea crispa* closed woodland
- 5.6 *Combretum molle* — *Setaria megaphylla* closed woodland
- 5.7 *Combretum molle* — *Terminalia sericea* closed woodland
- 5.8 *Combretum molle* — *Aristida diffusa* open woodland
  - 5.8.1 *Combretum molle* — *Aristida diffusa* — *Strychnos madagascariensis* variation
  - 5.8.2 *Combretum molle* — *Aristida diffusa* — *Vitex rehmannii* variation
- 5.9 *Combretum molle* — *Landolphia capensis* closed woodland

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- 5.10 *Combretum molle* — *Coleochloa setifera* open woodland
  - 5.9.1 *Combretum molle* — *Landolphia capensis* — *Burkea africana* variation
  - 5.9.2 *Combretum molle* — *Landolphia capensis* — *Tapiphyllum parvifolium* variation
- 5.10 *Combretum molle* — *Coleochloa setifera* open woodland
- 5.11 *Combretum molle* — *Heteropogon contortus* closed and open woodlands
  - 5.11.1 *Combretum molle* — *Heteropogon contortus* — *Rhus dentata* closed woodland variation
  - 5.11.2 *Combretum molle* — *Heteropogon contortus* — *Chaetacanthus costatus* open woodland variation
- 5.12 *Combretum molle* — *Themeda triandra* open woodland
- 5.13 *Combretum molle* — *Argyrolobium transvaalense* open woodland
- 5.14 *Combretum molle* — *Pachycarpus schinzianus* open woodland
- 5.15 *Combretum molle* — *Protea caffra* open woodland

C. Grassland, representative of Acocks's (1975) Sour Bushveld on moderatly deep soils in exposed, dry habitats.

5.16 *Andropogon appendiculatus* — *Eragrostis pallens* grassland

D. Woodland, representative of Acocks's (1975) North - Eastern Mountain Sourveld on moderately shallow soils in moderately exposed habitats.

5.17 *Protea roupelliae* — *Helichrysum nudifolium* sparse woodland.

E. Grassland, representative of Acocks's (1975) North - Eastern Mountain Sourveld on shallow, rocky soils in exposed habitats.

5.18 *Trachypogon spicatus* — *Eragrostis racemosa* grassland.

The vegetation structure was illustrated by means of structural diagrams (Ito, 1979) for each community. The alpha and beta diversity for each community was determined as well as the diversity

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per unit area for each relevé. Alpha diversity can indicate vegetation homogeneity or heterogeneity and can indicate whether vegetation is uniformly utilized. It was found that the range of alpha diversity in the study area is generally less than 14 species per 1 000 m^2 per community, indicating relatively homogeneous vegetation. Beta diversity appears to indicate trends in vegetation succession and with re-sampling could indicate the direction of such trends. The range of beta diversity varied from about 20 to 30 species per 1 000 m^2.

The vegetation is mostly overgrazed, according to the veld condition assessment. Suggestions for the application of the veld condition assessment in respect of grazing potential, in bushveld vegetation include the use of the quadrat method with the Domin-Krajina cover-abundance scale for estimating canopy cover.

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CURRICULUM VITAE

Robert Howard Westfall was born on the 17th December 1944, in Kokstad, Cape Province.

He completed high school at Fish Hoek, Cape Province in 1962. Until 1972 he was employed by the Trust Bank of Africa Limited. In 1976 he obtained a B.Sc. degree at the University of Pretoria with Botany and Zoology as major subjects.

He joined the staff of the Botanical Research Institute in Pretoria in 1977, from where he was seconded to complete the B.Sc.(Hons.) degree, at the University of Pretoria, majoring in plant ecology and taxonomy in 1978. Work on his M.Sc. thesis started in 1980 as a project for the Botanical Research Institute.

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TABLE 5.25 Plant families recorded on the farm Groothoek, Thabazimbi district, showing number of genera and species recorded in each family

Family	Genera	Species
PTERIDOPHYTA		
Selaginellaceae	1	1
Schizaeaceae	1	1
Cyatheaceae	1	1
Dennstaedtiaceae	1	1
Adiantaceae	2	3
Aspleniaceae	1	1
GYMNOSPERMAE		
Podocarpaceae	1	1
Cupressaceae	1	1
ANGIOSPERMAE		
MONOCOTYLEDONES		
Poaceae (Gramineae	30	50
Cyperaceae	6	13
Xyridaceae	1	1
Commelinaceae	2	4
Liliaceae	6	10
Amaryllidaceae	2	2
Hypoxidaceae	1	3
Velloziaceae	1	1
Iridaceae	3	3
DICOTYLEDONES		
Ulmaceae	1	1
Moraceae	1	3
Proteaceae	2	4
Loranthaceae	1	1
Santalaceae	2	2
Olacaceae	1	1
Amaranthaceae	4	5
Aizoaceae	2	2
Portulacaceae	2	2
Caryophyllaceae	1	1
Ranunculaceae	2	2
Annonaceae	1	1
Capparaceae	1	1
Crassulaceae	1	1
Pittosporaceae	1	1
Myrothamnaceae	1	1
Rosaceae	1	1
Leguminosae		
subfamily Mimosoideae (Mimosaceae)	2	5
Caesalpinioideae (Caesalpiniaceae)	2	2
Papilionoideae (Fabaceae)	14	23
Oxalidaceae	1	1
Erythroxylaceae	1	1
Rutaceae	2	2
Simaroubaceae	1	1
Malpighiacea	1	1
Polygalaceae	1	3
Euphorbiaceae	6	8
Buxaceae	1	1
Anacardiaceae	3	7
Celastraceae	2	4
Icacinaceae	1	1
Sapindaceae	1	1
Rhamnaceae	1	1
Vitaceae (Vitidaceae)	1	2
Tiliaceae	2	5
Malvaceae	1	1
Sterculiaceae	3	3
Ochnaceae	1	1
Guttiferae (Clusiaceae)	1	2
Elatinaceae	1	1
Cactaceae	1	1
Thymelaeaceae	2	2
Combretaceae	2	5
Myrtaceae	2	2
Melastomataceae	1	1
Araliaceae	1	2
Umbelliferae (Apiaceae)	1	1
Myrsinaceae	1	1
Sapotaceae	2	2
Ebenaceae	2	5
Oleaceae	3	3
Loganiaceae	3	5
Gentianaceae	1	1
Apocynaceae	3	3
Periplocaceae	1	1
Asclepiadaceae	3	5
Convolvulaceae	1	1
Boraginaceae	1	1
Verbenaceae	4	5
Labiatae (Lamiaceae)	4	7
Solanaceae	1	3
Scrophulariaceae	2	2
Selaginaceae	2	3
Acanthaceae	6	6
Rubiaceae	15	16
Dipsacaceae	1	1
Campanulaceae	2	3
Lobeliaceae	1	2
Compositae (Asteraceae)	22	39
Totals	227	333

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APPENDIX II

ANNOTATED CHECKLIST

This annotated checklist contains the 333 species recorded in the study area of which 310 occurred in sample quadrats and 23 outside the sample quadrats. The number of genera and species recorded for each family are shown in Table 5.25. The life form annotations are according to Dyer (1975, 1976). Decreaser/Increaser annotations are based on Foran, Tainton and Booysen (1978) and G. du Plooy* (pers. comm.) as well as experience gained during the course of field work. The Decreaser/Increaser annotations are provisional and may be subject to modification as more experience is gained.

The Pteridophyta are classified according to Schelpe (1969) and the Gymnospermae and Angiospermae according to Dyer (1975, 1976) based on De Dalla Torre and Harms (1958). Species are listed alphabetically within each genus. Nomenclature is according to current (January 1981) usage at the National Herbarium, Pretoria. Collector's numbers are indicated in parenthesis.

PTERIDOPHYTA

Selaginellaceae

Selaginella dregei (C. Presl) Hieron.
Schizaeaceae
Mohria caffrorum (L.) Desv.; INCREASER I.
Cyatheaceae
Alsophila dregei (Kunze) Tryon: INCREASER I (1 018).
Dennstaedtiaceae
Pteridium aquilinum (L.) Kuhn; INCREASER I.
Adiantaceae

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Cheilanthes hirta Swartz; INCREASER I (905, 1 004).
Pellaea calomelanos (Swartz) Link; INCREASER I.
Pellaea viridis (Forsk.) Prantl var. *glauca* (Sim) Sim; INCREASER I (1 002).

Aspleniaceae

Asplenium splendens Kunze; INCREASER I (945).

GYMNOSPERMAE

Podocarpaceae

13 *Podocarpus latifolius* (Thunb.) R. Br. ex Mirb.; tree, INCREASER I.

Cuppressaceae

38 *Widdringtonia nodiflora* (L.) Powrie; shrub, INCREASER I (926).

ANGIOSPERMAE

Monocotyledones

Poaceae (Gramineae)

K17(125) *Urelytrum squarrosum* Hack.; INCREASER II.
K28(132) *Elionurus muticus* (Spreng.) Kunth; INCREASER III.
K40(112) *Miscanthidium junceum* (Stapf) Stapf; not recorded in sample quadrats, INCREASER I (1 006).
K68(134f) *Schizachyrium sanguineum* (Retz.) Alston; INCREASER II.
K71(134) *Andropogon appendiculatus* Nees; INCREASER II (821).
K71(134) *Andropogon schirensis* Hochst. var. *angustifolius* Stapf; INCREASER II (913).
K72(134g) *Cymbopogon excavatus* (Hochst.) Stapf ex Burtt Davy; INCREASER I.
K72(134g) *Cymbopogon validus* Stapf ex Burtt Davy; INCREASER II (901, 924, 1 021).
K72(134g) *Cymbopogon* sp. (817).
K73(134h) *Hyparrhenia hirta* (L.) Stapf; INCREASER II (818).
K75(134i) *Monocymbium ceresiiforme* (Nees) Stapf; DECREASER (830).

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K78(131)	*Trachypogon spicatus* (L. f.) Kuntze; INCREASER I (917).
K80(134j)	*Heteropogon contortus* L.; DECREASER.
K81	*Diheteropogon amplectens* (Nees) Clayton; INCREASER II.
K83(136)	*Themeda triandra* Forssk.; DECREASER.
K89(166f)	*Digitaria diagonalis* (Nees) Stapf; INCREASER II)982).
K89(166f)	*Digitaria eriantha* Steud. subsp. *eriantha;* DECREASER (499).
K89(166F)	*Digitaria eriantha* Steud. subsp. *transvaalensis* Kok MS.; DECREASER (876).
K89(166f)	*Digitaria monodactyla* (Nees) Stapf; INCREASER II (955).
K94(166a)	*Alloteropsis semialata* (R. Br.) Hitchc.; INCREASER I (819).
K104(166c)	*Brachiaria nigropedata* (Munro) Stapf; DECREASER (878).
K107(161)	*Paspalum scrobiculatum* L.; DECREASER (838).
K116(166)	*Panicum maximum* Jacq.; DECREASER
K116(166)	*Panicum natalense* Hochst.; DECREASER.
K128(171)	*Setaria lindenbergiana* (Nees) Stapf; DECREASER (981).
K128(171)	*Setaria megaphylla* (Steud.) Dur. & Schinz; DECREASER (993).
K128(171)	*Setaria perennis* Hack.; DECREASER (1 026, 1 040).
K128(171)	*Setaria sphacelata* (Schumach.) Moss; DECREASER (837)
K132a(168a)	*Rhynchelytrum repens* Willd. C.E. Hubb; DECREASER.
K132a(168a)	*Rhynchelytrum setifolium* (Stapf) Chiov.; DECREASER.
K174(277)	*Tristachya biseriata* Stapf; INCREASER II.
K174(277)	*Tristachya rehmannii* Hack.; INCREASER II (849).
K175a(278a)	*Loudetia simplex* (Nees) C.E. Hubb.; INCREASER III (912).
K262(208)	*Aristida aequiglumis* Hack.; INCREASER II (859).
K262(208)	*Aristida canescens* Henr.; INCREASER II (954).
K262(208)	*Aristida diffusa* Trin. subsp. *burkei* (Stapf) Schweick.; INCREASER II (974).
K262(208)	*Aristida junciformis* Trin. & Rupr. subsp. *junciformis*; INCREASER II (820, 956).
K280(148)	*Perotis patens* Gand.; INCREASER II.
K283(230)	*Sporobolus africanus* (Poir.) Robyns & Tournay; DECREASER (1 044).
K286(341)	*Eragrostis capensis* (Thunb.) Trin.; DECREASER (827).
K286(341)	*Eragrostis curvula* (Schrad.) Nees; INCREASER II (880).
K286(341)	*Eragrostis gummiflua* Nees; INCREASER II (835).
K286(341)	*Eragrostis lappula* Nees var. *divaricata* Stapf.; INCREASER II (822).

