

A phytosociological study of Signal Hill, Cape Town, utilizing both perennial and ephemeral species

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Keywords: ephemeral, perennial, phytosociology, West Coast Renosterveld

ABSTRACT

A phytosociological study based on the collection of vegetation and environmental data from 53 randomly stratified sample plots on Signal Hill, Cape Town, was carried out over an area of 124 ha. The survey extended over 12 months to ensure the inclusion of as many plant species as possible, and a list of the vascular plant species was compiled. A total of 81 families, 255 genera and 460 species was identified. The phytosociological method revealed that only one major plant community occurs in the study area and two subcommunities, with a total of five variants correlated mostly with aspect and historic land use, were identified. The perennially and seasonally identifiable species were analysed separately to determine their relative contribution to the phytosociological classification. The two data sets gave similar classifications. A vegetation map as well as a soil map was compiled.

UITTREKSEL

'n Fitososiologiese studie, gegrond op die versameling van plantegroei- en omgewingsdata by 53 ewekansige gestratifiseerde monsterverskepe oor 'n gebied van 124 ha op Seinheuwel, Kaapstad, is gedoen. Die opname is oor 12 maande uitgevoer om te verseker dat soveel plantspesies as moontlik ingesluit word, waarna 'n lys van die vaatplante opgestel is. Altesaam 81 families, 255 genusse en 460 spesies is geïdentifiseer. Die fitososiologiese metode het aan die lig gebring dat slegs een hoofplantgemeenskap in die studiegebied voorkom, en twee subgemeenskappe met altesaam vyf variante wat meestal ten opsigte van aspek en historiese grondgebruik korreleer, is geïdentifiseer. Die meerjarige en efemere spesies is afsonderlik ontleed om elke groep se bydrae tot die plantegroei tipes te bepaal, en die twee stelle data het soortgelyke klassifikasies opgelewer. 'n Plantegroeikaart asook 'n grondkaart is opgestel.

INTRODUCTION

Since the earliest times the flora of the Cape has fascinated travellers, visitors and scientists (Raven-Hart 1967, 1971). The vegetation of Signal Hill has been used for grazing and fuel supplies since prehistoric times, and after European settlement some areas were cultivated and afforested (Joubert 1991). In 1964 the area was proclaimed a nature reserve (Ashton 1985). The natural vegetation has been protected since then.

The vegetation is broadly classified as West Coast Renosterveld (Moll & Bossi 1984) and falls within the Fynbos Biome (Kruger 1978). The area is a unique West Coast Renosterveld site as it is the only area on Malmesbury shale influenced by coastal fog. No plant community study has previously been made of the area except for a post-fire study (Michell 1922) of the vegetation along the eastern slopes.

Wenger (1974) states that 'In floristically rich areas ... communities can be clearly characterised floristically on the bases of floristic lists in which only permanently recognisable species are entered'. He further states that in arid regions perennials are generally better indicators of specific habitat factors because annuals are a relatively unimportant component. Le Roux (no date) found in Namaqualand that species composition and cover of ephemerals vary during the growth period and from year to year as new vegetation associations are formed annually.

Annuals have, however, been found to be very useful in some studies of arid vegetation (Wenger 1974). Thus one aim of the present study was to evaluate whether ephemerals were important for plant community studies. Therefore both perennially and seasonally identifiable species were recorded and the data were analysed to determine their relative contribution to the phytosociological classification. This form of comparison has not previously been published.

STUDY AREA

Locality

Signal Hill (latitude 33° 54' and longitude 18° 21') is a 2.5 km long ridge above Cape Town and is joined to the rest of the Table Mountain Nature Reserve by Lion's Head (Figure 1). The reserve was proclaimed in 1964 and is managed by the Cape Town City Council (CCC) (Ashton 1985).

The study area (124 ha) is situated on the northwest, north and southeast-facing slopes of Signal Hill, ranging between 120 m and 350 m above sea level. Several valleys and dry ravines of more or less equal depth dissect the hillside. The slope varies between 17° and 39°.

Geology

The rocks comprising Signal Hill form part of the Tygerberg Formation of the Malmesbury Group which consists mainly of irregular alternations of grey to green phyllitic shale, siltstone and medium to fine-grained greywacke

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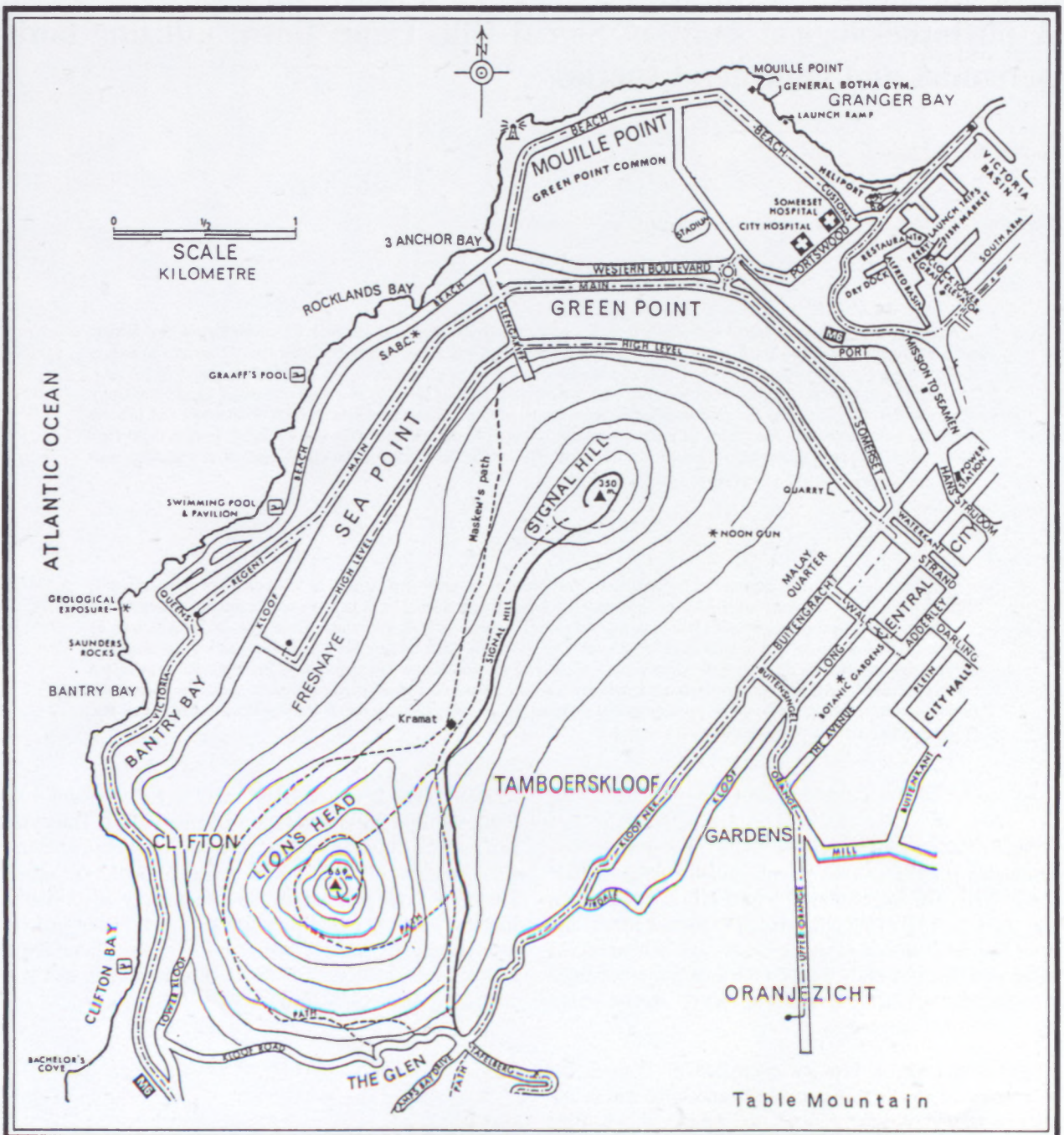


FIGURE 1.—Orientation map (after Captour).

which is generally more massively bedded than the pelitic rocks. Ripple cross-lamination as well as micro-layering is present in the steeply dipping greywacke beds and ripple marks, slumping and sole structures also occur on the bedding planes. A few thin layers of lava, pyroclastics, quartzite, grit as well as conglomerate are present in the Formation (Theron 1984).

The rocks of the Tygerberg Formation are to a large extent covered by superficial sediments and are frequently deeply weathered to red-brown or yellow clay and loamy soil. The degree and depth of weathering change considerably over relatively short distances (Theron 1984).

Climate

According to the Köppen classification the study area experiences a typical Mediterranean climate; i.e. the Csb

type (Schulze & McGee 1978). There is no weather station in the study area, though a rain gauge existed on the summit from 1882 until 1950. Data of various kinds are available from stations surrounding the area, and these indicate that local topography plays an important role in influencing the mesoclimates of the three respective slopes.

Rain is brought in winter by northwesterly winds when a cold front approaches the land (Schulze 1972). In late winter or spring an influx of cold air may occur, causing stormy weather and gales. As the cold front moves across the coast, showers occur after the passage of the front and clear up rapidly from the west (Schulze 1972).

Hot, dry, gusty berg winds prevail mainly during summer. Maximum temperatures recorded in the Fynbos Biome appear to be associated with these winds. With the onset of the wind, temperatures rise sharply and humidity

drops markedly (Fuggle 1981), creating a fire hazard in the area. The prevailing winds in the dry summer are strong southerly to southeasterly winds (Fuggle 1981). Signal Hill is about 350 m high and forms a barrier against the prevailing winds. When the southeaster blows, the northwestern aspect is completely protected, but the northern aspect less so. Likewise, when the cold north-wester blows from across the sea, the southeastern aspect is protected, while the northern aspect is once again exposed to the wind. The latter aspect is, therefore, more often exposed to wind.

Signal Hill receives a mean of 463.5 mm rain annually. Figure 2 illustrates the data collected during the period 1882 to 1950 (Weather Bureau 1986). Data for the study area and five stations from surrounding areas were collected over a period of about 70 years and appear in Table 1. Topography plays a major role as illustrated by the data collected on different sides of Signal Hill. In all cases the highest precipitation, i.e. 60% of the total, is experienced from May to August with a peak during June, while January and February are the driest months. The mean number of rainy days for Signal Hill is 86. July has the highest number of rainy days i.e. 12, and during December to February there are on average only three rainy days per month.

No temperature data for the study area are available, though data from stations in the vicinity show very clearly that a moderate temperature is experienced with no extremes on a daily or a seasonal basis. The hottest month is February and the coldest month is July.

Fog forms when warm air is blown over the cold Atlantic sea on northwesterly to westerly air drifts (Fuggle 1981), thus the western slopes receive most fog, with a peak during April and May according to data from the Cape Town Harbour.

Flora—historical records

It is impossible to visualise the vegetation of the study area before European settlement and the extent of the disturbances which followed, as the early descriptions only give a sketchy impression. Sparrman (1785) noted that such reports are not always reliable, as these men had spent months at sea, with the result that they tended to over-praise the Cape at the sight of greenery after such a long time at sea (Skead 1980).

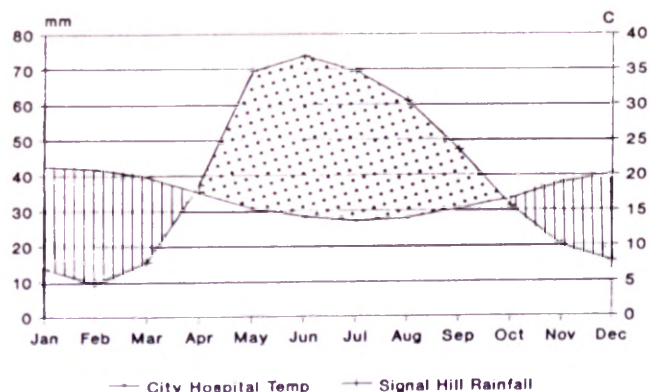


FIGURE 2.—Walter-Lieth climate diagram for Signal Hill and City Hospital, Cape Town.

TABLE 1.—Annual rainfall for Signal Hill, Cape Town and five surrounding stations

Station	Rainfall (mm)
Molteno Reservoir	812.0
Lower Reservoir	792.9
Tamboerskloof	725.2
Sea Point	571.2
Fresnaye	536.9
Signal Hill	463.5

One of the first descriptions of the study area was made by Van Riebeeck who, on 27 April 1652, 'went along the downs behind the rump of the Lion Mountain where we found between the mountain and the downs the most beautiful land for sowing and for grazing cattle that one can desire ... Crossing the Lion Mountain on the seaward side of the head, found the slopes on the other side dry and stony ...' (Skead 1980). A seaman who visited the seaward slopes during 1685 found the area 'not at all Rocky, but cover'd over with Grass' (Raven-Hart 1971). It appears that grass was already very common at this time as another seaman wrote in 1702 that the '... Lion's Rump ... is grown over with luxuriant grass and a few trees ...' (Raven-Hart 1971). A photograph dated \pm 1910 (Cape Archives: E 8144) shows grassland along the northern slopes, while another dated 1899 (Cape Archives: Dr. J 80) shows areas densely populated by low scrub, possibly *Elytropappus rhinocerotis* (renosterbush).

Between 1657 and 1665, some 80 Khoikhoi were living in a kraal on the eastern slopes of Signal Hill. During Kolbe's visit between 1707 and 1713 two large Khoikhoi kraals existed at the foot of the eastern slopes of the Lion's Hill (Fagan 1989). It is possible that their fires maintained the grassland on the slopes, and that they started this firing in an attempt to promote firewood and grazing for their herds, or to stimulate the growth of geophytes (Deacon 1983).

Michell (1922) compiled a detailed description of her post-fire study site on the eastern slopes (1919–1921). Unfortunately no study was made prior to the fire, with the result that the relative importance of renosterbush and *Rhus lucida* at this time is not known. She states that the vegetation is 'sclerophyllous bush, the characteristic vegetation of the southwestern region', though the area is 'deficient in several typical southwestern families'. All the species encountered during this period are listed by her, many with notes on their numbers and localities. Of particular interest is the following: The vegetation of the valleys 'show certain marked differences' from that of the open slopes. Michell states that the vegetation in the valleys was not badly burnt owing to the somewhat sheltered position of the watercourse in each valley, and that the valley bottoms were 'covered with *Acacia karroo*'. Adamson & Salter (1950) also note the presence of this species on Signal Hill. Today only isolated individuals occur. The slopes were dominated by *R. lucida* after the fire, which 'dotted' the landscape at 'frequent intervals'. The north-facing slopes had a 'more open type of vegetation' than the south-facing slopes. The latter had a conspicuously different plant population during the winter months, though the contrast was less during summer.

Clusia pulchella was common at the foot of one of the valleys (similar to relevé 28 of the present study). Michell (1922) also mentions the presence of *Noltea africana*. *Hyparrhenia hirta* was common and mentioned several times. Some 20 other grass species are also mentioned. *Protea repens*, *P. nitida* and *Leucadendron argenteum* are reported as being scarce. A number of annuals was associated with cattle manure.

