THE VEGETATION OF SWARTBOSCHKLOOF, JONKERSHOEK, CAPE PROVINCE, SOUTH AFRICA

by

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ABSTRACT

Swartboschkloof forms part of the Jonkershoek catchment complex at the headwaters of the Eerste River, Cape Province, South Africa. It has been selected for multi-disciplinary studies of Mountain Fynbos vegetation.

The study area has a mainly equatorial aspect (north-facing) and receives an average of 1600 mm rain per annum, mainly in winter. Temperatures do not reach extremes. Winds blow mainly from the south-east, increasing in strength in summer. North-west winds blow intermittently in winter, bringing rain. The altitude of Swartboschkloof ranges between 285 m and 1200 m and the soils are derived from quartzitic Table Mountain Sandstone and porphyritic Cape Granite.

Using the Braun-Blanquet phytosociological method, vegetation and environmental data were collected at 201 relevés throughout the study area; 101 of these relevés are correlated with a survey of soils of part of the same area. Sixteen fynbos communities, grouped into three groups and five forest communities, grouped into two groups, have been identified. The data of a previous study by Werger, Kruger and Taylor (1972) have been interpreted in the context of this study.

A map of the plant communities has been drawn and an attempt has been made to explain the distribution of the communities in terms of environmental factors. There is a strong link between the vegetation and soil geology but application of a method such as principal components analysis would be necessary to explain the relationship clearly.

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INTRODUCTION

The first comprehensive description of the vegetation of the western Cape Province, South Africa, was given by Marloth (1908). His work was followed by that of Adamson (1929, 1938) who described the broad divisions of what he called the 'south-western region'. Good (1974) recognized the flora of the southern and south-western Cape Province as constituting the smallest floral kingdom in the world; the Cape Floral Kingdom. Weimarck (1941), Taylor (1978) and Werger (1978) refer to this region as 'Capensis' and Goldblatt (1978) defined what he termed the Cape Floristic Region. The boundaries of the Cape Floristic Region are more or less the boundaries of the Fynbos Biome (Kruger, 1979a; Campbell, 1983).

The Capensis region has a mediterranean-type climate, making it one of five such regions in the world (Kruger, 1979a). The vegetation consists largely, but not exclusively, of fynbos, a vegetation physiognomically comparable with macchia (Mediterranean), chaparral (California), matorral (Chile) and heath (Australia).

Fynbos is characterized by three physiognomic-structural elements: restioid, ericoid and proteoid. The first consists of the Restionaceae and similar aphyllous grass-like plants, the second, ericoid plants which are most often short shrubs with small, stiff, narrow often-rolled leaves. Proteoid plants are taller shrubs with moderate-sized broad-sclerophyllous leaves (Kruger 1979a & 1979b; Taylor, 1978 and Van Wilgen, 1982).

Acocks (1975) divided the vegetation of the Capensis region into five Veld Types : West Coast Strandveld (Veld Type 34), Coastal Renosterveld (Veld Type 46), Coastal Macchia (Veld Type 47), Macchia (Veld Type 69 and False Macchia (Veld Type 70). Taylor (1972, 1978) used the term Mountain Fynbos to include Acocks' (1975) Macchia and False macchia and Coastal Fynbos to denote Coastal Macchia. He also clearly delineated the geographical extent of Mountain Fynbos (including Arid Fynbos as part of Mountain Fynbos). Kruger (1979a & 1979b) used this nomenclature as well.

Although these names are in general use, subdivision of the vegetation of the Capensis region and the nomenclature pertaining to these subdivisions is under revision (Boucher, in prep. ; Moll et al., in prep.).

In addition to the Veld Types mentioned above there are also broad-leafed forest and scrub-forest communities within the geographic limits of the Capensis region. White (1978) states that forest is the only Afromontane vegetation found in the Cape. In the western and south-western Cape, forest and scrub-forest communities replace the fynbos in moist, sheltered kloofs, on rock outcrops and on patches of boulder scree (Werger, Kruger & Taylor, 1972). McKenzie (1978) found that the Cape forests could be grouped into a number of types based on their floristic composition. Floristic composition is a function of moisture status and locality. He considered that an important attribute in the classification of forests in the Cape is the decrease in number of species along a decreasing moisture gradient from east to west. The Afromontane nature of these forests is also 'diluted' by the occurrence of several Cape species or transgressor species, the latter being widespread in their distribution (White, 1978).

In order to synthesize past research and co-ordinate future work dealing with fynbos, the Fynbos Biome Project was established (Kruger, 1978). Swartboschkloof, at Jonkershoek near Stellenbosch, was selected as the site for intensive multi-disciplinary studies of Mountain Fynbos. It was here that this study was carried out. The vegetation survey of Swartboschkloof also forms part of a Master Programme for surveys in Mountain Fynbos. This programme was drawn up to provide the Department of Environment Affairs (Directorate of Forestry) with information concerning the vegetation and floristics of mountain catchments. In addition it forms part of a resource inventory of Mountain Fynbos vegetation.

Three studies of the vegetation of Swartboschkloof have previously been carried out (Van der Merwe, 1966; Werger et al., 1972; Van Wilgen, 1981).

Those of Van der Merwe and Van Wilgen were mainly concerned with vegetation response to fire and that of Werger _et al_. was a phytosociological study. Fry (in prep.) has done a survey of the soils of Swartboschkloof.

Werger _et al_. (1972) sampled 35 relevés in fynbos and eight relevés in forest vegetation. Their findings are evaluated, taking into consideration that succession has proceeded for 11 years between the time their study was carried out and 1981, when this survey was started. A greater area has been covered than that sampled by Werger _et al_. (1972). Sampling has also been more intensive.

The objectives of this study are :

(i) To identify, describe and classify the Cape fynbos and remnant forest communities occurring in Swartboschkloof

(ii) To map the plant communities of Swartboschkloof

(iii) To relate the plant communities to the soils of Swartboschkloof

(iv) To relate the plant communities to selected habitat factors, apart from the edaphic factors, namely climate, altitude, aspect and topography.

1. THE STUDY AREA

1.1 Location

Swartboschkloof is situated in the Jonkershoek Forest Reserve, about 15 km from Stellenbosch (Fig. 1). It is 373 ha in extent and forms part of the greater Jonkershoek Catchment in the Hottentots Holland Mountains at 34° 00' S latitude and 18° 57' E longitude. Most of the study area has an equatorial (north-facing) aspect. In 1936 it was proclaimed a nature reserve in terms of the Forest Act (Werger *et al.*, 1972). The boundaries of the area selected for this survey do not coincide exactly with the boundaries of the Swartboschkloof-Sosyskloof Nature Reserve but are as follows:

> in the north-east the boundary is a ridge of sandstone cliffs; from the south-east corner to the south-west corner the firebreak forms the southerly boundary; on the west side the boundary is the drainage divide between the Swartboschkloof and Sosyskloof catchments; in the north, Sosyskloof stream forms the boundary; a short firebreak bounds a small section at the base of Swartboschkloof on the north to north-east side (Fig. 2).

The area between Sosyskloof stream and the 'zig-zag' firebreak which was sampled by Werger *et al.* (1972) was not included in this study because the vegetation was burnt in 1977 and considered to be immature.

At present Swartboschkloof is managed as part of the whole Jonkershoek catchment complex.

1.2 History of Human Influence

The western Cape has been inhabited for many thousands of years, probably first by Stone Age man, later by Bushman and still later by Hottentots or, more precisely, the Khoisan tribes. Stone Age sites have been excavated at Bosman's Crossing and many other areas in the Stellenbosch District (Seddon, 1966 & 1967). It is also documented that indigenous tribes intermittently visited Jonkershoek but probably did not settle there. These people most likely visited the Jonkershoek valley to graze their cattle and sheep and to collect *Watsonia* corms (Schapera, 1930; Werger *et al.*, 1972; Sampson, 1974; Deacon, 1976; Bands, 1977; Elphick, 1977).

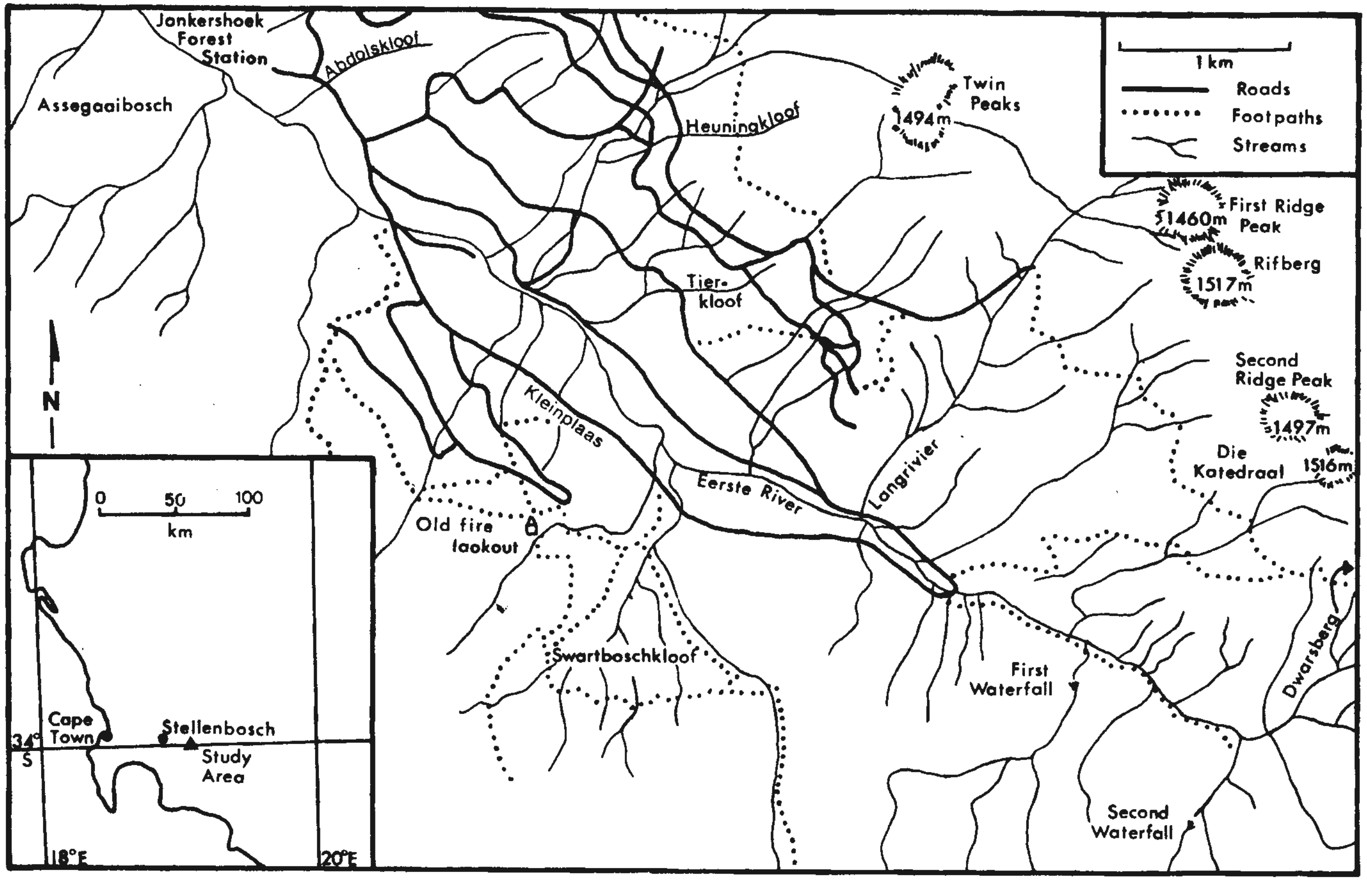
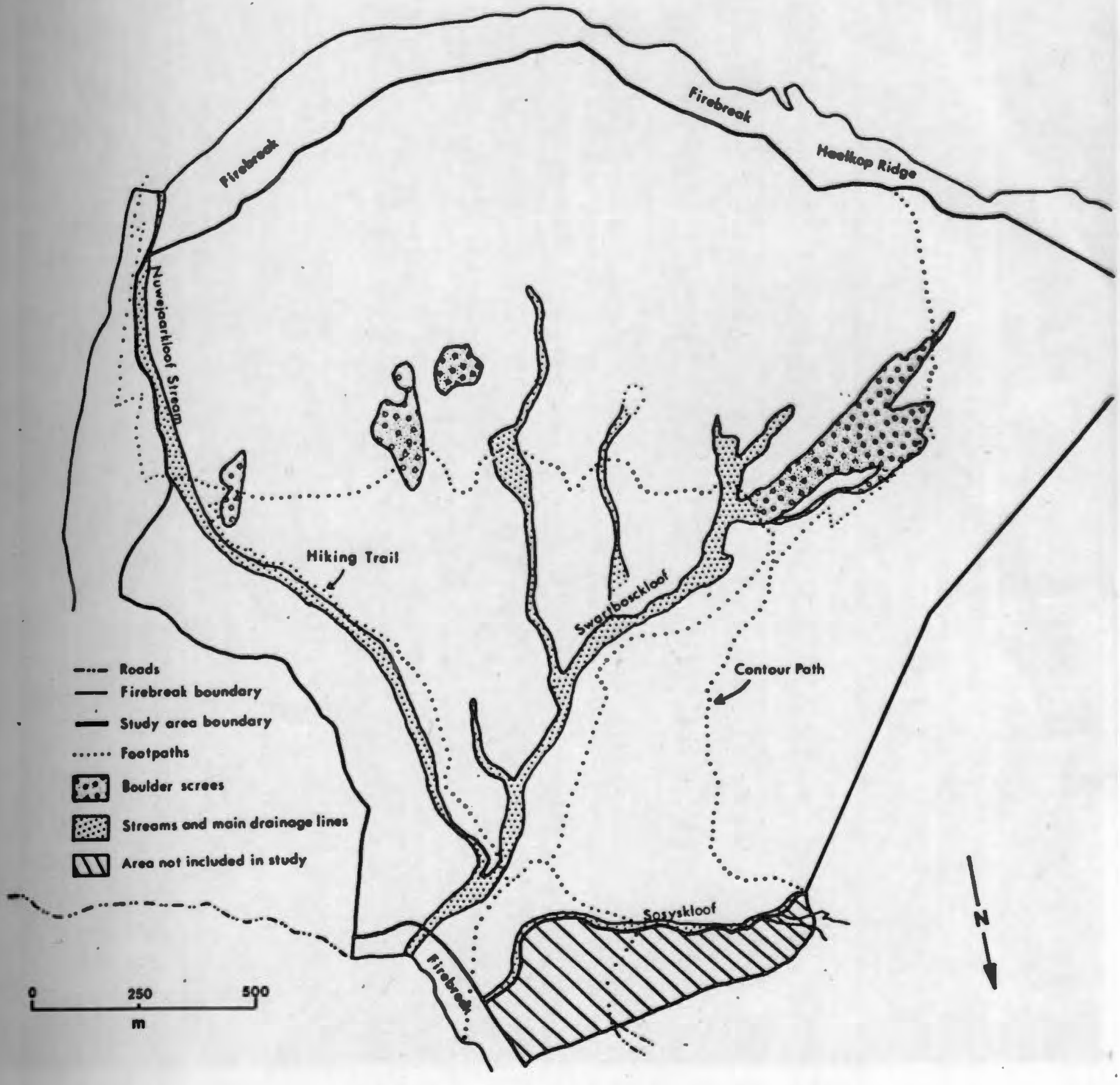


Fig. 1. Location of the study area, Swartboschkloof, in the Jonkershoek Forest Reserve, after Van Wilgen, 1981


Firebreak
Firebreak
Heelkop Ridge
Nuwejaarkloof Stream
Hiking Trail
Swartboschkloof
Contour Path
Sosyskloof
Firebreak
Roads
Firebreak boundary
Study area boundary
Footpaths
Boulder screes
Streams and main drainage lines
Area not included in study
0
250
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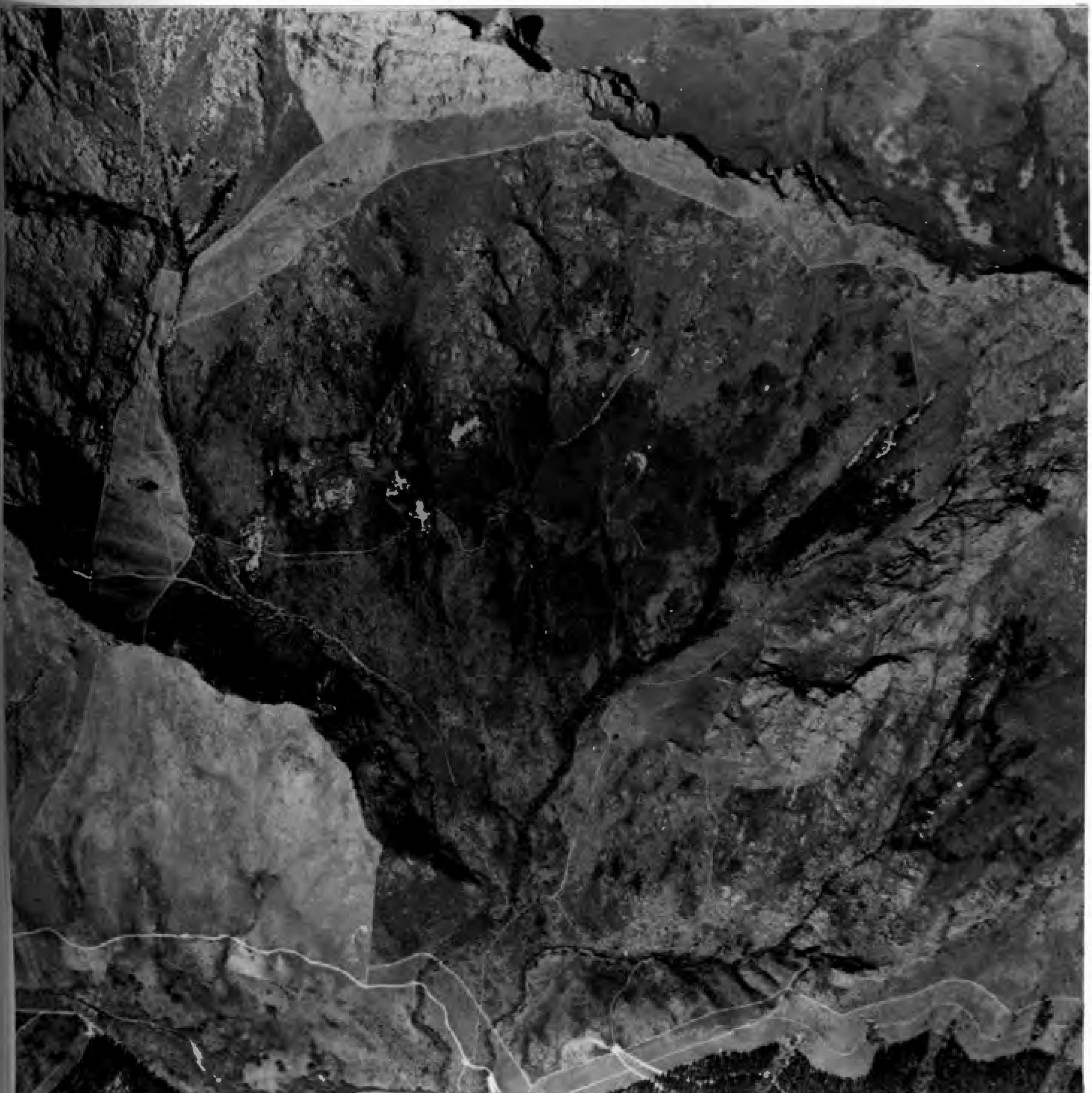


Fig. 2a. Aerial photograph of Swartboschkloof, showing main features.

Fig. 2b. Swartboschkloof, three years after the 1958 fire. Photograph used with permission from P. van der Merwe.

Fig. 2c. Swartboschkloof, 1973 Photograph : D. Bredenkamp

During this vegetation survey I found a rounded stone weight of the kind used by hunter-gatherers to weight their digging sticks. This substantiates the claim that indigenous tribes must have searched Jonkershoek, including Swartboschkloof for edible corms, bulbs and tubers.

The first white colonists settled in the Stellenbosch area in the late 1600's where they practised agriculture. Governor van der Stel granted the first freehold in Jonkershoek in 1692 to Jan de Jonker, alias Jan Andriessen, after whom the valley was named. However, Swartboschkloof was probably only affected after 1832 when it formed part of land ceded to a farmer in the Jonkershoek valley. Veld-burning was widely used to improve grazing for sheep, goats and cattle and probably occurred in Swartboschkloof at intervals of 4 - 10 years. No signs of cultivation are apparent (Werger et al., 1972).

The Department of Forestry acquired Jonkershoek, which included the area later proclaimed as the Swartboschkloof-Sosyskloof Nature Reserve, on a lease-hold from the Stellenbosch Municipality in 1933. Since then Swartboschkloof has been totally protected from fire except for accidental fires in 1942, 1958 and 1973 (Kruger, 1979 c). The only other human pressure on this area has been recreational hiking and walking, non-destructive research (Werger et al., 1972), the clearing of footpaths and burning of firebreaks on the perimeters at 6 - 7 year intervals.

1.3 Geology

Wellington (1955) discusses in broad terms the physiography of the Cape folded mountains, or the Cape Fold Belt. Two main zones of folding are distinguished, a north-south trending zone in the west forming a wide arc concave westward, and in the east where the folded belt has a west-east trend. He notes that in the west two different areas can be recognized. To the north of the Tulbagh Basin the mountain ranges are more or less parallel, but in the south the folding takes various directions. The latter situation is thought to be due to the meeting of the west-east and north-south folding pressures. Wellington (1955) states, 'In the southern area the most continuous orographic line starts in the south as the Hottentots Holland range and continues northwards as the Drakenstein, Klein Drakenstein, Hawequas, Limiet and Elandskloof Mountains.' De Villiers, Jansen and Mulder (1964) add that this unbroken range of mountains from Betty's Bay to beyond Bainskloof Pass is nowhere breached and its plan is irregular. This, together with westward extensions from the main mountain massif, gives rise to mountain-bound valleys known as 'hoeke' or 'corners' - Jonkershoek is one such area - where lithology and structure have allowed deep valleys to be eroded out of the mountains. De Villiers et al. (1964) give details of the phases of geological history for the area between Worcester and Hermanus but a short description of the geology of Jonkershoek will suffice here.

Porphyritic Cape Granites underlie the Table Mountain Group of quartzitic sandstones (T.M.S.) forming the precipitous mountains at Jonkershoek (Taljaard, 1949) and the granite forms the undulating floor of the Swartboschkloof valley. The sandstone cliffs do not erode readily. Nevertheless, the debris from these cliffs together with granite boulders form a colluvial admixture covering the granite floor of the valley. Van der Merwe (1966) notes that the granite is encountered up to about 530 m altitude, above which T.M.S. occurs. Fry (in prep.) however, found the granite-sandstone contact to be nearer 700 m. Granite crops out at only a few places in the valley.

There is some folding of the T.M.S. cliffs bounding Swartboschkloof but generally this feature is absent. Taljaard (1949) describes the straightness of the Jonkershoek valley, trending northwest-southeast, and its remarkable cross-sectional asymmetry. He notes that the T.M.S. is clearly down-faulted on the western side. Beekhuis, Bekker, Joubert and Marwick (1944) comment, 'It is not clear what kind of faulting took place, but it is thought that the Jonkershoek fault consists of a number of parallel fault planes.' They note that evidence of this faulting is found at Twin Peaks, Swartboschkloof and in the region of Second Waterfall. Werger et al. (1972) say, however, that the Swartboschkloof valley was formed by a series of secondary faults roughly at right angles to those faults which caused the main Jonkershoek valley.

1.4 Geomorphology and Topography

Swartboschkloof is a fan-shaped valley ranging from 285 m to 1 200 m in altitude. The head of the valley forms the widest part of the 'fan' and it narrows with a decrease in altitude. The slopes range from less than 5° to 45° with the steep slopes averaging 30°. About two per cent of the area consists of inaccessible, almost vertical cliffs.

Apart from the steep cliffs and colluvial slopes there are also loose boulder screes. These screes consist of T.M.S. boulders and are on the higher slopes immediately below the steep cliffs. In parts the screes have stabilized and support forest vegetation.

The streams in Swartboschkloof follow the fault lines. The main Swartboschkloof stream, which flows from south-west to north-east, is perennial and well-wooded. It is fed by three other seasonal streams. The other main stream, on the east side of the valley, is perennial but is not fed by other streams. It apparently carries less water than the main Swartboschkloof stream and is less wooded. These main streams join at the lower end of the valley before joining the Eerste River. The stream from Sosyskloof drains the area to the west of Swartboschkloof and flows independently into the Eerste River, which runs down the centre of the Jonkershoek valley (Beekhuis et al., 1944; Van der Merwe, 1966; De Villiers et al., 1964; Werger et al., 1972; Van Wilgen, 1981).

1.5 Soils

Kruger (1979 b) deals briefly with soils of the South African heathlands noting that there was no adequate synthesis of the pedology of the soils of the Fynbos Biome at that time. Lambrechts (1979) does, however, give a synthesis of the soils of the Fynbos Biome in some detail, including the genesis of soils encountered in the quartzitic fold ranges.

In a more recent study, Campbell (1983) has applied Principal Components Analysis (PCA) to the environmental variables affecting montane plant environments in the Fynbos Biome. With respect to soils, he discusses pedogenesis associated with aspect, altitude and gradient. For quartzitic soils he states, "The catena that can be expected from situations where soils are least developed to where they are best developed is : [Mispah] [Glenrosa, Cartref] [Hutton, Clovelly, Oakleaf] ". This trend is exhibited in Swartboschkloof, as shown by Fry (in prep.) (Table 1).

The local situation in Swartboschkloof is complex due to colluvial mixing of T.M.S. and granite. The presence of granite gives rise to soils of the Hutton, Magwa and Nomanci Forms. Seeps and other areas of impeded drainage are also found which results in development of soils in the Westleigh and Fernwood Forms.

Table 1. Soils of Swartboschkloof: legend for Fig. 4 (from Fry, in prep.)

Soil Groups	Predominant Parent Material	Dominant Features	Soil Classification			Map Symbol
			Form	Series	Phase	
Dark brown humic Soils	Granite	Well drained deep humic A with saprolite generally within 1m.	Nomanci	10		No
	Granite	Well drained shallow humic A with saprolite within 1m.	Glenrosa	15		gGs
	Granite	Moderate to well drained, deep humic A over yellowish brown B.	Magwa		Frequently sandstone stones and boulders in upper A horizon	gMa
	Mixed Granite and Sandstone				Usually 20% of the total soil volume consists of stones and boulders	mMa
	Granite	Moderately drained very deep black humus rich soil	Champagne	11		Ch
Moderately to well drained red and yellow Soils	Mixed Granite and Sandstone	Well drained reddish brown with stones and boulders generally 30% soil volume	Hutton	24		Hu
	Mixed Granite and Sandstone	Well drained yellowish brown with stones and boulders generally 30% soil volume.	Clovelly	14		mbCv
	Sandstone	Well drained yellowish brown soil.	Clovelly	11/14	Stones and boulders generally 30% of soil volume	sbCv
			Clovelly	11/14	Sandy soil with stones 30% and frequently less than 5% of the soil volume	ssCv
	Sandstone	Well drained yellowish brown shallow soil overlying sandstone saprolite, stones and boulders 30% of soil volume	Glenrosa	11		sGs
	Mixed Granite and Sandstone	Moderately drained yellowish brown soil showing vermic features in B horizon and having a varying % of stones and boulders in the profile	Oakleaf	31/34		Oa
Moderately to well drained pale soils	Sandstone	Moderately drained with a bleached E and yellowish brown B with stones and boulders 30% of soil volume	Constantia	11		Ct
	Sandstone	Moderately to poorly drained with a bleached E overlying a neocutanic B showing vermic features	Vilafontes	11		Vt
	Sandstone	Moderate to well drained showing greyish brown colours Stones and boulders constitute 30% of the soil volume	Fernwood	11		dFw
Hydromorphic	Sandstone	Poorly drained dark greyish brown soil with stones constituting 20% of soil volume	Fernwood	31		wFw
	Sandstone	Poorly drained with plinthic mottling up to the A horizon Stones constitute generally 20% of the soil volume	Westleigh	21		We

Fry (in prep.) has classified the soils of Swartboschkloof following the binomial classification for soils in South Africa (MacVicar et al., 1977). He has identified 12 forms with 14 series, Table 1. Fry did not sample the soils of the high steep slopes which are lithosols and probably fall into the Mispah Form.

1.6 Climate

1.6.1 Regional Climate

The climate and weather patterns of southern Africa are explained in terms of the change in position and intensity of three high-pressure cells: the South Atlantic anticyclone, the South Indian Ocean anticyclone and a third anticyclone found over the interior of southern Africa. The South Atlantic anticyclone is the principal high pressure cell which affects the south-western Cape. The summer aridity and strong southerly winds in this region are caused by the southward movement and the subsiding eastern extremity of the high-pressure cell. The northward movement of the South Atlantic anticyclone in winter allows successions of eastward-moving cyclones (depressions) of the westerly wind system to influence the south-western Cape. Cold, rainy conditions prevail at this time, associated with the passage of cold fronts (Jackson & Tyson, 1970; Fuggle, 1981).

Fuggle and Ashton (1979) discuss the climate of the Fynbos Biome. Fuggle (1981) summarized the climate data available for stations in the biome and discussed its application in interpreting the distribution of plant communities in the biome.

1.6.2 Local Climate

Wicht, Meyburgh and Boustead (1969) describe the climate of Jonkershoek as being "Etesian of the Mediterranean type". According to Köppen's (1931) system it would have an average temperature of below 22°C for the warmest month. It conforms to Climate Type IV in Walter and Leith's classification (Werger et al., 1972).

During the summer strong anti-cyclonic winds from the south-east enter the valley over the Dwarsberg, (see Fig. 1) having originated in high pressure cells between about 25° and 35° S latitude. This air is cold and as it passes over the Dwarsberg its temperature drops further causing moisture condensation into fine drops, creating the renowned south-east cloud like the 'table-cloth' on Table Mountain at Cape Town (Marloth, 1904 & 1907; Stewart, 1904; Nagel, 1956 & 1962; Kerfoot, 1968).

Exceptional rains from the south-east have been recorded when the cooling effect is enough to permit cloud to persist over the valley, when the air is not adiabatically heated and moisture re-absorbed into the atmosphere (Wicht et al., 1969).

In winter pre-frontal cyclonic winds of the westerly wind system bring moisture-laden air from the north-west into the Jonkershoek valley where they meet a mountain barrier, resulting in heavy orographic rain. After the passage of a cold front, wind direction changes from north-west to west and south-west, pressure rises and temperatures fall causing instability. It is at these times that showers and storms may occur (Wicht et al., 1969; Jackson & Tyson, 1970; Erasmus, 1981).

