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A PHYTOSOCIOLOGICAL RECONNAISSANCE OF THE MOUNTAIN ZEBRA NATIONAL PARK

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Abstract – The vegetation of the Mountain Zebra National Park, situated within the Eastern Mixed Karooveld of the Republic of South Africa, was surveyed and analysed according to the Braun-Blanquet phytosociological method of sampling and synthesis. Brief discussions on the phytogeography of the Karoo and the physiography and climate of the Park are included. Three distinct major vegetation types are described floristically, physiognomically and ecologically. A vegetation map of the Park is provided.

Introduction

The Republic of South Africa is well known for its extensive inland semi-desert lowland areas which house rich and distinct floras. Approximately 40% of its surface could be classified as such, receiving an average rainfall of less than 425 mm.

The best known portion of these lowlands is the Karoo, derived from the Hottentot word "Kuru" meaning dry, barren or harsh (Nienaber & Raper 1977). Bolus (1875) already recognized the Karoo as a distinct phytogeographical unit, apart from areas such as the Kalahari and the Namib.

The Mountain Zebra National Park (MZNP) is situated in a north-south orientated transitional zone (Tidmarsh 1948), between the arid karoobushveld of the western and central Karoo and the drier "sweet" grassveld in the east. The southern half of this zone is known as the Cape Midlands (Fig. 1) because of its peculiar setting within an approximate circle of mountain ranges (Fig. 2). Apart from the varying topography that characterizes the Cape Midlands, a heterogeneous vegetation known as the Eastern Mixed Karooveld (Fig. 3) (Tidmarsh 1948; Roux 1966a) is also very typical because of an overall codominance of grasses and karoobushes (dwarf shrubs). The vegetation is subjected to a continuous climatic tension because of the influence of an arid climate from the west and a more moderate climate from the east. A close relationship has been proved in this area (Roux 1966a; Roux 1966b) between seasonal rainfall and its effect on the growth of grasses and karooshrubs.

Fig 1. Karoo-areas of the Republic of South Africa.

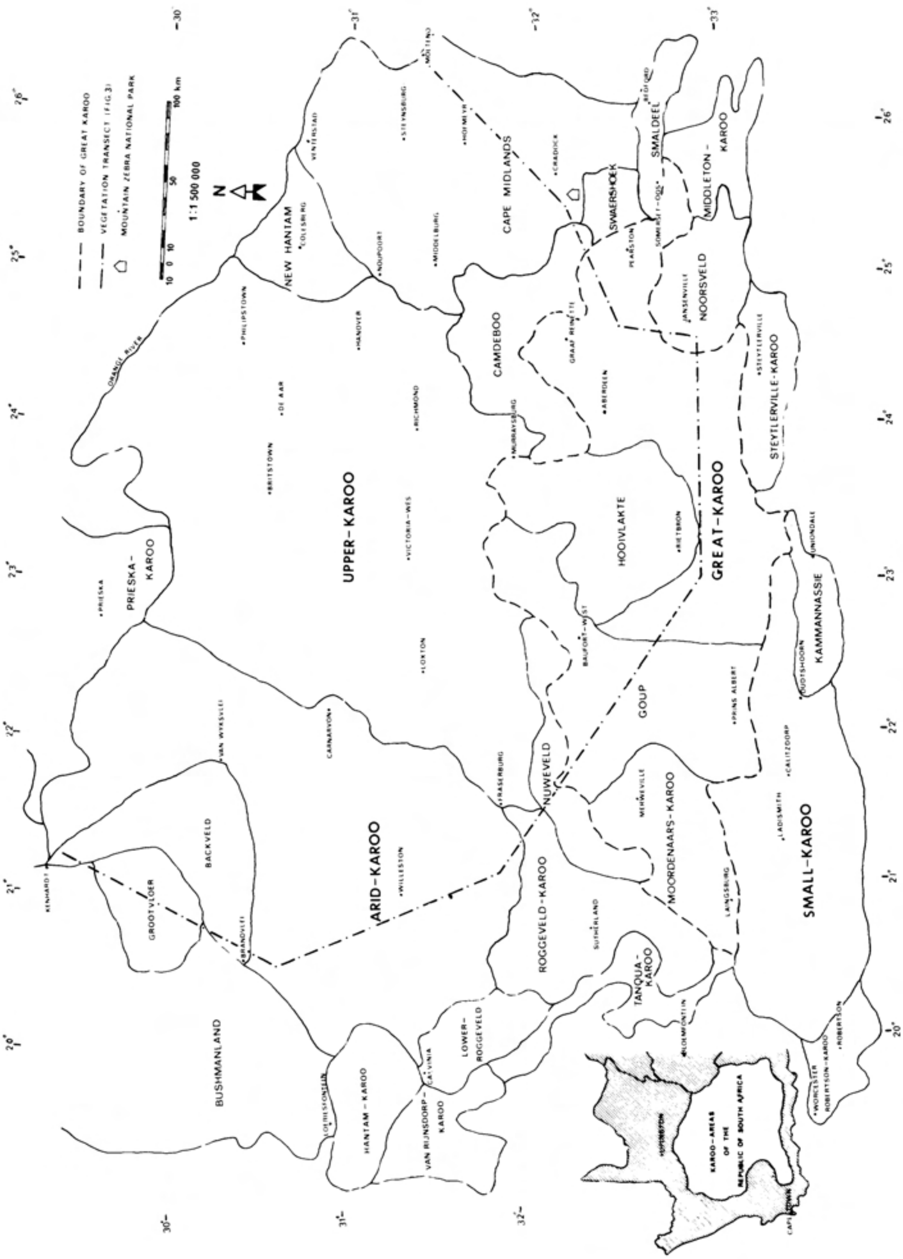
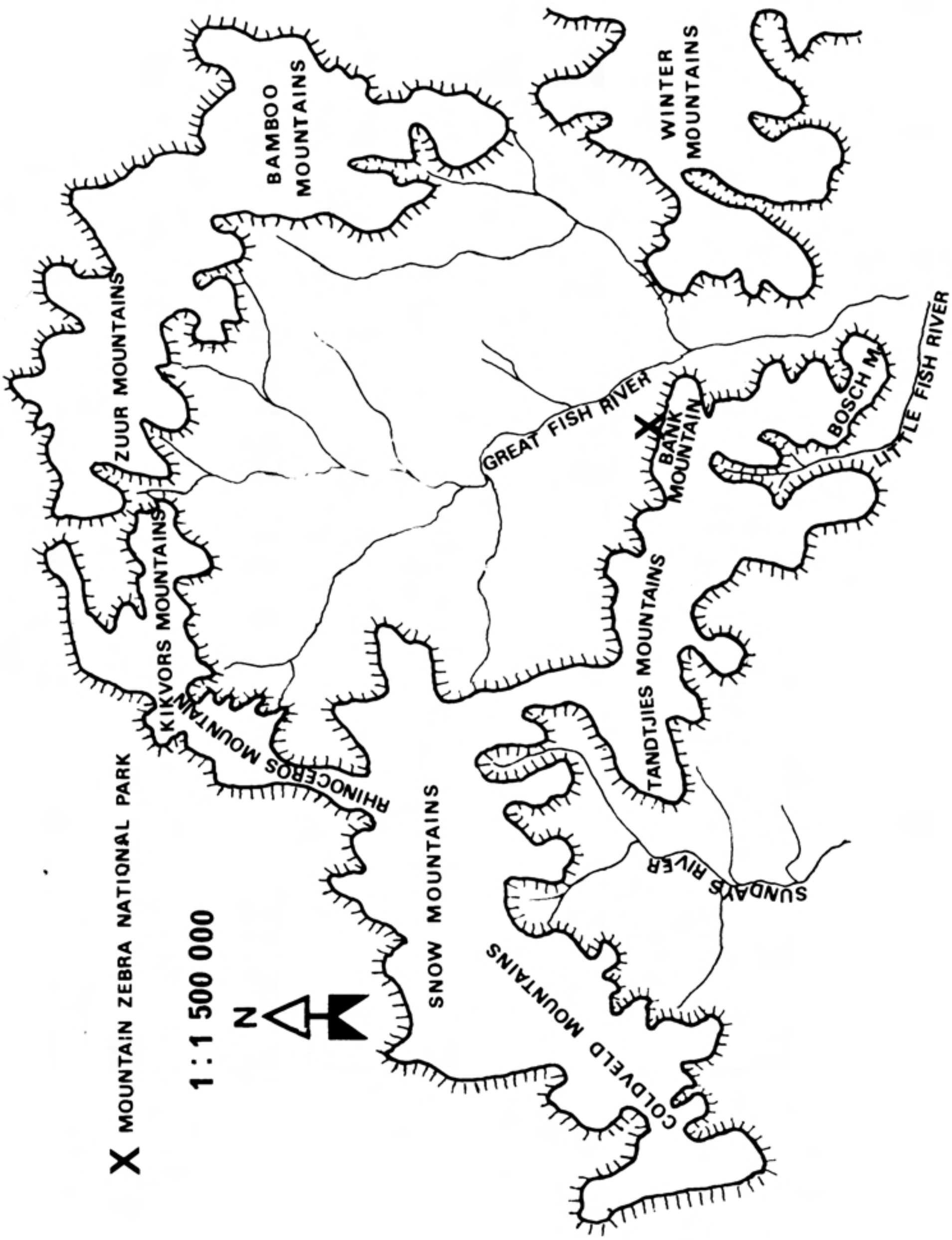


Fig. 2. Locality of the Mountain Zebra National Park within the circumferential mountain ranges.