Michell (1922) concludes by stating that the fire favoured the renosterbush which was 'far in advance of any others' and, with the exception of the northern slopes of the valleys, evenly distributed all over the area. The vegetation type established after the fire is termed 'Rhenosterveld' and considered an 'artificial one'. Members of the Proteaceae, Rutaceae and Ericaceae were 'only occasionally seen'. She states that 'especially in the case of the Proteaceae, bush fires have been largely instrumental in eradicating large numbers of species from these slopes'.

A few other descriptions from the early part of this century give an idea of what the vegetation was like at the time. According to these descriptions Proteaceae were common on the slopes of Signal Hill. Lückhoff (1951) states: 'Most of the original Signal Hill flora has been destroyed. The older generation still speaks of fields of proteas that once grew on the hill. Today only a few plants survive. For the rest we find pines, gums, taaibos and abundant grass—the latter always reliable evidence of repeated burning'. It appears that *Protea repens* was once extremely common (Jackson 1977) on the lower slopes of the study area, whereas large tracks of *P. lepidocarpodendron* were described by Marloth during the early part of this century (Lückhoff 1951). 'Almost the whole of Signal Hill used to be covered with Proteaceae, mainly *P. repens*, *P. lepidocarpodendron*, *P. nitida*, *Leucospermum conocarpodendron* and *Leucadendron argenteum*' (Lückhoff 1951). Today only isolated individuals of some of these species have survived. Adamson (1929) noted that renosterbush is 'well developed on the slopes of Signal Hill' and that the community is 'relatively pure and slow changing' on the western slopes. The area carried no appreciable forests (Lückhoff 1951).

METHODS

Soil map

A soil map was compiled for Signal Hill. Soil profiles were studied throughout the area. Soil samples were taken at four different localities and analysed by the Faculty of Agriculture at the University of Stellenbosch. The pH was measured in KCl. Resistance is expressed in ohms, using a standard USDA soil cup. The localities and soil profiles are marked A, B, C and D (Figure 3). The results of the soil analyses and the exposition as regards the symbols in Tables 3 & 4, are given in Table 2, as well as dominant soil families, a brief description of the soils and a topographical description of the sample plots.

Phytosociological study

The field work for the vegetation survey was started in December 1988 and completed in December 1989. Relevés were compiled from 53 stratified random plots (Werger

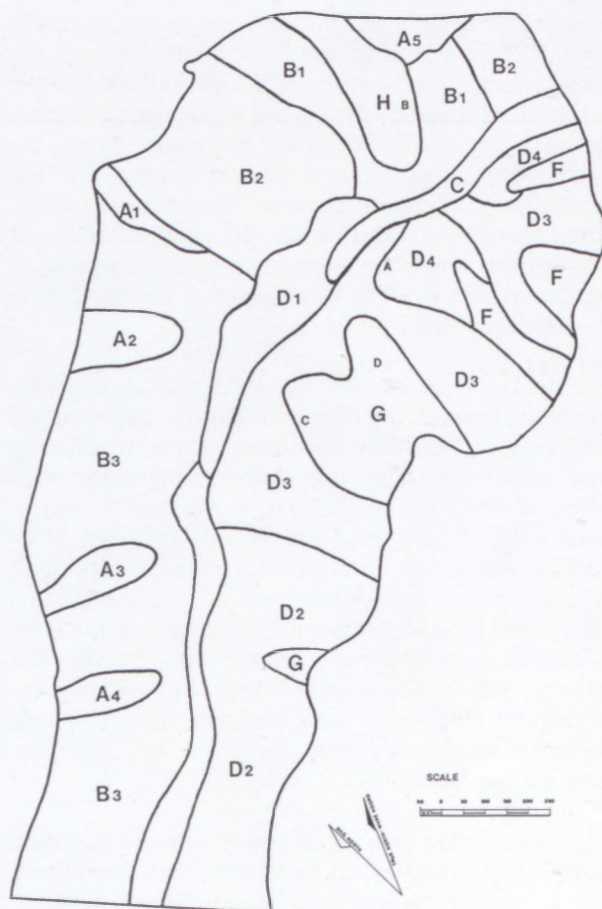


FIGURE 3.—Soil map of Signal Hill, Cape Town. See Table 2 for exposition of symbols. Soil profiles for four localities in the study area (marked A, B, C and D on the soil map). A, Glenrosa soil form: non-bleached A horizon (0.0–0.3 m) on a non-hard, non-wet, and non-calcareous lithocutanic B horizon (0.3–0.9 m) on saprolite (0.9–1.3 m); A horizon, pH = 4.7, R = 2730; B horizon, pH = 4.2, R = 2960. B, Oakleaf soil form: non-bleached A horizon (0.0–0.3 m) on a non-red, non-luvic B horizon on saline saprolite (shale); A horizon, pH = 5.0, R = 1360; Saprolite, pH = 5.1, R = 168. C, Oakleaf (to Inhoek) soil form: non-bleached (weak to moderate structured, dark coloured) A horizon (0.0–0.5 m) on a reddish coloured non-luvic neocutane B horizon (0.50–1.3 + m); A horizon, pH = 5.2, R = 2420; B horizon, pH = 4.4, R = 2630. D, Hutton (to Inanda or Sweetwater) soil form: mesotrophic (dark coloured, probably humic or humic phase A horizon) non-luvic red apedal B horizon (A + B horizon 0.9 m deep) on well-drained weathered saprolite (shale); A horizon, pH = 4.8, R = 2980; B horizon, pH = 4.5, R = 4450.

1974). These were permanently marked with a steel dropper, 1.3 m high. A 700 mm long white PVC conduit tubing with a diameter of 20 mm was fixed onto the dropper (Van Blerk 1990), rendering the plots easily detectable from a distance, especially in mid-high, mid-dense shrubland (Campbell *et al.* 1981). A numbered metal tag was fixed to the top of the dropper to ensure the location of the plots even after a veld fire.

Stratification was done on a topographical basis. Six such units were distinguished within the study area. The number of plots was determined on an area basis within the three major units, i.e. the three aspects with open slopes and ravines (Figure 4). Cultivated and built-up areas were excluded from the survey. Randomly stratified sample plots were sited in stands of vegetation which appeared floristically, structurally and environmentally as homogeneous as possible (Campbell & Moll 1977). The sample intensity

TABLE 2.—Exposition of symbols in Table 3 and on Figure 3 with brief description of soils and topography of Signal Hill, Cape Town

Phyto- socio- logi- cal table symbol	Map symbol	Dominant soil families	Description of soils	Topography	Relevé number
WELL DRAINED PEDISEDIMENTS OF VARYING DEPTH					
-	A1	Oa 1220 Oa 1120 Gs 1211	Moderately deep (<80 cm) gravelly to non-gravelly soils on shale; 10-20% clay in topsoil.	North-west facing valley.	
0	A2	Oa 1220 Oa 1120 Gs 1211	Moderate to deep (<60 cm) gravelly to non-gravelly soils on shale; 10-20% clay in topsoil.	North-west facing valley.	20; 32
1	A3	Oa 1220 Oa 1120 Gs 1211	Shallow to moderate (<45 cm) gravelly to non-gravelly soils on shale; 10-20% clay in topsoil.	West facing valley.	16; 26
2	A4	Oa 1220 Oa 1120 Gs 1211	Shallow (<40 cm) gravelly to non-gravelly soils on shale; 10-20% clay in topsoil.	West facing slope	13
-	A5	Oa 2120 Oa 2220 Gs 2211	Shallow to moderate (<45 cm) cobbly soils on shale; 10-20% clay in topsoil.	North facing valley bottom and lower slope.	
SHALLOW LITHOSOLS (E HORIZONS RARE)					
3	B1	Ms 2100 (Rock) Gs 2211	Shallow (<20 cm) soils, usually gravelly, topsoil overlying hard (shale) rock; 6-15% clay in topsoil. Rocky outcrops rare.	North facing open slopes and rocky ravines.	1; 2; 4; 5; 7; 9; 31
4	B2	Ms 2100 (Rock) Gs 2211 Cf 1200	Shallow (<30 cm), usually gravelly to cobbly topsoil overlying shale rock; 10-20% clay in topsoil. Rocky outcrops common; also in valley bottoms.	North-west and north-east facing open slopes and rocky ravines.	6; 10; 22; 23; 30; 33; 34; 35
5	B3	Ms 2100 Gs 2211 Cf 1200 Oa 2220 Rock	Shallow (<30 cm) usually gravelly to cobbly topsoil overlying shale rock; 10-20% clay in topsoil. Rocky outcrops rare to common in places; deepest soils along lower south facing slopes and in valley bottoms.	Extensive area of west and north-west facing open slopes.	11; 12; 14; 15; 17; 18; 19; 21; 24; 25; 27
SHALLOW LITHOSOLS (NO E HORIZONS)					
-	C	Ms 2100	Shallow (<25 cm) gravelly topsoil overlying shale rock; 10-25% clay in topsoil; rocky outcrops are rare.	North-east facing crest.	

TABLE 2.—Exposition of symbols in Table 3 and on Figure 3 with brief description of soils and topography of Signal Hill, Cape Town

Phyto- socio- logi- cal table symbol	Map symbol	Dominant soil families	Description of soils	Topography	Relevé number
SHALLOW TO MODERATELY DEEP LITHOSOLS WITH/WITHOUT AN E HORIZON					
-	D1	Gs 1211 Gs 2211 Cf 2200 Oa 2120	Shallow (<25 cm), usually gravelly topsoil overlying shale rock; 15-25% clay in topsoil.	Northern part of ridge on top of Signal Hill.	
6	D2	Gs 1211 Gs 2211 Cf 2200 Oa 2120	Shallow to moderate (<35 cm), usually gravelly topsoil over- lying shale rock; 15-25% clay in topsoil.	East facing open slopes.	36; 37; 38; 39; 40; 41; 42; 43
7	D3	Gs 1211 Gs 2211 Cf 2200 Oa 2120 Oa 1120	Moderately deep (<50 cm), usually gravelly to cobbly topsoil over- lying shale rock; 15-25% clay in topsoil. Deepest soils in valley bottoms.	East and south-east facing open slopes.	44; 45; 46; 51; 52
-	D4	Gs 1111 Gs 1211 Oa 2120 Oa 1120	Moderately deep (<60 cm) usually gravelly to cobbly topsoil over- lying shale; 15-25% clay in top- soil; deepest soil along lower slopes and in valley bottoms.	South-east facing open slope (Schoone Kloof).	
SOMEWHAT IMPERFECTLY DRAINED DUPLEX SOILS ON SHALE					
-	E	Km 2120 Km 1120 Es 2100 Cf 1200	Shallow to moderate (<50 cm), usually gravelly topsoil over- lying gleyed structured clay. 10-20% clay in topsoil.	Southern part of ridge on top of Signal Hill.	
LOW ORGANIC-RICH WELL DRAINED SOILS OF VALLEYS					
-	F	Oa 1110 Oa 1210 Hu 2200	Moderate to deep (80-120+ cm) soils; 15-30% clay in topsoil; organic carbon <1% in topsoil.	East and south-east facing valleys.	
MODERATE TO HIGH ORGANIC-RICH WELL DRAINED SOILS					
8	G	Hu 2100 Ia 1100 Sr 1210 Gs 1111 Gs 1211 Ik 2100	Deep (>100 cm), usually reddish coloured, apedal soils; 20-40% clay in topsoil; organic carbon 1-5% in topsoil.	East and south-east facing slopes and valleys.	28; 29; 47; 48; 49; 50; 53
STONY COLLUVIAL SOILS WITH SALT ACCUMULATION IN SUBSOILS					
9	H	Oa 1110 Oa 2110 Es 1100 Vf 1120	Moderately deep (60-90 cm) cobbly soils on shale rock; 15-25% clay in topsoil.	North facing open slope.	3; 8

TABLE 3.—Phytosociological table of the perennial species on Signal Hill, Cape Town

Variant	1.1.1.	1.1.2 .	1.1.3	1.2.1	1.2.2
Total no. spp.	.655.4655565.7777666566648364645544544			5543322334645	45455
	.235.0279228.3375748045563185086306886			0021586793124	48139
No. perennials	.223.2332333.44444342333242323222212			3221222222424	24333
	.985.3259573.3140562984969178152124693			0639822469580	80214
No. ephemerals	.322.1323122.3333222223223131222312322			2211000111111	11022
	.350.7020755.0235286161604017934282293			0492764334644	68925
Relevé number	.000.0000030.3112132111133142132222231			4353342544544	42454
	.574.1268913.4760922280130506451734593			3826729165017	98834
Species Group C					
<i>Aspalathus cymbiformis</i>	. ++.	+ ++	.0 +		
<i>Commelina africana</i>	. 0.	+ 0	. + + 1		
<i>Orbea variegata</i>	. .	0++	. + 1		
<i>Cynanchum zeyheri</i>	. 0.	0 +	. + +		
<i>Berkheya carlinifolia</i>	. .	+ .	0		+0
<i>Anthospermum galioides</i>	. .	+ +	. +		
<i>Zygophyllum sessilifolium</i>	. .	. +	. +		
<i>Crassula nudicaulis</i>	. .	0	. +		
Species Group D					
<i>Gnidia inconspicua</i>	. .	. .	. +	+++	+ 0
<i>Erica baccans</i>	. .	. .	0		++ + 0
<i>Diosma hirsuta</i>	. .	. .	. .	+	+ +
<i>Knowltonia capensis</i>	. .	. .	. .	0+	+
<i>Euryops abrotanifolius</i>	. .	. .	. .	1	1
Species Group E					
<i>Zantedeschia aethiopica</i>	. .	. .	. .	+	+++++
<i>Noltea africana</i>	. .	. .	. .		B 0
<i>Pentaschistis aspera</i>	. .	. .	. .		+ +
<i>Ehrharta erecta</i>	. .	. .	. .		0+
Species Group F					
<i>Cliffortia polygonifolia</i>	. .	. .	. +	OB1+++AAA1+++	1+0+
<i>Rhus tomentosa</i>	. .	. .	. .	10 +111A11A	B11+1
<i>Olea europaea</i>	. .	. .	. 0	00 010 + +	01++1
<i>Chironia baccifera</i>	. .	. .	. .	+0+ +010+	1 +00
<i>Stoebe cinerea</i>	. .	. .	. .	+ +AA0 11B	A 00
<i>Myrsine africana</i>	. .	. .	. 0 +	1+111 1	11101
<i>Cheilanthes capensis</i>	. .	. .	. +	++ + +	B1BA4
<i>Kiggelaria africana</i>	. .	. .	. .	0 01	0++A0
<i>Selago corymbosa</i>	. .	. .	. .	0+ + +	0+1
<i>Rhus angustifolia</i>	. .	. .	. .	A1 +	433
<i>Protasparagus rubicundus</i>	. .	. .	. .	+00	+0+
<i>Lobostemon fruticosus</i>	. .	. .	. A	+ + 0 0 +	+
<i>Putterlickia pyracantha</i>	. .	. .	. 0	+ +	1A
* <i>Pittosporum undulatum</i>	. .	. .	. .		00
* <i>Centranthus rober</i>	. .	. .	. .	0 0	+
<i>Euphorbia arceuthobioides</i>	. .	. .	. .		+
Species Group G					
<i>Chrysanthemoides monilifera</i>	.100.	0 0	.011 00+0 ++0 10 1	+ 0 0	
<i>Hibiscus aethiopicus</i>	. +.	+++ +.	+0+ + ++ + +	+ 00 + +	
<i>Felicia fruticosa</i>	.0+.	1 .	.00 + + + +++ 0	0+ + 0 0 0	
<i>Ischyrolepis capensis</i>	. ++.	+1+.1	0 1 1++11 + 0	+ +	
Species Group H					
<i>Ehrharta calycina</i>	.+++.	+0+++	.+++++ + 0++ + + ++++++		+ +1
<i>Linum thesioides</i>	. .	. +	. + +		+

