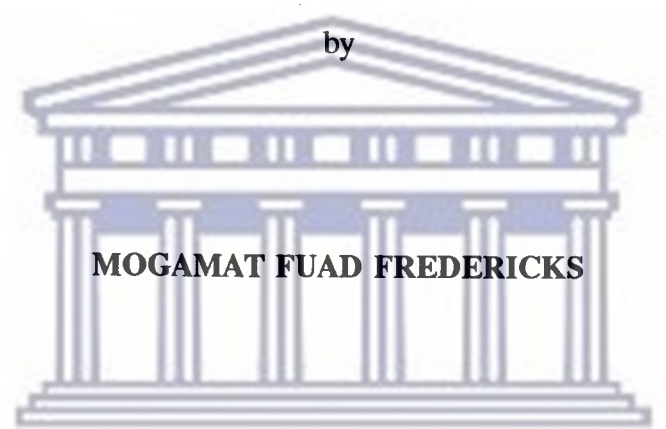
VEGETATION RELATIONSHIPS OF PRIORITY CONSERVATION SITES ON THE CAPE FLATS

by

MOGAMAT FUAD FREDERICKS



submitted in partial fulfilment of the requirements

for the degree of Magister Scientiae in

the Department of Botany,

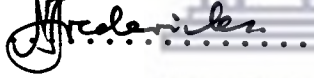
University of the Western Cape

Promoter: Prof. B. McKenzie

Joint promoter: Mr A.B. Low

March 1992

I declare **VEGETATION RELATIONSHIPS OF PRIORITY CONSERVATION SITES ON THE CAPE FLATS** is my own work and that all the sources I have used or quoted have been indicated and acknowledged by means of complete references.



MOGAMAT FUAD FREDERICKS

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ABSTRACT

The physical environment of the Cape Flats is outlined. The plant communities of twenty-one priority conservation sites are classified. Twenty-five communities, grouped into 15 associations, 8 alliances, 4 orders, 2 subclasses and a single class are defined. This is based entirely on floristic features, following the Braun-Blanquet approach and application of the Code of Phytosociological Nomenclature. These syntaxa are systematically described with reference to floristic, structural and macro-environmental features.

The distribution of the communities are indicated on 1:10 000 scale maps of the study sites.

The communities are described further in relation to soil chemical and physical variables. The analysis indicates that soil chemical variables are more important in determining vegetation-soil relationships than physical variables. The main variables are soil Ca, pH, P, K, Na, bulk density, moisture regime, % medium sand and % fine sand.

The "general summary and recommendations" is intended to serve as a guideline for interest groups so as to ensure that adequate representatives of each community are conserved.

ACKNOWLEDGEMENTS

I was introduced to the study of vegetation by Prof. Bruce McKenzie, to whom I wish to express my sincerest gratitude. My esteem for him flows from his excellent guidance, encouraging support, constructive criticisms and ability to disentangle and clarify seemingly complex issues. Mr Barrie Low is gratefully acknowledged for providing the initial stimulus and direction with regards to fieldwork and for identifying many of those similar but different species.

Dr Lincoln Raitt is thanked for his willingness to share his considerable field knowledge on the natural remnants of the eastern Cape Flats area. I also thank Dr Charlie Boucher for the time he spent assisting me to come to terms with the procedures involved in using ecology computer programs. Mr George Thompson and his team of lab assistants at the Soil Science Section, Elsenburg, are hereby gratefully acknowledged for analysing my soil samples, thus releasing me from those time-consuming procedures.

It would not have been possible for me to pursue further studies without financial support. Here Prof. Colin Johnson is gratefully acknowledged for his determined efforts towards establishing a culture of research in the Botany Department. I thankfully acknowledge the financial support from the Botany Department (Chairman's Fund Education Trust Bursary), Foundation for Research Development and Ford Internship.

The highlight of my academic career was definitely the opportunity granted to me by the African-American Institute (through Prof. Colin Johnson) to attend an American university for seven months. Prof. Michael Barbour and his students at the University of California, Davis, are heartily thanked for their genuine concern, inspiration, encouragement and helpfulness which made my visit so much more extraordinary. Scott Martens and Sylvia Hultain-Tweed, in particular, are thanked for providing the CANOCO program and the relevant literature - these proved to be indispensable. I shall always treasure their special efforts at accommodating me in their already full schedules.

My colleagues and friends in the Botany Department and the Environmental Education & Resources Unit at the University of the Western Cape are thanked for their assistance, support and encouragement.

Finally, I wish to thank my family and friends for their continued interest, encouragement and patience. A special friend, Faika Salie, provided much support throughout the study.

GENERAL INTRODUCTION

The Fynbos Biome (Kruger 1978; Day et al. 1979; Cowling 1992) - hereinafter referred to as "the Biome" - occurs in the south-western and southern Cape and covers an area of about 74 500 km^2. The topography of the Biome is dominated by the Cape Folded Mountain Belt bounded in the interior by the Karoo basin and bounded by the coast to the south and west (Moll & Bossi 1984; Rutherford & Westfall 1986). Lowlands, between the coast and mountains, also form part of the Biome.

Moll and Jarman (1984a) defined fynbos vegetation as being "evergreen, sclerophyllous shrublands, on oligotrophic soils, comprising essentially Cape Floristic Kingdom [restioid, ericoid and proteoid] elements, consisting predominantly of either functionally isobilateral picophyllous and/or microphyllous to mesophyllous-leaved shrubs and usually associated with evergreen aphyllous and/or narrow-leaved sclerophyllous hemicryptophytes". Typological controversies have, however, stimulated vigorous debate among scientists (see e.g. Moll & Jarman 1984a,b; Boucher 1987, chapter 3; Moll 1987; Cowling et al. 1988). Rutherford & Westfall (1986), using Raunkiaer's "life forms" categories, described the Biome as being characterized by the codominance of usually evergreen, sclerophyllous phanerophytes, chamaephytes and hemicryptophytes, - codominance being best developed in the

transitional (vegetation age up to about 10 years post-fire) and early mature phases - although, at sub-biomic scale, variations in dominance occur.

Following the "Veld Type" concepts of Acocks (1988), the Biome consists of Strandveld, Coastal Rhenosterbosveld, Coastal Macchia, Macchia and False Macchia. Taylor (1978) and Kruger (1979), modifying Acocks's concepts, delimited four major vegetation types (with various subdivisions), viz. Mountain Fynbos (Macchia and False Macchia), Coastal Fynbos (Coastal Macchia), Coastal Renosterveld and Strandveld. Boucher & Moll (1981) referred to the former two categories as "heathlands" and the latter "shrublands". Moll et al. (1984) proposed a scheme of major vegetation categories in and adjacent to the Biome as a second approximation to Acocks's veld types. Their four tier hierarchy, which contained nineteen categories, was mapped by Moll & Bossi (1984). According to Moll et al. (1984) and Moll (1987) the vegetation of the Biome, on the basis of structural, environmental and floristic characteristics, comprised at least six distinct, major shrubland assemblages, viz. (1) Cape Fynbos Shrublands (heathlands) - Mountain Fynbos (Wet, Mesic and Dry), Grassy Fynbos (Mesic and Dry) and Lowland Fynbos (Sand Plain Fynbos, Elim Fynbos and Limestone Fynbos), (2) Mosaic of Cape Fynbos Shrublands and Subtropical elements (Dune Fynbos), (3) Cape Transitional Shrublands (non-heathlands) - Renosterveld (West Coast Renosterveld, South West Coast Renosterveld,

Central Mountain Renosterveld and South Coast Renosterveld) and Strandveld (West Coast Strandveld and South Coast Strandveld), (4) Subtropical Transitional Thicket (Kaffrarian Thicket and Valley Bushveld), (5) Afromontane Forest and (6) Karroid Shrublands (non-heathlands). Applying the above criteria, two major vegetation types occur on the Cape Flats - Cape Fynbos Shrublands (Lowland Fynbos) and Cape Transitional Shrublands (Strandveld). Cowling et al. (1988) and Rebelo et al. (1991), however, extrapolated Campbell's (1985) mountain vegetation concepts successfully to the lowlands of the Biome and demolished any justification for retaining a Lowland Fynbos vegetation concept. Following this scheme there are three major vegetation groups on the Cape Flats - Dune Thicket, Dune Asteraceous Fynbos and Dry Restioid Fynbos. Dune Asteraceous Fynbos, a new concept, is confined to the coastal lowlands. Cowling & Holmes (1992) recognise the following communities in the Biome: Groups - Forest and Thicket, Karroid and Renoster Shrubland, Grassland and Grassy Shrubland (non-fynbos) and Cape Fynbos Shrublands (Series - Grassy Fynbos, Asteraceous Fynbos, Restioid Fynbos, Ericaceous Fynbos, Proteoid Fynbos and Closed-scrub Fynbos).

The lowland areas of the south-western Cape have been rated amongst the most threatened ecosystems in South Africa (Hall 1982; Moll & Bossi 1984; Jarman 1986; Hall 1989; Rebelo 1992). Threats to the remaining vegetation of the

lowlands include, e.g., an increased rate of urban expansion; insufficient conservation action; an increase in invasive alien plants (especially Australian acacias); genetic decline in the small, remaining natural populations of flora fragmented by development; intensive production farming methods; the increase in too frequent, accidental or ill-timed veld fires (especially in veld with a soil-stored seed bank of invasive aliens) and the increased use of off-road recreational vehicles in dune areas.

The plight of these areas, especially the Cape Flats, has been highlighted in various forms such as during symposia and in reports and articles (see e.g. Low 1979, 1982; Moll 1982; Parker 1982; Hall & Ashton 1983; Jarman 1986; Low & McKenzie 1988, 1989; McDowell 1989a,b; McDowell & Low 1990).

Jarman (1986) proposed 66 lowland sites of conservation value in the region between the Olifants River and False Bay, of which only seven were located on the Cape Flats. This report only considered fairly large sites (average size - 4 145 ha). The importance of linked, smaller (5 ha) habitats in plant conservation has been recognised recently (see Rebelo 1992). According to Boucher (1987) the Cape Flats supports a unique assemblage of plant communities (e.g., his Ehrharto-Ericetalia coarctatae Order is primarily located between Mitchell's Plain and Blackheath).

A recent report by McDowell & Low (1990) indicates the location of all major (>1 ha) natural habitats on the Cape Flats. These habitats were described and evaluated on a conservation priority basis but also took into account the potential importance they might have for people living around such areas. The report indicated that the Cape Flats experienced an approximate 50% decline in natural habitat over the period 1983-1989, with an accompanying increase in the concentration of threatened plants (15.3 species/km^2 for Sand Plain Fynbos). McDowell & Low (1990) identified 35 natural remnants and corridors, with 25 of these receiving conservation priority status.

No plot (relevé) data or rigorous analysis of species assemblages were undertaken in the latter survey and this aspect formed the basis for the present study which had as its major aims:

i) The phytosociological classification of the vegetation in 21 of the priority conservation areas identified by McDowell & Low (1990);

ii) the production of vegetation maps of each of these areas based on the classification;

iii) the provision of conservation guidelines for developers, planners and other interested groups.

Chapter 1 deals with the physical environment of the study area. Edaphic, geological and climatic factors are discussed.

The classification of the plant communities within the study sites is dealt with in **Chapter 2**. This chapter, which constitutes the main body of the thesis, is intended to serve as a databank on the floristics, structure and general habitat characteristics of the plant communities. Computer programs were used to produce differential and synoptic tables. Twenty-five communities were identified and described. Vegetation maps, indicating the approximate boundaries of the plant communities occurring in the study sites, were drawn from 1:10 000 orthophoto maps.

Chapter 3 details the relationships of the identified plant communities to soil micro-environmental variables. Statistical and ecology computer programs were used to investigate these relationships.

Chapters 2 and 3 are written in paper form to facilitate future publication.

Finally, the **general summary and recommendations** provides a guideline for developers, planners and other interested groups in the light of the findings of the aforegoing two chapters.

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CHAPTER 1

PHYSICAL ENVIRONMENT OF THE CAPE FLATS

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The boundaries of the Cape Flats were taken to be between $18^0 27'$ and $18^0 45'$ east longitude and $33^0 48'$ and $34^0 06'$ south latitude. Adjoining Cape Town, it forms an extensive sandy plain stretching between the Cape Peninsula Mountains in the west, the Hottentots-Holland Mountains in the east, the Tygerberg Hills to the north and the False Bay coastline to the south. This area is approximately 650 km^2 in extent.
It is assumed that the Cape Flats area developed after the closure of the "Cape Strait", which at one time presumably united False Bay with Table Bay, by the lowering of the sea-level and a probable rise of the basement rocks (Schalke 1973).

SOILS AND GEOLOGY

The nomenclature used in the ensuing discussion follows that of Theron (1984) and Schloms et al. (1983).

The Cape Flats is blanketed by a wide variety of surface deposits of the Bredasdorp Formation which cover the older rocks (Rogers 1982; Theron 1984). At a borehole in Philippi, sediments of shell-bearing white sand have a depth of 37,2m above the basement of phyllite, greywacke and quartzitic sandstone of the Tygerberg Formation, Malmesbury Group (Anonymous 1984).

1. SURFACE DEPOSITS

1.1 Alluvium

Alluvial deposits border the larger river courses such as the Liesbeek and Diep Rivers and consist largely of light- or dark-coloured organic sand (Fig. 1). The deposits are frequently not clearly defined and gradually merge into light-grey sandy soil. Alluvial deposits do not occur along the Kuils and Bottelary Rivers (Theron 1984). The soils are generally weakly developed and some are hydromorphic. Dominant soil forms are Dundee, Westleigh, Oakleaf and Valsrivier. Locally in lower-lying areas they may be very saline (Schloms et al. 1983).

1.2 Calcareous coastal sands

Shell-bearing, aeolian dune sand (of Holocene [<1,5 million years] and later Pleistocene [1,5-2 million years] age), stabilized by vegetation, cover extensive areas of the Cape Flats (Fig. 1). These calcareous dunes are found at elevations ranging from 0-200 m above sea-level. Between Muizenberg and Macassar, and northwards to Bellville, this extensive sand has accumulated into parabolic dunes some of which may rise as much as 82 m above sea-level. The dune landscape constitutes a total surface area of about 3 00 km^2. The sands are deep (>1 200 mm), slightly weathered and poorly leached due to their youth and the relatively low precipitation. The soils are mostly of the Fernwood (Fw 20,21) form; the Mispah (Ms 22) form is rare (Schloms et al. 1983).

The density of vegetation cover, its distribution and nature and the presence or absence of earlier drainage systems demonstrate age differences between the dunes (Theron 1984). It is suggested that the north-westerly orientation of the dunes clearly demonstrates the influence of the prevailing south-easterly winds on the south-facing sand beaches (Tinley 1985). It is also suggested that the dunes originated at the time of the last Würm Glacial (approximately 17 000 years ago) when the coastline had moved far to the south because of decline in sea-level and consequent exposure of huge amounts of sand to aeolian forces (Schalke 1973, Theron 1984). According to Hendey (1983) coastal dunes may have a complex history of erosion and redeposition by marine, fluviatile and aeolian processes.

1.3 Acid sands

Inland of the shell-bearing dune sands, along a sharply defined boundary, a light-grey to pale-red, acid, sandy soil underlies large areas of the southern and northern suburbs (Fig. 1). At Philippi it consists of particularly pure silica sand of similar grain size to the dune sand and with the larger grains mostly well-rounded. The constituent interwoven sandstone lenses are generally older than the shell-bearing dune sands.

It is considered that these sands were originally calcareous and have become decalcified through leaching

(Schloms et al. 1983). The main source of the parent material appears to be sands accumulated in embayments along the coast during the Pleistocene transgression with possible additional material contributed by dune plumes advancing inland.

South of Philippi a maximum thickness of 32 m is reached whereafter the deposit changes to a more poorly sorted, coarse-grained quartz sand characterized by less well-rounded grains. Farther north and east the whole succession decreases in thickness to 15 m at most and contains many clay and conglomerate lenses as well as thin lenses of ferricrete, especially in the northern areas (Theron 1984).

This sand mantle on the coastal platform forms a weakly undulating plain with an altitude of 70-110 m above sea-level. Bleached podzolized soils of the Lamotte (Lt 11), Constantia (Ct 11) and acid series of the Fernwood (Fw 11) forms are dominant. Ground water ferricretes occur in patches to form Wasbank form soils. The soil profiles in the acid sands are deep (>1 200 mm) and there are marked seasonal differences in the depth of the water tables. These sands also extend locally up footslopes of hills as a relatively thin mantle of predominantly yellow coloured sands belonging to the Clovelly and Constantia soil forms. Haematitic ferricretes occur in these sands as relict features in upslope positions. The presence of red and

yellow colours in the higher lying sands is an indication of an earlier stage of pedogenesis. Under conditions of hydromorphy and podzolization bleached sandy profiles have developed on the undulating plain.

1.4 Red apedal soils

Red apedal soils (Schloms et al. 1983) are widespread on high lying pediment plains and dissected footslopes and occur at 200-350 m altitude (Fig. 1). The parent material consists of highly weathered drift over preweathered saprolite and rock. Red kaolinitic clays are common with the Hutton (Hu 16) and Doveton (Hu 27) series of the Hutton form dominant. Stonelines on the boundary between the drift material and underlying saprolite and gravels are usually associated with these soils.

1.5 Residual soils

Where shales, phyllites and schists of the Malmesbury Group are the main preweathered parent substrates, residual soils occur (at 150-200 m above sea-level) - see Fig. 1. Shallow Mispah (Ms 10) and Glenrosa (Gs 13) soil forms are found here; duplex soils of the Swartland (Sw 31) and Sterkspruit (Ss 23) also occur where some thickness of preweathered substrate is preserved. The underlying shales and phyllites show a high degree of preweathering. True laterites with mottled saprolites are also common (Schloms et al. 1983).

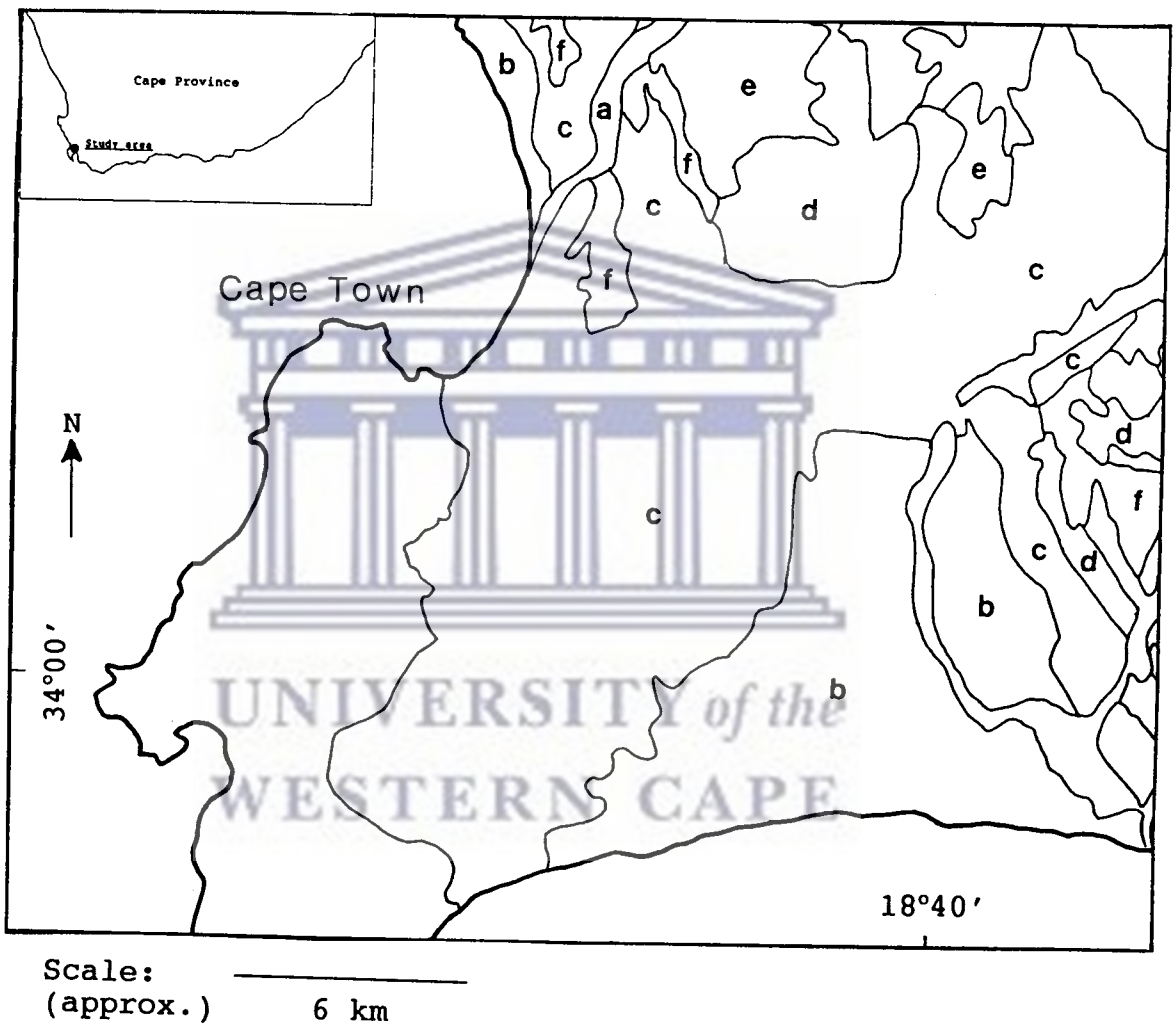

Fig. 1. Soils of the Cape Flats area (from Schloms et al. 1983); a - alluvium, b - calcareous coastal sands, c - acid sands, d - red apedal soils, e - residual soils, f - duplex soils.

1.6 Duplex soils

Duplex soils of binary origin, consisting of aeolian sands of medium grade on fluvial and residual clays occur at 44-75 m altitude, e.g. in the Milnerton area (see Fig. 1). Soils of the Kroonstad (Kd 21) and Estcourt (Es 41) forms are dominant. The subsoil clays are moderately sodic and stonelines are common at the sand-clay contact. The degree of weathering of the substrates is low (Schloms et al. 1983).

1.7 Silcrete and ferricrete

Although silcrete and ferricrete deposits occur separately in many places there are many instances where they merge marginally or are intimately mixed together.

Silcretes are widely distributed as isolated strips in the northern suburbs of Bellville, Durbanville, Kraaifontein, Parow and Kuils River. The most extensive outcrops are in the vicinity of Phesantekraal where silcrete forms a cliff several metres high. It varies from yellow to light-grey and coarse, gritty or conglomeratic to fine-grained. All outcrops consist at surface of typical, particularly hard, well-silicified rock that weathers into massive, smooth, partly rounded blocks with conchoidal fracture. Silicification varies so that hard lumps or rocky blocks of silcrete alternate with poorly consolidated, friable, white, sandy material.