1.6.2.1 Solar Radiation

The measurement of hours of sunshine at the Swartboschkloof weather station is not directly applicable to Swartboschkloof as a whole. This is due to variation of aspect and slope in the area. Wicht et al., (1969) state that the mountainous horizon restricts hours of sunshine to various degrees in the Jonkershoek valley. Topography and cloudiness affect sunshine duration. If sunshine is limited this reduces radiation received, which consequently increases the effectiveness of rainfall by reducing vapour losses.

Swartboschkloof, having a general equatorial aspect experiences high insolation over the greater part but particularly on the higher slopes in the summer. The few slopes with a southerly aspect experiences less direct sun and are thus cooler and moister.

Monthly and seasonal variation in mean daily hours of sunshine for the seven-year period, 1.1.1976 to 31.12.1982, is shown in Fig. 5. The data presented in Table 2, fit the typical pattern where the mid-summer and least cloudy months, January and February, have the greatest number of hours of sunshine. The wet mid-winter months, June and July, show the opposite tendency.

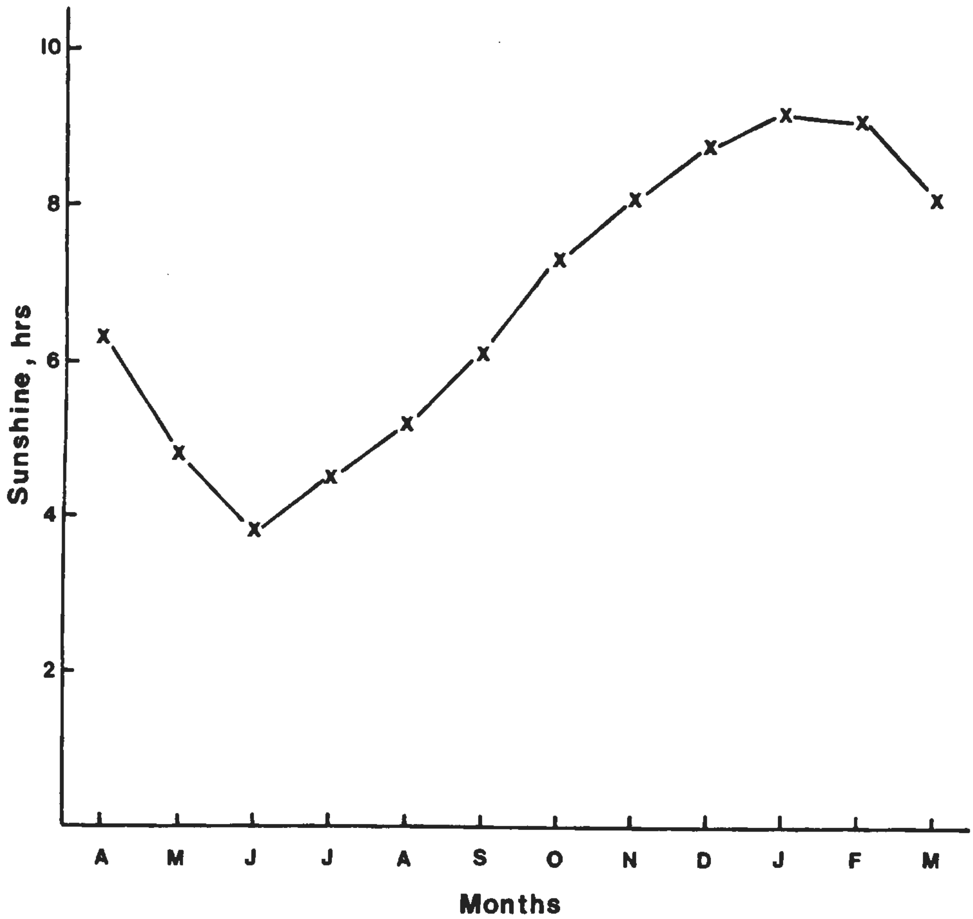


Fig. 5. Mean monthly sunshine at Swatboschkloof Weather Station, 1976 - 1982.

Table 2. Mean daily hours of sunshine at Swartboschkloof Weather Station for months of the year, 1976 -1982

	1976	1977	1978	1979	1980	1981	1982	Mean daily sunshine (hrs)
January	10,35	9,68	9,71	9,62	9,63	7,81	8,28	9,29
February	9,56	9,32	8,93	9,0	9,28	9,13	9,16	9,19
March	8,47	8,36	7,15	8,05	8,60	8,42	8,33	8,19
April	6,16	6,43	6,46	7,35	5,86	6,35	5,62	6,31
May	5,35	3,87	4,4	4,63	4,95	5,66	5,22	4,87
June	2,95	2,53	4,42	4,45	4,35	4,45	3,76	3,84
July	3,9	4,36	5,54	4,53	5,18	3,68	4,85	4,58
August	5,94	5,54	3,33	5,70	5,22	5,52	5,61	5,27
September	5,84	5,02	5,93	5,99	6,46	6,20	7,76	6,17
October	7,55	6,94	7,08	6,39	8,30	7,94	7,20	7,34
November	5,89	9,37	9,81	9,41	6,65	7,96	7,98	8,15
December	7,41	8,06	8,77	10,62	8,87	9,32	8,55	8,8

1.6.2.2 Precipitation

Wicht et al., (1969) discussed at length the occurrence of rain and its measurement, temperature changes and incoming radiation. The mean annual rainfall over 20 years is about 1 600 mm at the base of the Swartboschkloof valley (Swartboschkloof weather station), 50% of which falls from May to August and only 12% from December to March, the hottest, driest period. Snow occasionally falls at high altitudes at Jonkershoek (Wicht et al., 1969) but rarely at Swartboschkloof (Werger et al., 1972).

Bands (1977) presented data showing the gradient of mean annual rainfall in relation to elevation from Stellenbosch Gaol to Dwarsberg, Jonkershoek. Swartboschkloof weather station is situated mid-way between Stellenbosch and the Dwarsberg but at one-quarter of the altitude (a.s.l.). Taking the mean annual rainfall at the Dwarsberg as 100% (3330 mm, from Bands, 1977), then Swartboschkloof receives 54% less rain than the Dwarsberg on average per annum. Table 3 gives the total monthly rainfall for months of the hydrographic year for the period 1.1.1976 to 31.12.1982 at the Swartboschkloof weather station. Fig. 6 shows the mean monthly rainfall for the above seven-year period, in relation to monthly variation in mean maximum and mean minimum temperatures.

Swartboschkloof itself has an altitude difference of about 900 m from the mouth to the highest point on the ridge. Therefore, although there are no rainguages in Swartboschkloof to provide rainfall data, it seems feasible to suggest that different parts of the Swartboschkloof catchment receive different amounts of rainfall. This most likely depends on elevation and aspect.

Precipitation from south or south-east cloud does occur on the upper reaches of Swartboschkloof in the summer as illustrated in Fig. 7. This precipitation is indicated by the prolific growth of lichens and mosses on the trees and rocks on Haelkop Ridge.

Table 3. Total monthly rainfall (mm) at Swartboschkloof Weather Station, 1976 - 1982. Mean of two rainguages.

	1976	1977	1978	1979	1980	1981	1982	Monthly mean 1976-1982
January	0	34,1	23,85	50,35	71,3	169,35	65,1	59,15
February	15,75	44,3	45,7	146,65	51,45	2,6	10,5	45,28
March	65,9	51,25	52,0	13,7	10,35	85,3	24,25	43,25
April	90,95	226,35	126,05	44,6	144,8	134,0	213,7	140,06
May	119,9	331,15	145,7	201,05	214,45	55,35	92,7	165,76
June	533,65	457,0	62,65	205,95	313,9	195,6	195,3	280,58
July	221,9	228,1	81,8	137,25	54,65	301,55	144,1	167,05
August	212,75	226,15	268,55	94,7	171,95	229,1	131,5	190,67
September	218,6	128,3	169,5	118,1	82,15	200,2	40,85	136,81
October	121,9	53,45	126,05	225,15	84,65	44,95	106,55	108,96
November	228,85	33,9	22,45	17,75	172,55	105,15	72,2	93,26
December	121,11	75,65	112,65	9,8	99,55	56,65	247,6	103,29
Total annual rainfall	1951,26	1889,7	1236,95	1265,05	1471,75	1579,8	1344,35	1534,12

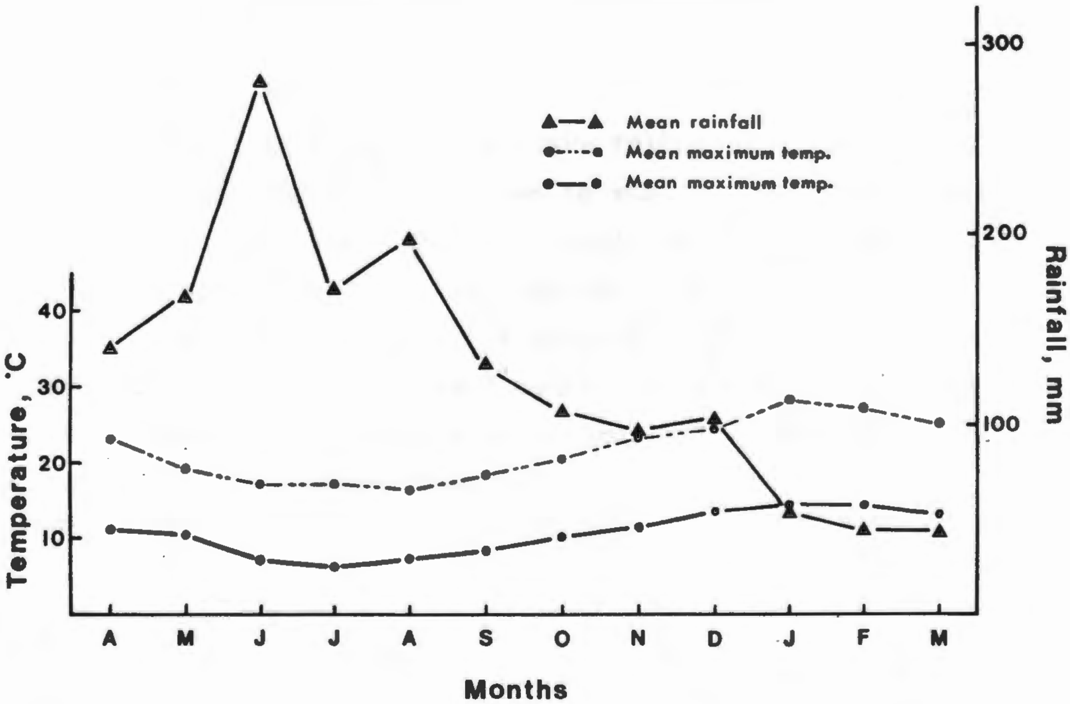


Fig. 6. Mean monthly temperature and rainfall, 1976 - 1982.

Fig. 7. South-east cloud over the high slopes of Swartboschkloof.

1.6.2.3 Temperature

Diurnal fluctuations in air temperature follow seasonal trends, tending to be greater in summer than in winter. On average summer days are hot and and the nights mild while winter days are mild and the nights cool and cold. Occasional very hot days occur throughout the year, (Wicht et al., 1969). A summary of daily maximum and minimum temperatures at the Swartboschkloof weather station for each month of the year for a seven-year period, 1.1.1976 - 31.12.1982, are given in Table 4, (see also Fig. 6).

Table 4. Daily mean maximum and mean minimum temperatures (°C) at Swartbosohkloof Weather Station, 1976 - 1982.

	1976		1977		1978		1979		1980		1981		1982		Mean	
	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min
January	31,2	15,58	25,61	12,25	27,66	15,36	26,84	14,76	27,29	15,62	24,28	14,3	24,79	13,36	28,71	14,46
February	28,37	13,92	27,7	14,95	26,33	14,31	27,89	14,49	26,90	14,33	27,35	16,75	27,11	13.92	27,38	14,67
March	29,6	12,92	26,56	13,65	26,02	13,22	24,41	12,15	18,2	13,88	26,0	13,5	25,84	13,7	25,23	13,29
April	24,54	11,22	23,81	12,27	22,31	11,63	24,08	11,19	21,88	10,74	23,04	11,17	21,64	10,91	23,04	11,3
May	21,31	10,65	16,83	8,04	18,16	8,17	19,73	10,58	18,4	18,39	20,89	10,26	19,83	8,96	19,31	10,72
June	16,14	7,82	15,93	8,23	18,95	7,36	24,41	7,69	16,96	7,78	16,13	5,47	16,92	6,00	17,92	7,19
July	15,34	5,48	15,26	4,88	19,38	8,31	23,27	6,52	19,67	7,3	14,93	4,86	17,27	5,55	17,87	6,13
August	17,2	4,83	18,3	6,26	15,0	7,19	17,04	8,67	18,58	8,92	15,11	7,64	17,18	6,01	16,92	7,22
September	18,42	7,62	17,3	7,38	17,39	6,7	18,1	8,14	18,76	8,72	18,04	7,52	22,24	10,1	18,61	8,03
October	20,83	9,84	20,41	8,86	18,52	8,36	19,9	9,71	21,71	9,8	22,69	10,97	22,68	12,67	20,96	10,03
November	18,87	8,57	26,52	12,04	25,17	12,47	24,7	12,62	20,37	10,23	22,87	11,56	22,71	11,88	23,03	11,34
December	23,66	12,33	25,38	13,38	25,88	14,54	27,97	15,82	24,16	13,8	25,54	14,59	23,59	10,33	24,74	13,54

1.6.2.4 Wind

Kruger (1974) commented on the clear seasonal cyclic nature of wind-run west of the Hottentots Holland divide, where a peak is reached in summer. The wind-run at Swartboschkloof follows this pattern. Winds blow mainly from the south-east the whole year through (Table 5). In summer, winds from the south-east are constantly strong (Fig. 8b) but they decrease from this direction in winter. Winds from the north-west increase in winter (Fig. 8c) with the eastward movement of depressions over the sub-continent.

The Swartboschkloof catchment is sheltered partly from the main force of the strong summer south-easterly winds which blow down the Jonkershoek valley. The higher parts of the south-east, east and north-east-facing slopes are most affected by these winds. These strong winds linked with high summer temperatures and high insolation lead to considerable drying-out of the vegetation.

Since Swartboschkloof has a northerly to north-westerly aspect it is probably influenced more by the milder, moisture-laden winter prevailing winds from the north-west. Föhn-like berg-winds are experienced throughout the year but are most noticeable on clear days in winter. These winds blow mainly from the north.

Winds seldom blow from the north-east and east and winds from the south-west are not very strong and do not prevail for long periods (see Fig. 8).

Wind speed data for the different seasons, from different bearings are presented in Table 5b. Abbreviations used in Table 5a are as follows:

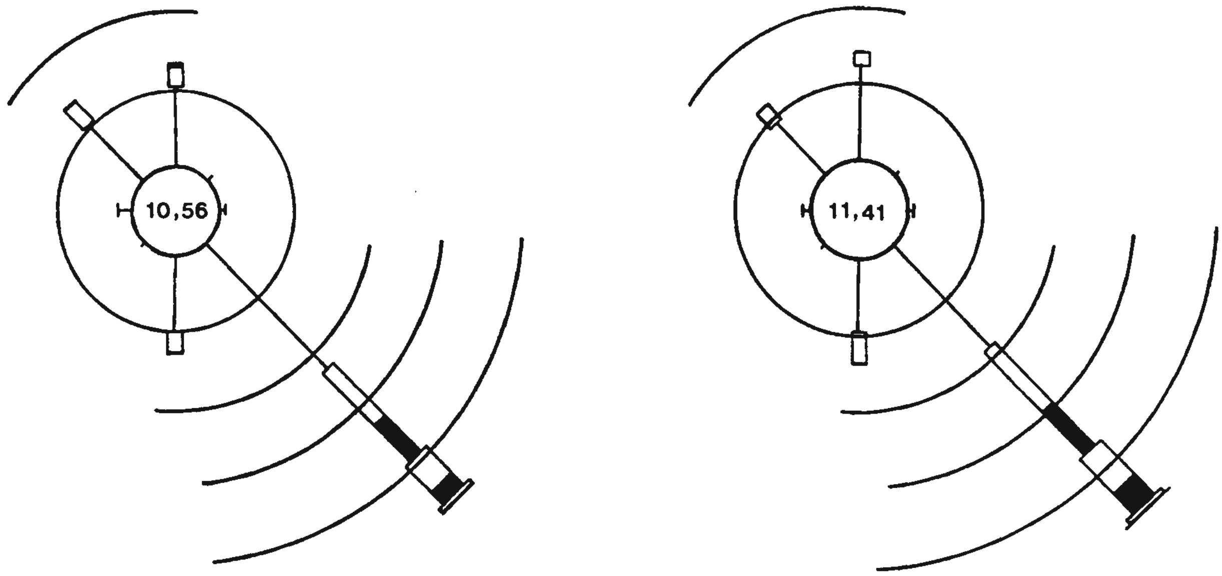
- $\bar{V}$ - average wind velocity
- a' - azimuth of wind direction (clockwise from north)
- S - steadiness of the wind: proportion of resultant wind-run to total wind-run expressed as a percentage.
- C - frequency of calms

Table 5a. Summary of monthly wind parameters at Swartboschkloof Weather Station 1.4.1979 - 31.3.1980

Month	Mean windrun km/day	a' (degrees)	$\overline{V}$ (km/hr)	Frequency of calms and winds from different directions (%)									
				S%	C	N	NE	E	SE	S	SW	W	NW
Apr	210,1	35,4	2,3	26,7	21,7	18,8	0,0	0,5	36,3	9,6	0,3	1,1	11,8
May	287,9	41,7	4,5	37,8	8,5	10,8	0,3	1,4	50,9	8,7	0,1	1,4	17,9
June	203,2	50,3	0,9	10,3	15,3	10,7	0	0,7	39,9	12,1	0,2	5,8	15,4
July	265,6	45,5	5,2	47,1	12,3	9,2	0,4	1,0	49,1	11,9	0,3	3,1	12,7
Aug	407,1	46,0	7,8	46,1	4,3	11,5	0,4	0,3	45,8	12,9	0	3,4	21,4
Sept	314,1	41,4	3,1	23,3	6,7	16,2	0	0,9	40,2	12,2	0,9	3,5	19,5
Oct	294,4	37,8	3,1	25,5	10,5	15,5	0,4	1,3	37,1	12,0	0,3	4,4	18,4
Nov	366,5	46,1	8,9	57,3	12,0	13,2	0,4	1,4	42,3	15,3	0,2	0,3	14,9
Dec	421,8	48,4	12,9	73,1	8,0	12,0	0,4	1,2	51,9	18,3	0,4	0,4	7,3
Jan	476,5	46,6	14,8	74,4	2,9	9,8	0	0,2	62,6	11,4	0	2,5	10,8
Feb	333,7	43,8	8,0	57,6	10,5	16,4	0,4	0,8	47,8	12,4	0,8	1,1	9,8
Mar	271,0	39,9	5,4	46,7	14,0	19,4	0	0,1	45,3	10,4	0,3	0,2	10,3

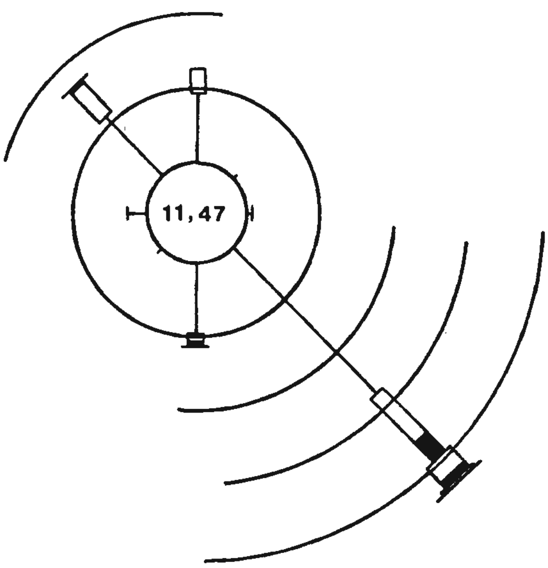
Table 5b. Mean speeds of winds from different bearings (km/hr)

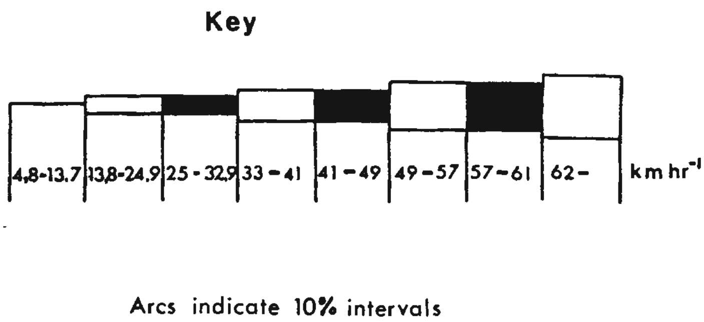
	N	NE	E	SE	S	SW	W	NW
Apr - June	10,77	3,06	7,59	10,84	9,46	10,35	9,35	11,3
July - Sept	11,86	5,68	7,63	17,85	9,44	8,01	10,66	12,37
Oct - Dec	10,74	8,17	10,78	21,58	11,1	8,45	8,69	10,89
Jan - Mar	9,76	3,49	14,65	20,04	11,16	7,89	9,73	10,64
Year	10,78	5,1	10,16	17,58	13,93	8,68	9,61	11,3



A

B





C

Fig. 8. Wind roses for 1979 : A. Whole year, B. Summer and C. Winter. Data recorded at Swartboschkloof Weather Station.

1.6.2.5 Evaporation

Many factors affect the evaporation of water from a moist surface or free water surface. Most important are temperature, wind and saturation-deficit of the air (Schulze, 1980).

It is difficult to relate the data presented in Table 6 for class "A" pan evaporation to other parameters, particularly moisture loss (evapo-transpiration) from plants. However, these data do show the seasonal trend in water loss through evaporation from an open water surface. As expected, evaporation is greatest in the hot summer months while in winter, evaporation is low. It is a regular occurrence for the class "A" pan at Swartboschkloof weather station to overflow in winter due to rainy conditions.

Table 6. Mean daily "A" pan evaporation (mm) at Swartboschkloof Weather Station

	1976	1977	1978	1979	1980	1981	1982	Monthly mean 1976–1982
January	13,46	8,57	11,44	11,04	11,49	8,17	7,91	10,32
February	10,05	9,81	9,41	8,54	9,09	10,66	9,31	9,55
March	8,67	8,0	6,50	6,57	7,85	8,48	7,83	7,7
April	4,44	4,02	5,14	4,43	3,25	3,53	4,48	4,18
May	3,17	1,88	2,43	2,98	2,46	3,23	2,38	18,53
June	1,29	1,09	2,3	1,69	1,99	1,41	1,54	1,62
July	1,49	1,18	3,04	2,27	2,31	1,23	1,65	1,88
August	2,23	2,98	1,8	3,47	3,07	3,29	2,76	2,8
September	3,43	3,93	2,89	3,99	4,57	3,74	6,49	4,15
October	5,93	5,12	4,93	5,0	6,53	7,22	7,24	6,0
November	3,93	8,67	13,46	9,19	5,58	6,76	7,95	7,93
December	7,65	8,99	9,33	12,75	8,90	10,38	6,58	9,23

2. METHODS

2.1 The Braun-Blanquet Phytosociological Method

Werger (1974) critically restated the concepts and techniques of the Zürich-Montpellier (Braun-Blanquet) method of vegetation survey. Prior to this the Braun-Blanquet (B.-B.) method had been used by only a few workers in southern Africa. Since then the B.-B. method has been used more extensively. Workers in other regions apart from the southern and south-western Cape have classified vegetation ranging from grassland through bushveld to forests: Bredenkamp & Theron (1978 & 1980), Coetzee (1974 & 1975), Coetzee et al., (1976), Furness & Breen (1980), Palmer & Lubke (1982), Van der Meulen (1978), Van Rooyen (1983), Werger (1973 a & b) and Westfall, 1981.

In his study of the vegetation of the Cape Point Nature Reserve, Taylor (1969) compared the use of association-analysis with the Braun-Blanquet (B.-B.) method. He concluded that, although the groups obtained by association-analysis could be ecologically meaningfully interpreted, they represented ..... "such small fragments of natural units that they do not give a harmonius picture of the vegetation". The B.-B. method, on the other hand, was found to be more consistent. The main reason for this is that, unlike association-analysis, the B.-B. method does not depend on the community being sub-divided on the basis of the presence or absence of a single species. Additionally, the B.-B. method "provides a more natural classification of fynbos communities" (Taylor, 1969) and readily demonstrates the relationship between communities (Boucher, 1977).

Werger et al. (1972), working in floristically rich Mountain Fynbos, tested Van Donselaar's (1965) statement that, to be used successfully, the B.-B. method should be applied where species numbers are moderate. These workers found, however, that the B.-B. method could be used with good results at Swartboschkloof. Subsequently, the Hierarchical Syndrome Analysis applied by Coetzee & Werger (1973) to the Swartboschkloof data verified the groupings previously obtained in the B.-B. study of Werger et al. (1972). Boucher (1972) also used the B.-B. method with satisfactory results in the floristically very rich Cape Hangklip area.

Since then this method has been widely employed in phytosociological studies in the fynbos and other vegetation types in the south-western Cape as shown by the following examples:

1977 Campbell and Moll - forests
1977 McKenzie, Moll and Campbell - forests
1977 Boucher - Mountain Fynbos
1977 Boucher and Jarman - West Coast Strandveld, Coastal Renosterveld, Coastal Macchia (Coastal Fynbos)
1978 Glyphis, Moll and Campbell - Mountain Fynbos, forests
1978 Laidler, Moll and Glyphis - Mountain Fynbos
1978 McKenzie - forests
1980 Campbell, Gubb and Moll - Cape Flats vegetation
1981 Taylor and Van der Meulen - Mountain Fynbos
1981 Van Wilgen - Mountain Fynbos

In view of this work and because the B.-B. method is now generally accepted as a reliable, repeatable and ecologically sound method, and applied as standard procedure in the Ecology Section (Regional Studies) of the Botanical Research Institute, I decided to employ the B.-B. technique in this project.

2.2 Sampling procedures

2.2.1 Plot shape and size

Werger (1972) reviewed the literature pertaining to species-area relationships and the determination of "minimal area" for vegetation samples. He came to the conclusion that "an objective definition of minimal area seems impossible", suggesting instead the use of optimal plot size. This would give the most satisfactory relationship between effort expended and information gained.

Assuming that one hectare would contain the species and structure of a uniform population or community, Werger (1972) said that this area could be taken as containing the 100% level of information. Depending then on the percentage of information required per plot, the plot size can be calculated.

Campbell & Moll (1981) took Werger's (1972) work further, paying attention to structural characteristics of the vegetation. They had some success relating optimal plot size to vegetation characteristics but found it difficult to explain the lack of correlation between optimal plot size and floristic richness.

In the B.-B. surveys in the south-western Cape listed in Table 7, size and shape of plots has varied according to the individual and the vegetation type. Campbell & Moll (1981) state that, "Choice of plot size is often dictated by success or failure of previously used plot sizes." This statement is true in this study where, taking all these methods into consideration, I decided to use rectangular quadrats of 5m x 10m ($50m^2$) in the fynbos communities and 10m x 20m ($200m^2$) in the riparian and forest communities of Swartboschkloof. Quadrats of $50m^2$ were used to sample the Halleria elliptica - Brabejum stellatifolium Short Forest as this size was adequate for this community. In the case of the boulder scree communities, quadrats of $200m^2$ were used; their shape was dependent on subjective assessment of each stand, since Boucher (1977) states "The relevé shapes could possibly have been more flexible, for instance in sampling riparian communities which form narrow bands along streams". The quadrats were divided, where possible, to give ten equal-sized sub-plots, for systematized data recording. The sub-plots were not nested and therefore the data collected are not suitable for drawing species-area curves or assessing species diversity.

2.2.2 Location of relevés

It is an accepted requirement that relevés for phytosociological studies be located in homogeneous stands of vegetation. This is important because information per sample is required from one vegetation unit only and not from mixed stands. Statistical measurement of homogeneity is troublesome and thus "many ecologists take the practical approach of subjectively assessing homogeneity of the plot in terms of the least possible obvious heterogeneity in floristics, structure and environmental features", (Werger et al., 1972; Werger, 1974).

There were two phases of fieldwork in this survey. During the first phase, 101 of the 114 soil pits sampled by Fry (in prep.) in his soil study of Swartboschkloof were relocated.

Table 7. - Summary of selected B.-B. surveys showing size of plot, shape of plot and type of vegetation.

Authors	Size of plot	Shape	Type of vegetation
Boucher, 1972, 1977 & 1978	5 m x 10 m ($50\ m^2$) 10 m x 20 m ($200\ m^2$)	Rectangular Rectangular	Mountain Fynbos, Riparian Communities Forests
Campbell, 1974	10 m x 10 m ($100\ m^2$)	Square	Forests
Campbell and Moll, 1977	10 m x 20 m ($200\ m^2$)	Rectangular	Forests
Glyphis _et al_., 1978	5 m x 5 m ($25\ m^2$) 5 m x 10 m ($50\ m^2$) 10 m x 10 m ($100\ m^2$)	Square Rectangular Square	Mountain Funbos $<$ 1 m high Mountain Fynbos $>$ 1 m high Forests
Laidler _et al_., 1978	5 m x 5 m ($25\ m^2$)	Square	Mountain Fynbos
McKenzie _et al_., 1977	10 m x 10 m ($100\ m^2$)	Square	Mountain Fynbos, Forests
Taylor, 1969	5 m x 10 m ($50\ m^2$)	Rectangular	Mountain and Coast Fynbos
Taylor & Van der Meulen, 1981	5 m x 10 m ($50\ m^2$)	Rectangular	Mountain Fynbos
Werger _et al_., 1972	10 m x 10 m ($100\ m^2$)	Square	Mountain Fynbos, Forests

Vegetation sample plots were placed as close as possible to these soil pits, to enable correlation between the soil series identified (Fry, in prep.) and the vegetation samples. This was done bearing in mind the requirement for sampling homogeneous stands of vegetation. It was however, not always possible to meet this requirement. The reason for this was that the soil pits themselves were often on boundaries in the soil catena, a feature reflected by the vegetation in some cases.

For the second phase of sampling it was necessary to first examine and interpret 1: 5 000 black-and-white and 1: 20 000 colour aerial photographs. This was done because Fry (in prep.) did not cover the whole area, as defined for this study, for his soil survey. In this instance the plots were placed in homogeneous stands in the vegetation units delimited on the aerial photos. A further 100 relevés were sampled during the second phase of fieldwork.