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No. perennials	.223.2332333.44444342333242323222212			3221222222424	24333
	.985.3259573.3140562984969178152124693			0639822469580	80214
No. ephemerals	.322.1323122.3333222223223131222312322			2211000111111	11022
	.350.7020755.0235286161604017934282293			0492764334644	68925
Relevé number	.000.0000030.3112132111133142132222231			4353342544544	42454
	.574.1268913.4760922280130506451734593			3826729165017	98834
Species Group H					
Sutera hispida	.	.	.	.	1
Euclea racemosa	.	1	0	.	+ 0
Indigofera racemosa	.	.	0 +	.	+
* Trifolium repens	.	+	.	+	+ +
Species Group I					
Elytropappus rhinocerotis	.	+	.+1+A A ++0+B1 A0+ + A+	B 1 10 00 +	0
Scabiosa columbaria	.	+	.+10+++ + 1 1++ 1 ++	+1+++ ++1 +0+	+
Pelargonium cucullatum	.	.	.0+ + 1 1 0+++	+ A +0++1 100	+
Lobostemon argenteus	.	.	.+ + + + + 0 0	+ + + 0 + +	
Passerina filiformis	.	.	.0 +0 0 0+ +	+++A + 0 +	
Cliffortia ruscifolia	.	.	.+ 1 0 0	00 +1+ + 1 0	
Gnidia laxa	.	.	.+0 00 0 + + +	+ + 0 +	
Montinia caryophyllacea	.	.	.10 0 0	+ + 0++	1
Anthospermum aethiopicum	.	.	.+ +	+ 1	
Helichrysum teretifolium	.	.	.	0 0	
Melica racemosa	.	.	.	+0 +	
Senecio pinifolius	.	.	.	+0	
Leucadendron salignum	.	.	.0 0	0	
Watsonia marginata	.	.	.0	0	
Species Group J					
Helichrysum cymosum	.	.+ 1	++ ++++++i++++ +i++11 0 1+ +A	++1ABA1111AA+	1+11+
Mohria caffrorum	.	++	+.+111 1 + + ++11+ + 1+1+	11A111AAAA++1	11A11
Stachys aethiopica	.	+++	+. A 0 + + + + + BB	1+	+ 1+
Athanasia trifurcata	.	.	.0. A+ +1 + 1	+ + + ++ 1++	0 10+
Diospyros glabra	.	.	.0 + + +	+ + + + +	0+01+
Berkheya armata	.	.	.+ 00 + 0	+ 0 +	0
Maytenus heterophylla	.	.	.0 0 0 0 0	0 0 0	B 1
Colpoon compressum	.	.	.0 0+	00	1
Viscum capense	.	.	.+ + +	+	0
Asparagus crispus	.	.	.0 +		+ ++
Species Group K					
Rhus lucida	.	.10+.B10A1 A.111A1B0AAAA111BBB3 10B0B3		BBBBB+1ABB33A	ABBB1
Chrysocoma coma-aurea	.	+++ .1+A +1+.++11++++++11++1+++A +++		++1++B++11+A1	11A1+
Helichrysum patulum	.	.A .A+A 11.11+1A++1+A1+1A+11++1A11AB		+1AABBBBB+1B1	A1BA1
Anthospermum spatulatum	.	++.+ ++ 11. ++0 ++++++ +++++ +1 +++++		1++++A1A++1++	++1++
Salvia africana-caerulea	.	.+11.++11 11.A++1+11++1+ A++1+ +1+++		0 + +0++	+++0
Senecio hastatus	.	.+A+.A+1 A+.+++1+A1++1+ +1+++++1A11 +		+ 0 + +	+ +
Cheilanthes hastata	.	.+ .++ ++ +. ++++++ +++++ +++++ 01++ +++		++ + +	0+ ++
Merxmüllera stricta	.	.+ ++ +++++.1++ +01+0 +++++ +++++ + +0 +		1B +0 ++	++
Rhus laevigata	.	.1 1. + 0 1+. 1 1 1 1 11 1 +0 111 +		+ 1 +1 + 1	A+ ++
Otholobium hirtum	.	.1 .+B+A 1.0+ 0 + 1 1 0110+		1 1 + +11 0	1A+++
Hermannia hyssopifolia	.	.+ 0.++ 1 +. ++0 + ++0 0+ +		+	1
Senecio pterophorus	.	.+ .0 + + + 1 + +		++ +	++
* Orobanche ramosa	.	.+ .+ + ++ +		++ ++	++
Relevé number	.000.0000030.3112132111133142132222231			4353342544544	42454
	.574.1268913.4760922280130506451734593			3826729165017	98834
Date	.222.2222132.2112212112123123122223321			0202222220222	21211
	.888.8888318.8557747459481520407970024			6262229136133	30300
	.111.1111101.11111111011011111011111			0101110110111	10100

TABLE 3.—Phytosociological table of the perennial species on Signal Hill, Cape Town

Variant	1.1.1.	1.1.2 .	1.1.3	1.2.1	1.2.2
Total no. spp.	.655.4655565.7777666566648364645544544	.235.0279228.3375748045563185086306886		5543322334645	45455
No. perennials	.223.2332333.4444434233324232323222212	.985.3259573.3140562984969178152124693		3221222222424	24333
No. ephemerals	.322.1323122.333322223223131222312322	.350.7020755.0235286161604017934282293		2211000111111	11022
Relevé number	.000.0000030.3112132111133142132222231	.574.1268913.4760922280130506451734593		4353342544544	42454
				3826729165017	98834
Date	.222.2222232.2222202224223222222422222	.888.8888888.888888888888888888888888888		1212223221222	21211
Aspect	. . . N . . . N W W E N E	. N . NN NN.N S N N NNNNNN N NNNNNN		S ES S SSSEE	SSSEE
Slope in degrees	.222.2222233.233333233232322233232123	.397.2269501.2259764427420946419702710		222222213222	22223
Soil depth in cm	.332.2222222.2424332253212332333333333	.452.9879810.2476695022469336623371212		2633343340337	33364
Altitude in m	.111.2111122.1222213212213121212122122	.696.3766572.8455771671370845585586960		2222222222222	22211
Vegetation age in years	. . . .2 2221221 2111 112211111	.212.2222212.0880004004808468360044464		1111111111111	11111
Bare soil in %	.445.3513343.333334534252341253331241	.005.0050050.50055050000005000005505		343111 44 411	11 1
Litter cover in %	.5 1.5464423.5666465343646448546668758	.755.0500050.50505000050505050055555		6476999669688	99998
Vegetation cover in %	.554.6455555.5345755456544546556466656	.005.5505005.05500000050505050500605		550005005055	00555
Soil family	.333.3349339.4510504554544561545545562			6676668777868	88887
Rocks(2-4 cm)	.323.3343233.34333324324222233+3343324			3342244433243	23 33
(5-20 cm)	.322.2223221.32322212333222333+211122			+1222122222+1	22 11
(25-50 cm)	.322.1212222.1+111+23+1212323+2+11122+			+0+1+000+2+1+	12 21
(>50 cm)	.+0+.120+002.000+00+20000100+02+0+10+			0000+00000000	01 1+
(bedrock)	.101.2201++1.+001+++20+0+2+00021000+00			00+0+00000+00	12121
No. of spp.	.223.2332333.4444434233324232323222212	.985.3259573.3140562984969178152124693		3221222222424	24333
Relevé number	.000.0000030.3112132111133142132222231	.574.1268913.4760922280130506451734593		4353342544544	42454
				3826729165017	98834

Species of single occurrence not included in the phytosociological table: species (relevé:cover); *Acacia karroo* (35:0); *Adenandra uniflora* (50:+); *Aspalathus hispida* (9:+); *Blaeria ericoides* (50:0); *Cliffortia hirta* (47:1); *Clutia alaternoides* (47:+); *Clutia pulchella* (28:3); *Crassula subulata* (40:0); *Dodonaea angustifolia* (32:0); *Ehrharta melicoides* (38:+); *Erepsia bracteata* (14:+); *Erica mauritanica* (40:0); *Erica hispidula* (47:+); *Erica plukenetii* (47:+); *Ficinia bergiana* (44:+); *Ficinia indica* (9:+); *Ficinia nigrescens* (11:+); *Helichrysum nudifolium* (47:+); *Heteropogon contortus* (9:0); *Hymenolepis parviflora* (48:0); *Lampranthus multiseriatus* (1:+); *Lessertia capensis* (50:+); *Metalasia muricata* (50:+); *Myrsiphyllum undulatum* (2:0); *Pennisetum setaceum* * (5:0); *Plantago lanceolata* * (38:+); *Podalyria sericea* (17:+); *Protasparagus africanus* (48:+); *Rubus cf. cuneifolius* * (47:+); *Ruschia pulchella* (18:0); *Selago adpressa* (31:+); *Selago serrata* (42:0); *Senecio rigidus* (48:0); *Senecio subcanescens* (48:0); *Solanum americanum* (25:0); *Solanum pseudocapsicum* * (35:0); *Stipagrostis zeyheri* (9:+); *Ursinia dentata* (50:+). * Introduced species

TABLE 4.—Phytosociological table of the ephemeral[#] species on Signal Hill, Cape Town

Variant	1.1.1.	1.1.2 .	1.1.3	1.2.1	1.2.2
Number of spp	.655.4655565	.7777666566648364645544544		5543322334645	45455
	.235.0279228	.3375748045563185086306886		0021586793124	48139
No. ephemerals	.322.1323122	.3333222223223131222312322		2211000111111	11022
	.350.7020755	.0235286161604017934282293		0492764334644	68925
No. perennials	.223.2332333	.44444342333242323222212		3221222222424	24333
	.985.3259573	.3140562984969178152124693		0639822469580	80214
Relevé number	.000.0000030	.3112132111133142132222231		4353342544544	42454
	.574.1268913	.4760922280130506451734593		3826729165017	98834
Species Group D					
Pterygodium alatum	.	.	.	+	+
Oxalis incarnata	.	.	.	+	+
Cyphia zeyherana	.	.	.	+	+
Species Group E					
Phacocapnos cracca	.	.	.	.	0++
Asplenium aethiopicum	.	.	.	.	+
Pelargonium alchemilloides	.	.	0	.	0 0
Species Group H					
* Torilis arvensis	.+	.+	.+	.+	++ ++
* Sonchus oleraceus	.++	.+++	.+	.+	++
* Avena barbata	.+	.+0	.00	.+00 0	0+ +
Rumex cordatus	.+	.	.++	.+	+
Trifolium angustifolium	.+	.	.	.0 0	0
Oxalis compressa	.	.	.+	.1	11
* Cynosurus echinatus	.	.	.+	.	00
* Bromus diandrus	.	.	.	.++	+
* Hypochaeris radicata	.	.+	.	.	+
Species Group I					
Pterygodium catholicum	.	.	.+	.+	+
Urginea altissima	.	.	.0++++++	.+	+
Arctopus echinatus	.	.	.+	.+	0
Oxalis tomentosa	.	.	.+	.+	+
Wachendorfia paniculata	.	.	.+	.+	+
Oxalis punctata	.	.	.+	.+	+
Haemanthus sanguineus	.	.	.0 0	.+	+
Pelargonium pinnatum	.	.0	.+	.+	0
Monadenia bracteata	.	.	.0	.+	+
Cyphia phyteuma	.	.	.	.+	+
Otholobium decumbens	.	.	.+	.+	+
Galium sp. (J347)	.	.	.+	.+	+
Pelargonium chamaedryfolium	.	.	.+++	.	+
Ixia scillaris	.	.	.	.+	+
Holothrix villosa	.	.	.	.+	+
* Aira caryophyllea	.	.	.	.++	+
Species Group J					
* Anagallis arvensis	.	.+	.+0+0+	.+	+
Sebaea aurea	.	.+	.+++ + +++	.+	+
Pelargonium columbinum	.	.	.+++ ++++	.+	+
Geissorhiza aspera	.	.	.++	.+	+
Sebaea excooides	.	.+	.+++	.+	+
Crassula capensis	.	.	.0+	.1	1+0++
Annesorrhiza capensis	.	.	.0 +0	.+	+
Lobelia erinus	.	.	.	.+	+
* Briza minor	.	.	.	.+	0 +

In this study ephemerals are those species not perennially identifiable e.g. geophytes (cryptophytes) and annuals (therophytes).

* Introduced species.

TABLE 4.—Phytosociological table of the ephemeral[#] species on Signal Hill, Cape Town

Variant	1.1.1.	1.1.2 .	1.1.3	1.2.1	1.2.2
Number of spp	.655.4655565.7777666566648364645544544	.235.0279228.3375748045563185086306886		5543322334645	45455
No. ephemerals	.322.1323122.3333222223223131222312322	.350.7020755.0235286161604017934282293		2211000111111	11022
No. perennials	.223.2332333.44444342333242323222212	.985.3259573.3140562984969178152124693		3221222222424	24333
Relevé number	.000.0000030.3112132111133142132222231	.574.1268913.4760922280130506451734593		4353342544544	42454
				3826729165017	98834
Species Group K	.	.	.		
<i>Pelargonium elongatum</i>	.+	+++++	+++0	+ 0+	++
<i>Oxalis glabra</i>	.+	+	+++++	++++	1++++ +
<i>Cyanella hyacinthoides</i>	.+++.	++++.	++ +++++	++ +	++ ++
<i>Oxalis purpurea</i>	.++	.+0+++.	+++ +++++	++ ++	+1 ++
<i>Pelargonium lobatum</i>	.++.	0 +++.	++++ 0 + +	+++11++++	+ ++
* <i>Briza maxima</i>	.++	.+ +	++++ +0	++++ +	++ ++
<i>Oxalis pes-caprae</i>	.+	++++	++++ +	+	+++ +
<i>Oxalis bifida</i>	.+	.+ +	+	+++	1+1+ +
<i>Moraea bellendenii</i>	.	. 0 +.	0 +	+ + + +	++

Species of single occurrence not included in the phytosociological table: species (relevé:cover);

Aristea africana (47:+); *Brachypodium distachyon* * (25:+); *Bromus pectinatus* * (2:+); *Carduus pycnocephalus* * (44:+); *Cerastium capense* (35:+); *Didymodoxa capensis* (35:+); *Eriospermum capense* (30:+); *Gastroidium phleoides* * (53:0); *Geissorhiza imbricata* (45:+); *Heliophila diffusa* (44:+); *Hesperantha falcata* (39:+); *Homeria flaccida* (22:0); *Ixia dubia* (14:+); *Ixia odorata* (17:+); *Lophochloa cristata* (20:0); *Micranthus alopecuroides* (43:+); *Microdon sparsiflorum* (14:+); *Osteospermum clandestinum* (5:+); *Otholobium uncinatum* (45:0); *Oxalis polyphylla* (40:+); *Oxalis pusilla* (10:+); *Pelargonium auritum* (10:+); *Pelargonium pillansii* (47:+); *Picris echioides* * (23:+); *Ranunculus multifidus* (48:+); *Rapistrum rugosum* * (7:+); *Senecio abruptus* (44:+); *Sonchus asper* * (23:+); *Spiloxene capensis* (38:+); *Vulpia bromoides* * (25:+); *Wahlenbergia capensis* (32:+); *Wahlenbergia obovata* (20:+); *Wurmbea spicata* (38:+); *Zehneria scabra* (26:+).