Ferricrete occurs in the vicinity of Table View, at Tygerberg, Phesantekraal, Durbanville, Plattekloof and De

Grendel. At the latter two localities the ferricrete is a hard, dark brown, knobbly rock and may be more than a metre thick. It forms a hard, gritty to conglomeratic, partly silicified to ferruginized rock where it grades into silcrete. At Durbanville, however, it consists of an amorphous, friable mass of ferruginized nodules and interstitial dark-brown, loamy soil.

These deposits formed near the surface by groundwater concentration of iron oxide and/or silica derived from the underlying weathered rocks (Theron 1984).

1.8 Limestone, calcrete and semi-consolidated lime-rich sand

These deposits reach maximum development along the coast between Strandfontein and Macassar. The whole calcareous succession is regarded as the Wolfgat Member of the Bredasdorp Formation (Theron 1984). It varies from typical massive, grey, sandy, surface limestone to cemented, well-bedded, sandy limestone and friable, partly cemented calcareous sand with shells and tree roots. Typical surface limestone, composed of a hard, irregular layer up to a few metres thick often covered by sand, constitutes more than 90% of all outcrops. The thickness of the sand varies according to the dune topography but in the valleys between dunes the lime beds are often exposed in excavations. The lime-rich bed over the greater part of the area is only a few metres thick and consists of an upper, hard, densely cemented zone resting on soft, sandy, yellow calcrete which

grades into calcareous sand, the lime content of which gradually decreases with depth (Theron 1984).

2. IGNEOUS ROCKS

2.1 Dolerite dykes

Dolerite dykes occur in the Bellville-Brackenfell area. Outcrops are very poor and frequently a series of dolerite boulders is all that represents the presence of a dyke. The dykes are medium-grained, dark-grey melanocratic rocks containing augite and plagioclase as the most important minerals. The rocks become paler on weathering and assume a grey-green colour as chlorite is developed. They frequently display a microporphyritic texture with feldspar crystals 1 to 2 mm long, set in a dense dark groundmass. The dykes are intrusive into granite and Malmesbury rocks (Theron 1984).

2.2 Hornblende-lamprophyre dykes

These dykes occur in several localities north of Bellville. At Welgemoed the rock consists of dark-brown to green hornblende phenocrysts up to 10 mm in length and 1 mm wide which are reasonably regularly scattered in a fine-grained, grey-coloured, feldspathic groundmass. It is not found at the surface. The origin of this rock is possibly as a result of reaction between basic magma and granite or other rocks under hydrous conditions in an environment having high CO_2 levels (Theron 1984).

2.3 Trachyte dykes

Several thin, fine-grained trachyte dykes occur north and west of Bellville and Durbanville. They generally weather to green, dense, compact, hard rocks with pale feldspar and dark mica phenocrysts. The rocks consist predominantly (84-87%) of a grey feldspathic groundmass in which individual feldspar crystals seldom exceed 0.2 mm (Theron 1984).

2.4 Granite

Granite of the Kuils River-Helderberg pluton, Cape Granite Suite, is predominant in the north-eastern corner of the study area. A fine-grained granite characterizes the wall of the pluton and is predominant in the Durbanville area. Several thin microgranite dykes also intrude into the Malmesbury rocks in the Durbanville area and dark-grey, fine-grained granodiorite bodies are present near Kuils River. The granite at Kuils River is chiefly a leucocratic, fine- to medium-grained, quartz-feldspar tourmaline granite. A coarse porphyritic granite, however, is also present, such as the smaller body at Brackenfell where biotite and muscovite are reasonably common. The granite is usually deeply weathered to kaolin and typical round rock masses are present in Brackenfell (Theron 1984). The age of the rocks of the Kuils River-Helderberg pluton is about 560±10 million years (SACS 1980).

2.5 Granodioritic rocks

Granodioritic rocks of the Cape Peninsula Pluton, Cape

Granite Suite, are confined to two localities near Kuils River. They consist of deeply weathered, grey to brown, fine-grained, crumbly rocks with white or light-grey flecks (Theron 1984).

3. TYGERBERG FORMATION, MALMESBURY GROUP ROCKS

According to SACS (1980) the Malmesbury Group is regarded as a geosynclinal succession of sedimentary and low-grade metamorphic rocks overwhelmingly of marine origin. However, evidence now suggests a much shallower, deltaic depositional environment (Theron 1984). Rocks of the Tygerberg Formation, Malmesbury Group are present over a large part of the area but, as mentioned previously, are largely covered by the variety of superficial sediments discussed above. The Tygerberg Formation consists predominantly of irregular alternations of grey to green phyllitic shale, siltstone and medium- to fine-grained greywacke (Theron 1984). Good outcrops occur in the Bellville-Durbanville area. The Malmesbury Group is thought to be of late Precambrian (approximately 4 500 million years) age (SACS 1980).

CLIMATE

The Cape Flats, situated on the west coast of the subcontinent, experiences a mediterranean climate. Broadly speaking, this implies a climate with warm, dry summers and cold, wet winters.

The weather patterns of the south-western Cape are affected mainly by the South Atlantic Subtropical Anticyclone. The summer aridity and strong southerly summer winds are caused by the southward and landward movement of this high-pressure cell. The northward and oceanward movement of this anticyclone in winter allows successions of eastward-moving cyclones (depressions), budded off from the circum-polar westerlies, to influence the south-western Cape. This causes the cold and wet conditions to prevail at this time, and is associated with the passage of cold fronts (Tyson 1969; Tinley 1985; Boucher 1987).

1. Classification

According to the climatic classification system of Köppen (Schulze & McGee 1978; Tinley 1985), the study area experiences a warm temperate climate (Csb).

An indication of variation in the climate can be obtained from the climate diagram (Fig. 2).

2. Solar radiation

Solar radiation is a fundamental climatic factor causing climatic variations in different topographic situations due to its influence on near-surface air temperatures, soil temperatures, evaporation and consequently on local moisture conditions. During summer there is little difference in potential radiation on all aspects and slopes of <30°. In winter radiation is strongly affected by the

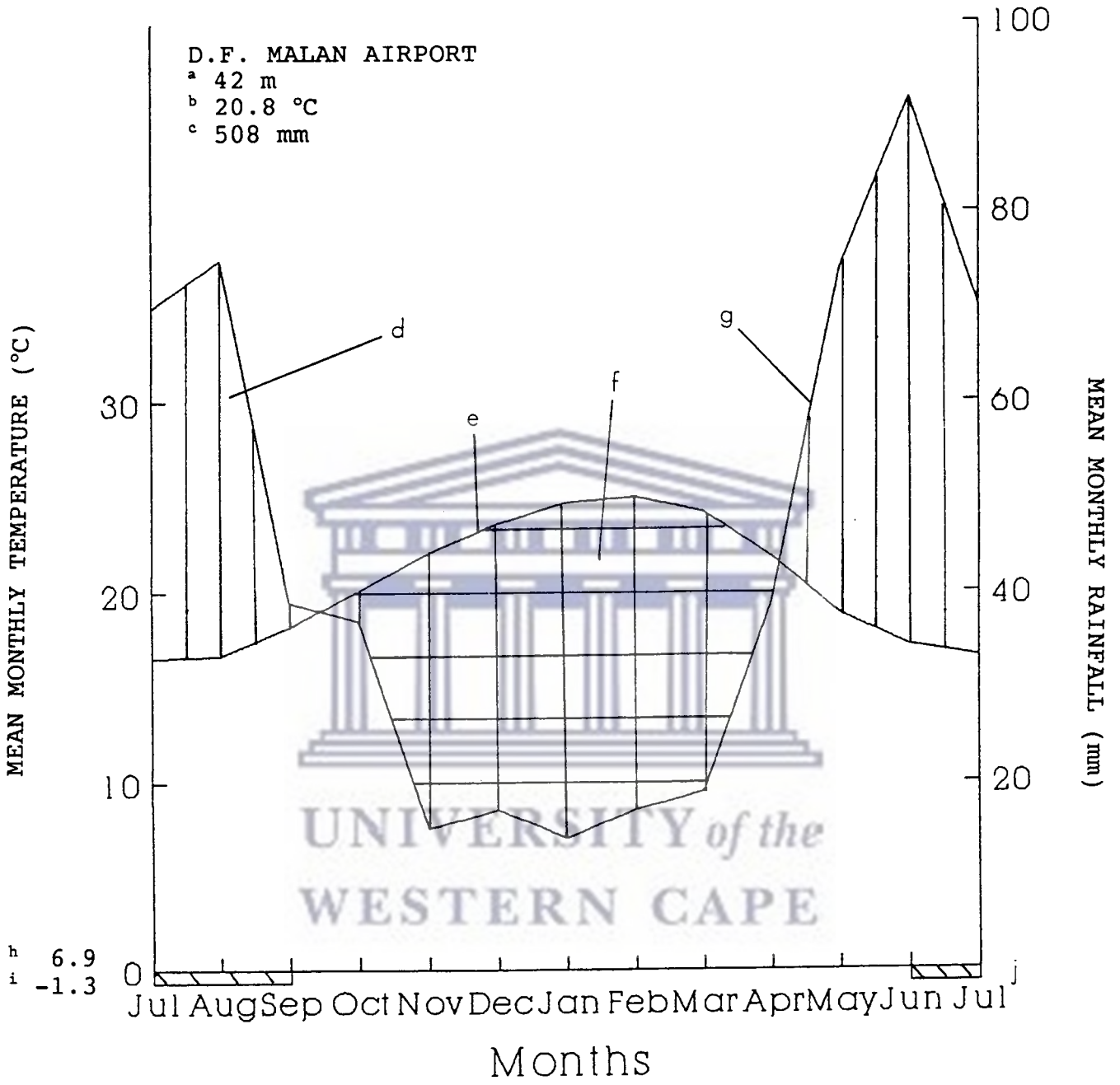

Fig. 2. Climate diagram for the Cape Flats (D.F. Malan Airport) (data from Weather Bureau 1986); a - altitude (in m), b - mean annual temperature (in °C), c - mean annual rainfall (in mm), d - wet season, e - mean monthly air temperature (in °C), f - dry season, g - mean monthly rainfall (in mm), h - mean daily temperature of coldest month (in °C), i - absolute minimum temperature (in °C), j - months with absolute daily minimum temperature below 0°C.

lower sun azimuth and steep north slopes receive markedly more radiation than steep south slopes (Fuggle & Ashton 1979; Boucher 1987). Table 1 gives an indication of the mean monthly radiation (diffuse) experienced in the study area.

3. Temperature, Rainfall, Wind and Relative Humidity

Mean annual temperature (at 14h00) recorded over a 29-year period at the D.F. Malan Airport weather station (33°59'S, 18°36'E) was 20.8°C. The highest mean monthly temperature (25.0°C) occurred in February; the lowest (16.6°C) in July (Weather Bureau 1986) (Table 1).

The mean annual rainfall received over this same period was 508 mm of which 76.6% fell between the months of April and September, thus defining the region as having winter rainfall (Table 1).

The coastline experiences a strongly bidirectional wind regime with the predominant winds blowing alternately from opposite quadrants throughout the year (Fig. 3). The changes in wind direction are due to alternating successions of depressions (in winter) and the anticyclones (in summer) which follow them. The wind roses indicate that the predominant winds are south and north-west. Winter is generally less windy than summer. In winter average wind speeds are 14 km/hr in the mornings, increasing to 20 km/hr, and in summer from 20 km/hr to 28 km/hr (Tinley

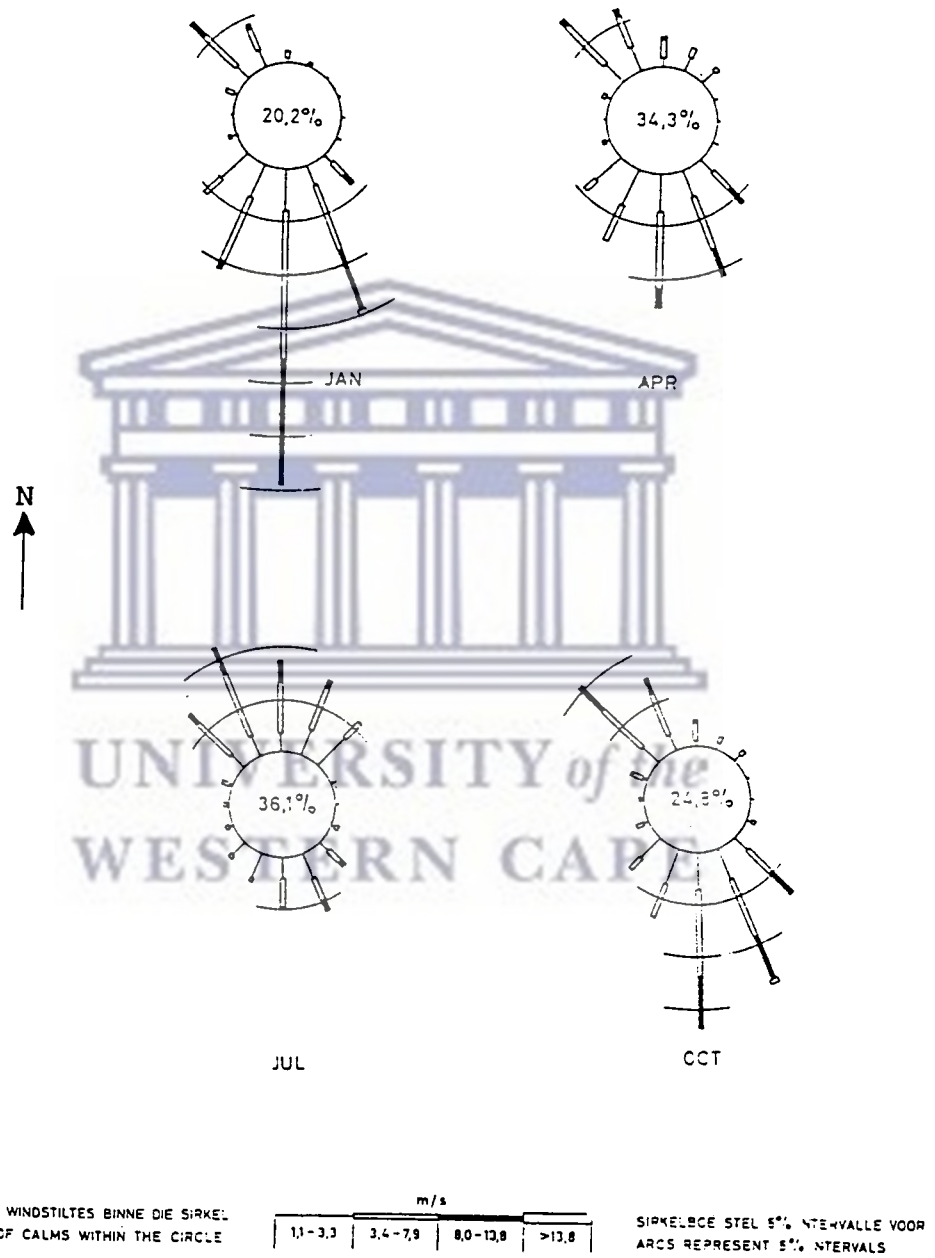

Fig. 3. Wind roses for January, April, July and October - D.F. Malan Airport (from Weather Bureau 1975).

1985).

A high year round humidity with a mean annual relative humidity (at 08h00) of 83% is experienced (Weather Bureau 1986) (Table 1).

Table 1. Selected climatic parameters for the Cape Flats (D.F. Malan Airport) (data from Weather Bureau 1986).

Month	Mean diffuse radiation ($daWm^{-2}$)	Mean air temperature (at 14h00) (°C)	Mean precipi-tation (mm)	Mean relative humidity (at 08h00) (%)
Jan	179	24.7	14	74
Feb	162	25.0	17	80
Mar	137	24.2	19	85
Apr	121	21.9	39	89
May	102	18.9	74	90
Jun	88	17.2	92	88
Jul	94	16.6	70	89
Aug	123	16.7	75	89
Sep	160	18.2	39	87
Oct	191	20.1	37	79
Nov	197	22.1	15	72
Dec	195	23.6	17	71
Year			508	

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CHAPTER 2

CLASSIFICATION OF THE PLANT COMMUNITIES

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CLASSIFICATION OF THE PLANT COMMUNITIES

INTRODUCTION

Pioneering work on the Cape Flats was done by Acocks (1933, in Boucher 1987) when he submitted a description of the vegetation of a portion of the Cape Flats (and a list of plants found there) as an M.Sc. thesis at the University of Cape Town. According to Boucher (1987), Acocks described and mapped nine regions in the vicinity of Kuils River at Brackenfell. The flora he described was later included under Coastal Renosterveld and Coastal Fynbos.

Taylor (1972) identified the following Coastal Fynbos communities on the Cape Flats:

a) Inland communities consisting of (i) Metalasia Inland Dune Fynbos and (ii) Inland Dwarf Fynbos;

b) Coastal communities consisting of (i) Metalasia Coast Dune Fynbos (ii) Coast Dwarf Fynbos of limestones.

Britton (1972, in Boucher 1987) confirmed that Taylor's Metalasia Coast Dune Fynbos is a distinct community but found it difficult to align Taylor's Coast Dwarf Fynbos with his findings in the Swartklip area. Britton distinguished five main communities, with his Coastal Fynbos subdivided into four types along a 2,5 km-wide coastal strip along False Bay.

Regarding Strandveld, Taylor (1972) described a Euclea-Rhus Inland Dune Scrub and a Pterocelastrus Coast Dune Scrub

from the Cape Flats. Middlemiss (1960, in Boucher 1987) simply provided a list of the dominants of a related dune scrub at Rondevlei while Britton subdivided the scrub at Swartklip into three pure and one transitional communities.

Taylor (1972) also described a grass-rush community occurring in low-lying, inland depressions inundated in winter. The families Poaceae, Cyperaceae, Restionaceae and Juncaceae showed marked local, single-species dominance - in contrast to coastal depressions which had a mixed flora with little single-species dominance.

Following the classification of Boucher (1987), the plant communities of the Cape Flats, including the sandy beach communities, belong to the classes Arctothecetea populifoliae (order Arctotheco-Cladoraphietalia cyperoidis), Ehrhartetea calycinae (particularly orders Ehrharto-Eucleetalia racemosae and Ehrharto-Ericetalia coarctatae) and Scirpetea nodosi. The analysis was largely based on data used by Britton (1972, in Boucher 1987) and Milton (1976, in Boucher 1987) in unpublished reports on the dune vegetation of the northern False Bay coast, as well as additional raw data collected. The original names used no longer applies.

This paper reports on the plant communities identified in 21 priority conservation sites (sensu McDowell & Low 1990) (Fig. 1) on the Cape Flats.

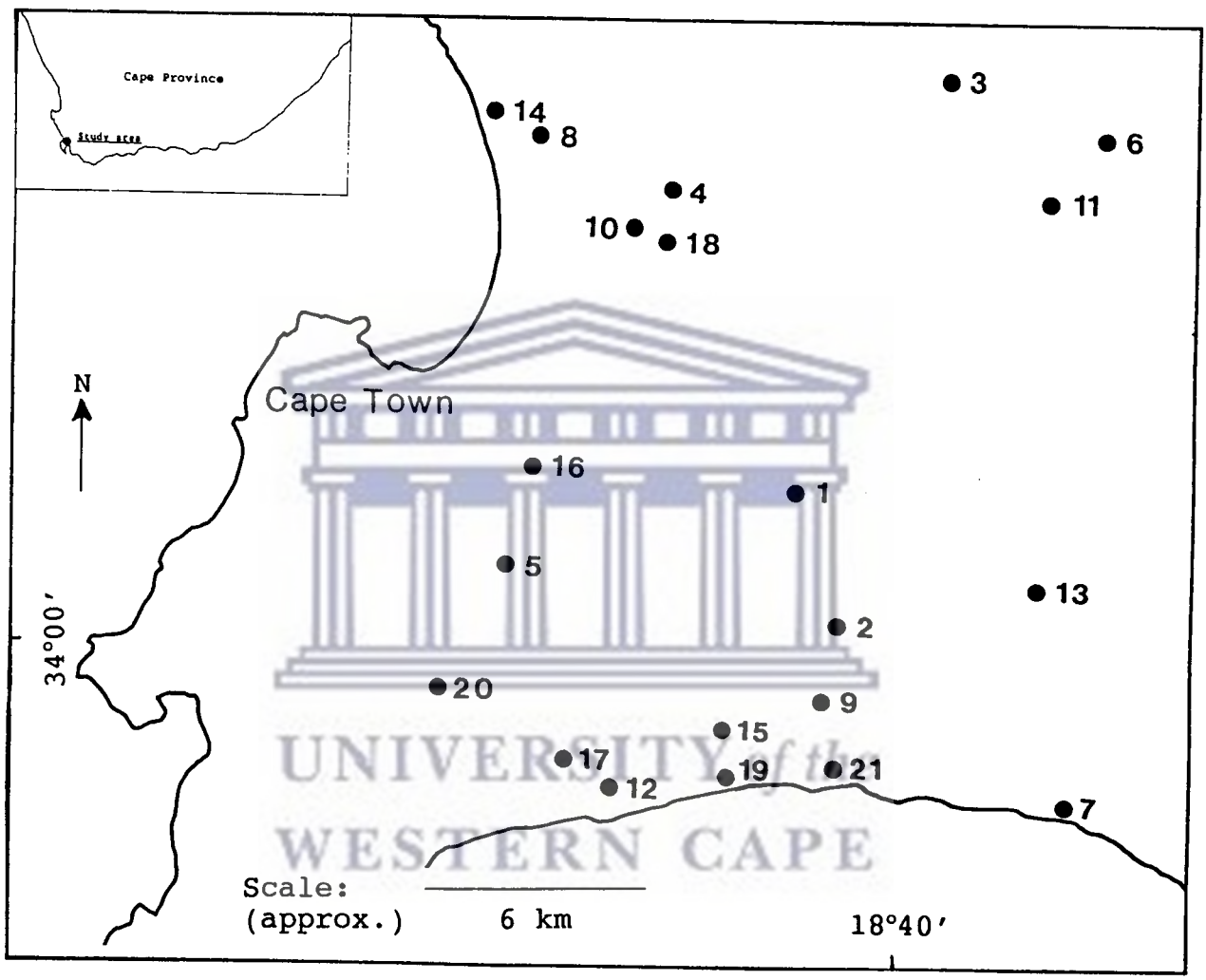

Fig. 1. Location of the study sites; 1 - Cape Flats Nature Reserve Extension, 2 - Driftsands Nature Reserve, 3 - Durbanville Racecourse, 4 - Eskom Powerline Reserve, 5 - Kenilworth Racecourse, 6 - Kraaifontein Forest Reserve, 7 - Macassar Dunes, 8 - Milnerton Racecourse, 9 - Mitchell's Plain-Khayelitsha Flats, 10 - N7/N1 Interchange, 11 - Northpine Commonage, 12 - Pelikan Park-Zeekoevlei Flats, 13 - Penhill Estate, 14 - Rietvlei Flats, 15 - Rocklands Dune, 16 - Rondebosch Commonage, 17 - Rondevlei Nature Reserve, 18 - Sixth Base Ordinance Depot, 19 - Strandfontein-Mnandi Coastal Dunes, 20 - Tokai Forest Reserve, 21 - Wolfgat Nature Reserve.