Fig. 3 shows the positions of relevés associated with Fry's (in prep.) soil pits, relevés sampled independently of Fry's survey and the positions of relevés sampled by Werger et al. (1972).

2.2.3 Data collection

Floristic data was gathered by (a) recording all permanently recognizable species together with their cover-abundance (B.-B.) values and (b) collecting those species not immediately recognizable as voucher specimens. The latter were identified with assistance from the Stellenbosch Botanical Research Unit Herbarium personnel. When ephemeral species such as annuals and geophytes were encountered they were recorded in parentheses.

Structural data was collected for each relevé by noting total cover (%) for each stratum and the dominant species in each stratum.

2.3 Table preparation

The computer programme, TABSORT, developed by the Directorate of Forestry at Jonkershoek and modified by the Botanical Research Institute (Boucher, 1977) was used for the sorting of relevé data in this study.

The manipulation of data was streamlined by using the CANDE system on the Burroughs B7800 computer of the Department of Agriculture.

The data were first arranged in a raw table. Thereafter each successive table generated was sorted visually and the "new" species-relevé combination entered into the computer. During the shuffling (sorting) process a point was reached where it became necessary to split the table into two, one for the fynbos vegetation and one for the forest vegetation. Continuous rearranging of the tables resulted in the final B.-B. tables, presented in Tables 8 & 10 Fifty shuffles were performed to reach the final fynbos B.-B. table while 38 shuffles were required to reach the final forest vegetation table. Summary tables for each of the final fynbos and forest B.-B. tables were also prepared.

Geophytes and annuals which are not permanently recognizable are not included in the tables. All species with two or more occurrences are included in the tables; those species with less than two-thirds presence in groups of related communities are listed at the end of each table in a "tail". Species with single occurrences and low cover-abundance values are listed for convenience in the Appendix.

Raw data for the Werger et al. (1972) survey were made available to me by one of the co-authors, Mr. H.C. Taylor. These data were encoded for computer manipulation following the procedures outlined above. By keeping the same relevé order as in the final tables of the Werger et al. (1972) study and using the order of species from the final tables of this study, it has been possible to prepare B.-B. tables (Tables 9 & 11) from the Werger et al. (1972) data which are directly comparable with those of this study.

Values in the phytosociological tables (Tables 8, 9, 10 & 11) follow the cover-abundance scale of Braun-Blanquet (Mueller-Dombois & Ellenberg, 1974), with "0" representing the occurrence of species within 1m around the outside of any given relevé. The values in the summary tables represent the percentage occurrence of a species in the group of relevés forming each community as follows:

5 =	80 -	100 %
4 =	60 -	79 %
3 =	40 -	59 %
2 =	20 -	39 %
1 =	5 -	19 %
+ =	1 -	5 %

2.4 Map preparation

A photographic enlargement of a black-and-white photograph of Swartboschkloof (Fig. 2) was used as the basis for the maps. The photograph was enlarged to give a scale of 1: 5 000 from which Fig. 3 & 9 were prepared. Fry's (in prep.) soil map (Fig. 4) was prepared from the same enlarged photograph.

Mapping procedures for the vegetation map, Fig. 9 were as follows: Firstly, the boundaries of the study area were delineated on the photograph. The positions of all relevés were then plotted together with symbols representing the respective communities into which the relevés were grouped. The positions of 40 relevés of the Werger <u>et al.</u> (1972) survey were also plotted, 15 of which fall outside the study area for this survey.

Stereoscopic viewing of 1: 20 000 colour aerial photographs (Job 794/77, 325 & 326) together with interpretation of the annotated black-and-white photograph made it possible to draw tentative boundaries of the plant communities on the 1: 5 000 black-and-white photograph.

The tentative boundaries of communities were then checked, using the B.-B. tables (Tables 9 & 10) to key out communities at points (see Fig. 3) where the vegetation was not sampled. Once the field-map (1: 5 000 photograph with community boundaries) was completed, it was copied to produce the final map of plant communities of Swartboschkloof (Fig. 9).

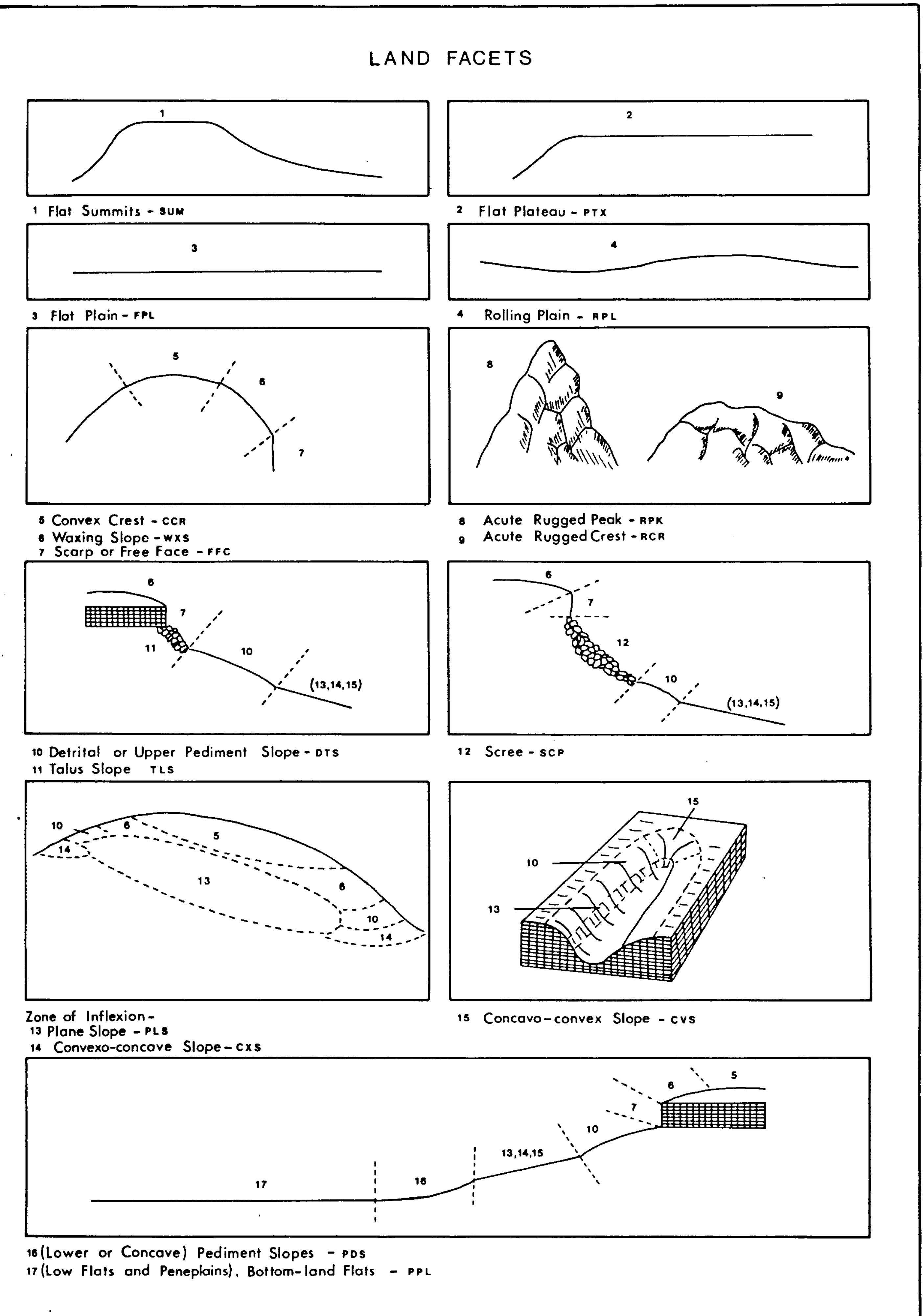
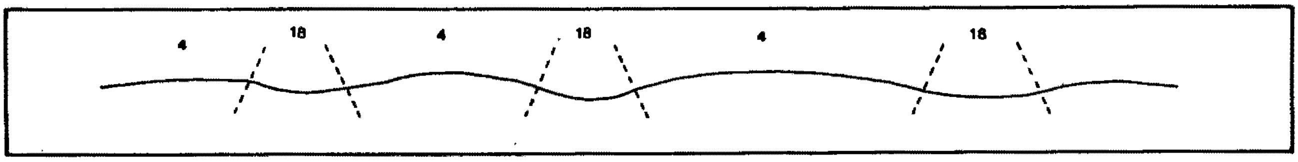
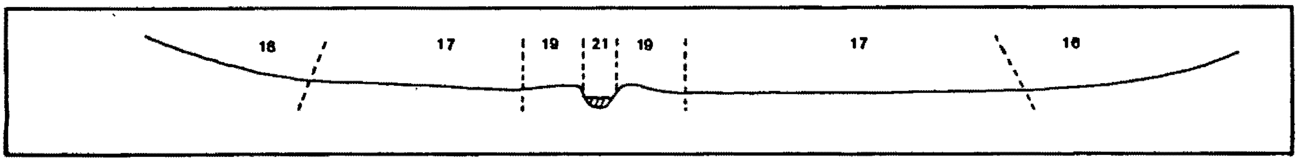


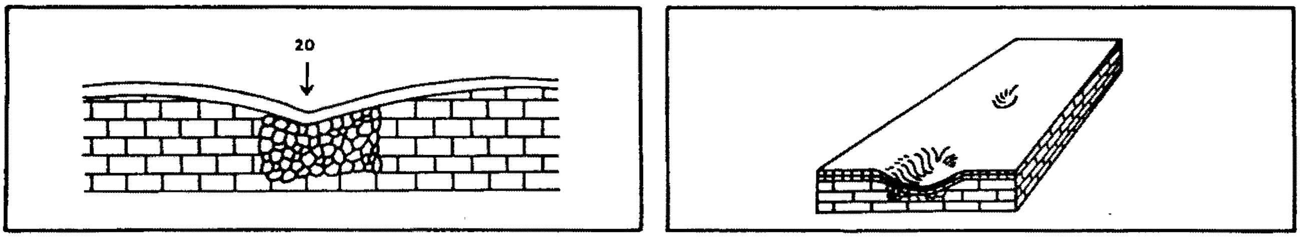
Fig. 10. Land-facets



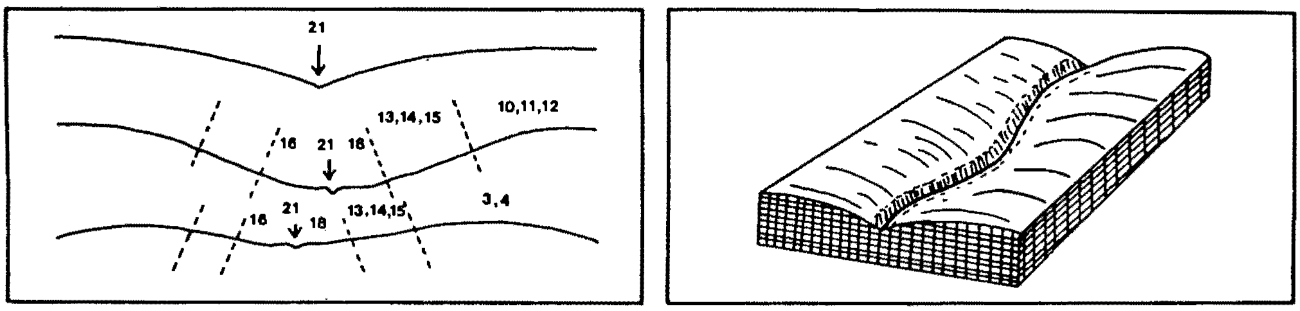
18 Swales ('Leegtes') - SWL



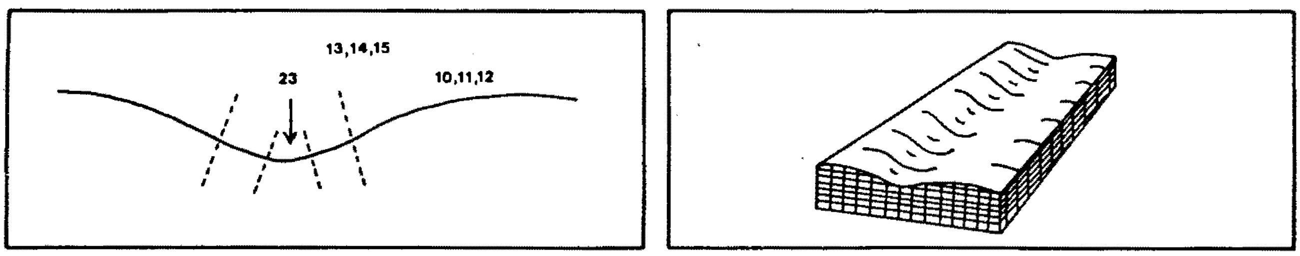
19 Levees (and Bottom-land Convexities) - LEV



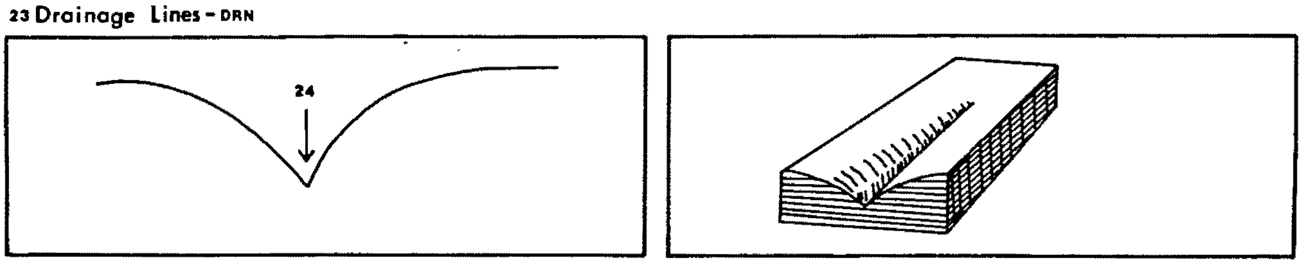
20 Hollows eg. Sink Holes - HOL



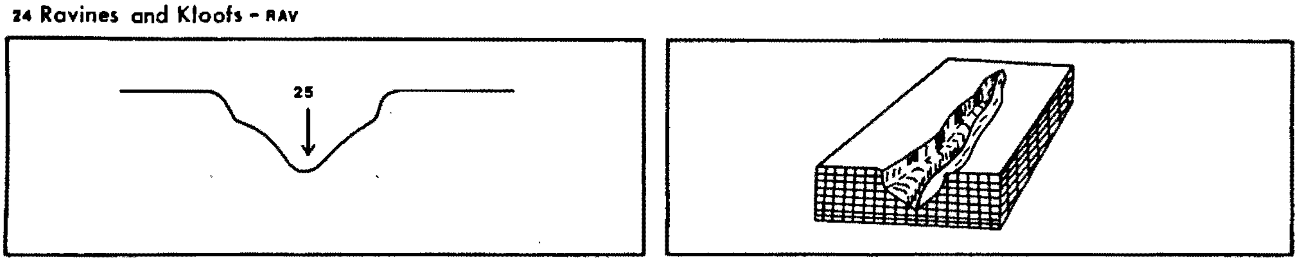
21 Water Courses - RIV 22 Estuaries - EST



23 Drainage Lines - DRN



24 Ravines and Kloofs - RAV



25 Dongas and Gullies - GUL

Fig. 10. cont. ...

3. THE VEGETATION

Six broad habitat categories for Mountain Fynbos have been described by Kruger (1979b). Taylor (1978) distinguishes between three "zones" of Mountain Fynbos encountered as one ascends mountain slopes : the Proteoid, the Ericoid-Restioid and Hygrophilous Fynbos zones. The latter includes those communities occurring on permanently wet or moist sites (phreatic sites of Wicht et al., 1969 and Kruger, 1979 b). Communities of this latter type are usually localized and can occur in either of the other two zones.

Trees are not a feature of fynbos except in a few instances e.g. Widdringtonia cedarbergensis Marsh, W. schwarzii (Marloth) Mast. and W. nodiflora (L.) Powrie. The first two species occasionally form open forests or woodlands, but populations are normally very sparse and restricted to special habitats on cliffs, in boulder fields and, occasionally, along watercourses. W. cedarbergensis and W. schwarzii are killed easily by fire and rely entirely on seed for survival whereas W. nodiflora, which is the only Widdringtonia sp. in the study area, has the capacity to sprout after fire and bears its seeds in serotinous cones (Kruger, 1979 b).

The vegetation of Swartboschkloof has been divided into two main types : (i) the Mountain Fynbos and (ii) the forests and riparian vegetation. This division is based on physiographic features as well as physiognomic, structural and floristic characteristics. The fynbos is the dominant type and is found in drier situations than the forests and riparian vegetation.

The fynbos fits broadly into Taylor's (1978) zonation patterns. On the lower slopes with mixed granite - T.M.S. soils, proteoid vegetation occurs mainly. On the upper, drier slopes with shallow sandy soils, plants in the families Restionaceae and Cyperaceae dominate. There are also localized perennial seeps where typical hygrophilous communities are found.

The forests are restricted to streambanks of perennial streams and rock screes. These forests are somewhat shorter than those of the southern Cape, probably because of more extreme climatic conditions.

The Halleria elliptica - Brabejum stellatifolium Short Forest grades into the high forest vegetation; it is most often found along drainage lines which have seasonal running water where forest vegetation does not develop. The plant communities described are based on floristic data presented in Tables 8 & 10,and in the summary tables.

Structural classification of the communities is based on averages of structural data from all relevés within each community. The classification proposed by Edwards (in press) has been applied. In each community description, the number of the relevé considered to be most representative of the community is underlined following Boucher & Shepherd (in press).

Information and data pertaining to the soils were obtained from Fry (in prep.) as well as from personal observation. All other environmental and habitat data presented in the community descriptions were recorded on site.

The Mountain Fynbos (further referred to as 'fynbos' unless otherwise stated) communities are described first, followed by a description of the forest and riparian communities. The order in which the communities are described follows the order in which they are presented in Tables 8 & 10.

For the naming of the communities a species-binomial system using two species in the syntaxon is used. These species may be either two differential species or a differential species and a dominant species that is not necessarily a differential species. Generally the first species was selected on the basis of its dominance. No suffixes such as - etosum, - etum and so on, which indicate syntaxonomical hierarchical ranking have been used. Much more extensive sampling of Mountain Fynbos is necessary before broad hierarchical ranking and hence broad syntaxonomic nomenclature can be meaningfully applied to the communities identified in this study (Barkman, Moravec & Rauschert, 1976; Küchler, 1967; Shimwell, 1971; Syntaxonomic Nomenclature Steering Committee, MS.; Werger, 1974).

In addition to the species-binomial, a structural name following Edwards (in press) is given for each community.

An alternative structural name following the system proposed by Campbell et al. (1981) for structural characterization of vegetation in the Fynbos Biome is also given. Other synonyms for the respective communities extracted from Boucher & M^cDonald (1982) and from other sources, as indicated, are given as well.

Three fynbos groups and one forest and riparian group occur in Swartboschkloof. They are systematically sub-divided on the basis of floristic relationships (Tables 8 & 10) . The term community is used as an abstract term (Shimwell, 1971) and does not imply any specific rank.

The communities are as follows :

3.1 Mountain Fynbos Communities

3.1.1 Erica hispidula - Diospyros glabra Shrublands

The shrublands grouped together here include specialized communities and those communities which favour heavier soils of granite or colluvial origin.

The effect of perennial free water appears to override the influence of substrate on the developement of the Diospyros glabra - Elegia capensis Shrubland and the Diospyros glabra - Cliffortia odorata Shrubland. In this sense they are regarded as specialized communities together with the Rhus angustifolia - Berzelia lanuginosa and Berzelia lanuginosa - Merxmuellera cincta Shrublands. The latter two communities, however, are apparently more substrate-dependent; they are found in a bottomland situation on deep, predominantly sandstone-derived soils. These communities are all referred to as 'hygrophilous communities'.

The other shrublands differ from those outlined above in their preference for drier situations on soils where granite is the major parent material.

3.1.1.1 Diospyros glabra - Elegia capensis High Closed Shrubland.

Campbell et al. (1981) structural equivalent: Tall Mid-dense Shrubland

Map Symbol: A

Community area: 4, 19 ha

Relevés (3): 148, 150, 151

Age of vegetation in relevés: 9 years

Average number of species per relevé: 20 (13-26)

Differential species: Blechnum punctulatum, Crassula coccinea, Crassula pellucida, Cullumia setosa, Elegia capensis, Hippia pilosa, Lampranthus deltoides, Nemesia acuminata

Dominant species: Arctotis semipapposa, Blechnum punctulatum, Cullumia setosa, Elegia capensis, Psoralea pinnata

Fig. 11. Diospyros glabra - Elegia capensis High Closed Shrubland

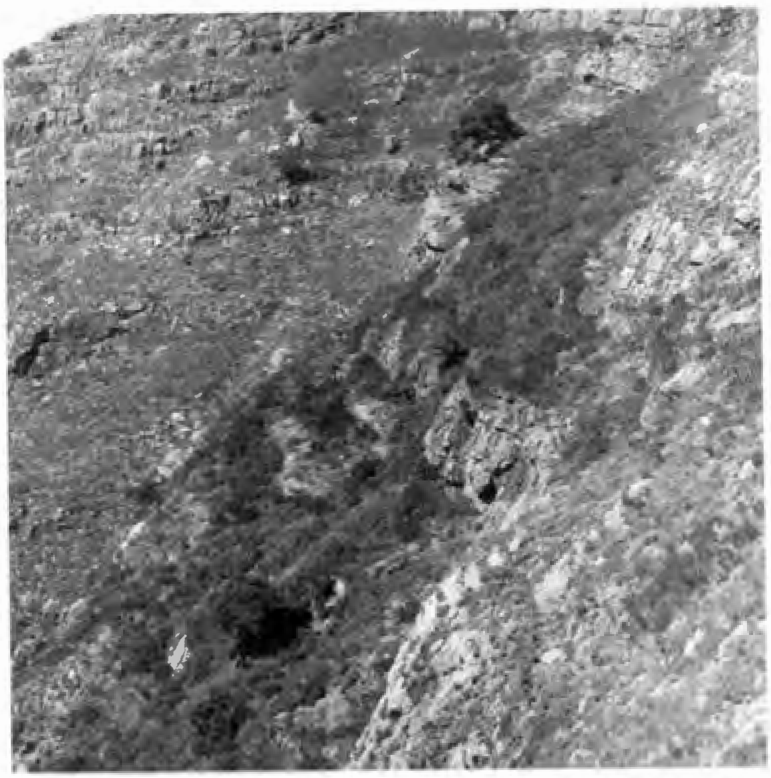


Fig. 12. The darker vegetation in this photograph is the Diospyros glabra - Elegia capensis Shrubland.

The Diospyros glabra - Elegia capensis Tall Closed Shrubland is found on slopes at high altitudes (800 - 930 m) with a south-easterly aspect in the south-west quarter of the study area (Fig. 9). The slopes have an average gradient of 18° (15 - 21°). The community is restricted to this part of the area although many species which occur in it are found in seep conditions at lower altitudes associated with other species which do not occur here.

This community is found on localized wet sites, usually dissected by drainage lines and the soil is usually waterlogged. Fry (in prep.) did not investigate these soils. However, I noted that they are sandy to loamy with a high organic content. The high organic content is most likely due to the high average litter cover of 88 % (75 - 99 %) and to local wet conditions. Exposed rock cover is low with an average of 6 % (2 - 10 %) but the substrate is notably rocky under the dense vegetation.

The estimated total cover of this community is 98 %. Three strata can be distinguished. The tallest stratum consists of shrubs, 2 - 3 m high, with an average projected canopy cover of 56 %. Elegia capensis and Psoralea pinnata are the dominant shrubs in this stratum. Cliffortia dentata, Cliffortia polygonifolia and Cullumia setosa dominate in the second shrub stratum which is 0,5 - 2 m high and has an average projected canopy cover of 46 %. The third stratum (< 0,5 m) consists of herbs and dwarf shrubs. Arctotis semipapposa and Blechnum punctulatum are prominent in this stratum. Projected canopy cover of the low stratum is estimated at 10 % on average.

Erica racemosa is found in this community and in the communities found on soils of sandstone origin. It is not found in the communities on heavier soils at lower altitudes. It was not found often in this study but could indicate specific habitat conditions not detected here but worth further investigation.

3.1.1.2 Diospyros glabra - Cliffortia odorata High Closed Shrubland

Campbell et al. (1981) structural equivalent: Low Closed Shrubland

Map symbol: B

Community area: 0, 13 ha

Relevés (1): 192

Age of vegetation in relevé: 24 years

Number of species in relevé: 26

Differential species: Centella eriantha, Cliffortia odorata, Leucadendron salicifolium

Dominant species: Cliffortia odorata, Leucadendron salicifolium

Fig. 13. Diospyros glabra - Cliffortia odorata High Closed Shrubland. The sections of the range-rod are 0,5m, total height is 2,5m.

This community is characterized on the basis of one relevé which, in strict terms, is not sufficient information to justify its existence as a distinct community. In Swartboschkloof it occurs as a localized stand too small to sample more extensively but for the sake of completeness it is described. The distinction between it and the other hygrophilous communities are shown in Table 8. The Diospyros glabra - Cliffortia odorata Shrubland has some species which are common to it and to the other hygrophilous communities: Gnidia oppositifolia, Osmitopsis asteriscoides and Psoralea pinnata.

The Diospyros glabra - Cliffortia odorata community was sampled at the top of a stabilized scree slope below cliffs at an altitude of 655 m. The aspect is north-facing and the slope is steep (34°). Water runs off the cliff above where the same community is found, falls over the rocks and then percolates through the rock rubble of the scree below. The scree rocks are covered (97 %) with a dense growth of prostrate Cliffortia odorata which dominates the lower stratum (< 1 m). Emergent through this layer are tall to high shrubs such as Leucadendron salicifolium, Osmitopsis asteriscoides and Psoralea pinnata with a projected canopy cover of 24 %.

Fry (in prep.) did not sample the soil at this site. However, the soil amongst the rocks is dark in colour and is rich in organic matter. The parent material of the soil here is T.M.S.

Further sampling of this community, if it were found in other parts of Jonkershoek, would probably indicate its exact status in the Jonkershoek vegetation as a whole.

This community is similar to the Berzelia lanuginosa - Leucadendron salicifolium community at Jakkalsrivier (Kruger, 1974) in that L. salicifolium is a prominent emergent shrub. The Diospyros glabra - Cliffortia odorata Shrubland described here does not have Berzelia lanuginosa present. In Swartboschkloof B. lanuginosa occurs at lower altitudes on deeper soils (see below).

The sites of the Werger et al. (1972) relevés 18 and 38 (318 and 338 in Table 12) were revisited during this survey. They previously recorded L. salicifolium at these sites but none was found when these sites were revisited.

3.1.1.3 Diospyros glabra - Rhus angustifolia Short to Tall Closed Shrublands

The common factor between the sub-categories in the Diospyros glabra - Rhus angustifolia Shrublands is apparently the presence of granite or granite-derived material in the soil. Fry (in prep.) found granite in 82 % of the soil profiles related to these shrublands. It is possible that the influence of granite is masked by an overburden of sandstone-derived soil in the remaining 18 % of the profiles. The plant communities could possibly be more sensitive indicators of the presence of granite material than methods of chemical soil analysis.

The highest point of the granite-sandstone contact is at about 700 m. Ten per cent of the relevés representing these shrublands are at higher altitudes (680 - 700 m) near the granite-sandstone contact. The other 90 % are mostly situated at lower altitudes (330 - 550 m) where the proportion of granite-derived material in the soil is greater.

3.1.1.3.1 Rhus angustifolia - Berzelia lanuginosa Short Closed Shrubland

Campbell et al. (1981) structural equivalent: Low Closed Shrubland

Map symbol: D

Community area: 2,5 ha

Relevés (3): 9, 10, 12

Age of vegetation in relevés: 27 (19 - 35)

Differential species: The differential species of this community are shared with the Berzelia lanuginosa - Merxmuellera cincta variant: Berzelia lanuginosa, Elegia asperiflora, Neesenbeckia punctoria. It is distinguished from the variant by the lack of differential species unique to the variant.

Dominant species: Berzelia lanuginosa, Elegia asperiflora, Tetraria fasciata

Fig. 14. Rhus angustifolia - Berzelia lanuginosa Short Closed Shrubland

The Rhus angustifolia - Berzelia lanuginosa Shrubland is found in the lower central part of the study area (altitude: 380 - 530 m) and has a north-easterly aspect. Estimated average rock cover is 15 % (5 - 25 %) which is fairly low but considerably more than in the Berzelia lanuginosa - Merxmuellera cincta Shrubland. Average litter cover is 65 % (50 - 80 %) which is somewhat lower than that in the latter community.

The soils where this community occurs are moist but well-drained. Fry (in prep.) classified these soils into three forms and three series: Westleigh Form, Witsand Series (We21); Fernwood Form, Warrington Series (Fw31) and Vilafontes Form, Hudley Sreies (Vf11), Table 1. The parent material is sandstone. The Witsand and Warrington Series are described as 'hydromorphic' soils and the Hudley Series as a 'pale' soil which is moderately to poorly drained.

This community is characterized by a low stratum < 0,5 m high, dominated by sedges, notably Tetraria fasciata. Cover of this stratum ranges between 76 - 95 % with an average of 87 %. Restios, grasses and other herbaceous species contribute to this layer as well. Berzelia lanuginosa is emergent from the low stratum; it occurs sparsely with an average cover of 10 % and does not reach more than 1 m in height.

It is interesting to note that Osmitopsis asteriscoides which is an ubiquitous seep species is absent from this community due to drier soil conditions. The presence or absence of this species can therefore be used in telling this community apart from the Berzelia lanuginosa - Merxmuellera cincta Shrubland.

Hypodiscus aristatus, a species usually found at higher altitudes on sandstone-derived soils, occurs here (Table 8). This indicates an affinity between this community and the 'pure' sandstone-associated communities described below.

3.1.1.3.1.1 Berzelia lanuginosa - Merxmuellera cincta Tall Closed Shrubland

Campbell et al. (1981) structural equivalent: Mid-high Mid-dense Shrubland

Map symbol: C

Community area: 1, 84 ha

Relevés (4): 99, 101, 102, 158

Age of vegetation in relevés: 24 years

Average number of species per relevé: 21 (13 - 30)

Differential species: Cunonia capensis, Laurentia arabidea, Merxmuellera cincta, Restio depauperatus

Dominant species: Berzelia lanuginosa, Merxmuellera cincta, Osmitopsis asteriscoides

Fig. 15. Berzelia lanuginosa - Merxmuellera cincta Tall Closed Shrubland. Sections of range-rod are 0,5m, total height is 2,5m.