Problematic aspects related to the Karoo flora are numerous and have been the subject of superficial investigations for many years. Well founded long-term research into these matters are, however, sadly lacking. Meanwhile, the identified Karoo elements are penetrating adjacent grassland areas at an alarming rate and the true Karoo flora itself is rapidly becoming less palatable and non-characteristic due mainly to injudicious utilization practices. Today this destruction is continuing uninterruptedly. The anxiety of the authorities, concerning this process of veld degradation, has been demonstrated over the last 20 years by the successive and very expensive veld preservation and subsidising schemes conducted in the Karoo and neighbouring areas.

The MZNP is the only proclaimed conservation unit in the Eastern Mixed Karooveld. It is thus an unique reference venue to monitor the changes in this dynamic vegetation type. As a necessary base line for such a project, this study intends to map and describe the vegetation of the Park.

The geographical coordinates of the MZNP are 32°15′S, 25°41′E and the Park is 6 536 ha in extent. It is situated 24 km west of the town of Cradock (Fig. 1).

The MZNP is administered by the National Parks Board of Trustees. The primary objective of its management here is (National Parks Board 1979) to conserve a viable, genetically uncontaminated, representative population of the Cape Mountain Zebra *(Equus zebra zebra* Linn., 1758) in a reasonable balance with their environment. Some secondary objectives are:

(a) To conserve a representative spectrum of the typical faunal elements of the MZNP under natural conditions.
(b) To conserve a representative spectrum of vegetation types that are unique for this region. These may be utilized by the animals but not damaged to the extent that they are no longer self-perpetuating.

The present survey also formed part of the South African National Programme for Environmental Sciences' project to inventorize plant communities in permanently conserved areas at a semi-detailed level (Edwards 1974). For this the Botanical Research Institute adopted the Braun-Blanquet Method of sampling and classification, described by Werger (1973, 1974) and Westhoff & Van der Maarel (1973).

Phytogeographical aspects of the Karoo

The Karoo is subdivided into a number of regions on a somewhat arbitrarial historical-phytogeographial basis (Fig. 1). Most of the regional names were conveyed from one generation to the next and is today well documented (Raper 1972).

Figure 3 depicts a west-east vegetation transect through some of the

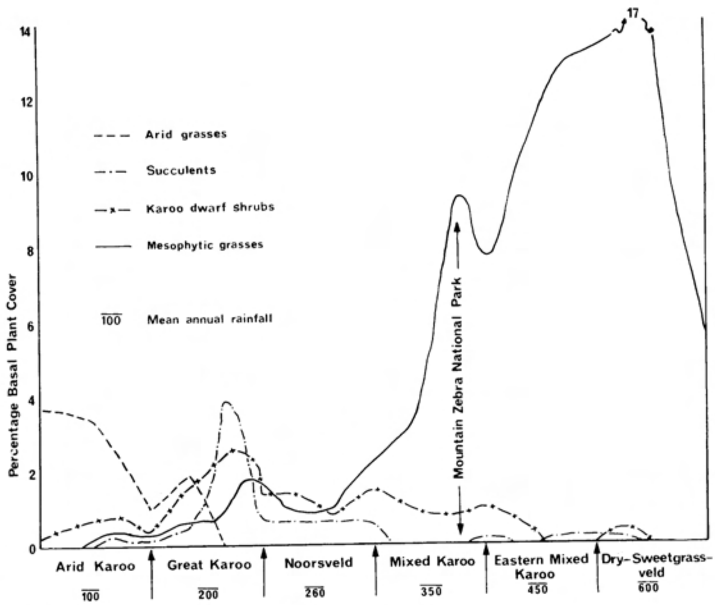


Fig. 3. Proportions of the four major Karoo plant growth forms along a west-east transect through the Karoo.

Karoo areas. The basal cover percentage data were obtained from point-surveys (Tidmarsh & Havenga 1955; Roux 1963) carried out by various officers of the Karoo Region, Department of Agricultural Technical Services (unpublished data), and by the author (Van der Walt 1968 and unpublished reports).

With an increase in rainfall the general vegetation trend in the Karoo from west to east is that of a desert grassland of low coverage gradually merging into the relatively stable plant cover of the Great Karoo where the four distinctive plant components of the Karoo (Fig. 3), *i.e.* arid grasses, succulents, karoo shrubs and mesophytic grasses, are more or less equally represented. In areas receiving an average annual rainfall of more than 300 mm, the more mesophytic grasses become more dominant until virtually pure grass stands are possible in areas receiving more than 600 mm rain per annum.

The Great Karoo could be considered as the proper Karoo because of its central geographical position (Fig. 1), and the relative dominance of the karoobush with regard to the other Karoo-like areas (Fig. 3). The variety of plant growth forms in the Great Karoo and the fact that each displays a different growth peak during the year (Roux 1966a), emphasizes its well balanced grazing potential which contributed significantly to the image of the Great Karoo as being good sheep country.

The transitional character of the MZNP is emphasized in Fig. 3. Karoo-shrubs are still well represented in the Park. However, the pronounced mixture of plant growth forms so characteristic for the Great Karoo is absent, while the amount of grasses is decidedly on the increase.

