The forest communities of Table Mountain, South Africa

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THE FOREST COMMUNITIES OF TABLE MOUNTAIN, SOUTH AFRICA*

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Introduction

No quantitative community studies on Table Mountain have been published. The only previous account of the communities is a descriptive one by Adamson (1927). The aim of this report is to provide a classification of the natural forest communities and an understanding of the major factors affecting their distribution. The forest communities occur in the deeper ravines on all sides of Table Mountain and on the mesic eastern and southern slopes, and contrast sharply to the low vegetation which generally occurs in the more exposed adjacent areas. The forest trees have broad, lauriphyllous leaves with dark polished surfaces, while the lower vegetation (locally known as Fynbos) generally has dull-surfaced, small, sclerophyllous leaves (Adamson 1927). There are very few species in common to these two major vegetation types.

The relationship of the forests of Table Mountain with those from other areas in the South Western Cape are briefly considered on the basis of published vegetation descriptions, and a limited number of relevés made by the present authors for this purpose. Areas of forest from which information is available are shown in Fig. 1.

General information on the environment is given in McKenzie et al. (1977).

* Nomenclature follows that used in the Bolus Herbarium, University of Cape Town.

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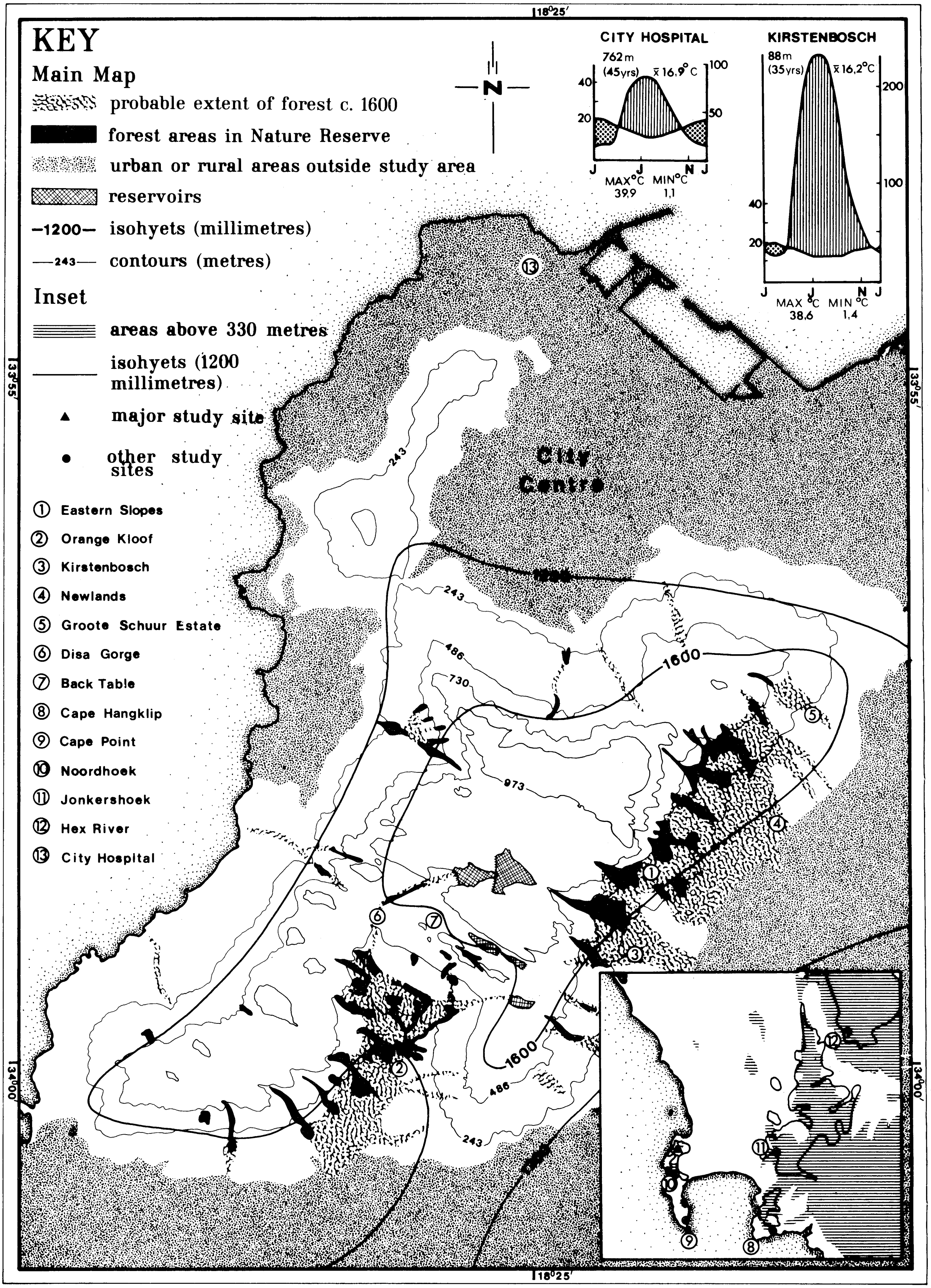
Anthropogenic influences

According to Theal (1882) who described the policies and actions of the first settlers at the Cape, the extent of indigenous forest was once much greater. All the lower eastern slopes and the Orange Kloof area down to Hout Bay were once forested. What remains today are small remnants which were too inaccessible or of too low a quality for complete exploitation. The destruction of the forests was largely completed in the first 50 years of settlement at the Cape in 1652 (Sim 1907).

Subsequently, many non-indigenous tree species have replaced the indigenous trees. In 1689, on instructions of Simon van der Stel, then Governor of the Cape, 16,000 oak trees (*Quercus robur*) were planted in much of the forest which remained (Zahn & Neetling 1929). The present oak forests above Kirstenbosch, Newlands and Groote Schuur are probably derived from spontaneously established individuals of these original plantings. *Pinus pinea*, also found in some forested areas, was introduced to the Cape in the 18th century for ornamental purposes (Zahn et al. 1929). Non-indigenous plant species sometimes are a pest in the vegetation of the South-Western Cape (Hall 1961, Taylor 1969, 1975), though rarely in closed canopy indigenous forest. Only in scrub-forest where the canopy is relatively sparse, are non-indigenous plants able to establish themselves readily. *Acacia melanoxylon*, which is an important economic timber tree, was probably introduced to South Africa in the mid-19th century (R. Poynton pers. comm.), and was probably introduced to the Mountain, in the late 19th century (Banks 1975). Since then it has spread to the detriment of the riverine forest in Disa Gorge and now forms the canopy in much of this area. Also much of the area