The Berzelia lanuginosa - Merxmuellera cincta Tall Closed Shrubland is a variant of the Rhus angustifolia - Berzelia lanuginosa Shrubland. It occurs in similar conditions to the latter community and the two communities are found closely associated in the lower central area of Swartboschkloof. It also occurs as a more distinct unit along a drainage line on the slopes above Sosyskloof stream. Here the slope is 34° which is much steeper than the average gradient (9°) in the lower central area. The altitudinal range at which this community was recorded in the study area is 380 - 530 m.

The soil at relevé 158 was not sampled by Fry (in prep.) but I noted that the soil at the surface was rich in organic material. This is a characteristic shared with the soils of the Warrington Series in the lower central area where the Berzelia lanuginosa - Merxmuellera cincta Shrubland is found. The amount of accumulated organic material on the soil surface is greater (91 % on average) than where the Rhus angustifolia - Berzelia lanuginosa Shrubland occurs. The diagnostic horizon of the soils of the Warrington Series consists of acid, medium grade, wet regic sand. No rocks were found at the soil surface in any of the relevés representing the Berzelia lanuginosa - Merxmuellera cincta Shrubland.

Structurally the Berzelia lanuginosa - Merxmuellera cincta Shrubland differs from the typical community in that the upper stratum is dominant. This stratum is 1 - 2 m high, has an average projected canopy cover of 60 % and is dominated by Berzelia lanuginosa, Merxmuellera cincta, Neesenbeckia punctoria and Osmitopsis asteriscoides. Merxmuellera cincta and Neesenbeckia punctoria grow as large tussocks between which Berzelia lanuginosa and Osmitopsis asteriscoides emerge. The lower stratum (< 1 m) has an average projected canopy cover of 45 % and is dominated by Elegia asperifolia, Erica hispidula and Restio depauperatus.

Evidence suggests that the developement of the Berzelia lanuginosa - Merxmuellera cincta Shrubland depends largely on the presence of a high water-table. The development of the Rhus angustifolia - Berzelia lanuginosa Shrubland, on the other hand, does not seem to have this requirement. Any presence and possible influence of granite-derivatives in the soils of the Berzelia lanuginosa - Merxmuellera cincta Shrubland is probably overriden by the effect of the waterlogged regic sands. In the areas where these two communities are closely associated they are mapped as a mosaic (Fig. 9).

Analysis of the Werger et al. (1972) data shows that the community they described as the Berzelia lanuginosa - Osmitopsis asteriscoides community is the same as the Berzelia lanuginosa - Merxmuellera cincta Shrubland. Kruger (1974) commented on the similarity between the Berzelia lanuginosa - Osmitopsis asteriscoides community and the Elegia thyrsifera - Restio purpurascens community at Jakkalsrivier. Taylor (1969) also described a similar community, the Berzelia - Osmitopsis Seepage Scrub Association, found on the terraced flats of the plateaus at Cape Point. Boucher (1978) described the Erica - Osmitopsis Seepage Fynbos in the Kogelberg. This community is very similar to the Berzelia lanuginosa - Merxmuellera cincta Shrubland of Swartboschkloof, having Osmitopsis asteriscoides, Merxmuellera cincta, Berzelia lanuginosa and Neesenbeckia punctoria in common. Campbell and Moll (1977) also drew attention to the similarity between the Berzelia lanuginosa - Osmitopsis asteriscoides Community of Werger et al. (1972) and the vegetation lining the perennial streams on Table Mountain.

3.1.1.3.2 Rhus angustifolia - Zantedeschia aethiopica High Closed Shrubland

Campbell et al. (1981) structural equivalent: Tall Closed Shrubland

Map Symbol: E

Community area: 5, 57 ha

Relevés (5): 57, 58, 62, 63, 64

Age of vegetation in relevés: 23 years

Average number of species per relevé: 15 (5 - 21)

Differential species: The differential species of this community are shared with the Myrsine africana - Olea europaea subsp. africana Shrubland. They are, Blechnum australe, Maytenus acuminata , Olea europaea subsp. africana and Zantedeschia aethiopica.

Dominant species: Pteridium aquilinum, Protea neriifolia, Rhus angustifolia

Fig. 16. Rhus angustifolia - Zantedeschia aethiopica High Closed Shrubland. Note 'tall' form in foreground and 'high' form in background.

The Rhus angustifolia - Zantedeschia aethiopica High Closed Shrubland is not divided into any sub-categories. It occurs in the mid-central part of the study area below the contour path at altitudes ranging from 450 - 530 m. The slope varies from 8 - 20° and the aspect from north-north-west through north to north-north-east. Land-facet varies from pediment slopes to waxing slopes depending on the steepness (Fig. 10).

Three relevés were situated in stands on soils of the Champagne Form, Champagne Series (Ch 11) and the other two in vegetation on soils of the Nomanci Form, Nomanci Series (No 10) and Magwa Form (Ma 9, undescribed series) respectively (Fry, in prep.). No rocks were found on the soil surface but accumulated litter was in excess of 90 % cover on average which is high in relation to the rest of the study area.

Champagne Series soils are dark, peaty soils with a high organic content. The tall form of the Rhus angustifolia - Zantedeschia aethiopica Shrubland is found on these soils. The short stratum (< 1 m) has the highest projected canopy cover (93 %) and is dominated by Pteridium aquilinum and Zantedeschia aethiopica. Rhus angustifolia is emergent from this stratum forming a shrub layer (1 - 2 m) with a projected canopy cover of 22 %. This form of the community is clearly distinguishable on aerial photographs and in the field, appearing as a separate physiognomic entity from the other form.

The second form has a high stratum (2 - 4 m) with a projected canopy cover of 70 %. Protea neriifolia is the dominant shrub in this stratum. It can also have a tall stratum (1 - 2 m) which, if present, is usually dominated by Brunia nodiflora and Cliffortia cuneata. The lowest stratum is a short (< 1 m) closed (56 % projected canopy cover) layer with Pteridium aquilinum dominant. This form of the community occurs on Nomanci and Magwa soil forms (Fry, in prep.).

It may be argued that the 'tall' form of the community is a separate community from the 'high' form, on the basis of physiognomic appearance and structure. However, on the basis of floristic composition, a distinction could not be made between them (Table 8). These two structural forms are therefore mapped as a single unit on the map of plant communities (Fig. 9).

In many respects the Rhus angustifolia - Zantedeschia aethiopica Shrubland is similar to the Rhus angustifolia - Myrsine africana Shrubland. They would be the same were it not for the absence of species such as Asparagus compactus, Myrsine africana and Rhus tomentosa from the former. This is particularly true of the 'high' form described above.

Werger et al. (1972) did not sample or describe this community in their study.

Porcupines are intermittent visitors to this shrubland where they root in the peaty soil for the fleshy rhizomes of Zantedeschia aethiopica.

3.1.1.3.3 Rhus angustifolia - Myrsine africana Short to High Closed Shrubland

This shrubland consists of two variants, the Myrsine africana - Olea europaea subsp. africana High Closed Shrubland and the Myrsine africana - Cliffortia dentata Tall Closed Shrubland. All the soils on which these communities occur, except Clovelly Form, Geelhout Series (Cv 11), have granite material in the profile. The influence of granite is apparently greater on the former than on the latter community. In the soils of the Myrsine africana - Cliffortia dentata Shrubland (except in the Glenrosa Form), sandstone-derived materials are also well-represented (Table 1).

The average altitudes at which these two communities occur differ by over 160 m. The gradient of slopes where the Myrsine africana - Cliffortia dentata Shrubland occurs average 38° which is almost twice as steep as those on which the Myrsine africana - Olea europaea subsp. africana Shrubland is found. The steeper slopes are also cooler and moister. They have a north-easterly to south-easterly aspect in contrast to the north-easterly to north-westerly aspect of the area where the Myrsine africana - Olea europaea subsp. africana Shrubland occurs.

Floristically the two variants are related by having a number of general (ubiquitous) species in common. More specifically, these shrublands have three species, Asparagus compactus, Psoralea cordata and Tetraria sylvatica which are exclusive to them (Table 8).

a.

b.

Fig. 16 a & b. Two stands of the *Myrsine africana* - *Olea europaea* subsp. *africana* High Closed Shrubland, showing variation in height.

3.1.1.3.3.1 Myrsine africana - Olea europaea subsp. africana High Closed Shrubland

Campbell et al. (1981) structural equivalent: Tall Closed Shrubland

Map Symbol: F

Community area: 5, 17 ha

Relevés (6): 37,38,39, 42, 56, 96

Age of vegetation in relevés: 23 years

Average number of species per relevé: 27 (11 - 38)

Differential species: The differential species of this community are shared with the Rhus angustifolia - Zantedeschia aethiopica, Myrsine africana - Cliffortia dentata and Restio grandichaudianus - Myrsine africana Shrubland communities. They are as follows: Asparagus compactus, Blechnum australe, Halleria lucida, Hartogiella schinoides, Maytenus acuminata, Myrsine africana, Olea europaea subsp. africana, Oxalis bifida, Psoralea cordata, Psoralea pinnata, Rapanea melanophloeos, Rhus tomentosa, Tetraria sylvatica, Zantedeschia aethiopica

Dominant species: Cliffortia cuneata, Diospyros glabra, Olea europaea subsp. africana, Protea neriifolia, Pteridium aquilinum, Rhus angustifolia

The Myrsine africana - Olea europaea subsp. africana High Closed Shrubland is found in the mid-central part of the study area. It does not occur as a single unit but rather as disjunct patches interspersed between other communities (Fig. 9). The slopes on which it is found range from 10 - 36° (average 22°) and estimated rock cover is low, 5 %. Relevé 37 is an exception since it has an estimated rock cover of 60 %. Estimated litter cover is high with an average of 90 %.

The soils of this community are all granite-derived and include the same three forms and series as for the Rhus angustifolia - Zantedeschia aethiopica Shrubland: Champagne Series (Ch 11), Nomanci Series (No 10) and Magwa Form (Ma 9, undescribed series).

The Myrsine africana - Olea europaea subsp. africana Shrubland is characterized by a high stratum (2 - 6 m) with an average projected canopy cover of 67 %. This stratum is dominated by Olea europaea subsp. africana Protea neriifolia and Rhus angustifolia. A tall stratum (1 - 2 m) with an average projected canopy cover of 25 % is found in some stands. It is dominated by Cliffortia cuneata. A short stratum (< 1 m) with average projected canopy cover of 24 % and dominated by Pteridium aquilinum is the typical understorey of this community.

Relevé 42 is somewhat anomalous in the Myrsine africana - Olea europaea subsp. africana Shrubland. It is grouped here by virtue of the presence of Myrsine africana and Rhus tomentosa (Table 8). It is situated on Champagne Series soil and is closely allied to the 'tall' form of the Rhus angustifolia - Zantedeschia aethiopica Shrubland. However, on the basis of floristic relationships relevé 42 is retained as representing the Myrsine africana - Olea europaea subsp. africana Shrubland (Fig. 9).

Werger et al. (1972) did not sample this community in their survey. Although Campbell and Moll (1977) and McKenzie, Moll & Campbell (1977) found Olea europaea subsp. africana in the communities they described on Table Mountain, none of these communities is analagous to the Myrsine africana - Olea europaea subsp. africana Shrubland.

3.1.1.3.3.2 Myrsine africana - Cliffortia dentata Short Closed Shrubland

Campbell et al. (1981) structural equivalent: Low Closed Shrubland

Map symbol: G

Community area: 3, 24 ha

Relevés (4): 29, 30, 31, 32

Age of vegetation in relevés: 23 years

Average number of species per relevé: 40 (31 - 54)

Differential species: Cliffortia dentata, Ficinia trichodes, Galium mucroniferum, Pelargonium c.f. tabulare, Pentaschistis aristidoides, Polyarrhena reflexa, Selago serrata

Dominant species: Aristea major, Cliffortia cuneata, Pteridium aquilinum

Fig. 17. Myrsine africana - Cliffortia dentata Short Closed Shrubland in foreground.

The Myrsine africana - Cliffortia dentata Short Closed Shrubland is found on cool north-east to south-east-facing slopes, in the south-west sector of Swartboschkloof. It ranges in altitude from 680 - 700 m. The slopes are steep varying from 32 - 42°. This is much steeper than the average gradient of the slopes in the catchment.

Four different soil series are found in the four relevés representing this community. Hutton Form, Clansthal Series (Hu 24); Glenrosa Form, Glenrosa Series (Gs 15); Clovelly Form, Mossdale Series (Cv 14) and Clovelly Form, Geelhout Series (Cv 11). These relevés are in a geomorphologically active zone; steep slopes below sandstone cliffs off which a large amount of water drains. The land-facets represented include waxing slopes and detrital slopes which indicate steepness and active geomorphological processes as well (Fig. 10).

Estimated rock cover is high (85 - 90 %) in two relevés compared with the very low (2 %) rock cover in the other two relevés. Estimated average litter cover is moderate (55 %) and total projected canopy cover averages 88 %.

The dominant stratum of the Myrsine africana - Cliffortia dentata Shrubland is a short layer (< 1 m) with an average projected canopy cover of 72 %. This stratum is dominated by Aristea major, Cliffortia dentata, Erica sphaeroidea and Pteridium aquilinum. In moist situations Cliffortia dentata forms extensive low mats. Above the short stratum is a tall shrub layer with an average projected canopy cover of 35 %. It is dominated by Aristea major, Cannomois virgata and Cliffortia cuneata. Cliffortia dentata, Ficinia trichodes and Selago serrata are common to the Diospyros glabra - Elegia capensis Shrubland and the Myrsine africana - Cliffortia dentata Shrubland. This suggests some affinity between these two communities, possibly due to the moist conditions in which they are found.

The Myrsine africana - Cliffortia dentata Shrubland is localized to the slopes adjacent to and above the path to Haelkop Ridge. I have not found this community at other localities and it was not sampled or described by Werger et al. (1972).

3.1.1.3.4 Rhus angustifolia - Restio gaudichaudianus High Closed Shrubland

Campbell et al. (1981) structural equivalent: Tall Closed Shrubland

Map symbol: I

Community area: 18, 66 ha

Relevés (18): 60, 61, 68, 71, 72, 73, 77, 78, 79, 81, 82, 83, 88, 92, 95, 97, 98, 195

Age of vegetation in relevés: 23 years

Average number of species per relevé: 31 (20 - 42)

Differential species: This community has no true differential species. It is characterized on the basis of low occurence or absence of Hartogiella schinoides, Myrsine africana, Oxalis bifida and Rhus tomentosa.

Dominant species: Aristea major, Merxmuellera stricta, Protea neriifolia, Pteridium aquilinum, Restio gaudichaudianus

Fig. 18. Rhus angustifolia - Restio gaudichaudianus High Closed Shrubland

The Rhus angustifolia - Restio gaudichaudianus High Closed Shrubland in its typical form occurs interspersed with the Rhus angustifolia - Myrsine africana Shrubland over a large part of the mid-central zone of the study area (390 - 550 m). It is found on a wide variety of soils: Champagne Series (Ch 11), Magwa Form (Ma 9, undescribed series), Nomanci Series (No 10), Tokai Series (Ct 11), Geelhout Series (Cv 11), Mossdale Series (Cv 14) and Glenrosa Series (Gs 15). At elevations between 550 m and 700 m, on the central mid-slopes it occurs on a mixture of Nomanci and Glenrosa soil forms (see Fig. 4 & 9).

Aspect where this community occurs varies between north-east to west, but is mainly north-east-facing. The gradient of the slopes where it is found ranges from fairly shallow, almost level (5°) to steep (34°). Land-facets where it is found depend on the steepness of slope and include convexo-concave slopes, concavo-convex slopes, pediment slopes, plain slopes, convex crests, waxing slopes and detrital slopes (see Fig. 10).

Rock cover is low, with an average of 4 % (0 - 20 %). This is one of the lowest rock cover values recorded for the fynbos shrublands on the lower slopes. Other low values were recorded in the Myrsine africana - Olea europaea subsp. africana Shrubland. Litter cover estimates average 80 % which is comparable with that of the Restio gaudichaudianus - Myrsine africana Shrubland. Total projected canopy cover is estimated at 87 %.

Protea neriifolia and Protea repens dominate the high shrub layer (2 - 5 m) which has an average projected canopy cover of 34 %. Following Edwards (in press), this is a moderately closed canopy. Seven of the 18 relevés sampled lacked this stratum.

A tall stratum (1 - 2 m) occurs in all but one relevé. It has an average projected canopy cover of 25 % and is dominated by Brunia nodiflora, Cannomois virgata, Cliffortia cuneata, Cliffortia ruscifolia, Diospyros glabra, Halleria elliptica and Leucadendron salignum. The short stratum (< 1 m) has the highest average projected cover (64 %). Dominant species are: Aristea major, Cymbopogon marginatus, Merxmuellera stricta, Pteridium aquilinum, Restio gaudichaudianus and Watsonia pyramidata.

By more extensive sampling it has been possible to divide the Protea arborea (nitida) - Rhus angustifolia Community (Werger et al., 1972) into two separate communities: the Rhus angustifolia - Restio gaudichaudianus Shrubland and the Restio gaudichaudianus - Myrsine africana Shrubland. Werger et al. (1972) relevés 4, 5, 6, 23,36 (304,305, 306, 323, 336 in Table 12) represent the Rhus angustifolia - Restio gaudichaudianus Shrubland which is not part of the 'Waboomveld' (sensu Taylor, 1963) as suggested by these workers.

3.1.1.3.4.1 Restio gaudichaudianus - Myrsine africana High Closed Shrubland

Campbell et al. (1981) structural equivalent: Tall Closed Shrubland

Map Symbol: H

Community area: 10, 97 ha

Relevés (15): 1, 2, 4, 7, 8, 59, 66, 69, 70, 74, 75, 76, 80, 111, 112

Age of vegetation in relevés: 23 years

Average number of species per relevé: 39 (24 - 52)

Differential species: This community has no true differential species. It is distinguished from the Rhus angustifolia - Restio gaudichaudianus Shrubland by having marked presence of Hartogiella schinoides, Myrsine africana Oxalis bifida and Rhus tomentosa.

Dominant species: Cliffortia ruscifolia, Cymbopogon marginatus, Merxmuellera stricta, Protea neriifolia, Protea nitida, Pteridium aquilinum, Restio gaudichaudianus

Fig. 19. Restio gaudichaudianus - Myrsine africana High Closed Shrubland.

The Restio gaudichaudianus - Myrsine africana High Closed Shrubland is found at altitudes from 330 - 500 m in the lower to mid-central parts of the study area, associated with the Rhus angustifolia - Myrsine africana Shrubland. The soils on which it is found are: Magwa (Ma 9, undescribed series), Geelhout Series (Cv 11), Oakleaf Form (Oa 34) and Glenrosa Series (Gs 15).

This community is mainly on north-east-facing slopes which range from level (2°) to steep (30°) with an average gradient of 9°. The land-facets on which it occurs include pediment slopes, peneplains, concavo-convex slopes, detrital slopes, plain slopes and convex crests (Fig. 10). Drainage is good at all the sites sampled.

There is a wide range in estimated rock cover (1 - 75 %). The average rock cover is 21 %, which is considerably more than for those sites where the Rhus angustifolia - Restio gaudichaudianus Shrubland is found. This could be important because dominance of Protea nitida (waboom) in the Restio gaudichaudianus - Myrsine africana Shrubland appears to be correlated with the amount of exposed rock. The Restio gaudichaudianus - Myrsine africana community is the only community where Protea nitida is consistently dominant throughout, in contrast to it appearing as a sporadic dominant in a number of other communities.

Estimated total projected canopy cover ranges from 80 - 97 % (average: 87 %) and estimated average litter cover is 78 %, which is somewhat higher than the average for the study area.

Three strata are distinguished in this community. The high stratum (2 - 5 m) is dominated by Protea nitida, Protea neriifolia and less commonly by Cliffortia ruscifolia and Protea repens. The average projected canopy cover for this stratum is 44 %. The tall (1 - 2 m) stratum which is dominated by Cliffortia cuneata, Diospyros glabra, Rhus angustifolia, Halleria elliptica and Cliffortia ruscifolia, has an average projected canopy cover of 22 %. The short (< 1 m) stratum has the highest average projected canopy cover (66 %). It is dominated by Aristea major, Cymbopogon marginatus, Merxmuellera stricta, Montinia caryophyllacea, Pteridium aquilinum and Restio gaudichaudianus.

This community is referred to by Taylor (1963) as 'Waboomveld' because of the dominance of Protea nitida. Other Protea sp. are poorly represented in this community. In Swartboschkloof, Waboomveld is best developed on Oakleaf Form (Oa 34) soils (relevés 1, 75, 76 & 111), see Fig. 4 & 9.

As mentioned above the Protea arborea (nitida) - Rhus angustifolia Community of Werger et al. (1972) has been separated into two communities in this study. The Werger et al. (1972) relevés 1, 2, 3, 41, 42 and 43 (301, 302, 303, 342 and 343 in Table 12) represent the Restio gaudichaudianus - Myrsine africana Shrubland or 'Waboomveld' in this study. Werger et al. (1972) relevés 2 and 41 may seem anomalous in this community when referring to Table 12. However, the first was situated in a firebreak and the second was part of a series of nested quadrats which can explain the absence of Hartogiella schinoides, Myrsine africana, Oxalis bifida and Rhus tomentosa from these relevés.

Van der Merwe (1966) referred to Waboomveld in broad terms, simply referring to 'sandstone-granite communities' where Protea nitida (waboom) is prominent. Other references to Waboomveld are made by Andrag (1970) in the Helderberg Nature Reserve and (1977) in the Cedarberg and Priday (1977) in the Groot-Winterhoek Reserve. Taylor (1969) referred to the Protea arborea Pseudo-savanna Association at Cape Point and (1970) to the Protea arborea Scrub Savanna in the Cedarberg.

3.1.2 Diospyros glabra - Protea repens Transitional Shrublands

The Diospyros glabra - Protea repens Shrublands consists of those communities which are transitional between the Erica hispidula - Diospyros glabra Shrublands and the Erica hispidula - Restio sieberi Shrublands. There are two groups, the Protea repens - Rhus angustifolia High Closed Shrubland and the Protea repens - Nebelia paleacea High Closed Shrubland. The first group has a typical community with two variants and the second has two variants.

All these communities, except for two relevés on soils derived mainly from granite, occur on sandstone-derived soils. The Protea repens- Rhus angustifolia Shrublands are more akin to the 'pure' communities found on soils of granite and mixed (granite-sandstone) derivation. In contrast, the Protea-repens - Nebelia paleacea Shrublands are allied to the 'pure' sandstone-associated communities of the Erica hispidula - Restio sieberi Shrublands.

Table 8 indicates a fall-off in the occurrence of those species with a granite or mixed-soil affiliation as one proceeds from left to right through the transitional communities. A sharp increase in the occurence of sandstone-favouring species is found in the Protea repens - Nebelia paleacea Shrubland communities compared with the Protea repens - Rhus angustifolia Shrubland communities.

Protea repens has been used in the binomial of the major group because there is no other species considered suitable for this purpose (Table 8). It may be argued that it is not a suitable species because it has a wide ecological tolerance and is adversely affected by fire. However, Protea repens is a conspicuous, easily identified shrub, which performs best in the transitional communities. These attributes outweigh those not in its favour.

3.1.2.1 Protea repens - Rhus angustifolia High Closed Shrubland

Campbell et al. (1981) structural equivalent: Tall Closed Shrubland

Map Symbol: L

Community area: 8, 60 ha

Relevés (1): 40, 43, 44, 49, 50, 55, 65, 67, 135, 136, 137

Age of vegetation in relevés: 23 years

Average number of species per relevés: 37

Differential species: The species which differentiate this community are shared with a number of other communities (Table 8). It is characterized by absence of many species of communities associated with granite-derived and mixed soils and increased presence of sandstone-favouring species.

Dominant species: Bobartia indica, Cliffortia ruscifolia, Protea neriifolia, Protea repens, Restio triticeus

Fig. 20. Protea repens - Rhus angustifolia High Closed Shrubland.

The Protea repens - Rhus angustifolia High Closed Shrubland in its typical form has a disjunct distribution in Swartboschkloof, at altitudes ranging from 430 - 570 m. It is found on the ridge in the north-eastern corner but mainly on waxing slopes, plain slopes and detrital slopes in the east-central part of the study area (Fig. 9) . Aspect is northerly to easterly but one relevé faces south-west. The gradient of the slopes range from almost level (4°) to steep (32°).

The soils on which the Protea repens - Rhus angustifolia Shrubland is found are generally sandy, with boulders and gravel, of the Geelhout Series (Cv 11). There are two exceptions: relevé 50 is on sandstone-derived soil of the Constantia Form, Tokai Series (Ct 11) and relevé 40 is on Nomanci Series (No 10), which is a humic clay-loam derived from granite. Rock cover varies from low (4 %) to moderate (50 %) with an average of 33 %. Estimated litter cover averages 70 % but can be as high as 90 %.

Four strata have been distinguished in this community. The dominant stratum is the high stratum (2 - 4 m) which has an average projected cover of 65 %. It is dominated by Protea neriifolia and Protea repens. Below the high stratum is a tall stratum (1 - 2 m) which is dominated by Cliffortia ruscifolia and in some cases by Brunia nodiflora. This stratum has an average projected canopy cover of 28 %. The third layer is a short shrub stratum (0,5 - 1 m) which has an average projected canopy cover of 63 %. It is dominated by Restio triticeus. A low stratum (<0,5 m) dominated by grasses such as Cymbopogon marginatus and Merxmuellera stricta is found below the short stratum.

In qualitative terms this community is somewhat more open and easier to penetrate than the other Protea-dominated shrublands. This makes for easier collection of floristic data and easier assessment of the structure of the community.

3.1.2.1.1 Rhus angustifolia - Restio sieberi Tall Closed Shrubland

Campbell et al. (1981) structural equivalent: Mid-high Mid-dense Shrubland

Map symbol: K

Community area: 12, 40 ha

Relevés (14): 11, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 27, 33, 36

Age of vegetation in relevés: 23 years (3 relevés)
8 years (11 relevés)

Average number of species per relevé: 38

Differential species: This community is characterized on the basis of a combination of presence, absence and relative abundance of species. It has no true differential species since it has many species in common with other communities.

Dominant species: Erica hispidula, Merxmuellera stricta, Restio sieberi, Stoebe plumosa

Fig. 21. Rhus angustifolia - Restio sieberi Tall Closed Shrubland, in foreground.

The Rhus angustifolia - Restio sieberi Tall Closed Shrubland is found on the west side of the study area, below the cliffs. Relevés 27 and 33 represent stands of this community along the paths to Haelkop Ridge at 741 m and 580 m respectively. This is higher than the average altitude (460 m) of the community. Aspect is mainly east to north-east and the gradient of the slopes ranges from 3 - 32° with an average of 12°. The land-facets on which this community occurs include detrital slopes, waxing slopes, plain slopes and concavo-convex slopes.

All the soils on which the Rhus angustifolia - Restio sieberi Shrubland is found are derived from sandstone. They include Hudley (Vf 11) Geelhout (Cv 11) and Tokai Series (Ct 11). Estimated rock cover ranges from 1 - 40 % with a low average of 7 %. Litter cover averages 49 % (10 - 90 %) which is less than that of the Protea-dominated communities but comparable with values for litter in the Erica hispidula - Restio sieberi Shrubland communities.

Three strata are found in the Rhus angustifolia - Restio sieberi Shrubland. The low stratum (< 0,5 m) which is dominated by Merxmuellera stricta, Restio sieberi and Stoebe plumosa has marginally less projected canopy cover (48 %) than the short stratum. The short stratum (0,5 - 1 m) is dominated by Erica hispidula and has a projected canopy cover of 50 %. The tall stratum (1 - 2 m) consists of tall shrubs which are emergent from the short stratum. The tall stratum has a projected canopy cover of 35 % and is dominated by Cliffortia cuneata and Erica hispidula. The Erica hispidula in the short and tall strata give this shrubland its characteristic 'ericoid' appearance.

The presence of Restio sieberi in the Rhus angustifolia - Restio sieberi Shrubland with moderate to high cover-abundance is significant. It separates this community from the Protea repens - Restio gaudichaudianus Shrubland because although Restio sieberi and Restio gaudichaudianus are morphologically very similar, they are ecologically mutually exclusive. Restio sieberi favours sandy soils whereas Restio gaudichaudianus favours deeper soils of granite or colluvial derivation.

Restio sieberi is usually found at high altitudes on sandy soils (E. Esterhuysen, pers. comm.). In Swartboschkloof this species is found at lower altitudes in some places, such as in the area where the Rhus angustifolia - Restio sieberi Shrubland mostly occurs. The apparent reason for this is that the T. M.S. has slumped into the valley on the west side, providing suitable conditions for Restio sieberi to grow at lower altitudes. In only a few instances does the presence of Restio sieberi overlap with that of Restio gaudichaudianus (see Table 8).

Protea repens is absent from the Rhus angustifolia - Restio sieberi Shrubland. This may be due to the habitat not being suitable for this species, although this seems unlikely, or as a result of an accidental fire in September 1973 (Jonkershoek Forestry Research Station Records).

Most of the area occupied by the Rhus angustifolia - Restio sieberi Shrubland was affected by the 1973 fire. It is thus not in a mature state (as shown by the many Protea neriifolia shrubs of about 10 years old scattered through the area) and should therefore be interpreted with this in mind. It may be that, given time, it could develop to become structurally, but not floristically, like the Rhus angustifolia - Maytenus oleoides Shrubland.

Werger et al. (1972) showed their relevé 21 (321 in Table 12) to be in the Thamnochortus gracilis - Hypodiscus aristatus Community they described. They also considered their relevé 22 (322 in Table 12) to represent an undersampled community. This study shows that both these relevés represent the Rhus angustifolia - Restio sieberi Shrubland (Fig. 3 & 9)

3.1.2.1.2 Protea repens - Maytenus oleoides High Closed Shrubland

Campbell et al. (1981) structural equivalent: Tall Closed Shrubland

Map Symbol: J

Community area: 21, 34 ha

Relevés (18): 41, 45, 46, 47, 48, 52, 84, 85, 86, 87, 100, 103, 138, 153, 155, 156, 157, 165

Age of vegetation in relevés: 23 years (11 relevés)
24 years (6 relevés)

Average number of species per relevé: 41(32 - 47)

Differential species: This community is characterized on the basis of a combination of presence, absence and relative abundance of species. It has no true differential species since it has many species in common with other communities.

Dominant species: Cliffortia ruscifolia, Cymbopogon marginatus, Diospyros glabra, Protea neriifolia, Protea repens, Restio gaudichaudianus, Restio triticeus

Fig. 22. Protea repens - Maytenus oleoides High Closed Shrubland.