In this study ephemerals are those species not perennially identifiable e.g. geophytes (cryptophytes) and annuals (therophytes).

* Introduced species.

for the vegetation of the study area is about one relevé per 2.4 ha. Sample plot size was 10 × 10 m on the open slopes (McKenzie *et al.* 1977; Campbell & Moll 1977) and 5 × 20 m in the dry ravines and valleys (Campbell & Moll 1977), resulting in plots of 100 m² each.

A total of 293 species was recorded for the phytosociological tables. The Braun-Blanquet method (Werger 1974) was used to classify the vegetation of the area in an effort to show the variation within, and the relationship between, the floristic units. Cover values for all species and heights for the perennial species were recorded. In addition to the values stated by Werger, an '0' was used to indicate species found within a 10 m wide belt outside the plots (McKenzie *et al.* 1977). Additional environmental data were recorded at each plot and tabulated at the bottom of the phytosociological table of the perennially identifiable species (Table 3). The plots were visited on a regular basis for 12 months in order to record as many species as possible and a separate table of these seasonally identifiable species was made (Table 4).

Two-way indicator species analysis TWINSpan (Hill 1979) was used to derive a first approximation of the vegetation types. A suite of computer programs used by Boucher & Shepherd (1988) was also used and proved most useful in this respect. The results of this classification were refined by the Braun-Blanquet classification technique as described by Mueller-Dombois & Ellenberg (1974), using a word processor package to shuffle relevés and species in order to obtain a final classification. All plots sampled are retained in the phytosociological tables (Tables 3 & 4).

The perennial species were treated separately from the ephemeral species to determine the contribution of each to the vegetation. Perennial species are considered to be those which are perennially identifiable (Werger 1974) and ephemeral species those which are not perennially identifiable. The latter includes both therophytes and cryptophytes. The results from the perennial species are listed separately from those of the ephemeral species in order to determine the relationship between the two groups. Species with a single occurrence were listed below



FIGURE 4.—Contour map showing the position of sample sites.

the relevant table together with the relevés in which they occurred and their cover-abundance values.

Diagnostic species listed in Tables 3 & 4 were used to identify the vegetation types in the veld as well as for mapping purposes. The system and terminology of

Campbell *et al.* (1981) was adopted in the description of the community types.

A list of 81 families, 255 genera and 460 vascular plant species was compiled. This list is based on species recorded during the present study as well as those recorded

by other botanists in the past. Old taxon names were updated using Gibbs Russell *et al.* (1985, 1987), or recent revisions, or by consulting specialists in particular taxa. Outdated taxon names which could not be updated were excluded from the list. Species mentioned by Adamson & Salter (1950) as occurring on Signal Hill were checked with the Guthrie Collection (Bolus Herbarium). Only those species which occur as actual specimens in the herbarium and which were collected on Signal Hill were added to the list. Species encountered incidentally during herbarium work, for which Signal Hill is given as the locality, were also included.

RESULTS

Soil

The more gentle slopes of Signal Hill consist mainly of shale horizons (Smith-Baillie *et al.* 1976). Oakleaf (Oa) and Glenrosa (Gs) overlying shale rock are the dominant soil forms in the study area. Other soil families are Mispah (Ms), Cartref (Cf), Hutton (Hu), Inanda (Ia), Inhoek (Ik), Estcourt (Es), Vilafontes (Vf), Klappmuts (Km) and Sweetwater (Sr). See Figure 3 for the soil map and Table 2 for the exposition of the symbols on the soil map.

Along the northern open slopes shallow, gravelly lithosols with 6–15% clay in the topsoil generally occur. E horizons are rare. An area of stony, moderately deep, cobbly colluvial soils with salt accumulation in the subsoils is also present. Rocky outcrops are common in the valley bottoms. Shallow to moderately deep, well-drained cobbly pedisements with 10–20% clay in the topsoil occur in the valley bottoms.

The northwest-facing slopes generally have shallow, gravelly to cobbly lithosols with 10–20% clay in the topsoil. The deepest soils occur along the lower south-facing slopes and in valley bottoms. In the area transitional to the northern slopes, rocky outcrops are common as well as in the valley bottoms. Well-drained pedisements of varying depth with 10–20% clay in the topsoil occur in the valleys.

Shallow to moderately deep lithosols with/without an E horizon occur on the open east-facing slopes. The topsoil is usually gravelly to cobbly with 15–25% clay in the topsoil. Deep, moderately to highly organic-rich well-drained soils with 20–40% clay in the topsoil occur in the southeast-facing valleys. The organic carbon content of the valley soils is the highest recorded in the study area, i.e. 1–5%.

Phytosociological study

The analysis resulted in the identification of one major plant community and two subcommunities, one of which has three and the other two variants. Each of these vegetation types is related to a particular set of environmental conditions, of which aspect and historic land use differences were the most significant. There appears to be no clear correlation between soil forms and vegetation types. These community types have been mapped in Figure 5.

The phytosociological classification, as well as the floristic relationship between the different subcommunities and variants, is given in Tables 3 & 4. A list of the vascular plant species recorded appears in the Appendix.

In this survey the taxonomic entities *Mohria caffrorum* and *Cheilanthes contracta* were merged. Introduced woody species such as *Pinus pinaster*, *P. radiata*, *Acacia cyclops*, *A. saligna* and *Eucalyptus* spp., which occur as scattered individuals, were excluded from Table 3.

1. *Rhus lucida*–*Chrysocoma coma-aurea* Community

The community occupies the entire study area and consequently occurs in a variety of habitats; i.e. on open slopes as well as in dry ravines, on different geological formations and soil types, on various aspects and at different altitudes. The community is characterised by the species of Species Group K (Tables 3 & 4).

The vegetation comprises an evergreen, mid-high to low, small to large-leaved shrubland with a grassy understorey.

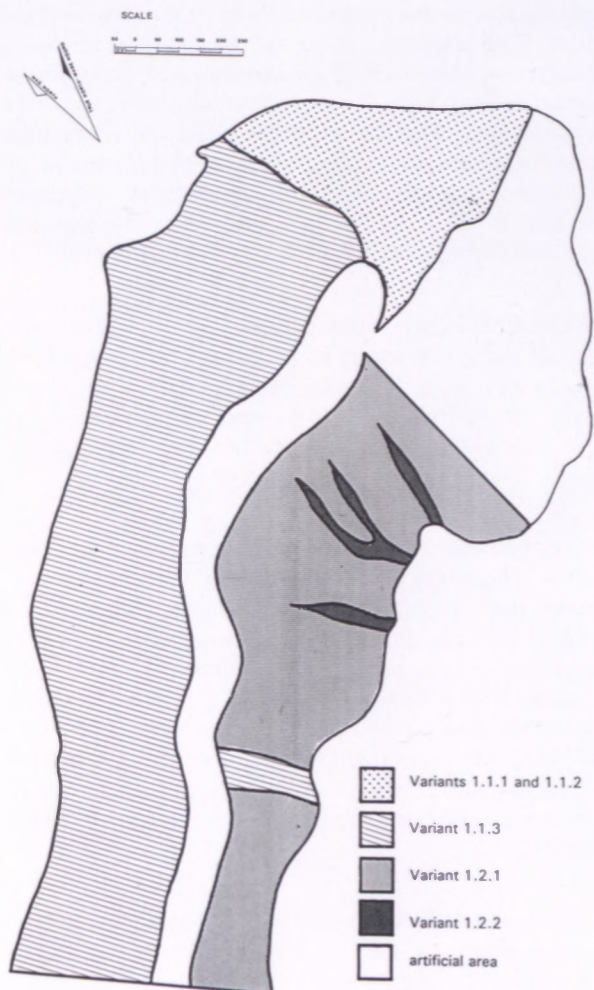


FIGURE 5.—Vegetation map of Signal Hill, Cape Town. *Rhus lucida*–*Chrysocoma coma-aurea* Community. *Hyparrhenia hirta*–*Rhus glauca* Subcommunity: Variants 1.1.1, 1.1.2 & 1.1.3. *Cliffortia polygonifolia*–*Rhus tomentosa* Subcommunity: Variants 1.2.1 & 1.2.2.

Depending on local site factors, the shrub canopy closure varies from sparse to mid-dense; similarly the grass understorey varies from very sparse to open (Campbell *et al.* 1981). There are very few trees, but the multi-stemmed shrub, *Rhus lucida*, is abundant and more or less evenly distributed.

Three strata are generally recognised, namely a canopy of mid-high sparse to mid-dense shrubs; a sparse to open grassy/low shrub stratum; and a very sparse seasonal herb layer. *Rhus lucida*, *Anthospermum spathulatum* and *Otholobium hirtum* are the most constant species present in the canopy, having a height of 1–2 m and a cover of 10–60%. *Viscum capense* was often recorded as growing on *R. lucida*. The second stratum is dominated by the woody shrubs *Chrysocoma coma-aurea*, *Helichrysum patulum*, *Salvia africana-caerulea*, *Rhus laevigata*, *Hermannia hyssopifolia* and *Senecio pterophorus*, and the grass *Merxmüllera stricta* with a height of 0.25–1.0 m and a cover of 10–25%.

The herbaceous layer with a cover of generally <5% consists of the forbs *Senecio hastatus* and *Orobancha ramosa*, and the fern *Cheilanthes hastata*. Geophytes are a feature on the northern aspects in particular, and autumn to spring ephemerals are prominent in areas of sparse vegetation. Characteristic ephemeral species are the forbs *Pelargonium elongatum*, *P. lobatum*; the geophytes *Oxalis glabra*, *O. purpurea*, *O. pes-caprae*, *O. bifida*, *Cyanella hyacinthoides*, *Moraea bellendenii* and the introduced grass *Briza maxima*. Lichens and mosses were recorded, but omitted from the phytosociological table. It appears that lichens are generally less common on the east and southeast-facing slopes than in the rest of the area.

Plant litter cover varies between 5% and 95%, and consists mainly of leaves of *R. lucida* and *H. patulum*, grasses and twigs. The total canopy cover of the vegetation varies from 35–140%, and an average of 31 perennial and 22 ephemeral species was recorded per relevé.

Very few species were found growing under the *Rhus* bushes. Those which did occur include *Senecio hastatus*, *Stachys aethiopica*, *Scabiosa columbaria*, *Annesorrhiza capensis*, *Oxalis* spp., annual orchids and fern clusters under the larger bushes. The climber, *Helichrysum patulum*, with a height of about 0.7 m, often scrambles into other shrubs such as *R. lucida* and *R. glauca*, and when thus supported can reach a height of about 1.2 m. Other scramblers in *R. lucida* are *Helichrysum cymosum* and *Chrysocoma coma-aurea*, though to a lesser extent.

This community is divided into two subcommunities. Subcommunity 1.1, the *Hyparrhenia hirta*–*Rhus glauca* Subcommunity, occurs in the drier parts, and is characterised by the species listed in Species Group C (Tables 3 & 4). Subcommunity 1.2, the *Cliffortia polygonifolia*–*Rhus tomentosa* Subcommunity occurs in the wetter parts, and is characterised by the species listed in Species Group F (Table 3). The diagnostic ephemeral species for the latter subcommunity are less well defined and are listed in Species Groups D and E (Table 4).

1.1 *Hyparrhenia hirta*–*Rhus glauca* Subcommunity

This subcommunity of 35 relevés is the most extensive and occupies approximately 80 ha (64% of the study area). It occurs mostly on the north and northwest-facing seaward side, though two relevés, Nos 39 and 40, face east-north-east. This is the more diverse subcommunity, probably related to the diversity of microhabitats available because of the occurrence of a variety of soil types, and as a result of disturbance history including fire. The soils are generally shallow, usually gravelly to cobbly, with the topsoil overlying shale rock and having 6–40% clay in the topsoil. Rocky outcrops are rare to common.

The high constancy (100%) and relatively high canopy cover, ranging from <1% to 40%, of *H. hirta* and relatively constant presence (80%) and locally high canopy cover, up to 45%, of *R. glauca*, are features of this subcommunity. The rest of the differential species in this subcommunity have a relatively low canopy cover. The high constancy and canopy cover of *H. hirta*, and the low cover of woody species is an indication of the generally poor condition of this vegetation, attributed to frequent fires, especially in variants 1.1.1 and 1.1.2.

Species which differentiate this subcommunity are listed in Species Group C (Tables 3 & 4). An average of 32 perennial and 26 ephemeral species was recorded per relevé.

In this open grassy/low shrubland three strata are evident. The mid-high sparse shrub stratum, with a canopy cover of 10–20%, is 1.3 m tall and consists mainly of *Rhus lucida*, *Anthospermum spathulatum* and *Otholobium hirtum*. The open grassy/low shrub stratum is dominated by the woody *R. glauca* (0.90–0.96 m tall; 7% cover), and the grass *H. hirta* (0.86 m tall; 10–25% cover). Other species in this stratum of 0.25–1.0 m tall and cover of 35–40% are the low woody shrubs *Protasparagus capensis*, *Hermannia alnifolia*, *H. prismatocarpa*, *Aspalathus ericifolia*, *A. cordata*, *A. cymbiformis* and *Sutherlandia frutescens*. The sparse herbaceous component includes, apart from *H. hirta*, other grass species such as *Ehrharta calycina* and *Tribolium hispidum*.

The very sparse herb/dwarf-shrub stratum (<0.25 m) with a cover of <5% is represented by the woody *Hermannia althaeifolia*, *Helichrysum cylindriflorum*, *H. asperum*, *Aspalathus acuminata*, *Pelargonium myrrhifolium* and *Leysera gnaphalodes*. A fairly common climber in *R. lucida* is *Pelargonium candicans*. The most common succulents are *Lampranthus emarginatus*, *Ruschia rubricaulis*, *Orbea variegata* and *Cynanchum zeyheri*. The forbs include *Indigofera incana*, *Cineraria geifolia*, *Euphorbia crispa*, *Aizoon sarmentosum* and *Commelina africana*; and the ephemerals as listed in Species Group C (Table 4). Of these ephemerals, species such as the geophytes *Lachenalia fistulosa*, *Babiana disticha*, *Ornithogalum thyrsoides*, *Trachyandra muricata*, *Oxalis hirta*, *Albuca canadensis*, *Bulbine alooides*; the herbs *Dimorphotheca pluvialis*, *Felicia bergerana*, *Cenia turbinata*, *Crassula campestris*, *Pelargonium rapaceum*, *Ursinia anthemoides*, *Gnaphalium subfalcatum*; and the grass *Pentaschistis airoides* are the most common.