KEY
Main Map
probable extent of forest c. 1600
forest areas in Nature Reserve
urban or rural areas outside study area
reservoirs
—1200— isohyets (millimetres)
—243— contours (metres)
Inset
areas above 330 metres
isohyets (1200 millimetres)
major study site
other study sites
① Eastern Slopes
② Orange Kloof
③ Kirstenbosch
④ Newlands
⑤ Groote Schuur Estate
⑥ Disa Gorge
⑦ Back Table
⑧ Cape Hangklip
⑨ Cape Point
⑩ Noordhoek
⑪ Jonkershoek
⑫ Hex River
⑬ City Hospital
N
18°25′
33°55′
34°00′
CITY HOSPITAL
762 m
(45 yrs)
x̄ 16,9° C
MAX °C 39,9
MIN °C 1,1
KIRSTENBOSCH
88 m
(35 yrs)
x̄ 16,2° C
MAX °C 38,6
MIN °C 1,4
City Centre
243
486
730
973
1600

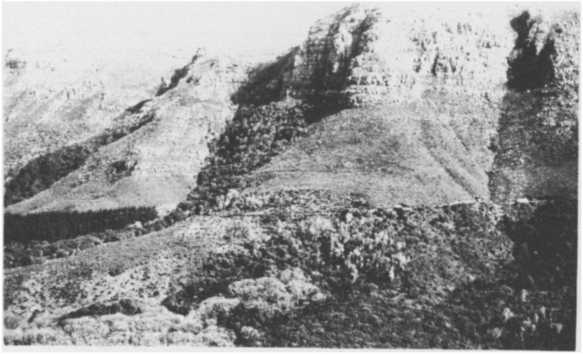


Fig. 2. Orange Kloof showing forest in a refuge habitat above the road, and showing forest scrub, forest and *Quercus robur* (deciduous) mosaic below the road.

previously forested has been afforested with non-indigenous pine and eucalyptus which has further prevented the natural re-establishment of indigenous forest. In other areas fire has destroyed indigenous forest lands as indicated by Sim (1907) and Adamson (1927), and by the presence of forest remnants in areas surrounded by sclerophyllous scrub vegetation (particularly apparent in Orange Kloof; see Fig. 2).

In this study only forest which has not been greatly disturbed was sampled although all forests show signs of exploitation. Areas excluded from the study are burnt forest areas where introduced plant species comprise more than 25 % of the canopy cover. Many trees are multiple-stemmed, probably due to cutting, and species such as *Curtisia dentata*, *Ocotea bullata* and *Podocarpus latifolius*, which should be canopy species, are usually present only as regenerating species in the understorey; almost certainly due to exploitation in the past.

Methods

In this study the Braun-Blanquet concepts and techniques (Werger 1974) are chiefly followed. The 105 relevés were sited subjectively in stands of vegetation which appeared floristically, structurally and environmentally as homogenous as possible. Ninety-four relevés were sited in forest on Table Mountain, giving an average sampling intensity for the forest area of one per ha. Eleven relevés, from forests other than those on Table Mountain, have been included in this study to show their relationships to the Table Mountain forests. A relevé size of 10 × 10 m was used in the survey, as this size had proved useful in previous studies of Cape Forests (Campbell 1974, Werger et al. 1972). Relevés of equal size (20 × 5 m) were used in the forest communities which line the streams.

Environmental data recorded included altitude, geology, rockiness, geomorphology, aspect, slope, soil colour, soil texture and soil depth. Percentage canopy cover and heights of each stratum, and total percentage canopy cover was also recorded.

The final phytosociological table was prepared using the computer-based method described by Campbell & Moll (1976). This involves the hierarchical classification of relevés by group-average sorting (Field 1970, 1971) based on the Canberra similarity measure (Williams et al. 1973) to give the basis of the table classification which was then refined manually. For this analysis the cover-abundance values were transformed r = 1; 0 = (+) = 2; + = 5; 1 = 10; 2 = 20; 3 = 30; 4 = 40; 5 = 50: (cf. Coetzee & Werger 1973). Major noda in the table were designated as 'associations', whilst 'sub-association' was used to designate noda with their own differential species, and 'variant' to designate the lowest unit recognized which generally lacked differential species. These units, which are named after the dominant and/or differential species, are tentative as there is insufficient data from other forest areas in the Cape Province of South Africa.

Results

Numerical classification resulted in a dendrogram, which is not shown here. The communities recognized are shown in Table 1, in which most of the dendrogram groups could be retained. Only at the lowest level of subdivision have all the dendrogram groups not been maintained. Such decisions were made after considering the phytosociological table. The decision to assign sub-association status to one group (1.3) is not justified by the dendrogram. However, the phytosociological table justifies this, as this group has a number of good differen-

Fig. 1. The present, and reconstructed past distribution of forest patches on Table Mountain, and the important rainfall isohyets. Inset shows the South-Western Cape Province and the location of the other study sites.

Table 1. Phytosociological table of Table Mountain communities.