The Protea repens - Maytenus oleoides High Closed Shrubland has a widespread but scattered distribution through the study area. It occurs as patches within the Protea repens - Nebelia paleacea Shrubland on the lower western slopes as well as adjacent to the Boland Hiking Trail path before it reaches the 'zig-zags' up to the contour path. Smaller stands are found alongside and above the stream from Nuwejaarkloof on the south-eastern boundary; below the contour path in the mid-central area; near the granite-sandstone contact on the slopes in the south-westerly sector and adjacent to the firebreak in the north-east corner (Fig.9).

The average altitude at which the Protea repens - Maytenus oleoides Shrubland occurs is 518 m with a range from 400 - 700 m. The gradient of the slopes average 24° (4° - 37°) with aspect varying from south-east through north to north-west. Land-facets on which this community is found include the following: waxing slopes, plain slopes, convexo-concave slopes, detrital slopes and in one case a convex crest.

Fry (in prep.) classified the soils where this shrubland is found into the following forms and series: Clovelly Form, Geelhout (Cv 11) and Springfield Series (Cv 24); Fernwood Form, Fernwood Series (Fw 11); Constantia Form, Tokai Series (Ct 11) and Glenrosa Form, Glenrosa Series (Gs 15). There are some exceptions. The classification of the soils at relevés 103, 138, 153, 155, 156, 157 and 165 is either not known or is unclear from Fry's soil map (Fig.4).

Rock cover is estimated to average 31 % (2 - 65 %) and litter cover is moderate, averaging 56 % (20 - 95 %). Total projected canopy cover of the vegetation has a high average of 86 % (65 - 95 %).

Structurally this community can be sub-divided into three strata. The high stratum (2 - 5 m), which is not found in all stands of this community, has an estimated projected canopy cover of 55 %. This stratum is composed of shrubs and is dominated by Protea neriifolia and Protea repens. A tall shrub stratum (1 - 2 m) is found below the high stratum. It has an estimated average projected canopy cover of 24 % and is dominated by shrubs: Cliffortia cuneata, Cliffortia ruscifolia, Diospyros glabra, Erica hispidula and Protea nitida. The short stratum (< 1 m) is composed mainly of grasses and restios. It is dominated by Aristea major, Cymbopogon marginatus, Restio gaudichaudianus and Restio triticeus and has an average projected canopy cover of 60 %.

Since this is a transitional community closely related to the Restio gaudichaudianus - Myrsine africana Shrubland and Rhus angustifolia - Restio sieberi Shrubland (with species having affinity for sandstone-derived soil) it is more or less a 'sink' for those relevés which cannot be unequivocally placed in 'pure' communities. It has stronger affinities to those communities found on heavier soils of granite or mixed derivation. This is indicated by the constant presence of Restio gaudichaudianus.

3.1.2.2 Protea repens - Nebelia paleacea High Closed Shrubland

The Protea repens - Nebelia paleacea Shrubland consists of two variants, the Nebelia paleacea - Erica sphaeroidea High Closed Shrubland and the Nebelia paleacea - Restio perplexus High Closed Shrubland. They occur on shallow ($\leqslant$ 0,5 m), well-drained, sandstone-derived soils at altitudes between 400 m and 950 m. The gradient of slopes where these communities occur ranges from moderately steep to steep (14 - 40°) with an average gradient of 27°. Aspect varies through all bearings except south.

This transitional shrubland is most akin to the 'pure' communities of the Erica hispidula - Restio sieberi Shrublands.

3.1.2.2.1 Nebelia paleacea - Erica sphaeroidea High Closed Shrubland

Campbell et al. (1981) structural equivalent: Tall Closed Shrubland

Map symbol: M

Community area: 19, 16 ha

Relevés (15): 28, 51, 53, 54, 104, 122, 123, 125, 126, 130, 131, 149, 152, 159, 175

Age of vegetation in relevés: 8 years (2 relevés)
23 years (5 relevés)
24 years (8 relevés)

Average number of species per relevé: 39

Differential species: No true differential species are found here. This community is characterized by absence of many species found in the previously described communities and presence of species most allied to the Erica hispidula - Restio sieberi Shrubland communities.

Dominant species: Cliffortia cuneata, Cliffortia polygonifolia, Cliffortia ruscifolia, Protea neriifolia, Protea repens and Restio sieberi.

Fig. 23. Nebelia paleacea - Erica sphaeroidea High Closed Shrubland. The range-rod is 2,5m in height.

The Nebelia paleacea - Erica sphaeroidea Shrubland is widespread, occuring in small patches at a number of different places in Swartboschkloof. In the north-western sector it is found associated with the Rhus angustifolia - Maytenus oleoides and Restio sieberi - Nebelia paleacea Shrublands. On the eastern slopes it also occurs as part of a mosaic with the latter community. In the south-eastern sector it tends to occur as more uniform stands over larger areas (Fig. 9). Altitudes at which it is found range from 415 - 885 m (550 m on average).

Most of the slopes where this community occurs, range from moderately steep to steep (16-18°) with an average gradient of 26°. The land-facet classes of these slopes depends on the gradient and they include detrital slopes, waxing slopes, concavo-convex slopes and plain slopes.

All the soils on which this community is found are derived from sandstone. They are well-drained and are usually ≤0,5 m deep. Fry (in prep.) classified these soils into the Geelhout (Cv 11) and Fernwood Series (Fw 11) as well as a mixture of Clovelly and Glenrosa Forms (Fig. 4 & 9). Rock cover estimates range from 10 - 90 % with an average of 45 %. This average is almost twice as high as the general average for rock cover in the study area. Litter cover also has a wide range (10 - 90 %) with an average of 57 % which is below average for the study area.

Average projected canopy cover of this shrubland is 87 %. Both floristically and structurally it is mid-way between the Protea repens - Rhus angustifolia and Nebelia paleacea - Restio perplexus shrubland communities.

It has two structural forms. Sixty per cent of the relevés representing the Nebelia paleacea - Erica sphaeroidea community do not have shrubs higher than two metres. The remaining 40 % (six relevés) have a high stratum (2 - 5 m) similar to that of the Protea repens - Rhus angustifolia Shrubland.

The first structural form is the 'low-closed' form. The low stratum (<0,5 m) is dominant, with an average projected canopy cover of 72 %. Dominant species in this stratum are Blaeria dumosa, Restio sieberi and

Thamnochortus gracilis. The short stratum (0,5 - 1 m) has an average projected canopy cover of 58 % and is dominated by Cliffortia polygonifolia, Cliffortia ruscifolia, Erica hispidula and Penaea mucronata. The tall stratum (1 - 2 m) has an average projected canopy cover of 31 %. It is dominated by Brunia nodiflora, Cliffortia cuneata, Cliffortia polygonifolia, Protea nitida and Watsonia pyramidata.

The second form or 'high closed' shrubland is dominated by a high stratum (2 - 5 m) and has no low stratum. The high stratum is dominated by Cliffortia ruscifolia, Protea neriifolia and Protea repens. It has an average projected canopy cover of 76 %. The tall stratum (1 -2 m) which has a projected canopy cover of 16 % is dominated by Brunia nodiflora, Cliffortia cuneata, Cliffortia polygonifolia and Penaea mucronata. The short stratum has an average projected canopy cover of 53 % and is dominated by Ehrharta ramosa, Pentaschistis colorata and Restio triticeus.

Floristic data collected in this study (Table 8) show that the two structural forms described here, although structurally different, cannot be separated on a floristic basis.

3.1.2.2.2 Nebelia paleacea - Restio perplexus High Closed Shrubland

Campbell et al. (1981) structural equivalent: Tall Open Shrubland

Map symbol: N

Community area: 33, 29 ha

Relevés (17): 26, 124, 128, 129, 139, 142, 147, 154, 170. 173, 176, 177, 178, 179, 180, 189, 191

Age of vegetation in relevés: 7 years (2 relevés)
9 years (3 relevés)
23 years (1 relevé)
24 years (11 relevés)

Average number of species per relevé: 36 (21 - 53)

Differential species: No true differential species are found in this community. It lacks presence of many species found in the previously described communities.

Dominant species: Blaeria dumosa, Cliffortia polygonifolia, Erica hispidula, Protea repens, Restio perplexus, Watsonia pyramidata

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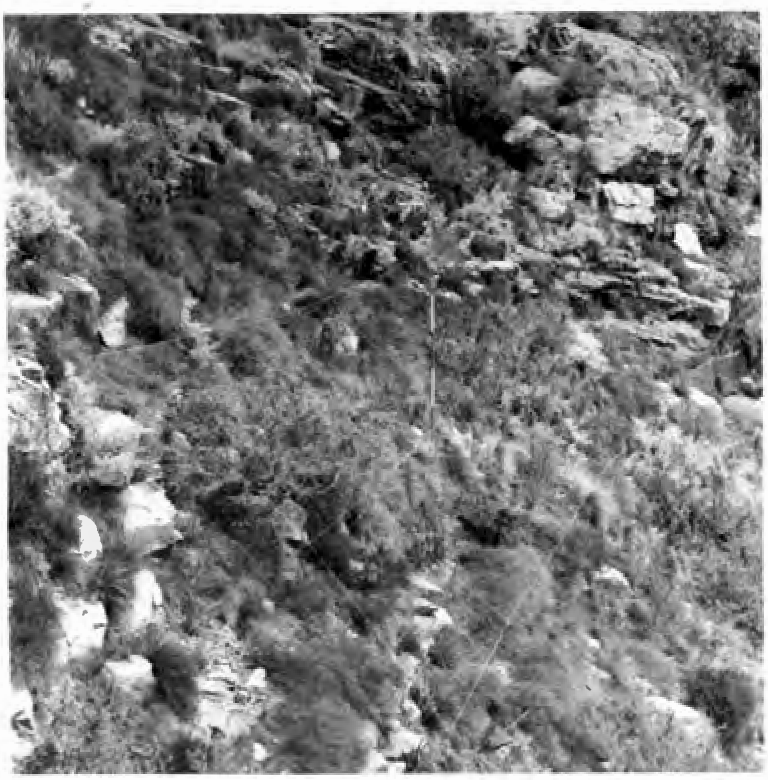

Fig. 24. Nebelia paleacea - Restio perplexus High Closed Shrubland, on rocky cliffs.

The Nebelia paleacea - Restio perplexus Low Closed Shrubland was sampled at elevations from 485 - 924 m with an average altitude of 757 m. It occurs mainly in three areas of Swartboschkloof. On the Western slopes it is found in patches associated with the Restio sieberi - Nebelia paleacea Shrubland and the Protea repens - Restio gaudichaudianus Shrubland. In the eastern part it occurs again as part of a mosaic with the latter two communities. In the south-eastern sector at altitudes from 560 - 830m, it occurs uniformly as pure stands. At relatively high elevations (700 - 930 m) in the south-western sector it is found in rocky situations, particularly on the cliffs close to the southern boundary (Fig. 9).

This community is found on well-drained slopes with gradients averaging 28° (14 - 40°). Aspect varies from south-easterly to north-westerly and land-facets include detrital slopes, waxing slopes and concavo-convex slopes. Rock cover averages 53 %, ranging from low (5 %) to very high (95 %). Estimated litter cover also has a wide range (10 - 80 %) with a moderate average of 46 % which is almost a third less than the general average (65 %) for the study area.

The soils on which this community is found are all derived from sandstone. They are shallow, (0,1 - 0,5 m) with an average depth of 0,27 m. Fry (pers. comm.) did not sample the soils where relevés 129, 139, 142, 147, 154, 170, 176, 177, 178, 179, 180, 189 and 191 are situated.

The area where relevés 176, 177, 178, 179 and 180 are situated Fry (in prep.) are classified and mapped (Fig. 4) as a mixed matrix of Clovelly and Glenrosa soil forms. The soil series of relevés 124 and 128 are Hudley (Vf 11) and Geelhout (Cv 11) Series respectively.

The total projected canopy cover of the Nebelia paleacea - Restio perplexus Shrubland is 89 % on average. It can be sub-divided into four strata. The high stratum has an average projected canopy cover of 31 % and is dominated by Protea neriifolia and Protea repens. It was only encountered in three relevés: 124, 129 and 189. The vegetation sampled at relevé 128 would probably develop a high stratum were it not for apparent severe wind-pruning. Protea repens at this site has a high cover-abundance score (4) but the shrubs do not reach more than 1,5 m in height.

The tall stratum (1 - 2 m) is dominated by Brunia nodiflora, Cliffortia ruscifolia, Cliffortia polygonifolia, Diospyros glabra and Erica hispidula. It has an average projected canopy cover of 33 %. The short stratum (0,5 - 1 m) has an average projected canopy cover of 67 % with Aristea major, Erica hispidula, Hypodiscus albo-aristatus, Restio perplexus and Watsonia pyramidata dominant. The low stratum (<0,5 m) has the highest average projected canopy cover (75 %). Dominant species in this stratum are: Blaeria dumosa, Cymbopogon marginatus, Elegia juncea, Pentaschistis colorata, Pentaschistis curvifolia, Restio sieberi and Staberoha cernua.

Relevés 124, 129 and 189 are structurally similar to the 'high closed' form of the Nebelia paleacea - Erica sphaeroidea Shrubland. However, these relevés lack presence of species such as Anthospermum aethiopicum, Asparagus rubicundus, Erica sphaeroidea, Pteridium aquilinum and Rhus angustifolia which would place them in the latter community.

Two relevés (180 and 191) in this community are in the firebreak. The objective in placing relevés in the firebreak was to assess the change in floristic composition of the communities through which the firebreak passes. Relevé 191 is a paired sample with relevé 117. In this case these relevés do not represent the same community since relevé 117 represents the Restio sieberi - Nebelia paleacea Shrubland and relevé 191 represents the Nebelia paleacea - Restio perplexus Shrubland (Table 8). This could be attributed to the effects of fire on the vegetation sampled at relevé 191 or to the absence of these effects at relevé 117. Relevé 180 (in the firebreak) is paired with relevé 179. Both relevés here represent the Restio sieberi - Nebelia paleacea Shrubland which suggests that the fire effect has not had any noticeable effect on the floristics of the vegetation at relevé 180. These findings are contradictory and suggest that further investigation is necessary to clarify the reason for this contradiction.

3.1.3 Erica hispidula - Restio sieberi Shrublands

There are two shrubland communities grouped together here: the Restio sieberi - Nebelia paleacea and Restio sieberi - Tetraria involucrata Shrublands. They are found at relatively high altitudes on shallow sandstone-derived soils. Restio sieberi has been used as one of the species in the naming of these communities because it prefers sandstone-derived soils at higher altitudes (see description of Rhus angustifolia - Restio sieberi Shrubland above).

It would be necessary to sample the vegetation of this type more extensively (outside the study area) to establish its place in the vegetation of Jonkershoek as a whole.

3.1.3.1 Restio sieberi - Nebelia paleacea Tall Closed Shrubland

Campbell et al. (1981) structural equivalent: Low Closed Shrubland

Map symbol: P

Community area: 41, 58 ha

Relevés (22): 24, 25, 34, 90, 91, 105, 106, 117, 118, 119, 120, 121, 127, 133, 134, 140, 141, 143, 144, 145, 146, 185

Age of vegetation in relevés: 9 years (6 relevés)
23 years (6 relevés)
24 years (9 relevés)

Average number of species per relevé: 36 (23 - 58)

Differential species: Berzelia intermedia, Cliffortia exilifolia, Erica coccinea, Leptocarpus membranaceus, Sympieza articulata, Tetraria burmanni

Dominant species: Erica coccinea, Erica hispidula, Nebelia paleacea, Restio sieberi, Tetraria capillacea

Fig. 25. Restio sieberi - Nebelia paleacea Tall Closed Shrubland

The Restio sieberi - Nebelia paleacea Shrubland is found mostly on the slopes of the ridges bordering the study area on the west and east sides and in the south-east corner. Below the contour path in the mid-western part it is found in patches associated with the Nebelia paleacea - Restio perplexus Shrubland (Fig. 9).

This shrubland occurs on a wide variety of land-facets which include waxing slopes, detrital slopes, plain slopes, concavo-convex slopes, a free face, drainage lines and convexo-concave slopes. The land-facets depend largely on the steepness of the slopes which range from almost level (4°) to steep (37°), with an average of 23°. It was sampled at altitudes from 420 - 910 m (643 m on average) but may occur at higher elevations on inaccessible cliffs which were not sampled.

Sandstone is the parent material of all the soils on which this community is found. Fry (in prep.) sampled the soils at relevés 24, 25, 34, 90 and 91. These he classified into the Geelhout (Cv 11)and Tokai (Ct 11) Series (see Tables 1 & 8). Using Fry's (in prep.) soil map (Fig. 4) it is possible to classify the soils of relevés 117, 118, 119, 120, 121 and 127 as Geelhout Series (Cv 11). Rock cover ranges from low (10 %) to very high (90 %), with an average of 44 %, which is about twice the general average (25 %) for the whole study area. Average litter cover is 50 % which is 15 % less than the general average; in this shrubland litter cover ranges from 15 - 80 %.

Three strata can be distinguished in this shrubland. The low stratum (< 0,5 m) has the highest projected canopy cover (76 %). Dominant species in this stratum include: Elegia juncea, Restio sieberi, Staberoha cervua and Tetraria capillacea. The short stratum (0,5 - 1 m) has an average projected canopy cover of 58 % and is dominated by Erica hispidula and Nebelia paleacea. A tall stratum (1 - 2 m) is found in 10 relevés (45 % of the relevés sampled) and it has an average projected canopy cover of 20 %. Dominant species in this stratum are Brunia nodiflora, Cliffortia polygonifolia, Erica coccinea, Nebelia paleacea and Protea neriifolia.

The accidental fire in September 1973 swept through the Restio sieberi - Nebelia paleacea Shrubland on the western slopes of the study area. This could explain the absence of Erica coccinea from this area (relevés 140, 141, 143, 144, 145 and 146; Table 8). Alternatively, the absence of this species from the above-mentioned relevés and relevés 133, 134 and 185 could be due to aspect or soil-related factors which are not known. Erica coccinea is an important food plant for the Orange-breasted Sunbird (Anthobaphes violacea L.) which feeds on the nectar of the flowers (A. Rebelo, pers. comm.).

From this study it is apparent that the Thamnochortus gracilis - Hypodiscus aristatus Community described by Werger et al. (1972) represents a broad concept which can now be split into a number of more specific communities. One of these is the Restio sieberi - Nebelia paleacea Shrubland. Six relevés: 17, 19, 20, 24, 25 and 28 (317, 319, 320, 324 and 325 in Table 12) from the Thamnochortus gracilis - Hypodiscus aristatus Community fall into the Restio sieberi - Nebelia paleacea Shrubland.

McKenzie et al.(1977) drew correlations between the Leptocarpus membranaceus - Hypodiscus aristatus Community at Orange Kloof, Table Mountain and the Thamnochortus gracilis - Hypodiscus aristatus Community at Swartboschkloof (Werger et al.,1972). Now it is possible to draw even more specific correlations between the Leptocarpus membranaceus - Hypodiscus aristatus Community and the Restio sieberi - Nebelia paleacea Shrubland. The latter community also resembles the Willdenowia sulcata communities (more specifically the Willdenowia sulcata - Erica brevifolia Community) which are found at Jakkalsrivier (Kruger, 1974).

3.1.3.2 Restio sieberi - Tetraria involucrata Tall Closed Shrubland

Campbell et al. (1981) structural equivalent: Low Closed Shrubland

Map symbol: R

Community area: 30, 21 ha

Relevés (13): 132, 168, 169, 171, 172, 174, 181, 182, 184, 186, 187, 188, 190

Age of vegetation in relevés: 7 years (4 relevés)
8 years (1 relevé)
24 years (8 relevés)

Average number of species per relevé: 36 (24 - 48)

Differential species: Tetraria involucrata

Dominant species: Cliffortia polygonifolia, Erica hispidula, Hypodiscus albo-aristatus, Restio sieberi, Tetraria involucrata

Fig. 26a. Restio sieberi - Tetraria involucrata Tall Closed Shrubland, mature vegetation (24 years).

The Restio sieberi - Tetraria involucrata Shrubland is found at the highest altitudes in the study area, situated between 590 m and 960 m, with an average altitude of 840 m. Four relevés (171, 187, 188 and 190) representing this community are situated in the firebreak on the southern boundary of the study area. They are thus not in the study area as such but were placed in the firebreak as 'paired samples' with relevés 168, 186, 133 and 134 respectively.

This community favours detrital slopes, convexo-concave slopes and drainage lines with a north-easterly to westerly aspect. Gradients range from moderately steep to steep (12 - 38°), with an average of 28°. The soils (not investigated by Fry) are sandy, with a high percentage of boulders and stones all derived from T.M.S. These soils are well-drained and shallow; average depth is 20 cm. Estimated rock cover ranges from low to very high (2 - 85 %) with a moderate average of 42 %. Litter cover also has a wide range (5 - 80 %) but has a lower average value (27 %).

Two strata are typically found in this community. The tall stratum (1 - 2 m) has an average projected canopy cover of 11 % and is dominated by emergent shrubs such as Cliffortia cuneata, Cliffortia polygonifolia and Penaea mucronata. Below this is a short stratum (< 1 m) which is dominated by Aristea major, Elegia juncea, Hypodiscus albo-aristatus, Restio sieberi and Watsonia pyramidata. It has an average projected canopy cover of 78 %.

In five relevés a high (2 - 2,5 m) shrub stratum was found. It has an average projected canopy cover of 38 % in these relevés, but if taken in the community as a whole it has a much lower projected canopy cover of 7 %. Dominant shrubs in this stratum are Cliffortia cuneata, Cliffortia polygonifolia and Protea nitida. The high shrub stratum is thought to be atypical of the Restio sieberi - Tetraria involucrata Shrubland as a whole.

Once again a contradictory situation is apparent with the 'paired samples'. Relevés 168 and 171 in mature vegetation represent the same community (Restio sieberi - Tetraria involucrata Shrubland) as their respective paired samples, 186 and 187, which are situated in the firebreak. Conversely, relevés 188 and 190 in the firebreak represent the Restio sieberi - Tetraria involucrata Shrubland, whereas their respective paired relevés represent the Restio sieberi - Nebelia paleacea Shrubland.

It is interesting to note that species such as Erica curvirostris, Hypodiscus aristatus, Pentaschistis curvifolia, Pentaschistis steudeli, Restio cuspidatus and Thamnochortus gracilis are absent or have low presence and low cover-abundance scores in the Restio sieberi - Tetraria involucrata Shrubland.

The Restio sieberi - Tetraria involucrata Shrubland bears strong resemblance to the Hypodiscus albo-aristatus Community on Table Mountain, described by McKenzie et al. (1977) from one relevé. Tetraria involucrata and Hypodiscus albo-aristatus link these two communities.

Werger et al.(1972) did not sample the high-lying slopes of Swartboschkloof and thus did not characterize the Restio sieberi - Tetraria involucrata Shrubland or a possible equivalent.

Fig. 26b. Restio sieberi - Tetraria involucrata Tall Closed Shrubland in the firebreak; the vegetation is about eight years old.

3.2 Riparian and Forest Communities

3.2.1 Hartogiella schinoides - Diospyros glabra Riparian and Forest Communities

The communities which make up the riparian and forest vegetation are mostly associated with moist situations, often with running water in kloofs, gullies and watercourses. Two groups of communities are distinguished: the Diospyros glabra - Halleria elliptica High Closed Shrubland to Short Forest and the Diospyros glabra - Rapanea melanophloeos Tall Forest.

The two groups of communities are floristically related but are different in many respects in terms of habitat requirements. They are found at different altitudes on slopes with different average gradients. Soil development and estimated rock and litter cover are also strikingly dissimilar between the groups.

The Halleria elliptica - Cliffortia cuneata Shrubland is at the interface between the fynbos and the riparian communities. This community has a large proportion of fynbos species as well as some forest species. It therefore forms a link between the fynbos and forest vegetation types in Swartboschkloof.

3.2.1.1 Halleria elliptica - Brabejum stellatifolium Short Forest

Campbell et al. (1981) structural equivalent: Low Forest

Map symbol: T

Community area: 0, 79 ha

Relevés (4): 107, 108, 109, 110

Age of vegetation in relevés: 24 years

Average number of species per relevé: 16 (15 - 18)

Differential species: Brabejum stellatifolium is shared with the Halleria elliptica - Cliffortia cuneata High Closed Shrubland and the Rapanea melanophloeos - Cunonia capensis High Forest. Blechnum australe is shared with both the above communities and the Rapanea melanophloeos - Heeria argentea Short Forest.

Dominant species: Blechnum australe, Brabejum stellatifolium and Halleria elliptica

Fig. 27. Halleria elliptica - Brabejum stellatifolium Short Forest.

The Halleria elliptica - Brabejum stellatifolium Short Forest is distinctive in physiognomic appearance and relatively easy to distinguish from the other forest communities, except where it intergrades with the Rapanea melanophloeos - Cunonia capensis Forest. It is found in drainage lines in the lower reaches of the study area, at altitudes between 300 - 420 m. Along the drainage line between the Boland Hiking Trail path and the major Swartboschkloof stream (see Fig. 9) it occurs as a pure stand. To the west of the lower reaches of the main Swartboschkloof stream it occurs in patches interspersed with other communities, along a drainage line which enters the Sosyskloof stream. The gradient is shallow, varying between 6° and 7°. At the sites sampled, the aspect is northerly, but it can change due to changes in course of the drainage lines.

Two relevés of this community are on Oakleaf Form soils (Fry in prep.). The soils of the other two relevés were not classified, but it was observed that they are composed of granite and sandstone material. These latter two sites are wet in the winter when run-off water fills the drainage lines and is not onfined to the main streams. Estimated rock cover ranges widely from 1 - 95 % with an average of 29 %. Litter cover is high except in relevé 110; it ranges from 40 - 95 % with an average of 79 %.

The vegetation has a projected canopy cover of 100 %; it is very dense and almost impenetrable. The crowns of the individual plants of Brabejum stellatifolium interlock, creating shady conditions for plants in the understorey.

Three strata are distinguished in this community. The upper stratum (3 - 6 m) has an estimated cover of 97 % and is dominated by Brabejum stellatifolium which reaches the stature of a short forest. Below the upper stratum is a layer 1 - 3 m high which can have a percentage cover ranging from 5 - 80 %, with an average of 35 %. Dominant species in this stratum are Diospyros glabra, Halleria elliptica and Rhus angustifolia. This stratum was not found in relevé 110. A short to low stratum (< 1 m) was found in three relevés (all except relevé 109) with an average percentage cover of 29 %. The dominant species in this stratum is Blechnum australe.

Van der Merwe (1966) recognized the existence of this community but included it in his broad concept "Oewergemeenskappe" (streambank forests). Werger _et al_. (1972) described what they termed the "_Brabejum stellatifolium_ Community". I have found that the relevés (31, 37 & 39) used by Werger _et al_. (1972) to characterize the latter community fit more precisely into the _Halleria elliptica_ - _Cliffortia cuneata_ Shrubland, which is described below (see relevés 331, 337 & 339 in Table 11).

Boucher (1978) described the "_Brabejum_ - _Rhus_ Riverine Scrub" in the Kogelberg which he divided into three zones. The part referred to as the "middle zone" corresponds most closely with the _Halleria elliptica_ - _Brabejum stellatifolium_ Short Forest in Swartboschkloof.

3.2.1.2 Halleria elliptica - Cliffortia cuneata High Closed Shrubland

Campbell et al. (1981) structural equivalent: Tall Closed Shrubland

Map symbol: S

Community area: 2, 17 ha

Relevés (7): 3, 5, 6, 35, 93, 94, 166

Age of vegetation in relevés: 23 years (6 relevés)
24 years (1 relevé)

Average number of species per relevé: 30 (23 - 37)

Differential species: Anthospermum aethiopicum, Aristea major, Asparagus asparagoides, Cymbopogon marginatus, Erica sphaeroidea, Ficinia filiformis, Freylinia lanceolata, Glia gummifera, Lichtensteinia lacera, Mohria caffrorum, Montinia caryophyllacea, Oxalis bifida, Pelargonium myrrhifolium, Phylica pubescens, Protea neriifolia, Protea nitida, Psoralea spicata, Restio triticeus, Rhus rosmarinifolia, Salvia africana, Schizaea pectinata, Tetraria bromoides

Dominant species: Brabejum stellatifolium, Cliffortia cuneata, Halleria elliptica, Protea nitida, Pteridium aquilinum

Fig. 28. Halleria elliptica - Cliffortia cuneata High Closed Shrubland

The Halleria elliptica - Cliffortia cuneata Shrubland is found on the forest margins at the interface between the fynbos communities and the riparian forest communities, at altitudes from 320 - 560 m (Fig.9). Aspect varies from south-easterly to north-westerly and gradient of the slopes ranges from 6 - 9° with an average of 7°. Land-facets where this community occurs include pediment slopes, detrital slopes, plain slopes and convexo-concave slopes.

The soils where this community is found are derived from granite and sandstone. They average 0,5 m in depth and are classified into the Clansthal Series (Hu 24), Warrington Series (Fw 31), Magwa Form (Ma 9, undescribed series) and Oakleaf Form (Oa). Estimated rock cover is low compared with the overall average (25 %) for the study area; it ranges from 1 - 13 % with an average of 5 %. Estimated litter cover is very high, ranging from 85 - 99 % with a mean value of 93 %. Most of the sites are well-drained. The only site subject to seasonal waterlogging is at relevé 5, situated on Warrington Series (Fw 31) soils.

The vegetation of the Halleria elliptica - Cliffortia cuneata Shrubland has a high, average projected canopy cover (96 %); it ranges from 88 - 100 %. Three strata are distinguished. The highest stratum (2 - 4 m) is dominated by Brabejum stellatifolium, Cliffortia cuneata and Protea nitida. It has an average projected canopy cover of 22 %. Below the high stratum is a tall stratum (1 - 2 m) with an average projected canopy cover of 41 %. The tall stratum is dominated by Diospyros glabra and Halleria elliptica. A short stratum (<1 m) with an average projected canopy cover of 54 % is found below the tall stratum. This layer is dominated by Aristea major and Pteridium aquilinum.

This community is floristically, closely akin to the Restio gaudichaudianus - Myrsine africana High Closed Shrubland. These two communities could be considered to be one were it not for the presence of Brabejum stellatifolium in the Halleria elliptica - Cliffortia cuneata Shrubland. Estimated average rock cover of these communities is also markedly different.

3.2.2 Diospyros glabra - Rapanea melanophloes Tall Forest

Campbell et al. (1981) structural equivalent: Tall Forest

Map symbol: W

Community area: 8, 35 ha

Relevés (7): 113, 160, 161, 162, 183, 193, 198

Age of vegetation in relevés: Unknown

Differential species: No true differential species are found in this community.