Geology and Geomorphology

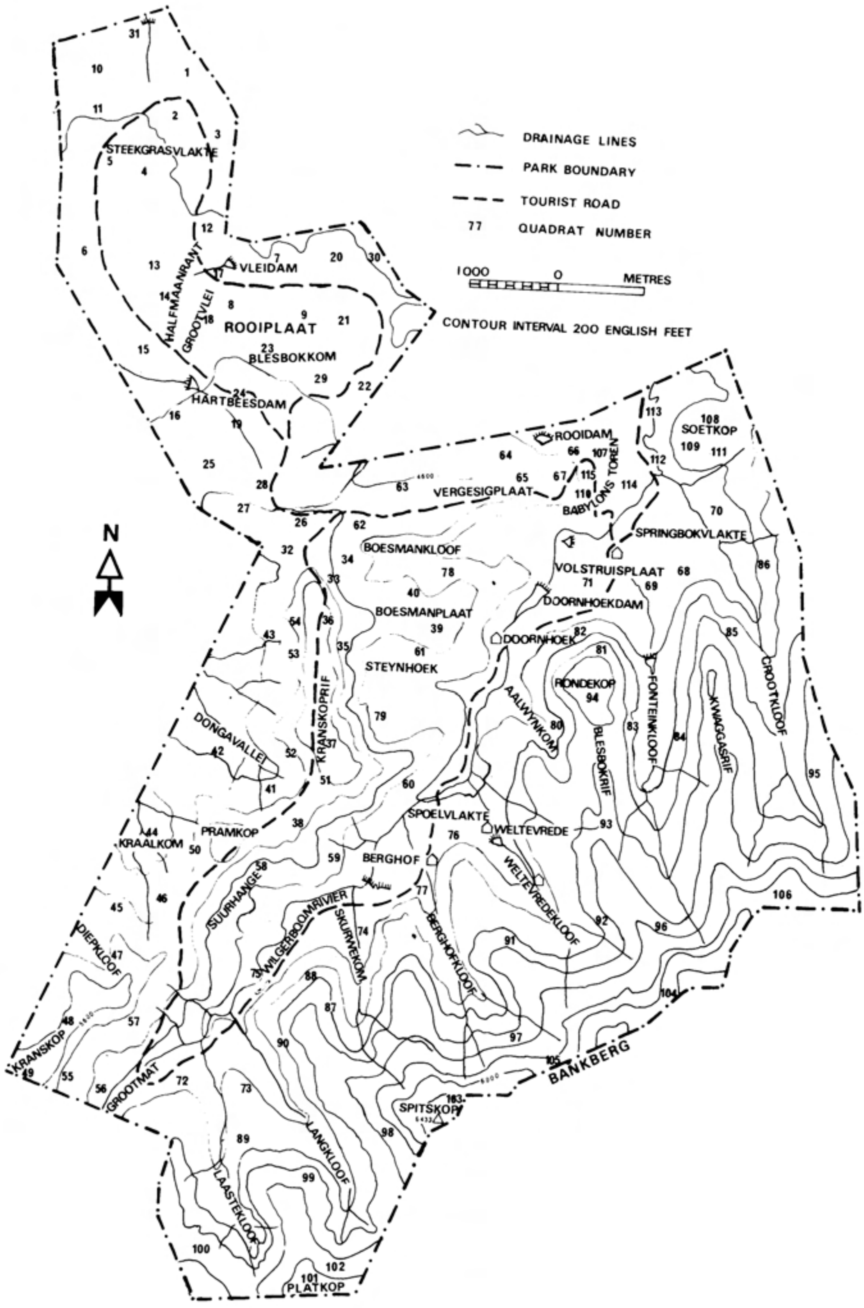


Fig. 4. Topographical and locality map of the Mountain Zebra National Park.

Fig. 5. Panoramic view of the Mountain Zebra National Park.

Topographic features:

1–Bankberg	2–Spitskop
3–Rondekop	4–Fonteinkloof
5–Grootkloof	6–Vergesigplaat
7–Kwaggasrif	8–Volstruisplaat
9–Doornhoekdam	10–Boesmanplaat
11–Boesmankloof	12–Kranskoprif
13–Spoelvlakte	14–Steynhoek

Plant communities:

DA *Diospyros lycioides – Acacia karroo* Riverine community

SA *Setaria neglects – Acacia karroo* Shrubland on stabilized hot shaly slopes

Ps *Pentzia sphaerochephala* Small Shrubland on restricted valley bottoms

GR *Grewia occidentalis – Rhus lucida* Shrubland of lower doloritic pediment slopes

HR *Heteropogon contortus – Rhus erosa* Shrubland on shallow, stoney soils.

WF *Walafrida saxatilis – Felicia filifolia* Dwarf Shrubland on shaly moderately xeric slopes.

ET *Eragrostis curvula – Themeda triandra* Grassland

Me *Merxmuellera disticha – Euryops annuus* Grass- and Shrubland on steep mesic slopes

MS *Merxmuellera disticha – Selago corymbosa* Summit Grass- and Shrubland

Physiography

Geology and Geomorphology

The mountainous terrain of the MZNP (Fig. 2, 4, 5) is part of the southern quarter of the Karoo Mountain Veld Complex. This Complex in turn forms part of the most outstanding feature of South African physiography namely the Great Escarpment, which is described by King (1942) and Fair & King (1954). Although the character of the Complex is not that of an escarpment in the strict sense, the different mountain ranges (Fig. 2) represents remnants of the former scarp (continental Gondwana, Fair *et al.* 1954) which is still being eroded away by major eroding agents such as the Great- and Little Fish- and Sunday Rivers. In this process of pediplenation the big upper Fish River basin was formed, part of which lies at the lower or northern end of the Park.

The landscape of the MZNP has evolved on sedimentary rock types of the Series Beaufort of the Karoo System (Dohse 1976; Toerien 1972). This geographical system consists of a very thick succession of near horizontal strata of sedimentary rocks.

The mudstones and shales of the Beaufort Series are relatively unstable. Mechanical and chemical weathering are quite common on the talus slopes and pediments. The material derived from these processes is usually rich in clay and salts.

The sediments in the MZNP are penetrated on a large scale by Post-Karoo dolerite intrusions in the form of large sheets and a number of dykes. A massive dolerite sheet is responsible for the well known mountainous character of the Park (Fig. 5). Approximately 50% of the central and southern parts of the Park are characterized by dolerite outcrops that are remnants of the former sheet. Conspicuous rounded hills like Rondekop, Babylons Toren and Soetkop (Fig. 4 & 5) terminate the ridges formed by these remnants.

The physiography of the MZNP and the immediate adjacent farms to the north (which may become part of the Park in the near future) is in three stages of pediplenation (Dohse 1976):

(a) Youth stage – this stage dominates the landscape of the Park. Relief is pronounced with the resistant Bankberg (1 957 m at its highest summit namely Spitskop (Fig. 4 & 5)) as the most prominent feature. Up to now this dolerite sheet has largely withstood the erosion onslaught of the upper reaches of the Wilgerboom and Little Fish Rivers – hence the origin of its name of being an embankment to elements such as frontal winds and other eroding agents. The northern slopes of Bankberg are characterized by steep-sided V-shaped kloofs (Fig. 5), formed at a rectangle to the long axis of Bankberg by the Wilgerboom River and its tributaries. Summits, escarps and talus slopes dominate the scene. Alluvial and colluvial flats such as Springbok- and Spoelvlakte (Fig. 4 & 5) are still very small.

Along the western boundary of the MZNP, a high ridge (with the dolerite capped Kranskop (1 800 m) being the highest point), which eventually flattens into the low-lying Rooiplaat plateau (1 400 m), serves as a watershed between the catchments of the Wilgerboom and Kareebosch Rivers – both tributaries of the Great Fish River. An eastward extension of this ridge terminates in a prominent dolerite dome which is known as Babylons Toren.

(b) & (c) Mature and old-age stages – these stages are found on the neighbouring farms to the north where hills contribute insignificantly to the general landscape.

Soils

Dohse (1976) identified the following dominant soil associations in the MZNP (for a description of each soil series and the standard codes see Macvicar, De Villiers, Loxton, Verster, Lambrechts, Merryweather, Le Roux, Van Rooyen and Harmse 1977):

1. Sw 11 SKILDERKRANS (Swartland form), Sw 21 BROEKSPRUIT (Swartland form) and Gs 16 WILLIAMSON (Glenrosa form) – This association is confined to the flat valley crests of the mature stage of pediplenation. Dolerite played an important role in the formation of these soils. The soils are generally clayey, dark red-brown and it is seldom deeper than 80 cm to the bedrock.
2. Ms 10 MISPAH series – These soils are confined to the valley crests of the mature and old-age stages of pediplenation. They are generally very shallow (< 30 cm) and stoney.
3. Hu 46 SHIGALO (Hutton form) and Oa 26 LETABA (Oakleaf form) – Located along the sloping pediments of the youth and late-youth stage of pediplenation. The soils are generally deep (± 100 cm), well drained, reddish and are calcareous colluvial soils which developed in the deposited material on the sloping (4–6%) pediments.
4. 0a 33 VAALRIVIER, 0a 34 LEVUBU, 0a 36 JOZINI } Oakleaf form and Du 10 DUNDEE (Dundee form)
   This association presents the narrow flood plain of the primary drainage channels of the youth- and late-youth stages of pediplenation and is confined to very narrow strips adjacent to the major watercourses. These young soils are of an alluvial origin, generally very deep and often incised by donga erosion.
5. A major portion of the MZNP consists of very shallow lithosols along the steep slopes and escarpments.

The soils derived from doloritic parent material are more resistant to erosion than those which evolved from shale and mudstone (Dohse 1976). This is due to the more favourable chemical and mineralogical composition of the dolerite. Chemical weathering is secondary in importance to mechanical weathering in the MZNP due to the dry climate.

The steep slopes and scattered plant cover of the pediments, coupled with the frequent occurrence of thunderstorms, accelerates the transportation of weathering products to the better vegetated lower lying areas where deposition takes place. In the lower lying sandy pediments and plains most of the surface water disappears underground due to good internal drainage. Quite a number of fountains ensure a relatively permanent supply of surface water.

Climate

According to Köppen's classification of world climate (Schulze 1947), the MZNP has a BSkw' climate which is described as a "arid climate, cold and dry, with the mean annual temperature below 64,4°F but the hottest month exceeding 64,4°F; the dry season is in winter and the height of the rainy season in autumn (March-April)".