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K286(341)	*Eragrostis pallens* Hack.; INCREASER II.
K286(341)	*Eragrostis racemosa* (Thunb.) Steud.; INCREASER II.
K294(281)	*Microchloa caffra* Nees; INCREASER II.
K296(282)	*Cynodon dactylon* (L.) Pers.; INCREASER II (961).
K334(337a)	*Pogonarthria squarrosa* (Licht. ex Roem. & Schult.) Pilg.; INCREASER II.
K353(337c)	*Trichoneura grandiglumis* (Nees) Ekman; INCREASER II.
K357(310)	*Enneapogon pretoriensis* Stent; INCREASER II (975).

Cyperaceae

459	*Cyperus albostriatus* Schrad.; sedge, INCREASER II (949).
459	*Cyperus denudatus* L. f.; sedge, INCREASER II (812).
459	*Cyperus leptocladus* Kunth; sedge, INCREASER II (894).
459	*Cyperus margaritaceus* Vahl; sedge, INCREASER II (888).
459	*Cyperus obtusiflorus* Vahl; sedge, not recorded in sample quadrats, INCREASER II (782).
459	*Cyperus rupestris* Kunth; sedge, INCREASER II (775).
459	*Cyperus sphaerospermus* Schrad.; sedge, not recorded in sample quadrats, INCREASER II (761).
459c	*Mariscus rehmannianus* C.B. Cl.; sedge, INCREASER II (497).
471a	*Bulbostylis boeckeleriana* (Schweinf.) Beetle; sedge, INCREASER II (811).
471a	*Bulbostylis burchellii* (Fical. & Hiern) C.B. Cl.; sedge, INCREASER II (842).
492	*Rhynchospora rugosa* (Vahl) Gate; sedge, not recorded in sample quadrats, INCREASER II (762).
512	*Coleochloa setifera* (Ridley) Gilly; sedge, INCREASER II (904).
525	*Carex spicato-paniculata* C.B. Cl.; sedge, INCREASER II (952, 1 019).

Xyridaceae

826	*Xyris congensis* Buettn.; forb not recorded in sample quadrats, INCREASER II (773).

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Commelinaceae

896 *Commelina africana* L. var. *lancispatha* C.B. Cl.; forb, INCREASER II (931, 967).

896 *Commelina erecta* L.; forb, INCREASER II (530).

896 *Commelina undulata* R. Br.; forb, not recorded in sample quadrats, INCREASER II (789).

904 *Cyanotis pachyrrhiza* Oberm. sp. nov. MS.; forb, not recorded in sample quadrats, INCREASER II (774).

Liliaceae

964 *Littonia modesta* Hook.; geophyte, INCREASER II (887).

989 *Anthericum galpinii* Bak. var. *norlindii* (Weim.) Oberm.; geophyte, INCREASER II (1 013).

1012 *Eriospermum* sp.; geophyte, INCREASER II (857).

1026 *Aloe transvaalensis* Kuntze; succulent, INCREASER II.

1086 *Scilla nervosa* (Burch.) Jessop; geophyte, INCREASER II. (941).

1113 *Asparagus asparagoides* (L.) Wight; climber, INCREASER II (1 008).

1113 *Asparagus buchananii* Bak.; suffrutex, INCREASER II.

1113 *Asparagus setaceus* (Kunth) Jessop; suffrutex, INCREASER II (1 048).

1113 *Asparagus suaveolens* Burch.; suffrutex, INCREASER II.

1113 *Asparagus virgatus* Bak.; climber, INCREASER II (950).

Amaryllidaceae

1167 *Scadoxus puniceus* (L.) Friis & Nordal; geophyte, not recorded in sample quadrats, INCREASER II (755).

1177 cf. *Brunsvigia radulosa* (L.) Powrie; geophyte, INCREASER II (927).

Hypoxidaceae

1230 *Hypoxis angustifolia* Lam.; geophyte, INCREASER II (723).

1230 *Hypoxis obtusa* Burch.; geophyte, INCREASER II (851).

1230 *Hypoxis rigidula* Bak.; geophyte, INCREASER II (863, 1 028).

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Velloziaceae

1247a *Xerophyta retinervis* Bak.; forb, INCREASER II.

Iridaceae

1295 *Aristea woodii* N.E. Br.; geophyte, INCREASER II (939)
1306 *Tritonia nelsonii* Bak.; shrub, INCREASER II (983).
1310 *Babiana hypogea* Burch.; geophyte, INCREASER II (1 039).

DICOTYLEDONES

Ulmaceae

1898 *Celtis africana* Burm. f.; tree, INCREASER I.

Moraceae

1961 *Ficus burkei* (Miq.) Miq.; tree, INCREASER II (1 058).
1961 *Ficus capensis* Thunb.; tree, INCREASER I (713).
1961 *Ficus ingens* (Miq.) Miq.; tree, INCREASER I.

Proteaceae

2034 *Faurea saligna* Harv.; tree, INCREASER II (770).
2035 *Protea caffra* Meisn.; tree or shrub, INCREASER II.
2035 *Protea gaguedi* J.F. Gmel.; shrub, INCREASER II.
2035 *Protea roupelliae* Meisn.; tree or shrub, INCREASER II.

Loranthaceae

2074 *Tapinanthus natalitius* (Meisn.) Danser subsp. *zeyheri* (Harv.) Wiens; parasitic shrub, not recorded in sample quadrats (715).

Santalaceae

2108 *Osyris lanceolata* Hochst. & Steud.; shrub, INCREASER I & II (1 066).
2118 *Thesium racemosum* Bernh.; forb, INCREASER II (836).

Olacaceae

2136 *Ximenia americana* L.; shrub, not recorded in sample quadrats, INCREASER I & II (793).

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Amaranthaceae

2309 *Cyphocarpa angustifolia* Lopr.; forb, INCREASER II (893, 979).

2312 *Cyathula cylindrica* Moq.; forv, INCREASER II (1 007).

2328 *Achyranthes aspera* L.; forb, INCREASER II (786).

2328 *Achyranthes sicula* (L.) All.; forb, INCREASER II (1 016).

2330 *Brayulinea densa* (Willd.) Small; forb, INCREASER II (962).

Aizoaceae

2376 *Limeum viscosum* (Gay) Fenzl subsp. *viscosum* var. *glomeratum* (Eckl. & Zeyh.) Friedr.; forb, INCREASER II (882).

2379 *Psammotropha mucronata* (Thunb.) Fenzl var. *mucronata*; forb, INCREASER II (930).

Portulacaceae

2406 *Talinum caffrum* (Thunb.) Eckl. & Zeyh.; forb, INCREASER II (490).

2421 *Portulaca kermesina* N.E. Br.; forb, INCREASER II (911).

Caryophyllaceae

2502 *Dianthus mooiensis* F.N. Williams subsp. *kirkii* (Burtt Davy) Hooper; forb, INCREASER II (779).

Ranuncalaceae

2542 *Clematis* sp.; climber, INCREASER II (1 042).

2542a *Clematopsis scabiosifolia* (DC.) Hutch.; forb, not recorded in sample quadrats, INCREASER II (790).

Annonaceae

2716 *Hexalobus monopetalus* (A. Rich.) Engl. & Diels; shrub, INCREASER II (896).

Capparaceae

3082 *Cleome maculata* (Sond.) Szyszyl.; forb, INCREASER II (874).

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Crassulaceae
3168 *Crassula sarcocaulis* Eckl. & Zeyh. subsp. *sarcocaulis*; succulent forb, INCREASER II (1 035).

Pittosporaceae
3252 *Pittosporum viridiflorum* Sims; tree, INCREASER II (1 052).

Myrothamnaceae
3282 *Myrothamnus flabellifolius* Welw.; shrublet, INCREASER II.

Rosaceae
3405 *Parinari capensis* Harv. subsp. *capensis*; shrublet, INCREASER II (834).

Leguminosae
subfamily Mimosoideae (Mimosaceae)
3446 *Acacia ataxacantha* DC.; semi-scandent shrub, INCREASER I.
3446 *Acacia caffra* (Thunb.) Willd.; tree, INCREASER II (1 011).
3446 *Acacia karroo* Hayne; tree, INCREASER II.
3467 *Elephantorrhiza burkei* Benth.; shrub, INCREASER II (899, 900).
3467 *Elephantorrhiza obliqua* Burtt Davy var. *glabra* Phill.; shrub, INCREASER II (749).

subfamily Caesalpinioideae (Caesalpiniaceae)
3474 *Burkea africana* Hook.; tree, INCREASER II (722).
3536 *Cassia comosa* Vogel var. *capricornia* Steyaerts; forb, INCREASER II (781).

subfamily Papilionoideae (Fabaceae)
3607 *Calpurnia* cf. *C. aurea* (Ait.) Benth.; tree, INCREASER II (1073).
3657 *Lotonis* sp.; forb, INCREASER II (815).
3657a *Pearsonia cajanifolia* (Harv.) Polhill subsp. *cryptantha* (Bak.) Polhill; forb, INCREASER II (1 033).
3657a *Pearsonia sessilifolia* (Harv.) Dümmer subsp. *sessilifolia*; forb, INCREASER II (850).

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3673 *Argyrolobium transvaalense* Schinz; shrub, INCREASER II (861).

3702 *Indigofera comosa* N.E. Br.; shrublet, INCREASER II (1 023).

3702 *Indigofera egens* N.E. Br.; forb, INCREASER II (868).

3702 *Indigofera filipes* Benth.; forb, INCREASER II (960).

3702 *Indigofera hedyantha* Eckl. & Zeyh.; forb, INCREASER II (920).

3702 *Indigofera hilaris* Eckl. & Zeyh.; forb, not recorded in sample quadrats, INCREASER II (746).

3702 *Indigofera spicata* Forssk,; forb, INCREASER II (847).

3702 *Psoralea polysticha* Benth.; shrub, INCREASER II (1 047).

3718 *Tephrosia elongata* E. Mey, var. *elongata;* forb, INCREASER II (918).

3718 *Tephrosia longipes* Meisn. var. *lurida* (Sond.) J.B. Gillett; forb, INCREASER II (879).

3719 *Mundulea sericea* (Willd.) A. Chev.; shrub, INCREASER II (734).

3804 *Zornia milneana* Mohl.; forb, INCREASER II (854, 1 038).

3856 *Abrus laevigatus* E. Mey.; twining undershrub, INCREASER II (992, 1 061).

3864 *Glycine wightii* (Wight & Arn.) Verdc. subsp. *wightii* var. *longicauda* (Schweinf.) Verdc.; twining forb., INCREASER II (988).

3870 *Erythrina lysistemon* Hutch.; shrub, INCREASER (989).

3897 *Rhynchosia monophylla* Schltr.; twining forb, INCREASER II (853, 925).

3897 *Rhynchosia spectabilis* Schinz.; undershrub, INCREASER II (980).

3897 *Rhynchosia totta* (Thunb.) DC.; twining forb, INCREASER II (966).

3907 *Sphenostylis angustifolia* Sond.; shrublet, INCREASER II (1 031).

Oxalidaceae

3936 *Oxalis depressa* Eckl. & Zeyh.; forb, INCREASER II (777).

Erythroxylaceae

3956 *Erythroxylum emarginatum* Thonn.; shrub, INCREASER I (890).

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Rutaceae

4035 *Calodendrum capense* (L.f.) Thunb.; tree, not recorded in sample quadrats, INCREASER I (808).

4076 *Vepris lanceolata* (Lam.) G. Don.; shrub, INCREASER I (1 063).

Simaroubaceae

4128 *Kirkia wilmsii* Engl.; tree, INCREASER I (994).

Malpighiaceae

4219 *Sphedamnocarpus pruriens* (Juss.) Szyszyl. var. *pruriens;* climber, INCREASER II (1 074).

Polygalaceae

4273 *Polygala amatymbica* Eckl. & Zeyh.; forb, INCREASER (745).

4273 *Polygala hottentotta* Presl.; forb, INCREASER II (928).

4273 *Polygala uncinata* E. Mey. ex Meisn.; forb, not recorded in sample quadrats, INCREASER II (802).

Euphorbiaceae

4295 *Pseudolachnostylis maprouneifolia* Pax ; shrub, INCREASER II (886).