Dominant species: Hartogiella schinoides, Maytenus acuminata, Olinia ventosa, Podocarpus elongatus, Rapanea melanophloeos

Fig. 29. Diospyros glabra - Rapanea melanophloeos Tall Forest on T.M.S. boulder scree.

The Diospyros glabra - Rapanea melanophloeos Tall Forest is the typical variant of the second group of forest communities. It is found on stabilized boulder screes below the sandstone cliffs in the south-central and south-west parts of the study area (Fig. 9). The aspect of these screes varies from north-easterly to north-westerly. The gradient ranges from 25 - 34° with an average of 28°.

There is very little soil development on the boulder screes. What soil there is amongst the boulders is humus which comes from decayed leaf litter and other organic matter. For this reason Fry (in prep.) simply mapped these areas as screes or established screes. It was noted that the Diospyros glabra - Rapanea melanophloeos community occurs where the boulder scree has stabilized. A possible reason for this is that it is in this situation that the trees can develop fully. On less stable screes it is most likely more difficult for trees to become established. As expected, rock cover is high, 80 - 99 %, averaging 92 %. Litter is estimated to have an average cover of 24 %, ranging from 10 - 45 %.

The development of these forests probably also depends largely on moisture availability. Apart from the dense canopy which creates shady, cool, moist conditions on the ground, there is also perennial percolation of water through the rock crevices. This water is trapped on the upper slopes of the catchment; it runs over the cliffs, percolates through the boulder screes and finally runs into the main streams which drain Swartboschkloof. The trees can exploit this water as it passes through the boulder screes.

The canopy trees, mainly Hartogiella schinoides, Olinia ventosa and Podocarpus elongatus reach from 8 - 20 m in height. As noted above, they form a dense canopy with only a few patches through which light can penetrate. The cover of this stratum is estimated at 77 %. The vegetation of relevés 113 and 193 do not have a canopy which reaches up to 20 m. The height of the canopy of these latter stands is comparable with the height of the sub-canopy (2 - 8 m) of the forest stands in the other relevés. However, they still have the same dominant species. The sub-canopy is dominated by Halleria lucida, Maytenus acuminata, Podocarpus elongatus and Rapanea melanophloeos and has an average projected canopy cover of 63 %. Below the sub-canopy there is a ground layer (< 1 m), with Asparagus scandens, Knowltonia vesicatoria and Zantedeschia aethiopica most common. The ground layer has an average projected canopy cover of 11 %. A climber, Secamone alpini, is found entwined in sub-canopy shrubs and trees.

Van der Merwe (1966) referred to this community under the general title, "Dasbosse of woude op talus" (Dasbosse or forest on talus). He did not distinguish between the typical variant, the Diospyros glabra - Rapanea melanophloeos Tall Forest and the Rapanea melanophloeos - Heeria argentea Short Forest. Heyns (1957) in a study of the forest communities at Assegaaibos (near Swartboschkloof) also made no distinction between these two variants. Werger et al. (1972), however, did make a distinction. The former community they designated as the "Rapanea melanophloeos Community" and the latter as the "Heeria argentea Community". No true analogue of the Diospyros glabra - Rapanea melanophloeos Forest has been identified on Table Mountain or in the Kogelberg (McKenzie et al., 1977; Campbell and Moll, 1977; Boucher, 1978).

3.2.2.1 Rapanea melanophloeos - Cunonia capensis High Forest

Campbell et al. (1981) structural equivalent: Tall Forest

Map symbol: U

Community area: 15, 89 ha

Relevés (7): 163, 164, 194, 199, 200, 201, 202

Age of vegetation in relevés: Unknown

Average number of species per relevé: 18 (14 - 22)

Differential species: Blechnum punctulatum, Brachylaena neriifolia, Cunonia capensis, Dipogon lignosus, Ehrharta sp., Ilex mitis, Kobresia lancea, Oxalis sp., Sanicula europaea, Todea barbara

Dominant species: Brabejum stellatifolium, Cunonia capensis, Ilex mitis, Maytenus acuminata , Rapanea melanophloeos

Fig. 30. Rapanea melanophloeos - Cunonia capensis High Forest along a perennial stream.

The Rapanea melanophloeos - Cunonia capensis High Forest is the second variant of the Diospyros glabra - Rapanea melanophloeos Forest. It is found along the main drainage lines and streams where there is perennial running water. It is restricted to the streambanks and can be seen as a narrow ribbon of dark-coloured vegetation following the main watercourses. In the mid-central region of the study area it is well-developed, particularly around the middle-reaches of the main Swartboschkloof stream. At this point two tributary streams flow into the main stream. This community does not occur in relatively short, seasonal drainage lines where the Halleria elliptica - Brabejum stellatifolium Short Forest is found (Fig. 9).

The Rapanea melanophloeos - Cunonia capensis Forest from the middle to upper reaches of the Nuwejaarkloof stream is fragmented. This is probably due to a lack of strong perennial water-flow and the nature of the boulder bed, which is like a boulder scree in places (Fig. 2).

In the study area the altitudinal range of this community is from 330 - 800 m. Aspect varies between north-easterly (the main stream flows from south-west to north-east) and north. The tributary streams flow in a northerly direction before they are intercepted by the main stream. The gradient ranges from 10 - 27° with an average of 18°.

Soil development is minimal. The soil that is present is usually a mixture of sand and humus which accumulates on the banks of the streams. This alluvial soil material is often washed away when the streams rise in winter after heavy rains. These soils are not described by Fry (in prep.) who simply refers to the streams as "incised drainage lines". Average rock cover (62 %) is much less than that of the boulder screes where it exceeds 90 %. Accumulated litter has an average cover of 41 % (10 - 70 %) which is greater than that of the boulder screes.

There are two tree layers in this community. The highest stratum (8 - 25 m) is dominated by Cunonia capensis, Ilex mitis, Rapanea melanophloeos and Brabejum stellatifolium. It has an estimated cover of 88 %. The sub-canopy (1 - 8 m) has an estimated cover of 38 %. It is dominated by Maytenus acuminata, Halleria lucida and Brabejum stellatifolium. The undergrowth is estimated to have an average cover of 16 %. Dominant species in the ground layer are: Asparagus scandens, Blechnum australe and Kobresia lancea.

Van der Merwe (1966) included the vegetation described as the Rapanea melanophloeos - Cunonia capensis High Forest in this study in the broad concept of "Oewergemeenskappe" (streambank forests). Werger et al.(1972) did not distinguish the streambank forests as a separate community from the tall forests on the boulder screes. The reason for this is that they only had two samples (relevés 330 & 332 in Table 11) in the tall to high forest vegetation, which represent the Diospyros glabra - Rapanea melanophloeos Forest variant.

The forest communities on Table Mountain which most resemble the Rapanea melanophloeos - Cunonia capensis High Forest are: the Cunonia capensis - Ilex mitis - Rapanea melanophloeos community (McKenzie et al., 1977) and the Cunonia capensis - Ilex mitis sub-association (Campbell and Moll, 1977). None of the forests of the Kogelberg (Boucher, 1978) floristically resemble this forest community at Swartboschkloof, although some species are the same.

3.2.2.2 Rapanea melanophloeos - Heeria argentea Short Forest

Campbell et al. (1981) structural equivalent: Low Forest

Map symbol: V

Community area: 1, 65 ha

Relevés (4): 115, 116, 196, 197

Age of vegetation in relevés: Unknown

Average number of species per relevé: 14 (13 - 16)

Differential species: Heeria argentea

Dominant species: Hartogiella schinoides, Heeria argentea, Maytenus acuminata, Podocarpus elongatus

Fig. 31a. Rapanea melanophloeos - Heeria argentea Short Forest on T.M.S. boulder scree. Note Aloe mitriformis in foreground and Podocarpus elongatus prostrate on the rocks.

Fig. 31b. Boulder scree with Rapanea melanophloeos - Heeria argentea Short Forest at lower end. Note the contour path and the 'zig-zags' of the Boland Hiking Trail path.

Fig. 31c. Rapanea melanophloeos - Heeria argentea Short Forest on a rock outcrop.

This variant of the Diospyros glabra - Rapanea melanophloeos Forest occurs on the loose, unstable boulder screes and on rocky outcrops. In Swartboschkloof it is best developed at two localities; firstly on a boulder scree below the contour path near the south-east boundary and secondly on a scree in the south-west sector of Swartboschkloof adjacent to the path to Haelkop Ridge. It is found in drier situations than the Diospyros glabra - Rapanea melanophloeos Forest where drainage is good.

The Rapanea melanophloeos - Heeria argentea Short Forest does not occur at altitudes higher than 700 m in Swartboschkloof and since the boulder screes face north-east to north this community is exposed to high temperature and insolation.

There is little or no soil development on the boulder screes where the Rapanea melanophloeos - Heeria argentea Short Forest is found. The average litter cover is low (18 %), with a range from 15 - 20 %. There is almost total cover of large boulders under the vegetation (97 % on average) and drainage is consequently good.

A single tree stratum and a ground were distinguished. The tree stratum (2 - 8 m) has a projected cover of 80 % and is dominated by Hartogiella schinoides, Heeria argentea, Olinia ventosa and Maytenus acuminatus. Below this is a short stratum (< 1 m) where Podocarpus elongatus can spread in a prostrate fashion on the boulders (Fig. 31a). Other species in this stratum include Aloe mitriformis, Blechnum australe, Knowltonia vesicatoria and Rumohra adiantiformis. None of these species is dominant and Aloe mitriformis is found where the canopy is open. Secamone alpini is found from ground level into the sub-canopy climbing amongst other plants.

Van der Merwe (1966) did not distinguish or describe a community with Heeria argentea as an important species. Werger et al. (1972) described the Heeria argentea Community, but two out of the three relevés (315, 316 & 326 in Table 14) used to characterize this community were situated outside Swartboschkloof, in the adjacent Sosyskloof catchment (see Fig. 3). The Rapanea melanophloeos - Heeria argentea Short Forest is localized to a few patches on the rock screes in the study area and although Werger _et al_. (1972) recorded high cover-abundance scores for _Heeria argentea_ in their relevés, this was not found to be generally true in Swartboschkloof.

Campbell and Moll (1977) recorded a community in the Hex River Mountains which they referred to as the _Heeria argentea_ association, also found on sandstone screes. In a survey of the vegetation of the Kapteinskloofberg, Moss & Metelerkamp (1980) found a forest community typified by _Heeria argentea_. The distribution of _Heeria argentea_ which has an affinity for dry, rocky situations makes it possible to compare the forest or scrub-forest patches where it occurs, over a wide geographical range. This could be worth further investigation.

4. DISCUSSION

Phytosociologists in the western Cape started testing the Zürich-Montpellier (Braun-Blanquet) method on Cape vegetation in the late 1960's and early 1970's (Boucher, 1972; Taylor, 1969 and Werger et al., 1972). Werger et al. (1972) were successful in the application of the B.-B. method in species-rich Mountain Fynbos but were of the opinion that much more data would be required for a successful classification of fynbos vegetation. In saying this they challenged South African ecologists to "prove and improve the classification and so build up an understanding of the vegetation."

The challenge has been accepted and numerous phytosociological studies have been completed since the early 1970's. Many of these studies have had Cape fynbos and remnant forests as their subjects of attention. None, however, have involved the re-evaluation of any previous study of the same area. The reasons for this are probably two-fold: (i) the shortage of trained phytosociologists and (ii) the need to accumulate data from a wide area rather than to exhaustively study relatively small study sites; the latter approach was applied for catchment evaluation reasons at Jakkalsrivier (Kruger, 1974) but to date no follow-up study has been undertaken there.

In 1977 the Fynbos Biome Project was established and attention became focused on two intensive study sites in the western Cape Province. One is situated in Coastal Fynbos at Pella near Atlantis and the other is located in Mountain Fynbos at Swartboschkloof, Jonkershoek. Classification and maps of the vegetation of these study sites were required. Swartboschkloof additionally presented a useful opportunity to re-survey the vegetation and thereby re-evaluate the work done by Werger et al. (1972). This study therefore represents a direct acceptance of the challenge by these workers to "prove and improve" their classification of the vegetation of Swartboschkloof.

Taylor (1969) and Boucher (1977) compared the Braun-Blanquet method with association-analysis and found that the B.-B. method gave better results than association-analysis because it depends on the total species complement of each relevé for classification into community groupes. Association-analysis can result in misclassification of relevés due to the chance absence of a single species, particularly if that species is a dividing species between groups. Boucher (1977) also found that application of homogeneity functions to the data he collected did not yield satisfactory results for the classification of relevés. Neither of the latter two methods have been applied in the present study. Principal components analysis as applied by Campbell (1983) in montane environments in the Fynbos Biome has not been applied at Swartboschkloof. This method warrants testing as it could explain more clearly the complex relationships between the vegetation and the environmental factors.

In this vegetation survey the B.-B. method with the TABSORT computer programme (Boucher, 1977) has proved successful, though time-consuming, in determining both the forest and fynbos communities. It was difficult to clearly define the transitional or ecotonal communities because they have no true differential species. As one proceeds through the ecotone there is a decrease in occurrence of those species which are usually associated with granite or colluvial soils. This decrease corresponds with a gradual change from heavier, deeper soils to shallow sandy soils. A concurrent increase in occurrence of sandstone-associated species is evident. The transitional communities are thus defined on the basis of relative abundance of the two 'types' of species.

Sampling in Swartboschkloof has been more intensive in this study than in the survey carried out by Werger et al.,(1972). There are three reasons for this: (i) Werger et al. only did a quick survey to test the application of the B.-B. method in Mountain Fynbos (ii) in the first phase, 101 of Fry's (in prep.) soil pits were relocated and (iii) it was necessary to have sufficient sample points for mapping at a detailed scale. The highest concentration of relevés is in the area below the contour path (see Fig. 3) where Fry (in prep.) concentrated his work. There are fewer relevés on the higher slopes above the contour path because the sample sites were carefully selected in predetermined physiographic-physiognomic units from aerial photographs. The second phase of sampling was more efficient than the first because it did not involve the time-consuming relocation of soil pits. If a thorough interpretation of aerial photographs and reconnaissance of the study area had been completed initially, fewer relevés would probably have been necessary in certain areas. Effort could then have been spent on locating and sampling communities such as the Diospyros glabra - Cliffortia odorata Shrubland which are undersampled. If used, this approach may have given better results than those achieved in this study, particularly if the requirement of sampling homogeneous stands of vegetation was adhered to more strictly.

Since the sub-plots in the relevés were not nested, determination of optimum plot size is not possible. However, from subjective assessment I have concluded that 50 m^2 rectangular plots are suitable for sampling the tall to high shrubland vegetation, whereas smaller plots of 5m x 5m ($25m^2$) although not used, would probably be adequate for short fynbos vegetation (see Glyphis et al., 1978; Laidler et al., 1978). Plots of $200m^2$ are apparently suitable for tall to high forest vegetation which has a dense canopy but low basal cover. In the dense Halleria elliptica - Brabejum stellatifolium Short Forest, 5m x 10m ($50m^2$) plots were found to be suitable.

Two vegetation types were recognized on the basis of their floristic composition and structure, namely fynbos and forest. Sixteen fynbos communities were identified which are grouped into three groups. The first fynbos group includes the hygrophilous communities and the shrublands associated with soils of granite or colluvial derivation. The hygrophilous communities are placed in this fynbos group for convenience only, they are essentially azonal. The second or intermediate group includes the transitional or ecotonal communities which fall between those communities associated with granite-derived and colluvial soils and the third group which consists of the 'true' Mountain Fynbos communities associated with sandstone-derived soils. Five forest communities are recognized, grouped into two groups. The first group consists of a community transitional between fynbos and forest vegetation, and a short forest community along seasonal drainage lines. The second group of forest communities comprises the three variants of the Diospyros glabra - Rapanea melanophloeos Forest.

In addition to these communities there is the Brunia nodiflora - Psoralea rotundifolia Community, a fynbos community recognized by Werger et al. (1972). It was not found within the boundaries of the present study area but occurs on granite-derived soils on south-east-facing slopes on the northern side of Sosyskloof (see Fig. 2 & 3). This community has, however, been mapped (Fig. 9) from the raw data of Werger et al. (1972) but requires further investigation and verification. Comparisons between Tables 8 & 9 clearly justify identification of the Brunia nodiflora - Psoralea rotundifolia Community as a distinct community. Psoralea rotundifolia and Osteospermum tomentosum, two differential species of this community, were seldom encountered in the study area defined for the present study. They do, however, occur more abundantly in the area on the northern side of Sosyskloof.

The forests at Swartboschkloof are poorer in species than the forests of Table Mountain (Campbell & Moll, 1977; McKenzie et al., 1977) or the Kogelberg (Boucher, 1978). This difference is most likely due to the substrate on which these respective forests are found. In Swartboschkloof the forests are found on T.M.S. boulder screes and along boulder-lined watercourses; at Orange Kloof, Table Mountain and in places in the Kogelberg the forests are found along watercourses but often on soils derived from shale. The shale-derived soils are much finer-textured (Campbell, 1983) than the rocky scree substrate as well as being more nutrient-rich. It would allow for greater diversification of the forest flora at Orange Kloof and in the Kogelberg whereas this process is probably restricted in the forest communities of Swartboschkloof.

The general northerly aspect of forests in Swartboschkloof may also be important because high insolation could cause rapid decomposition of litter material, particularly on the exposed boulder screes. In the south-facing forests on Table Mountain and the Kogelberg, the decomposition process is probably slower. Loss of nutrients is probably higher where decomposition rates are higher, which would also affect the growth of forest species.

Correlation between the distribution of the plant communities and the occurrence of the soil forms is generally good, whereas relating plant communities to soil series is more difficult except in some instances where the communities are localized and reflect specific edaphic conditions. An example of this is the 'tall form' of the Rhus angustifolia - Zantedeschia aethiopica Shrubland which is found on deep organic soils of the Champagne Series (Ch 11). Localized communities on phreatic sites such as the Berzelia lanuginosa - Merxmuellera cincta Shrubland also show association with specific soil series; in this case with Warrington Series (Fw 31).

Perhaps the most important aspect arising from the correlation of the soils with the vegetation is the broad relationships between the groups of communities and the soil geology, rather than specific communities associated with specific forms or series. This is demonstrated by the relationship between the tall to high shrublands occurring on granite-derived or colluvial soils where the soils are deep, have a higher clay content due to the granite and are probably more nutrient-rich. The sandstone-derived soils have less clay, less nutrients, lower pH and are shallow. These soils consequently support a shorter vegetation with more restios and sedges than shrubs. Campbell (1983) presented results which suggest that soil texture variables and not chemical variables are important in distinguishing quartzite-derived soils from non-quartzitic soils. This may offer some explanation for the distribution of plant communities in Swartboschkloof, particularly in the case of the Restio gaudichaudianus - Myrsine africana Shrubland (Waboomveld) and in the transitional communities, where rockiness is considered to be important.

A striking feature of the fynbos vegetation of Swartboschkloof is the lack of coincidence between the structure of the vegetation and the boundaries of the communities (Werger et al., 1972). In the present study this feature was noted particularly in the Protea-dominated shrublands. Widespread tall to high shrubs with high cover-abundance, like Protea neriifolia, extend across and mask floristically-determined community boundaries. A suggested explanation for this is the prevalence of extreme habitat factors or occurrence of extreme events such as fires which result in deceptive boundaries (Werger et al., 1972). I agree with the latter part of this explanation in the instance of the Rhus angustifolia - Restio sieberi Shrubland, the structure of which can be attributed largely to the accidental fire of September, 1973. The pre- and post-fire structural boundaries of the Rhus angustifolia - Restio sieberi Shrubland do not agree, yet floristically the community appears to have remained the same. The lack of coincidence between the floristic boundaries and the structural boundaries of the shrublands of the lower to middle slopes is attributed to edaphic factors rather than to extremes of climate or to fire. This is particularly so since this vegetation is considered to be mature; it was last burnt in 1958.

Since the greater part of Swartboschkloof has a northerly aspect it is not easy to assess the effect of aspect on plant growth. A few slopes face southwards but these slopes do not support vegetation noticeably different from that in the rest of the study area. North-west-facing slopes most likely intercept more rain in winter than slopes with other aspects, but once again any noticeable effect on community structure or composition is not apparent. One community, the Myrsine africana - Cliffortia dentata Shrubland is found on cool north-east to south-east-facing slopes. In this instance the type of vegetation could be attributed to aspect but a more likely explanation is that moisture is almost always available to this community from a perennial seep on the steep slopes above. Werger et al. (1972) commented on "the strict aspect preferences of the Protea arborea - Rhus angustifolia and the Brunia nodiflora - Psoralea rotundifolia Communities". I hesitate to support this observation because it is difficult to evaluate aspect preference of plant communities in Swartboschkloof. I suggest that the distribution of these two communities is determined by edaphic factors rather than by aspect. The Protea arborea - Rhus angustifolia Community (divided in this study between the Restio gaudichaudianus - Myrsine africana and the Rhus angustifolia - Restio gaudichaudianus Shrublands) is associated with detrital and colluvial soils of granite and sandstone origin, typically of the Oakleaf Form. I have observed that the Brunia nodiflora - Psoralea rotundifolia Community (which I did not sample) is associated with deep soils of granite origin.

Altitude and topography are closely linked. The high slopes comprise waxing, talus and detrital slopes whereas the lower slopes comprise plain, convexo-concave, concavo-convex and pediment slopes. The type of vegetation that becomes established on these different land-facets depends on the steepness of the slopes and the amount of soil developed. The steep cliffs at high altitude in Swartboschkloof where soil development is probably minimal, support low restioid-ericoid vegetation. (This vegetation was not sampled because the cliffs are inaccessible.) In contrast the lower slopes, where soils are better developed, support much taller shrubland vegetation such as the Rhus angustifolia - Restio gaudichaudianus High Closed Shrubland. Incised drainage lines where riparian vegetation is found occur from low to high altitudes in Swartboschkloof.

Kruger (1974) recognized two categories of Cape Mountain Fynbos ecosystems. Swartboschkloof falls within the limits of the first of these where,"the climate is warm, less humid and has a more pronounced contrast between winter and summer". Annual precipitation is high at Jonkershoek although the summers are hot and dry. During the summer months the fynbos is dormant, except for seep vegetation, whereas in the winter when moisture is readily available from rain, active growth occurs which is not depressed by cold temperatures. The forest vegetation continues to grow throughout the year (Wicht *et al.*, 1969), but growth is most vigorous in spring. The optimum time for sampling the vegetation is therefore in late winter and spring, when the greatest number of species are growing vigorously and flowering, rather than during the dry summer and autumn months when the plants are difficult to identify or do not have visible above-ground parts.

The Jonkershoek valley is prone to strong winds. Wind data for an arbitrary year (1979) presented diagrammatically in Fig. 8 show that winds blow from the south-east the whole year through with an increase in duration and speed from this direction in summer. This has important consequences because the vegetation is subject to desiccation from the wind which probably enhances the effect of summer drought. It also makes the vegetation more prone to fire (Kruger, 1977). There is an increase in the incidence of wind from the north-west in winter although compared with the south-easterly winds they are much weaker and last for shorter periods. Calm periods make up only 10 % of the total yearly wind cycle. One instance of the mechanical effects of wind was noted at and near relevé 128, where the wind has pruned Protea repens shrubs to a height of 1,5 m.

The last major fire in Swartboschkloof was in February 1958. The vegetation has apparently recovered to its former stature and composition except in the area subsequently burnt in September, 1973. A considerable amount of litter has built up under the vegetation, particularly under the Protea-dominated shrublands. In some places the large shrubs are dying which adds to the litter and creates openings in the canopy which in turn allows understorey plants to proliferate. Absence of seed-regenerating shrubs in the firebreaks on the perimeter of the study area is attributed to the short fire frequency of the burning regime and to the shallow sandy soils as, the firebreaks are mostly at high elevations (Van Wilgen, 1981).

There are two main alien plant species in Swartboschkloof: Pinus pinaster and Hakea sericea. Both pose a threat to the natural vegetation. Pinus pinaster can invade undisturbed sites, whereas Hakea sericea tends to invade disturbed sites (Neser and Fugler, 1978) although it has been noted in undisturbed vegetation in Swartboschkloof (Fig. 9). An interesting observation is that there are many Hakea sericea individuals (9 - 10 years old) which have become established in the area burnt in the 1973 fire. In one stand on the western slopes, as many as 57 individuals were counted. This is c use for concern because if another uncontrolled fire occurs, Hakea sericea could invade other areas of Swartboschkloof. Urgent eradication of these invader plants is required before they spread further.

It is clear, therefore, that the distribution of the plant communities is not determined by any single factor but by an interaction of all the environmental factors mentioned. As Campbell (1983) points out, it is difficult to separate the effects of the environmental factors, like the effects of soil from the effects of climate. No single environmental component can be treated in isolation although it does appear that in Swartboschkloof, water availability and soil geology play a dominant role in determining the pattern of community distribution.

Comparisons between the plant communities of Swartboschkloof and other Mountain Fynbos vegetation show interesting similarities between at least some of the communities. It shows that there are probably a limited number of 'habitat-types' found throughout the Cape mountains (cf. Campbell, 1983) but that due to local factors the species composition of any given community is different, although structurally and functionally the communities are similar. A good example of this is the parallel between the Leptocarpus membranaceus - Hypodiscus aristatus Community on Table Mountain (McKenzie et al., 1977), the Willdenowia sulcata communities at Jakkalsrivier (Kruger, 1974) and the Restio sieberi - Nebelia paleacea Shrubland at Swartboschkloof. This supports the view expressed by Werger et al. (1972) that to classify fynbos vegetation it will be necessary to "distinguish geographical races of an association, or regional associations with a limited geographical extension" and even though this study is a re-evaluation and extension of their work, it serves as a pointer to possible future research on the interactions between plant communities and the physical environment at Swartboschkloof.

5. CONCLUSIONS

The conclusions that may be drawn from this study are as follows:

1. The Braun-Blanquet phytosociological method is suitable for sampling both the fynbos and forest vegetation. It is, however, inadequate for clearly showing the relationship between plant community distribution and environmental factors determining this distribution.

2. Ordination or principal components analyses should be applied to data such as those collected in this study, to determine the causal relationships between physical environment and vegetation.

3. Aerial photograph interpretation is essential at the outset of a phyto-sociological survey to determine physiographic-physiognomic units for sample site selection.

4. Accurate maps of plant communities of areas surveyed are a necessity. Such maps can be used to monitor successional changes in the vegetation, particularly if mature vegetation happens to be burnt.

5. Positions of relevés should be carefully plotted on base maps. It is then possible to re-evaluate relevés in subsequent studies as has been done with the Werger et al. (1972) data in the present study.

6. Correlation of plant community description with soils provides valuable information for interpreting plant community floristics and structure.

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APPENDIX

Species excluded from Table 8 (relevés and cover-abundance values in brackets).

Adenandra marginata (111: 1)
Agathosma cf. serpyllacea (69: +)
Argyrolobium lunaris (119: R)
Artemisia afra (64: 0)
Aristea africana (28: +)
Asclepias cancellata (41: +)
Aspalathus ciliaris (188: 0)
Aspalathus retroflexa (152: 2)
Brabejum stellatifolium (102: 0, 59: 0)
Berkheya sp. (151: +)
Blechnum sylvaticum (102: +)
Centella calliodus (18: +, 105: R)
Cheilanthes contracta (138: 0)
Chrysocoma coma-aurea (157: +)
Cliffortia complanata (120: 0)
Cliffortia graminea (102: 0)
Cliffortia integerrima (153: 0)
Cliffortia pterocarpa (123: 1)
Clutia pterogona (37: +)
Conyza ulmifolia (63: 1)
Crassula dejecta (123: +)
Dodonaea viscosa (1: 0)
Elytropappus glandulosus (1: 0)
Elytropappus gnaphaloides (1: 0)
Erica corifolia (133: +)
Erica lutea (121: +)
Erica sp. (46: +)
Erica sp. (149: R)
Euphorbia erythrina (31: +)
Harveya capensis (131: r)
Helichrysum asperum (103: +)
Helichrysum nudifolium (33: R)
Helichrysum sp. (99: R)
Heliophila scoparia (138: +)
Hibiscus aethiopicus (1: 1)
Lampranthus acutifolius (149: +)
Leptocarpus esterhuyseniae (133: +)
Leucospermum lineare (40: +)
Linum africanum (157: +)
Linum quadrifolium (4: +)
Microloma tenuifolium (165: R)
Othonna quinquedentata (180: 1)
Passerina vulgaris (12: +)
Pelargonium cucculatum (18: +)
Pentameris thuarii (32: +)
Peucedanum galbaniopse (179: +)
Podalyria cf. calyptrata (4: 0)
Polygala garcini (180: +)
Priestleya cf. tomentosa (30: +)
Prismatocarpus tenerrimus (145: R)
Rafnia capensis (55: 0)
Restio cf. monanthus (31: +)
Restio pusillus (158: +)
Rubus sp. (64: +)
Salvia sp. (99: R)
Scirpus sp. (99: 1)
Scirpus venustulus (143: r)
Sebaea exacoides (92: 0)
Solanum retroflexum (79: 0)
Stoebe prostrata (143: +)
Struthiola cf. ciliata (13: 0)
Struthiola myrsinites (96: 1)
Tetraria cf. crassa (191: +)
Tetraria sp. (25: +)
Thamnochortus cf. dichotomus (10: +)
Thesium capitatum (31: +, 156: 0)
Thesium strictum (4: +)
Thesium sp. (191: +)
Todea barbara (151: 0)
Ursinia dentata (144: 0)

Species excluded from Table 10 (relevés and cover-abundance values in brackets)

Anemia simii (110: +)
Asclepias cancellata (6: 0)
Aristea cf. confusa (35: 0)
Centella cf. eriantha (94: +)
Centella flexuosa (114: +)
Conyza floribunda (194: +)
Cullumia setosa (94:2)
Ficinia trichodes (3: 1)
Galium mucroniferum (167: +)
Gleichenia polypodioides (114: 2)
Leucadendron salignum (35: 0)
Merxmuellera stricta (166: +)
Olea capensis (116: +)
Osmitopsis asteriscoides (167: +)
Passiflora quadrangularis (163: +)
Penaea mucronata (3: 2)
Pentaschistis aristidoides (202: 0)
Phylica spicata (3: +)
Podalyria cf. montana (110: 1)
Psoralea obliqua (166: +)
Psoralea pinnata (35: 0)
Restio cf. monanthus (6: 1)
Scirpus ecklonii (114: +)
Salvia chamaelaeagnea (166: +)
Tetraria cuspidata (166: +)
Tetraria sp. (6: +)
Ursinia pinnata (35: +)
Watsonia pyramidata (3: +)

Abbreviations used in Braun-Blanquet Tables :

Moisture Index

W - Permanent free water

T - Temporary free water

M - Waterlogged soil : mottled or peaty, can be seasonal

D - Well-drained soil

Substrate

C	Clay	(0,002 mm ∅)
A	Silt	(0,002 - 0,02 mm ∅)
S	Sand	(0,02 - 2,0 mm ∅)
L	Loam	(mixture C, A & S)
O	Organic	
G	Gravel	(2 - 20 mm ∅)
I	Stones	(20 - 200 mm ∅)
B	Boulders	(200 - 2000 mm ∅)
R	Bedrock	
D	Rock ridges	(e.g. dykes)

Geology

C1Q	Table Mountain Sandstone
G	Cape Granite

Disturbance

N None (ground layer complete)

L Light (ground layer present but disturbed)

M Moderate (ground layer absent between shrubs)

H Heavy (bare ground dominates the vegetation)

F Firebreak

Fig. 3, 4 and 9

Tables 8, 9, 10 and 11

Note: 1. Relevé numbers and habitat data should be read vertically.