Table 1

Annual rainfall (mm) in the Mountain Zebra National Park (1962-1978)

Month	Mean	Range
January	53,4	20,6–117,5
February	52,7	6,0–111,5
March	85,8	2,5–208,0
April	40,3	8,4–66,3
May	20,8	0–89,0
June	10,8	0–24,5
July	11,3	0–45,0
August	19,0	0–87,0
September	10,1	0–35,0
October	27,2	0–55,0
November	34,8	0–80,3
December	31,5	0–117,0

Annual mean: 397,7 mm

Table 2

Average air temperature and relative humidity recorded in the Mountain Zebra National Park during 1969, 1971 and 1972

Month	Temperature (°C)				Relative Humidity (%)			
	Maximum		Minimum		Maximum		Minimum	
	Mean	*Range*	*Mean*	*Range*	*Mean*	*Range*	*Mean*	*Range*
January	29,1	18 to 37	13,7	7 to 21	72,5	46 to 96	25,0	14 to 50
February	27,4	15 to 37	12,6	7 to 21	83,4	52 to 95	31,3	14 to 72
March	24,9	13 to 34	11,6	5 to 18	58,9	47 to 94	39,9	13 to 68
April	19,3	6 to 28	6,4	1 to 13	86,5	73 to 95	34,4	16 to 71
May	16,8	8 to 25	3,9	–5 to 13	85,3	58 to 96	35,1	14 to 66
June	15,0	7 to 23	0,4	–7 to 10	83,2	36 to 96	33,7	18 to 57
July	15,8	5 to 22	–0,1	–6 to 8	76,1	42 to 96	29,8	15 to 61
August	17,6	3 to 28	1,0	–7 to 8	69,5	28 to 96	27,8	12 to 80
September	19,4	6 to 32	4,1	–6 to 18	65,2	19 to 94	28,4	11 to 87
October	22,8	9 to 35	7,7	–1 to 15	73,1	20 to 97	31,4	14 to 92
November	25,4	12 to 36	9,5	1 to 17	74,2	17 to 94	28,0	14 to 69
December	28,2	17 to 36	11,5	4 to 12	75,3	33 to 27	26,6	11 to 46

Reliable rainfall records for the MZNP, measured near the Warden's office at the bottom of Babylons Toren, are only available for the 16-year period 1962–1978 (Table 1). The ambient temperature and relative humidity were recorded in a Stevenson Screen at the same site in 1969, 1971 and 1972 (Penzhorn 1979) (Table 2).

In view of the mountainous terrain and relatively large altitudinal differences within the Park, local climate variations could be expected.

Precipitation

The mean annual rainfall for the period 1962–1978 was 397,7 mm. During this period about 70% of the total precipitation was recorded between October and March and about 30% during April-September. March had the highest mean precipitation (85,8 mm) and September the lowest (10,1 mm). The longest period without precipitation was three months (June-August 1969). Most of the precipitation occurred in the form of rain but a few snowfalls (up to 20 cm) were recorded each winter (Penzhorn 1979). The high Bankberg and Kranskoprif (Fig. 4) areas experienced snowfall the most often. Hail occurred infrequently while severe frost is likely during the period May-October.

Based on personal observations by staff, the following conclusions with regard to the rainfall pattern in the MZNP could be drawn:

(a) The western portion receives more rainfall than the areas east of Kranskoprif.
(b) The Grootmat basin is the highest rainfall area in the Park.
(c) The lower section of the Wilgerboom River valley in the MZNP falls within a rainfall shadow created by the presence of Kranskoprif and Bankberg. Seeing that the thunderstorms advance most often from the northwest during the summer, this rainfall is particularly enhanced in the western and southern summit areas. Winter precipitation originates mainly from cold fronts from the south. Therefore this rainfall favoures particularly the southern summit areas of the Park.

Temperature and relative humidity

The mean monthly maximum temperatures varied between 29,1°C in January and 15,0°C in June and the mean minimum temperatures between 13,7°C in January and –0,1°C in June. There were marked differences between daily maximum and minimum temperatures and also wide ranges of these. The highest maximum temperature (37°C) was recorded in January and February and the lowest minimum temperature (–7°C) in June. During October-March the maximum temperature exceeded 20°C. Minimum temperatures below 0°C were recorded from May-October.

The monthly maximum humidity varied between 58,9% and 85,3%

and the mean minimum between 25,0% and 34,9%. No pattern was readily discernible.

In an area like the MZNP with marked slope and aspect variations, important radiation (see Tables 5 & 6) and temperature differences between hot north and north-west facing aspects on the one hand and cool south and southeast facing aspects on the other hand, could be expected. The importance of Bankberg as a barrier to the regular cold fronts during winter, is also of utmost importance to the general ecological set up in the Park. From experience it is known that a much more temperate climate prevails on Bankberg while a warmer climate is experienced in the sheltered valley below.

Wind

During the winter the dominant winds range between north and west while the southeastern dominates in summer. The stronger winds in summer are from a north-westerly direction. The wind responsible for the frequent picturesque winter mist-blanket over Bankberg which usually preceeds a cold front, follows the course of the neighbouring Little Fish River valley in the south (Fig. 2).

Wildlife

In addition to the Cape mountain zebra, the ony large mammals occurring in the MZNP at its inception were mountain reedbuck *Redunca fulvorufula*, grey rhebuck *Pelea capreolus*, grey duiker *Sylvicapra grimmia*, steenbok *Raphicerus campestris* and klipspringer *Oreotragus oreotragus* (Penzhorn 1979). The following animals were present in the Park in July 1979 (Grobler 1979):

Mountain zebra	178
Mountain reedbuck	600–700
*Springbok *Antidorcas marsupialis*	150–160
*Blesbok *Damaliscus dorcas phillipsi*	135
*Black wildebeest *Connochaetes gnou*	75
*Eland *Taurotragus oryx*	100–120
*Gemsbok *Oryx gazella*	29
*Red hartebeest *Alcelaphus buselaphus caama*	42
Grey rhebuck	10
*Ostrich *Struthio camelus*	30
Grey duiker	30–40
Steenbok	20–30
Klipspringer	20–30
Kudu *Tragelaphus strepsiceros*	11

*Species that were re-introduced or introduced into the MZNP (Penzhorn 1971).

Since September 1972 the numbers of springbok, blesbok, black wildebeest, eland, mountain reedbuck and ostrich were reduced more or less annually to avoid over exploitation of the available natural resources.

No large carnivores occur in the Park. De Graaff & Nel (1970) and Nel & Pretorius (1971) listed 33 small mammal species in the Park. Of these, the rock dassie *Procavia capensis* occurs very abundantly and exert a high grazing pressure around rock outcrops.

Survey methods

As was mentioned earlier the Braun-Blanquet Method of sampling and synthesis was followed. The practical implementation thereof in mountainous terrain, where strong topographic differences are of major importance (*cf.* Van Vuuren 1961; Theron 1973; Coetzee 1974), was described by Coetzee (1975). The latter author's sample was stratified on physiognomy and vegetation physiognomy. Basically, the same approach was followed in the MZNP, where the heterogeneous vegetation is strongly correlated with topography and its associated climatic conditions.

Prior to the actual field work, the topographic complex in the Park was divided into its various relief units such as plateaux, slopes and plains, using 1:40 000 air photos. Further subdivision was based on variations in vegetation structure and dominant plant species that were brought about by habitat and utilization conditions in the past. Thirteen stratification classes were identified in this way. These were interpreted in the final vegetation map (Fig. 6) on the basis of floristic tables.

To record the total floristic variety in the MZNP as adequately as possible, a reconnaissance was made of the composition of each stratification unit. Regardless of the size of a unit, sampling quadrats were selected to represent all facets of the near total floral spectrum of the unit. Boundaries between units were avoided where possible.

Eventually the high plateau areas accomodated 10% of the ultimate number of quadrats, the low plateau areas 25%, the higher valley slopes 33%, the lower valley slopes 13% and the plains and water courses 19%.

The quadrat size for the relatively open dwarf shrub-grass communities was 50 m^2 and for the denser, shrubby, valley vegetation 200 m^2.