METHODS

Data collection

The Zürich-Montpellier (Braun-Blanquet/Relevé) method (see Braun-Blanquet 1972, Mueller-Dombois & Ellenberg 1974, Werger 1974 and Westhoff & van der Maarel 1978) of vegetation survey was adopted. A plot size of 10x5 m with a 1.5 m outside surround was used. A minimum of three plots were placed in any seemingly homogeneous vegetation unit; sandy beach communities and vegetation of permanent wetlands were not sampled. The structure of the vegetation units were recorded according to the system proposed by Campbell et al. (1981). A total of 186 relevés were recorded. Species nomenclature follows Bond & Goldblatt (1984).

Data Analysis

Two computer program packages were used interchangeably in data analysis, viz. PCTables (Boucher 1990) and TWINSPAN (Hill 1979). PCTables provides programs facilitating data input into ecology programs and also contains programs which construct the relevant tables required. TWINSPAN is a polythetic, divisive method of classification by a continued dichotomy of reciprocally averaged data. All the relevés, but only perennial indigenous species, were included in the analysis. All parameters, except "pseudospecies cut levels" and "maximum level of divisions" were set to the defaults. The pseudospecies cut levels 0, 1, 2, 3, 4 (default values 0, 2, 5, 10, 20) and a maximum

of five (default value six) levels of divisions were used. According to Hill (1979) the "pseudospecies" is the quantitative equivalent of the differential species (which is essentially qualitative). Each species abundance is replaced by the presence of one or more pseudospecies; the more abundant a species, the more pseudospecies are defined (Jongman et al. 1987). The order of samples (relevés) as proposed by TWINSPAN was used in the subsequent construction of the phytosociological tables but the order of species was refined according to Braun-Blanquet table arrangement procedures. Six relevés (33, 34, 77, 78, 182 and 183) were excluded from the final phytosociological table as they were regarded as being "poor" relevés, i.e. a combination of more than one community. The dendrogram derived from TWINSPAN was used as a basis for syntaxonomic classification. The Code of Phytosociological Nomenclature (Barkman et al. 1986) was followed in the naming of the syntaxa; the second generic epithet of the higher rank was placed before the full name of the differentiating taxon of the succeeding rank to emphasize the relationship between the noda (sensu Boucher 1987).

A vegetation map of each priority conservation site was drawn (Figs. 2 - 22), using the base maps (1:10 000 scale) of McDowell & Low (1990).

RESULTS & DISCUSSION

Table 1 represents the final phytosociological table of the vegetation sampled within the study sites. Twenty-five communities are identified and are also depicted in the dendrogram-synoptic table of the classification (Table 2);

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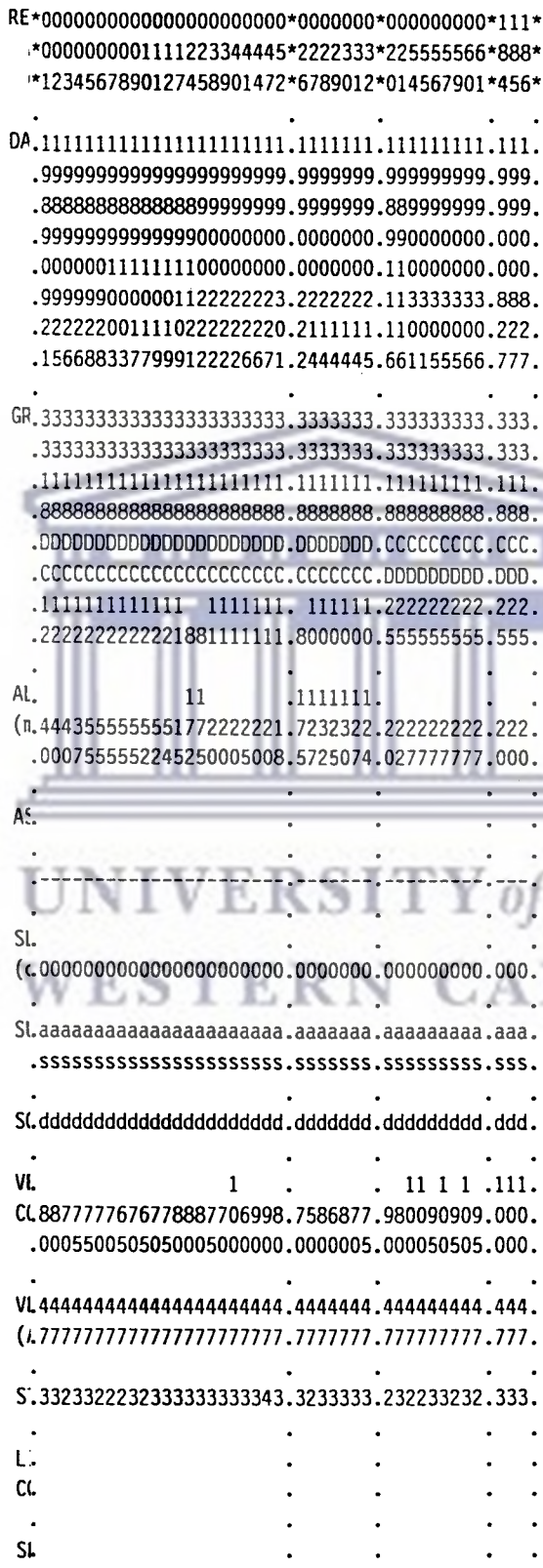

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12535*141210496989881699612 8*3493811*661067312*259*
     .                      .       .         .   .
11111*000000000000000000000*0000000*000000000*111*
55555*000000000111122334444 5*2222333*225555566*888*
56789*123456789012745890147 2*6789012*014567901*456*
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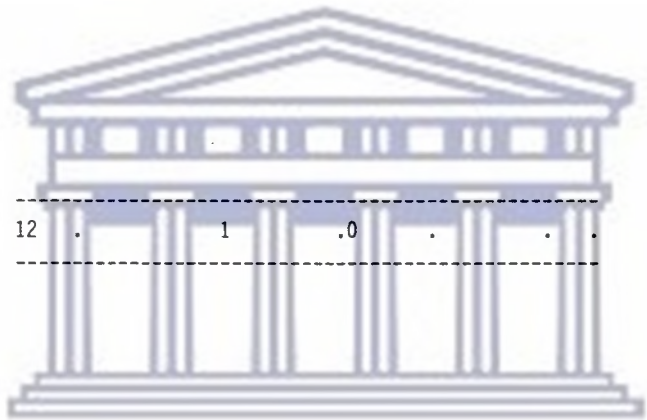

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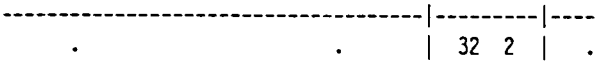
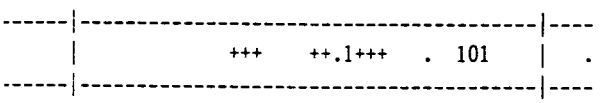
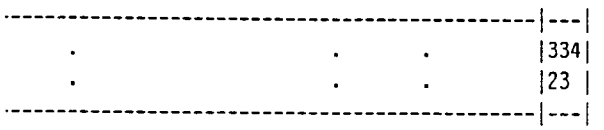
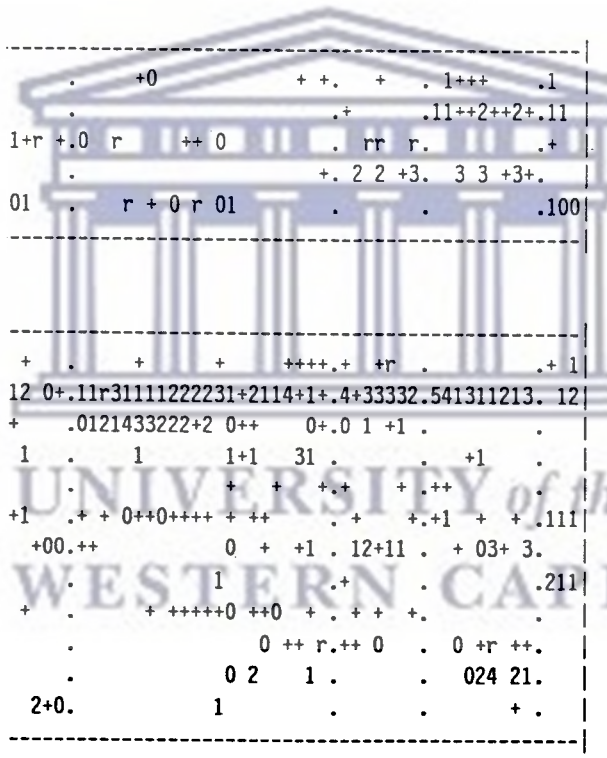
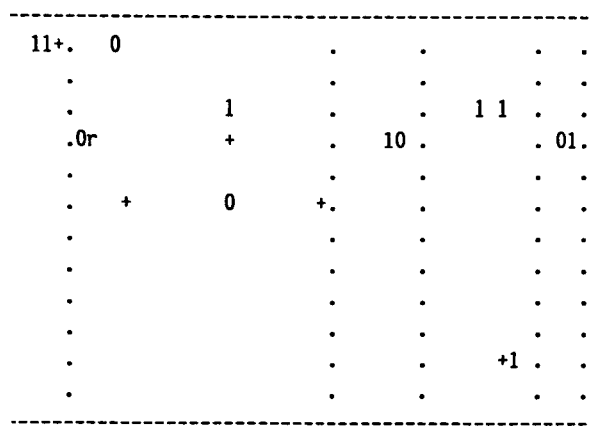






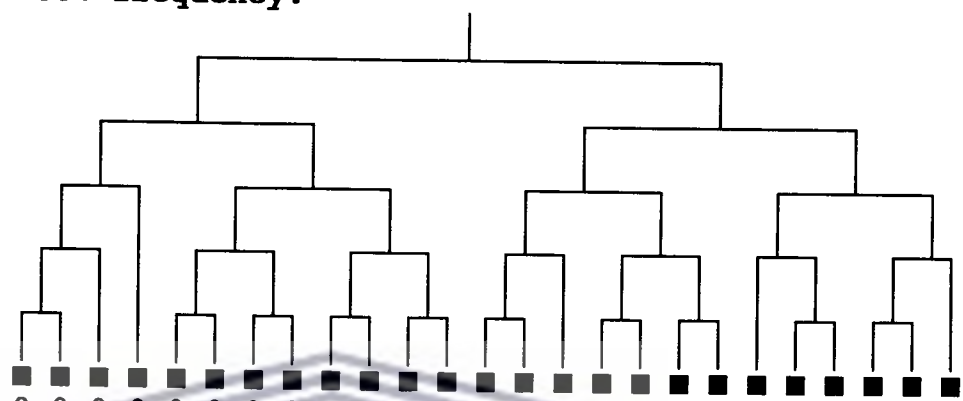




Soil drainage: d - dry, well-drained soil
m - temporary moist, poorly drained soil
Special feature: l - limestone
See **Appendix 1** for full species names
Cover-abundance values:

0 - outside relevé, but within 1,5 m radius
r - very rare, usually only a single individual, cover less than 0.1 % of the area
+ - present but not abundant and cover less than 1% of the relevé area
1 - numerous but covering less than 1 % of the relevé area, or covering between 1-5% of the area but not abundant
2 - very numerous and covering less than 5 % of the relevé area, or covering between 5-25 % of the area independent of abundance
3 - covering between 25-50 % of the relevé area, independent of abundance
4 - covering 50-75 % of the relevé area, independent of abundance
5 - covering between 75-100 % of the relevé area, independent of abundance

Table 2. **TWINSPAN dendrogram and the synoptic (summary) table of the plant communities.**
Key to the abundance value related to each abbreviated species name (see Appendix 1 for full species names): + = 1-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = 61-80%, 5 = 81-100% frequency.



Community no.	0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2
	1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
No. of relevés	. . . . . 2 2 . 1 . . . . . 2 . . .
	3 2 3 4 6 4 6 4 6 3 0 4 2 5 3 9 7 6 3 3 6 2 7 9 3
No. of species	0 0 1 1 3 2 3 5 5 1 3 2 1 1 1 4 3 1 1 1 4 6 2 3 1
	5 9 4 7 2 5 5 2 6 8 4 4 2 6 3 0 7 9 4 3 5 9 9 3 9
Differential species of the Ruschio-Willdenowion incurvatae	
Will incu	5 5 5 2 . . . . . 3 + 1 . .
Differential species of the Willdenowio-Chrysanthemetum incanae and the Ruschio-Tetragonietum fruticosae	
Chry inca	. 3 5 5 . . . . .
Differential species of the salvietosum of the Eucleo-Protasparagetum compacti	
Prot comp	5 3 2 . . . 1 3 . . . . . 3 . . . .
Rhus cren	5 2 1 + ...
Side iner	4 . . . . .
Euph maur	4 . 1 1 . . . . .
Cyna obtu	4 2 . . + ...
Putt pyra	2 . . + ...
Differential species of the ericetosum of the Eucleo-Oleetum exasperatae	
Eric cocc	5 . . . . .
Cass pera	5 . . . . .
Chir bacc	5 . . . . . 1 . . . .
Clif obco	5 + ...

Differential species of the Ischyrolepido-Eucleion racemosae

Olea exas	3. .5.3	. . . . .
Tham spic	4.2.5.1	. .1. . .1. .1. . . . .
Kedr nana	3.2. .3	1. . . . . .1. . . . .+. . . .

Differential species of the indigoferetosum of the Passerino-Phylicetum ericoidis

Indi brac	3	2. . . . .
Ligh tene	2	. . . . .
Eric coar	1	. . . . .
Anth pros	1	.1. . . . . .1. . . .

Species common to communities 8 and 9

Colp comp	2.2	. . . . .
Otho coro	1.1	.1. . . . .

Species common to communities 7, 8 and 9

Phyl eric	5.2.5	.1. . . . . .1. . .
Carp acin	2.1.3	2.1. . . . .
Cass mari	2.2.2	. . . . .

Differential species of the cullumietosum of the Passerino-Phylicetum ericoidis

Cull squa	5	. . . . .

Species common to communities 5 to 10

Rhus glau	4.5.4.5.4.5	1.2. . . . .
Eucl race	3.5.4.5.4.2	. . . . . .1. . . .
Salv afri	5. .4.4.3.2	1. . . . . .1. . .3. . . .
Pter tric	2. .4.3.3.4	. . . . .
Visc cape	3.4.2.3.2.	. . . . .

Differential species of the ficinietosum of the Passerino-Rhoetum laevigatae

Fici dune	5	. . . .1. . .2.2. . . .
Nyla spin	4	. . . . . .1. .
Heli nive	4	. . . . . .1. . . .

Differential species of the Tetragonio-Ischyrolepidetalia eleocharis

Isch eleo	1.3.5.2.5.5.3.5	5. .2. . . . . .+. . . .
Pass rigi	. .1.1.5. .1.4	. .2. . . . .2. . . . .
Chry moni	2. .2.2.3.2.1.2	.1. .2.2.1. . . .1. . . .
Otho frut	. .2.2.3. . .3	. . . . .
Zygo flex	1.2. .1.2. .2.	.1. . . . . .+. . . .
Prot cape	2.2.1.2.1. .2.2	. . .1.1. . . .1.+. . .2.
Iflo repe	. . .1.+.2.1.	3. . . . .

Differential species of the Ehrharto-Tetragonienea fruticosae

Tetr frut	5.5.5.5.3.5. .2.1. .2.2	. . . . .1. . . . .
Rusc maco	5.5.5.5.1.2.1.2.2. .1.	. . .1. . . . . .+. .1. .
Cyna afri	.5.5.2. .4.2.1.2. .2.2	. . . . . .2. . . .

Differential species of the Chondropetalo-Imperation cylindricae

Impe cyli	. . . . . .+. .2.3	5	5	5	.2. . . . .1.2. . .

Differential species of the leucadendretosum of the Cynodonto-Chondropetaletum tectorum

Leuc levi	. . . . .	4	2. . . . .
Orph frut	. . . . .	4	1. .4. . . . .
Clif eric	. . . . .	2	. . . . .+. . . .

Species common to communities 15, 16 and 17

Chon tect	. . . . . .+. .1. . .1	5.5.3	. . . .1.1.2. .

Differential species of the senecionetosum of the Stenotaphro-Juncetum krausii

Sene hali	. . . . . .+. .1. .5. .5.1.1	5	. . . . .
Plec serp	. . . . . .+. . . . . .2. .2	4	2. . . . .2. .
Scir nodo	. . . . . .4. .1	3	. . . . .

Species common to communities 17, 18 and 19

Junc krau	. . . . .	4.2.4	. . . . .

Differential species of the Metalasio-Restionetum

Rest cf b	. . . . . .1.	5	.+. .3. .
Stoe cf c	. . . . .	5	1. . . . .
Carp edul	. . . . .2. .1. . . . . .1. . .	5	.1.3.3. .

Differential species of the phylicetosum of the Metalasio-Thamnochortetum lucentis

Phyl stip	5	2. . . .
Clif poly	5	.2.3. .

Differential species of the calopsietosum of the Metalasio-Thamnochortetum lucentis

Calo impo	2	. . .
Pela mult	2	. . .
Cras sp.	1	1.1. .

Differential species of the Metalasio-Thamnochortetum lucentis

Tham luce	5.5	. . .
Phyl ceph	5.5	. . .
Leuc hypo	3.2	. . .

Species common to communities 22 and 23

Clif falc	3.5	. .
Plag unio	2.3	1. .
Serr fasc	2.3	. .
Dias prot	1.3	. .

Differential species of the stenotaphretosum of the Passerino-Willdenowietum teretis

Eric subd	2	.

Species common to communities 22, 23 and 24

Clif cf j	2.3.2	.

Differential species of the Passerino-Cliffortietum hirtae

Clif hirt	5
Aspa cord	4

Differential species of the Ehrharto-Passerinenea vulgaris

Cyno dact	.1. .5.3. .5. . .1.1.3.2
Sten secu	. .2. .3.5.2. . . .1.5.4
Thes spic	. . .2. . . . .5.2.3. .2
Stoe plum	. . . .3.1.4. . .+.3.3.
Pela tris	. . . . . .2.2. . .5

Differential species of the Ehrhartetea villosae

Ehrh vill	. .2.4.5.5. .2.4.5.4.5.5.2. .2.1. . . .1.2.3. .4
Pass vulg	5. .2.4. . . .+.+. . . .5. .2.1.5.2.2.2.5.5.5.5.4
Meta muri	. . . . . . .1.1.5. .1.4.5.4. . .3. . .5.1.4.3. .
Rhus laev	. . . . . .2. .3.3.2.5.4.3.5.4. .1. . . .1.2. .2.
Heli patu	. . . . .2.2.3.2.4.5.1. . . .2.4.5. . . . . .1.2.2.
Ehrh caly	. .2.2.2.2. .1.2.5.1.2. . .2. .1. .5. .3.3.2.3.5
Will tere	. . . . . . .5.1.1. .3. . .2.2.1. . .2. .3.2.4.3.
Aspa hisp	4.3. .5. . . .1.2. .3.3.3.2. .2. . . . . . .+.1. .5
Fici bulb	.5.5.2. . . .+.1. . .3. . . . . .1. . . .2.3.3. .
Pela capi	. . . . .2.2.1. . .1. . .3. . .2. .1.3.3.
Rhus luci	. . . . . .3.2.2.1. . . . . . . .1.2. . . . . .1. .3.
Anth aeth	. . . . . . .1.1.1. . .4.3.3. . .1.1. . .3.+. .1.

Species sporadically encountered in the Ehrhartetea villosae

Ceph proc	. . . . .1.1. .1. . . . . .3.+. . . .
Zygo fulv	. . . .2.1.2.1. .1. .1.2. . . . .
Chon nudu	. . . . .1.1. .4.2. .+. .2. .
Stru stri	. . . . .1. . . . . .1.2. .4.
Hell memb	. .3. . . . . .1.3.3.2. . . . .
Chon micr	. . . .+. . . . . . . .2. . . . . .1. . . .
Stoe capi	. . . . . . .2. .1.2. . . . .
Ciss cape	. . . . .1.2. .1. . . . .
Sola quad	. . . . . .3. .1.1. . . . .
Erio afri	. . . . .1. .1.+. . .1. . . . .
Serr cf t	. . . . .2.1. . . . . .2. .
Pela betu	. . . . .1.1. . . . .

the full hierarchical classification is presented in Appendix 2. The description of the communities are based on the tables (sensu Boucher 1987) and on averaged structural data (sensu Campbell et al. 1981).

CLASS: EHRHARTETEA VILLOSAE

This syntaxon typifies the communities found throughout the study area. Boucher (1987) groups most of the coastal foreland vegetation of the Cape Province into his Ehrhartetea calycinae class. Ehrharta calycina is here regarded as one of the differential species of the Ehrhartetea villosae.

The class is divided into two subclasses on the basis of TWINSPAN indicators (pseudospecies). The subclasses are:

(i) Ehrharto-Tetragonienea fruticosae (indicators - Rhus glauca, Euclea racemosa and Ischyrolepis eleocharis).

(ii) Ehrharto-Passerinenea vulgaris (indicator - Passerina vulgaris).

The former subclass comprises communities formerly delimited as Strandveld or West Coast Strandveld by Acocks (1975, 1988) and Moll et al. (1984) respectively. Boucher (1987) classifies similar communities on the Cape Flats within his Ehrharto-Eucleetalia racemosae Order.

The Ehrharto-Passerinenea vulgaris contains some West Coast

Strandveld and Sand Plain Lowland Fynbos communities (sensu Moll et al. 1984). Boucher (1987) classifies Sand Plain Lowland Fynbos communities within his Ehrharto-Phylicetalia cephalanthae Order.

Relevé habitat summary

Altitudinal range: 5 - 175 m.

Aspect: None to variable.

Slope: 0 - 40 degrees.

Substrate: Acidic, non-calcareous and alkaline, calcareous sand.

Soil drainage: Dry, free-draining and temporary moist soil.

Relevé vegetation summary

Vegetation cover: 50 - 100%.

Veld Types: Strandveld and Coastal Fynbos.

Number of strata: 2 - 4.

Species richness: 4 - 28.

Differential species: Ehrharta villosa, Passerina vulgaris, Metalasia muricata, Rhus laevigata, Helichrysum patulum, Ehrharta calycina, Willdenowia teres, Aspalathus hispida, Ficinia bulbosa, Pelargonium capitatum, Rhus lucida and Anthospermum aethiopicum.

SUBCLASS: Ehrharto-Tetragonienea fruticosae

This subclass is represented by communities 1-12.

This syntaxon is divided into two orders, viz.

(i) Tetragonio-Ruschietalia macowanii (indicators - Ruschia macowanii, Tetragonia fruticosa, Willdenowia incurvata and Chrysanthemoides incana).

(ii) Tetragonio-Ischyrolepidetalia eleocharis (indicator - Rhus glauca).

Relevé habitat summary

Altitudinal range: 5 - 77 m.

Aspect: None to variable.