2. Aspect refers to corrected compass reading.

3. Soil series code follows Macvicar et al. (1977).

4. Cover abundance symbols after Kuchler (1967), 0 refers to species within 1 m outside any relevé.

5. Land-facet abbreviations as in Fig. 10.

6. Vegetation age in years.

7. Abbreviations for geology, substrate, soil moisture and disturbance amplified in the Appendix

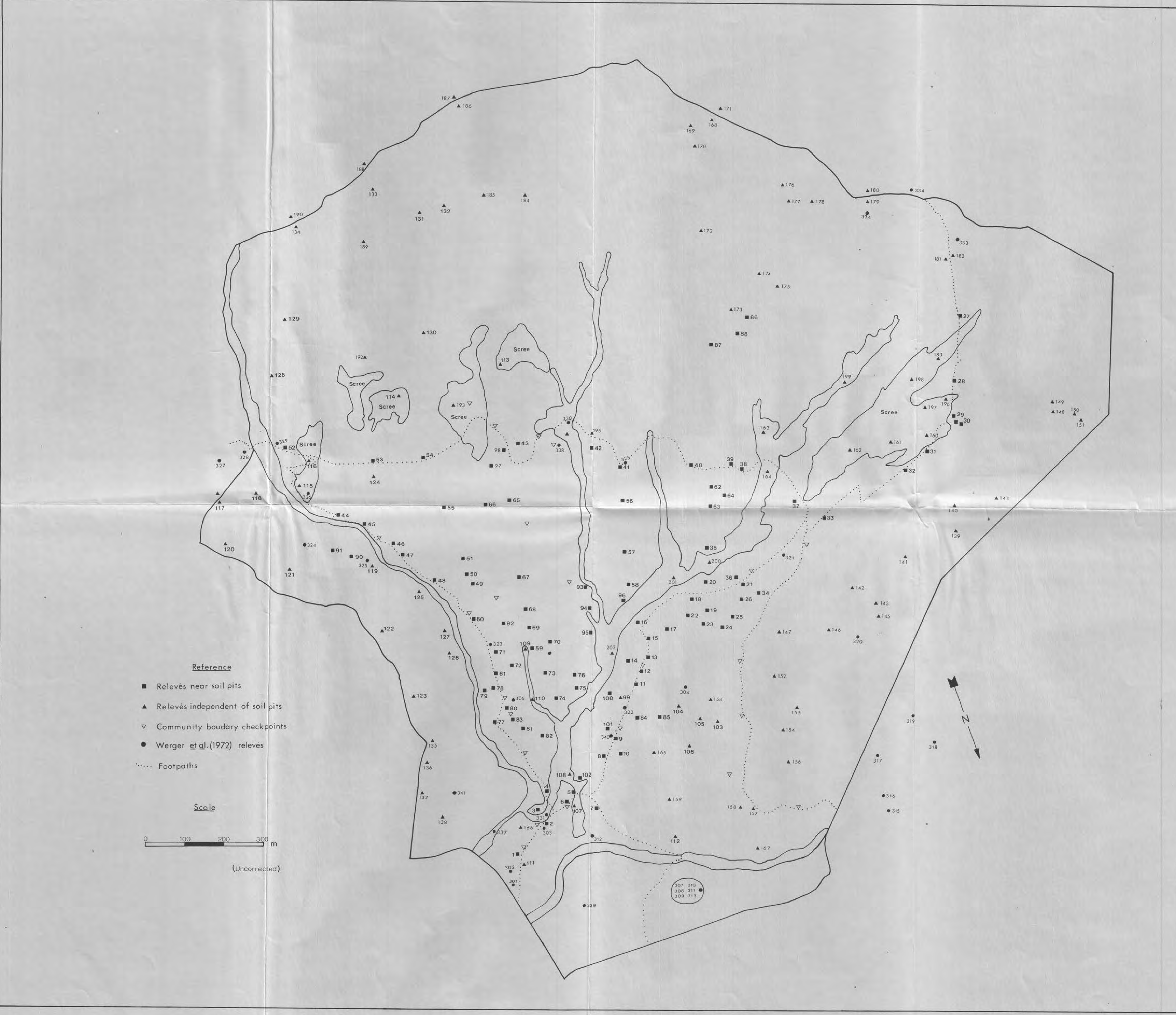

Fig. 3 . Sketch-map of Swartboschkloof, showing location of relevés.

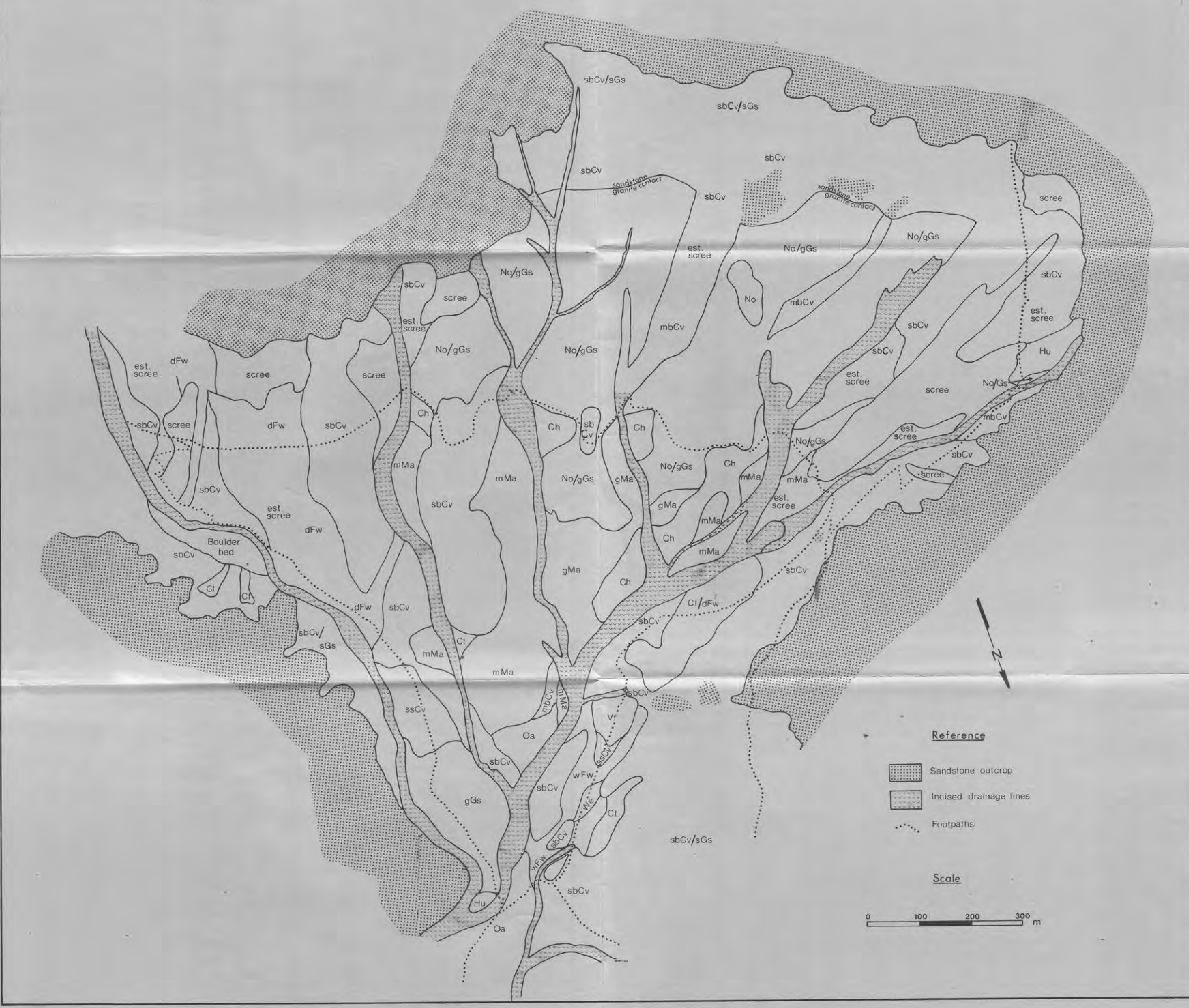

Fig. 4. The Soils of Swartbosckloof; redrawn after Fry (in prep.). Refer to Table 1 for the classification.

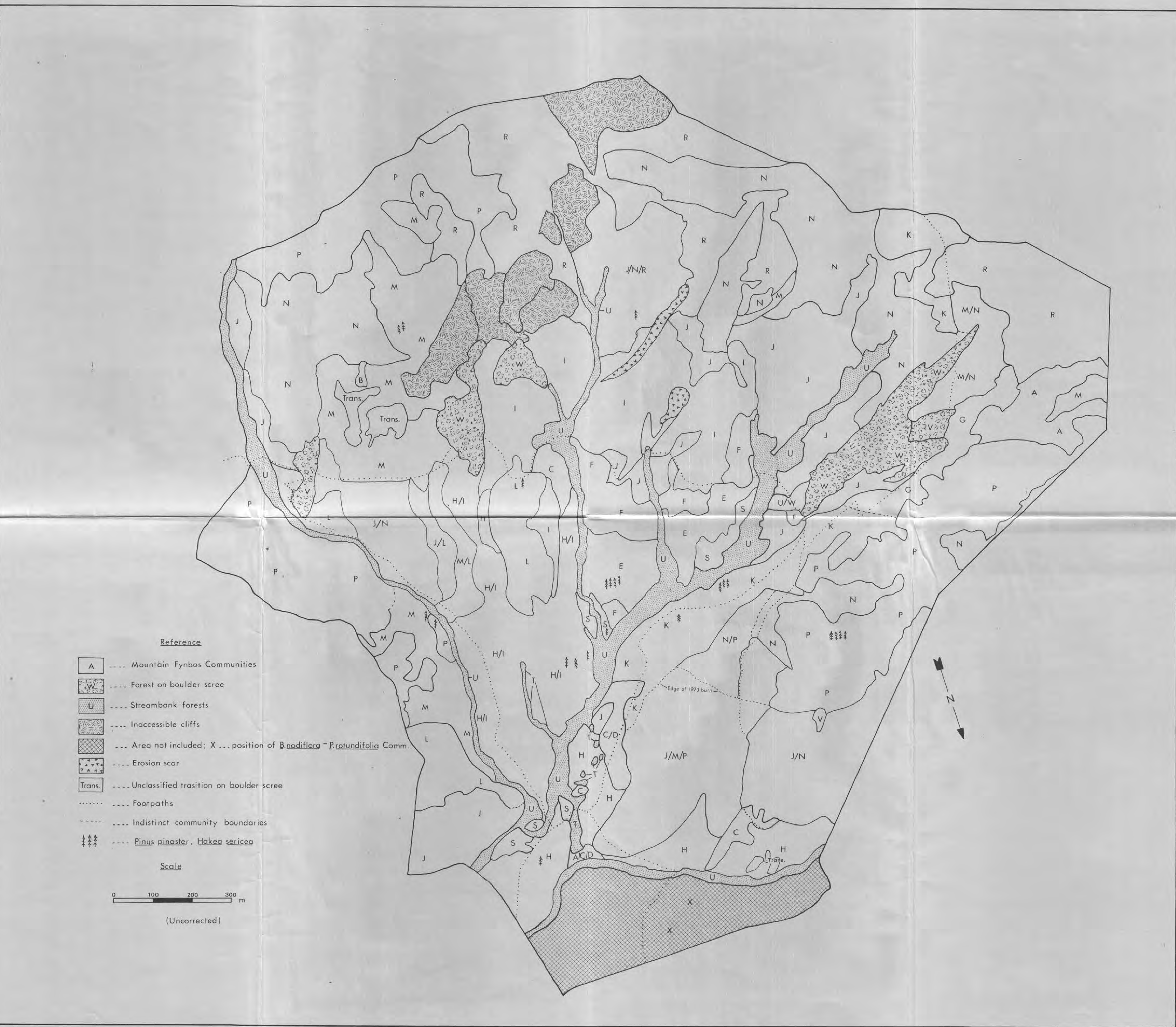

Fig.9. The Plant Communities of Swartboschkloof.

Table 8. Phytosociological table of the Mountain Fynbos of Swartboschkloof.

Header	Relevé data	Summary Table
RELEVE NUMBERS	[illegible]	
DATE	[illegible]	
GRID REFERENCE	[illegible]	
LAND FACET	[illegible]	
ALTITUDE IN METRES	[illegible]	
ASPECT	[illegible]	
SLOPE IN DEGREES	[illegible]	
GEOLOGY	[illegible]	
SUBSTRATE	[illegible]	
SOIL SERIES CODE	[illegible]	
SOIL DEPTH IN CMS	[illegible]	
SOIL MOISTURE	[illegible]	
ROCK COVER %	[illegible]	
LITTER COVER %	[illegible]	
VEGETATION COVER %	[illegible]	
DISTURBANCE	[illegible]	
VEGETATION AGE	[illegible]	
NUMBER OF SPECIES	[illegible]	
RELEVE NUMBERS	[illegible]	
COMMUNITY REF. NO.	[illegible]	[illegible]

Genus	Species	Relevé data	Summary Table
3. 1. 1. 1 DIFFERENTIAL SPECIES OF THE DIOSPYROS GLABRA-ELEGIA CAPENSIS SHRUBLAND			
ELEGIA	CAPENSIS	[illegible]	[illegible]
BLECHNUM	PUNCTULATUM	[illegible]	[illegible]
COLLOMIA	SETOSA	[illegible]	[illegible]
CRASSULA	PELLUCIDA	[illegible]	[illegible]
NEMESIA	ACUMINATA	[illegible]	[illegible]
CRASSULA	COCCINEA	[illegible]	[illegible]
HIPPIA	PILOSA	[illegible]	[illegible]
LAMPRANTHUS	DELTOIDES	[illegible]	[illegible]
3. 1. 1. 2 DIFFERENTIAL SPECIES OF THE DIOSPYROS GLABRA-CLIFFORTIA ODORATA SHRUBLAND			
CLIFFORTIA	ODORATA	[illegible]	[illegible]
LEUCADENDRON	SALICIFOLIUM	[illegible]	[illegible]
BRACHYLAENA	NERIIFOLIA	[illegible]	[illegible]
CENTELLA	ERIANTHA	[illegible]	[illegible]
ELEGIA	THYSIFERA	[illegible]	[illegible]
SCIRPUS	SP.	[illegible]	[illegible]
3. 1. 1. 3. 1. 1 DIFFERENTIAL SPECIES OF THE BERZELIA LANUGINOSA - MERXMUELLERA CINCTA SHRUBLAND			
MERXMUELLERA	CINCTA	[illegible]	[illegible]
RESTIO	DEPAUPERATUS	[illegible]	[illegible]
CUNONIA	CAPENSIS	[illegible]	[illegible]
GNIDIA	OPPOSITIFOLIA	[illegible]	[illegible]
LAURENTIA	ARABIDEA	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 1. 1, 3. 1. 1. 2 & 3. 1. 1. 3. 1. 1			
OSMITOPSIS	ASTERISCOIDES	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 1. 1 & 3. 1. 1. 3. 1. 1			
LEPTOCARPUS	PANICULATUS	[illegible]	[illegible]
ERICA	CURVIFLORA	[illegible]	[illegible]
CARPHA	GLOMERATA	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 1. 3. 1 & 3. 1. 1. 3. 1. 1			
BERZELIA	LANUGINOSA	[illegible]	[illegible]
ELEGIA	ASPERIFLORA	[illegible]	[illegible]
NEESENBECKIA	PUNCTORIA	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 1. 3. 2 & 3. 1. 1. 3. 3. 1			
OLEA	EUROPAEA SUBSP AFRICANA	[illegible]	[illegible]
MAYTENUS	ACUMINATA	[illegible]	[illegible]
ZANTEDESCHIA	AETHIOPICA	[illegible]	[illegible]
BLECHNUM	AUSTRALE	[illegible]	[illegible]
RAPANEA	MELANOPHLOEOS	[illegible]	[illegible]
HALLERIA	LUCIDA	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 1. 1, 3. 1. 1. 2, 3. 1. 1. 3. 3. 1 & 3. 1. 1. 3. 3. 2			
PSORALEA	PINNATA	[illegible]	[illegible]
3. 1. 1. 3. 3. 2 DIFFERENTIAL SPECIES OF THE MYRSINE AFRICANA - CLIFFORTIA DENTATA SHRUBLAND			
CLIFFORTIA	DENTATA	[illegible]	[illegible]
PENTASCHISTIS	ARISTIDOIDES	[illegible]	[illegible]
FICINIA	TRICHODES	[illegible]	[illegible]
GALIUM	MUCRONIFERUM	[illegible]	[illegible]
PELARGONIUM	?TABULARE	[illegible]	[illegible]
POLYARRHENA	REFLEXA	[illegible]	[illegible]
SELAGO	SERRATA	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 1. 3. 3. 1 & 3. 1. 1. 3. 3. 2			
ASPARAGUS	COMPACTUS	[illegible]	[illegible]
PSORALEA	CORDATA	[illegible]	[illegible]
TETRARIA	SYLVATICA	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 1. 3. 3. 1, 3. 1. 1. 3. 3. 2, 3. 1. 1. 3. 4 & 3. 1. 1. 3. 4. 1			
MYRSINE	AFRICANA	[illegible]	[illegible]
RHUS	TOMENTOSA	[illegible]	[illegible]
OXALIS	BIFIDA	[illegible]	[illegible]
HARTOGIELLA	SCHINOIDES	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 1. 3. 4, 3. 1. 1. 3. 4. 1, 3. 1. 2. 1, 3. 1. 2. 1. 1 & 3. 1. 2. 1. 2			
RESTIO	GAUDICHAUDIANUS	[illegible]	[illegible]
OXALIS	VERSICOLOR	[illegible]	[illegible]
PELARGONIUM	MYRRHIFOLIUM	[illegible]	[illegible]
PSORALEA	SPICATA	[illegible]	[illegible]
EUPHORBIA	GENISTOIDES	[illegible]	[illegible]
HELICHRYSUM	ZEYHERI	[illegible]	[illegible]
PHYLICA	SPICATA	[illegible]	[illegible]
PENTASCHISTIS	ASPERA	[illegible]	[illegible]
TETRARIA	FLEXUOSA	[illegible]	[illegible]
AGATHOSMA	JUNIPERIFOLIA	[illegible]	[illegible]
METALASIA	CEPHALOTES	[illegible]	[illegible]
MOHRIA	CAFFRORUM	[illegible]	[illegible]
RHYNCHOSIA	TOTTA	[illegible]	[illegible]
HELICHRYSUM	TERETIFOLIUM	[illegible]	[illegible]
MURALTIA	HEISTERIA	[illegible]	[illegible]
HELICHRYSUM	AURICULATUM	[illegible]	[illegible]
OSTEOSPERMUM	TOMENTOSUM	[illegible]	[illegible]
PSORALEA	ROTUNDIFOLIA	[illegible]	[illegible]
AGATHOSMA	CAPENSIS	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 1. 3. 1, 3. 1. 1. 3. 1. 1, 3. 1. 1. 3. 2, 3. 1. 1. 3. 3. 1, 3. 1. 1. 3. 3. 2, 3. 1. 1. 3. 4, 3. 1. 1. 3. 4. 1, 3. 1. 2. 1, 3. 1. 2. 1. 1, 3. 1. 2. 1. 2 & 3. 1. 2. 2. 1			
RHUS	ANGUSTIFOLIA	[illegible]	[illegible]
PTERIDIUM	AQUILINUM	[illegible]	[illegible]
ANTHOSPERMUM	AETHIOPICUM	[illegible]	[illegible]
ERICA	SPHAEROIDEA	[illegible]	[illegible]
MAYTENUS	OLEOIDES	[illegible]	[illegible]
RHUS	ROSMARINIFOLIA	[illegible]	[illegible]
ASPARAGUS	RUBICUNDUS	[illegible]	[illegible]
FICINIA	FILIFORMIS	[illegible]	[illegible]
HALLERIA	ELLIPTICA	[illegible]	[illegible]
CHIRONIA	BACCIFERA	[illegible]	[illegible]
PHYLICA	PUBESCENS	[illegible]	[illegible]
AGAPANTHUS	AFRICANUS	[illegible]	[illegible]
HELICHRYSUM	CYMOSUM	[illegible]	[illegible]
HELICHRYSUM	ODORATISSIMUM	[illegible]	[illegible]
ARISTIDA	JUNCIFORMIS	[illegible]	[illegible]
SENECIO	UMBELLATUS	[illegible]	[illegible]
ASPARAGUS	ASPARAGOIDES	[illegible]	[illegible]
CHASMANTHE	AETHIOPICA	[illegible]	[illegible]
ELEGIA	NEESII	[illegible]	[illegible]
HELICHRYSUM	CRISPUM	[illegible]	[illegible]
OFTIA	AFRICANA	[illegible]	[illegible]
PENTASCHISTIS	CAPENSIS	[illegible]	[illegible]
PSORALEA	FRUTICANS	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 1. 3. 1, 3. 1. 1. 3. 2, 3. 1. 1. 3. 3. 1, 3. 1. 1. 3. 3. 2, 3. 1. 1. 3. 4, 3. 1. 1. 3. 4. 1, 3. 1. 2. 1, 3. 1. 2. 1. 1, 3. 1. 2. 1. 2, 3. 1. 2. 2. 1 & 3. 1. 2. 2. 2			
PROTEA	NITIDA	[illegible]	[illegible]
PROTEA	REPENS	[illegible]	[illegible]
BRUNIA	NODIFLORA	[illegible]	[illegible]
MONTINIA	CARYOPHYLLACEA	[illegible]	[illegible]
THEMEDA	TRIANDRA	[illegible]	[illegible]
OLIA	GUMMIFERA	[illegible]	[illegible]
3. 1. 3. 1 DIFFERENTIAL SPECIES OF THE RESTIO SIEBERI - NEBELIA PALEACEA SHRUBLAND			
ERICA	COCCINEA	[illegible]	[illegible]
LEPTOCARPUS	MEMBRANACEUS	[illegible]	[illegible]
CLIFFORTIA	EXILIFOLIA	[illegible]	[illegible]
TETRARIA	BURMANII	[illegible]	[illegible]
SYMPIEZA	ARTICULATA	[illegible]	[illegible]
BERZELIA	INTERMEDIA	[illegible]	[illegible]
SPECIES COMMON TO ALL COMMUNITIES EXCEPT 3. 1. 3. 2			
DIOSPYROS	GLABRA	[illegible]	[illegible]
TETRARIA	BROMOIDES	[illegible]	[illegible]
CLIFFORTIA	RUSCIFOLIA	[illegible]	[illegible]
LEUCADENDRON	SALIGNUM	[illegible]	[illegible]
THAMNOCHORTUS	FRUTICOSUS	[illegible]	[illegible]
ERICA	NUDIFLORA	[illegible]	[illegible]
CANNOMOIS	VIRGATA	[illegible]	[illegible]
TETRARIA	USTULATA	[illegible]	[illegible]
WIDDRINGTONIA	NODIFLORA	[illegible]	[illegible]
3. 1. 3. 2 DIFFERENTIAL SPECIES OF THE RESTIO SIEBERI - TETRARIA INVOLUCRATA SHRUBLAND			
TETRARIA	INVOLUCRATA	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 2. 2. 1, 3. 1. 2. 2. 2, 3. 1. 3. 1 & 3. 1. 3. 2			
NEBELIA	PALEACEA	[illegible]	[illegible]
TETRARIA	CAPILLACEA	[illegible]	[illegible]
CLUTIA	POLYGONOIDES	[illegible]	[illegible]
RESTIO	PERPLEXUS	[illegible]	[illegible]
BOBARTIA	GLADIATA	[illegible]	[illegible]
ERICA	LONGIFOLIA	[illegible]	[illegible]
CLUTIA	RUBRICAULIS	[illegible]	[illegible]
ERICA	CALYCINA	[illegible]	[illegible]
EURYOPS	ABROTANIFOLIUS	[illegible]	[illegible]
PRISMATOCARPUS	DIFFUSUS	[illegible]	[illegible]
AGATHOSMA	SP. 925/47, 927/9	[illegible]	[illegible]
ERICA	RACEMOSA	[illegible]	[illegible]
STOEBE	SPIRALIS	[illegible]	[illegible]
HELICHRYSUM	FELINUM	[illegible]	[illegible]
CRASSULA	PRUINOSA	[illegible]	[illegible]
PENTASCHISTIS	AMPLA	[illegible]	[illegible]
SPECIES COMMON TO COMMUNITIES 3. 1. 2. 1, 3. 1. 2. 1. 1, 3. 1. 2. 1. 2, 3. 1. 2. 2. 1, 3. 1. 2. 2. 2, 3. 1. 3. 1 & 3. 1. 3. 2			
RESTIO	SIEBERI	[illegible]	[illegible]
ELEGIA	JUNCEA	[illegible]	[illegible]
PENTASCHISTIS	COLORATA	[illegible]	[illegible]
PENTASCHISTIS	CURVIFOLIA	[illegible]	[illegible]
ANTHOSPERMUM	CILIARE	[illegible]	[illegible]
STABEROHA	CERNUA	[illegible]	[illegible]
PENAEA	MUCRONATA	[illegible]	[illegible]
THAMNOCHORTUS	GRACILIS	[illegible]	[illegible]
CORYMBIUM	GLABRUM	[illegible]	[illegible]
HYPODISCUS	ALBO-ARISTATUS	[illegible]	[illegible]
PSORALEA	ACULEATA	[illegible]	[illegible]
CORYMBIUM	VILLOSUM	[illegible]	[illegible]
FICINEA	DEUSTA	[illegible]	[illegible]
HYPODISCUS	ARISTATUS	[illegible]	[illegible]
MERXMUELLERA	LUPULINA	[illegible]	[illegible]
COLEONEMA	JUNIPERINUM	[illegible]	[illegible]
BLAERIA	DUMOSA	[illegible]	[illegible]
METALASIA	MURICATA	[illegible]	[illegible]
AGATHELPIS	DUBIA	[illegible]	[illegible]
RESTIO	FILIFORMIS	[illegible]	[illegible]
BERKHEYA	HERBACEA	[illegible]	[illegible]
THAMNOCHORTUS	DICHOTOMUS	[illegible]	[illegible]
WILLDENOWIA	SULCATA	[illegible]	[illegible]
OSMITOPSIS	AFRA	[illegible]	[illegible]
FICINIA	NIGRESCENS	[illegible]	[illegible]
ERICA	CURVIROSTRIS	[illegible]	[illegible]
PENTASCHISTIS	STEUDELII	[illegible]	[illegible]
PEUCEDANUM	SIEBERIANUM	[illegible]	[illegible]
SCABIOSA	COLUMBARIA	[illegible]	[illegible]
CENTELLA	GLABRATA	[illegible]	[illegible]
RESTIO	CUSPIDATUS	[illegible]	[illegible]
FICINIA	BERGIANA	[illegible]	[illegible]
ERICA	CERINTHOIDES	[illegible]	[illegible]
HETEROLEPIS	ALIENA	[illegible]	[illegible]
PENTAMERIS	MACROCALYCINA	[illegible]	[illegible]
STRUTHIOLA	CILIATA	[illegible]	[illegible]
CARPACOCE	VAGINELLATA	[illegible]	[illegible]
ERICA	ARTICULARIS	[illegible]	[illegible]
GNIDIA	ANOMALA	[illegible]	[illegible]
ATHRIXIA	HETEROPHYLLA	[illegible]	[illegible]
INDIGOFERA	MAURETANICA	[illegible]	[illegible]
BERZELIA	ABROTANOIDES	[illegible]	[illegible]
EROEDA	IMBRICATA	[illegible]	[illegible]
WIDESPREAD SPECIES IN THE FYNBOS COMMUNITIES			
ARISTEA	MAJOR	[illegible]	[illegible]
CYMBOPOGON	MARGINATUS	[illegible]	[illegible]
ERICA	HISPIDULA	[illegible]	[illegible]
RESTIO	TRITICEUS	[illegible]	[illegible]
MERXMUELLERA	STRICTA	[illegible]	[illegible]
TETRARIA	CUSPIDATA	[illegible]	[illegible]
PROTEA	NERIIFOLIA	[illegible]	[illegible]
BOBARTIA	INDICA	[illegible]	[illegible]
ARISTEA	?CONFUSA	[illegible]	[illegible]
PROTEA	ACAULOS	[illegible]	[illegible]
CLUTIA	ALATERNOIDES	[illegible]	[illegible]
STOEBE	PLUMOSA	[illegible]	[illegible]
CLIFFORTIA	POLYGONIFOLIA	[illegible]	[illegible]
OXALIS	LANATA	[illegible]	[illegible]
CLIFFORTIA	CUNEATA	[illegible]	[illegible]
URSINIA	CRITHMOIDES	[illegible]	[illegible]
EREMIA	TOTTA	[illegible]	[illegible]
DIOSMA	HIRSUTA	[illegible]	[illegible]
WATSONIA	PYRAMIDATA	[illegible]	[illegible]
LICHTENSTEINIA	LACERA	[illegible]	[illegible]
SCHIZAEA	PECTINATA	[illegible]	[illegible]
CASSYTHA	CILIOLATA	[illegible]	[illegible]
PELARGONIUM	SANICULAEFOLIUM	[illegible]	[illegible]
EHRHARTA	RAMOSA	[illegible]	[illegible]
LEUCADENDRON	SPISSIFOLIUM	[illegible]	[illegible]
ERICA	PLUKENETII	[illegible]	[illegible]
CACSIA	CONTORTA	[illegible]	[illegible]
HAPLOCARPHA	LANATA	[illegible]	[illegible]
PSORALEA	OBLIQUA	[illegible]	[illegible]
LOBELIA	CORONOPIFOLIA	[illegible]	[illegible]
ARCTOTIS	SEMIPAPPOSA	[illegible]	[illegible]
PELLAEA	PTEROIDES	[illegible]	[illegible]
DILATRIS	SP	[illegible]	[illegible]
URSINIA	PINNATA	[illegible]	[illegible]
EHRHARTA	DURA	[illegible]	[illegible]
CASTALIS	NUDICAULIS	[illegible]	[illegible]
TETRARIA	FASCIATA	[illegible]	[illegible]
GERBERA	CROCEA	[illegible]	[illegible]
STOEBE	CINEREA	[illegible]	[illegible]
RESTIO	SUBVERTICILLATUS	[illegible]	[illegible]
PODALYRIA	?MONTANA	[illegible]	[illegible]
HAKEA	SERICEA	[illegible]	[illegible]
SELAGO	SPURIA	[illegible]	[illegible]
CRASSULA	FASCICULARIS	[illegible]	[illegible]
SENECIO	CYMBALARIAEFOLIUS	[illegible]	[illegible]
CYPHIA	VOLUBILIS	[illegible]	[illegible]
MURALTIA	ALOPECUROIDES	[illegible]	[illegible]
OSTEOSPERMUM	JUNCEUM	[illegible]	[illegible]
CRASSULA	NUDICAULIS	[illegible]	[illegible]
AGATHOSMA	SERPYLLACEA	[illegible]	[illegible]
ANAXETON	ASPERUM	[illegible]	[illegible]
CENTELLA	?ERIANTHA	[illegible]	[illegible]
CENTELLA	FLEXUOSA	[illegible]	[illegible]
CENTELLA	SP	[illegible]	[illegible]
FICINIA	GRANDIFLORA	[illegible]	[illegible]
GAZANIA	SERRATA	[illegible]	[illegible]
GRASS	813/19, 814/33	[illegible]	[illegible]
GRASS	879/24, 881/12	[illegible]	[illegible]
HELICHRYSUM	LITORALE	[illegible]	[illegible]
KNOWLTONIA	VESICATORIA	[illegible]	[illegible]
MAIREA	MICROCEPHALA	[illegible]	[illegible]
MURALTIA	MACROCERAS	[illegible]	[illegible]
MYRICA	SERRATA	[illegible]	[illegible]
OSTEOSPERMUM	CILIATUM	[illegible]	[illegible]
PELARGONIUM	?PATULUM	[illegible]	[illegible]
PELLAEA	CALOMELANOS	[illegible]	[illegible]
PINUS	PINASTER	[illegible]	[illegible]
PRIESTLEYA	ELLIPTICA	[illegible]	[illegible]
PSORALEA	APHYLLA	[illegible]	[illegible]
ROELLA	CILIATA	[illegible]	[illegible]
SALVIA	CHAMAELAEAGNEA	[illegible]	[illegible]
TETRARIA	CRASSA	[illegible]	[illegible]
VISCUM	PAUCIFOLIUM	[illegible]	[illegible]

Table 9. Phytosociological table of the Mountain Fynbos of Swartboschkloof, using data from Werger et al. (1972).