4299 *Phyllanthus incurvus* Thunb.; forb, INCREASER II (504).

4299 *Phyllanthus parvulus* Sond.; forb, INCREASER II (881).

4348 *Croton gratissimus* Burch. subsp. *subgratissimus* (Prain) Burtt Davy ; tree, INCREASER II (889).

4407 *Acalypha angustata* Sond. var. *glabra* Sond.; forb, INCREASER II (914).

4448 *Clutia pulchella* L.; shrub, INCREASER I & II (892, 935, 948).

4498 *Euphorbia ingens* E. Mey. ex Boiss.; tree, INCREASER I.

4498 *Euphorbia schinzii* Pax; succulent herb, INCREASER II.

Buxaceae

4533 *Buxus macowani* Oliv.; shrub, INCREASER I (987, 1 067).

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Anacardiaceae

4563 *Lannea discolor* (Sond.) Engl.; shrub, INCREASER II (877).

4563 *Lannea edulis* (Sond.) Engl.; shrublet, INCREASER II (875).

4589a *Ozoroa paniculosa* (Sond.) R. & A. Fernandes ; tree or shrub, INCREASER II (797).

4594 *Rhus dentata* Thunb.; shrub, INCREASER I & II (1 037).

4594 *Rhus dura* Schonl.; shrub, INCREASER I (873).

4594 *Rhus leptodictya* Diels ; tree or shrub, INCREASER I & II.

4594 *Rhus pyroides* Burch.; shrub, INCREASER II (957, 1 054).

Celastraceae

4626 *Maytenus tenuispina* (Sond.) Marais ; shrub, INCREASER II (856, 883).

4626 *Maytenus undata* (Thunb.) Blakelock ; tree, INCREASER I & II (971, 1 059).

4630 *Pterocelastrus echinatus* N.E. Br.; shrub, INCREASER II (951).

4630 *Pterocelastrus rostratus* (Thunb.) Walp.; shrub, INCREASER I (1 010).

Icacinaceae

4686 *Apodytes dimidiata* E. Mey. ex Arn. subsp. *dimidiata ;* shrub, INCREASER I (895, 907, 970).

Sapindaceae

4784 *Pappea capensis* Eckl. & Zeyh.; tree, INCREASER II (1 053).

Rhamnaceae

4861 *Ziziphus mucronata* Willd. subsp. *mucronata ;* shrub, INCREASER II (963).

Vitaceae (Vitidaceae)

4917 *Rhoicissus digitata* (L.f.) Gilg & Brandt ; shrub, INCREASER I & II (869).

4917 *Rhoicissus tridentata* (L.f.) Wild & Drum.; shrub, INCREASER II (1 025).

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Tiliaceae

4966 *Grewia monticola* Sond.; shrub, INCREASER II (1 071).

4966 *Grewia occidentalis* L.; shrub, INCREASER I & II (809).

4966 *Grewia rogersii* Burtt Davy & Greenway ; shrub, not recorded in sample quadrats, INCREASER II (738).

4975 *Triumfetta rhomboidea* Jacq.; shrublet, INCREASER II.

4975 *Triumfetta sonderi* Fical. & Hiern ; forb, INCREASER II (852).

Malvaceae

5007 *Pavonia columella* Cav.; forb, INCREASER II (1 020).

5053 *Dombeya rotundifolia* (Hochst.) Planch. var. *rotundifolia ;* tree, INCREASER I & II.

5056 *Hermannia depressa* N.E. Br.; forb, INCREASER II (1 072).

5059 *Waltheria indica* L.; forb, INCREASER II (485).

Ochnaceae

5112 *Ochna pulchra* Hook.; tree or shrub, INCREASER I & II.

Guttiferae (Clusiaceae)

5168 *Hypericum aethiopicum* Thunb. supsp. *sonderi* (Bred.) N.K.B. Robson ; forb, INCREASER II (841).

5168 *Hypericum lalandii* Choisy ; forb, INCREASER II (831).

Elatinaceae

5230 *Bergia decumbens* Planch. ex Harv.; forb, INCREASER II (816, 826).

Cactaceae

5417 *Opuntia* sp.; exotic, INCREASER II.

Thymelaeaceae

5435 *Gnidia caffra* Meisn.; forb, not recorded in sample quadrats, INCREASER II (798).

5461 *Passerina montana* Thoday ; ericoid shrub, INCREASER I (756).

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Combretaceae

5538 *Combretum appiculatum* Sond.; tree, INCREASER II.
5538 *Combretum moggii* Exell ; shrub, INCREASER I (891, 998).
5538 *Combretum molle* R. Br. ex G. Don ; tree, INCREASER II.
5538 *Combretum zeyheri* Sond.; tree, INCREASER II.
5544 *Terminalia sericea* Burch. ex DC.; tree, INCREASER II.

Myrtaceae

5583 *Syzygium guineense* (Willd.) DC.; tree, not recorded in sample quadrats,INCREASER I & II (729).
5588a *Heteropyxis natalensis* Harv.; tree, INCREASER I & II (848).

Melastomataceae

5659 *Dissotis debilis* (Sond.) Triana var. *debilis* forma *debilis;* forb, not recorded in sample quadrats, INCREASER I & II (765).

Araliaceae

5872 *Cussonia paniculata* Eckl. & Zeyh.; tree, INCREASER II (1 029).
5872 *Cussonia spicata* Thunb.; tree or shrub, INCREASER I & II (978).

Umbelliferae (Apiaceae)

5992 *Heteromorpha arborescens* (Spreng.) Cham. & Schlechtd.; shrub, INCREASER II (1 068).

Myrsinaceae

6313 *Myrsine africana* L.; shrub, INCREASER I & II (946).

Sapotaceae

6377a *Bequaertiodendron magalismontanum* (Sond.) Heine & J.H. Hemsl.; tree or shrub, INCREASER I & II.
6386 *Mimusops zeyheri* Sond.; shrub, INCREASER II (910).

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Ebenaceae

6404 *Euclea crispa* (Thunb.) Gürke var. *crispa ;* shrub, INCREASER I & II (518).

6404 *Euclea linearis* Zeyh. ex Hiern ; shrub, INCREASER II.

6404 *Euclea natalensis* A. DC.; shrub, INCREASER II (959, 1 049).

6406 *Diospyros lycioides* Desf. subsp. *guerkei* (Kuntze) De Winter ; shrub, INCREASER II (958, 1 050).

6406 *Diospyros whyteana* (Hiern) F. White ; shrub, INCREASER II (944).

Oleaceae

6422 *Schrebera alata* (Hochst.) Welw.; tree, INCREASER II (972).

6434 *Olea europaea* L. subsp. *africana* (Mill.) P.S. Green ; shrub, INCREASER II (999, 1 065).

6440 *Jasminum multipartitum* Hochst.; climbing shrub, INCREASER I (754).

Loganiaceae

6460 *Strychnos cocculoides* Bak.; tree, INCREASER II.

6460 *Strychnos madagascariensis* Poir.; tree, INCREASER II (973).

6460 *Strychnos pungens* Soler.; tree, INCREASER II (872).

6469 *Nuxia congesta* R. Br. ex Fresen.; tree, INCREASER II (909, 997).

6473 *Buddleia salviifolia* (L.) Lam.; tree, INCREASER I (1 017).

Gentianaceae

6503 *Chironia purpurascens* (E. Mey.) Benth. & Hook. f. subsp. *humilis* (Gilg) Verdoorn; forb, INCREASER II (829).

Apocynaceae

6558 *Acokanthera oppositifolia* (Lam.) Codd ; shrub, INCREASER II (1 057).

6562 *Landolphia capensis* Oliv.; shrub, INCREASER II (866).

6589 *Diplorhynchus condylocarpon* (Müll. Arg.) Pichon ; tree, INCREASER II (544).

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Periplocaceae

6740 *Cryptolepis oblongifolia* (Meisn.) Schltr.; shrub, INCREASER II.

Asclepiadaceae

6787a *Pachycarpus schinzianus* (Schltr.) N.E. Br.; forb, INCREASER II (846).

6791 *Asclepias fruticosa* L.; forb, INCREASER II (711).

6791 *Asclepias* sp.; forb, INCREASER II (828).

6860 *Secamone alpinii* Schultes ; shrubby climber, INCREASER II (953).

6860 *Secamone filiformis* (L.f.) J.H. Ross ; shrubby climber, INCREASER I (991).

Convolvulaceae

7003 *Ipomoea bathycolpos* Hallier f. var. *bathycolpos ;* forb, INCREASER II (858).

Boraginaceae

7043 *Ehretia rigida* (Thunb.) Druce ; shrub, INCREASER II (1 069).

Verbenaceae

7144 *Lantana rugosa* Thunb.; shrub, INCREASER I & II (509).

7145 *Lippia javanica* (Burm. f.) Spreng.; shrublet, INCREASER II (840, 1 041).

7186 *Vitex pooara* Corbishley ; tree, INCREASER II (885).

7186 *Vitex rehmannii* Gürke ; tree or shrub, INCREASER II (538).

7191 *Clerodendrum glabrum* E. Mey.; tree, INCREASER II (1 070)

Labiatae (Lamiaceae)

7264 *Leonotis leonurus* (L.) Ait.; forb, INCREASER II.

7281 *Stachys natalensis* Hochst. var. *galpinii* (Briq.) Codd; forb, not recorded in sample quadrats, INCREASER II (740).

7281 *Stachys natalensis* Hochst. var. *natalensis* ; forb, INCREASER II (862, 969).

7350 *Plectranthus fruticosus* L'Herit.; forb, INCREASER II (947).

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7350 *Plectranthus verticillatus* (L.f.) Druce; forb, INCREASER II (990).

7350 *Plectranthus* sp.; undershrub, INCREASER II (906).

7366a *Becium obovatum* (E. Mey. ex Benth.) N.E. Br.; forb, INCREASER II (902).

Solanaceae

7407 *Solanum giganteum* Jacq.; forb, INCREASER II (1 009).

7407 *Solanum panduraeforme* E. Mey.; forb, INCREASER II (1 051).

7407 *Solanum rigescens* Jacq.; forb, not recorded in sample quadrats, INCREASER II (771).

Scrophulariaceae

7476 *Nemesia fruticans* (Thunb.) Kuntze ; forb, INCREASER II (929).

7519 *Sutera palustris* Hiern ; forb, INCREASER II (1 022).

Selaginaceae

7568 *Selago capitellata* Schltr.; forb, INCREASER II (919).

7625 *Striga bilabiata* (Thunb.) Kuntze ; parasitic forb (968).

7625 *Striga gesnerioides* (Willd.) Vatke ex Engl.; parasitic forb (984).

Acanthaceae

7941 *Chaetacanthus costatus* Nees ; shrublet, INCREASER II (933).

7965 *Ruellia cordata* Thunb. ; forb, INCREASER II (860).

7973 *Barleria bremekampii* Oberm.; shrublet, INCREASER II (1 005).

7980 *Blepharis subvolubilis* C.B. Cl. var. *subvolubilis* ; forb, INCREASER II (976).

7985 *Crossandra greenstockii* S. Moore ; shrublet, not recorded in sample quadrats, INCREASER II (731).

8032 *Hypoestes verticillaris* (L.f.) R. Br. ex C.B. Cl.; forb, INCREASER II (995).

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Rubiaceae

8136/20 *Oldenlandia herbacea* (L.) Roxb.; forb, INCREASER II (763).

8278 *Tarenna barbertonensis* (Brem.) Brem.; shrub, INCREASER II (1 000).

8285 *Gardenia spatulifolia* Stapf & Hutch.; shrub, INCREASER I & II (884, 1 046).

8285a *Rothmannia capensis* Thunb.; tree, INCREASER I (1 015).

8308 *Tricalysia lanceolata* (Sond.) Burtt Davy ; tree, INCREASER I (1 060).

8348 *Pentanisia angustifolia* (Hochst.) Hochst.; forb, INCREASER II (943).

8351 *Vangueria infausta* Burch.; shrub, INCREASER II (772).

8351b *Pygmaeothamnus zeyheri* (Sond.) Robyns var. *zeyheri* ; perennial herb with woody rootstock, INCREASER II (832, 897).

8351c *Tapiphyllum parvifolium* (Sond.) Robyns ; shrub, INCREASER II (871).

8352 *Canthium gilfillanii* (N.E. Br.) O.B. Miller ; shrub, not recorded in sample quadrats, INCREASER I (717).

8352 *Canthium huillense* Hiern ; shrub, INCREASER II (996).