1. *Kiggelaria africana-Rapanea melanophloeos* ASSOCIATION	
1.1 *Virgilia oroboides* sub-association	
V. oroboides	2433 3 2 O O
Rubus pinnatus	112+ 1 1 + O R
Rhynchosia capensis	+R
Solanum mauritianum	RR O
1.2 *Rhus tomentosa* sub-association	
R. tomentosa	+1+O1 + 1
R. lucida/mucronata	2O 2+ + + 1 +
Polygala myrtifolia	++ 1 +11 +
Myrsine africana	+ ++ + O + +
Putterlickia pyracantha	11 1
Phylica buxifolia	+ 1
Albizia lophantha	+ 1
Commelina africana	++ +
Briza maxima	1 R
Achyranthes aspera	++ ++ +
1.3 *Maytenus oleoides* sub-association	
Ehrharta capensis	+131 +++ 1 + + O O1 ++ + ++
Maytenus oleoides	O3335 O 1 2 2
Pellaea pteroides	1 112 + + O O 1+
Ficinia acuminata	++
1.4 *Scutia myrtina-Scolopia mundii* sub-association	
Secamone alpinii	+ 12O +11+++ O2++1+1+++1+21+ 21 1O1+OO+22+ +O111111++++1+++1++1 + 1+ 1 + +O + 111
Scutia myrtina	+2 +1 +++1+ 12+21+111 1 2++1+1+11R+++2+ ++1+++1O1++++++OOO ++ + + R 21 +
Scolopia mundii	25O ++ +3+ 21++1+ 1O11+O + + O
Grewia occidentalis	++ 1 + R 1 +R+ +ORO+O1 2+
Asplenium lunulatum	+ +O+++ ++
Stipa dregeana	12 + + O+ 1R++1+++ 2 O 2
Carex aethiopica	2 ++3+OR ++1 O O++1+ + + +
Adiantum aethiopicum	+ + + + 1 + O+
Linociera foveolata	1212 O O 3 22+1224132233+1222120+1+++O O22++1+++ +++++21 1++ 1 11
1.5 *Cunonia capensis-Ilex mitis* sub-association	
C. capensis	4 O + 1315O 212+41353 4555554+2 2
Ilex mitis	O + + 221+1 OO231 1
Blechnum attenuatum	12+1+ + +4
Hymenophyllum tunbridgense/ capense	2 1 ++
Alsophila capensis	11+ 3
Acacia melanoxylon	+ 1 2
Todea barbara	++ + 1
Platylophus trifoliatus	14
Histiopteris incisa	+1
Olea capensis	+ + 1 1122 1O21+12213 1+23 +11212 +21O123221+31+1+2532334111212+33+O212111 O1O 2212 2 +
Asparagus scandens	+ +1 + 12+++3O + R 4R+211+++12++22+ 11++21221+12+++++++111+++++++++++R+R +11+R1 11O++ ++O
Curtisia dentata	+11+2 2 OOO 2 1O O O2 12 O2222+ +O121202 11221+ + O O1O 3+
Hartogia capensis	1 212 + +O 12 O + 1333332 1O O2OO +11 11 22
Schoenoxiphium lanceum	+ O 1++1 1 1 O +O +1+O 2 ++1 +O O+42 3 3+2+141++ 2 1
Ocotea bullata	1 2+O ++ 1 1 R11
1.6 *Maurocenia frangularia-Olea africana* sub-association	
M. frangularia	1 1 O+ O + R O 11 +2+2133324424
Pleopeltis lanceolatum	++ O + R +O+ + 1+1+ + + + + +++O+++
Nemesia macrocarpa	+ ++
Rapanea melanophloeos	2432 +2222221 21++243211223 21+32+ 22123+111 1-O+212+2O111O1O3321 1++111221231+3+ 2 1+ 21+++33
Diospyros whyteana	3222 231 11111 11 11112++1111++11++241+1+21231322 3212 3222111 1+1111+O++O21+1112 +++ 341+1 O1+2+
Knowltonia capensis	+ R++ +1112++1++ +R++++ +R++O++1+++1++1+O++O++++1+++1++++++++++O ++O++O+O+ +++ O ++++++++ ++OO++ +
Kiggelaria africana	2113 +121 ++ 12111 12 1 +O R + + O 1 +++ 1+++221 ++ 1+O221 +11++++++ 2 O+2121+21O42+
Halleria lucida	2 +2 2 +++2 2OOO22O3 O 1+O1O O 1 211220 2 O1 +++ +12 21
Blechnum australe	++O + ++++11 +22O++ O +1 ++++++++12+++1++++++++ O++ +1 ++ + +1+ + + + +
Cassine capensis	1R+O1 1332O121+2+ 2+334322320432343350444324434421344123112221122 11331 32+++11 O 12 2 3 3
Canthium ventosum	++2+2433 2 22+O ++++ 2 + 12+22122 21O1 112 1112122++111+1121++11+1++311 +1++ 1 R 3O1
C. mundianum	+O 231 O 2211+1++1 3 ++2+ 1 +O+ OO+O OO + O ++ 1 ++ 2 1122322 32+O
Maytenus heterophylla	R 11212 3 1111 O +1 RR+ O++O + + O 1 + 2 132
Olea africana	31+ 2 431 2+ 232+1++ 3 + 23+22 OO + +OO1O 2 +2+1344324 22 112
Asparagus aethiopicus	+1+1+ 1 + + O+1R + R ++++ + OR +O R +R + +++ +R 211+1+1 1R +O1+
Maytenus acuminata	1 1+2O 1212++2O R 1 +1122 + 2 1+ 1O+2 R11111 R +O+ 22121+ O11+1+1+ 1 11 O 22+
Asplenium adiantum-nigrum	++ +12 +++ + O ++ +O+++ +R O+ + + O + 1+++O++ +
Clutia pulchella	11 2++12 RO + + O + + O O+1+11 + 12
Podocarpus latifolius	1122 313 OO 1111321 +1+311 +112 211O1+1O+ 1O++32 OOO+O1 O+211+O 22 1O 2O3 2
Olinia cymosa	+1O 22 O 22OO223 RO 34 3222 1 3++111O2+23+++113O+22213 O 1+O+2124R+ + +O 1 2O4 2 2 2
Apodytes dimidiata	+ + +12112 O1 2 1R R ++1+O 111++1+++ 221+ OO 1+O1 + +122 + 2 2O + O + 21
Cussonia thyrsiflora	+ + + O++ O1 + + OO ++ - 1 1
Schoenoxiphium lehmanni	2RR ++ + 1 + + + + +
Zantedeschia aethiopica	+ OO + + R O + +OR + R ++ R ++
Asparagus africanus	++ + + 1 ++
Asplenium aethiopicum	+ + ++ R+ +
Celtis africana	22
2. *Heeria argentea* ASSOCIATION	
H. argentea	22
3. *Metrosideros angustifolia* ASSOCIATION	
M. angustifolia	5
Erica caffra	O +

Table 2. Table showing environmental and structural characteristics of forest communities.
Location: B = Back Table; C = Cape Hangklip Mountains; F = Northern slopes; H = Hex River Mountains; K = Kirstenbosch; N = Newlands; O = Orange Kloof; P = Noordhoek Mountains; W = Western slopes.
Exposition: O = Open slopes; E = exposed ravine; P = protected ravine; S = stream.
Slope: l = level (0–3°); g = gentle (3–8,5°); m = moderate (8,5–16,5°); s = steep (16,5–26,5°); us = very steep (26,5–45°).
Geology: G = granite; T = Table Mountain Sandstone; S = Shale (Table Mountain Series); A = Alluvial.
Rock Cover: Given on Braun-Blanquet Scale.
Rock Size: Only recorded if greater than 25% rock cover: a = average size 2,5 cm; b = average of 15 cm; c = average of 60 cm; d = average of 2,2 m; e = bedrock.
Soil Texture: 1 = coarse sand; 2 = fine sand; 3 = coarse sandy loam; 4 = fine sandy loam; 5 = sandy clay loam.