Slope: 0 - 40 degrees.

Substrate: Acidic, non-calcareous and alkaline, calcareous sand.

Soil drainage: Dry, free-draining and temporary moist soil.

Relevé vegetation summary

Vegetation cover: 85 - 100%.

Veld Type: Strandveld.

Number of strata: 2 - 4.

Species richness: 4 - 24.

Differential species: Tetragonia fruticosa, Ruschia macowanii and Cynanchum africanum.

ORDER: TETRAGONIO-RUSCHIETALIA MACOWANII

This order is restricted to Rietvlei Flats. This unique Strandveld order occurs on acidic, non-calcareous sand, unlike all the other Strandveld communities encountered. It

is represented by communities 1-4.

The order is divided into two alliances, viz.

(i) Ruschio-Willdenowion incurvatae (indicator - Willdenowia incurvata).

(ii) Ruschio-Tetragonion fruticosae.

Relevé habitat summary

Altitude: 5 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 95 - 100%.

Veld Type: Strandveld.

Number of strata: 2 - 3.

Species richness: 4 - 16.

Differential species: None.

Dominant species: Ruschia macowanii and Tetragonia fruticosa.

ALLIANCE: Ruschio-Willdenowion incurvatae

This alliance is represented by communities 1-3.

It is divided into two associations, viz.

(i) Willdenowio-Ruschietum macowanii (indicator -

Willdenowia incurvata).

(ii) Willdenowio-Chrysanthemetum incanae.

Relevé habitat summary

Altitude: 5 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 95 - 100%.

Veld Type: Strandveld.

Number of strata: 3.

Species richness: 4 - 11.

Differential species: Willdenowia incurvata.

Dominant species: Willdenowia incurvata, Ruschia macowanii and Tetragonia fruticosa.

ASSOCIATION: Willdenowio-Ruschietum macowanii

This association is represented by communities 1 to 2.

It is sub-divided into two subassociations, viz.

(i) passerinetosum.

(ii) thamnochortetosum (indicator - Cynanchum africanum).

Relevés

Number: 5.

List: 130, 131, 132, 133 and 136.

Site: Rietvlei Flats.

Grid location: 3318 CD 15.

Relevé habitat summary

Altitude: 5 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 95 - 100%.

Veld Type: Strandveld.

Number of strata: 3.

Species richness: 4 - 8.

Dominant species: Willdenowia incurvata and Ruschia macowanii.

SUBASSOCIATION: passerinetosum

This subassociation is represented in the tables by community 1.

Relevés

Number: 3.

List: 130, 131 and 132.

Site: Rietvlei Flats.

Grid location: 3318 CD 15.

Map reference: W-Rmp.

Area: 5.8 ha.

Relevé habitat summary

Altitude: 5 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 98%.

Veld Type: Strandveld.

Number of strata: 3.

Species richness: 4 - 5 (average 5).

Differential species: Willdenowia incurvata.

Dominant species: Willdenowia incurvata and Ruschia macowanii.

Structural formation: Tall Mid-dense Restioland with a Low Sparse Succulent Shrub Understorey.

Structure: The tall, mid-dense, top layer mainly has aphyllous restioids. The low, sparse, restioid shrub layer has simple, evergreen, succulent nanophyll leaves. The very sparse, dwarf, ground layer has simple and compound, evergreen, orthophyllous leptophyll, succulent nanophyll to microphyll leaves and prostrate stems.

SUBASSOCIATION: thamnochortetosum

This subassociation is represented by community 2.

Relevés

Number: 2.

List: 133 and 136.

Site: Rietvlei Flats.

Grid location: 3318 CD 15.

Map reference: W-Rmt.

Area: 0.87 ha.

Relevé habitat summary

Altitude: 5 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 98%.

Veld Type: Strandveld.

Number of strata: 3.

Species richness: 7 - 8 (average 8).

Differential species: Willdenowia incurvata.

Dominant species: Willdenowia incurvata, Ruschia macowanii, Tetragonia fruticosa and Thamnochortus spicigerus.

Structural formation: Tall Closed Restioland with a Low

Open Succulent Shrub Understorey.

Structure: The tall, closed, top layer mainly has aphyllous restioids and spiny shrubs with simple, evergreen, sclerophyllous broad microphyll leaves. The low, open, restioid shrub layer mainly simple, evergreen, succulent leptophyll, sclerophyllous broad nanophyll and succulent nanophyll to mesophyll leaves and climbing stems. The very sparse, dwarf, bottom layer mainly has simple and compound, orthophyllous broad nanophyll, succulent microphyll and orthophyllous broad mesophyll leaves.

ASSOCIATION: Willdenowio-Chrysanthemetum incanae

This association is represented in the tables by community 3.

Relevés

Number: 3.

List: 134, 135 and 138.

Site: Rietvlei Flats.

Grid location: 3318 CD 15.

Map reference: W-Ci.

Area: 34.5 ha.

Relevé habitat summary

Altitude: 5 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 99%.

Veld Type: Strandveld.

Number of strata: 3.

Species richness: 7 - 11 (average 9).

Differential species: Willdenowia incurvata and Chrysanthemoides incana.

Dominant species: Willdenowia incurvata, Chrysanthemoides incana and Ruschia macowanii.

Structural formation: Tall Open Restioland/Low Open Shrubland.

Structure: The tall, open layer consists mainly of aphyllous restioids. The low, open, graminoid shrub layer mainly has simple, evergreen, succulent leptophyll, sclerophyllous broad nanophyll, succulent nanophyll and sclerophyllous broad microphyll leaves and spiny and climbing stems. The very sparse, dwarf, bottom layer consists mainly of compound, orthophyllous broad nanophyll leaves.

ALLIANCE: Ruschio-Tetragonion fruticosae

This is a monotypic alliance, containing the association Ruschio-Tetragonietum fruticosae. The alliance differs from the other alliance in this order by the general absence of

Willdenowia incurvata and the higher cover-abundance of Ruschia macowanii and Tetragonia fruticosa.

ASSOCIATION: Ruschio-Tetragonietum fruticosae

This association is represented by community 4.

Relevés

Number: 4.

List: 127, 128, 129 and 137.

Site: Rietvlei Flats.

Grid location: 3318 CD 15.

Map reference: R-Tf.

Area: 3.16 ha.

Relevé habitat summary

Altitude: 5 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 97%.

Veld Type: Strandveld.

Number of strata: 2.

Species richness: 7 - 16 (average 9).

Differential species: Chrysanthemoides incana.

Dominant species: Ruschia macowanii, Tetragonia fruticosa and Aspalathus hispida.

Structural formation: Low Closed Succulent Shrubland.

Structure: The low, closed, shrub layer mainly has simple, evergreen, sclerophyllous cupressoid leptophyll, broad orthophyllous to sclerophyllous nanophyll and succulent nanophyll leaves. The very sparse, dwarf, bottom layer mainly has simple and compound, orthophyllous broad nanophyll to succulent nanophyll leaves and prostrate stems.

SUBCLASS: Ehrharto-Tetragonienea fruticosae

ORDER: Tetragonio-Ischyrolepidetalia eleocharis

This order is represented by communities 5-12. Boucher's (1987) Eucleo-Ischyrolepion eleocharidis Alliance (especially the Ischyrolepo-Oleetum exasparatae, Ischyrolepo-Kedrostietum nanae, Ischyrolepo-Iflogetum ambiguae, Ischyrolepo-Myricetum cordifoliae, Ischyrolepo-Crassuletum subulatae and Ischyrolepo-Cullumietum squarrosae associations) represents similar communities, with common differential and dominant species such as Ischyrolepis eleocharis, Phylica ericoides, Otholobium fruticans, Euclea racemosa, Metalasia muricata and Rhus glauca.

The order is divided into two alliances, viz.

(i) Ischyrolepido-Eucleion racemosae (indicators - Euclea racemosa and Olea exasperata).

(ii) Ischyrolepido-Passerinion rigidae (indicators - Passerina rigida, Metalasia muricata, Ischyrolepis eleocharis and Rhus laevigata).

Relevé habitat summary

Altitudinal range: 5 - 77 m.

Aspect: None to various.

Slope: 0 - 40 degrees.

Substrate: Alkaline, calcareous sand.

Soil drainage: Dry, free-draining and temporary moist soil.

Relevé vegetation summary

Vegetation cover: 85 - 100%.

Veld Type: Strandveld.

Number of strata: 2 - 4.

Species richness: 4 - 24.

Differential species: Ischyrolepis eleocharis, Passerina rigida, Chrysanthemoides monilifera, Otholobium fruticans, Zygophyllum flexuosum, Protasparagus capensis and Ifloga repens.

ALLIANCE: Ischyrolepido-Eucleion racemosae

This alliance is represented by communities 5-8.

It is divided into two associations, viz.

(i) Eucleo-Protasparagetum compacti (indicators - Rhus crenata, Protasparagus compactus and Ehrharta villosa).

(ii) Eucleo-Oleetum exasperatae.

Relevé habitat summary

Altitudinal range: 5 - 77 m.

Aspect: None to various.

Slope: 0 to 40 degrees.

Substrate: Alkaline, calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 85 - 100%.

Veld Type: Strandveld.

Number of strata: 2 - 4.

Species richness: 5 - 23.

Differential species: Olea exasperata, Thamnochortus spicigerus and Kedrostis nana.

Dominant species: Rhus glauca, Euclea racemosa, Olea exasperata, Salvia africana-lutea and Pterocelastrus tricuspidatus.

ASSOCIATION: Eucleo-Protasparagetum compacti

This association is represented by communities 5-6.

It is subdivided into two subassociations, viz.

(i) salvietosum (indicator - Salvia africana-lutea).

(ii) cynanchetosum (indicators - Ehrharta villosa and Rhus glauca).

Relevés

Number: 10.

List: 95, 96, 98, 99, 100, 106, 97, 160, 162 and 181.

Sites: Macassar Dunes, Rondevlei Nature Reserve and Driftsands Nature Reserve.

Grid location: 3418 BB 6, 3418 AB 10, 3418 BA 4 and 3418 BA 6.

Relevé habitat summary

Altitudinal range: 10 - 50 m.

Aspect: None to NE, ENE, SSW, NNE, WSW and ESE.

Slope: 0 to 32 degrees.

Substrate: Alkaline, calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 95 - 100%.

Veld Type: Strandveld.

Number of strata: 3 - 4.

Species richness: 9 - 17.

Differential species: None.

Dominant species: Rhus glauca and Euclea racemosa.

SUBASSOCIATION: salvietosum

This subassociation is represented in the tables by community 5. It occurs only at Macassar Dunes, where it occupies a position along the lower dune slopes.

Relevés

Number: 6.

List: 95, 96, 98, 99, 100 and 106.

Site: Macassar Dunes.

Grid location: 3418 BB 6.

Map reference: E-Pcs.

Area: 1.37 ha.

Relevé habitat summary

Altitudinal range: 15 - 50 m.

Aspect: NE, ENE, SSW and NNE.

Slope: 10 to 32 degrees.

Substrate: Alkaline, calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 99%.

Veld Type: Stranveld.

Number of strata: 3 - 4.

Species richness: 12 - 17 (average 15).

Differential species: Protasparagus compactus, Rhus crenata, Sideroxylon inerme, Euphorbia mauritanica, Cynanchum obtusifolium and Putterlickia pyracantha.

Dominant species: Rhus crenata, Sideroxylon inerme, Rhus glauca, Salvia africana-lutea and Euclea racemosa.

Structural formation: Mid-high Mid-dense to Tall Open Large-leaved Shrubland.

Structure: The tall, open, shrub layer mainly has simple, evergreen, sclerophyllous broad microphyll leaves. The mid-high, mid-dense, restioid shrub layer (sometimes the top layer) mainly has simple and compound, evergreen, sclerophyllous broad nanophyll to microphyll leaves and climbing stems. The low, very sparse, graminoid shrub layer mainly has simple and compound, evergreen, orthophyllous narrow nanophyll, sclerophyllous broad nanophyll and sclerophyllous broad microphyll leaves and succulent stems. The dwarf, very sparse, ground layer mainly has simple and compound, evergreen, orthophyllous to succulent leptophyll and orthophyllous broad mesophyll leaves.

SUBASSOCIATION: cynanchetosum

This subassociation is represented by community 6. The differential species of the salvietosum are generally lacking in this subassociation while Cynanchum africanum is found almost throughout.

Relevés

Number: 4.

List: 97, 160, 162 and 181.

Sites: Macassar Dunes, Driftsands Nature Reserve and Rondevlei Nature Reserve.

Grid location: 3418 BB 6, 3418 BA 4 and 3418 BA 6.

Map reference: E-Pcc.

Area: 14.5 ha.

Relevé habitat summary

Altitudinal range: 10 - 40 m.

Aspect: None to ENE, WSW and ESE.

Slope: 0 to 30 degrees.

Substrate: Alkaline, calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 99%.

Veld Type: Strandveld.

Number of strata: 4.

Species richness: 9 - 13 (average 11).

Differential species: None.

Dominant species: Rhus glauca and Euclea racemosa.

Structural formation: Mid-high to Tall Open Large-leaved Shrubland.

Structure: The tall, open, shrub stratum mainly has simple and compound, evergreen, sclerophyllous broad nanophyll to microphyll leaves and climbing stems. The mid-high, open, shrub stratum mainly has simple and compound, evergreen, sclerophyllous broad nanophyll, orthophyllous narrow and broad microphyll, and sclerophyllous broad microphyll leaves and climbing stems. The low, sparse, shrub stratum mainly has simple and compound, evergreen, sclerophyllous broad nanophyll, succulent nanophyll, orthophyllous narrow

to sclerophyllous broad microphyll and orthophyllous broad mesophyll leaves and spiny and climbing stems. The dwarf, very sparse, bottom layer mainly has simple and compound, orthophyllous leptophyll and orthophyllous broad mesophyll leaves.

ASSOCIATION: Eucleo-Oleetum exasperatae

This association is represented by communities 7 and 8.

It is subdivided into two subassociations, viz.

(i) ericetosum (indicators - Erica coccinea, Cassine peragua and Chironia baccifera).

(ii) kedrostietosum.

Relevés

Number: 30.

List: See relevant subassociations.

Sites: Macassar Dunes, Rondevlei Nature Reserve, Wolfgat Nature Reserve, Rocklands Dune, Cape Flats Nature Reserve, Mitchell's Plain-Khayelitsha Flats, Strandfontein-Mnandi Coastal Dunes, Pelikan Park-Zeekoevlei Flats and Driftsands Nature Reserve.

Grid location: 3418 BB 6, 3418 AB 10, 3418 BA 8, 3418 BA 7, 3318 DC 18, 3418 BA 3, 3418 BA 10, 3418 BA 6 and 3418 BA 4.

Relevé habitat summary

Altitudinal range: 5 - 77 m.

Aspect: None to NE, SSW, SW, WSW and SW.

Slope: 0 to 40 degrees.

Substrate: Alkaline, calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 85 - 100%.

Veld Type: Strandveld.

Number of strata: 2 - 4.

Species richness: 5 - 23.

Differential species: None.

Dominant species: Olea exasperata, Rhus glauca, Euclea racemosa, Pterocelastrus tricuspidatus and Rhus lucida.

SUBASSOCIATION: ericetosum

This subcommunity is represented by community 7. It is associated with the presence of limestone outcrops on dune slopes in Macassar.

Relevés

Number: 6.

List: 102, 103, 104, 107, 108 and 109.

Site: Macassar Dunes.

Grid location: 3418 BB 6.

Map reference: E-Oee.

Area: 2.35 ha.

Relevé habitat summary

Altitudinal range: 45 - 77 m.

Aspect: SSW, SW and NE.

Slope: 10 to 26 degrees.

Substrate: Alkaline, calcareous dune sand (associated with limestone outcrops).

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 97%.

Veld Type: Strandveld.

Number of strata: 2 - 3.

Species richness: 12 - 20 (average 16).

Differential species: Erica coccinea, Cassine peragua, Chironia baccifera and Cliffortia obcordata.

Dominant species: Olea exasperata, Pterocelastrus tricuspidatus, Erica coccinea, Cassine peragua, Rhus glauca, Thamnochortus spicigerus and Ischyrolepis eleocharis.

Structural formation: Low Mid-dense to Mid-high Sparse Shrubland.

Structure: The mid-high, sparse, shrub layer (not always present) mainly has simple, evergreen, sclerophyllous broad microphyll leaves and climbing stems. The low, mid-dense, restioid shrub layer mainly has simple and compound, evergreen, sclerophyllous cupressoid leptophyll, orthophyllous narrow nanophyll and sclerophyllous narrow and broad microphyll leaves.

The dwarf, very sparse, restioid shrub ground layer mainly has simple, evergreen, orthophyllous narrow nanophyll to microphyll leaves.

SUBASSOCIATION: kedrostietosum

This subassociation is represented by community 8. It is the most widespread community in the study area.

Relevés

Number: 24.

List: 67, 68, 69, 70, 79, 81, 82, 84, 89, 93, 94, 101, 105, 112, 113, 121, 122, 124, 139, 148, 172, 174, 175 and 176.

Sites: Wolfgat Nature Reserve, Rocklands Dune, Cape Flats Nature Reserve Extension, Mitchell's Plain-Khayelitsha Flats, Macassar Dunes, Strandfontein-Mnandi Coastal Dunes, Pelikan Park-Zeekoevlei Flats, Driftsands Nature Reserve and Rondevlei Nature Reserve.

Grid location: 3418 BA 8, 3418 BA 7, 3318 DC 18, 3418 BA 3, 3418 BB 6, 3418 BA 10, 3418 BA 6 and 3418 BA 4.

Map reference: E-Oek.

Area: 587.7 ha.

Relevé habitat summary

Altitudinal range: 5 - 75 m.

Aspect: None to NE, SSW, SW and WSW.

Slope: 0 to 40 degrees.

Substrate: Alkaline, calcareous dune sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 99%.

Veld Type: Strandveld.

Number of strata: 2 - 4.

Species richness: 5 - 23 (average 11).

Differential species: None.

Dominant species: Rhus glauca, Euclea racemosa, Pterocelastrus tricuspidatus (at some sites only) and Olea exasperata.

Structural formation: Low Open to Mid-high Mid-dense Large-leaved Shrubland (sometimes with a Tall Open Large-leaved Shrub Overstorey).

Structure: The tall, open, shrub layer (where present) mainly has simple and compound, evergreen, sclerophyllous broad nanophyll to microphyll leaves and climbing stems. The mid-high, mid-dense, shrub layer (where present) mainly has simple and compound, evergreen, sclerophyllous broad microphyll leaves and climbing stems. The low, open, shrub layer (sometimes the top layer) mainly has simple and compound, evergreen, sclerophyllous broad nanophyll to microphyll leaves. The dwarf, very sparse, restioid shrub layer (where present) mainly has simple, orthophyllous narrow nanophyll leaves.

ALLIANCE: Ischyrolepido-Passerinion rigidae

This alliance is represented by communities 9-12.

It is divided into two associations, viz.

(i) Passerino-Phylicetum ericoidis (indicators - Phylica ericoides, Rhus glauca, Euclea racemosa, Passerina rigida, Helichrysum patulum and Indigofera brachystachya).

(ii) Passerino-Rhoetum laevigatae (indicator - Rhus laevigata).

The Passerino-Rhoetum laevigatae includes some of the communities occurring in temporary moist depressions between alkaline, calcareous dune ridges.

Relevé habitat summary

Altitudinal range: 5 - 60 m.

Aspect: None to various.

Slope: 0 to 36 degrees.

Substrate: Alkaline, calcareous dune sand.

Soil drainage: Dry, free-draining and temporary moist, water-retentive soil.

Relevé vegetation summary

Vegetation cover: 85 - 100%.

Veld Type: Strandveld.

Number of strata: 2 - 3.

Species richness: 5 - 24.

Differential species: None.

Dominant species: Rhus laevigata, Passerina rigida, Metalasia muricata and Ischyrolepis eleocharis.

ASSOCIATION: Passerino-Phylicetum ericoidis

This association is subdivided into two subassociations, communities 9 and 10, viz.

(i) indigoferetosum (indicators - Passerina rigida and Phylica ericoides).

(ii) cullumietosum.

Relevés

Number: 29.

List: See relevant subassociations.

Sites: Wolfgat Nature Reserve, Rocklands Dune, Macassar Dunes, Strandfontein-Mnandi Coastal Dunes, Pelikan Park-Zeekoevlei Flats, Cape Flats Nature Reserve Extension, Mitchell's Plain-Khayelitsha Flats and Driftsands Nature Reserve.

Grid location: 3418 BA 8, 3418 BA 7, 3418 BA 10 and 3418 BA 6.

Relevé habitat summary

Altitudinal range: 7 - 65 m.

Aspect: None to W, SW, SE, SSE, NE, ENE, WNW and SSW.

Slope: 0 to 36 degrees.

Substrate: Alkaline, calcareous dune sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 95 - 100%.

Veld Type: Strandveld.

Number of strata: 2 - 3.

Species richness: 8 - 24.

Differential species: See relevant subassociations.

Dominant species: Rhus glauca, Metalasia muricata, Ischyrolepis eleocharis, Euclea racemosa and Helichrysum patulum.

SUBASSOCIATION: indigoferetosum

This subassociation is represented by community 9. This community contains the highest number of relevés and is one of the most extensive communities in the study area. Boucher's (1987) Erico-Aspalathion Alliance (Order Ehrharto-Ericetalia coarctatae) represents similar communities to those recorded at the Macassar Dunes and Wolfgat Nature Reserve, with common differential and dominant species such as Erica coarctata, Indigofera brachystachya, Lightfootia tenella and Ischyrolepis eleocharis.

Relevés

Number: 26.

List: 62, 63, 64, 65, 66, 72, 73, 74, 75, 76, 80, 110, 111, 114, 115, 116, 117, 123, 125, 126, 140, 141, 142, 143, 144 and 145.

Sites: Wolfgat Nature Reserve, Rocklands Dune, Macassar

Dunes, Strandfontein-Mnandi Coastal Dunes and Pelikan Park-Zeekoevlei Flats.

Grid location: 3418 BA 8, 3418 BA 7, 3418 BA 10 and 3418 BA 6.

Map reference: P-Pei.

Area: 87.86 ha.

Relevé habitat summary

Altitudinal range: 7 - 65 m.

Aspect: None to W, SW, SE, SSE, NE, ENE and WNW.

Slope: 0 to 36 degrees.

Substrate: Alkaline, calcareous dune sand (associated with limestone outcrops at Wolfgat Nature Reserve and Macassar Dunes).

Soil drainage: Dry, free-draining (very seldom temporary moist) soil.

Relevé vegetation summary

Vegetation cover: average 97%.

Veld Type: Strandveld.

Number of strata: 2 - 3.

Species richness: 10 - 24 (average 16).

Differential species: Indigofera brachystachya, Lightfootia tenella, Erica coarctata (only at Wolfgat Nature Reserve and Macassar Dunes) and Anthospermum prostratum.