8359 *Pachystigma triflorum* Robyns ; shrub, INCREASER I & II (870).

8359a *Fadogia monticola* Robyns ; shrublet, INCREASER II (799).

8438 *Anthospermum rigidum* Eckl. & Zeyh.; forb, INCREASER II (855).

8464 *Richardia brasiliensis* (Moq.) Gomez; procumbent forb, INCREASER II (843).

8473 *Borreria scabra* (Schumach. & Thonn.) K. Schum.; forb. (1 043).

Dipsacaceae

8546 *Scabiosa columbaria* L.; forb, INCREASER II (825).

Campanulaceae

8668 *Wahlenbergia caledonica* Sond.; forb, INCREASER II (922).

8668 *Wahlenbergia lycopodioides* Schltr. & V. Brehm.; forb, INCREASER II (938).

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8670 *Lightfootia paniculata* Sond.; forb, not recorded in sample quadrats, INCREASER II (750).

Lobeliaceae

8694 *Lobelia aquaemontis* E. Wimm.; forb, INCREASER II (940).

8694 *Lobelia decipiens* Sond.; forb, INCREASER II (814).

Compositae (Asteraceae)

8751 *Vernonia galpinii* Klatt; shrublet, INCREASER II (977, 1 012).

8751 *Vernonia natalensis* Sch. Bip.; shrublet, INCREASER II (865, 1 027).

8751 *Vernonia oligocephala* (DC.) Sch.Bip. ex Walp.; shrublet, INCREASER II (844).

8751 *Vernonia staehelinoides* Harv.; forb, INCREASER II (965, 1 032).

8919 *Felicia muricata* (Thunb.) Nees subsp. *strictifolia* Grau ; forb, INCREASER II (803).

8926 *Conyza scabrida* DC.; forb, INCREASER II (1 055).

8936 *Brachylaena rotundata* S. Moore ; shrub, INCREASER II (903).

8972 *Amphidoxa filaginea* Fical. & Hiern ; forb, INCREASER II (824).

9006 *Helichrysum caespititium* (DC.) Harv.; forb, INCREASER II (751).

9006 *Helichrysum cephaloideum* DC.; forb, INCREASER II (937).

9006 *Helichrysum kraussii* Sch. Bip.; shrublet, INCREASER II.

9006 *Helichrysum mimetes* S. Moore ; forb, INCREASER II (923).

9006 *Helichrysum nudifolium* (L.) Less. var. *nudifolium ;* forb, INCREASER II (839).

9006 *Helichrysum univervium* Burtt Davy ; forb, INCREASER II (778).

9006 *Helichrysum* sp.; forb, INCREASER II (921).

9037 *Stoebe vulgaris* Levyns ; ericoid shrublet, INCREASER III (724).

9090 *Geigeria burkei* Harv. subsp. *burkei* var. *burkei*; shrublet, INCREASER II (833).

9090 *Geigeria burkei* Harv. subsp. *burkei* var. *zeyheri* (Harv.) Merxm.; shrublet, INCREASER II (934).

9090 *Geigeria elongata* Alston ; forb, INCREASER II (898).

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9237	*Bidens pilosa* L.; exotic forb, INCREASER II.
9291	*Schkuhria pinnata* (Lam.) Cabr.; forb, exotic, INCREASER II (964).
9311	*Tagetes minuta* L.; forb, exotic, INCREASER II.
9370a	*Brachymeris bolusii* Hutch.; shrublet, INCREASER II (1 014).
9401	*Lopholaena coriifolia* (Sond.) Phill. & C.A. Sm.; shrub, INCREASER II (1 036).
9406	*Cineraria lobata* L'Herit.; forb, INCREASER II (932).
9411	*Senecio barbertonicus* Klatt ; shrub, INCREASER II (1 003).
9411	*Senecio conrathii* N.E. Br.; forb, INCREASER II (823).
9411	*Senecio erubescens* Ait. var. *crepidifolius* DC.; forb, INCREASER II (813).
9411	*Senecio oxyriifolius* DC.; forb, INCREASER II (1 024).
9411	*Senecio pleistocephalus* S. Moore ; shrub, INCREASER II (1 056).
9411	*Senecio ruwenzoriensis* S. Moore ; forb, INCREASER II (1 034).
9411	*Senecio venosus* Harv.; forb, INCREASER II (864).
9417	*Euryops pedunculatus* N.E. Br.; shrub, INCREASER II (916).
9427	*Osteospermum jucundum* (Phill.) T. Norl.; forb, INCREASER II (942).
9431	*Ursinia nana* DC.; forb, INCREASER II (936).
9434	*Gazania krebsiana* Less. subsp. *serrulata* (DC.) Roessl.; forb, INCREASER II (804).
9438	*Berkheya carlinopsis* Welw. ex O. Hoffm. subsp. *magalismontana* (H. Bol.) Roessl.; forb, INCREASER II (908).
9501	*Dicoma anomala* Sond. supsp. *anomala* ; forb, INCREASER II (915).
9528	*Gerbera ambigua* (Cass.) Sch. Bip.; forb, INCREASER II (1 030).

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APPENDIX I

EXPLANATION OF CLASS SYMBOLS USED IN TABLE 5.2

(See chapter 4.1.1.2 for details of habitat data)

VEGETATION FORMATION (see paragraph 4.1.1.2(d))

Feature	Symbol	Class
CANOPY COVER (classes, according to Edwards, 1976)(see Tables 4.2 and 4.3)	C	Closed (0-2 canopy diameters apart)
	O	Open (> 2-8 canopy diameters apart)
	S	Sparse (> 8-27 canopy diameters apart)
FORMATION		
(classes, according to Edwards, 1976)(see Table 4.3)	F	Forest (< 0 canopy diameters apart)
	W	Woodland
	S	Shrubland
	D	Dwarf shrubland
	G	Grassland

HABITAT DATA

GEOMORPHOLOGY

Feature	Symbol	Class
(classes, according to Scheepers, 1975) (paragraph 4.1.1.2(g)(i))	A	Summit: upper
		lower
	B	Plateau: upper
		lower
	CF	Cliff face
	D	Upper slope
	E	Lower slope
	H	Steep bank/kloof
	K	Ridge/knoll

ALTITUDE

Feature	Symbol	Class
(arbitrary 100 m class intervals except for class 0 which has a 200 m class interval, to the nearest 1 m) (paragraph 4.1.1.2(g)(ii)).	1	1001-1100 m low
	2	1101-1200 m low
	3	1201-1300 m low
	4	1301-1400 m moderate
	5	1401-1500 m moderate
	6	1501-1600 m moderate
	7	1601-1700 m high
	8	1701-1800 m high
	9	1801-1900 m high
	0	1901-2100 m high

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SLOPE

(classes used by the Botanical Research Institute, Private Bag X101, Pretoria) (paragraph 4.1.1.2(g)(iii))

Symbol	Class	Description
L	Level	0- 3,49°
G	Gentle	3,50-17,62°
M	Moderate	17,63-36,39°
S	Steep	≥36,4 °

ASPECT

(classes according to an 8 point rosette, paragraph 4.1.1.2(g)(iv) to the nearest 1°)

Symbol	Class	Description
1	North	338-360; 0-22°
2	North-east	23- 67°
3	East	68-112°
4	South-east	113-157°
5	South	158-202°
6	South-west	203-247°
7	West	248-292°
8	North-west	293-337°

GEOLOGY

Symbol	Outcrop	Group	Subgroup	Formation
DI	diabase	Post-Waterberg		
S3	sandstone	Waterberg	Kransberg	Sandriviersberg
S2	sandstone	Waterberg	Matlabas	Aasvoëlkop
SH	shale	Waterberg	Matlabas	Aasvoëlkop
CO	conglomerate	Waterberg	Nylstroom	Alma Graywacke
S1	sandstone	Waterberg	Nylstroom	Alma Graywacke

The above classification is according to SACS (1980) and a correlation is given with the system of De Vries (1968-69) in Table 2.1.

SURFACE ROCK COVER

(classes according to van der Meulen, 1979 to the nearest 1%)(paragraph 4.1.1.2(g)(vi))

Symbol	Class	Description
0	< 1%	No limitation on mechanical utilization
L	1- 4%	Low limitation on mechanical utilization
M	5- 34%	Moderate limitation on mechanical utilization
H	35- 84%	High limitation on mechanical utilization
V	85-100%	No mechanical utilization possible

SOIL DEPTH

(Arbitrary class intervals, to the nearest 10 mm) (paragraph 4.1.12(g)(vii))

Symbol	Soil depth
A	0- 120 mm shallow
B	130- 240 mm moderate
C	250- 480 mm moderate
D	490-1 000 mm moderate
E	>1 000 mm deep

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SOIL FORM AND SERIES

(MacVicar, et al., 1977)
(paragraph 4.1.1.2(g)(viii))

Symbol	Soil Form	Soil Series
MM	Mispah	Mispah
SB	Shortlands	Bokuil
HM	Hutton	Middelburg
WS	Westleigh	Sibasa
KS	Kroonstad	Slangkop

CHEMICAL ANALYSIS OF THE A-HORIZON

CARBON

(arbitrary class intervals)
(paragraph 4.1.1.2(g)(ix))

Symbol	Class
1	0-1% low
2	>1-2% low
3	>2-3% moderate
4	>3-4% moderate
5	10,4% high (only one sample)

TITRATABLE ACIDITY

(arbitrary class intervals, to the nearest 0,1 me/100g soil)
(paragraph 4.1.1.2(g)(ix)

1	≤ 2,9 low
2	3,0- 3,9 low
3	4,0- 4,9 low
4	5,0- 5,9 moderate
5	6,0- 6,9 moderate
6	7,0- 7,9 moderate
7	8,0- 8,9 moderate
8	9,0-11,9 moderate
9	12,0-14,9 high
0	15,0-29,9 high

ALUMINIUM

(arbitrary class intervals, to the nearest 0,1 me % soil
(paragraph 4.1.1.2(g)(ix))

0	0,0 me % low
1	0,1 me % low
2	0,2 me % low
3	0,3 me % low
4	0,4-0,5 me % low
5	0,6-0,7 me % moderate
6	0,8-0,9 me % moderate
7	1,0-1,1 me % moderate
8	1,2-1,4 me % high
9	1,5-2,0 me % high

ELECTRICAL RESISTANCE

(arbitrary class intervals to the nearest 100 ohms)
(paragraph 4.1.1.2(g)(ix))

1	≤1900 ohms low
2	2000-2900 ohms low
3	3000-3900 ohms moderate
4	4000-4900 ohms moderate
5	5000-5900 ohms moderate
6	6000-6900 ohms high
7	7000-7900 ohms high
8	8000-8900 ohms high

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	Symbol	Class
SOIL pH (in distilled water solution)		
(classes according to MacVicar, *et al.*, 1977)	M	pH 5,5-6,5 moderately acid
	S	pH < 5,5 strongly acid
BUFFER CAPACITY		
(arbitrary class intervals of 0,1 to the nearest 0,1 being difference in pH in H_2O and $CaCl_2$, Russell, 1961)(paragraph 4.1.1.2(g)(ix))	1	0,1 low
	2	0,2 low
	3	0,3 low
	4	0,4 moderate
	5	0,5 moderate
	6	0,6 moderate
	7	0,7 high
	8	0,8 high
	9	0,9 high
T-VALUE (cation exchange capacity)		
(arbitrary class intervals to the nearest 0,1 me/100g soil) paragraph 4.1.1.2(g)(ix))	1	<5 me/100 g low
	2	5,0- 5,9 me/100 g low
	3	6,0- 6,9 me/100 g low
	4	7,0- 7,9 me/100 g moderate
	5	8,0- 8,9 me/100 g moderate
	6	9,0- 9,9 me/100 g moderate
	7	10,0-11,0 me/100 g high
	8	12,0-14,9 me/100 g high
	9	15,0-22,0 me/100 g high
WATERTABLE DEPTH		
(arbitrary class intervals, to the nearest 10 mm)(paragraph 4.1.1.2(g)(x))	H	0- 250 mm high
	M	260- 500 mm moderate
	L	510-1000 mm low
	0	Not observable

VELD CONDITION ASSESSMENT (Foran, Tainton & Booysen, 1978) (see paragraph 4.2)