Relevé Number	Associations	Sub-associations	Variations	Ground Cover (%)	Canopy Cover (%)	Canopy Height (m)	Soil Texture	Soil Depth (m)	Rock size	Rock Cover	Geology	Aspect	Slope	Altitude (m)	Exposition	Location
34				20	60	10	5	1		1	G	SE	m		O	K
35		1.1		25	80	10	5	1		1	G	SE	m		O	K
32				10	60	10	5	1		1	G	SE	m		O	K
6				5	75	12	5	1		1	G	SE	m		O	K
73				10	75	7	1	.2	b	3	T	NW	m		E	W
71				20	60	6	1	.1	b	4	T	NW	m		E	W
94		1.2		35	80	9	3	1		+	G	S	g		O	K
57				1	45	10	1	.2	c	3	TS	NE	m		E	F
59				10	45	6	3	1		+	G	SE	m	240	O	O
46		1.3		50	85	9	3	.1	c	5	TG	SE	s	330	OE	O
45				50	70	9	1	.1	c	4	TG	S	s	330	OE	O
44				45	85	8	1	.1	c	3	TG	S	s	330	OE	O
102				5	90	11	3	.1		1	T	S	g		O	P
88			1.4.1	1	95	13	3	1		+	A	S	us	165	OE	O
60				55	98	18		1		+	G	W	s	245	OE	O
72				50	75	13	3	.1	c	4	T	N	m		SE	W
99				3	75	18	1	.1	c	5	T	S	g		O	P
58			1.4.2	4	95	15	3	.2	c	2	T	SE	us	420	O	O
96				1	85	12	3	.1	c	5	T	NW	g		P	C
12				1	85	15	3	.1	b	2	TG	SE	m		P	K
8			1.4.3	2	85	15	3	.1	c	4	T	SE	m		P	K
9				1	75	12	3	.1	c	3	T	NE	us		P	K
7				1	75	12	3	.1	c	4	T	NE	s		P	K
67				70	60	15	3	.2	c	2	T	SE	m	200	O	O
39				1	95	10	3	.1	c	3	T	SE	g	220	O	O
13				5	85	13	3	.2	c	4	T	SE	m	225	O	O
14				4	65	15	3	.5		+	T	SE	m	225	O	O
15				10	70	15	3	.5		+	T	SE	m	225	O	O
16				5	85	15	3	.2		1	T	SE	g	225	O	O
17				1	90	12	3	.05	c	5	T	SE	g	225	O	O
18			1.4.4	1	75	12	1	.1	c	3	T	SE	g	225	O	O
21				10	80	15	1	.1	c	4	T	SE	g	215	O	O
22				3	95	15	1	.1	c	3	T	SE	g	220	O	O
69				40	90	12	3	.2		1	T	S	m	200	O	O
19				5	75	12	1	.05	c	4	T	SE	m	230	O	O
33				15	90	12	1	.05	c	3	T	S	g	225	O	O
68				12	90	13	3	.3	c	2	T	S	m	205	O	O
70				25	80	15	3	.3	c	2	T	S	s	200	O	O
20				5	95	13	3	.1	c	3	T	SE	g	225	O	O
79				3	90	12	3	.5		+	A	SE	m	165	O	O
85				10	90	15	3	.5		+	A	SE	m	165	O	O
89				10	85	15	3	.5			A	W	us	200	O	O
82				10	70	14	5	.2	c	2	AT	SE	m	165	E	O
40				1	80	15	3	.5		+	G	SE	m	160	O	O
61				20	95	12	3	.4			A	S	m	165	O	O
64		1.4		5	80	15	3	.5	c	2	AT	SW	m	165	O	O
62				1	90	15	4	.6			A	SW	s	155	O	O
51			1.4.5	15	85	15	3	.6		+	A	S	s	160	O	O
66				5	90	18	4	.5			A	SW	m	165	O	O
50	1			5	80	12	3	.4		+	A	SE	m	165	O	O
49				5	90	10	3	.5		+	G	SE	m	245	O	O
63				30	60	18	5	.2	d	2	AT	SW	m	165	O	O
56				+	80	15	1	.3		+	A	S	us		E	N
42				1	80	15	5	.2			G	SW	us	160	O	O
86				10	85	15	5	.2		+	A	S	s	165	O	O
52				1	75	15	3	.2		+	A	SW	s	160	O	O
11				25	75	14	3	.1	c	3	T	SW	us		P	K
3			1.4.6	1	70	17	3	.1		1	T	SW	us		P	K
4				1	80	15	3	.1	c	2	T	SW	us		P	K
23				2	75	15	3	.2	c	2	T	E	s		E	K
25				8	80	15	3	.3		1	T	E	s		E	K
24				5	75	15	3	.3		1	T	E	s		E	K
28			1.4.7	5	80	15	5	.5	c	2	G	SE	s		OE	K
27				5	90	17	5	.6	b	2	G	SE	s		OE	K
26				10	95	18	5	.5	b	2	G	SE	s		OE	K
31			1.4.8	3	80	17	5	.3	b	2	G	S	us		EP	K
30				1	90	16	5	.3		1	G	SW	s		EP	K
29				1	90	15	5	.5		1	G	S	us		EP	K
84				20	90	18	3	.1	c	3	T	SW	us		E	N
81			1.4.9	1	95	17	1	.05	c	5	T	S	m		O	N
80				1	90	15	1	.05	c	5	T	SE	m		O	N
83				1	95	15	1	.05	c	4	T	SE	m		O	N
82				1	70	20	1	.05	cd	4	T	S	us		E	N
1			1.4.10	1	75	15	1	.05	c	5	T	SW	s		P	K
91				60	85	18	3	.1	c	2	T	S	us	480	O	O
93				30	85	12	1	.1	c	5	T	SW	us	360	O	O
98				30	80	12	1	.01	c	3	T	S	m		OE	P
65			1.4.11	35	90	25	3	1			G	SW	g	150	S	O
41				1	98	25	3	1	c	1	TG	S	m	150	SP	O
43				50	98	15	3	1	c	1	A	SW	g	150	S	O
48				50	70	17	1	.4	de	4	T		l		P	B
2				1	85	20	1	.05	cd	5	T	SE	m		SP	K
47				25	85	20	1	.05	cd	5	T	SE	s	255	SP	O
10		1.5		1	95	25	1	.05	c	5	T	SE	m		SP	K
53				1	90	20	1	.05	b	5	T	S	m		SP	K
54				65	90	18	1	.1	b	3	T	S	us		P	K
55				70	95	22	1	.1	c	3	T	S	us	660	S	O
95				1	90	15	3	1			T		l		SP	L
97				1	85	18	1	.05	c	5	T	SW	m		SP	L
78				2	80	10	1	.1	b	4	T	N	us		E	W
5				1	75	8	1	.05	c	5	T	SE	m		O	K
77				2	85	8	1	.1	c	5	T	W	s		E	W
75				2	90	7	1	.1	b	4	T	N	us		E	W
76				1	95	7	1	.1	c	4	T	W	us		E	W
74		1.6		1	80	7	1	.1	c	4	T	W	s		E	W
38				1	60	10			d	5	T	S	s		O	K
37				1	60	10			d	5	T	S	m		O	K
36				1	70	9	1	.05	d	5	T	S	s		O	K
101				1	60	15			d	5	T	SE	m		OE	P
100				1	60	18			d	5	T	S	m		OE	P
92				1	75	15	1	.05	d	5	T	SW	m	450	O	O
90				1	85	10	1	.05	d	5	T	S	us	450	O	O
105	2			1	80	10	1	.1	c	4	T	S	g		OE	H
104				+	85	10			c	5	T	N	g		OE	H
103	3			1	90	10	1	.1	c	5	T	S	g		S	H

tial species. Table noda have been interpreted ecologically using the environmental data available (Table 2). Infrequent species occurring in six or less relevés are listed in Appendix 1.