The following characters were noted for each survey site (see Tables 4–6):

(i) Geology (after Toerien 1972)
(ii) Relief units (after Dohse 1976)
(iii) Slope
(iv) Aspect
(v) Radiation (after Barry & Chorley 1970)
(vi) Soil association (after Dohse 1976)
(vii) Stone size and abundance
(viii) Estimated total vegetation canopy cover percentage for each stratum

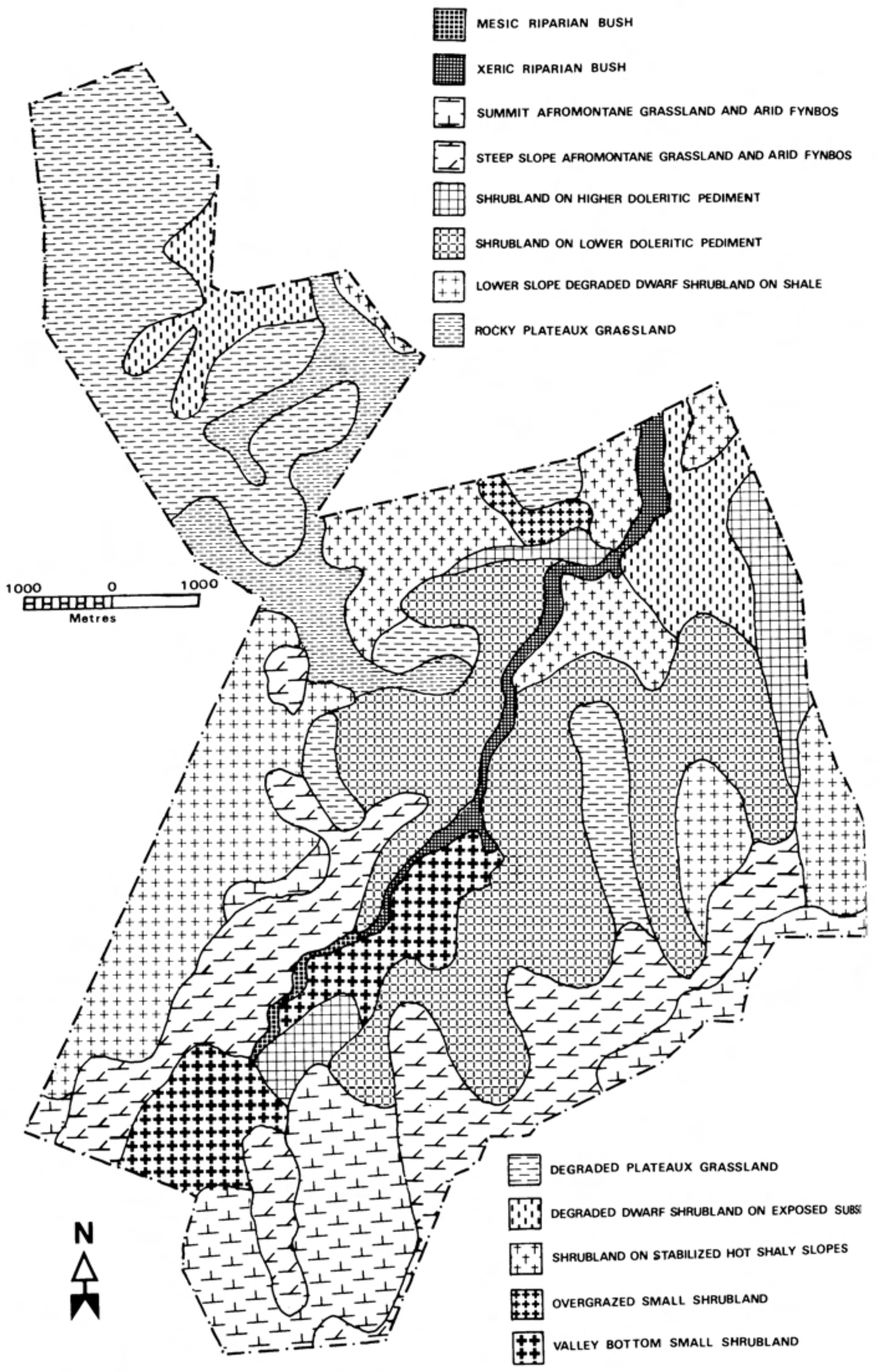


Fig. 6. Vegetation map of the Mountain Zebra National Park.

(ix) The evident past degree of utilization
(x) The dominant plant species for each stratum
(xi) A list of all plant species in a quadrat was made and a canopy cover value was assigned to each species according to the following standard Braun-Blanquet scale:
r A solitary individual that may presumably prove to be peculiar to the general floristic combination
+ 1% cover
1 1–5% cover
2 5–25% cover
3 25–50% cover
4 50–75% cover
5 75–100% cover

The synthesis of the field data into organized floristic tables (Tables 3–6) was done according to the technique described by Coetzee & Nel (1978).

Plant communities

The vegetation of the MZNP can be divided into three major groups of plant communities:

1. Riparian communities (Table 4).
2. Communities of the valley slopes and summits (Table 5).
3. Communities of the plateaux and hot shaly slopes (Table 6).

Species groups

In the synoptic table (Table 3) species are classified on their overall distribution in the MZNP into 13 major groups, which reflect their habitat affinities.

1. *Diospyros lycioides* Communities
(Riparian communities, Table 4)

Tall woody riverine vegetation occurs along the middle and lower reaches of the Wilgerboom River, in the lower dolerite region of the Park, where relatively small levees of fine alluvial sand have accumulated alongside the bouldery talus bed of the river. These levees widen in the lower portions of the River. Due to the fertile substrate, the thickets were exterminated here in patches during pre-Park times to establish lands for cultivation. Along the relatively steep upper drainage lines no definite riparian communities are evident, owing to the high water runoff.

Notable differentials for the two riparian communities include (Table 4): the trees *Diospyros lycioides* subsp. *lycioides*, *Lycium oxycarpum* and *Rhus* *baurii*, which are typical elements of mesic bush in the eastern Cape; the shrubs *Maytenus heterophylla, Lycium cinereum* and *Melianthus comosus;* the grass *Stipa dregeana* var. *elongata;* and the forb *Ballota africana*.

1.1 *Diospyros lycioides – Leucosidea sericea* Community
(Mesic riparian bush)

The mesic type of riparian bush occurs upstream where the soils are presumably moist and strongly leached owing to the wet temperate climate and steep fall.

Fig. 7. A well-developed mesic type of riparian bush on a patch of deep sand.

This community (Quadrat 75; Figs 4 & 7) is well developed on patches of deep sand where it reaches a canopy cover of 90%. It is usually three-layered consisting of tall (5 m) trees with average cover of 80%, an open 1–2 m shrub layer, and a field layer up to about 0,4 m of herbs, grasses and small shrubs.

The community is dominated by the well known montane element (Killick 1978) *Leucosidea sericea*. Other differential species in the tree layer include elements of typical mesic eastern Cape bush *e.g. Rhamnus prinoides* and *Rapanea melanophloeos*. The conspicuous trees *Buddleia salviifolia* and *Olea africana* are very widely scattered. The previous owners of this area utilized this latter species very heavily because of the quality of its wood.

The grasses *Ehrharta erecta, Bromus wildenowii* and *Eragrostis curvula* dominate the field layer without occurring in the more xeric bush downstream (Table 4). The mesic type of riparian bush is further differentiated by the forbs *Carex spicato-paniculata, Berkheya armata* and *Senecio burchellii*.

1.2 *Diospyros lycioides – Acacia karroo* Community (Xeric riparian bush)

The relatively xeric community (Quadrats 112 and 113; Fig. 4), occurs extensively on the lower alluvial levees of the Wilgerboom River in the Park. It differs markedly in composition and structure from the previously described community and has much fewer species.

The climate in this low, relatively wide valley is hotter and drier than that further upstream. The gentler fall, wider valley floor and associated accumulation of salts that may be expected, presumably adds to the relative dryness of the soils here.

The structure is the most complex in the Park and is largely impenetrable. The xeric riparian bush is four-layered, consisting of a tree layer from 6–9 m with an average cover of 35%, an open 2–4 m tall shrub layer, a scattered small shrub layer with an average height of 0,4 m, and a relatively dense field layer consisting mostly of creeping herbs and grasses.

The recognized Karoo elements in all four of its layers, is in accordance with its xeric character relative to its counterpart upstream. The most exclusive differentiating species for the whole community (Table 4) is the thorny *Acacia karroo*, which dominates the tree layer. Scattered individuals of the tree *Rhus lancea* are also evident, especially along the bouldery talus bed. Very conspicuous in *A. karroo* of the tree layer is the very high density of the epiphytic parasite *Viscum capense* which is very palatable to game. Under a relatively open tree layer, the comparatively tall shrubs *Lycium oxycarpum* and *Diospyros lycioides* subsp. *lycioides* are prominent together with climbers such as *Asparagus suaveolens* and the field layer dominants are *Atriplex semibaccata* and *Felicia muricata*. Under denser tree canopies, a less common type of small shrub layer, dominated by *Ballota africana, Garuleum pinnatifidum* and *Psilocaulon absimile*, and a field layer with shade-loving grasses and herbs such as *Panicum coloratum* var. *coloratum, Stipa dregeana* var. *elongata, Teucrium africanum, Stellaria media* and *Cineraria lobata*, predominate.