This subcommunity is divided into three variants. Species listed in Species Group C (Tables 3 & 4) indicate the relationship among these three variants.

Variants 1.1.1 and 1.1.2

Most of this area was burnt during early 1986, less than three years prior to the survey.

These two variants can be treated as a single unit as they are closely related. The difference between the two variants is characterised by the two species, *Eragrostis curvula* and *Erepsia anceps* present in variant 1.1.1, but absent from variant 1.1.2. The relationship between these two variants is shown by the relative absence of species listed in Species Group B (Tables 3 & 4). These variants are also discerned from variant 1.1.3 by the absence of these species.

This vegetation occurs on open slopes as well as in dry ravines (Figure 6). These variants occur on steep (22°–31°), predominantly convex, mainly north-facing slopes characterised by extreme exposure to solar radiation in the driest and hottest part of the study area. They cover some 20 ha (16%) of the study area on a variety of soils. The vegetation generally (seven of the 10 relevés) occurs on shallow lithosols, some 200 mm deep. These are usually gravelly, with the topsoil overlying shale rock, and with 6–15% clay in the topsoil. Rocky outcrops and E horizons are rare. Relevé 6 occurs on soils similar to



FIGURE 6.—Variant 1.1.1. Dry north-facing ravine.

those associated with variant 1.1.3. Moderately deep (600–900 mm) stony colluvial soils with salt accumulation in the subsoils were recorded in relevés 3 and 8. These are cobbly soils with 15–25% clay in the topsoil. The substrate of these variants is generally rather rocky and most of the rocks fall into the category 20–200 mm diameter. Bedrock occurs in most of the relevés, irrespective of altitude whether they are in dry ravines or on open slopes.

Between 15% and 55% of the surface is bare. Litter cover is between 5% (relevé 7, a fire having been experienced a year previously) and 60% (relevé 6, on the open slope). Total canopy cover during summer varies between 45% and 65%. During winter cover increases by about 10% and is associated with the appearance of ephemeral species. The height of the vegetation does not exceed 1.5 m.

The total number of plant species recorded per relevé varies between 40 and 62, with about 32 perennial and 24 ephemeral species per relevé. Species Groups I and J (Table 3) list those perennial species which occur throughout the study area, though generally not in these two variants. Species listed in Species Group I do not occur in the valleys on the southeast-facing slopes either. Conspicuous species which are absent from these two variants are the woody shrubs *Elytropappus rhinocerotis*, *Pelargonium cucullatum*, *Lobostemon argenteus*, *Passerina filiformis*, *Cliffortia ruscifolia*, *Gnidia laxa*, *Montinia caryophyllacea*, *Athanasia trifurcata*, *Diospyros glabra*; and the herb *Scabiosa columbaria*.

Species Group J (Table 4) lists the ephemeral species which occur all over the study area except in these variants. The most prominent of these are the forbs *Anagallis arvensis*, *Sebaea aurea*, *S. exacoides*, *Pelargonium columbinum*; and the geophytes *Geissorhiza aspera*, *Crassula capensis* and *Annesorrhiza capensis*. Species Group I (Table 4) lists the ephemeral species which occur all over the study area except in these variants and generally not in the valleys on the southeast-facing slopes either. Such absent species are the geophytes *Urginea altissima*, *Oxalis tomentosa*, *O. punctata* and *Haemanthus sanguineus*; and the forbs *Pterygodium catholicum*, *Arctopus echinatus* and *Wachendorfia paniculata*.

Three strata are evident in this xeric open grassy/low shrubland. The vegetation (Figure 7) is almost entirely dominated by the constant occurrence of the grass *Hyparrhenia hirta* (0.8 m tall) and, to a lesser extent, the woody shrub *Rhus glauca* (0.9 m tall). The mid-high sparse shrub stratum, about 1.2 m tall, with a canopy cover which varies from absence to 18% and an average of 10%, consists mainly of *Rhus lucida*, *Anthospermum spathulatum* and *Otholobium hirtum*. The open grassy/low shrub stratum is dominated by *H. hirta* and *R. glauca* with a cover of 25% and 6.5% respectively. Other species in this stratum with a cover of some 40% as well as those in the very sparse herb/dwarf-shrub stratum are similar to those listed in the general discussion on this subcommunity and to a lesser extent those listed in Species Groups A and B (Table 4).

This vegetation creates an appearance of almost pure grassveld since woody plants are not prominent. The



FIGURE 7.—Variant 1.1.3. *Rhus lucida* dotting the slopes with *Hyparrhenia hirta* and *Helichrysum patulum*.

floristic analysis, however, revealed that the woody species in many areas, though not conspicuous, are present. Species such as *R. lucida* (1.4 m), *R. glauca* (0.9 m), *R. laevigata* (1 m) and *Anthospermum spathulatum* (1 m) are often dwarfed. Conspicuous in this grassveld are the often tall (up to 1.45 m) *A. spathulatum* individuals at higher altitudes.

It appears that frequent fires played an important role in determining vegetation structure and floristic composition. Evidence from historical photographs indicates that parts of this vegetation have been grassveld for at least nine decades. The high cover of *Hyparrhenia hirta* seems to be a result of these frequent fires. The frequency of fires has, however, decreased in recent years.

There appears to be no difference floristically between the open slopes and dry ravines. An attempt was consequently made to determine whether a difference on a structural basis existed between these two habitats. The canopy cover and height of the woody *R. lucida*, *R. glauca* and *Otholobium hirtum* were studied. It was found that *R. glauca* attains the highest canopy cover value and height in the ravines; i.e. in relevés 1, 2 and 5. A mean canopy cover of 18% and a height of 1.1 m was recorded in the ravines, versus a mean canopy cover of 2% and a height of 0.75 m on the open slopes. The other two species did not show this tendency. It was also noted during field work that *O. hirtum* forms extensive thickets in the valley bottoms, though no data were collected in these areas. A mean canopy cover of <3% for this species in these two variants was recorded, though local high values were recorded; i.e. 15% in relevé 2 (a dry ravine) and 10% in relevé 8 (with moderately deep soil on the open slope).

The cause of the similarity in species composition between the dry ravines and open slopes may be the extremely shallow soil in the former as bedrock attains its highest cover in the ravines. None of these ravines is wet for a long period, and runoff is probably rapid.

It appears that these two variants are at present in a relatively stable subclimax stage induced abiotically by excessive firing over a relatively long period.

Variant 1.1.3

This is the most extensive variant in the study area and covers some 60 ha (48%) of the study area. It occurs on the less xeric, mostly west and northwest-facing slopes. The slope varies between 17° and 39°. Only three ravines occur and these are situated on the north-north-west-facing side (relevés 24, 25 and 35), although open low-lying areas occur on the west-facing side (relevé 26). With an average of 33 perennial and 26 ephemeral species recorded per relevé, it is floristically the richest of the five variants.

The vegetation occurs on a variety of soils, though generally on shallow lithosols (E horizons are rare), which are <0.3 m deep and usually with gravelly to cobbly topsoil overlying shale rock with 10–20% clay in the topsoil. Rocky outcrops are rare to common in places, and also occur in the valley bottoms. The deepest soils occur along the lower southwest-facing slopes and in valley bottoms. Relevés 20 and 30 occur on well-drained pedisements of moderate depth (<600 mm) which are gravelly to non-gravelly.

The age of the vegetation also varies significantly, i.e. between 8 and 20 years. Between 10% (relevé 26) and 50% (relevés 12, 33 and 35) of the surface is bare during summer. During winter this percentage decreases by about 10%. Species responsible for this increase in cover are mainly *Senecio hastatus*, *Stachys aethiopica* and the ephemeral species listed in Species Groups B, C, H, I, J and K (Table 4). The total canopy cover for summer varies between 35% (relevé 17) and 70% (relevé 19).

The relatively high canopy cover of *Elytropappus rhinocerotis* in relevé 33 suggests frequent fires in the past (Michell 1922). The extreme rockiness of this relevé may be attributed to surface erosion under such conditions. Brownlie (1982) found a positive correlation between *E. rhinocerotis* and eroded areas on clay soil. Many large (4 m²) bare patches are conspicuous in relevés 20 and 32 which occur on the same southwest-facing slope. In these relevés, 30–35% of the surface is bare. The vegetation is about 20 years old. Very large specimens of both old and dead *E. rhinocerotis* individuals were recorded.

Litter cover varies between 30% in a high lying rocky relevé with several succulent species (relevé 12) to about 75–85% in ravines at lower altitudes (relevés 13, 24, 25 and 26). The highest litter values appear to be correlated with wet areas and not with the age of the vegetation.

This variant is characterised by the prominence of species listed in Species Group B (Tables 3 & 4), although these species also occur to a lesser extent in variant 1.1.2 of this subcommunity.

Three strata are evident in this sparse grassy/low to mid-high open shrubland. The mid-high sparse shrub stratum, about 1.3 m tall and with a canopy cover of about 20%, is dominated by *R. lucida*, which has a canopy cover of 11% in this variant versus 6% in the former two variants. Other species in the mid-high shrub stratum (1–2 m tall) are *Anthospermum spathulatum*, *Otholobium hirtum*, *Chrysanthemoides monilifera*, *Pelargonium cucullatum*, *Cliffortia ruscifolia* and *Athanasia trifurcata*.

Characteristic woody shrubs in the sparse grassy/low sparse to open shrub stratum (0.25–1.0 m) with a canopy cover of about 35%, are *Elytropappus rhinocerotis*, *Lobostemon argenteus*, *Eriocephalus africanus*, *Salvia africana-lutea*, *Chrysanthemoides incana* and *Euclea tomentosa*. The tall *H. hirta* (0.85–0.90 m) with a canopy cover which ranges from <1–30%, and a mean of 10%, is generally conspicuous, and the stunted *Themeda triandra* (<1–20%), *Cymbopogon marginatus* (<1–6%) and *Tribolium uniolae* are locally prominent.

In the sparse herb/dwarf-shrub layer (<0.25 m) with a canopy cover of <5%, *Hermannia althaeifolia*, *Helichrysum cylindriflorum*, *Leysera gnaphalodes*, *Pelargonium myrrhifolium* and *Helichrysum asperum* are prominent woody shrubs. The climbers *Indigofera psoraleoides*, *Cissampelos capensis*, *Lessertia excisa* and *Tephrosia capensis* occur locally. This layer generally has a canopy cover of <5% in summer which can increase to 75% in winter (relevé 25). Prominent herb species in this stratum are *Senecio hastatus*, *Stachys aethiopica*, the fern *Mohria caffrorum* and the ephemeral species listed in Species Group B (Table 4) which occur scattered with low canopy covers.

Low-growing succulents are found scattered in this variant. These are often found among rocks and on rocky outcrops at higher altitudes in particular. Soil is generally shallow (<250 mm) and common species are *Othonna arborescens*, *Euphorbia caput-medusae*, *Tylecodon grandiflorus*, *Adromischus hemisphaericus*, *Crassula scabra*, *Lampranthus emarginatus* and *Ruschia rubricaulis*.

At higher altitudes, such as in relevé 19, wind-pruned shrubs of *R. lucida* and *Euclea tomentosa* occur. The latter is particularly prominent locally in these rocky parts. Isolated pine trees, mainly *P. pinaster*, occur on the slopes.

As in the former variant, the ravines appear to be no different floristically from the open slopes. Structural differences occur in that both *Rhus glauca* and *Hyparrhenia hirta* are taller in some ravines (relevés 24 and 25), though they do not have a higher canopy cover. The same applies to *H. hirta* in relevé 35, though not to *R. glauca* (Figure 8). Species listed in Species Groups G, I and J (Table 3), appear to be almost absent from relevés 24, 25 and 35 (ravines) as well as from relevés 21, 23 and 27 (open slopes).

Conspicuous in this variant is the much drier appearance of the north-north-west-facing slopes where *H. hirta* is prominent, versus the southwest-facing slopes where shrubs are dominant, giving the latter a green lush appearance. A vertical firebreak on a west-facing slope is maintained by using bush-cutters (Figure 9). The shrubs are thus prevented from reaching any considerable height. The vegetation in this firebreak is consequently artificially converted to grassveld dominated by *H. hirta*. The occurrence of this grass firebreak and the high cover of *H. hirta* on the north-north-west-facing slopes indicate the strong relationship among the three variants in this subcommunity.

Two of the relevés on the east-facing slopes appear to belong to this variant rather than to subcommunity 1.2. This may be due to the fact that these relevés occur along an east-north-east-facing slope. Variant 1.1.3 may be considered as transitional between the two subcommunities. Species listed in Species Group I (Tables 3 & 4) indicate



FIGURE 8.—Variant 1.1.3. Dry ravine with *Acacia karroo*, *Rhus glauca* and *Hyparrhenia hirta* (relevé 35).



FIGURE 9.—Variant 1.1.3. Grass fire-break along west-facing slope.

the relationship between variants 1.1.3 and 1.2.1. The woody shrubs *Elytropappus rhinocerotis*, *Pelargonium cucullatum*, *Lobostemon argenteus*, *Passerina filiformis*, *Cliffortia ruscifolia*, *Gnidia laxa*, *Montinia caryophyllacea*; the herbs *Scabiosa columbaria*, *Pterygodium catholicum*, *Arctopus echinatus*, *Wachendorfia paniculata*; and the geophytes *Urginea altissima*, *Oxalis tomentosa*, *O. punctata* and *Haemanthus sanguineus* indicate this relationship.

1.2 *Cliffortia polygonifolia*—*Rhus tomentosa* Subcommunity

This subcommunity of 18 relevés occupies some 45 ha (36% of the study area) and occurs on the mesic eastern and southeastern inland slopes and valleys. The slope varies between 17° and 34°. The soils are generally shallow to deep, gravelly or non-gravelly with 15–40% clay in the topsoil. The deepest soils occur in the valley bottoms.

The high constancy and canopy cover values of many species such as *Rhus lucida*, *Chrysocoma coma-aurea*, *Helichrysum patulum*, *Cliffortia polygonifolia*, *Rhus tomentosa*, *Olea europaea* subsp. *africana*, *Chironia baccifera*, *Stoebe cinerea* and *Myrsine africana* are features of this subcommunity. *Rhus lucida*, with a canopy cover of about 17%, is the most constant species (100%). Diagnostic species listed in Species Group F (Table 3) are the trees *Kiggelaria africana* and *Olea europaea* subsp. *africana*; the woody shrubs *Cliffortia polygonifolia*, *Rhus tomentosa*, *Chironia baccifera*, *Stoebe cinerea*, *Myrsine africana*, *Selago corymbosa*, *Rhus angustifolia*, *Protaspargus rubicundus*, *Lobostemon fruticosus*, *Putterlickia pyracantha*; and the fern *Cheilanthes capensis*.

This vegetation has been protected from fire for about 16 years. Prior to 1972, extensive pine plantations existed on the southeastern slopes, but it appears that the veld along these slopes has recovered to a large extent, except for the area in which relevés 29 and 51 are situated. This latter area has been subjected to afforestation for a much longer period than the rest of the area. Floristically this part has also recovered and cannot be distinguished from the rest of the slope, though the general height of the

vegetation is lower than that in the rest of the subcommunity.