Dominant species: Passerina rigida, Metalasia muricata,

Rhus glauca, Indigofera brachystachya, Ischyrolepis eleocharis, Euclea racemosa, Phylica ericoides and Salvia africana-lutea.

Structural formation: Low Mid-dense to Mid-high Sparse Shrubland.

Structure: The mid-high, sparse, shrub layer (where present) mainly has simple, evergreen, sclerophyllous cupressoid leptophyll and sclerophyllous broad microphyll leaves. The low, mid-dense, graminoid shrub layer (often the top layer) mainly has simple and compound, evergreen, sclerophylloys cupressoid leptophyll, orthophyllous narrow to sclerophyllous broad nanophyll and sclerophyllous broad microphyll leaves. The dwarf, sparse, restioid shrub layer mainly has simple, sclerophyllous cupressoid leptophyll, orthophyllous narrow nanophyll and succulent nanophyll to microphyll leaves and prostrate stems.

SUBASSOCIATION: cullumietosum

This subassociation is represented by community 10. This community is restricted to the Strandfontein-Mnandi Coastal Dunes. The Ischyrolepo-Cullumietum squarrosae Association of Boucher (1987) is similar to this community, with common differential and common species such as Cullumia squarrosa and Ischyrolepis eleocharis.

Relevés

Number: 3.

List: 118, 119 and 120.

Site: Strandfontein-Mnandi Coastal Dunes.

Grid location: 3418 BA 8.

Map reference: P-Pec.

Area: 6.9 ha.

Relevé habitat summary

Altitudinal range: 15 - 17 m.

Aspect: SW and SSW.

Slope: 12 - 16 degrees.

Substrate: Alkaline, calcareous dune sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 98%.

Veld Type: Strandveld.

Number of strata: 2.

Species richness: 8 - 14 (average 10).

Differential species: Cullumia squarrosa.

Dominant species: Cullumia squarrosa, Helichrysum patulum, Ischyrolepis eleocharis and Euclea racemosa.

Structural formation: Low Closed Shrubland.

Structure: The low, closed, restioid shrub layer mainly has simple and compound, evergreen, sclerophyllous cupressoid leptophyll, orthophyllous narrow nanophyll, sclerophyllous narrow to broad nanophyll, orthophyllous narrow to sclerophyllous broad

microphyll leaves. The dwarf, sparse, graminoid shrub layer mainly has simple, orthophyllous narrow nanophyll leaves.

ASSOCIATION: Passerino-Rhoetum laevigatae

This association is represented by communities 11 to 12.

It is subdivided into two subassociations, viz.

(i) willdenowietosum.

(ii) ficinietosum (indicator - Ficinia dunensis).

Relevés

Number: 14.

List: 71, 83, 85, 90, 91, 92, 149, 150, 161, 166, 167, 168, 169 and 170.

Sites: Wolfgat Nature Reserve, Cape Flats Nature Reserve Extension, Mitchell's Plain-Khayelitsha Flats, Pelikan Park-Zeekoevlei Flats and Driftsands Nature Reserve.

Grid location: 3418 BA 8, 3318 DC 18, 3418 BA 3, 3418 BA 6, 3418 BA 4 and 3318 DC 23.

Relevé habitat summary

Altitudinal range: 5 - 50 m.

Aspect: None to NE.

Slope: 0 to 10 degrees.

Substrate: Alkaline, calcareous sand.

Soil drainage: Dry, free-draining and temporary moist, water-retentive soil.

Relevé vegetation summary

Vegetation cover: 85 - 100%.

Veld Type: Strandveld.

Number of strata: 2 - 3.

Species richness: 4 - 14.

Differential species: None.

Dominant species: Rhus laevigata, Ischyrolepis eleocharis and Ehrharta villosa.

SUBASSOCIATION: willdenowietosum

This subassociation is represented by community 11.

Relevés

Number: 10.

List: 71, 83, 85, 90, 91, 92, 149, 150, 161 and 166.

Sites: Wolfgat Nature Reserve, Cape Flats Nature Reserve Extension, Mitchell's Plain-Khayelitsha Flats, Pelikan Park-Zeekoevlei Flats and Driftsands Nature Reserve.

Grid location: 3418 BA 8, 3318 DC 18, 3418 BA 3, 3418 BA 6 and 3418 BA 4.

Map reference: P-Rlw.

Area: 6.1 ha.

Relevé habitat summary

Altitudinal range: 5 - 50 m.

Aspect: None to NE.

Slope: 0 to 10 degrees.

Substrate: Alkaline, calcareous sand.

Soil drainage: Dry, free-draining and temporary moist, water-retentive soil.

Relevé vegetation summary

Vegetation cover: average 98%.

Veld Type: Strandveld.

Number of strata: 2 - 3.

Species richness: 5 - 13 (average 9).

Differential species: None.

Dominant species: Rhus laevigata, Willdenowia teres, Ischyrolepis eleocharis, Ehrharta villosa and Aspalathus hispida.

Structural formation: Low Mid-dense to Mid-high Open Shrubland.

Structure: The mid-high, open, shrub layer mainly has simple and compound, deciduous, sclerophyllous broad microphyll leaves. The low, mid-dense, restioid shrub layer mainly has simple and compound, evergreen and deciduous, sclerophyllous cupressoid leptophyll and sclerophyllous broad microphyll leaves. The dwarf, very sparse, restioid shrub bottom layer mainly has simple and compound, orthophyllous leptophyll leaves and prostrate stems.

SUBASSOCIATION: ficinietosum

This subassociation is represented by community 12.

Relevés

Number: 4.

List: 167, 168, 169 and 170.

Site: Driftsands Nature Reserve.

Grid location: 3418 BA 4 and 3318 DC 23.

Map reference: P-R1f.

Area: 13.92 ha.

Relevé habitat summary

Altitudinal range: 25 - 35 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Alkaline, calcareous sand.

Soil drainage: Temporary moist, water-retentive and dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 93%.

Veld Type: Strandveld.

Number of strata: 3.

Species richness: 10 - 14 (average 13).

Differential species: Ficinia dunensis, Nylandtia spinosa and Helichrysum niveum.

Dominant species: Rhus laevigata, Ischyrolepis eleocharis, Anthospermum aethiopicum, Metalasia muricata and Passerina rigida.

Structural formation: Low Mid-dense to Mid-high Sparse

Shrubland.

Structure: The mid-high, sparse, shrub layer mainly has simple, evergreen, orthophyllous to sclerophyllous cupressoid leptophyll leaves. The low, mid-dense, graminoid shrub layer mainly has simple and compound, evergreen and deciduous, orthophyllous to sclerophyllous cupressoid leptophyll, orthophyllous broad nanophyll, orthophyllous narrow microphyll, sclerophyllous broad microphyll and orthophyllous narrow mesophyll leaves and spiny stems. The dwarf, sparse, graminoid shrub layer mainly has simple and compound, orthophyllous leptophyll to broad nanophyll leaves.

SUBCLASS: Ehrharto-Passerinenea vulgaris

This subclass is represented by communities 13 to 25. It includes all the communities occurring on acidic, non-calcareous sand and most of the communities occurring in temporary moist, water-retentive habitats. According to Moll et al. (1984) these communities are referred to as Sand Plain Lowland Fynbos and West Coast Strandveld, respectively [Acocks' (1975, 1988) Coastal Fynbos and Strandveld Veld Types].

This subclass is divided into two orders, viz.

(i) Passerino-Chondropetaletalia tectorum (indicators - Chondropetalum tectorum, Senecio halimifolius and Imperata cylindrica).

(ii) Passerino-Cliffortietalia falcatae (indicators - Passerina vulgaris, Thamnochortus lucens, Phylica cephalantha and Cliffortia falcata).

Relevé habitat summary

Altitudinal range: 4 - 175 m.

Aspect: None to WSW.

Slope: 0 to 14 degrees.

Substrate: Alkaline, calcareous sand and (mostly) acidic, non-calcareous sand.

Soil drainage: Temporary moist, water-retentive and dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 50 - 100%.

Veld Type: Strandveld and Coastal Fynbos.

Number of strata: 2 - 4.

Species richness: 3 - 28.

Differential species: Cynodon dactylon, Stenotaphrum secundatum, Thesium spicatum, Stoebe plumosa and Pelargonium triste.

ORDER: Passerino-Chondropetaletalia tectorum

This order is represented by communities 13 to 19. It includes most of the communities associated with temporary moist, water-retentive habitats.

The order is divided into two alliances, viz.

(i) Chondropetalo-Imperation cylindricae (indicator - Imperata cylindrica).

(ii) Chondropetalo-Cynodontion dactyli.

Relevé habitat summary

Altitudinal range: 4 - 111 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Alkaline, calcareous and acidic, non-calcareous sand.

Soil drainage: Temporary moist, water-retentive and dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 60 - 100%.

Veld Type: Strandveld and Coastal Fynbos.

Number of strata: 2 - 3.

Species richness: 3 - 17.

Differential species: None.

Dominant species: Passerina vulgaris, Cynodon dactylon and Stenotaphrum secundatum.

ALLIANCE: Chondropetalo-Imperation cylindricae

This alliance is represented by communities 13 to 15.

It is divided into two associations, viz.

(i) Imperato-Metalasietum muricatae.

(ii) Imperato-Chondropetaletum tectorum (indicator - Chondropetalum tectorum).

Relevé habitat summary

Altitudinal range: 5 - 50 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Alkaline, calcareous and acidic, non-calcareous sand.

Soil drainage: Temporary moist, water-retentive and dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 90 - 100%.

Veld Type: Strandveld and Coastal Fynbos.

Number of strata: 2 - 3.

Species richness: 3 - 11.

Differential species: Imperata cylindrica.

Dominant species: Imperata cylindrica and Rhus laevigata.

ASSOCIATION: Imperato-Metalasietum muricatae

This association is represented by communities 13 to 14.

It is subdivided into two subassociations, viz.

(i) passerinetosum (indicator - Ischyrolepis eleocharis).

(ii) rhoetosum.

Relevés

Number: 7.

List: 164, 165, 46, 86, 87, 88 and 171.

Sites: Driftsands Nature Reserve, Sixth Base Ordinance Depot and Cape Flats Nature Reserve Extension.

Grid location: 3418 BA 4, 3318 DC 11, 3318 DC 18 and 3318 DC 24.

Relevé habitat summary

Altitudinal range: 20 - 50 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Alkaline, calcareous and acidic, non-calcareous sand.

Soil drainage: Temporary moist, water-retentive and dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 90 - 100%.

Veld Type: Strandveld and Coastal Fynbos.

Number of strata: 2 - 3.

Species richness: 3 - 10 (average 7).

Differential species: None.

Dominant species: Imperata cylindrica and Rhus laevigata.

SUBASSOCIATION: passerinetosum

This subassociation is represented by community 13.

Relevés

Number: 2.

List: 164 and 165.

Site: Driftsands Nature Reserve.

Grid location: 3418 BA 4.

Map reference: I-Mmp.

Area: 1.05 ha.

Relevé habitat summary

Altitude: 20 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Alkaline, calcareous sand.

Soil drainage: Temporary moist, water-retentive soil.

Relevé vegetation summary

Vegetation cover: average 95%.

Veld Type: Strandveld.

Number of strata: 3.

Species richness: 8 - 10 (average 9).

Differential species: None.

Dominant species: Imperata cylindrica, Passerina vulgaris, Ischyrolepis eleocharis, Anthospermum aethiopicum, Ehrharta villosa and Rhus laevigata.

Structural formation: Mid-dense Grassland with a Mid-high Sparse Shrub Overstorey.

Structure: The mid-high, sparse, graminoid shrub layer

mainly has simple, evergreen and deciduous, orthophyllous to sclerophyllous cupressoid leptophyll, orthophyllous narrow microphyll to sclerophyllous broad microphyll leaves. The low, mid-dense, shrub grass layer mainly has simple, evergreen, orthophyllous to sclerophyllous cupressoid leptophyll, orthophyllous broad nanophyll, orthophyllous narrow microphyll and mesophyll leaves. The dwarf, sparse, restioid shrub layer mainly has simple, orthophyllous leptophyll and orthophyllous narrow mesophyll leaves and prostrate stems.

SUBASSOCIATION: rhoetosum

This subassociation is represented by community 14.

Relevés

Number: 5.

List: 46, 86, 87, 88 and 171.

Sites: Sixth Base Ordinance Depot, Cape Flats Nature Reserve Extension and Driftsands Nature Reserve.

Grid location: 3318 DC 11, 3318 DC 18 and 3318 DC 24.

Map reference: I-Mmr.

Area: 56.33 ha.

Relevé habitat summary

Altitudinal range: 20 - 50 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous and alkaline, calcareous sand.

Soil drainage: Dry, free-draining and temporary moist, water-retentive soil.

Relevé vegetation summary

Vegetation cover: average 98%.

Veld Type: Coastal Fynbos and Strandveld.

Number of strata: 2 - 3.

Species richness: 3 - 9 (average 7).

Differential species: None.

Dominant species: Imperata cylindrica and Rhus laevigata.

Structural formation: Closed Grassland (sometimes with a Mid-high Emergent Shrub Overstorey).

Structure: The mid-high, emergent, shrub stratum mainly has simple, evergreen, sclerophyllous cupressoid leptophyll leaves. The low, closed, shrub grass layer mainly has simple and compound, evergreen and deciduous, sclerophyllous broad microphyll and orthophyllous narrow mesophyll leaves and aphyllous restioids. The dwarf, very sparse, graminoid bottom layer mainly has simple, orthophyllous narrow nanophyll to microphyll leaves.

ASSOCIATION: Imperato-Chondropetaletum tectorum

This association is represented by community 15.

Relevés

Number: 3.

List: 146, 147 and 173.

Sites: Pelikan Park-Zeekoevlei Flats and Driftsands Nature Reserve.

Grid location: 3418 BA 6 and 3418 BA 4.

Map reference: I-Ct.

Area: 1.9 ha.

Relevé habitat summary

Altitudinal range: 5 - 20 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Alkaline, calcareous sand.

Soil drainage: Temporary moist, water-retentive soil.

Relevé vegetation summary

Vegetation cover: average 98%.

Veld Type: Strandveld.

Number of strata: 2 - 3.

Species richness: 5 - 11 (average 7).

Differential species: None.

Dominant species: Imperata cylindrica, Chondropetalum tectorum and Senecio halimifolius.

Structural formation: Mid-dense Grassland (sometimes with a Tall Open Restioid Overstorey).

Structure: The tall, open layer mainly has aphyllous

restioids. The low, mid-dense, shrub grass layer mainly has simple, sclerophyllous cupressoid leptophyll, sclerophyllous broad microphyll and orthophyllous narrow mesophyll leaves. The dwarf, very sparse, graminoid bottom layer mainly has simple, orthophyllous narrow nanophyll leaves and prostrate stems.

ALLIANCE: Chondropetalo-Cynodontion dactyli

This alliance is represented by communities 16 to 19.

It is divided into two associations, viz.

(i) Cynodonto-Chondropetaletum tectorum (indicator - Chondropetalum tectorum).

(ii) Stenotaphro-Juncetum krausii (indicator - Helichrysum patulum).

Relevé habitat summary

Altitudinal range: 4 - 111 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous and alkaline, calcareous sand.

Soil drainage: Temporary moist, water-retentive and dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 60 - 100%.

Veld Type: Coastal Fynbos and Strandveld.

Number of strata: 2 - 3.

Species richness: 4 - 17.

Differential species: None.

Dominant species: Chondropetalum tectorum and Cynodon dactylon.

ASSOCIATION: Cynodonto-Chondropetaletum tectorum

This association is represented by communities 16 and 17.

It is subdivided into two subassociations, viz.

(i) leucadendretosum (indicator - Chondropetalum tectorum).

(ii) juncetosum (indicators - Passerina vulgaris and Juncus krausii).

Relevés

Number: 16.

List: See relevant subassociations.

Sites: Milnerton Racecourse, Sixth Base Ordinance Depot, N7/N1 Interchange, Rondebosch Commonage and Driftsands Nature Reserve.

Grid location: 3318 DC 11, 3318 CD 25 and 3418 BA 4.

Relevé habitat summary

Altitudinal range: 14 - 25 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous and alkaline, calcareous sand.

Soil drainage: Temporary moist, water-retentive and dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 75 - 100%.

Veld Type: Coastal Fynbos and Strandveld.

Number of strata: 2 - 3.

Species richness: 5 - 17.

Differential species: None.

Dominant species: Chondropetalum tectorum.

SUBASSOCIATION: leucadendretosum

This subassociation is represented by community 16.

Relevés

Number: 9.

List: 13, 14, 15, 16, 18, 19, 45, 50 and 51.

Sites: Milnerton Racecourse, Sixth Base Ordinance Depot and N7/N1 Interchange.

Grid location: 3318 DC 11.

Map reference: C-Ctl.

Area: 21.5 ha.

Relevé habitat summary

Altitudinal range: 14 - 20 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Temporary moist, water-retentive and dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 85 - 100%.

Veld Type: Coastal Fynbos.

Number of strata: 2 - 3.

Species richness: 5 - 16 (average 10).

Differential species: Leucadendron levisanus, Orphium frutescens and Cliffortia ericifolia (only at Milnerton Racecourse).

Dominant species: Chondropetalum tectorum, Leucadendron levisanus and Cynodon dactylon.

Structural formation: Low to Mid-high Open Restioid Shrubland.

Structure: The mid-high, open, restioid shrub layer mainly has simple, evergreen, orthophyllous and sclerophyllous leptophyll and nanophyll leaves. The low, open, restioid shrub layer mainly has simple, evergreen, orthophyllous and sclerophyllous cupressoid leptophyll and orthophyllous narrow microphyll leaves. The dwarf, sparse, grassy, ground layer mainly has simple, orthophyllous narrow nanophyll to microphyll leaves and prostrate stems.

SUBASSOCIATION: juncetosum

This subassociation is represented by community 17.

Relevés

Number: 7.

List: 23, 37, 42, 43, 48, 49 and 163.

Sites: Rondebosch Commonage, Sixth Base Ordinance Depot, N7/N1 Interchange and Driftsands Nature Reserve.

Grid location: 3318 CD 25, 3318 DC 11 and 3418 BA 4.

Map reference: C-Ctj.

Area: 3.37 ha.

Relevé habitat summary

Altitudinal range: 18 - 25 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous and alkaline, calcareous sand.

Soil drainage: Dry, free-draining and temporary moist, water-retentive soil.

Relevé vegetation summary

Vegetation cover: average 85%.

Veld Type: Coastal Fynbos and Strandveld.

Number of strata: 2 - 3.

Species richness: 7 - 17 (average 11).

Differential species: None.

Dominant species: Chondropetalum tectorum, Passerina vulgaris, Stenotaphrum secundatum and Juncus krausii.

Structural formation: Low to Mid-high Open Graminoid Shrubland.

Structure: The mid-high, open, restioid shrub stratum mainly has simple, evergreen, sclerophyllous cupressoid leptophyll to sclerophyllous broad microphyll leaves. The low, open, graminoid shrub stratum mainly has simple and compound, evergreen, sclerophyllous cupressoid leptophyll to orthophyllous narrow nanophyll leaves. The dwarf, very sparse, grassy, bottom layer mainly has simple, orthophyllous narrow nanophyll to microphyll leaves.

ASSOCIATION: Stenotaphro-Juncetum krausii

This association is represented by communities 18 and 19. It differs from the foregoing association (Cynodonto-Chondropetaletum tectorum) in the general abundance of Stenotaphrum secundatum and the lower constancy of Cynodon dactylon.

It is subdivided into two subassociations, viz.

(i) senecionetosum.

(ii) cynodontetosum (indicator - Cynodon dactylon).

Relevés

Number: 9.

List: See relevant subassociations.

Sites: Kenilworth Racecourse, Rondevlei Nature Reserve, Rondebosch Commonage and Kraaifontein Forest Reserve.

Grid location: 3318 CD 25, 3418 BA 6, 3418 AB 10 and 3318 DC 10.

Relevé habitat summary

Altitudinal range: 4 - 111 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous and alkaline, calcareous sand.

Soil drainage: Dry, free-draining and (mostly) temporary moist, water-retentive soil.

Relevé vegetation summary

Vegetation cover: 60 - 100%.

Veld Type: Coastal Fynbos and Strandveld.

Number of strata: 2 - 3.

Species richness: 4 - 13.

Differential species: None.

Dominant species: Stenotaphrum secundatum.

SUBASSOCIATION: senecionetosum

This subassociation is represented by community 18.

Relevés

Number: 6.

List: 53, 58, 177, 178, 179 and 180.

Sites: Kenilworth Racecourse and Rondevlei Nature Reserve.

Grid location: 3318 CD 25, 3418 BA 6 and 3418 AB 10.

Map reference: S-Jks.

Area: 2.9 ha.

Relevé habitat summary

Altitudinal range: 4 - 27 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous and alkaline, calcareous sand.

Soil drainage: Dry, free-draining and (mostly) temporary moist, water-retentive soil.

Relevé vegetation summary

Vegetation cover: average 98%.

Veld Type: Coastal Fynbos and Strandveld.

Number of strata: 3.

Species richness: 4 - 13 (average 6).

Differential species: Senecio halimifolius, Plecostachys serpyllifolia and Scirpus nodosus.

Dominant species: Senecio halimifolius and Stenotaphrum secundatum.

Structural formation: Low Mid-dense to Mid-high Open Cyperoid Shrubland.

Structure: The mid-high, open, cyperoid shrub layer mainly has simple, evergreen, orthophyllous broad nanophyll

to sclerophyllous broad microphyll leaves. The low, mid-dense, cyperoid shrub layer mainly has simple, evergreen, orthophyllous broad nanophyll, sclerophyllous broad microphyll and orthophyllous broad mesophyll leaves. The dwarf, very sparse, grassy, ground layer mainly has simple, orthophyllous narrow microphyll leaves and prostrate stems.

SUBASSOCIATION: cynodontetosum

This subassociation is represented by community 19.

Relevés

Number: 3.

List: 22, 35 and 36.

Sites: Rondebosch Commonage and Kraaifontein Forest Reserve.

Grid location: 3318 CD 25 and 3318 DC 10.

Map reference: S-Jkc.

Area: 0.92 ha.

Relevé habitat summary

Altitudinal range: 25 - 111 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Temporary moist, water-retentive soil.

Relevé vegetation summary

Vegetation cover: average 73%.

Veld Type: Coastal Fynbos.

Number of strata: 2 - 3.

Species richness: 5 - 10 (average 8).

Differential species: None.

Dominant species: Juncus krausii and Cynodon dactylon.

Structural formation: Mid-dense Sedgeland with a Very Sparse Grassy Understorey.

Structure: The mid-high, emergent, shrub layer (where present) mainly has simple, sclerophyllous narrow microphyll leaves. The low, mid-dense, shrub cyperoid layer mainly has simple, orthophyllous narrow nanophyll leaves. The dwarf, very sparse, grassy, ground layer mainly has simple, orthophyllous narrow nanophyll leaves.