This community is well utilized by the more timid animal species such as the grey duiker and kudu, while eland and especially the gemsbok take shelter here during severe cold spells.

2. *Merxmuellera disticha* Communities (Communities of valley slopes and summits, Table 5)

Approximately 77% of the total Park area is occupied by these communities.

The communities occupy the more rugged mountainous doleritic and sandstone areas of the MZNP, *i.e.* summits, escarps and hot and cold talus slopes of steep inclination. The soils are mainly shallow lithosols. On the higher altitudes a temperate climate prevails while a hotter climate is experienced in the lower valley areas. The comparatively cool-moist climate and highly leached soils determine the under-utilized "sour" nature of the vegetation and distinguish these communities from other communities in the Park.

Structurally the vegetation diminishes in stature from the lower slopes to the summit. Tall shrub almost abruptly gives way at a height of 1 400 m to grassland along the cooler aspects and dwarf shrubland along the warmer slopes with a less abundant grass component. These latter types are then overtopped on Bankberg by an "island" of interesting floristic composition where grass and small shrubland alternatively dominate in patches.

The vegetation of the Bankberg complex could generally be regarded as an inland outlier where representatives of two major distinct floras are still to be found, *i.e.* Afromontane grassland and Arid Fynbos. White (1978) and Taylor (1978) describe the characteristics of these vegetation types.

The dominance, in all the upper slopes and summit communities, of grasses such as *Merxmuellera disticha, Themeda triandra, Elionurus argenteus, Eragrostis curvula, Melica decumbens, Festuca scabra, Koeleria cristata, Helictotrichon capense, Ehrharta erecta, Karoochloa purpurea* and *Pentaschistis* spp., indicates that of the two floras the Afromontane grassland is the best developed. This grassland relates to the Dohne Sourveld and *Festuca – Themeda* Mountain Veld (Acocks 1975). Arid Fynbos occurs only as traces, intermingled with the grassland. Ericoid, proteoid and restioid forms, which predominate on the upper slopes of the nearby Boschberg (50 km to the south) described by Van der Walt (1972), are only very locally conspicuous on Bankberg. The latter lacks important Fynbos groups such as Proteaceae, Rutaceae and Restionaceae.

Basically the communities of the valley slopes and summits can be classified into two mesic communities and three stongly related xeric communities. The mesic communities occur on the high sandstone areas and the xeric communities on the lower sandstone and doleritic slopes. The sandstone area, particularly the higher lying part of it, is more leached than the doleritic area because of a higher orographic rainfall. Nutrient poor, fibrous grasses predominate on the upper extremely sandy, cool, moist and leached parts of the slopes and summits. This area is generally avoided by the bulk of the grazing animals because of the harsh winter climate and unpalatable nature of the vegetation.

Mesic niches, caused by water runoff, are also characteristically found at the bottom of conspicuous dolerite outcrops (Fig. 8). Cool temperate forest elements such as *Celtis africana, Pittosporum viridiflorum, Diospyros scabrida, Maytenus undata, Rhamnus prinoides, Myrsine africana* and *Buddleia glomerata* dominate these niches.

Despite the fact that the xeric communities exhibit a wider species diversity than the mesic communities, more recognizable communities and sub-communities are found under mesic conditions. The vegetation structure in the latter is also more simple.

A comparison of species composition of the two groups reveals the following noteworthy similarities and differences: (i) Of the grasses that were recorded in releves of the valley slopes and summits, the following

Fig. 8. Typical patches of cool temporate forest elements at the lower ends of dolerite outcrops.

50% had an overall distribution (in order of abundance): *Merxmuellera disticha, Eragrostis curvula, Themeda triandra, Aristida diffusa* var. *burkei, Tragus koeleroides, Eustachys paspaloides, Cymbopogon plurinodis, Digitaria eriantha, Heteropogon contortus* and *Aristida adscensionis*. (ii) All the taller shrubs (1,5 m+) were confined to the two most xeric communities while only *Felicia filifolia* amongst the smaller shrubs (0,7–1,5 m) and 47% of the dwarf shrubs occurred essentially throughout.

Not many Karoo-like (Karroid False Fynbos, Acocks 1975) species which are well represented in the Arid Fynbos, occur in all these communities. Those that do are *Chrysocoma tenuifolia, Melolobium microphyllum, Helichrysum dregeanum, Lightfootia tenuis* and *Pelargonium quercifolium*.

The following typical elements of the drier more open Karoo mountain scrub are often recorded on all the valley slopes and summits: *Felicia filifolia, Aristida diffusa* var. *burkei, Eustachys paspaloides, Tragus koeleroides, Cymbopogon plurinodis, Senecio burchellii, Lotononis laxa, Sutera caerulea* and *S. mollis*. Only in the heavily grazed lower valley slopes and summits, which are situated close to animal concentration areas, the following similar elements tend to occur in all the communities: *Heteropogon contortus, Digitaria eriantha, Aristida adscensionis, Felicia muricata, Gazania krebsiana* subsp. *arctotoides, Nenax microphylla* and *Helichrysum zeyheri*.

2.1. *Merxmuellera disticha – Euryops annuus* Community
(Mesic, steep slope, sclerophyllous shrubland)

This community is found exclusively on moderately high, cool sandstone slopes.

The community is two layered with the shrub layer ranging from 1–2 m and the field layer from 0,1–0,5 m (Fig. 9).

Fig. 9. Mesic sclerophyllous shrubland dominated by *Merxmuellera disticha* and *Euryops annuus*.

The following differential species *Euryops annuus* and *Elytropappus rhinocerotis* characterize the shrub layer of this community. *Diascia capsularis* is a field layer differential species (Table 5). *E. rhinocerotis*, *E. annuus* and *M. disticha* are well known (Acocks 1964, 1975; Roux 1966b) in the False Karoo for being members of a group of indigenous plants which have the ability to encroach overgrazed mountain grassland and to eventually become dominant components thereof. The Renosterbosveld *(E. rhinocerotis)*, Harpuisveld *(Euryops* spp.) and Suurpolveld *(M. disticha)* in the MZNP could thus each be regarded as a false climax or a grazing disclimax, which developed during the pre-Park period, *i.e.* before 1965. Today these sub-communities are relatively stable in their composition and cover in the Park. As an entity, they are fine examples of vegetation types that are unique to the Karoo Mountain Complex and belongs to typical Arid Fynbos (see Acocks 1971). Their unique and well-developed character could mainly be attributed to a management policy of light grazing and no fire, which was adopted for the Park.

The grass *M. disticha* is the usual field layer dominant of this community. Occasional dominants include the grasses *Themeda triandra* and *Eragrostis curvula* and the small shrub *Felicia filifolia* (Table 5).

2.1.1. *Eriochephalus eximius* Sub-community (Table 5)

High up on steep slopes (25–30°) and protected by nearby rocky outcrops, *E. rhinocerotis* and *E. annuus* tend to give way to *Eriochephalus eximius*, which is very localized in its distribution, and to a lesser extent to *Pelargonium grossularioides*. These species again emphasize this shrubland's link with Fynbos.

2.1.2. *Koeleria cristata* Sub-community

The sub-community of 10–30° south facing sandstone slopes (Table 5), represent the optimum development of *M. disticha* grassveld in the Park. In quadrat 51 (Fig. 4) a total basal cover of 15,7% was recorded which was mainly brought about by the wiry tussock growth form of *M. disticha*. The growth of more palatable sub-tropical grasses like *Themeda triandra* and *Eragrostis curvula* are suppressed by *M. disticha* but also disguised against grazing to some extent by the luxuriant leaf growth of the latter. The relatively inconspicuous, small near herbs *Helichrysum ericifolium* and *Hermannia linearifolia* seem to have a special preference for this cool mountain grassveld (Table 5).

2.1.3. *Cymbopogon plurinodis* Transitional Sub-community

A transitional community between the mesic and xeric groups of the valley slopes, is represented by quadrats 57, 91 and 89 (Table 5). Despite the steepness of these sites (18–24°), the dominant plants *Euryops annuus*, *Felicia filifolia*, *Berkheya armata* and *Sonchus dregeanus* indicate a slight degree of overutilization. This could well be the case seeing the proximity of game concentration areas such as Grootmat and Spoelvlakte (Fig. 4).