Symbol	Final score, Composition score, Decreasers, Increaser I, Increaser II, Increaser III and *Selaginella dregei* (arbitrary 10% class intervals, to the nearest 1%)	Basal cover (arbitrary 3% class intervals, to the nearest 1%)
Blank		
1	1- 10%	1- 3%
2	11- 20%	4- 6%
3	21- 30%	7- 9%
4	31- 40%	10-12%
5	41- 50%	13-15%
6	51- 60%	16-18%
7	61- 70%	19-21%
8	71- 80%	22-24%
9	81- 90%	25-27%
0	91-100%	28-30%

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TABLE 5.3 PHYTOSOCIOLOGICAL CLASSIFICATION OF THE FARM GROOTHOEK, THABAZIMBI DISTRICT - SYNOPTIC TABLE *

SUMMARY OF SPECIES CONSTANCY IN THE STUDY AREA

COMMUNITY NUMBER	5.01	5.02	5.03	5.04	5.05	5.06	5.07	5.08.1	5.08.2	5.09.1	5.09.2	5.10	5.11.1	5.11.2	5.12	5.13	5.14	5.15	5.16		5.17	5.18
TOTAL NUMBER OF RELEVES	02	08	06	10	03	04	03	06	06	08	12	08	10	08	13	05	06	08	12	02	15	15
DIFFERENTIAL SPECIES OF THE Celtis africana - Erythrina lysistemon KLOOF FOREST																						
A																						
Plectranthus verticillatus (F) **	5																					
Erythrina lysistemon (S)	5																					
Glycine wightii (F)	5			1																		
DIFFERENTIAL SPECIES OF THE Celtis africana - Osyris lanceolata KLOOF FOREST																						
B																						
Osyris lanceolata (S)		5																				
Acokanthera oppositifolia (S)		5																				
Tricalysia lanceolata (T)		4																				
Ficus burkei (T)		3																				
Calpurnia cf.c.aurea (T/S)		3																				
Sphedamnocarpus pruriens (S)		3																				
Ehretia rigida (S)		3																				
Euphorbia ingens (T)		2																				
Vepris lanceolata (S)		2																				
Clerodendrum glabrum (T)		2																				
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.1 & 5.2																						
C																						
Olea europaea (S)	3	5				2																
Buxus macowani (S)	5	4																				
Abrus laevigatus (S)	5	2																				
Kirkia wilmsii (T)	3	2				2																
Secamone filiformis (S)	5	2																				
DIFFERENTIAL SPECIES OF THE Celtis africana - Asplenium splendens KLOOF FOREST																						
D																						
Asplenium splendens (P)			5																			
Carex spicato-paniculata (C)			4																			
Cyathula cylindrica (F)			2																			
Pterocelastrus echinatus (S)			2																			
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.2 & 5.3																						
E																						
Myrsine africana (S)		3	5																			
Asparagus virgatus (S)		3	5																			
Plectranthus fruticosus (F)		2	5																			
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.1, 5.2 & 5.3																						
F																						
Diospyros whyteana (S)	5	4	5	1	2	3			2				1									
Celtis africana (T)	5	3	5																			
DIFFERENTIAL SPECIES OF THE Combretum molle - Panicum maximum CLOSED WOODLAND																						
G																						
Achyranthes aspera (F)				5																		
Tagetes minuta (F)				4			4															
Clematis sp. (S)				4									1	1	1							
Bidens pilosa (F)				3																		
Panicum maximum (G)				2	2																	
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.2, 5.3, 5.4 & 5.5																						
H																						
Cyperus albostriatus (C)		4	5	2																3	1	
Secamone alpinii (S)		2	5	2	4								1									
Pellaea viridis (P)		3	1	2	2	2																
Solanum giganteum (F)		1	2	3																		
Pterocelastrus rostratus (S)		2	2		2																	
DIFFERENTIAL SPECIES OF THE Combretum molle - Setaria megaphylla CLOSED WOODLAND																						
I																						
Setaria megaphylla (G)	5					5																
Hypoestes verticillaris (F)						4																
Senecio barbertonicus (S)						3																
DIFFERENTIAL SPECIES OF THE Combretum molle - Terminalia sericea CLOSED WOODLAND																						
J																						
Terminalia sericea (T)							5						1									
Rhus pyroides (S)				1			4										1					
Indigofera filipes (F)							4															
DIFFERENTIAL SPECIES OF THE Combretum molle - Aristida diffusa OPEN WOODLAND																						
K																						
Aristida diffusa (G)								5	5	1												
DIFFERENTIAL SPECIES OF THE Combretum molle - Aristida diffusa - Strychnos madagascariensis VARIATION																						
L																						
Schrebera alata (T/S)								3														
Rhynchosia totta (F)								3														
Enneapogon pretoriensis (G)								3														
Strychnos madagascariensis (T)								3														
Blepharis subvolubilis (F)								2														
DIFFERENTIAL SPECIES OF THE Combretum molle - Landolphia capensis CLOSED WOODLAND																						
M																						
Landolphia capensis (S)									1	4	4	1	1									
Lannea discolor (S)						3	2	1		4	3			1								
Cyperus margaritaceus (C)										1	1											
Hexalobus monopetalus (S)										1	1											
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.8 & 5.9																						
N																						
Diplorhynchus condylocarpon (T/S)						3		5	5	3	3											
Pseudolachnostylis maprouneifolia (T/S)								5	2	2	4	1										
Tephrosia longipes (F)								4	2	2	1		1									
Littonia modesta (GEO)								3		1	3											
DIFFERENTIAL SPECIES OF THE Combretum molle - Coleochloa setifera OPEN WOODLAND																						
O																						
Coleochloa setifera (C)												5										1
Becium obovatum (F)												2	1									
Combretum moggii (S)						2						2										
Plectranthus sp. (S)												2										
Mimusops zeyheri (S)												2										
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.9.2 & 5.10																						
P																						
Selaginella dregei (P)									1		4	5			1			1				
Eragrostis curvula (G)							2				4	2						1				
Myrothamnus flabellifolius (S)											2	2						1				
Vitex pooara (T/S)											2	1										
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.5, 5.6, 5.7, 5.8, 5.9, 5.10 & 5.11																						
Q																						
Aristida aequiglumis (G)					2	2	5	5	5	5	5	4	3	2					1			
Strychnos pungens (T/S)						3	5	3	3	5	5	2	4	2								
Ochna pulchra (T/S)					4	4	2	2	2	5	5	1	4	3			1				1	
Burkea africana (T/S)				1	4	2	4	1	2	5	4		4	4				1				
Tapiphyllum parvifolium (S)					2	2		1	2	4	5	4	1	2								
Brachiaria nigropedata (G)							2	4	3	2	3	3	2	1								
Rhoicissus digitata (S)						3	2	4	2	2	2	2	1	1	1							
Cryptolepis oblongifolia (S)	3			1	2	3		2	3	2	1		2	4								
Digitaria eriantha ssp.transvaalensis (G)							4	1		3	2	4	2									
Elephantorrhiza burkei (S)					2	4		3	4		1	2	1	1								
Apodytes dimidiata (T/S)					2	2		4	4		1	2			1							
Pachystigma triflorum (T/S)	3				2	2		2		2	3	1	1		1							
DIFFERENTIAL SPECIES OF THE Combretum molle - Argyrolobium transvaalense OPEN WOODLAND																						
R																						
Vernonia oligocephala (F)															1	5	1	1				
Argyrolobium transvaalense (S)																5						
Ruellia cordata (F)																5						
DIFFERENTIAL SPECIES OF THE Combretum molle - Pachycarpus schinzianus OPEN WOODLAND																						
S																						
Pachycarpus schinzianus (F)															1	2	5					
Triumfetta sonderi (F)																	2					
Talinum caffrum (F)																	2					
DIFFERENTIAL SPECIES OF THE Andropogon appendiculatus - Eragrostis pallens GRASSLAND																						
T																						
Cyperus denudatus (C)							4											2	5			
Andropogon appendiculatus (G)															1		1	1	4			
Eragrostis lappula (G)							2												3			
Asclepias sp. (F)																1			2			
Eragrostis gummiflua (G)																			2			
Setaria sphacelata (G)																			2			
Trichoneura grandiglumis (G)																			1			
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.15 & 5.16																						
U																						
Stoebe vulgaris (S)				1													1	3	3			
Hypericum lalandii (F)																		2	2			
Paspalum scrobiculatum (G)																		1	2			
Perotis patens (G)							4											2	1			
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.13, 5.14, 5.15 & 5.16																						
V																						
Senecio erubescens (F)																5	1	3	5			
Bulbostylis boeckeleriana (C)									1						1	3		4	5			
Eragrostis capensis (G)																4	3	2	3		1	
Bergia decumbens (F)																	1	3	4		1	
Chironia purpurascens (F)																2	2	3	3		1	
Alloteropsis semialata (G)																	3	1	4			
Amphidoxa filaginea (F)																2	2		3			
Gazania krebsiana (F)											1					3	1	1	1			
Geigeria burkei var. burkei (S)															1		3	1	2			
Hypoxis angustifolia (GEO)																3		1	2			
Pearsonia sessilifolia (F)																1	2	1	1			
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15 & 5.16																						
W																						
Schizachyrium sanguineum (G)					2	2	2	5	3	5	3	1	4	4	1		1	2	3			
Elionurus muticus (G)							2	4	2	4	3	4	1		2	5	4	2	3			
Setaria perennis (G)							2		2	1	1		1	2	5	5	5	4	3	3		
Aristida junciformis (G)				1			2	1		1	2	2	1		2		2	2	3			
DIFFERENTIAL SPECIES OF THE Protea roupelliae - Helichrysum nudifolium SPARSE WOODLAND																						
X																						
Helichrysum nudifolium (F)																1		1	1		4	
Brachymeris bolusii (F)				1									1	1							4	
Vernonia galpinii (F)								1	1				1		1						3	
DIFFERENTIAL SPECIES OF THE Trachypogon spicatus - Eragrostis racemosa GRASSLAND																						
Y																						
Trachypogon spicatus (G)			1												2						1	5
Helichrysum uninervium (F)																					1	4
Selago capitellata (F)																					1	4
Tephrosia elongata (F)																				3		3
Widdringtonia nodiflora (S)			2																			2
Polygala hottentotta (F)																					1	2
Ursinia nana (F)																						1
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.17 & 5.18 (a)																						
Z																						
Protea roupelliae (T/S)																					3	3