ORDER: Passerino-Cliffortietalia falcatae

This order is represented by communities 20 to 25. It includes only those communities associated with deep, acidic, non-calcareous sands. Acocks (1975, 1988) delimits these communities as Coastal Fynbos while Campbell et al. (1984) categorise it as Sand Plain Lowland Fynbos. Boucher (1987) classifies the communities of similar habitats within his Ehrharto-Phylicetalia cephalanthae Order.

The Passerino-Cliffortietalia falcatae is divided into two alliances, viz.

(i) Cliffortio-Metalasion muricatae (indicators - Thamnochortus lucens, Phylica cephalantha, Metalasia muricata and Phylica stipularis).

(ii) Cliffortio-Passerinion vulgaris (indicators - Stenotaphrum secundatum, Stoebe plumosa and Willdenowia teres).

Relevé habitat summary

Altitudinal range: 15 - 175 m.

Aspect: None to WSW.

Slope: 0 to 14 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 50 - 100%.

Veld Type: Coastal Fynbos.

Number of strata: 2 - 4.

Species richness: 6 - 28.

Differential species: None.

Dominant species: Passerina vulgaris and Metalasia muricata.

ALLIANCE: Cliffortio-Metalasion muricatae

This alliance is represented by communities 20 to 22.

It is divided into two associations, viz.

(i) Metalasio-Restionetum (indicator - Stoebe cf

cinerea).

(ii) Metalasio-Thamnochortetum lucentis.

Relevé habitat summary

Altitudinal range: 15 - 175 m.

Aspect: None to WSW.

Slope: 0 to 14 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 60 - 100%.

Veld Type: Coastal Fynbos.

Number of strata: 2 - 4.

Differential species: None.

Dominant species: Passerina vulgaris and Metalasia muricata.

ASSOCIATION: Metalasio-Restionetum

This association is represented by community 20.

Relevés

Number: 3.

List: 151, 152 and 153.

Site: Tokai Forest Reserve.

Grid location: 3418 AB 9.

Map reference: M-R.

Area: 4.05 ha.

Relevé habitat summary

Altitude: 20 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 78%.

Veld Type: Coastal Fynbos.

Number of strata: 3.

Species richness: 6 - 9 (average 8).

Differential species: Restio cf bifurcus, Stoebe cf cinerea and Carpobrotus edulis.

Dominant species: Metalasia muricata and Restio cf bifurcus.

Structural formation: Low Mid-dense to Mid-high Sparse Restioid Shrubland.

Structure: The mid-high, sparse, restioid shrub layer mainly has simple, evergreen, sclerophyllous cupressoid leptophyll leaves. The low, mid-dense, restioid shrub layer mainly has simple, evergreen, sclerophyllous cupressoid leptophyll and orthophyllous broad mesophyll leaves. The dwarf, very sparse, graminoid shrub ground layer mainly has simple and compound, deciduous, orthophyllous leptophyll,

orthophyllous narrow to broad nanophyll and microphyll and succulent microphyll leaves and prostrate stems.

ASSOCIATION: Metalasio-Thamnochortetum lucentis

This association is represented by communities 21 to 22.

It is subdivided into two subassociations, viz.

(i) phylicetosum (indicator - Cliffortia polygonifolia).

(ii) calopsietosum.

Relevés

Number: 28.

List: See relevant subassociations.

Sites: Penhill Estate, Northpine Commonage, Eskom Powerline Reserve and Milnerton Racecourse.

Grid location: 3318 DC 25, 3318 DC 15, 3318 DC 12, 3318 DC 11 and 3318 DC 8.

Relevé habitat summary

Altitudinal range: 15 - 175 m.

Aspect: None to WSW.

Slope: 0 to 14 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 60 - 100%.

Veld Type: Coastal Fynbos.

Number of strata: 2 - 4.

Species richness: 6 - 28.

Differential species: Thamnochortus lucens, Phylica cephalantha and Leucospermum hypophyllocarpodendron.

Dominant species: Thamnochortus lucens, Passerina vulgaris, Phylica cephalantha and Metalasia muricata.

SUBASSOCIATION: phylicetosum

This subassociation is represented by community 21. The community occurring at Penhill Estate differs from the one at Northpine Commonage - the former has an additional recognizable stratum and is more species-rich. Boucher (1987) classifies the communities in the Penhill Estate area within his Phylico-Salvion africana-luteae Alliance.

Relevés

Number: 6.

List: 154, 155, 156, 157, 158 and 159.

Sites: Penhill Estate and Northpine Commonage.

Grid location: 3318 DC 25 and 3318 DC 15.

Map reference: M-T1p.

Area: 1.95 ha.

Relevé habitat summary

Altitudinal range: 105 - 113 m.

Aspect: None to WSW.

Slope: 0 to 14 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 85%.

Veld Type: Coastal Fynbos.

Number of strata: 2 - 3.

Species richness: 13 - 23 (average 18).

Differential species: Phylica stipularis and Cliffortia polygonifolia.

Dominant species: Phylica cephalantha, Phylica stipularis, Cliffortia polygonifolia and Passerina vulgaris.

Structural formation: Low Mid-dense to Mid-high Sparse Restioid Shrubland.

Structure: The mid-high, sparse, restioid shrub layer mainly has simple, evergreen, sclerophyllous broad nanophyll leaves. The low, mid-dense, restioid shrub layer mainly has simple, evergreen, orthophyllous to sclerophyllous cupressoid leptophyll leaves. The dwarf, very sparse, graminoid shrub ground layer mainly has simple and compound, orthophyllous leptophyll to orthophyllous narrow microphyll leaves.

SUBASSOCIATION: calopsietosum

This subassociatiom is represented by community 22. It contains the highest overall number of perennial species encountered in a community (69).

Relevés

Number: 22.

List: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 17, 24, 25, 38, 39, 40, 41, 44, 47 and 52.

Sites: Eskom Powerline Reserve, Milnerton Racecourse, Durbanville Racecourse, Sixth Base Ordinance Depot and N7/N1 Interchange.

Grid location: 3318 DC 12, 3318 DC 11 and 3318 DC 8.

Map reference: M-T1c.

Area: 35.18 ha.

Relevé habitat summary

Altitudinal range: 15 - 175 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 76%.

Veld Type: Coastal Fynbos.

Number of strata: 2 - 4.

Species richness: 6 - 28 (average 13).

Differential species: Calopsis impolitus, Pelargonium multicaule and Crassula sp.

Dominant species: Thamnochortus lucens, Passerina vulgaris, Metalasia muricata, Phylica cephalantha and

Cliffortia falcata.

Structural formation: Low Mid-dense Restioid Shrubland (often with Mid-high to Tall Emergent Shrubs).

Structure: The tall, emergent, large-leaved shrub layer (where present) mainly has compound, evergreen, sclerophyllous broad microphyll leaves. The mid-high, emergent, small-leaved shrub layer (where present) mainly has simple, sclerophyllous cupressoid leptophyll leaves. The low, mid-dense, restioid shrub layer mainly has simple, evergreen, sclerophyllous cupressoid leptophyll to orthophyllous narrow nanophyll leaves. The dwarf, very sparse, graminoid ground layer mainly has simple and compound, orthophyllous narrow nanophyll, microphyll and mesophyll leaves.

ALLIANCE: Cliffortio-Passerinion vulgaris

This alliance represents communities 23 to 25.

It is divided into two associations, viz.

(i) Passerino-Willdenowietum teretis.

(ii) Passerino-Cliffortietum hirtae (indicator - Pelargonium triste).

Relevé habitat summary

Altitudinal range: 20 - 175 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 50 - 100%.

Veld Type: Coastal Fynbos.

Number of strata: 2 - 3.

Species richness: 6 - 16.

Differential species: None.

Dominant species: Passerina vulgaris.

ASSOCIATION: Passerino-Willdenowietum teretis

This association is represented by communities 23 to 24.

It is subdivided into two subassociations, viz.

(i) cliffortietosum (indicator - Cliffortia falcata).

(ii) stenotaphretosum (indicator - Stenotaphrum secundatum).

Relevés

Number: 16.

List: See relevant subassociations.

Sites: Durbanville Racecourse, Kraaifontein Forest Reserve, Rondebosch Commonage and Kenilworth Racecourse.

Grid location: 3318 DC 8, 3318 DC 10 and 3318 CD 25.

Relevé habitat summary

Altitudinal range: 20 - 175 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: 50 - 100%.

Veld Type: Coastal Fynbos.

Number of strata: 2 - 3.

Species richness: 6 - 16.

Differential species: None.

Dominant species: Passerina vulgaris, Willdenowia teres and Stoebe plumosa.

SUBASSOCIATION: cliffortietosum

This subassociation is represented by community 23.

Relevés

Number: 7.

List: 26, 27, 28, 29, 30, 31 and 32.

Sites: Durbanville Racecourse and Kraaifontein Forest Reserve.

Grid location: 3318 DC 8 and 3318 DC 10.

Map reference: P-Wtc.

Area: 2.86 ha.

Relevé habitat summary

Altitudinal range: 124 - 175 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 69%.

Veld Type: Coastal Fynbos.

Number of strata: 2 - 3.

Species richness: 8 - 14 (average 11).

Differential species: None.

Dominant species: Passerina vulgaris, Willdenowia teres and Cliffortia falcata.

Structural formation: Low Mid-dense Restioid Shrubland (often with Mid-high Emergent Small-leaved Shrubs).

Structure: The mid-high, emergent shrubs mainly have simple, evergreen, sclerophyllous cupressoid leptophyll leaves. The low, mid-dense, restioid shrub layer mainly has simple, evergreen, sclerophyllous cupressoid leptophyll to orthophyllous narrow nanophyll leaves. The dwarf, very sparse, graminoid ground layer mainly has simple, orthophyllous narrow nanophyll leaves.

SUBASSOCIATION: stenotaphretosum

This subassociation is represented by community 24.

Relevés

Number: 9.

List: 20, 21, 54, 55, 56, 57, 59, 60 and 61.

Sites: Rondebosch Commonage and Kenilworth Racecourse.

Grid location: 3318 CD 25.

Map reference: P-Wts.

Area: 52.87 ha.

Relevé habitat summary

Altitudinal range: 20 - 27 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 95%.

Veld Type: Coastal Fynbos.

Number of strata: 2 - 3.

Species richness: 6 - 16 (average 10).

Differential species: Erica subdivaricata (only at Kenilworth Racecourse).

Dominant species: Passerina vulgaris, Stenotaphrum secundatum and Stoebe plumosa.

Structural formation: Low Closed Graminoid Small-leaved to Mid-high Sparse Shrubland.

Structure: The mid-high, sparse, shrub layer mainly has

simple and compound, evergreen, sclerophyllous cupressoid leptophyll to sclerophyllous broad microphyll leaves. The low, closed, graminoid shrub layer mainly has simple, evergreen, orthophyllous to sclerophyllous cupressoid leptophyll leaves. The dwarf, very sparse, grassy ground layer mainly has simple, orthophyllous narrow nanophyll to microphyll leaves and prostrate stems.

ASSOCIATION: Passerino-Cliffortietum hirtae

This association is represented by community 25. It is restricted to a small area on Rondebosch Commonage.

Relevés

Number: 3.

List: 184, 185 and 186.

Site: Rondebosch Commonage.

Grid location: 3318 CD 25.

Map reference: P-Ch.

Area: 0.9 ha.

Relevé habitat summary

Altitude: 20 m.

Aspect: None.

Slope: 0 degrees.

Substrate: Acidic, non-calcareous sand over laterite.

Soil drainage: Dry, free-draining soil.

Relevé vegetation summary

Vegetation cover: average 100%.

Veld Type: Coastal Fynbos.

Number of strata: 3.

Species richness: 9 - 15 (average 12).

Differential species: Cliffortia hirta and Aspalathus cordata.

Dominant species: Cliffortia hirta, Aspalathus cordata, Aspalathus hispida, Passerina vulgaris and Ehrharta calycina.

Structural formation: Mid-high Mid-dense Small-leaved Shrubland.

Structure: The mid-high, mid-dense, shrub layer mainly has simple, evergreen, orthophyllous to sclerophyllous cupressoid leptophyll leaves. The low, open, grassy shrub layer mainly has simple, evergreen, sclerophyllous cupressoid leptophyll, sclerophyllous broad nanophyll, succulent nanophyll to orthophyllous narrow microphyll leaves. The dwarf, very sparse, grassy ground layer mainly has simple and compound, orthophyllous broad nanophyll leaves.

KEY TO VEGETATION MAPS

C-Ctj - Cynodonto-Chondropetaletum tectorum juncetosum (community 17)

C-Ctl - Cynodonto-Chondropetaletum tectorum leucadendretosum (community 16)

E-Oee - Eucleo-Oleetum exasperatae ericetosum (communty 7)

E-Oek - Eucleo-Oleetum exasperatae kedrostietosum (community 8)

E-Pcc - Eucleo-Protasparagetum compacti cynanchetosum (community 6)

E-Pcs - Eucleo-Protasparagetum compacti salvietosum (community 5)

I-Ct - Imperato-Chondropetaletum tectorum (community 15)

I-Mmp - Imperato-Metalasietum muricatae passerinetosum (community 13)

I-Mmr - Imperato-Metalasietum muricatae rhoetosum (community 14)

M-R - Metalasio-Restionetum (community 20)

M-Tlc - Metalasio-Thamnochortetosum lucentis calopsietosum (community 22)

M-Tlp - Metalasio-Thamnochortetosum lucentis phylicetosum (community 21)

P-Ch - Passerino-Cliffortietum hirtae (community 25)

P-Pec - Passerino-Phylicetum ericoidis cullumietosum (community 10)

P-Pei - Passerino-Phylicetum ericoidis indigoferetosum (community 9)

P-Rlf - Passerino-Rhoetum laevigatae ficinietosum (community 12)

P-Rlw - Passerino-Rhoetum laevigatae willdenowietosum (community 11)

P-Wtc - Passerino-Willdenowietum teretis cliffortietosum (community 23)

P-Wts - Passerino-Willdenowietum teretis stenotaphretosum (community 24)

R-Tf - Ruschio-Tetragonietum fruticosae (community 4)

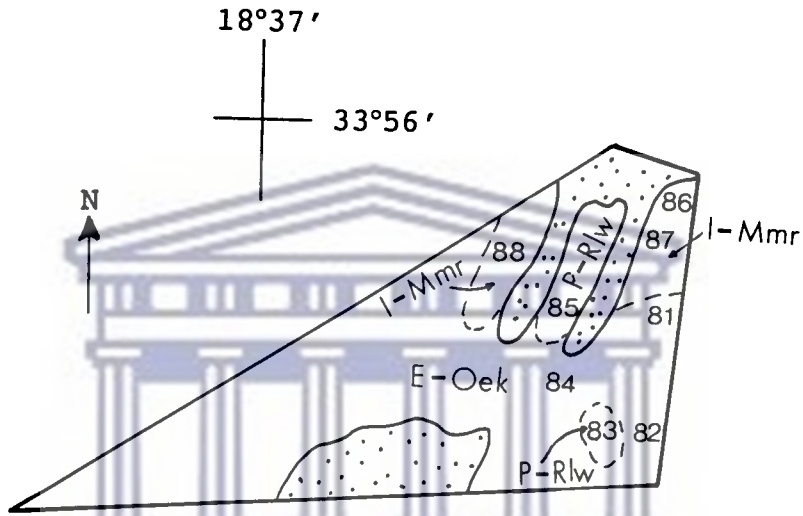
S-Jkc - Stenotaphro-Juncetum krausii cynodontetosum (community 19)

S-Jks - Stenotaphro-Juncetum krausii senecionetosum (community 18)

W-Ci - Willdenowio-Chrysanthemetum incanae (community 3)

W-Rmp - Willdenowio-Ruschietum macowanii passerinetosum (community 1)

W-Rmt - Willdenowio-Ruschietum macowanii thamnochortetosum (community 2)



⁝⁝ Dense alien infestation

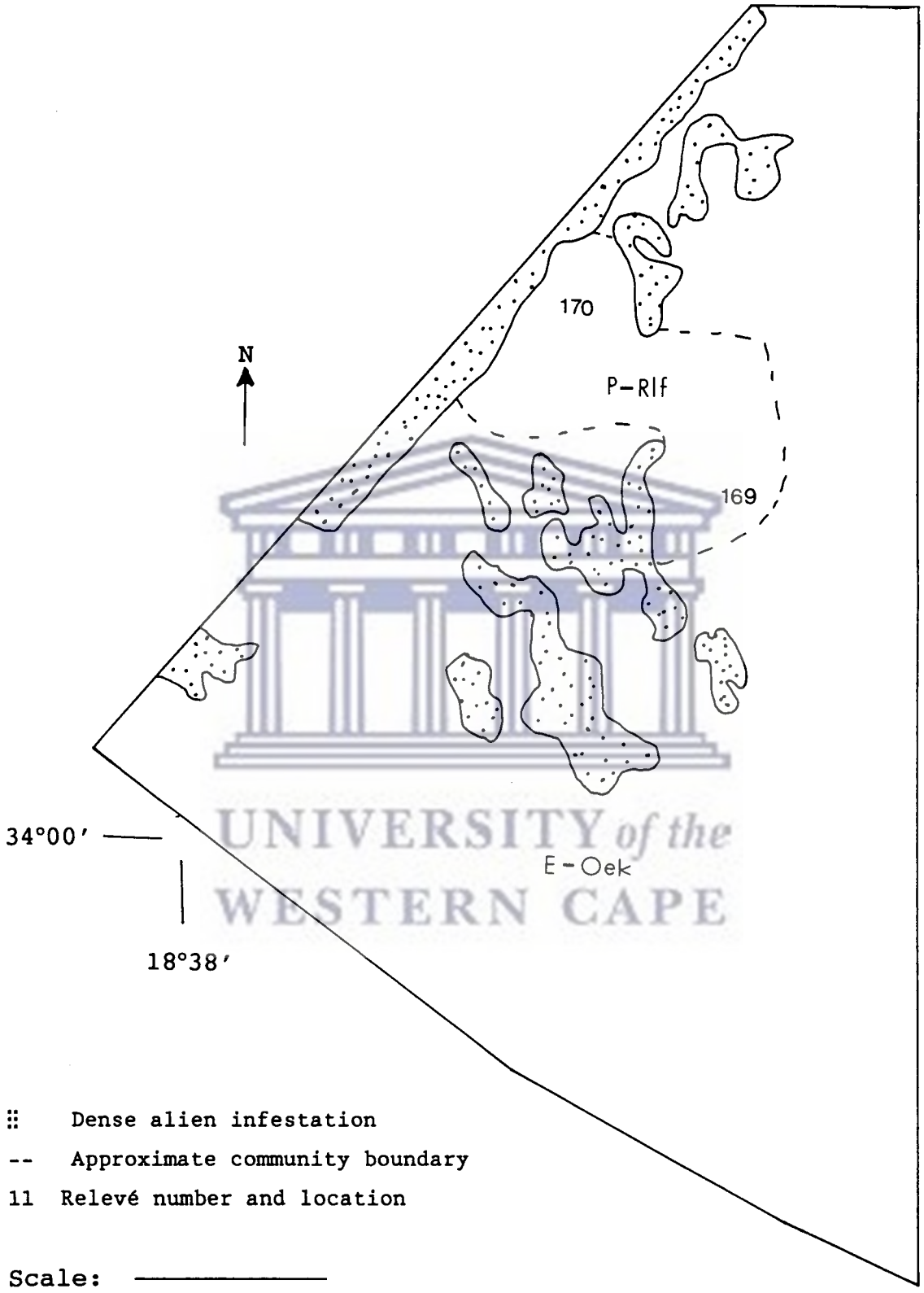
-- Approximate community boundary

11 Relevé number and location

Scale: ——————

300 m

Fig. 2. Vegetation map of the Cape Flats Nature Reserve Extension; 3318 DC 18.



⁞⁞ Dense alien infestation

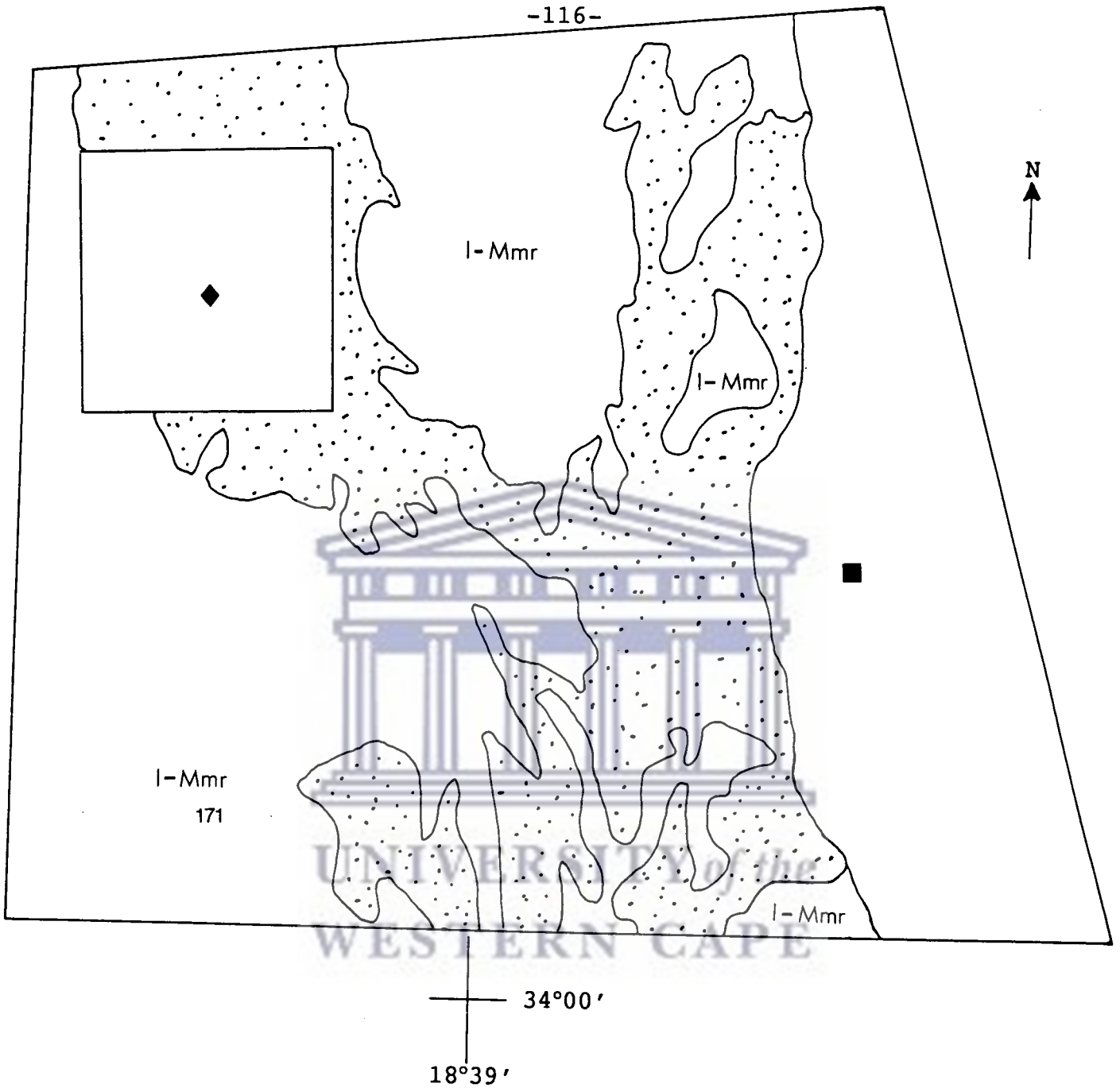
-- Approximate community boundary

11 Relevé number and location

Scale: ——————

300 m

Fig. 3a. **Vegetation map of Driftsands Nature Reserve; 3318 DC 23, 3418 BA 3.**



⣿ Dense alien infestation

■ Standing water

♦ Built environs

11 Relevé number and location

Scale: ——————

300 m

Fig. 3b. Vegetation map of Driftsands Nature Reserve; 3318 DC 24.