2.2. *Merxmuellera disticha – Selago corymbosa* Community
(Mesic summit grass- and shrubland)

Fig. 10. Shrubby representatives of the Arid Fynbos on the Bankberg plateau.

This summit community extends up to 300 m above the aforementioned *Merxmuellera disticha – Euryops annuus* Community of moderately high slopes, *i.e.* from Kranskoprif to the top of Bankberg. Accordingly the climate here is extremely cool and moist in Park context. The altitudinal range and associated climatic gradient together with a more intricate pattern of differing soil conditions, gave rise to a complicated vegetational pattern. This pattern was, however, somewhat obscured during pre-Park times by an over-utilization of the grazing resources. This all resulted in a dense *M. disticha*-dominated tussock grassland (0,3 m high). Shrubby representatives (0,3–1,3 m high) of the Arid Fynbos are commonly found scattered throughout the Bankberg plateau while some tend to dominate in patches (Fig. 10). Along the upper reaches of limited summit areas such as Platkop and Kranskop, grassland is largely replaced by a *Chrysocoma tenuifolia* dominated shrubland of 1 m height (Relevés 102 and 49, Table 5).

Differential species are mainly herbs and dwarf shrubs, such as *Selago corymbosa, Helichrysum odoratissimum, H. nudifolium, H. splendidum, H. peduncplatum, Chrysocoma tenuifolia, Senecio speciosus* and *Bulbine narcissifolia* while only *Elionurus argenteus* and *Melica decumbens* are important differential grasses. The patchy and localized distribution pattern of these and other species over the summit areas of the MZNP, as well as the differentiating character (Table 5) of such well known (Van der Walt 1972) overgrazed veld invaders such as *S. corymbosa* and *E. argenteus*, emphasize the role injudicious grazing has played in the past.

2.2.1. *Elionurus argenteus* Sub-community

A sub-community differentiated by the mesic forb *Helichrysum nudifolium* and the disturbance indicator grass *Elionurus argenteus* characterizes those mesic non-rocky summit areas that have probably been subjected to sustained heavy grazing in the past.

2.2.2. *Bulbine narcissifolia* Sub-community

This sub-community is characterized by *Bulbine narcissifolia*, an indicator of deep-moist soils in the mesic summit region.

2.3. *Walafrida saxatilis – Felicia filifolia* Community
(Moderately xeric lower slope, dwarf shrubland on the shale).

This community (Fig. 11) may be regarded as a transition between the mesic and xeric groups of mountain valley communities in the Park. It occurs at lower altitudes (1 300 m) in heavily grazed stoney sandstone areas. The climate is presumably hotter than in the higher lying areas. However, the influence of a less harsh climate on plant development is evident from the high species diversity (Table 5). The average number of herb and dwarf shrub species in these relevés is 69% higher and the number of grass species 44% higher than in the relevés of the two mesic communities, of higher altitudes.

Fig. 11. Moderately xeric dwarf shrubland on the shale dominated by *Walafrida saxatilis* and *Felicia filifolia*.

An one-layered (0,4 m high) dwarf shrubland predominates along these relatively warm slopes. On localized south-westernly aspects, however, the familiar *M. disticha* grassland is again conspicuous.

The community is weakly differentiated by a set of Karoo dwarf shrubs with low density and slight importance from a grazing point of view: *Walafrida saxatilis, Hermannia coccocarpa, Indigofera alternans, I. sessilifolia, Chasmatophyllum musculinum, Selago albida* and *Lightfootia nodosa*. These are the only shrubs which show a definate preference for shaly soils (Table 5).

The more palatable grass and dwarf shrub components of these lower slopes, comprise a more meaningful differential group, which link this moderately xeric community to the two more xeric communities (2.4.1 and 2.4.2.). These species show no marked tendency to differentiate between the moderately xeric shaly and more xeric doleritic soils and include *Digitaria eriantha, Heteropogon contortus, Aristida adscensionis* subsp. *guineensis, Eragrostis lehmanniana, Felicia muricata, Nenax microphylla* and *Helichrysum zeyheri*. No taller (0,7 m+) shrub species forms part of this link between the two variations.

Some of the species with an overall distribution on the valley slopes and summits of the MZNP but a known affinity for the more xeric habitats, are distinctly abundant in this lower slope moderately xeric community and in its more xeric counterparts. These species are *Aristida diffusa* var. *burkei, Eustachys paspaloides, Tragus koeleroides* and *Helichrysum dregeanum* (Tables 5 & 6). The generally overgrazed conditions along the western mountain slopes which was the outcome of an abnormal game concentration from 1974–1977, caused the distinctively high cover values (Table 5) for *Felicia filifolia* in this community.

2.4. *Heteropogon contortus – Rhus* spp. Communities (Xeric shrubland of doleritic valley slopes)

This shrubland is found on the lower doleritic slopes of nearly the whole catchment of the Wilgerboom River in the Park. The hot climate of the steep, generally north and west facing, low altitude slopes of numerous valleys in the MZNP, together with their dry, mineral rich doleritic soils (Dohse 1976), are the salient habitat features.

The dominance of large shrubs and trees (Table 5) is presumably associated with these hot, near eutrophic conditions and they probably occur despite, rather than because, of the relative aridness of the climate and soils. The structure and dominants vary with aspect, soil depth and community.

The aforementioned habitat conditions are obviously near ideal for a species-rich community to develop in this region. The number of species that differentiate this xeric community, is nearly double the total for the mesic commumities (2.1–2.3, Table 5). Notable differential species for the group include the tall shrubs *Rhus lucida* and *Dodonaea viscosa*, the small shrubs *Pegolettia retrofracta* and *Hermannia vestita*, and the grass *Enneapogon scoparius* (Table 5).

Two distinct communities are associated with steep slopes, surface stoneyness and soil depth which in turn are related to topographic position.

2.4.1. *Grewia occidentalis – Rhus lucida* Community

This community is the more extensive of the two and occurs generally on the lower pediment slopes of less exposed smaller valleys such as Steynhoek, Fontein- and Boesmankloof.

The woody structure is relatively diverse and generally denser than in the next sub-community (2.4.2.). *Rhus lucida, Grewia occidentalis* and *Diospyros austro-africana* var. *austro-africana*, which are the most constant woody species in this sub-community, are also prominent and highly characteristic. Other occasionally prominent and characteristic woody species include *Acacia karroo, Maytenus heterophylla, Olea africana, Diospyros lycioides* and *Clutia pulchella* (Table 5). *Aristida adscensionis* is the most common field layer dominant. Other dominant or sub-dominant grasses may include *Eragrostis curvula, Aristida diffusa* var. *burkei, Eragrostis lehmanniana* and *Themeda triandra*.

Differential species other than the prominent woody species mentioned, are shown in Table 5.

2.4.2. *Heteropogon contortus – Rhus erosa* Community

This xeric doleritic valley slope community of shallow, stoney litholitic soils, is found on more exposed higher pediment slopes, near the transition from dolerite to shale.

Shrubs, other than dwarf shrubs, provide sparse cover and consist largely of the constantly occurring *Rhus erosa*. The latter species is also highly differential, together with the hardy forbaceous fern *Pellaea calomelanos* and the grass *Hyparrhenia hirta* (Table 5). The dominant grasses are usually *Aristida* var. *burkei, Heteropogon contortus* and *Eragrostis curvula,* or occasionally *A. adscensionis* or *Themeda triandra.*

3. *Eragrostis obtusa – Eragrostis curvula* Communities
(Grass- and shrubland of the plateau and hot shaly slopes).

These communities are found on the northern relatively level sandstone and doleritic plateaux and steep hot shaly slopes of the Park. The soils are relatively shallow and not highly leached. The comparatively hot dry climate, nutrient rich soils and high grazing pressure, determine primarily the "sweet" over-utilized nature of the vegetation and distinguish these communities from other communities in the Park.

The communities represent that part of the MZNP flora and vegetation that must endure the major grazing onslaught under free roaming Park conditions. An estimated 85% of the total herbivore biomass in the Park reveals a definite preference for this undulating plateau veld, the main portion (Rooiplaat, Fig. 4) which adjoins the main body of the Park in the northwestern corner. This relatively fixed grazing pattern of the animals in the Park has led to serious veld deterioration that badly violates the main conservation objectives. The only solution to the problem is a realistic expansion of the Park's boundaries to satisfy the topographical requirements of a limited herbivore community.

The main species differences between the plant communities and subcommunities shown in Table 6, are the outcome of a prolonged deflected plant development caused by a spectrum of excessive grazing regimes.