Euryops pedunculatus (S)													1		1						2	3
Geigeria burkei var. zeyheri (S)																					1	1
Pentanisia angustifolia (F)																					1	1
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.17 & 5.18 (b)																						
AA																						
Helichrysum kraussii (F)													1	2						3	3	5
Indigofera hedyantha (F)															1					3	4	3
Acalypha angustata (F)																				3	1	5
Helichrysum mimetes (F)														1						3	2	4
Wahlenbergia caledonica (F)																				3	1	2
Aristea woodii (GEO)															1						2	1
Psammotropha mucronata (F)																				5	1	1
Nemesia fruticans (F)		1																		5	1	1
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.11.2, 5.12, 5.17 & 5.18																						
AB																						
Helichrysum sp. (F)			1	1	2				1					2	3					5	4	5
Dicoma anomala (F)														2	2			1			3	5
Chaetacanthus costatus (F)				1										5	2					5	3	2
Helichrysum cephaloideum (F)															3						3	3
Sphenostylis angustifolia (F)														4							1	
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14 & 5.15																						
AC																						
Combretum molle (T/S)				5	5	4	5	5	5	5	5	5	4	5	2	3	4	3				
Faurea saligna (T/S)				3	4	3		1		1		4	2		4	4	2	2				
Ozoroa paniculosa (T/S)				1			4	1		4	3	4	2	2	1	1	1	2				
Heteropyxis natalensis (T/S)		1		3	2	3			1		1	5	2		2			2			1	
Euclea crispa (S)		1		4	5	2	2						1	1	2	2		1				
Oldenlandia herbacea (F)				2			2	1	2	2	3	1	1	1				1				
Rhus leptodictya (T/S)	3			4			4						1		1	1	2	2				
Pygmaeothamnus zeyheri (S)				1	4		2			1	1		2	2	1				1			
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15 & 5.17																						
AD																						
Heteropogon contortus (G)				2	5	3	4	4	1	1		3	4	5	5	1	2	2		5	5	
Indigofera comosa (F)					2		2	1	2	3	3	4	5	4	2	3	5	4		3	2	
Protea caffra (T/S)				1	2					1			2	4	4	3	5	4	1	5	4	
Vitex rehmannii (T/S)				2	4	2		3	5		1	5	2	1	4	3		1			1	
Stachys natalensis var. natalensis (F)				1	2	2		3	1	1	1	4	1	2	2	1		1		3	3	
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15, 5.17 & 5.18																						
AE																						
Bulbostylis burchellii (C)				1	4		4	1	4	5	5	5	3	4	1		2	2		3	5	5
Fadogia monticola (S)				1	4	4	5		3	4	4	5	2	4	2		5	3			1	3
Rhus dentata (S)			1	5	4	3		1		2	1	1	4	2	3		2	4			2	1
Cyperus leptocladus (C)			1	3	5	4	2		1		1	3	4	3	1			1			1	3
Commelina africana (F)					4	4		5	5	1	1	2	3	4	1		1				1	2
Maytenus tenuispina (S)				1		3	2	2	2	5	4	3	2		1		2	1				1
Tristachya biseriata (G)								3	4	1	1				3	3	1	2		3	2	2
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15, 5.16, 5.17 & 5.18																						
AF																						
Eragrostis racemosa (G)				1	4		2	3	3	3	2	1	2	2	4	5	5	5	5	5	5	4
Vangueria infausta (T/S)	5			5	5	5	4	5	5	3	3	4	5	5	2		2	2		3	1	3
Andropogon schirensis (G)				1	5	3	2	2	5	4	4	4	3	2	2				1	5	3	5
Loudetia simplex (G)					4			4			2	2	4	4				2	3	5	4	5
Themeda triandra (G)				1				3	1		1	1	2	1	5	5	3	3	2	3	3	3
Panicum natalense (G)				1	2			2		1			1	3	3		2	2	3	5	5	2
Diheteropogon amplectens (G)							2	5	4	2	1		2	2	4	4	2	2	1	3	2	
Rhynchelytrum setifolium (G)				1		2		4	3			1	1	1	4	1	3	1	1	3	1	1
GENERAL AND INFREQUENT SPECIES																						
TREES AND SHRUBS																						
Bequaertiodendron magalismontanum	5	1		1	4	4	2	5	5	4	5	5	4	5	1							2
Brachylaena rotundata		3		2	2	3		1	3			5	2	2	2							
Acacia caffra		2	2	4	2	2							2		3	4	2	2				
Asparagus suaveolens				1				4	2	2	2	2	1	1	1						1	1
Podocarpus latifolius	5	1	5	2	2	2														3		2
Clutia pulchella			5	1	2	3			1	1	1		1									1
Dombeya rotundifolia		1		3							1		1		2	1						
Passerina montana			3			3															2	2
Parinari capensis										4	1						3	2	1			
Cussonia spicata		2		3	2				2												1	
Tritonia nelsonii	3														2						2	
Rothmannia capensis			1	2	5								1	2							1	
Mundulea sericea								1		1	1	5	1									
Croton gratissimus	3	3				2			2	1	1	1										
Maytenus undata		5						2	2													
Rhoicissus tridentata		4		1	4																1	
Gardenia spatulifolia				1			2			1	2		1									
Diospyros lycioides		1		2			2						1		1							
Euclea linearis							2	4		1												
Ziziphus mucronata		1		1		2	2								1	1						
Ficus capensis	5	1	2	1																		
Elephantorrhiza obliqua										1	1						2	2				
Nuxia congesta	3					2		1				2										1
Euclea natalensis		1		1			2	2														
Lannea edulis							4			1	1				1							
Aloe transvaalensis				1							1		1		1							
Opuntia sp.				1	2																	
Lopholaena coriifolia													1	1				1				
Acacia karroo				1											1	1						
Pappea capensis		1		1							1					1						
Asparagus buchananii				1	2										1							
Combretum apiculatum						2									1	1						
Strychnos cocculoides				1											1			1				
Combretum zeyheri													1					1				
Protea gaguedi							2											1				
Tarenna barbertonensis	3					2																
Acacia ataxacantha		1																				
Ficus ingens		1																				
Grewia occidentalis							2															
Jasminum multipartitum																						1
Lantana rugosa										1												
Rhus dura											1											
Erythroxylum emarginatum									1													
Canthium huillense						2																
Barleria bremekampi						2																
Asparagus asparagoides			1																			
Buddleia salviifolia			1																			
Cussonia paniculata																					1	
Psoralea polysticha				1																		
Asparagus setaceus				1																		
Pittosporum viridiflorum				1																		
Senecio pleistocephalus				1																		
Heteromorpha arborescens		1																				
Grewia monticola															1							
GRASSES																						
Eragrostis pallens				3	2								2	2	2		4	3	5			
Monocymbium ceresiiforme					2					1				2	1			1	2	5	4	2
Cymbopogon validus			1	3	2				1			2	2		2						1	1
Rhynchelytrum repens				1	2		4	2			2	2	2	2	1		2	1	1			1
Cymbopogon sp.						2		1					1		2	5	3	2	2			
Urelytrum squarrosum									2	2	1			1	2	2		2			1	
Digitaria diagonalis		1		2		2			1					1	3							
Sporobolus africanus		2		3	2										1							
Hyparrhenia hirta				3															2			
Setaria lindenbergiana		1				3									1							
Microchloa caffra												1						2				1
Cymbopogon excavatus									1						1				1			
Digitaria eriantha ssp eriantha																		1				
Pogonarthria squarrosa																			1			
Tristachya rehmannii																		1				
Aristida canescens			1																			
Digitaria monodactyla			1																			
Cynodon dactylon							2															
SEDGES																						
Mariscus rehmannianus							2										1					
Cyperus rupestris												1						1				
GEOPHYTES																						
Eriospermum sp.												1		1	2	2	2					1
Hypoxis obtusa										1			1			1	3	2	1		1	
Hypoxis rigidula															1			1			1	
cf.Brunsvigia radulosa																					1	1
Babiana hypogea															1							
Anthericum galpinii																					1	
Scilla nervosa																						1
FERNS																						
Pellaea calomelanos	3	3	5	1	5	3		3	2	1	3	5	4	2	2					3	1	2
Cheilanthes hirta			1			4			1			4		1						5	2	
Mohria caffrorum	5		1			3			1						1							3
Pteridium aquilinum			5	1	2									1						3	2	
Alsophila dregei			1																			
OTHER FORBS																						
Senecio conrathii													1	2	3	2	2	1	3		3	3
Oxalis depressa			2	4	4		2					2	1		2	1	2	1	1	3	2	
Scabiosa columbaria				1									1		3	4	4	3	3		2	1
Indigofera egens							2	1	3	2	4	2	1		4							
Berkheya carlinopsis				1				3	1			2	1		1					3	2	3
Xerophyta retinervis											2	4		1	1					3	2	3
Hypericum aethiopicum													1		3	4	4	3	1			1
Thesium racemoyum										2			1	1	1	1	3	2	2		2	
Lippia javanica				3	2								1	1	1		2	2	2			
Vernonia staehelinoides								4	3				1	4	1						1	
Anthospermum rigidum						2	4	3	1		1	1	1		2		2					
Felicia muricata																1	2	3				3
Senecio venosus		2		2										2	1	3		2				
Phyllanthus incurvus							2			1		2	1		1	1	2	1	1			
Cassia comosa							2		1		1	1	1			2	2	1	1	3		
Waltheria indica								3			2	3			1							
Rhynchosia monophylla														1			2				1	3
Cleome maculata										2	2	3							1			
Rhynchosia spectabilis				1	4	2							1	1	1						1	
Richardia brasiliensis							4			2	1		1			2	1	1				
Vernonia natalensis														2	1	1		1			1	
Striga bilabiata				1	2			1	2						1						1	
Zornia milneana											2				1		1		1			
Cineraria lobata															1						1	1
Conyza scabrida				1	2																	
Lobelia aquaemontis			1																		1	1
Striga gesnerioides														1	1						1	
Solanum panduraeforme				1													1	1				
Borreria scabra				1									1									
Polygala amatymbica																	1	2				
Ipomoea bathycolpos															1		2					
Indigofera spicata										1							1	1				
Lobelia decipiens																		1	1			
Leonotis leonurus				1					1					1								
Cyphocarpa angustifolia						2			1		1											
Brayulinea densa							2								1							
Sutera palustris																				3	1	
Triumfetta rhomboidea															1			1				
Schkuhria pinnata							2	1														
Wahlenbergia lycopidioides																					1	1
Helichrysum caespititium																		1	1			
Phyllanthus parvulus											1											
Asclepias fruticosa																		1				
Commelina erecta											1											
Dianthus mooiensis															1							
Euphorbia schinzii											1											
Lotononis sp.																			1			
Limeum viscosum											1											
Geigeria elongata											1											
Portulaca kermesina												1										
Osteospermum jucundum																						1
Achyranthes sicula			1																			
Pavonia columella			1																			
Senecio oxyriifolius																					1	
Gerbera ambigua																					1	
Pearsonia cajanifolia																					1	
Senecio ruwenzoriensis																					1	
Crassula sarcocaulis																					1	
Hermannia depressa															1							