Description of forests

1. *Kiggelaria africana-Rapanea melanophloeos association*

This association includes all the forest on Table Mountain and also of some other areas, but due to the lack of data from areas other than Table Mountain it is not possible to suggest differential species. High constancy canopy tree species include *Kiggelaria africana*, *Rapanea melanophloeos* and *Cassine capensis*, while *Diospyros whyteana* is constant in the ill-defined understorey. Most constant in the poor ground layer are *Knowltonia capensis* and *Blechnum australe*. A physiognomic feature of most of the forest is the paucity of the ground layer. Only in wetter forest, and where the canopy is slightly open, does the ground layer have a high cover value. This lack of a distinct ground layer appears to be a character of broad-leaved forest of winter-rainfall areas (Ellenberg & Mueller-Dombois 1967). A shrub and small tree understorey are usually ill-defined and with low cover values (5–25 %). Canopy height varied from some 8 m in scree forest to some 25 m in wet forest, with an average of 12–18 m. Where relatively undisturbed, the canopy was usually closed; exceptions are scree forest and pioneer forest (*Virgilia oroboides* sub-association). The forests are evergreen, the only true deciduous species being *Celtis africana* which has a very restricted distribution. The forests occur on soils derived from sandstone, granite and shale.

1.1. *Virgilia oroboides* sub-association

The dominant and major differential species of this sub-association is *Virgilia oroboides*. An introduced species, *Rubus pinnatus*, is also a differential species and may have a high cover in the ground layer. In the canopy *Rapanea melanophloeos* has high cover values while *Diospyros whyteana* has high values in the understorey.

This association has an 8–10 m high canopy and 15 m tall emergent trees of *V. oroboides*. The canopy is relatively open, and the ground layer is usually well developed. The sparse canopy also allows the establishment of the introduced species *Solanum mauritianum* and *Rubus pinnatus*.

Extensive patches of this association only occur on the eastern slopes, especially at Kirstenbosch, on deep granite soils with low rock cover. *V. oroboides* is a light-demanding pioneer species growing abundantly on heavily exploited and burnt forest sites (Phillips 1931). This community is, therefore, a seral community. This is also shown by the absence of a number of common species of well-developed forest (*Curtisia dentata*, *Hartogia capensis*, *Podocarpus latifolius* and *Olinia cymosa*).

1.2. *Rhus tomentosa* sub-association

This sub-association is characterized by the absence of many common forest trees (*Rapanea melanophloeos*, *Canthium mundianum*, *Podocarpus latifolius*, *Curtisia dentata* and *Hartogia capensis*) and the presence of shrub species not typical of forest such as *Rhus tomentosa*, *Myrsine africana*, *Putterlickia pyracantha* and *Rhus lucida* (in this survey the taxonomic entities *R. lucida* and *R. mucronata* were lumped).

The ground layer is usually well developed, as the canopy is open, and may have high cover values of grasses (*Ehrharta capensis*, *Briza maxima*, *Stipa dregeana*) or sedges (*Carex aethiopica*), while introduced plants are able to establish themselves: *Albizia lophantha*, *Acacia mearnsii*, *Homalanthus populifolious*, *Phoenix* sp., *Pinus pinaster* and *Quercus robur*. In the low canopy (6 to 10 m), *Canthium ventosum* is often dominant while the shrub *Maytenus heterophylla* has high cover values in the understorey.

This sub-association is based on relevés from different habitats and after further sampling it may be sub-divided. Three relevés are from the dry northern or western slopes, one from an exposed slope at Kirstenbosch and one from an exposed slope at Orange Kloof; this last relevé (59) probably represents the most mesic habitat in this group. However, all the relevés are from relatively dry areas and some showed signs of recent disturbance.

1.3. *Maytenus oleoides* sub-association

M. oleoides, a species of scrub-forest, scrub and even Fynbos (Moll & Campbell 1976, Werger et al. 1972) develops into a medium-sized tree (9 m) and has high cover values in this association. Other differential species are the ground layer species, *Pellaea pteroides* and *Ficinia acuminata* and the grass *Ehrharta capensis* is constant. This sub-association contains most of the tree species largely confined to tall, well developed forest, i.e. species not found in the first two associations and not in forest on rock screes. These species are *Olea capensis*, *Curtisia dentata*, *Hartogia capensis* and *Linociera foveolata*. Tree species other than the dominant, *M. oleoides*, which have high cover values are *Cassine capensis* and *Rapanea melanophloeos*. This forest is low (8–10 m) with a relatively open canopy and a well developed understorey, and was only recorded from one area in Orange Kloof, but can be expected to be found in all exposed areas on marginal forest sites with a shallow sandy soil and high rock cover.

1.4. *Scutia myrtina – Scolopia mundii* sub-association

This sub-association is the most extensive on the Mountain. It has a closed canopy (averaging 15 m high) and a sparse ground layer. Good differential species are lacking. *S. myrtina* is the most constant of the differential species and only occasionally appears in other forest types. *S. mundii*, *Grewia occidentalis*, *Stipa dregeana* and *Carex aethiopica* are also differential species, but are usually restricted to only some of the variants of this sub-association. *Secamone alpini* is constant but is also a differential species of the *Heeria argentea* association. This forest type contains most of the forest trees recorded on the Cape Pensula and usually only excludes *Virgilia oroboides*, *Maytenus oleoides* and *Maurocenia frangularia*.

Eleven variants of the *Scutia myrtina – Scolopia mundii* sub-association can be distinguished within the same area on floristic composition. These are:

1.4.1. The *Maytenus heterophylla-Kiggelaria africana* variant occurs on disturbed (tree cutting), usually dry, sites. Relevé 72 contains *Cunonia capensis*, growing in a local spring. *Maytenus heterophylla* is constant and has a high cover in the understorey. *Kiggelaria africana*, *Canthium ventosum* and *Rapanea melanoploeos* are the major canopy species. Disturbance is indicated by *M. heterophylla*, *K. africana* and the introduced species *Homalanthus populifolius*, *Solanum mauritanum* and *Rubus pinnatus*.