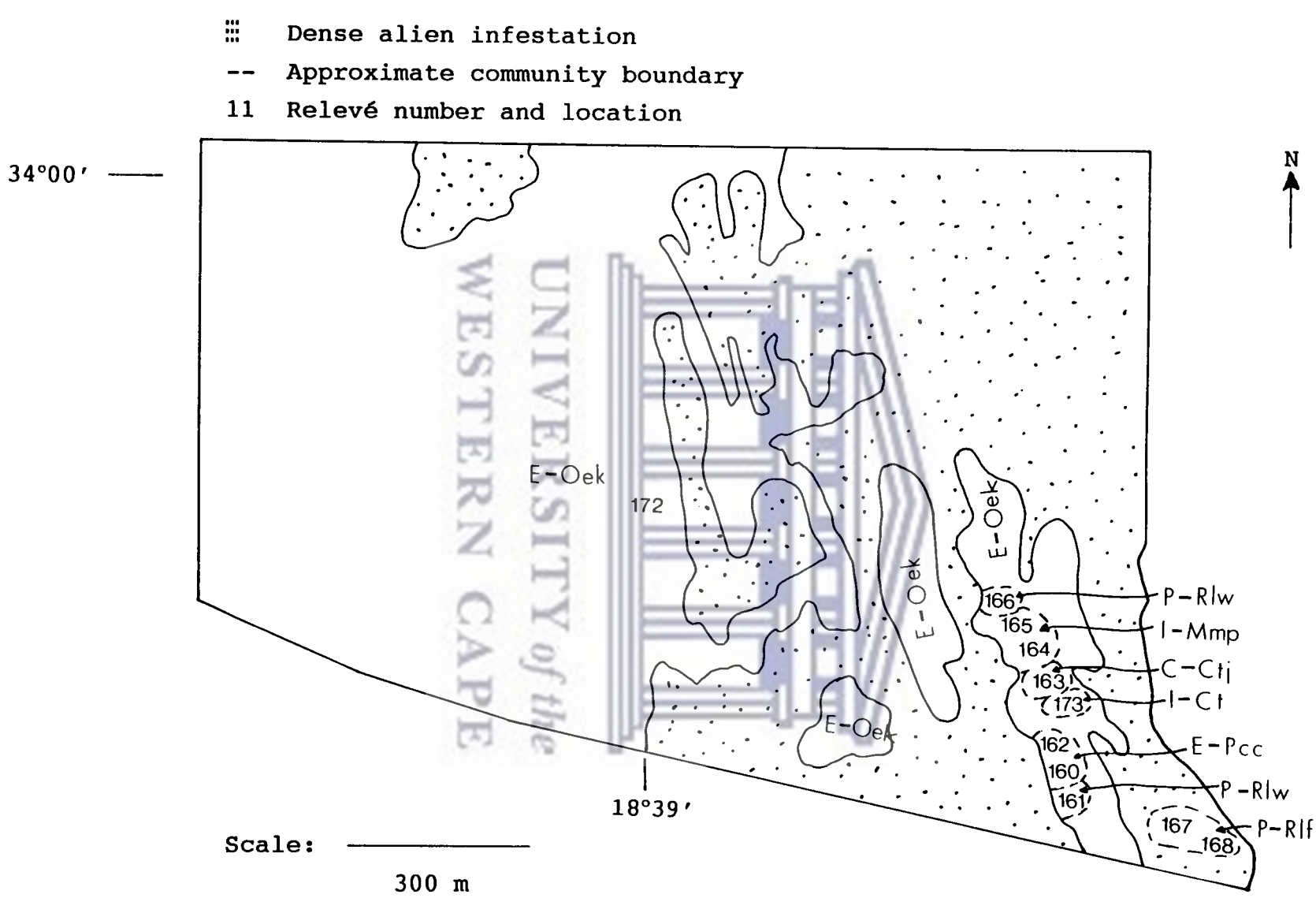
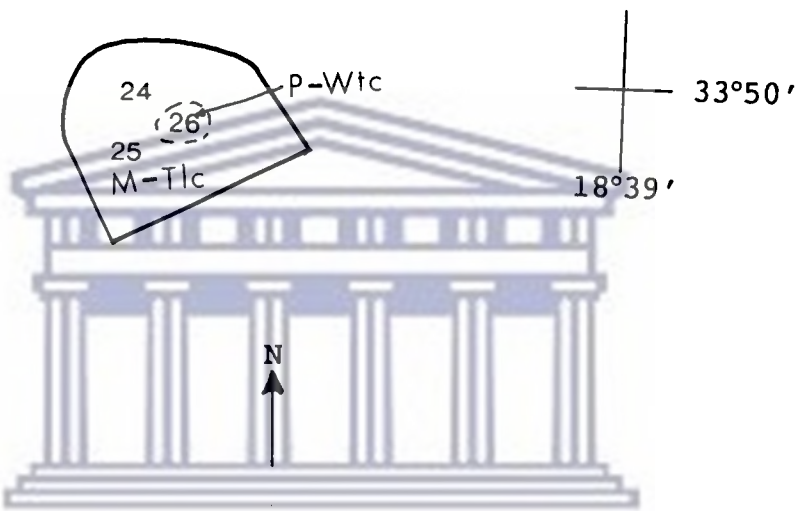


Fig. 3c. Vegetation map of Driftsands Nature Reserve; 3418 BA 4.



11 Relevé number and location

-- Approximate community boundary

Scale: ——————

300 m

Fig. 4. Vegetation map of Durbanville Racecourse; 3318 DC 8.

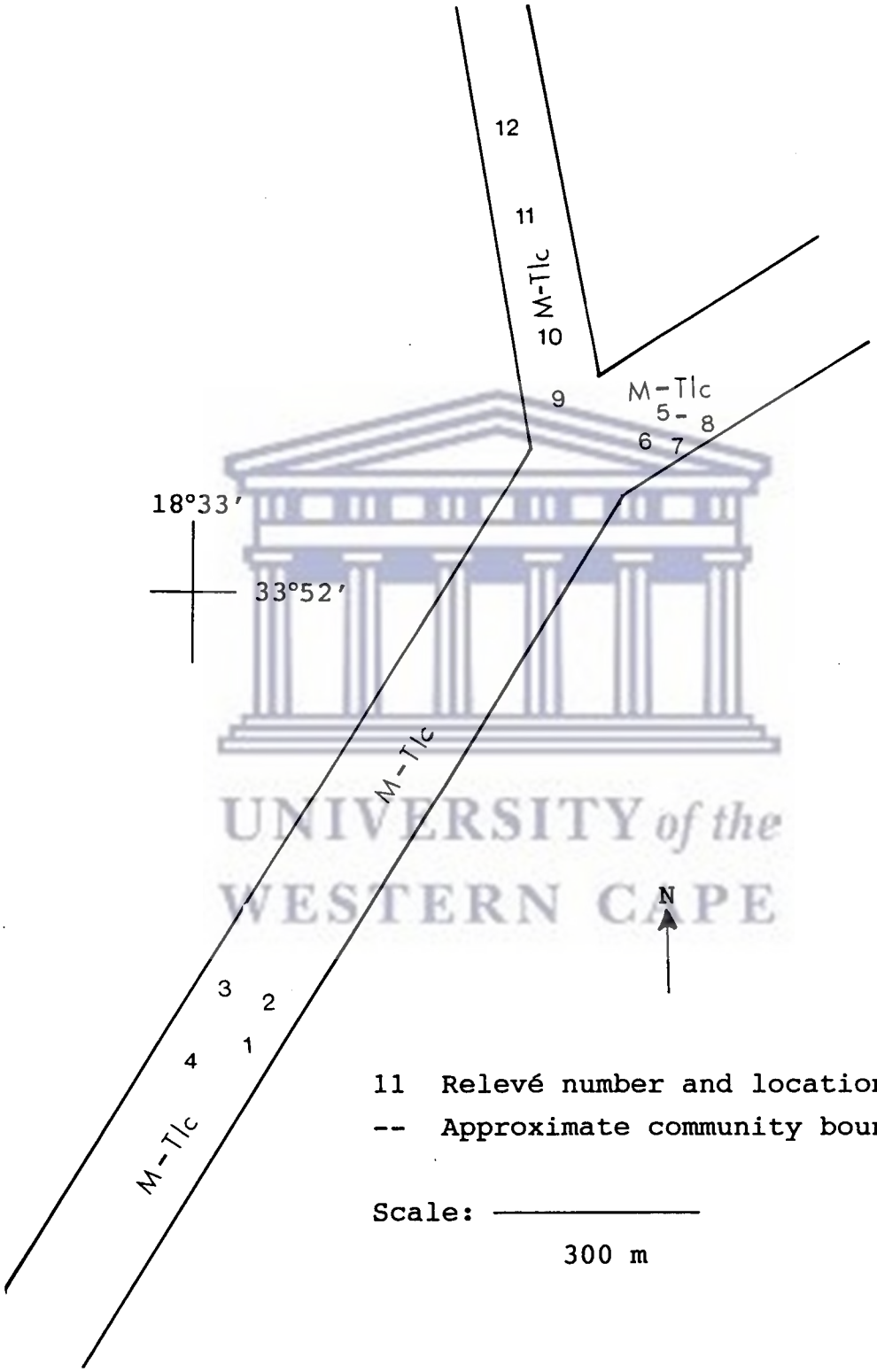
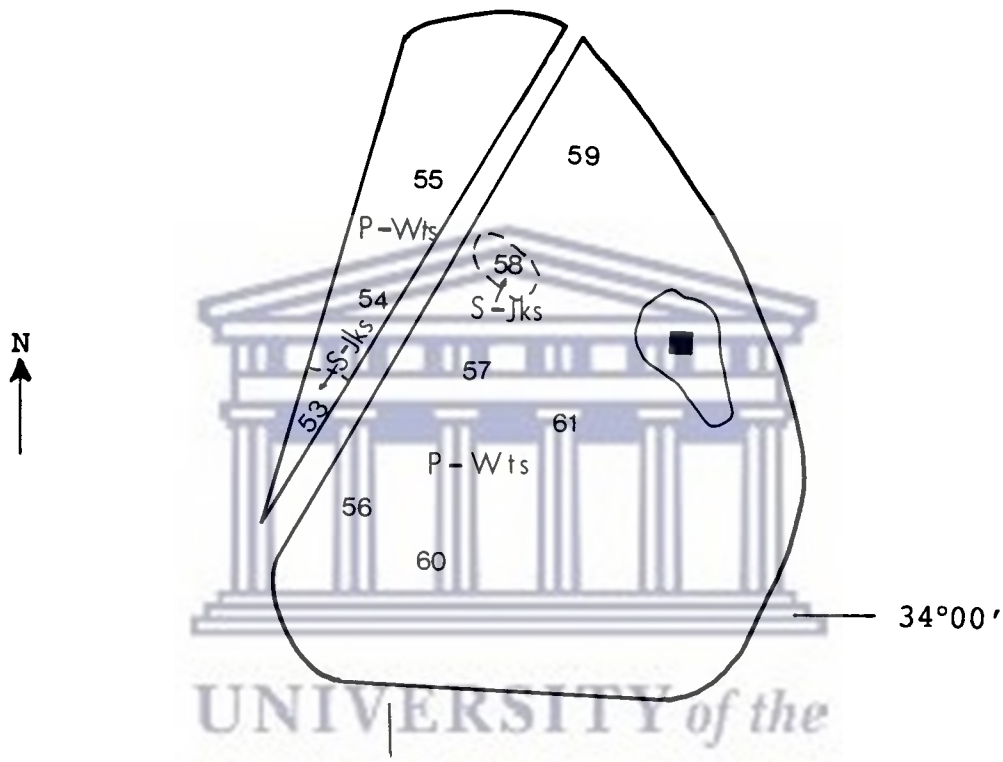


Fig. 5. **Vegetation map of Eskom Powerline Reserve; 3318 DC 12.**



■ Standing water

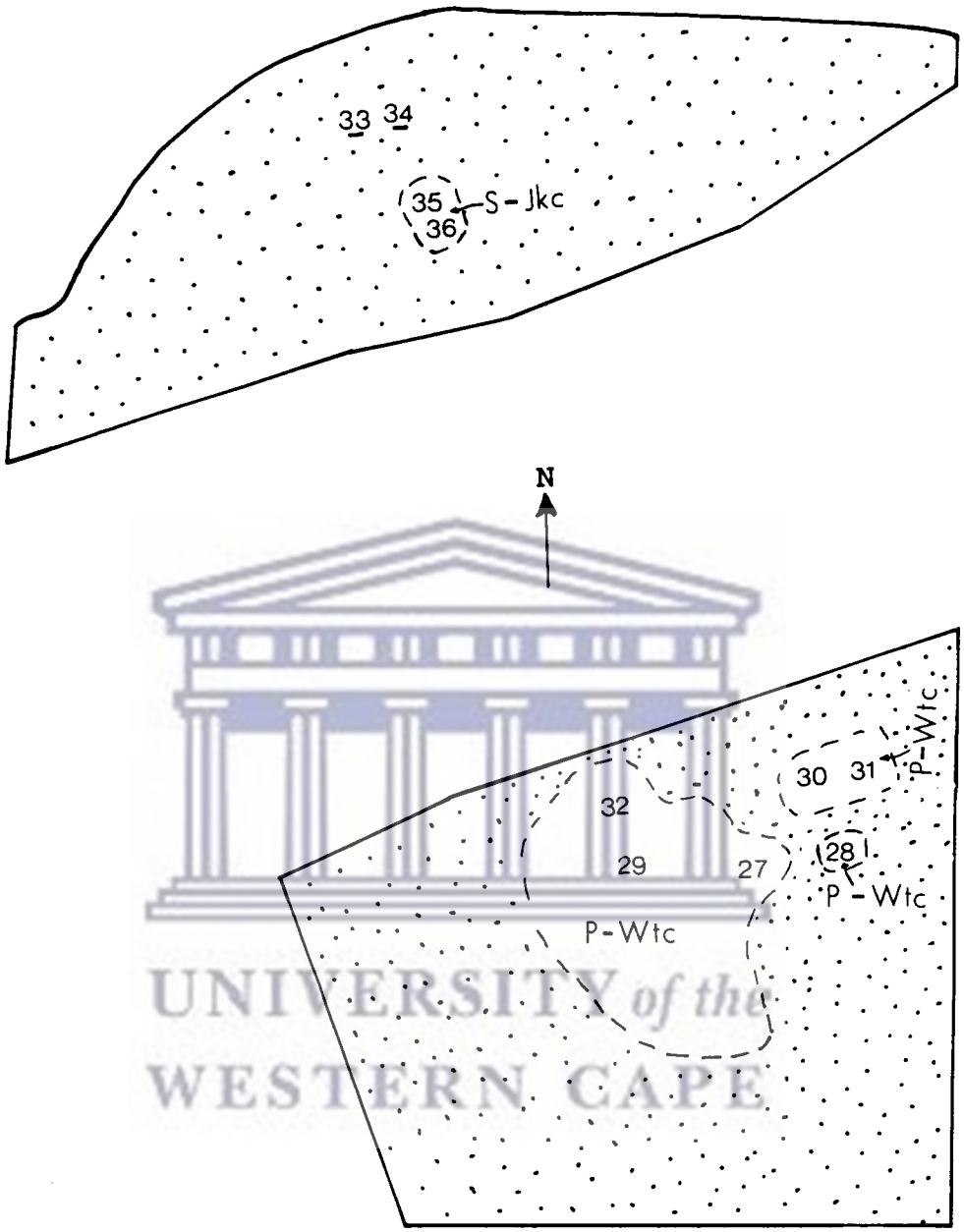
-- Approximate community boundary

11 Relevé number and location

Scale: ——————

300 m

Fig. 6. **Vegetation map of Kenilworth Racecourse; 3318 CD 25.**



⁞⁞ Dense alien infestation
-- Approximate community boundary
11 Relevé number and location
(11 - "poor" relevé)

18°45′
33°51′

Scale: ——————
300 m

Fig. 7. Vegetation map of Kraaifontein Forest Reserve; 3318 DC 10.

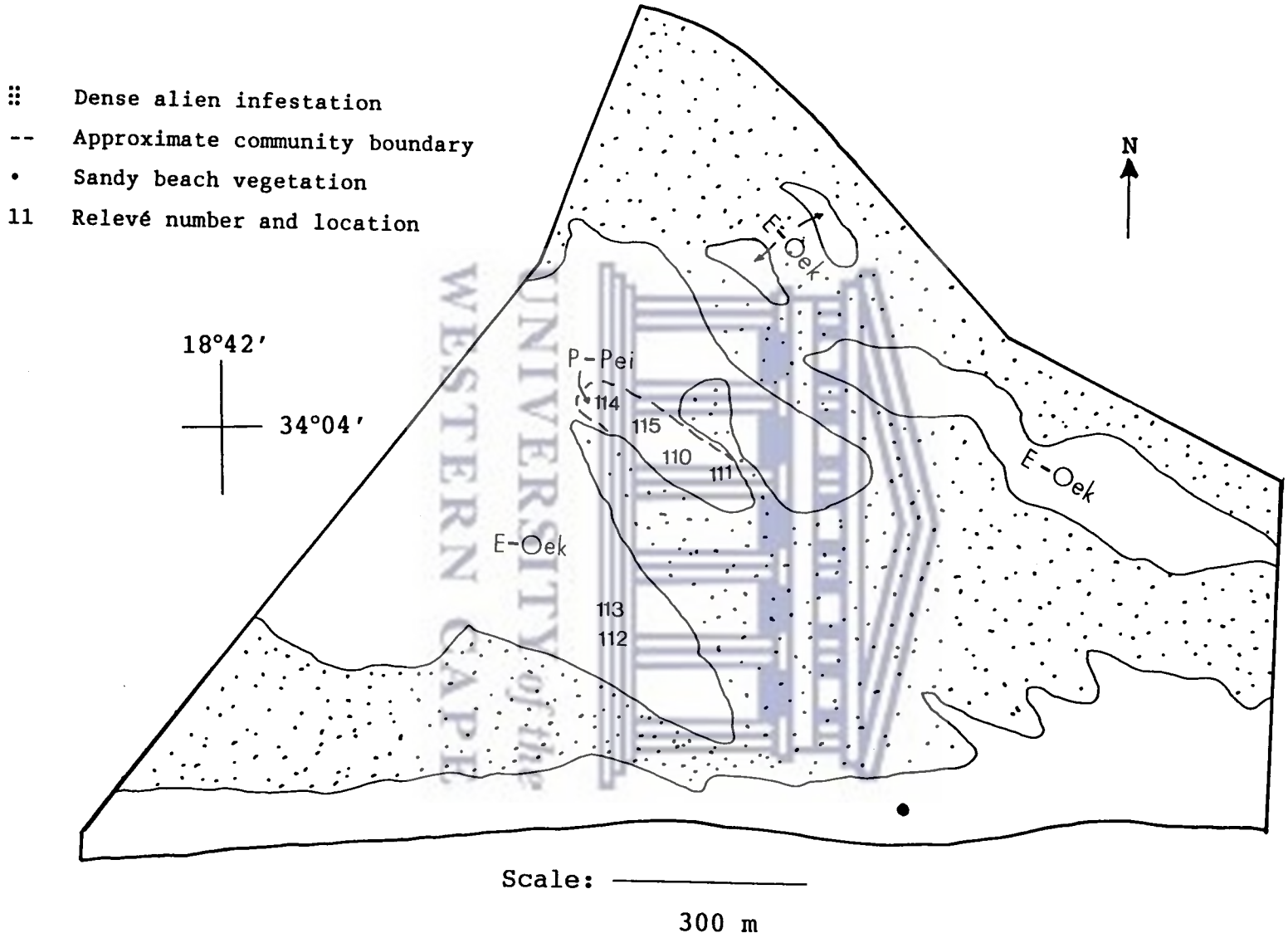


Fig. 8a. Vegetation map of Macassar Dunes; 3418 BA 10.