Two variants are recognised in this subcommunity; i.e. variant 1.2.1 which occurs on the open slopes and variant 1.2.2 which occurs in the valleys. The floristic differences between the valleys and the open slopes are rather weak. Species Groups D and E (Tables 3 & 4) list the characteristic species for the open slopes and valleys respectively.

Variant 1.2.1

This is the most extensive variant in this subcommunity and occurs on the east and southeast-facing inland slopes except for relevés 39 and 40 which appear to be more closely related to variant 1.1.3 on the northwest-facing slopes. The vegetation on the east-facing slopes generally occurs on shallow to moderately deep (<350 mm) lithosols with or without an E horizon. The topsoil is usually gravelly, overlying shale rock with 15–25% clay in the topsoil. The southeast-facing relevés occur mostly on moderately deep (<500 mm) lithosols with gravelly to cobbly topsoil overlying shale rock with 15–25% clay in the topsoil. Rocks are predominantly of the smaller size (20–200 mm), with bedrock only in 3 of the 13 relevés.

The total number of species per relevé varies between 26 and 61, and for perennials between 19 and 45. An average of 29 perennial and 12 ephemeral species per relevé was recorded. The number of ephemerals was exceptionally low in some relevés and varied between 4 and 24 species. Between 5% and 40% of the surface is bare in summer. Litter cover varies between 45% and 95%, while total canopy cover varies between 50% and 80%.

The east-facing slopes (relevés 36, 37, 38, 41 and 42) are significantly disturbed and occur on a multiple fire-break which is shifted periodically. The vegetation cover in this firebreak is not lower than in the rest of the variant. The species richness in these relevés, as well as in relevés 29 and 51, is generally lower than in the rest of the area. In the disturbed area occupied by relevés 29 and 51, *Helichrysum patulum* attains its highest canopy cover in

the study area, namely up to 25% with a mean of 16%, giving this short veld a silver-grey colour.

Some of the former eucalypt firebreaks along these slopes are at present reduced to the occasional tree stump on which coppices frequently appear. Isolated pine trees, mainly *Pinus pinaster*, occur on the slopes. Dead, burnt pine tree stumps and relicts from dry-packed stone walls are also encountered.

Evidence from historical photographs [Cape Archives: J 765(5)] dated 1885, indicates that this vegetation has recovered structurally to a very large extent and possibly floristically as well. Considering that the last pine plantations were destroyed by fire some 16 years ago, the recovery of these slopes is indeed remarkable.

Three strata are recognised in this mid-high open shrubland. The open canopy, 1–2 m tall, with a cover of 40%, is formed by the small tree *Olea europaea* subsp. *africana* and mid-high shrubs *Rhus lucida*, *Anthospermum spathulatum*, *Otholobium hirtum*, *Cliffortia polygonifolia*, *R. tomentosa*, *R. angustifolia*, *Chrysanthemoides monilifera*, *Elytropappus rhinocerotis*, *Cliffortia ruscifolia*, *Erica baccans* and *Euryops abrotanifolius* (Figure 10).

The low sparse shrub stratum, (0.25–1.0 m tall) with a canopy cover of 20%, consists of *Chrysocoma comaurea*, *Helichrysum patulum*, *R. laevigata*, *Chironia baccifera*, *Stoebe cinerea*, *Myrsine africana*, *Selago corymbosa*, *Lobostemon fruticosus*, *Felicia fruticosa*, *Pelargonium cucullatum*, *Lobostemon argenteus*, *Passerina filiformis*, *Gnidia laxa*, *Montinia caryophyllacea*, *Helichrysum cymosum* and *Athanasia trifurcata*. The most common grass species is *Merxmuellera stricta* with a height up to 0.5 m and a cover of <1%.

The third stratum, the sparse herbaceous layer (<0.25 m tall), consists of the very sparse dwarf shrubs *Hibiscus aethiopicus* and *Gnidia inconspicua*; the forbs *Knowltonia capensis* and *Scabiosa columbaria*; ephemeral species and ferns, and has a cover of 15%.

The total canopy cover for this variant is 60% which increases by 10–20% during winter. Ephemeral species

listed in Species Groups D, I, J and K (Table 4) contribute to this increase in cover. Apart from the ephemerals listed, ferns such as *Mohria caffrorum* and *Cheilanthes capensis*, also increase in cover during winter.

The high constancy and canopy cover values of many species such as *Cliffortia polygonifolia*, *Rhus tomentosa*, *Olea europaea* subsp. *africana*, *Stoebe cinerea* and *Myrsine africana* are features of this subcommunity. *Rhus lucida* is the most constant species (100%) with a canopy cover of about 21%. Diagnostic species are listed in Species Groups D (Tables 3 & 4) and include the perennial *Gnidia inconspicua*, *Erica baccans*, *Diosma hirsuta*, *Knowltonia capensis* and *Euryops abrotanifolius*.

Some of the species which were recorded in this variant and nowhere else in the study area are the woody shrubs *Adenandra uniflora*, *Blaeria ericoides*, *Cliffortia hirta*, *Clutia alaternoides*, *Diosma hirsuta*, *Erica hispidula*, *E. mauritanica*, *E. plukenetii*, *Euryops abrotanifolius*, *Helichrysum nudifolium*, *Knowltonia capensis* and *Selago serrata*.

This variant is characterised by the absence of the perennial and ephemeral species in Species Groups A, B, C, E and H (Tables 3 & 4).

Variant 1.2.2

This variant occurs in five narrow valleys along the southeast-facing slope. These valleys occur on moderately to highly organic-rich, well-drained soils which are deep (>1.0 m), usually reddish in colour, apedal, with 20–40% clay and 1–5% organic carbon in the topsoil. This is the highest organic carbon content found in the study area. Rocks are mostly of a smaller size (20–40 mm), though larger rocks as well as bedrock were recorded. The slope varies between 23° and 30°.

The total canopy cover varies between 50% (relevé 44) and 140% (relevé 48) in summer. During summer between 5% and 15% of the surface is bare. In winter the canopy cover increases, mainly due to the growth of the fern *Cheilanthes capensis* (especially in relevé 44) and an added component in the form of ephemeral species as listed



FIGURE 10.—Variant 1.2.1. *Rhus lucida* amongst a variety of mid-high shrubs.

in Species Groups E, H, J and K (Table 4). The litter cover is generally high (90%).

Four strata are recognised in this mid-high mid-dense shrubland. The low tree layer with an open canopy cover of 15% is represented by *Noltea africana*, *Kiggelaria africana* and the shrub *Maytenus heterophylla*. The mid-high mid-dense shrub layer (1.0–2.0 m) has a canopy cover of 60% and includes the shrubs *Rhus lucida*, *R. tomentosa*, *R. angustifolia*, *Otholobium hirtum*, *Cliffortia polygonifolia*, *Anthospermum spathulatum*, *Clutia pulchella* and the small tree *Olea europaea* subsp. *africana*. Low shrubs and forbs occur in open places in the canopy. The low sparse shrub layer (0.25–1.0 m), with a canopy cover of about 10%, includes the woody *Chrysocoma coma-aurea*, *Helichrysum cymosum*, *Myrsine africana*, *Diospyros glabra*, *Putterlickia pyracantha*, *Rhus laevigata* and the scrambler *Helichrysum patulum*. The latter varies in height and can reach up to 1.5 m when supported by the shrubs previously mentioned or by *M. heterophylla*, as is the case in relevé 49.

Owing to the relatively dense shrub strata, the herbaceous layer is sparse and poorly developed directly under large shrubs such as *Rhus angustifolia* and *Clutia pulchella*. This layer consists mainly of low-growing ferns such as *Cheilanthes capensis*, *C. hastata*, *Mohria caffrorum* and *Asplenium aethiopicum*, with a cover generally not higher than 15%. In the case of *Cheilanthes capensis* very high cover values, up to 75% (relevé 44), were recorded. *Zantedeschia aethiopica* was recorded in all the valleys. Grasses are poorly represented and include low cover values for *Ehrharta calycina* which was recorded in three valleys. This species was not recorded on the open slopes of this subcommunity. In the dry valley relevé 44, it was recorded under *R. angustifolia*. Other grass species recorded are *Pentaschistis aspera* and *Ehrharta erecta*.

Shrubs in this variant generally have a higher cover than in variant 1.2.1 and trees are more common and also have a higher cover than in the previous variant. Species which differentiate this variant on their characteristically higher cover are *Rhus angustifolia*, *R. tomentosa* and *Putterlickia pyracantha*. Two species which were not found anywhere else in the study area, i.e. *Clutia pulchella* and *Noltea africana*, have a cover of about 30% in relevé 28. In relevés 44, 48 and 53, *R. angustifolia* is the most dominant species with a cover which ranges from 30–55%, whereas both *R. tomentosa* and *Maytenus heterophylla* have a cover of 20% in relevé 49.

The number of species recorded per relevé varies from 41 to 59. An average of 33 perennial and 18 ephemeral species per relevé was recorded. This variant is characterised by the presence of the perennial species in Species

Groups E, F, H, J and K and the absence of species in Species Groups A, B, C, D, G and I (Table 3). The presence of ephemeral species listed in Species Groups E, H, J and K and the absence of species listed in Species Groups A, B, C, D and I (Table 4) are characteristic of this variant. Diagnostic species are listed in Species Group E (Tables 3 & 4) and include the tree *Noltea africana*, the forb *Zantedeschia aethiopica*, and the fern *Asplenium aethiopicum*. Several species were recorded in this variant only and nowhere else in the study area. The most prominent are the woody *Noltea africana* and *Clutia pulchella* and the fern *Asplenium aethiopicum*.

CONCLUSION

One community and two subcommunities with a total of five variants were recognised. These are correlated with differences mainly in aspect, climate and historic land use. The ephemeral species confirm the fact that only two subcommunities with their variants are recognised and this corresponds with Werger's (1974) statement that communities in floristically rich areas can be clearly characterised floristically on the bases of floristic lists in which only permanently recognisable species are entered. Le Roux (no date), however, found in Namaqualand that most ephemeral vegetation units occur dispersed among the perennial plant communities on the plains, with little relationship between ephemeral vegetation units and perennial communities, whereas relevés with no ephemeral species occur mainly on the rocky outcrops.

Variants 1.1.1 and 1.1.2, which occur on the hot, dry northern slopes as well as in the dry ravines are dominated by the grass *Hyparrhenia hirta* and stunted woody shrubs of which *Rhus lucida* and *R. glauca* are the most prominent. These two variants are related to the more mesic variant 1.1.3 on the northwest-facing slopes and ravines where *H. hirta* is less conspicuous and the woody elements are more prominent. Table 5 shows an increase in cover by *R. lucida* from 6% on the north-facing slopes to 11% on the northwest-facing slopes. *H. hirta* shows a decrease from 25% to 10% in these areas. The prominence of *H. hirta* on the north-north-west-facing slopes in variant 1.1.3 as well as in a firebreak maintained by bush-cutting shows the relationship among the three variants of this subcommunity.

Rhus lucida shows an increase from 11% in variant 1.1.3 to 21% on the wetter open slopes and to about 13% in the valleys of subcommunity 1.2. A large number of other mid-high shrubs was also recorded in these valleys. *R. lucida* showed an increase in height from the drier to the wetter parts. *H. hirta* is almost completely absent from

TABLE 5.—The mean height (H) and cover (C) of *Rhus lucida*, *Hyparrhenia hirta*, and the mid-high and low shrub strata of the five variants distinguished on Signal Hill, Cape Town

Species/Stratum Variant	<i>R. lucida</i>		<i>H. hirta</i>		Mid-high		Low	
	H(m)	C(%)	H(m)	C(%)	H(m)	C(%)	H(m)	C(%)
1.1.1 & 1.1.2	1.37	6	0.80	25	1.24	10	0.67	15
1.1.3	1.30	11	0.86	10	1.30	20	0.80	25
1.2.1	1.70	21	—	—	1.37	40	0.60	20
1.2.2	1.90	13	—	—	1.60	60	0.65	10

subcommunity 1.2 and is replaced by the grass *Merxmuellera stricta* on the open slopes, though the cover values are much lower. Introduced grass species of Mediterranean origin were recorded throughout the study area, though only low cover values occur. The most constant of these was the annual *Briza maxima*.

Mid-high shrubs (1–2 m) showed an increase from the drier to the wetter parts throughout the five variants. Low shrubs (0.25–1.0 m) also showed this tendency, though a decrease was recorded in the wet valleys on the southeast-facing slopes.

Variant 1.1.3 is a transitional area between the xeric north-facing parts and wetter east and southeast-facing parts. This is indicated by the presence of certain shrub and forb species and the high local cover values for *H. hirta*. Relevés 39 and 40 occur on an east-north-east-facing slope, which means that these slopes receive more solar radiation than the other slopes in subcommunity 1.2. Its relationship with variant 1.1.3 (subcommunity 1.1) shows that the east-north-east-facing slopes of subcommunity 1.2 can with inadequate management be converted into the more xeric variant 1.1.3.

Subcommunity 1.1 indicated that *Elytropappus rhinocerotis* can increase with an increase in fire frequency and/or erosion (relevé 33). With even higher fire frequencies grassland may become dominant (Variants 1.1.1 and 1.1.2). Very few young *E. rhinocerotis* individuals were recorded. These occurred mainly along the edge of natural vegetation adjacent to the eucalypt firebreaks.

During winter an increase in total canopy cover is experienced which is caused by ferns in the wetter valleys and forbs, especially ephemeral species, along the drier northern slopes. A mean of 26 ephemeral species per relevé was recorded for subcommunity 1.1, versus a mean of 15 ephemeral species per relevé for subcommunity 1.2.

The relative stability of the vegetation was indicated by examination of aerial and historical photographs. There appears to have been little permanent change in the vegetation structure during the last century.