* CONSTANCY VALUES USED ARE AS FOLLOWS:
1 = >0 - 20%, 2 = >20 - 40%, 3 = > 40 - 60%,
4 = >60 - 80%, 5 = >80 - 100%.

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ABLE 5.2

PHYTOSOCIOLOGICAL CLASSIFICATION AND HABITAT CORRELATION OF THE FARM GROOTHOEK, THABAZIMBI DISTRICT *

COMMUNITY NUMBER	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8.1	5.8.2	5.9.1	5.9.2	5.10	5.11.1	5.11.2	5.12	5.13	5.14	5.15	5.16	5.17	5.18
VELD TYPE NUMBER	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	08. 08	08
CANOPY COVER CLASS				CCCCCCCCCO	CCC	CCCC	CCO	OOOOOO	OOOOCC	CCCCCCCO	CCCOCCCOOCOO	OOOOOOOO	CCCCCCOOOC	OOOCCOOC	COOOOCCOSOSCC	OOOOO	OOOOOO	SOOOOOOO	CCCCCCOCCCCC	SS. OOOSOSSSSSOSSSS	CCCCCCCCCCCCCCC
FORMATION CLASS	FF	FFFFFFFF	FFFFFF	WWWWWWWWWW	WWW	WWWW	WWW	WWWWWW	WWWWWW	WWWWWWWW	WWWWWWWWWWWW	WWWWWWWW	WWWWWWWWWW	WWWWWWWW	WWWWWWWWWWWWW	WWWWW	WWWWWW	SWWWWWWW	GGGGGGGGGGDG	WW. WWWWWWWWWWWWWWW	GGGGGGGGGGGGGGG
SPECIES DIVERSITY (PER SQ.M)	35	33322332	351323	6686665726	455	6465	696	666465	555554	84445456	353546444564	56556555	4664565444	65555575	6566536757676	97689	877778	67586677	764676578647	65. 767775766677656	766676666565666
FINAL SCORE CLASS	04	31227301	091113	0212111111	041	1105	110	140122	132301	33233302	134243541012	55564350	0773331111	06555332	0432225544121	51240	131180	12032342	341130111611	06. 767687765705655	666066675565655
COMPOSITION SCORE CLASS	05	33227301	095435	0222122221	042	1305	120	450323	144302	33233302	255343643033	55566450	0777653211	06666654	0655555544143	63350	333280	12032342	342350332613	07. 877687777707776	676066675565655
BASAL COVER CLASS	22	21121212	111111	2213211111	231	2135	112	233242	232442	44337313	133359441423	23332232	5554233333	68444343	7444320879953	43335	343154	13345533	876327265804	64. 556705644564445	213233323233333
DECREASERS CLASS	11	424		812311 113	532	5376	111	126121	1 1222	1 22 31	11 11111 2 1	12122223	8689644321	79887443	7666657455226	43257	322157	13838332	3525771 24 2	78. 877688098698887	1 121 121111 11
INCREASER I CLASS	75	77583648	987737	111 111211	111	1311		111	11		1 11 1	11111111	111111 11	1 11	1 3 4 4 1	11111	1 111	1 113	2 11 211 1	11. 1 111 1111	234344465544445
INCREASER II CLASS	36	44635443	234484	3998090998	448	5634	004	085090	000997	90089089	798689970906	85687357	3322445689	41234658	4552541626695	67843	888053	08383876	658543098749	42. 322123123422223	463533432233332
INCREASER III CLASS				1	23		7	11 111	11	1 11 1 1	11 11 111 12	131 2111	211241211	21 13	3 2 1 1	11111	11111	1 1121	2111111 1171	11. 122411 11 1111	634244425544444
Selaginella dregei CLASS									2		3 3431 31 3	1412641			2			1			
GEOMORPHOLOGY CLASS	HH	HHHHHHHH	HHHHHH	EEEEEEEEEE	EEE	HHHH	BBB	EEEEEE	EEEEEH	EDDEEDEE	EEEEDDDDDDDD	AAAAAAAA	EEEEEEEBAA	EEEEEEEE	EEEEEEEEEEEEE	EEEEE	EEBBEE	BBBEBEBB	BBBBBBBBBBBB	DD. DDDADDDDDDDDDDD	AAAAAAAAAAAAAAA
ALTITUDE CLASS	11	44444443	899677	5555655556	665	4441	555	333343	444444	55555655	555555556565	66566566	6555555545	65666665	5656654444455	55556	555555	55565555	555555554555	77. 876877997979978	000000900000000
SLOPE CLASS	LG	GLMGLGGG	MMMMGM	GGGGGMGGLG	GGG	GLGG	LLL	GGLLLL	LLLLMM	LGGGLLLG	LGGGGGGGGLLG	MMMMMMMM	GGGGGGGLMM	GGMGLGGG	GGLGLGMMMMMGG	LGGGM	GLLLGL	LLLMGGLL	LLLLLLLLLLLL	MM. SMMLMMMMMMMMMMM	GLLLGGGLGLLLGGG
ASPECT CLASS	56	75776765	545555	5555555555	554	5556	111	655555	555 41	11122131	122111112221	55555555	5555555 55	55555555	5455555566547	6465	551 55	15544555	5545G6 15 45	45. 465 55655765555	2 834 1 162
SOIL FORM	MM	SSSSSSSS	MMMMMM	MMMMMMMMMM	MMM	MMMM	HHH	MMMMMM	MMMMMM	MMMMMMMM	MMMMMMMMMMMM	MMMMMMMM	MMMMMMMMMM	MMMMMMMM	MMMMMMMMMMMSS	MMMMM	MMMMWW	MMMMMMMW	MMMMMKMMKMMK	MM. MMMMMMMMMMMMMMM	MMMMMMMMMMMMMMM
SOIL SERIES	MM	BBBBBBBB	MMMMMM	MMMMMMMMMM	MMM	MMMM	MMM	MMMMMM	MMMMMM	MMMMMMMM	MMMMMMMMMMMM	MMMMMMMM	MMMMMMMMMM	MMMMMMMM	MMMMMMMMMMMBB	MMMMM	MMMMSS	MMMMMMMS	MMMMMSMMSMMS	MM. MMMMMMMMMMMMMMM	MMMMMMMMMMMMMMM
SOIL DEPTH CLASS	CB	BCBBCBCB	BCBBCB	CBCBBBCDCB	BBB	BBBB	CDB	ABABBB	ABABBB	BCCBBBBA	ABBABBBAABAA	AAAAAAAA	BBBABBAAAB	BBBBBBAB	BBCBBABBBBAAA	BAABB	BBAAED	BBCABCBE	DDDDBECBECBD	AA. AAAABBABAABAAAA	AAAAAAAAAAAAAAA
WATERTABLE DEPTH CLASS	00	00000000	000000	0000000000	000	0000	000	000000	000000	00000000	000000000000	00000000	0000000000	00000000	0000000000000	00000	000000	H0000000	L00L0LMHL00M	00. 000000000000000	000000000000000
CARBON % CLASS	22	33333333	555555	2222222222	222	2222	111	222222	222222	22222222	222222222222	22222222	2232332222	22222221	1211112222222	22222	222211	12221221	333331331331	24. 233222224222243	333333333333333
ALUMINIUM % CLASS	88	22222222	999999	4444444444	444	8888	555	000000	000049	99999999	999999999999	99999999	6696990999	56666648	2622224444466	00000	000011	30002001	555555555555	58. 655667778757785	777777777777777
PH (IN WATER) CLASS	SS	MMMMMMMM	SSSSSS	SSSSSSSSSS	SSS	SSSS	SSS	SSSSSS	SSSSSS	SSSSSSSS	SSSSSSSSSSSS	SSSSSSSS	SSSSSSMSSS	SSSSSSSS	SSSSSSSSSSSSS	MMMMM	MMMMMM	SMMSSMMM	SSSSSSSSSSSS	SS. SSSSSSSSSSSSSSS	SSSSSSSSSSSSSSS
BUFFER CAPACITY CLASS	77	66666666	333333	4444444444	444	7777	111	444444	444477	77777777	777777777777	77777777	3333336777	33333343	1311127777733	66666	666655	96661665	333332332332	37. 344333337333374	999999999999999
TITRATABLE ACIDITY CLASS	77	22222222	000000	6666666666	666	7777	555	222222	222248	88888888	888888888888	88888888	6696993888	56666665	2622234444466	33333	333311	33332331	888884884884	58. 766775558555586	888888888888888
ELECTRICAL RESISTANCE CLASS	44	11111111	222222	4444444444	444	4444	666	333333	333366	66666666	666666666666	66666666	4434332666	44444445	3433346666644	22222	222222	42223222	333334334334	48. 444445558545584	444444444444444
CEC (T VALUE) CLASS	66	99999999	999999	5555555555	555	6666	222	444444	444447	77777777	777777777777	77777777	4484886777	54444453	1411134444444	66666	666611	26661661	777772772772	57. 633664447454473	777777777777777
SURFACE ROCK COVER CLASS	HH	MMMMMMHM	HHVHHH	LLLLMMMLMH	HMM	MHHH	LLL	HHHHHH	HHHHHH	MMMMMMMM	HHMHMMMHHMHM	HHHHHHHH	MHHHMMMMHH	HMHHMHHH	MMMMMHHHHHHMM	MMMMM	LLLL00	LLLMMLLL	000000000000	HH. HHHHHHHHHHHHHHH	VVVVHHHVHHHVHHH
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	77	32332323	535575	1999491100	129	8887	555	222232	233349	11109151	400111119001	33233233	4210114422	22444402	1411114444432	88888	556644	55681765	344221247104	98. 111117768696681	998918187779811
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TOTAL NUMBER OF SPECIES PER RELEVE	12	21122221	121111	2322232222	233	2222	332	333233	222322	32222212	222323222322	33333233	3221123223	22222222	2222222222222	32222	222222	12222232	211222112211	22. 322223222222212	222232322212222
	71	23811311	943686	1284636244	504	7671	002	810332	539370	11419095	161054445467	13003610	0549962460	61062276	4424136888496	19265	465667	85324706	385352478027	71. 233040373186473	946437505293338