1.4.2. The *Olea africana – Podocarpus latifolius* variant has a high cover of *O. africana* and *P. latifolius*, and appears to lack forest trees such as *Linociera foveolata* and *Curtisia dentata*. Other canopy trees that occur are *Olea capensis*, *Maytenus acuminata* and *Rapanea melanophloeos*. This variant prefers rocky, shallow, sandy soils.

1.4.3. The *Halleria lucida – Rapanea melanophloeos* variant is characterized by a general absence of some tree species (e.g. *Linociera foveolata* and *Olea africana*) and a high cover of *H. lucida* and *R. melanophloeos*. It occurs in the protected Skeleton Gorge area.

1.4.4. and 1.4.5. The *Linociera faveolata – Cassine capensis* variant and the *Scolopia mundii – Cassine capensis* variant are very similar, and there are a number of intermediate relevés. In the former *L. foveolata* is co-dominant with *C. capensis*, while in the latter *S. mundii* is co-dominant with *C. capensis*, and *Curtisia dentata* and *Blechnum australe* are constant species.

Environmentally the *Scolopia* type differs from the *Linociera* type as it occurs on deep granite or alluvial soils with a high rock cover; the species composition indicates a more mesic environment than for the *Linociera* type.

1.4.6. The *Olea capensis – Curtisia dentata* variant can usually be recognized by the dominance of *O. capensis* and *C. dentata*. *Ocotea bullata* is a differential species though is also found in the *Cunonia capensis – Ilex mitis* sub-association. Unlike in other communities *Asplenium lunulatum* is often present. This type of forest was found in Kirstenbosch, either on shallow sandy soils in protected areas or deeper sandy soils in more exposed areas.

1.4.7. and 1.4.8. The *Hartogia capensis – Rapanea melanophloeos* variant, and the *Hartogia capensis – Cunonia capensis* variant are closely related and could perhaps be combined into a *Hartogia capensis* community. Both types occur in Kirstenbosch, and can be differentiated from the previous type by the lack of a high cover of either *Curtisia dentata* or *Olea capensis*. Instead *H. capensis* has high cover values, and *Halleria lucida* is notably absent.

These variants are distinguished from other climax forest at Kirstenbosch by being on soils derived from granite which are deeper and have more clay. The two variants can be distinguished environmentally by exposure: on the more exposed sites and on forest margins, *C. capensis* is absent and *R. melanophloeos* has high cover values, and on the more protected sites *C. capensis* is present and the canopy is taller (15–17 m as opposed to 12–14 m).

1.4.9, 1.4.10. and 1.4.11. The *Cunonia capensis – Olinia cymosa* variant, the *Cunonia capensis – Apodytes dimidiata* variant and the *Cunonia capensis – Ilex mitis – Rapanea melanophloeos* variant are all similar because *C. capensis*, usually associated with various other tree species, is dominant. These types are similar to the *Cunonia capensis – Ilex mitis* sub-association and appear to be intermediates between the drier *Scutia myrtina – Scolopia mundii* sub-association and wetter *Cunonia capensis – Ilex mitis* sub-association.

The *Cunonia capensis – Olinia cymosa* type (See Fig. 3) is usually dominated by *C. capensis* and/or *O. cymosa*, and lacks a number of ground layer species as it is found on sites with a high rock cover and little soil development (*Pleopeltis lanceolatum* was often present on the rocks). The relevés representing this variant were all from the slopes above Newlands, i.e. in a high rainfall area. The *Cunonia capensis – Apodytes dimidiata* type differs from the above by having ground layer species such as *Schoenoxiphium lanceum* and *Blechnum australe*, and having high cover values of *A. dimidiata*. This variant occurs in wind-protected areas on wet, open slopes in Orange Kloof and in the deep Skeleton Gorge. The *Cunonia capensis – Ilex mitis – Rapanea melanophloeos* variant differs from the two other types by the absence, or low cover, of *Cassine capensis*, *Olinia cymosa*, *Apodytes dimidiata* and *Curtisia*

Fig. 3. *Cunonia capensis – Olinia cymosa* community in Kirstenbosch. Note the rocky ground and poor ground layer.

dentata, and by the presence of a number of riverine species such as *Ilex mitis*, *Blechnum attenuatum* and *Alsophila capensis*. The introduced *Acacia melanoxylon* is also often present where this community occurs at Orange Kloof. Unlike the other variants this type occurs along streams, or in the proximity of underground streams.

1.5. *Cunonia capensis – Ilex mitis* sub-association

This community is found on the wettest forest sites such as along streams and at high altitudes where mist is an important source of additional precipitation, especially in summer. Unlike the *Cunonia capensis – Ilex mitis – Rapanea melanophloeos* variant of the *Scutia myrtina – Scolopia mundii* sub-association, this sub-association lacks many of the common forest tree species (especially *Rapanea melanophloeos*, *Diospyros whyteana* and *Linociera foveolata*, perhaps because rock cover is very high), and is dominated almost exclusively by *Cunonia capensis*. *Ilex mitis*, although not usually dominant, is more-or-less restricted to this sub-association. In the ground layer ferns are numerous and include *Blechnum attenuatum* and *Alsophila capensis*. The introduced *Acacia melanoxylon* is also present and may dominate the canopy, particularly in Orange Kloof. The canopy of the sub-association is usually high (18 to 22 m).

Two relevés from the Cape Hangklip area are included in this sub-association. They differ by possessing *Platylophus trifoliatus*, a species which is not found elsewhere on the Cape Peninsula but which occurs in wet forest types in the Southern Cape (McKenzie pers. comm.) and in Knysna (Von Breitenbach 1972).

1.6. *Maurocenia frangularia – Olea africana* sub-association

This sub-association is characterized by the dominance of *M. frangularia* and/or *O. africana* and, to a lesser extent, by *Canthium mundianum* and *Olinia cymosa*. It lacks many forest tree species such as *Linociera foveolata*, *Scolopia mundii*, *Cunonia capensis*, *Olea capensis*, *Hartogia capensis* and *Curtisia dentata*. The canopy is often low (8–10 m) and the ground layer is poorly developed. This sub-association is found on poor forest sites, either in the drier ravines of the western slopes, or on shallow rocky soils under more mesic conditions, but then on sites with 100% cover of large boulders (2 m in diameter) with *Pleopeltis lanceolatum* usually associated with these boulders.