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REFERENCES

- ADAMSON, R.S. 1929. The vegetation of the southwestern region. In R.S. Adamson *et al.*, *Botanical features of the southwest Cape Province*. Speciality Press, Cape Town & Wynberg.
- ADAMSON, R.S. & SALTER, T.M. 1950. *Flora of the Cape Peninsula*. Juta, Cape Town.
- ASHTON, E.R. 1985. Cape Town Municipality: Table Mountain and Silvermine Nature Reserves. In I.A.W. Macdonald, M.L. Jarman & P. Beeston, *Management of invasive alien plants in the Fynbos Biome*. South African National Scientific Programmes Report No. 111. CSIR, Pretoria.
- BOUCHER, C. & SHEPHERD, P.A. 1988. Plant communities of the Pella site. In M.L. Jarman, *A description of the Fynbos Biome Project intensive study site Pella*, Ch. 4. Occasional Report 33. CSIR, Pretoria.
- BROWNLIE, S.F. 1982. *The effects of recent land use on a fynbos site. Final report*. School of Environmental Studies, University of Cape Town.
- BURCHELL, W.J. 1822. *Travels in the interior of southern Africa*. Vol. 1. Longmans, London.
- CAMPBELL, B.M., COWLING, R.M., BOND, W. & KRUGER, F.J. 1981. *Structural characterization of vegetation in the Fynbos Biome*. South African National Scientific Programmes Report No. 52. CSIR, Pretoria.
- CAMPBELL, B.M. & MOLL, E.J. 1977. The forest communities of Table Mountain, South Africa. *Vegetatio* 34: 105–115.
- DEACON, H.J. 1983. The peopling of the Fynbos Region. In H.J. Deacon, Q.B. Hendey & J.J.N. Lambrechts. *Fynbos palaeoecology: a preliminary synthesis*. South African National Scientific Programmes Report No. 75. CSIR, Pretoria.
- FAGAN, G. 1989. *The Company's garden*. Vol. 1. Municipality of Cape Town. Unpublished report.
- FUGGLE, R.F. 1981. *Macro-climatic patterns within the Fynbos Biome*. National Programme for Environmental Sciences. Fynbos Biome Project. CSIR, Pretoria.
- GIBBS RUSSELL, G.E., REID, C., VAN ROOY, J. & SMOOK, L. 1985. List of species of southern African plants. Edn 2, Part 1. *Memoirs of the Botanical Survey of South Africa* No. 51.
- GIBBS RUSSELL, G.E., WELMAN, W.G., RETIEF, E., IMMELMAN, K.L., GERMISHUIZEN, G., PIENAAR, B.J., VAN WYK, M. & NICOLAS, A. 1987. List of species of southern African plants. Edn 2, Part 2. *Memoirs of the Botanical Survey of South Africa* No. 56.
- HILL, M.O. 1979. *TWINSPAN. A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes*. Ecology and Systematics, Cornell University, Ithaca, New York.
- JACKSON, W.P.U. 1977. *Wild flowers of Table Mountain*. Timmins, Cape Town.
- JOUBERT, C. 1991. *History and description of contemporary vegetation, Signal Hill, Cape Town*. M.Sc. thesis, University of Cape Town.
- KRUGER, F.J. 1978. *A description of the Fynbos Biome Project*. South African National Scientific Programmes Report No. 28. CSIR, Pretoria.
- LE ROUX A. no date. *'n Fitososiologiese studie van die Hester Malan-natuurreservaat*. M.Sc. thesis, University of Pretoria.
- LÜCKHOFF, C.A. 1951. *Table Mountain. Our national heritage after three hundred years*. Balkema, Cape Town.
- McKENZIE, B., MOLL, E.J. & CAMPBELL, B.M. 1977. A phytosociological study of Orange Kloof, Table Mountain, South Africa. *Vegetatio* 34: 41–53.
- MICHELL, M.R. 1922. Some observations on the effects of a bush fire on the vegetation of Signal Hill. *Transactions of the Royal Society of South Africa* 10: 213–232.
- MOLL, E.J. & BOSSI, L. 1984. Assessment of the extent of the natural vegetation of the Fynbos Biome of South Africa. *South African Journal of Science* 80: 355–358.
- MUELLER-DOMBOIS, D. & ELLENBERG, H. 1974. *Aims and methods of vegetation ecology*. John Wiley, New York.
- RAVEN-HART, R. 1967. *Before Van Riebeeck. Callers at South Africa from 1488 to 1652*. Struik, Cape Town.
- RAVEN-HART, R. 1971. *Cape Good Hope 1652–1702. The first fifty years of Dutch colonisation as seen by callers*. 2 Volumes. Balkema, Cape Town.
- SCHULZE, B.R. 1972. South Africa. In J.F. Griffiths, *Climates of Africa. World survey of climatology*. Vol. 10. Elsevier, Amsterdam.
- SCHULZE, R.E. & McGEE, O.S. 1978. *Climatic indices and classifications in relation to the biogeography of southern Africa*. Junk, The Hague.
- SKEAD, C.J. 1980. *Historical mammal incidence in the Cape Province. Vol. 1. The western and northern Cape*. Department of Nature and Environmental Conservation, CPA.
- SMITH-BAILLIE, A.L., RUDMAN, R.B., OOSTHUIZEN, A.B., ELLIS, F. & DOHSE, T.E. 1976. *Soil survey of the Cape Peninsula*. Soil and Irrigation Research Institute, Department of Agricultural Technical Services, Pretoria.

- SPARRMAN, A. 1785. *Voyage to the Cape of Good Hope*. Vol. I. London.
 THERON, J.N. 1984. *The geology of Cape Town and environs*.
 Department of Mineral and Energy Affairs, Pretoria.
 THUNBERG, C.P. 1793–1795. *Travels at the Cape of Good Hope*
 1772–1775. London.
 VAN BLERK, E.F. 1990. *A census of grysbok Raphicerus melanotis in*
the Rondevlei Nature Reserve, Cape Town. Unpublished report.

- Department of Biological Sciences: Nature Conservation, Cape
 Technikon.
 WEATHER BUREAU 1986. *Climate of South Africa. Climate Statistics*
up to 1984. WB 40, Pretoria.
 WERGER, M.J.A. 1974. On concepts and techniques applied in the
 Zürich-Montpellier method of vegetation survey. *Bothalia* 11:
 309–323.

APPENDIX

List of the vascular plant species on Signal Hill, Cape Town. The following symbols are used: * introduced species; # recorded by Michell (1922) after a fire; + sight record only; • isolated individuals; J, author's collection number.

PTERIDOPHYTA

SCHIZAEACEAE

Mohria caffrorum (L.) Desv., J189

ADIANTACEAE

Cheilanthes Swartz
capensis (Thunb.) Swartz, J51
contracta Mett. ex Kuhn, J52
hastata (L. f.) Kunze, J53

ASPLENIACEAE

Asplenium aethiopicum (Burm. f.) Becherer, J27

GYMNOSPERMAE

PINACEAE

Pinus L.
halepensis Mill.*+
pinaster Ait.* J254
pinia L.*+
radiata D. Don*, J255

ANGIOSPERMAE—MONOCOTYLEDONAE

POACEAE

Cymbopogon marginatus (Steud.) Stapf ex Burt Davy, J77
Hyparrhenia hirta (L.) Stapf, J150
Heteropogon contortus (L.) Roem. & Schult., J145
Themeda triandra Forssk., J320
Paspalum dilatatum Poir*, J414
Pennisetum setaceum (Forssk.) Chiov*, J246
Ehrharta Thunb.
calycina J.E. Sm., J92
erecta Lam., J93
melicoides Thunb., J94
villosa Schult. f., J435
Aira caryophyllea L.*, J7
Avena barbata Brot*, J31
Helictotrichon leoninum (Steud.) Schweick., Levyns s.n.
Merxmüllera stricta (Schrad.) Conert, J185
Pentaschistis Stapf
airoides (Nees) Stapf, J247
aspera (Thunb.) Stapf, J248
Gastridium phleoides (Nees & Meyen) C.E. Hubb*, J162
Stipagrostis zeyheri (Nees) De Winter, J312
Sporobolus africanus (Poir.) Robyns & Tournay+
Eragrostis curvula (Schrad.) Nees, J96
Cynodon dactylon (L.) Pers. #
Cynosurus echinatus L.*, J78
Lophochloa cristata (L.) Hyl., J366
Melica racemosa Thunb., J183
Tribolium Desv.
ciliare (Stapf) Renvoize #
echinatum (Thunb.) Renvoize, J323
hispidum (Thunb.) Renvoize, J324
uniolae (L. f.) Renvoize, J325
Briza L.
maxima L.*, J39
minor L.*, J40

Festuca scabra Vahl #
Vulpia bromoides (L.) S.F. Gray*, J335
Bromus L.
catharticus Vahl* #
diandrus Roth*, J41
hordeaceus L. subsp. *molliformis* (J. Lloyd) Maire & Weiller*, J43
pectinatus Thunb.* J44
Brachypodium distachyon (L.) Beauv., J38
Lolium L.
multiflorum Lam., J177
rigidum Gaudin* #
Hordeum murinum L.*, J436

CYPERACEAE

Cyperus tenellus L.f. #
Ficinia Schrad.
bergiana Kunth, J364
filiformis (Lam.) Schrad., J118
indica (Lam.) Pfeiffer, J119
nigrescens (Schrad.) J. Raynal, J120, J381

ARACEAE

Zantedeschia aethiopica (L.) Spreng., J349

RESTIONACEAE

Restio multiflorus Spreng., J437
Ischyrolepis Steud.
capensis (L.) Linder, J156
triflora (Rottb.) Linder, J438

COMMELINACEAE

Commelina africana L., J66

JUNCACEAE

Juncus bufonius L.* #

ANTHERICACEAE

Chlorophytum triflorum (Ait.) Kunth, Levyns s.n.

ASPARAGACEAE

Asparagus crispus Lam., J196
Protasparagus Oberm.
africanus (Lam.) Oberm., J262
capensis (L.) Oberm., J263
rubicundus (Berg.) Oberm., J264, J372a
Myrsiphyllum undulatum (L. f.) Kunth, J197

ASPHODELACEAE/LILIACEAE

Bulbine Willd.
aloooides (L.) Willd., J45
favosa (Thunb.) Roem. & Schult. #
tuberosa (Mill.) Oberm., J47
Trachyandra Kunth
chlamydophylla (Bak.) Oberm., Levyns s.n.
muricata (L. f.) Kunth, J322

COLCHICACEAE

Baeometra uniflora (Jacq.) G.J. Lewis, J34
Wurmbea spicata (Burm. f.) Dur. & Schinz, J340

ERIOSPERMACEAE

Eriospermum Jacq. ex Willd.

capense (L.) Salter, J107
lancifolium Jacq. #

HYACINTHACEAE

Albuca L.
canadensis (L.) Leighton, J9
spiralis L. f., Michell s.n.
Urginea altissima (L. f.) Baker., J329
Tenicroa exuviata (Jacq.) Speta, J432
Dipcadi brevifolium (Thunb.) Fourc., J433
Ornithogalum L.
graminifolium Thunb., J202
hispidum Hornem. subsp. bergii (Schlechud.) Oberm., J203
pilosum L. f., Michell s.n.
suaveolens Jacq., Levyns s.n.
thyrsoides Jacq., J204
Lachenalia Jacq. f. ex Murray
fistulosa Bak., J163
orchioides (L.) Ait.
var. glaucina, J164a
var. orchioides, J164b
unifolia Jacq. #

HAEMODORACEAE

Wachendorfia paniculata Burm., J336

ARYLLIDACEAE

Haemanthus sanguineus Jacq., J130

HYPOXIDACEAE

Empodium plicatum (Thunb.) Garside, J434
Hypoxis sp. #
Spiloxene Salisb.
capensis (L.) Garside, J309
serrata (Thunb.) Garside, J417a

TECOPHILAEACEAE

Cyanella hyacinthoides L., J76

IRIDACEAE

Romulea Maratti
flava (Lam.) De Vos var. flava, J281, J417
hirsuta (Eckl. ex Klatt) #
rosea (L.) Eckl. var. australis (Ewart) De Vos, J282
Galaxia ovata Thunb. #
Moraea Mill.
bellendenii (Sweet) N.E. Br., J192
ciliata (L. f.) Ker-Gawl., J193
gawleri Spreng., J423
papilionacea (L. f.) Ker-Gawl. #
tripetala (L. f.) Ker-Gawl. #
vegeta L., Levyns s.n.
Ferraria crispa Burm., J117
Homeria Vent.
collina (Thunb.) Salisb. #
flaccida Sweet, J148
Bobartia indica L. #
Aristea africana (L.) Hoffmg., J19
Geissorhiza Ker-Gawl.
aspera Goldbl., J122
imbricata (Delaroché) Ker-Gawl. var. bicolor (Thunb.) Goldbl., J123
inflexa (Delaroché) Ker-Gawl., J430
Hesperantha Ker-Gawl.
falcata (L. f.) Ker-Gawl., J144
spicata (Burm. f.) N.E. Br., J431
Ixia L.
dubia Vent., J157
odorata Ker-Gawl., J158
scillaris L., J159
Sparaxis grandiflora (Delaroché) Ker-Gawl. subsp. fimbriata (Lam.)
Goldbl., J308
Babiana Ker-Gawl.
disticha Ker-Gawl., J32
stricta (Ait.) Ker-Gawl., J33
Gladiolus L.
brevifolius Jacq. var. brevifolius, J126
gracilis Jacq. #
Homoglossum priorii (N.E. Br.) N.E. Br., J46, J408
Micranthus (Pers.) Eckl.
alopeuroides (L.) Rothm., J187

tubulosus (Burm.) N.E. Br., J188
Lapeirousia corymbosa (L.) Ker-Gawl., J167
Watsonia marginata (L. f.) Ker-Gawl., J339

ORCHIDACEAE

Holothrix villosa Lindl. var. villosa, J147, J371
Satyrium Swartz
bicornis (L.) Thunb. #
odorum Sond., J418
Disa tenuis Lindl. #
Monadenia bracteata (Swartz) Dur. & Schinz, J190
Disperis Swartz
circumflexa (L.) Dur. & Schinz #
villosa (L. f.) Swartz #
Pterygodium Swartz
alatum (Thunb.) Swartz, J266
catholicum (L.) Swartz, J267
Corycium orobanchoides (Swartz) Schltr., J68, J426

DICOTYLEDONAE

URTICACEAE

Didymodoxa capensis (L. f.) Friis & Wilmot-Dear var. integrifolia (Wedd.)
Friis & Wilmot-Dear, J84

PROTEACEAE

Protea L.
lepidocarpodendron (L.) L. ●, J428
repens (L.) L. ●, J427
Leucadendron salignum Berg., J170
Hakea suaveolens R. Br.* #

LORANTHACEAE

Viscum capense L. f., J334

SANTALACEAE

Colpoon compressum Berg., J65

POLYGONACEAE

Rumex L.
acetosella L.* #
cordatus Poir., J283
Polygonum undulatum (L.) Berg., J411

CHENOPODIACEAE

Chenopodium ambrosioides L.* #
Atriplex semibaccata R. Br., J30

AIZOACEAE

Adenogramma glomerata (L. f.) Druce, J5
Limeum africanum L., Adamson 1858
Galenia pubescens (Eckl. & Zeyh.) Druce, J121, J384
Aizoon sarmentosum L. f., J8
Tetragonia herbacea L., J319, J379

MESEMBRYANTHEMACEAE

Delosperma asperulum (Salm-Dyck) L. Bol., Page s.n.
Drosanthemum striatum (Haw.) Schwant., J90
Erepsia N.E. Br.
anceps (Haw.) Schwant., J98
bracteata (Ait.) Schwant., J99
Lampranthus N.E. Br.
emarginatus (L.) N.E. Br., J165
multiseriatus (L. Bol.) N.E. Br., J166
Ruschia Schwant.
pulchella (Haw.) Schwant., J284
rubricaulis (Haw.) L. Bol., J285

CARYOPHYLLACEAE

Cerastium capense Sond., J50
Silene L.
burchellii Orth., J439
clandestina Jacq., J302

ILLECEBRACEAE

Petrorhagia prolifera (L.) Ball & Heywood*, J249

RANUNCULACEAE

Anemone tenuifolia (L. f.) DC., J11
Knowltonia capensis (L.) Huth, J161

Ranunculus L.