Only annual and generally unpalatable grass and dwarf shrub components display an overall distribution, emphasizing the advanced influence of the grazing factor. In order of importance these are *Eragrostis curvula, Tragus koeleroides, Chrysocoma tenuifolia, Aristida congesta* subsp. *barbicollis, Eragrostis obtusa, Helichrysum dregeanum, Walafrida saxatilis, Hermannia coccocarpa, Lycium cinereum, Indigofera alternans* and *Phymaspermum parvifolium.*

Two major groups of communities of the plateaux and hot shaly slopes are associated with degree of erosion of the topsoil.

3.1 *Eragrostis curvula – Themeda triandra* Grassland
(Communities with topsoil intact)

This grassland is found in very restricted parts of the southern quarter of Rooiplaat where the influence of grazing and trampling were relatively moderate due to a good cover of stone rubble (see 3.1.1.). The grassland is characterized by the grasses *Themeda triandra* and *Eustachys paspaloides,* the dwarf shrubs *Melolobium microphyllum, Felicia filifolia* and *Asparagus acocksii* and the forb *Arcthotheca calendula* (Table 6).

3.1.1. *Themeda triandra – Felicia filifolia* Community (Rocky Plateau Grassland)

Fig. .12. A patch of the former widespread plateau grassland on Rooiplaat.

The plant composition and cover of this community are remnants of the former widespread plateau grassland (Fig. 12). Its preservation is ascribed to a good cover of medium sized stone rubble (Table 6). The rectangular shaped sandstone rubble contributes to a cool micro-habitat for each plant and their average height of 8 cm and relatively small size, prevent the overgrazing of grass tufts and seedlings which are able to develop profusely between the stones.

Themeda triandra, Eragrostis curvula and *Tragus koeleroides* are the dominant grasses. The most notable differential floristic features include the high cover for South Africa's most important grass *Themeda triandra* (Acocks 1971), together with features shared with the less heavily grazed valley slopes, *e.g.* the high constancy of the grass *Eustachys paspaloides* and the dwarf shrubs *Argyrolobium collinum* and *Helichrysum zeyheri*. However, many indicators of veld degradation do nevertheless occur in this grassland: *Felicia filifolia, Melolobium microphyllum, Arctotheca calendula, Eragrostis curvula, Tragus koeleroides* and *Chrysocoma tenuifolia*.

3.1.2. *Cynodon incompletus* Community (Ridge Top Trampled Grassland)

Plains loving game species tend to migrate during winter into the valley areas of the Park in an effort to escape the harshness of the climate. During such times these animals concentrate on the relatively small ridge tops of Blesbok- and Kranskoprif (Fig. 4). An unstable plant community is the inevitable result but because of the flat nature of the terrain and the high grazing pressure which encourages the development of creepers, the topsoil is still largely intact.

Characteristic floristic features for these sites are the high cover of the creeping grass *Cynodon incompletus,* and the presence of *Cyperus usitatus, Lasiospermum bipinnatum, Selago albida* and *Melica decumbens* (Table 6). The latter two species are both poisonous to livestock but game seem to avoid grazing these plants.

3.1.3. *Themeda triandra – Pentzia globosa* Community
(Degraded Plateau Grassland)

This community is representative of those areas on Rooiplaat where a still significant amount of stone rubble is present but covers 30% of the surface. The topsoil is still largely intact. These areas therefore will revert back to grassland in a relatively short spell of complete grazing withdrawal. As such it could be considered as a critical transitional stage between a stable grassland and an unstable dwarf shrubland.

The field layer dominants are the dwarf shrub *Pentzia globosa* and the grass *Eragrostis curvula.* The community is primarily differentiated by the combined presence of *P. globosa,* which is shared with more disturbed shrubland, and species such as the grass *Themeda triandra,* which is a remnant of a less disturbed vegetation shared with Rocky Plateau Grassland (3.1.1.).

3.2. *Eragrostis lehmanniana – Pentzia incana* Dwarf shrubland and shrubland
(Communities with topsoil eroded)

Due to the near absence of stone rubble in the northern half of Rooiplaat, on the gentle sloping ground of the Vergesigplaat and on the small isolated plains of Spoel- and Springbokvlakte, and the continuous grazing pressure these areas had to endure over the years, their plant composition and sparse cover contribute to a considerable removal of topsoil. Several species succeeded in dominating the various distinct habitats.

Along the hot slopes of Babylons Toren, the development of a definite set of plant species (Community 3.2.3.A) retarded the erosional process remarkably.

3.2.1. *Eragrostis lehmanniana – Pentzia globosa* Community
(Moderately degraded plateau dwarf shrubland)

This community represents a moderately advanced stage of deterioration in grazing quality. The soils are unduly eroded but some topsoil still remain; annuals and less palatable species are prominent and include the characteristic combination of dominants *i.e.: Pentzia globosa, Eragrostis lehmanniana* and *E. curvula* as well as *E. obtusa, Tragus koeleroides, Cynodon incompletus* and *Chrysocoma tenuifolia.* The main colonizer of sheet-eroded areas in the Karoo, *Pentzia incana* is also scattered throughout (Table 6).

3.2.2. *Eragrostis lehmanniana – Pentzia incana* Community
(Severely degraded plateau dwarf shrubland on exposed subsoil)

Fig. 13. A severely degraded dwarf shrubland with some topsoil eroded dominated by *Pentzia incana*.

A near dominant stand of *Pentzia incana* is found in all the main drainage channels on Rooiplaat and on severely grazed areas, when topsoil has largely disappeared (Fig. 13). This most characteristic species of the Karoo flora has a remarkable capability to spread in vulnerable areas and to withstand severe grazing. The bi-annual grass *Eragrostis lehmanniana* is frequently found while the same set of species as in community 3.2.1. occurs in much smaller numbers on small isolated patches where some topsoil still remains.

3.2.3. *Hibiscus pusillus – Pentzia incana* Communities
(Shrublands of hot shaly slopes and valley alluvium)

A group of communities that was well degraded in the past shares a number of species, *e.g. Gazania krebsiana, Sutera mollis* and *Hibiscus pusillus,* with communities (3.1) on relatively well preserved but stoney soils (Table 6):

(A) *Setaria neglecta – Acacia karroo* Community
(Shrubland on Stabilized Hot Shaly Slopes)

The hot northern and north-eastern shaly slopes of the dolerite capped Babylons Toren, were since the proclamation of the MZNP in 1931 the main concentration areas for the mountain zebra herd. Since the enlargement of the Park in 1965, only a moderate grazing impact prevailed which resulted in an improvement of grazing quality, demonstrated by the remarkable increase in cover of *Setaria neglecta* in some areas.

The area is dominated by the tree *Acacia karroo*, the dwarf shrub *Pentzia incana* and the grass *S. neglecta*.

Unlike the more unpalatable shrub composition of the cooler mountain slopes in the MZNP (Table 5), the hot slopes of Babylons Toren are covered with much more palatable shrubs, dwarf shrubs and trees (Table 6) like *Acacia karroo, Grewia occidentalis, Diospyros lycioides* subsp. *lycioides* and *Limeum aethiopicum*. That an element of overgrazing is still present in this community, is shown by the presence of *Pentzia incana, P. globosa, Tragus koeleroides* and *Eragrostis obtusa*. A good cover of *S. neglecta* has developed on these slopes. This palatable grass experienced a marked decrease in its former distribution in the Karoo (Acocks 1971) due to over-utilization thereof.

(B) *Becium burchellianum* Community
(Localized overgrazed small shrubland on the plateau)

Fig. 14. Overgrazed small shrubland on the plateau dominated by *Becium burchellianum*.

Long term over-exploitation of available grazing resources in the Karoo, often leads to the formation of a dominant stand of some unpalatable shrub, *Becium burchellianum* in this case. Such colonisation may eventually lead to an incised microrelief with each shrub elevated on top of a small hill. Due to a high water runoff, the development of other plants in between the shrubs becomes difficult. The *B. burchellianum* Community represents such conditions in small localised places on the Vergesigplaat (Fig. 4 & 14). The community is differentiated by the small shrubs *Becium burchellianum* and *Eriochephalus ericoides* and the dwarf shrub *Sutera atropurpurea*.

(C) *Pentzia sphaerocephala* Community
(Restricted Valley Bottom Small Shrubland)

On the small isolated alluvium areas in the valley system of the Park, excessive grazing has altered the former grassland into a small shrubland dominated by *Pentzia sphaerocephala* with scattered trees like *Acacia karroo* and pioneer grasses such as *Eragrostis lehmanniana* and *Tragus koeleroides*.

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