The sub-association is represented by two extreme types, between which there is apparent continuous variation. In the *Olea africana – Canthium mundianum* variant *M. frangularia* may have very low cover values while *O. africana*, *C. ventosum*, *Olinia cymosa* and *Diospyros whyteana* may have high cover values. This type occurs in the dry ravines of the western slopes, or on dry scree sites, where rock cover is usually lower and boulders are smaller. In the *Maurocenia frangularia* variant *M. frangularia* often dominates to the exclusion of other species, especially on the wet scree sites on open slopes as at Orange Kloof and Noordhoek.

2. *Heeria argentea association*

This and the following association are excluded from the major group, the *Kiggelaria africana – Rapanea melanophloeos* association. They do not occur on the Cape Peninsula, and lack numerous typical forest species. The *Heeria argentea* association has high cover values of *H. argentea*, a species not found on the Cape Peninsula. Other species of high cover, but which are also found in the *Kiggelaria africana – Rapanea melanophloeos* association are *Maytenus acuminata*, *Olea africana* and *Hartogia capensis*. The two relevés representing this association were recorded in the Hex River mountains on sandstone screes with little soil development.

3. *Metrosideros angustifolia association*

The single relevé representing this association was almost totally dominated by *Metrosideros angustifolia*, which is not found on the Cape Peninsula. Also important in this community is *Brachyleana neriifolia* and *Ilex mitis*, both of which were recorded in the *Cunonia capensis – Ilex mitis* sub-association on the Peninsula. The relevé representing this community was sampled at a stream bank in the Hex River mountains.

Discussion

The forest types recognized in this study mostly occur in one particular part of the Table Mountain area. This suggests that each part is sufficiently environmentally discrete to enable it to support a particular forest type. Moisture conditions, degree of rockiness and soil depth appear to be the major factors affecting the type of forest. The possible relationships between the various forest communities and these environmental factors are summarized in Fig. 4 which also shows the suggested relationship between forest and Fynbos. On Table Mountain the *Rhus tomentosa* sub-association appeared to be the most dissimilar to other forest types (Fig. 3). These relevés have, therefore, been re-analysed with relevés from non-forest areas (Campbell & Moll 1976). In Fig. 4, the *Maytenus oleoides* sub-association is shown to have Fynbos affinities. *M. oleoides*, the characteristic species, as well as a number of other species recorded in this community such as *Ficinia acuminata*, *Aristea* sp. and *Ficinia trichodes*, are also found in Fynbos.

Of the forest communities recognized, the *Heeria*

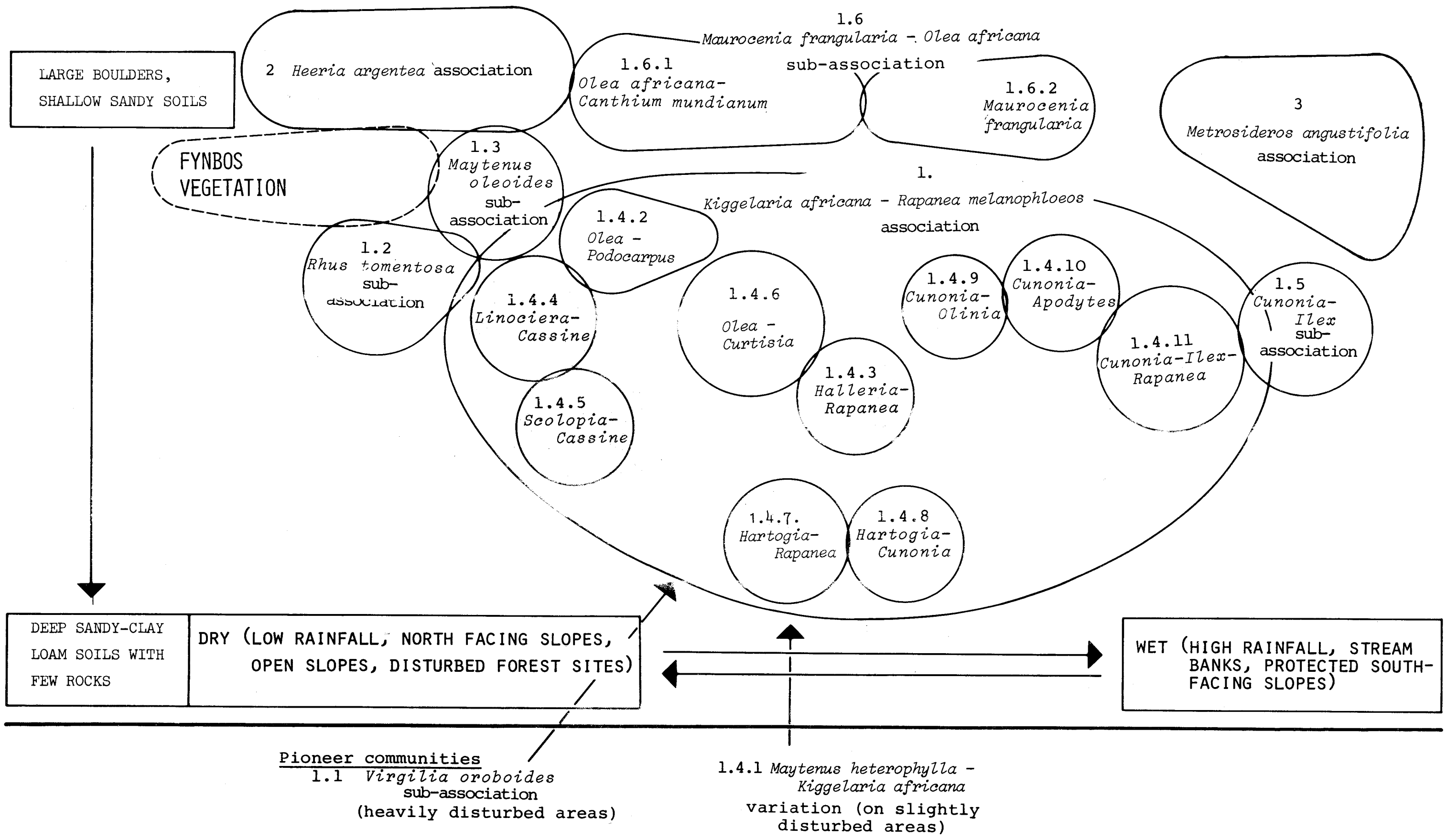


Fig. 4. Ordination showing suggested relationships between forest communities, and between forest communities and environmental factors. The communities recognized and their relationships are shown by circles.

argentea and *Metrosideros angustifolia* associations do not occur on Table Mountain, or on the rest of the Cape Peninsula. These communities would fall into the *Heeria argentea* and *Brabejum stellatifolium* communities of Werger et al. (1972). The single relevé available in the present study from the *Metrosideros angustifolia* association supports the suggestion of these authors that their *B. stellatifolium* community can be subdivided into two communities, one with the character species *M. angustifolia* and one without it.