	% *** CONS.	*** MEAN% COVER	TREE DENSITY PER RELEVE	PER HECTAR
DIFFERENTIAL SPECIES OF THE Celtis africana - Erythrina lysistemon KLOOF FOREST				
A				
lectranthus verticillatus (F) **	100	0,5		
rythrina lysistemon (S)	100	<0,1		
lycine wightii (F)	100	0,3		
DIFFERENTIAL SPECIES OF THE Celtis africana - Osyris lanceolata KLOOF FOREST				
B				
syris lanceolata (S)	100	34,8		
okanthera oppositifolia (S)	100	4,8		
icalysia lanceolata (T)	75	12,1	4,5	225
cus burkei (T)	50	3,8	1,3	65
lpurnia cf.c.aurea (T/S)	50	7,8	1,6	80
hedamnocarpus pruriens (S)	50	0,3		
retia rigida (S)	50	2,5		
phorbia ingens (T)	38	0,2	0,4	20
pris lanceolata (S)	38	0,7		
erodendrum glabrum (T)	25	1,3	0,5	25
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.1 & 5.2				
ea europaea (S)	80	6,9		
xus macowani (S)	70	6,4		
rus laevigatus (S)	50	0,1		
rkia wilmsii (T)	40	3,6	1,1	55
camone filiformis (S)	40	0,3		
DIFFERENTIAL SPECIES OF THE Celtis africana - Asplenium splendens KLOOF FOREST				
plenium splendens (P)	83	0,2		
rex spicato-paniculata (C)	67	0,7		
athula cylindrica (F)	33	0,2		
erocelastrus echinatus (S)	33	0,8		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.2 & 5.3				
rsine africana (S)	71	1,5		
paragus virgatus (S)	64	0,1		
ectranthus fruticosus (F)	57	1,0		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.1, 5.2 & 5.3				
ospyros whyteana (S)	88	3,0		
ltis africana (T)	75	26,2	3,2	16
DIFFERENTIAL SPECIES OF THE Combretum molle - Panicum maximum CLOSED WOODLAND				
hyranthes aspera (F)	100	1,2		
getes minuta (F)	80	2,8		
ematis sp. (S)	70	0,5		
dens pilosa (F)	60	0,3		
nicum maximum (G)	40	0,8		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.2, 5.3, 5.4 & 5.5				
perus albostriatus (C)	56	0,8		
camone alpinii (S)	52	1,2		
llaea viridis (P)	33	<0,1		
lanum giganteum (F)	30	0,2		
erocelastrus rostratus (S)	19	0,3		
DIFFERENTIAL SPECIES OF THE Combretum molle - Setaria megaphylla CLOSED WOODLAND				
ria megaphylla (G)	100	13,1		
estes verticillaris (F)	75	0,9		
cio barbertonicus (S)	50	<0,1		
DIFFERENTIAL SPECIES OF THE Combretum molle - Terminalia sericea CLOSED WOODLAND				
J				
erminalia sericea (T)	100	28,1	15,0	75
hus pyroides (S)	67	1,7		
ndigofera filipes (F)	67	0,3		
DIFFERENTIAL SPECIES OF THE Combretum molle - Aristida diffusa OPEN WOODLAND				
K				
ristida diffusa (G)	92	4,8		
DIFFERENTIAL SPECIES OF THE Combretum molle - Aristida diffusa - Strychnos madagascariensis VARIATION				
L				
Schrebera alata (T/S)	25	0,1	0,1	
Rhynchosia totta (F)	25	<0,1		
Enneapogon pretoriensis (G)	25	0,7		
Strychnos madagascariensis (T)	25	0,3	0,5	2
Blepharis subvolubilis (F)	17	<0,1		
DIFFERENTIAL SPECIES OF THE Combretum molle - Landolphia capensis CLOSED WOODLAND				
M				
Landolphia capensis (S)	70	0,8		
Lannea discolor (S)	60	1,4		
Cyperus margaritaceus (C)	15	<0,1		
Hexalobus monopetalus (S)	10	0,1		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.8 & 5.9				
N				
Diplorhynchus condylocarpon (T/S)	69	2,7	2,1	10
Pseudolachnostylis maprouneifolia (T/S)	60	1,3	0,7	3
Tephrosia longipes (F)	34	0,1		
Littonia modesta (GEO)	31	<0,1		
DIFFERENTIAL SPECIES OF THE Combretum molle - Coleochloa setifera OPEN WOODLAND				
O				
Coleochloa setifera (C)	100	1,8		
Becium obovatum (F)	38	<0,1		
Combretum moggii (S)	38	<0,1		
Plectranthus sp. (S)	25	<0,1		
Mimusops zeyheri (S)	25	0,1		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.9.2 & 5.10				
P				
Selaginella dregei (P)	75	1,3		
Eragrostis curvula (G)	55	<0,1		
Myrothamnus flabellifolius (S)	25	0,2		
Vitex pooara (T/S)	25	0,1	0,1	
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.5, 5.6, 5.7, 5.8, 5.9, 5.10 & 5.11				
Q				
Aristida aequiglumis (G)	68	1,1		
Strychnos pungens (T/S)	63	1,3	0,9	4
Ochna pulchra (T/S)	59	2,4	0,1	
Burkea africana (T/S)	54	7,0	5,3	26
Tapiphyllum parvifolium (S)	41	0,4		
Brachiaria nigropedata (G)	35	0,3		
Rhoicissus digitata (S)	31	0,3		
Cryptolepis oblongifolia (S)	28	0,4		
Digitaria eriantha ssp.transvaalensis(G)	28	0,3		
Elephantorrhiza burkei (S)	25	1,1		
Apodytes dimidiata (T/S)	22	0,2		
Pachystigma triflorum (T/S)	22	0,2		
DIFFERENTIAL SPECIES OF THE Combretum molle - Argyrolobium transvaalense OPEN WOODLAND				
R				
Vernonia oligocephala (F)	100	<0,1		
Argyrolobium transvaalense (S)	100	<0,1		
Ruellia cordata (F)	100	<0,1		
DIFFERENTIAL SPECIES OF THE Combretum molle - Pachycarpus schinzianus OPEN WOODLAND				
S				
Pachycarpus schinzianus (F)	64	<0,1		
Triumfetta sonderi (F)	33	0,6		
Talinum caffrum (F)	33	0,6		
DIFFERENTIAL SPECIES OF THE Andropogon appendiculatus - Eragrostis pallens GRASSLAND				
T				
Cyperus denudatus (C)	75	0,5		
Andropogon appendiculatus (G)	75	1,7		
Eragrostis lappula (G)	42	1,0		
Asclepias sp. (F)	25	<0,1		
Eragrostis gummiflua (G)	25	1,0		
Setaria sphacelata (G)	25	1,5		
Trichoneura grandiglumis (G)	17	0,4		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.15 & 5.16				
U				
Stoebe vulgaris (S)	55	2,5		
Hypericum lalandii (F)	30	<0,1		
Paspalum scrobiculatum (G)	20	0,7		
Perotis patens (G)	20	0,3		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.13, 5.14, 5.15 & 5.16				
V				
Senecio erubescens (F)	68	<0,1		
Bulbostylis boeckeleriana (C)	61	0,4		
Eragrostis capensis (G)	52	1,5		
Bergia decumbens (F)	45	<0,1		
Chironia purpurascens (F)	42	<0,1		
Alloteropsis semialata (G)	42	<0,1		
Amphidoxa filaginea (F)	32	0,1		
Gazania krebsiana (F)	23	<0,1		
Geigeria burkei var. burkei (S)	23	0,2		
Hypoxis angustifolia (GEO)	23	<0,1		
Pearsonia sessilifolia (F)	16	0,6		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15 & 5.16				
W				
Schizachyrium sanguineum (G)	47	1,1		
Elionurus muticus (G)	45	0,8		
Setaria perennis (G)	41	1,0		
Aristida junciformis (G)	26	0,7		
DIFFERENTIAL SPECIES OF THE Protea roupelliae - Helichrysum nudifolium SPARSE WOODLAND				
X				
Helichrysum nudifolium (F)	73	<0,1		
Brachymeris bolusii (F)	67	0,9		
Vernonia galpinii (F)	53	<0,1		
DIFFERENTIAL SPECIES OF THE Trachypogon spicatus - Eragrostis racemosa GRASSLAND				
Y				
Trachypogon spicatus (G)	100	8,6		
Helichrysum uninervium (F)	67	0,2		
Selago capitellata (F)	67	1,0		
Tephrosia elongata (F)	53	<0,1		
Widdringtonia nodiflora (S)	33	0,1		
Polygala hottentotta (F)	33	<0,1		
Ursinia nana (F)	13	<0,1		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.17 & 5.18 (a)				
Z				
Protea roupelliae (T/S)	57	1,0	0,6	
Euryops pedunculatus (S)	43	0,5		
Geigeria burkei var. zeyheri (S)	13	<0,1		
Pentanisia angustifolia (F)	10	<0,1		
IFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.17 & 5.18 (b)				
chrysum kraussii (F)	75	0,3		
gofera hedyantha (F)	66	0,2		
alypha angustata (F)	56	0,1		
Helichrysum mimetes (F)	53	0,1		
Wahlenbergia caledonica (F)	22	<0,1		
Aristea woodii (GEO)	22	<0,1		
Psammotropha mucronata (F)	19	<0,1		
Nemesia fruticans (F)	16	<0,1		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.11.2, 5.12, 5.17 & 5.18				
AB				
Helichrysum sp. (F)	68	0,5		
Dicoma anomala (F)	57	<0,1		
Chaetacanthus costatus (F)	45	0,1		
Helichrysum cephaloideum (F)	43	<0,1		
Sphenostylis angustifolia (F)	11	<0,1		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14 & 5.15				
AC				
Combretum molle (T/S)	78	3,1	2,0	1
Faurea saligna (T/S)	32	1,4	1,3	6
Ozoroa paniculosa (T/S)	31	0,4	0,2	1
Heteropyxis natalensis (T/S)	25	0,5	0,i	1
Euclea crispa (S)	18	0,4		
Oldenlandia herbacea (F)	17	<0,1		
Rhus leptodictya (T/S)	15	0,6	0,2	1
Pygmaeothamnus zeyheri (S)	14	0,1		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15 & 5.17				
AD				
Heteropogon contortus (G)	56	6,4		
Indigofera comosa (F)	44	0,2		
Protea caffra (T/S)	38	1,1	0,9	4
Vitex rehmannii (T/S)	33	0,8	0,2	1
Stachys natalensis var. natalensis (F)	28	<0,1		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15, 5.17 & 5.18				
AE				
Bulbostylis burchellii (C)	60	0,7		
Fadogia monticola (S)	45	0,5		
Rhus dentata (S)	35	0,5		
Cyperus leptocladus (C)	31	0,2		
Commelina africana (F)	27	<0,1		
Maytenus tenuispina (S)	27	0,2		
Tristachya biseriata (G)	21	0,7		
DIFFERENTIAL SPECIES OF COMMUNITY NUMBERS 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15, 5.16, 5.17 & 5.18				
AF				
Eragrostis racemosa (G)	59	1,7		
Vangueria infausta (T/S)	52	0,7	0,1	
Andropogon schirensis (G)	46	1,3		
Loudetia simplex (G)	40	1,5		
Themeda triandra (G)	34	1,5		
Panicum natalense (G)	32	1,1		
Diheteropogon amplectens (G)	29	0,6		
Rhynchelytrum setifolium (G)	21	0,3		
GENERAL AND INFREQUENT SPECIES				
TREES AND SHRUBS				
Bequaertiodendron magalismontanum	41	0,8		
Brachylaena rotundata	19	0,2		
Acacia caffra	18	0,5		
Asparagus suaveolens	12	<0,1		
Podocarpus latifolius	11	2,5		
Clutia pulchella	9	0,2		
Dombeya rotundifolia	9	0,3		
Passerina montana	8	0,1		
Parinari capensis	8	<0,1		
Cussonia spicata	7	<0,1		
Tritonia nelsonii	7	0,2		
Rothmannia capensis	7	0,1		
Mundulea sericea	7	0,8		
Croton gratissimus	6	<0,1		
Maytenus undata	6	<0,1		
Rhoicissus tridentata	5	<0,1		
Gardenia spatulifolia	5	<0,1		
Diospyros lycioides	4	<0,1		
Euclea linearis	4	<0,1		
Ziziphus mucronata	4	0,3		
Ficus capensis	4	0,1		
Elephantorrhiza obliqua	4	<0,1		
Nuxia congesta	4	<0,1		
Euclea natalensis	3	<0,1		
Lannea edulis	3	<0,1		
Aloe transvaalensis	3	<0,1		
Opuntia sp.	2	0,2		
Lopholaena coriifolia	2	<0,1		
Acacia karroo	2	<0,1		
Pappea capensis	2	<0,1		
Asparagus buchananii	2	<0,1		
Combretum apiculatum	1	<0,1		
Strychnos cocculoides	1	<0,1		
Combretum zeyheri	1	<0,1		
Protea gaguedi	1	<0,1		
Tarenna barbertonensis	1	<0,1		
Acacia ataxacantha	1	<0,1		
Ficus ingens	1	<0,1		
Grewia occidentalis	1	<0,1		
Jasminum multipartitum	1	<0,1		
Lantana rugosa	1	<0,1		
Rhus dura	1	<0,1		
Erythroxylum emarginatum	1	<0,1		
Canthium huillense	1	<0,1		
Barleria bremekampi	1	<0,1		
Asparagus asparagoides	1	<0,1		
Buddleia salviifolia	1	<0,1		
Cussonia paniculata	1	<0,1		
Psoralea polysticha	1	<0,1		
Asparagus setaceus	1	<0,1		
Pittosporum viridiflorum	1	<0,1		
Senecio pleistocephalus	1	<0,1		
Heteromorpha arborescens	1	<0,1		
Grewia monticola	1	<0,1		
GRASSES				
Eragrostis pallens	21	0,6		
Monocymbium ceresiiforme	17	0,4		
Cymbopogon validus	14	0,4		
Rhynchelytrum repens	14	0,1		
Cymbopogon sp.	13	0,5		
Urelytrum squarrosum	9	0,5		
Digitaria diagonalis	9	0,1		
Sporobolus africanus	5	0,2		
Hyparrhenia hirta	5	0,2		
Setaria lindenbergiana	3	0,1		
Microchloa caffra	2	<0,1		
Cymbopogon excavatus	2	<0,1		
Digitaria eriantha ssp eriantha	1	<0,1		
Pogonarthria squarrosa	1	<0,1		
Tristachya rehmannii	1	<0,1		
Aristida canescens	1	<0,1		
Digitaria monodactyla	1	<0,1		
Cynodon dactylon	1	<0,1		
SEDGES				
Mariscus rehmannianus	1	<0,1		
Cyperus rupestris	1	<0,1		
GEOPHYTES				
Eriospermum sp.	6	<0,1		
Hypoxis obtusa	6	<0,1		
Hypoxis rigidula	2	<0,1		
cf.Brunsvigia radulosa	1	<0,1		
Babiana hypogea	1	<0,1		
Anthericum galpinii	1	<0,1		
Scilla nervosa	1	<0,1		
FERNS				
Pellaea calomelanos	35	<0,1		
Cheilanthes hirta	10	<0,1		
Mohria caffrorum	9	<0,1		
Pteridium aquilinum	9	0,2		
Alsophila dregei	1	0,1		
OTHER FORBS				
Senecio conrathii	22	<0,1		
Oxalis depressa	19	<0,1		
Scabiosa columbaria	18	0,1		
Indigofera egens	17	<0,1		
Berkheya carlinopsis	15	<0,1		
Xerophyta retinervis	14	<0,1		
Hypericum aethiopicum	14	<0,1		
Thesium racemoyum	12	<0,1		
Lippia javanica	11	<0,1		
Vernonia staehelinoides	10	<0,1		
Anthospermum rigidum	10	<0,1		
Felicia muricata	8	<0,1		
Senecio venosus	8	<0,1		
Phyllanthus incurvus	8	<0,1		
Cassia comosa	8	<0,1		
Waltheria indica	7	<0,1		
Rhynchosia monophylla	6	<0,1		
Cleome maculata	6	<0,1		
Rhynchosia spectabilis	6	<0,1		
Richardia brasiliensis	6	<0,1		
Vernonia natalensis	5	<0,1		
Striga bilabiata	4	<0,1		
Zornia milneana	4	<0,1		
Cineraria lobata	3	<0,1		
Conyza scabrida	3	0,4		
Lobelia aquaemontis	2	<0,1		
Striga gesnerioides	2	<0,1		
Solanum panduraeforme	2	<0,1		
Borreria scabra	2	<0,1		
Polygala amatymbica	2	<0,1		
Ipomoea bathycolpos	2	<0,1		
Indigofera spicata	2	<0,1		
Lobelia decipiens	2	<0,1		
Leonotis leonurus	2	<0,1		
Cyphocarpa angustifolia	2	<0,1		
Brayulinea densa	1	<0,1		
Sutera palustris	1	<0,1		
Triumfetta rhomboidea	1	<0,1		
Schkuhria pinnata	1	<0,1		
Wahlenbergia lycopidioides	1	<0,1		
Helichrysum caespititium	1	<0,1		
Phyllanthus parvulus	1	<0,1		
Asclepias fruticosa	1	<0,1		
Commelina erecta	1	<0,1		
Dianthus mooiensis	1	<0,1		
Euphorbia schinzii	1	<0,1		
Lotononis sp.	1	<0,1		
Limeum viscosum	1	<0,1		
Geigeria elongata	1	<0,1		
Portulaca kermesina	1	<0,1		
Osteospermum jucundum	1	<0,1		
Achyranthes sicula	1	<0,1		
Pavonia columella	1	<0,1		
Senecio oxyriifolius	1	<0,1		
Gerbera ambigua	1	<0,1		
Pearsonia cajanifolia	1	<0,1		
Senecio ruwenzoriensis	1	<0,1		
Crassula sarcocaulis	1	<0,1		
Hermannia depressa	1	<0,1		

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* FOR EXPLANATION OF CLASS SYMBOLS USED SEE APPENDIX I

** (C) SEDGE; (F) FORB; (G) GRASS; (GEO) GEOPHYTE; (P) FERN; (S) SHRUB; (T) TREE.

*** PERCENTAGE RELATIVE CONSTANCY AND MEAN COVER CALCULATED FOR EACH BLOCKED COMMUNITY

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