Note: The relevé order follows Werger et al. (1972), Table 7, and the community names and species order follow those in Table 8 of the present study.

RELEVE NUMBERS	[illegible]
DATE	[illegible]
GRID REFERENCE	[illegible]
LAND FACET	[illegible]
ALTITUDE IN METRES	[illegible]
ASPECT	[illegible]
SLOPE IN DEGREES	[illegible]
GEOLOGY	[illegible]
SUBSTRATE	
SOIL SERIES CODE	
SOIL DEPTH IN CMS	[illegible]
SOIL MOISTURE	
ROCK COVER %	
LITTER COVER %	
VEGETATION COVER %	[illegible]
DISTURBANCE	[illegible]
VEGETATION AGE	[illegible]
NUMBER OF SPECIES	[illegible]
RELEVE NUMBERS	[illegible]
COMMUNITY REF. NO	1 2 3 4 5

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3.1.1.1 DIFFERENTIAL SPECIES OF THE DIOSPYROS GLABRA - ELEGIA CAPENSIS SHRUBLAND

ELEGIA	CAPENSIS
BLECHNUM	PUNCTULATUM
CULLUMIA	SETOSA
CRASSULA	PELLUCIDA
NEMESIA	ACUMINATA
CRASSULA	COCCINEA
HIPPIA	PILOSA
LAMPRANTHUS	DELTOIDES

3.1.1.2 DIFFERENTIAL SPECIES OF THE DIOSPYROS GLABRA CLIFFORTIA ODORATA SHRUBLAND

CLIFFORTIA	ODORATA
LEUCADENDRON	SALICIFOLIUM
BRACHYLAENA	NERIIFOLIA
CENTELLA	ERIANTHA
ELEGIA	THYSIFERA
SCIRPUS	SP.

3.1.1.3.1.1 DIFFERENTIAL SPECIES OF THE BERZELIA LANUGINOSA - MERXMUELLERA CINCTA SHRUBLAND

MERXMUELLERA	CINCTA
RESTIO	DEPAUPERATUS
CUNONIA	CAPENSIS
GNIDIA	OPPOSITIFOLIA
LAURENTIA	ARABIDEA

SPECIES COMMON TO COMMUNITIES 3.1.1.1, 3.1.1.2 & 3.1.1.3.1.1

OSMITOPSIS	ASTERISCOIDES

SPECIES COMMON TO COMMUNITIES 3.1.1.1 & 3.1.1.3.1.1

LEPTOCARPUS	PANICULATUS
ERICA	CURVIFLORA
CARPHA	GLOMERATA

SPECIES COMMON TO COMMUNITIES 3.1.1.3.1 & 3.1.1.3.1.1

BERZELIA	LANUGINOSA
ELEGIA	ASPERIFLORA
NEESENBECKIA	PUNCTORIA

SPECIES COMMON TO COMMUNITIES 3.1.1.3.3 & 3.1.1.3.3.1

OLEA	EUROPAEA SUBSP AFRICANA
MAYTENUS	ACUMINATA
ZANTEDESCHIA	AETHIOPICA
BLECHNUM	AUSTRALE
RAPANEA	MELANOPHLOEOS
HALLERIA	LUCIDA

SPECIES COMMON TO COMMUNITIES 3.1.1.1, 3.1.1.2, 3.1.1.3.3.1 & 3.1.1.3.3.2

[illegible]

SPECIES COMMON TO COMMUNITIES 3.1.2.1, 3.1.2.1.1, 3.1.2.1.2, 3.1.2.2.1, 3.1.2.2.2, 3.1.3.1 & 3.1.3.2

RESTIO	SIEBERI
ELEGIA	JUNCEA
PENTASCHISTIS	COLORATA
PENTASCHISTIS	CURVIFOLIA
ANTHOSPERMUM	CILIARE
STABEROHA	CERNUA
PENAEA	MUCRONATA
THAMNOCHORTIS	GRACILIS
CORYMBIUM	GLABRUM
HYPODISCUS	ALBO-ARISTATUS
PSORALEA	ACULEATA
CORYMBIUM	VILLOSUM
FICINEA	DEUSTA
HYPODISCUS	ARISTATUS
MERXMUELLERA	LUPULINA
COLEONEMA	JUNIPERINUM
BLAERIA	DUMOSA
METALASIA	MURICATA
AGATHELPIS	DUBIA
RESTIO	FILIFORMIS
BERKHEYA	HERBACEA
THAMNOCHORTUS	DICHOTOMUS
WILLDENOWIA	SULCATA
OSMITOPSIS	AFRA
FICINIA	NIGRESCENS
ERICA	CURVIROSTRIS
PENTASCHISTIS	STEUDELII
PEUCEDANUM	SIEBERIANUM
SCABIOSA	COLUMBARIA
CENTELLA	GLABRATA
RESTIO	CUSPIDATUS
FICINIA	BERGIANA
ERICA	CERINTHOIDES
HETEROLEPIS	ALIENA
PENTAMERIS	MACROCALYCINA
STRUTHIOLA	CILIATA
CARPACOCE	VAGINELLATA
ERICA	ARTICULARIS
GNIDIA	ANOMALA
ATHRIXIA	HETEROPHYLLA
INDIGOFERA	MAURETANICA
BERZELIA	ABROTANOIDES
EROEDA	IMBRICATA

WIDESPREAD SPECIES IN THE FYNBOS COMMUNITIES

ARISTEA	MAJOR
CYMBOPOGON	MARGINATUS
ERICA	HISPIDULA
RESTIO	TRITICEUS
MERXMUELLERA	STRICTA
TETRARIA	CUSPIDATA
PROTEA	NERIIFOLIA
BOBARTIA	INDICA
ARISTEA	?CONFUSA
PROTEA	ACAULOS
CLUTIA	ALATERNOIDES
STOEBE	PLUMOSA
CLIFFORTIA	POLYGONIFOLIA
OXALIS	LANATA
CLIFFORTIA	CUNEATA
URSINIA	CRITHMOIDES
EREMIA	TOTTA
DIOSMA	HIRSUTA
WATSONIA	PYRAMIDATA
LICHTENSTEINIA	LACERA
SCHIZAEA	PECTINATA
CASSYTHA	CILIOLATA
PELARGONIUM	SANICULAEFOLIUM
EHRHARTA	RAMOSA
LEUCADENDRON	SPISSIFOLIUM
ERICA	PLUKENETTI
CAESIA	CONTORTA
HAPLOCARPHA	LANATA
LOBELIA	CORONOPIFOLIA
ARCTOTIS	SEMIPAPPOSA
PELLAEA	PTEROIDES
DILATRIS	SP
URSINIA	PINNATA
EHRHARTA	DURA
CASTALIS	NUDICAULIS
TETRARIA	FASCIATA
GERBERA	CROCEA
STOEBE	CINEREA
RESTIO	SUBVERTICILLATUS
PODALYRIA	?MONTANA
HAKEA	SERICEA
SELAGO	SPURIA
CRASSULA	FASCICULARIS
SENECIO	CYMBALARIAEFOLIUS
CYPHIA	VOLUBILIS
MURALTIA	ALOPECUROIDES
OSTEOSPERMUM	JUNCEUM
CRASSULA	NUDICAULIS
AGATHOSMA	SERPYLLACEA
ANAXETON	ASPERUM
CENTELLA	?ERIANTHA
CENTELLA	FLEXUOSA
CENTELLA	SP
FICINIA	GRANDIFLORA
GAZANIA	SERRATA
GRASS	013/19, 014/33
GRASS	079/24, 081/12
HELICHRYSUM	LITORALE
KNOWLTONIA	VESICATORIA
MAIREA	MICROCEPHALA
MURALTIA	MACROCERAS
MYRICA	SERRATA
OSTEOSPERMUM	CILIATUM
PELARGONIUM	?PATULUM
PELLAEA	CALOMELANOS
PINUS	PINASTER
PRIESTLEYA	ELLIPTICA
PSORALEA	APHYLLA
ROELLA	CILIATA
SALVIA	CHAMAELAEAGNEA
TETRARIA	CRASSA
VISCUM	PAUCIFOLIUM

ADDITIONAL SPECIES WITH TWO OR MORE OCCURRENCES IN THE WERGER ET AL. (1972) SURVEY, NOT FOUND IN THE PRESENT STUDY

ELYTROPAPPUS	GLANDULOSUS
SALVIA	AFRICANA
GNIDIA	INCONSPICUA
ASPALATHUS	LARICIFOLIA
DROSERA	HILARIS
STOEBE	AETHIOPICA
EHRHARTA	BULBOSA
CRASSULA	OBVALLATA
WACHENDORFIA	PANICULATA
APODYTES	DIMIDIATA
CYPHIA	BULBOSA
CORYMBIUM	SCABRUM
ANAPALINA	BURCHELLII
HYPODISCUS	WILLDENOWIA
SENECIO	ERUBESCENS
ADENANDRA	SERPYLLACEA
SENECIO	PINIFOLIUS
LINUM	THUNBERGII
CLIFFORTIA	ATRATA
ARISTEA	SPIRALIS
HYPOLAENA	GRAMINIFOLIA
SCYPHOGYNE	MUSCOSA
ELEGIA	RACEMOSA
PROTEA	CYNAROIDES
ANTHOSPERMUM	PROSTRATUM
EROEDA	CAPENSIS
TETRARIA	MICROSTACHYS

Table 10. Phytosociological table of the forests of Swartboschkloof.

Attribute	Values
RELEVE NUMBERS	0000001 1111911 1111222 1111 1111111
	0003996 0001916 6699000 1199 1966698
	3565346 7890847 3449012 5667 3301283
DATE	. 1111111. 1111. 11. 1111111. 1111. 1111111
	. 9999999. 9999. 99. 9999999. 9999. 9999999
	. 8888888. 8888. 88. 8888888. 8888. 8888888
	. 1111112. 2222. 22. 2222222. 2222. 2222222
	. 0000001. 0000. 01. 1111111. 0011. 0111111
	. 4445990. 2222. 20. 0011111. 2211. 2100010
	. 2221001. 2222. 21. 0022222. 2222. 2200022
	. 2225338. 2223. 48. 6634555. 4344. 4355347
GRID REFERENCE	. 3333333. 3333. 33. 3333333. 3333. 3333333
	. 3333333. 3333. 33. 3333333. 3333. 3333333
	. 1111111. 1111. 11. 1111111. 1111. 1111111
	. 8888888. 8888. 88. 8888888. 8888. 8988888
	. DDDDDDD. DDDD. DD. DDDDDDD. DDDD. DDDDDDD
	. DDDDDDD. DDDD. DD. DDDDDDD. DDDD. DDDDDDD
LAND FACET	. PDPPPPC. DDDD. SS. DDRRRRR. SSSS. SSSSSSS
	. DTDDLLX. RRRR. CC. RRIIIII. CCCC. CCCCCCC
	. SSSSSSS. NNNN. RR. NNVVVVV. RRRR. RRRRRRR
ALTITUDE IN METRES	. 3334443. 3343. 64. 5556444. 5566. 6566666
	. 5867534. 6819. 29. 6344750. 1298. 2885493
	. 9029688. 1284. 12. 4654046. 5479. 1322122
ASPECT	. NNWENNE. NNNN. NN. NNNNEEN. NNEE. NNEEENN
	. ENNSN . . N. NNNN . NN. NNNNNEN
	. EWEE . . E. EEEE . EE. EWEEE E
SLOPE IN DEGREES	. . . 33. 211 1 . 2233. 3322222
	. 0849666. 76 7. 28. 702 0 . 2222. 4097757
GEOLOGY	. GCCGCCC. CCCC. CC. CCCCCCC. CCCC. CCCCCCC
	. 11C111. 1111. 11. 1111111. 1111. 1111111
	. 001G00. 0000. 00. 0000000. 0000. 0000000
	. G00G00. G000. . G000000. .
SUBSTRATE	. LS LLLB. LLBB. BB. BBBBBBB. BBBB. BBBBBBB
	. L B000. B LL. I. IILLOIL. 00. OIIIOO
	. SGB . . 0. 0010 00. . 000
SOIL SERIES CODE	. HFMMMMO. 00 . . . .
	. UWAAAAA. AA . . . .
	. 2311113. 33 . . . .
	. 4100004. 44 . . . .
SOIL DEPTH IN CMS	. 1 . 11 . . . .
	. 5405551. 00 . . 42 3 . . 1
	. 0000003. 00 . . 05 0 . . 5
SOIL MOISTURE	. DDDDDDD. MMM. DD. DDTWWWW. DDDD. DDDDDDD
ROCK COVER %	. 1 1 . 19. 99. 1190836. 9999. 9989999
	. 00340 4. 055. 90. 0555505. 9505. 9500055
LITTER COVER %	. 99099 9. 994. 1. 7417464. 212. 2136412
	. 99560 0. 000. 50. 0000000. 050. 0005555
VEGETATION COVER %	. 1. 111. . 1 1 . .
	. 99998 0. 000. 28. 9909909. 9999. 8899998
	. 78588 0. 000. 50. 0005505. 0050. 0005005
DISTURBANCE	. LNNNNNN. NNN. NN. N NNNNN. NNN. NNNNNNN
VEGETATION AGE	. 2222222. 222. ??. ? ?????. ????. ??????
	. 3333334. 444. . . .
NUMBER OF SPECIES	3233333 111 22 1121111 1111 1122111
	0372301 655 50 8624799 3636 3300845

Attribute	Values	Summary Table
RELEVE NUMBERS	0000001 1111 11 1111222 1111 1111111	
	0003996 0001 16 6699000 1199 1966698	
	3565346 7890 47 3449012 5667 3301283	
COMMUNITY REF NO.	3. 3. 3. 3. 3.	3.3. 3.3.3.
	2. 2. 2. 2. 2.	2.2. 2.2.2.
	1. 1. 2. 2. 2	1.1. 2.2.2
	2 1 1 2	21 12

3.2.1.2 DIFFERENTIAL SPECIES OF THE HALLERIA ELLIPTICA - CLIFFORTIA CUNEATA SHRUBLAND

Genus	Species	Relevé scores	Summary Table
CLIFFORTIA	CUNEATA	2 2222+	5
ANTHOSPERMUM	AETHIOPICUM	111++1	5
ERICA	SPHAEROIDEA	++1++	4
PSORALEA	SPICATA	1 1+++	4
PROTEA	NITIDA	2 21+	3
CLUTIA	ALATERNOIDES	11+ +	3
CYMBOPOGON	MARGINATUS	++++	3
MOHRIA	CAFFRORUM	10+ 1	3
MONTINIA	CARYOPHYLLACEA	1+ ++	3
PELARGONIUM	MYRRHIFOLIUM	+0++	3
CHIRONIA	BACCIFERA	111 +	3 1
FREYLINIA	LANCEOLATA	000	3
PROTEA	NERIIFOLIA	1 1 4	3
RHUS	ROSMARINIFOLIA	+ + +	3
FICINIA	FILIFORMIS	+ +	2
GLIA	GUMMIFERA	+ +	2
LICHTENSTEINIA	LACERA	+ 0	2
TETRARIA	BROMOIDES	21	2
SCHIZAEA	PECTINATA	2 0	2
SALVIA	AFRICANA	+1	2
ASPARAGUS	ASPARAGOIDES	+ + +	2 1
RESTIO	TRITICEUS	++	2
OXALIS	BIFIDA	R R	2

SPECIES COMMON TO COMMUNITIES 3.2.1.1. & 3.2.1.2

Genus	Species	Relevé scores	Summary Table
HALLERIA	ELLIPTICA	14 525. 21 1	433
CASSYTHA	CILIOLATA	1+1++1+. 0 R+	525
ASPARAGUS	RUBICUNDUS	10+11 01 0	43 1
ARISTEA	MAJOR	11+1111 R1	5 5
RHUS	TOMENTOSA	11 111. + +	423
PHYLICA	PUBESCENS	1 ++ . R	3 3
RESTIO	GAUDICHAUDIANUS	12+ +. +	3 1
EHRHARTA	RAMOSA	1 + RR R+ +	2351
LEPTOCARPUS	PANICULATUS	0 1	12
RESTIO	SUBVERTICILLATUS	1 11	13
BOBARTIA	INDICA	+ 0 +	22
CANNOMOIS	VIRGATA	++	2

3.2.2.1 DIFFERENTIAL SPECIES OF THE RAPANEA MELANOPHLOEOS - CUNONIA CAPENSIS FOREST

Genus	Species	Relevé scores	Summary Table
CUNONIA	CAPENSIS	14 4503343	55
ILEX	MITIS	5 333	3
BLECHNUM	PUNCTULATUM	1 + +0++	34
KOBRESIA	LANCEA	+11 131 +	5 1
SANICULA	EUROPAEA	1++ 0	3 1
BRACHYLAENA	NERIIFOLIA	4 1	31
DIPOGON	LIGNOSUS	00 0	3
TODEA	BARBARA	1 + +	32
OXALIS	SP. PINK-WHITE FLRS 1000/6	+ +	2
EHRHARTA	SP.	0 R	2

SPECIES COMMON TO COMMUNITIES 3.2.1.1, 3.2.1.2 & 3.2.2.1

Genus	Species	Relevé scores	Summary Table
BRABEJUM	STELLATIFOLIUM	211 4 5555 3333	35 3
OXALIS	LANATA	++++ +	3 1
RUBUS	RIGIDUS	+	1
BLECHNUM	AUSTRALE	+111 4 R2 2212111 +	32552

3.2.2.2 DIFFERENTIAL SPECIES OF THE RAPANEA MELANOPHLOEOS - HEERIA ARGENTEA FOREST

Genus	Species	Relevé scores	Summary Table
HEERIA	ARGENTEA	331+	5

SPECIES COMMON TO COMMUNITIES 3.2.2, 3.2.2.1 & 3.2.2.2

Genus	Species	Relevé scores	Summary Table
RAPANEA	MELANOPHLOEOS	+ 2 1323211 1+ 3 2+2+1	1 3535
OLINEA	VENTOSA	1+1+++ 1+ 4 222531	5-5
SECAMONE	ALPINI	+ 2 ++11 1+2++1+	3155
PODOCARPUS	ELONGATUS	+ 440 2114232	1-5
ASPLENIUM	ADIANTUM-NIGRUM	+ 1+ +	131
ALOE	MITRIFORMIS	1 +1	22
VISCUM	PAUCIFOLIUM	R +	21
SOLANUM	RETROFLEXUM	00+ 0	3
DIOSPYROS	WHYTEANA	1 1+2	1 3
CARDAMINE	AFRICANA	1 ++ +	3 1
ASPLENIUM	AETHIOPICUM	+ + 0	1 2

WIDESPREAD SPECIES IN THE FOREST COMMUNITIES

Genus	Species	Relevé scores	Summary Table
DIOSPYROS	GLABRA	1021+12. 11+ ++ + +++ + R0+ 0	345144
ASPARAGUS	SCANDENS	+ +1 + 22+1111 +++++ ++++++	135555
KNOWLTONIA	VESICATORIA	+1 0++ +++ ++++ ++++++1	13 553
MAYTENUS	ACUMINATA	0 1+ 222 220 2+33 2233233	133555
HARTOGIELLA	SCHINOIDES	1 1 0 1 2 42 +++ 2331 2 11223	323485
MYRSINE	AFRICANA	0 + 10+ ++ R1 + 1+ ++ + 0	433333
MAYTENUS	OLEOIDES	0 1+ 11 + +12 111+ 11	423145
KIGGELARIA	AFRICANA	+ 1+ 1 1+ ++++ 1 2+3+ ++	133525
ZANTEDESCHIA	AETHIOPICA	+ R R + + + + 00+++0+	233233
PTERIDIUM	AQUILINUM	352523+ ++ + 0+	533 3
HALLERIA	LUCIDA	+ 1 + 1+11 1 1 221	23423
RHUS	ANGUSTIFOLIA	0+1111+ 1++ 1	54 2
PELLAEA	PTEROIDES	1 1 1+ + + +0 +	233 23
ASPARAGUS	COMPACTUS	+ ++ + R +	323 2
ELEGIA	CAPENSIS	+	3
CLIFFORTIA	RUSCIFOLIA	1 +	1 3
CLIFFORTIA	POLYGONIFOLIA	1 +	1 3

Table 11. Phytosociological table of the forests of Swartboschkloof, using data from Werger et al. (1972), Table 2.

Note: The relevé order follows Werger et al. (1972), Table 2, and the community names and species order follow those in Table 10 of the present study.

RELEVE NUMBERS		93339339333 93339339112 01798020566	
DATE		. 111. 11. 111 . 999. 99. 999 . 777. 77. 777 . 000. 00. 000 . 000. 00. 000 . 888. 88. 888 . 111. 11. 111 . 888. 78. 447	
GRID REFERENCE		. 333. 33. 333 . 333. 33. 333 . 111. 11. 111 . 888. 88. 888 . DDD. DD. DDD . DDD. DD. DDD	
LAND FACET		. DDD. DS. SSS . RRR. RC. CCC . NNN. NR. RRR	
ALTITUDE IN METRES		. . . . 333. 57. 665 . 532. 60. 641 . 000. 00. 700	
ASPECT		. . NN. EEN . . E. N . . . E	
SLOPE IN DEGREES		. . 12. 331 . . 55. 555	
GEOLOGY		. CC. G . CCC . 11. C . 111 . QQ. 1 . QQQ . GG. Q .	
SUBSTRATE		. . . .	
SOIL SERIES CODE		. . . .	
SOIL DEPTH IN CMS		. 111. 1 . . 000. 0 . . 000. 0 .	
SOIL MOISTURE		. . .	
ROCK COVER %		. . . . . .	
LITTER COVER %		. . . . . .	
VEGETATION COVER %		. 111. . . 000. 98. 998 . 000. 55. 009	
DISTURBANCE		. . .	
VEGETATION AGE		. 1 . . . 2 . .	
NUMBER OF SPECIES		4 4 4 92339219111 87048488850	
RELEVE NUMBERS		93339339333 93339339112 01798020566	SUMMARY TABLE
COMMUNITY REF. NO.		6 7 8	678
3.2.1.2 DIFFERENTIAL SPECIES OF THE HALLERIA ELLIPTICA - CLIFFORTIA CUNEATA SHRUBLAND			
CLIFFORTIA	CUNEATA	1++. .	. 5
ANTHOSPERMUM	AETHIOPICUM	. R .	. 3
ERICA	SPHAEROIDEA	. .	.
PSORALEA	SPICATA	. .	.
PROTEA	NITIDA	R . .	. 2
CLUTIA	ALATERNOIDES	. .	.
CYMBOPOGON	MARGINATUS	. .	.
MOHRIA	CAFFRORUM	. .	.
MONTINIA	CARYOPHYLLACEA	. .	.
PELARGONIUM	MYRRHIFOLIUM	. .	.
CHIRONIA	BACCIFERA	+ . . RR	. 2 4
FREYLINIA	LANCEOLATA	2+ . .	4
PROTEA	NERIIFOLIA	R . .	. 2
RHUS	ROSMARINIFOLIA	. .	.
FICINIA	FILIFORMIS	. .	.
GLIA	GUMMIFERA	. .	.
LICHTENSTEINIA	LACERA	. .	.
TETRARIA	BROMOIDES	. .	.
SCHIZAEA	PECTINATA	. .	.
SALVIA	AFRICANA	. .	.
ASPARAGUS	ASPARAGOIDES	R +. .	4
RESTIO	TRITICEUS	. .	
OXALIS	BIFIDA	. .	.
SPECIES COMMON TO COMMUNITIES 3.2.1.1 & 3.2.1.2			
HALLERIA	ELLIPTICA	. +11. .	. 5
CASSYTHA	CILIOLATA	++5. .	. 5
ASPARAGUS	RUBICUNDUS	. ++R. .	. 5
ARISTEA	MAJOR	++ . .	. 4
RHUS	TOMENTOSA	. .	
PHYLICA	PUBESCENS	+ . .	. 2
RESTIO	GAUDICHAUDIANUS	. ++. .	. 4
EHRHARTA	RAMOSA	+1+. .	. 5
LEPTOCARPUS	PANICULATUS	+ . .	2
RESTIO	SUBVERTICILLATUS	2+ . +. ++	. 434
BOBARTIA	INDICA	. . .	.
CANNOMOIS	VIRGATA	. .	.
3.2.2.1 DIFFERENTIAL SPECIES OF THE RAPANEA MELANOPHLOEOS - CUNONIA CAPENSIS FOREST			
CUNONIA	CAPENSIS	. 1R . +.	. 43
ILEX	MITIS	. 1 2. 2 .	. 43
BLECHNUM	PUNCTULATUM	. 1 1. 2+. R	452
KOBRESIA	LANCEA	. + .	. 3
SANICULA	EUROPAEA	. . .	.
BRACHYLAENA	NERIIFOLIA	. 22. + .	. 43
DIPOGON	LIGNOSUS	. . .	
TODEA	BARBARA	. . .	
OXALIS	SP. PINK-WHITE FLRS 1000/6	. . .	
EHRHARTA	SP.	. . .	.
SPECIES COMMON TO COMMUNITIES 3.2.1.1, 3.2.1.2 & 3.2.2.1			
BRABEJUM	STELLATIFOLIUM	. 343. .	. 5
PHYLICA	SPICATA	. . .	.
RUBUS	RIGIDUS	. . .	.
BLECHNUM	AUSTRALE	. 11+. .	5
3.2.2.2. DIFFERENTIAL SPECIES OF THE RAPANEA MELANOPHLOEOS - HEERIA ARGENTEA FOREST			
HEERIA	ARGENTEA	. . . 333	5
SPECIES COMMON TO COMMUNITIES 3.2.2, 3.2.2.1 & 3.2.2.2			
RAPANEA	MELANOPHLOEOS	. . 32.	5
OLINEA	VENTOSA	. . 12. 4	32
SECAMONE	ALPINI	. +. +1. 122	255
PODOCARPUS	ELONGATUS	. . 32. 133	35
ASPLENIUM	ADIANTUM-NIGRUM	. . .	
ALOE	MITRIFORMIS	. . . 1+	. 4
VISCUM	PAUCIFOLIUM	. . . +	. 2
SOLANUM	RETROFLEXUM	. . .	.
DIOSPYROS	WHYTEANA	. . .	.
CARDAMINE	AFRICANA	. . .	.
ASPLENIUM	AETHIOPICUM	. . +R.	. 5
WIDESPREAD SPECIES IN THE FOREST COMMUNITIES			
DIOSPYROS	GLABRA	. ++ . + .	. 43
ASPARAGUS	SCANDENS	. + 1. 1+.	. 45
KNOWLTONIA	VESICATORIA	. + . ++. +	252
MAYTENUS	ACUMINATA	. . 32. + 1	54
HARTOGIELLA	SCHINOIDES	. R. 1. 212	235
MYRSINE	AFRICANA	. +. + . + +	234
MAYTENUS	OLEOIDES	. 11 . 2+. 12	435
LINUM	QUADRIFOLIUM	. . .	.
ZANTEDESCHIA	AETHIOPICA	. . +. 1++	35
PTERIDIUM	AQUILINUM	. +1+. .	5
HALLERIA	LUCIDA	. . 11. R+	54
RHUS	ANGUSTIFOLIA	. +++. .	. 5
PELLAEA	PTEROIDES	. . ++.	5
ASPARAGUS	COMPACTUS	. .	.
ELEGIA	CAPENSIS	. 1+. .	4
CLIFFORTIA	RUSCIFOLIA	. .	.
CLIFFORTIA	POLYGONIFOLIA	. . .	
ADDITIONAL SPECIES WITH TWO AND MORE OCCURRENCES IN THE WERGER ET AL. (1972) SURVEY, NOT FOUND IN THE PRESENT STUDY			
OFTIA	AFRICANA	. . . ++	4
PODALYRIA	CALYPTRATA	. 331. R .	53
RUMOHRA	ADIANTIFORMIS	. . . 11	4
OPLISMENUS	HIRTELLUS	. R +. R .	43
RESTIO	QUADRATUS	+ +. .	4
PENTAMERIS	THUARII	. R++. .	5
CARPHA	GLOMERATA	+ R. .	. 4