It is challenging to speculate on reasons for the absence of these associations on the Cape Peninsula. The *Heeria argentea* association appears to be replaced on similar sites on Table Mountain by the *Maurocenia frangularia – Olea africana* sub-association which occurs on wet screes, as is evidenced by the presence of *Cunonia capensis*. One variant of the *Maurocenia frangularia – Olea africana* sub-association occurs either on screes in high rainfall areas or in protected kloofs. There are few screes on open dry slopes on Table Mountain, which appears to be the habitat of the *Heeria argentea* association. The *Metrosideros angustifolia* association would appear to occur along perennial streams. On Table Mountain this kind of habitat is usually lined with forest below the level of the plateau, while perennial streams running from the upper to lower plateau are lined with vegetation consisting largely of *Berzelia lanuginosa*, *Osmitopsis asteriscoides* and *Elegia thyrsifera*. It is, therefore, similar to the *Berzelia lanuginosa – Osmitopsis asteriscoides* Fynbos community of Werger et al. (1972). However, the tree *Cunonia capensis* may also be present, scattered through the community.

According to our observations other forests on the Cape Peninsula appear to be similar to the forests of Table Mountain, although forest is much less extensive on the remainder of the Peninsula. This is probably due to lower rainfall (Fig. 1). The most extensive forest patches other than on Table Mountain occur above Noordhoek, in a protected south-facing valley, and these have been shown to be similar to those on Table Mountain. Taylor (1969b) recognized two scrub forest communities in the Cape Point Nature Reserve at the southern end of the Peninsula. One of these, the *Maurocenia frangularia – Linociera foveolata* tall scrub association at Cape Point has similarities to the drier facies of the *Olea africana – Canthium mundianum* variant of the *Maurocenia frangularia – Olea africana* sub-association. Common to both these communities are the woody species *M. frangularia*, *Cussonia thyriflora*, *Maytenus heterophylla*, *Rhus lucida*, *R. mucronata*, *R. tomentosa* and *Myrsine africana*, and *Knowltonia capensis* and *Asparagus aethiopicus* in the ground layer.

However, Taylor's unit can probably be separated as a distinct association of rock screes in drier areas as it is not well developed and lacks numerous forest tree genera such as *Rapanea*, *Diospyros*, *Kiggelaria*, *Halleria*, *Cassine*, *Olea* and *Canthium*. Furthermore, a number of marginal forest species occur (e.g. *Tarchonanthus camphoratus* which is often dominant, *Cassine barbara*, *Colpoon compressum* and *Euclea racemosa*).

The tall forest types of other South-Western Cape areas are essentially similar to that on Table Mountain. Two relevés of Werger et al. (1972) from Jonkershoek, which represent their *Rapanea melanophloeos* community, would both be placed in our *Rapanea melanophloeos – Kiggelaria africana* association. At a finer level one relevé would be placed in the *Cunonia capensis – Iles mitis – Rapanea melanophloeos* variant, and the second could best be placed in our *Olea africana – Podocarpus latifolius* variant. Our results from the Cape Hangklip area show that that forest is also related to the *Kiggelaria africana – Rapanea melanophloeos* and the *Cunonia capensis – Ilex mitis* associations.

What appears to be lacking from areas in the South-Western Cape, other than those on the Peninsula, is extensive forest on deep soils such as occur at Orange Kloof (the *Scolopia mundii – Cassine capensis* variant).

Summary

The forest communities of Table Mountain have been classified using the Braun-Blanquet technique together with numerical analysis. Three major communities, termed associations, have been recognised. Some of these associations have been subdivided. Each community has been described in terms of floristic, structural and environmental factors. The dominant factors affecting the distribution of forest communities appear to be moisture conditions, soil rockiness and soil depth. Information from other South-Western Cape forest areas is discussed. The forests from Table Mountain are similar to these.

However, two forest communities are not found on the Cape Peninsula and extensive areas of *Cassine* dominated forest on deep soils referred to as the *Scolopia mundii – Cassine capensis* variant do not appear to be found outside Orange Kloof.

Appendix 1

Infrequent species occurring in six or less relevés and not included in the phytosociological table.

Acacia longifolia (57:2); *A. mearnsii* (57:0); *Anthospermum aethiopicum* (104:+); *Antisoma capensis* (73:+; 102:+; 78:+; 76:+); *Aristea macrocarpa/thrysiflora* (59:1; 45:+); *Asparagus asparagoides* (101:+); *Asplenium erectum* (89:1; 48:+); *Brabejum stellatifolium* (94:2); *Brachylaena neriifolia* (95:+; 97:2; 103:1); *Cannomois virgata* (59:1); *Cardamine africana* (99:+); *Chasmanthe aethiopica* (99:+); *Chrysanthemoides monilifera* (57:0); *Coleonema album* (73:0; 77:1); *Cynosurus echinatus* (73:1); *Cynanchum obtusifolium* (14:+; 66:+; 63:+); *Dryopteris inaequalis* (3:+; 30:+; 29:0); *Fagelia bituminosa* (59:+); *Ficinia trichodes* (59:+; 45:+); *Helichrysum cymosum* (59:+); *Homalanthus populifolius* (59:0; 88:1; 60:0; 41:0; 43:+; 47:0); *Hypolepis sparsisora* (54:+); *Leonotis leonurus* (71:+; 58:+); *Leucadendron argenteum* (59:1); *Melothria punctata* (10:R; 48:+); *Peperomia retusa* (48:+); *Peucedanum galbanum* (76:+); *Phoenix* sp. (71:+); *Phytolacca americana* (34:+); *Pinus pinaster* (57:0); *Pittosporum undulatum* (82:1); *Podalyria calyptrata* (34:+; 94:+); *Populus canescens* (20:R); *Psoralea pinnata* (95:0); *Pteridium aquilinum* (59:1); *Pteris dentata* (88:0; 60:0; 41:1; 54:1); *Pteroclastrus rostratus* (95:0); *Quercus robur* (94:1; 67:3; 83:0); *Rumohra adiantiforme* (84:0); *R. pungens* (2:+); *Salvia africana/aurea/chamelaegnea* (57:1); *Schizaea tenella* (65:+); *Senecio rigidus* (71:+); *Stachys aethiopica* (9:R; 48:0); *Vinca major* (94:+); *Widdringtonia nodiflora* (59:0).

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