- multifidus Forssk., J269
 muricatus L., J270

MENISPERMACEAE

- Cissampelos capensis L. f., J59

FUMARIACEAE

- Phacocarpus cracca (Cham. & Schlecht.) Bernh., J251
 Fumaria muralis Sond. ex Koch* #

BRASSICACEAE

- Heliophila diffusa (Thunb.) DC. var. diffusa, J138
 Lepidium africanum (Burm. f.) DC., J403
 Raphanus raphanistrum L.*, J271
 Rapistrum rugosum (L.) All.*, J272

DROSERACEAE

- Drosera cistiflora L., J91

CRASSULACEAE

- Tylecodon grandiflorus (Burm. f.) Toelken, J328
 Crassula L.
 brevifolia Harv. #
 campestris (Eckl. & Zeyh.) Endl. ex Walp. subsp. campestris, J69
 capensis (L.) Baill., J70
 ciliata L., J424
 fascicularis Lam., J71
 muricata Thunb. #
 nudicaulis L., J72
 saxifraga Harv. #
 scabra L., J73
 subulata L., J74
 tetragona L., Levyns s.n.
 Adromischus hemisphaericus (L.) Lem., J6

MONTINIACEAE

- Montinia caryophyllacea Thunb., J191

PITTOSPORACEAE

- Pittosporum undulatum Vent.*, J256

ROSACEAE

- Rubus cf. cuneifolius Pursh.*, J358
 Cliffortia L.
 hirta Burm. f., J60
 polygonifolia L., J61
 ruscifolia L., J62

FABACEAE

- Paraserianthus lophantha (Willd.) Nielsen subsp. lophantha*, J227
 Acacia Mill.
 cyclops A. Cunn. ex G. Don*, J1
 karroo Hayne, J2
 mearnsii De Wild.*, J367
 saligna (Labill.) Wendl.*, J413
 Virgilia oroboides (Berg.) Salter, J333
 Podalyria Willd.
 calyptrata Willd., J258
 sericea R. Br., J259
 Lotononis (DC.) Eckl. & Zeyh.
 oxyptera (E. Mey.) Benth., Salter 7686
 peduncularis Benth., J178
 perplexa (E. Mey.) Eckl. & Zeyh., Penfold 6812
 prostrata Benth., J179
 cf. umbellata Benth., J440
 Aspalathus L.
 acuminata Lam., J21
 cephalotes Thunb. subsp. violacea Dahlg., J22
 chenopoda L., J23
 cordata (L.) Dahlg., J24
 cymbiformis DC., J25
 ericifolia L. subsp. ericifolia, J26
 hispida Thunb. subsp. hispida, J365
 spinosa L. #
 uniflora Dahlg., Salter 6408
 Melolobium aethiopicum (L.) Druce, J184
 Spartium junceum L.*+
 Medicago polymorpha L. var. polymorpha, J182

Trifolium L.

- angustifolium L., J326
 campestre Schreb.* #
 glomeratum L.* #
 repens L.*, J327
 Indigofera L.
 cardiophylla Harv., J151
 incana Thunb., J152
 psoraleoides L., J153, J154
 racemosa L., J155
 Psoralea imbricata (L. f.) Thunb., J442
 Otholobium C.H. Stirton
 decumbens (Ait.) C.H. Stirton, J208, J385
 fruticans (L.) C.H. Stirton, J441
 hirtum (L.) C.H. Stirton, J209
 uncinatum (Eckl. & Zeyh.) C.H. Stirton, J356
 Tephrosia capensis (Jacq.) Pers., J318
 Sutherlandia frutescens R. Br., J316
 Lessertia DC.
 capensis (Berg.) Druce, J168
 excisa DC., J169
 tomentosa DC. #
 Vicia L.
 benghalensis L.*, J351
 sativa L.*, J443
 Dolichos decumbens Thunb., J89

GERANIACEAE

- Geranium L.
 dissectum L.* #
 molle L.*, J124
 purpureum Vill.*, J125
 Erodium L'Hérit..
 malachoides (L.) Willd. #
 moschatum (L.) L'Hérit. ex Ait.*, J108
 Pelargonium L'Hérit.
 alchemilloides (L.) L'Hérit., J230
 auritum (L.) Willd. subsp. auritum, J231
 candicans Spreng., J232
 capitatum (L.) L'Hérit., J444
 chamaedryfolium Jacq., J233
 columbinum Jacq., J234
 cucullatum (L.) L'Hérit. subsp. tabulare Volschenk, J235
 elongatum (Cav.) Salisb., J236
 grossularioides (L.) L'Hérit. #
 hirtum (Burm. f.) Jacq., J237
 lobatum (Burm. f.) L'Hérit., J239
 longifolium (Burm. f.) Jacq., V.d. Walt 483
 myrrhifolium (L.) L'Hérit. var. myrrhifolium, J240
 pillansii Salter, J241
 pinnatum (L.) L'Hérit., J242
 proliferum (Burm. f.) Steud., J243
 rapaceum (L.) L'Hérit., J244
 tabulare (L.) L'Hérit., V.d. Walt 478
 triste (L.) L'Hérit., J245, J375

OXALIDACEAE

- Oxalis L.
 bifida Thunb., J212
 compressa L. f. J213
 flava L., J214, J380
 glabra Thunb., J215
 hirta L., J210, J216, J415
 incarnata L., J217
 lanata L. f., J225
 livida Jacq. #
 luteola Jacq., J218
 obtusa Jacq., J219
 pes-caprae L., J220
 polyphylla Jacq., J221
 punctata L. f., J222, J382
 purpurea L., J223
 pusilla Jacq., J224
 tomentosa L. f., J226, J409

LINACEAE

- Linum thesioides Bartl., J173

ZYGOPHYLLACEAE

- Zygophyllum L.
 cf. fulvum L., J445
 sessilifolium L., J343

RUTACEAE

- Adenandra uniflora* (L.) Willd., J4
Diosma hirsuta L., J86

POLYGALACEAE

- Polygala* L.
bracteolata L., J260
myrtifolia L., J261
Muraltia heisteria (L.) DC., J194

EUPHORBIACEAE

- Clusia* L.
alaternoides L., J63
pulchella L., J64
Euphorbia L.
arceuthobioides Boiss., J111
caput-medusae L., J112
crispa (Haw.) Sweet, J113
genistoides Berg. #

ANACARDIACEAE

- Schinus molle* L.*, J353
Rhus L.
angustifolia L., J274
glauca Thunb., J275
laevigata L., J276
lucida L., J277, J279, J402
rosmarinifolia Vahl, J278
tomentosa L., J280

CELASTRACEAE

- Maytenus heterophylla* (Eckl. & Zeyh.) N.K.B. Robson, J181
Putterlickia pyracantha (L.) Szyszyl., J268

SAPINDACEAE

- Dodonaea angustifolia* L. f., J88

RHAMNACEAE

- Noltea africana* (L.) Reichb. f., J199
Phyllica L.
imberbis Berg., J373
plumosa L., J252

MALVACEAE

- Hibiscus aethiopicus* L., J146

STERCULIACEAE

- Hermannia* L.
alnifolia L., J140
althaeifolia L., J141
cuneifolia Jacq. #
hyssopifolia L., J142
prismatocarpa E. Mey. ex Harv., J143

FLACOURTIACEAE

- Kiggelaria africana* L., J160, J348, J350

THYMELAEACEAE

- Gnidia* L.
inconspicua Meisn., J129
laxa (L. f.) Gilg, J128
sericea L., J446
Passerina L.
filiformis L., J228
vulgaris Thoday, J229

MYRTACEAE

- Eucalyptus*
cladocalyx F. Muell., J461
ficifolia F. Muell., J458
gomphocephala DC., J462
leucoxydon F. Muell., J460
tereticornis Smith*, J459

ONAGRACEAE

- Oenothera* cf. *nocturna* Jacq.*, J447

APIACEAE

- Centella* L.
affinis (Eckl. & Zeyh.) Adamson, Levyns 2542
glabrata L., J42, J407

- Arctopus echinatus* L., J17

- Torilis arvensis* (Huds.) Link*, J321
Lichtensteinia lacera Cham. & Schlecht., J172
Annesorrhiza Cham. & Schlecht.
capensis Cham. & Schlecht., J12
hirsuta Eckl. & Zeyh., Levyns s.n.
Peucedanum galbanum (L.) Benth. & Hook. f., J250

ERICACEAE

- Erica* L.
baccans L., J101
hispidula L., J104
mauritanica L., J102
plukenetii L., J105
strigosa Soland., J448
Blaeria ericoides L., J37, J406

MYRSINACEAE

- Myrsine africana* L., J195

PRIMULACEAE

- Anagallis arvensis* L.*, J10

EBENACEAE

- Euclea* Murray
racemosa Murray, J109
tomentosa E. Mey. ex A. DC., J110
Diospyros glabra (L.) De Winter, J87

OLEACEAE

- Olea europaea* L. subsp. *africana* (Mill.) P.S. Green, J200

GENTIANACEAE

- Sebaea* Soland. ex R. Br.
aurea (L. f.) Roem. & Schult., J289
exacoides (L.) Schinz, J290
Chironia baccifera L., J54

ASCLEPIADACEAE

- Microlooma* sp. #
Asclepias cancellata Burm. f., J20
Cynanchum zeyheri Schltr., J75
Orbea variegata (L.) Haw., J201

BORAGINACEAE

- Lobostemon* Lehm.
argenteus (Berg.) Buek, J175
fruticosus (L.) Buek, J176
glaucophyllus (Jacq.) Buek, J449
Echium plantagineum L.*, J450

LAMIACEAE

- Leonotis leonurus* (L.) R. Br. +
Stachys L.
aethiopica L., J310
arvensis L.*, J311
Salvia L.
africana-caerulea L., J286
africana-lutea L., J287

SOLANACEAE

- Lycium afrum* L., J451
Solanum L.
 cf. *americanum* Mill., J303
guineense L., J452
hermannii Dun. #
nigrum L.*, J304
pseudocapsicum L.*, J305

SCROPHULARIACEAE

- Diascia capensis* (L.) Britten, J83
Hemimeris montana L. f., J139
Nemesia Vent.
barbata (Thunb.) Benth., J198
parviflora Benth. #
Linaria spuria (L.) Mill., Kelmann s.n.
Antirrhinum orontium L.*, J16
Manulea cheiranthus (L.) L., J180

Sutera Roth

- antirrhinoides* (L. f.) Hiern, J314
hispidula (Thunb.) Druce, J315
Phyllopodium cordatum (Thunb.) Hilliard, J253
Zaluzianskya divaricata Walp., J341

SELAGINACEAE

- Hebenstretia repens* Jarosz, J131
Selago L.
adpressa Choisy, J291
corymbosa L., J292
fruticulosa Rolfe, J293
ramosissima Rolfe, Levyns 7090
serrata Berg., J294
spuria L., J453

BIGNONIACEAE

- Tecomaria capensis* (Thunb.) Spach, J401

OROBANCHACEAE

- Orobanche ramosa* L.*, J205

PLANTAGINACEAE

- Plantago lanceolata* L.*, J257

RUBIACEAE

- Anthospermum* L.
aethiopicum L., J13
galioides Reichb. f. subsp. *galioides*, J14
spathulatum Spreng. subsp. *spathulatum*, J15
Nenax hirta (Cruse) Salter, Salter 6407
Galium sp., J347

VALERIANACEAE

- Centranthus ruber* (L.) DC.*, J332

DIPSACACEAE

- Scabiosa columbaria* L., J288

CUCURBITACEAE

- Zehneria scabra* (L. f.) Sond. subsp. *scabra*, J342

CAMPANULACEAE

- Prismatocarpus sessilis* Eckl. ex A. DC. #
Wahlenbergia Schrad. ex Roth
capensis (L.) A. DC., J337
obovata V. Brehm., J338
Microcodon cf. *sparsiflorum* A. DC., J352
Cyphia Berg.
bulbosa (L.) Berg., J79
digitata (Thunb.) Willd., J80
incisa (Thunb.) Willd., Levyns 2883
phyteuma (L.) Willd., J81
volubilis (Burm. f.) Willd. #
zeyheriana Presl ex Eckl. & Zeyh., J82
Lobelia erinus L., J174
Monopsis lutea (L.) Urb. #

ASTERACEAE

- Pteronia hirsuta* L. f., J454
Felicia Cass.
bergeriana (Spreng.) O. Hoffm., J115
fruticosa (L.) Nicholson, J116
tenella (L.) Nees #
Conyza Less.
canadensis (L.) Cronq.*, J67
scabrida DC. #
Chrysocoma coma-aurea L., J57
Tarchoanthus camphoratus L., J317
Gnaphalium subfalcatum Cabrera*, J127

Troglophyton parvulum (Harv.) Hilliard & Burt #

Pseudognaphalium undulatum (L.) Hilliard & Burt, J265

Helichrysum Mill.

asperum (Thunb.) Hilliard & Burt

var. *asperum*, J132

var. *glabrum* Hilliard, J132a

cylindriflorum (L.) Hilliard & Burt, J133

cymosum (L.) D. Don subsp. *cymosum*, J134

nudifolium (L.) Less., J355, J405

patulum (L.) D. Don, J135

revolutum (Thunb.) Less., J136

teretifolium (L.) D. Don, J137

Stoebe L.

alopecuroides (Lam.) Less. #

cinerea Thunb., J313

Elytropappus rhinocerotis (L. f.) Less., J95

Metalasia muricata (L.) D. Don, J186

Relhania L'Hérit. emend. Bremer

fruticosa (L.) Bremer, J273

genistifolia (L.) L'Hérit., J372

Leysera gnaphalodes (L.) L., J171

Eriocephalus africanus L., J106

Athanasia L.

capitata (L.) L., Levyns s.n.

dentata (L.) L., J28

trifurcata (L.) L., J29

Hymenolepis parviflora (L.) DC., J149

Cenia turbinata (L.) Pers., J49

Cineraria geifolia (L.) L., J58

Senecio L.

cf. *abruptus* Thunb., J295

arenarius Thunb., J296

burchellii DC., J297

hastatus L., J298

pinifolius (L.) Lam., J299

pterophorus DC., J300

pubigerus L., J412

rigidus L., J301

subcanescens (DC.) Compton, J363

Euryops abrotanifolius (L.) DC., J114

Othonna arborescens L., J211

Dimorphotheca pluvialis (L.) Moench, J85

Osteospermum L.

clandestinum (Less.) T. Norl., J206

spinosum L., J207

Chrysanthemoides Tourn. ex Medik.

incana (Burm. f.) T. Norl., J55

monilifera (L.) T. Norl., J56

Ursinia Gaertn.

anthemoides (L.) Poir. subsp. *anthemoides*, J330

dentata (L.) Poir., J331

Arctotheca calendula (L.) Levyns, J18, J421

Gorteria personata L. subsp. *personata*, J348

Gazania pectinata (Thunb.) Spreng., J457

Berkheya Ehrh.

armata (Vahl) Druce, J35

carlinifolia (DC.) Roessl. subsp. *promontorii* Roessl., J36

pinnatifida (Thunb.) Thell. Levyns s.n.

rigida (Thunb.) H. Bol. & Wolley-Dod ex Adamson & Salter, J455

Carduus pycnocephalus L.*, J48

Hypochoeris L.

glabra L.* #

radicata L.*, J368

Urospermum picroides (L.) Scop. ex F.W. Schmidt* #

Picris echioides L.*, J456

Sonchus L.

asper (L.) Hill*, J306

dregeanus DC. #

oleraceus L.*, J307