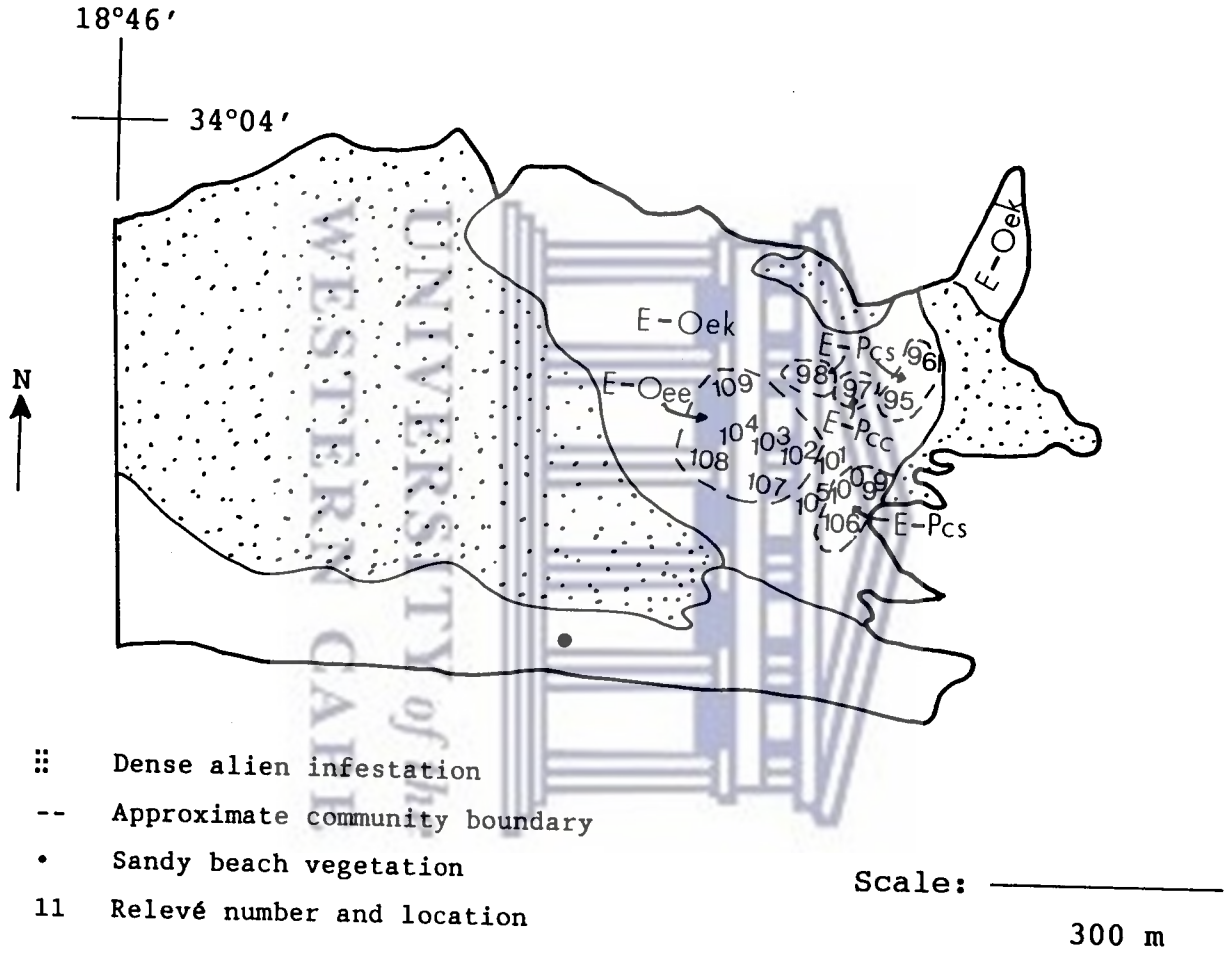
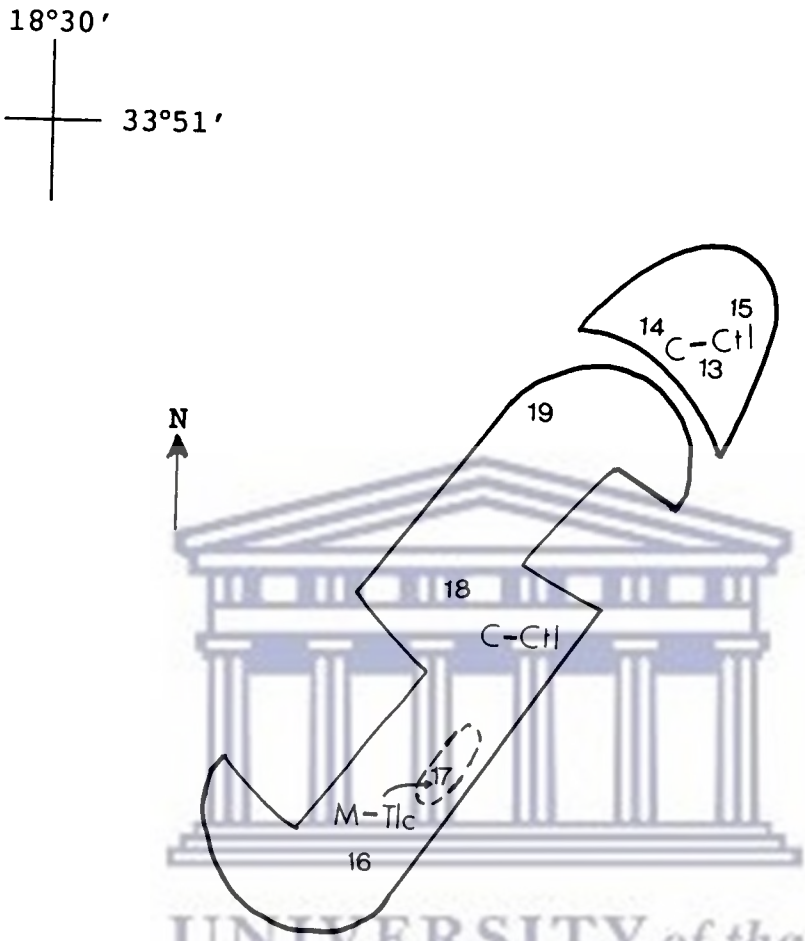


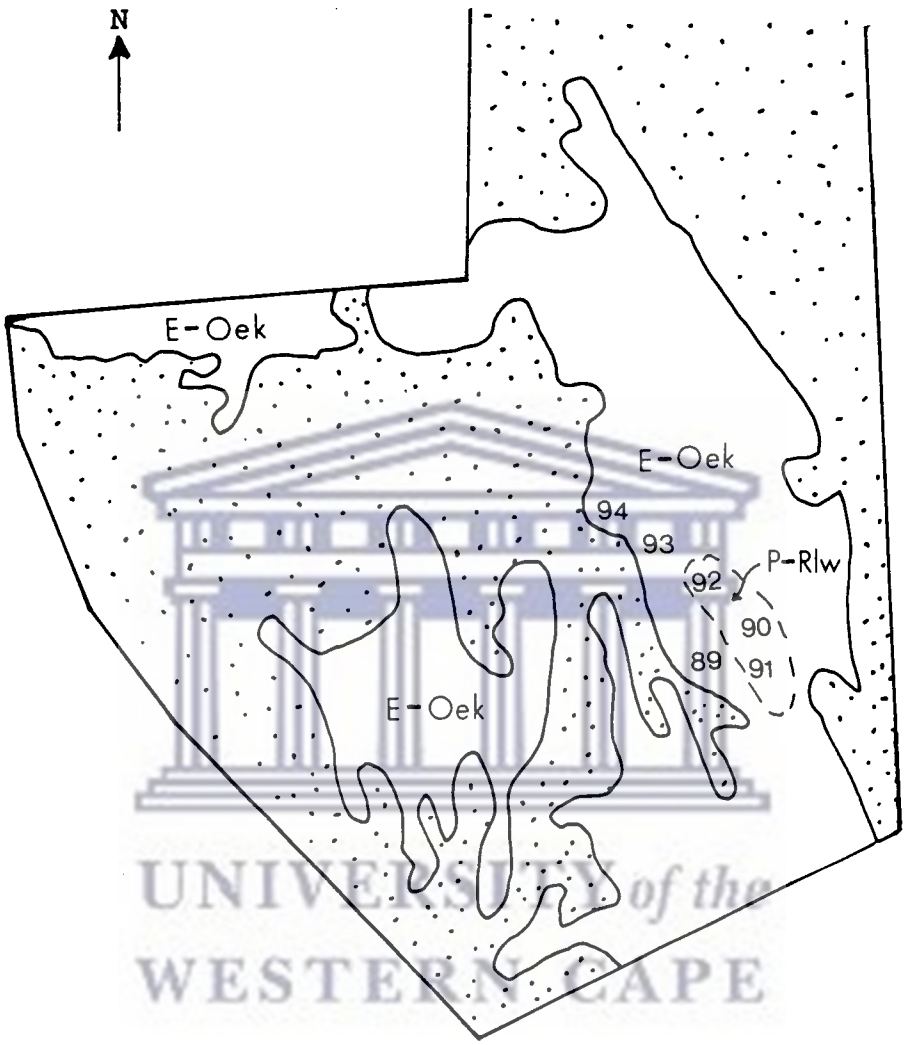
Fig. 8b. Vegetation map of Macassar Dunes; 3418 BA 10, 3418 BB 6.



-- Approximate community boundary
11 Relevé number and location

Scale: ———————
300 m

Fig. 9. **Vegetation map of Milnerton Racecourse; 3318 DC 11.**



34°03′

18°39′

⣿ Dense alien infestation

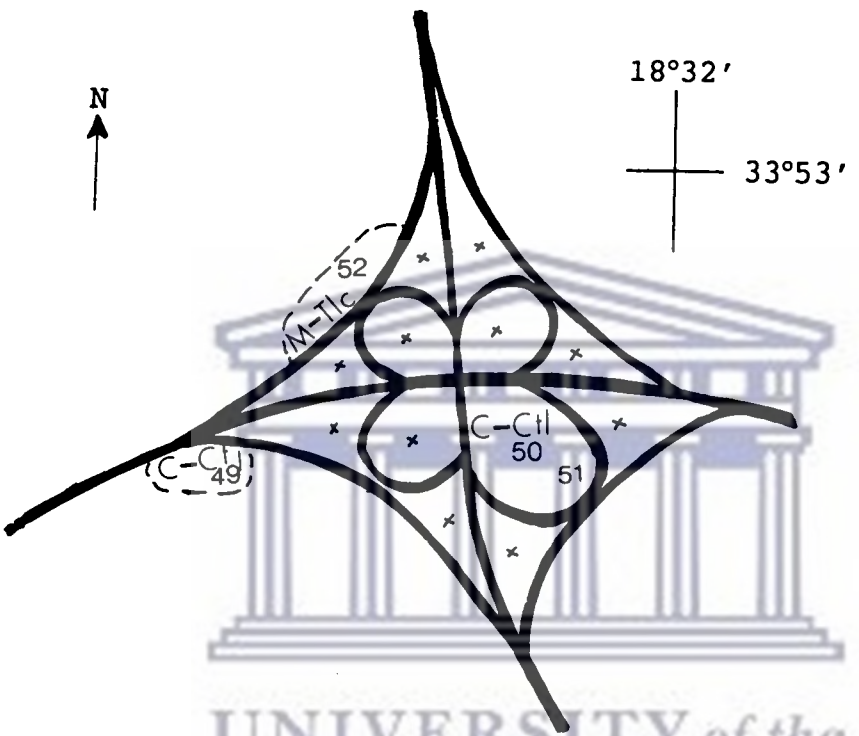
-- Approximate community boundary

11 Relevé number and location

Scale: ——————

300 m

Fig. 10. Vegetation map of Mitchell's Plain-Khayelitsha Flats; 3418 BA 3.



-- Approximate community boundary

Roads

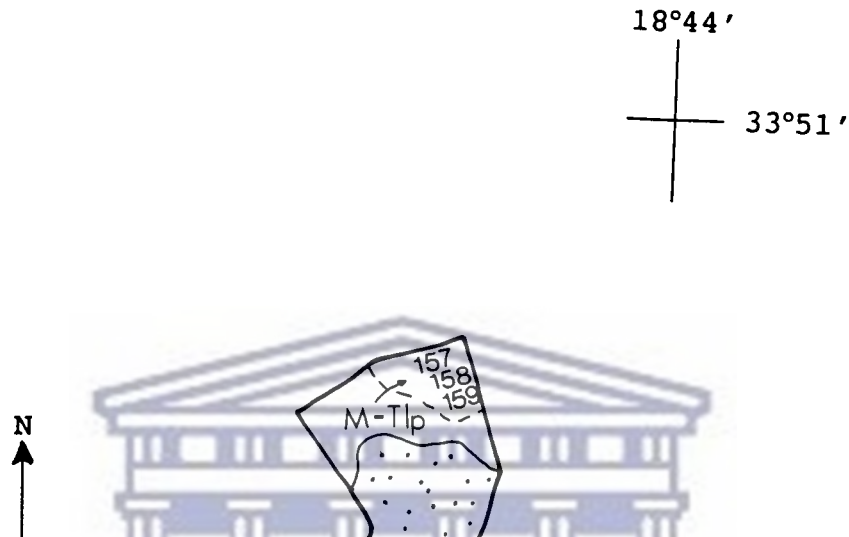
11 Relevé number and location

x Unsampled areas

Scale: ———————

300 m

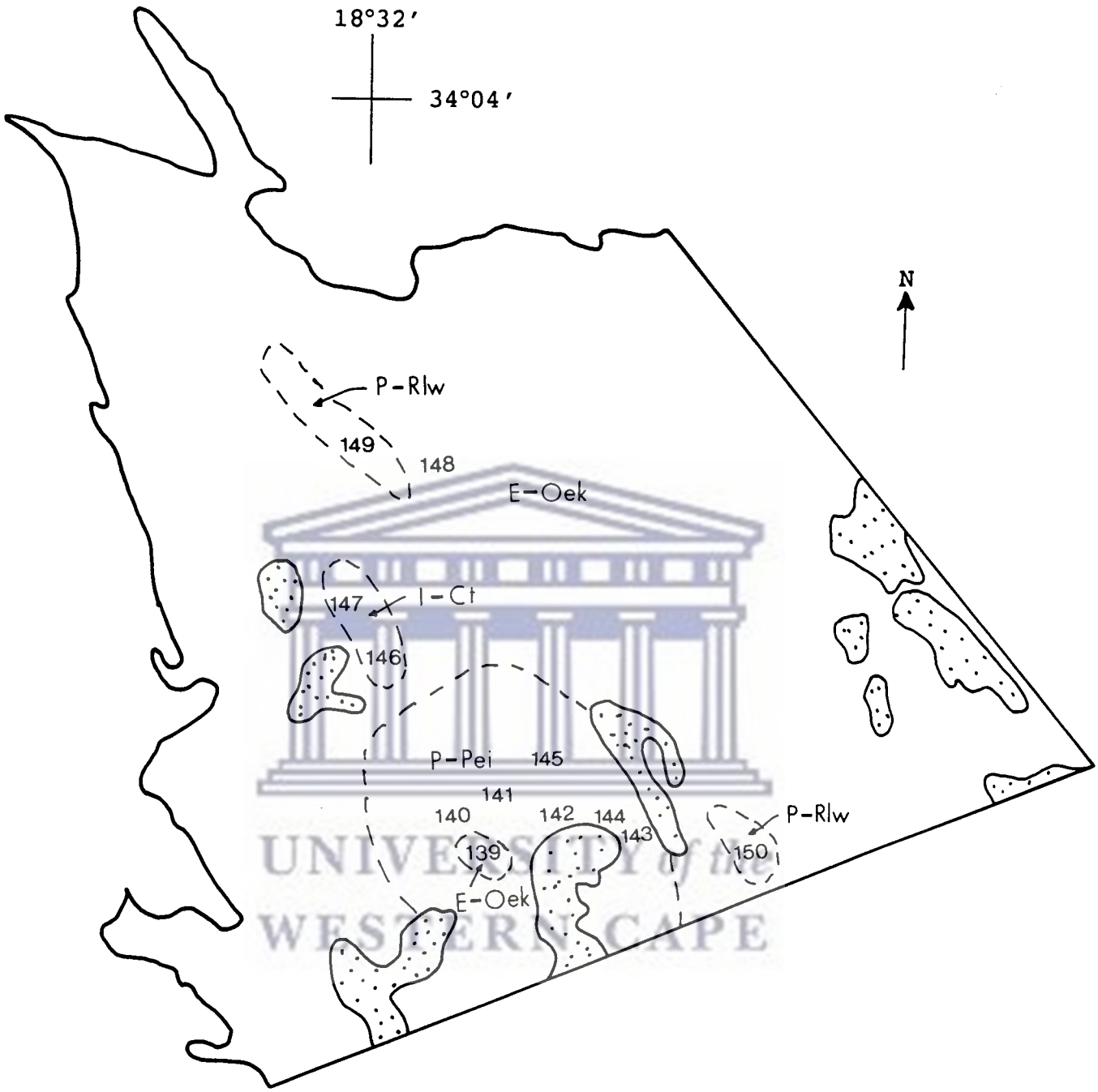
Fig. 11. Vegetation map of N7/N1 Interchange; 3318 DC 11.



⁞⁞ Dense alien infestation
-- Approximate community boundary
11 Relevé number and location

Scale: ——————
300 m

Fig. 12. Vegetation map of Northpine Commonage; 3318 DC 15.



⠿ Dense alien infestation

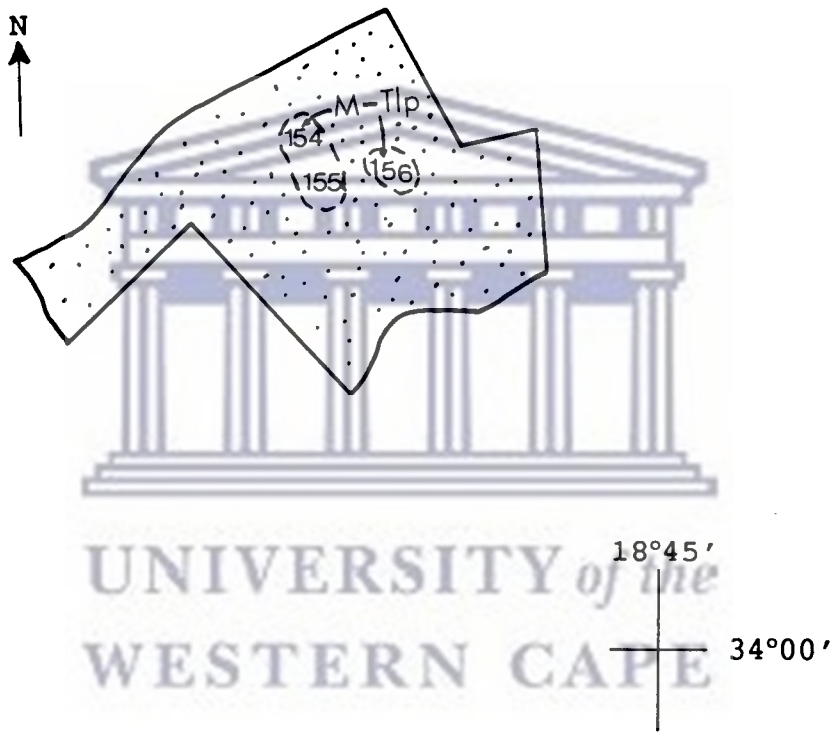
-- Approximate community boundary

11 Relevé number and location

Scale: ———————

300 m

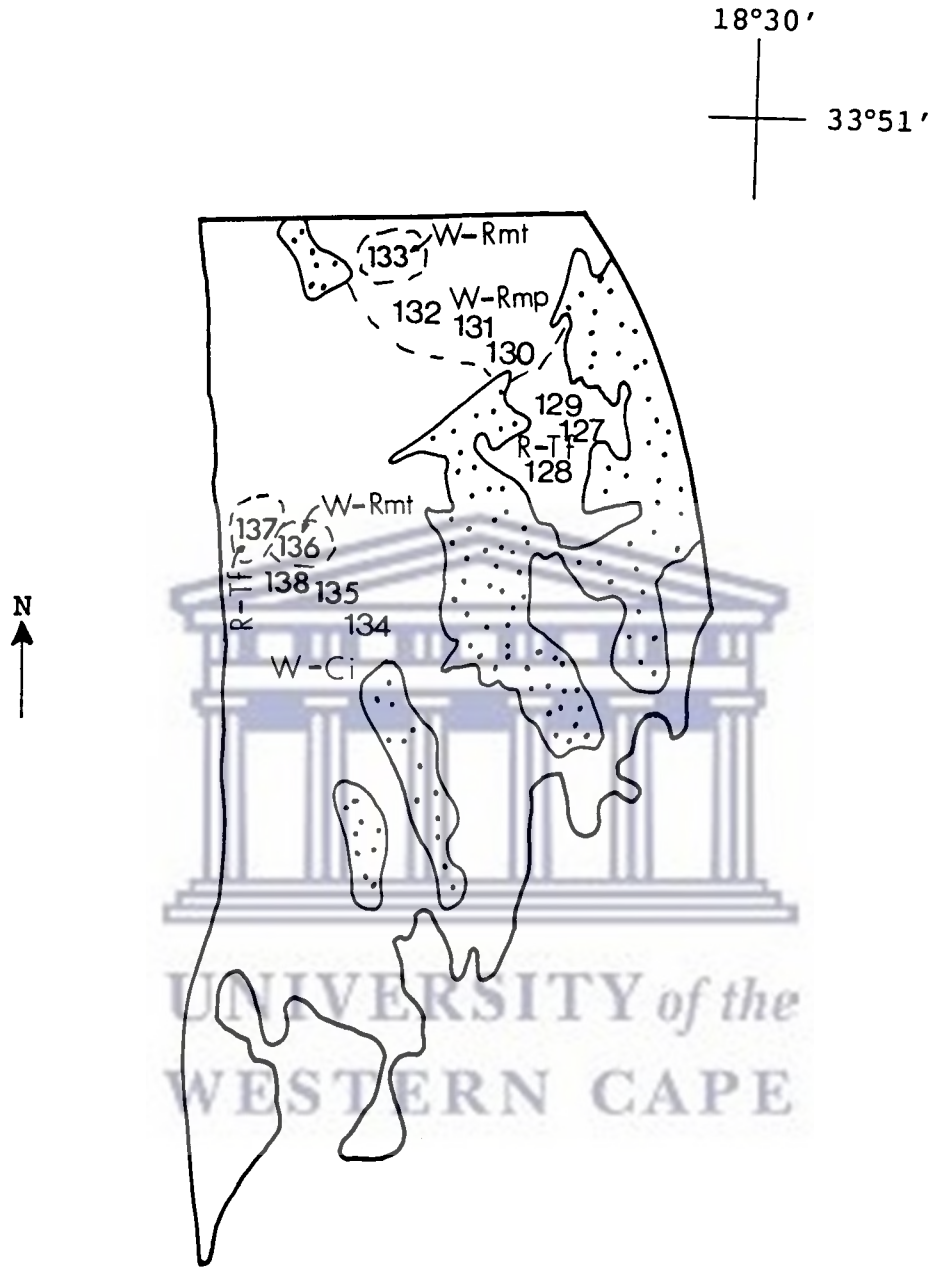
Fig. 13. Vegetation map of Pelikan Park-Zeekoevlei Flats; 3418 BA 6.



⁞⁞ Dense alien infestation
-- Approximate community boundary
11 Relevé number and location

Scale: ——————
300 m

Fig. 14. Vegetation map of Penhill Estate; 3318 DC 25.



⠿ Dense alien infestation

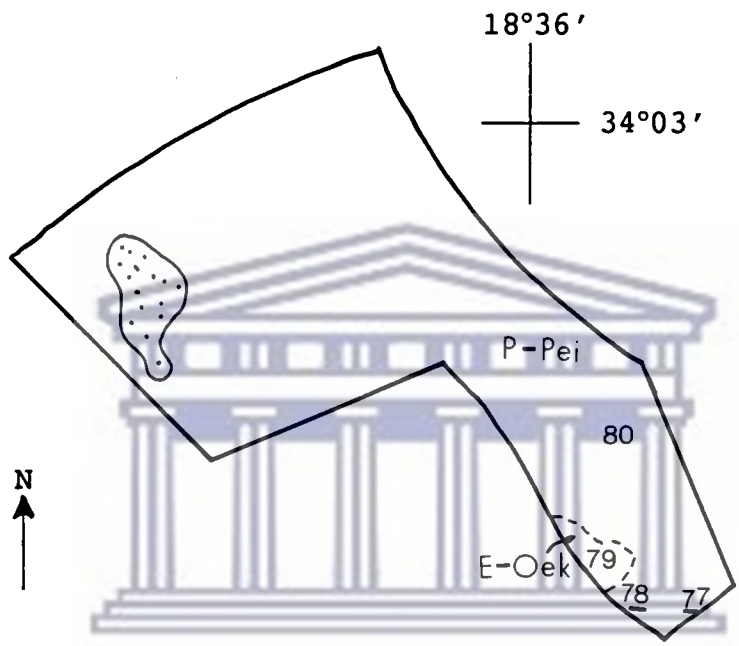
-- Approximate community boundary

11 Relevé number and location

Scale: ——————

300 m

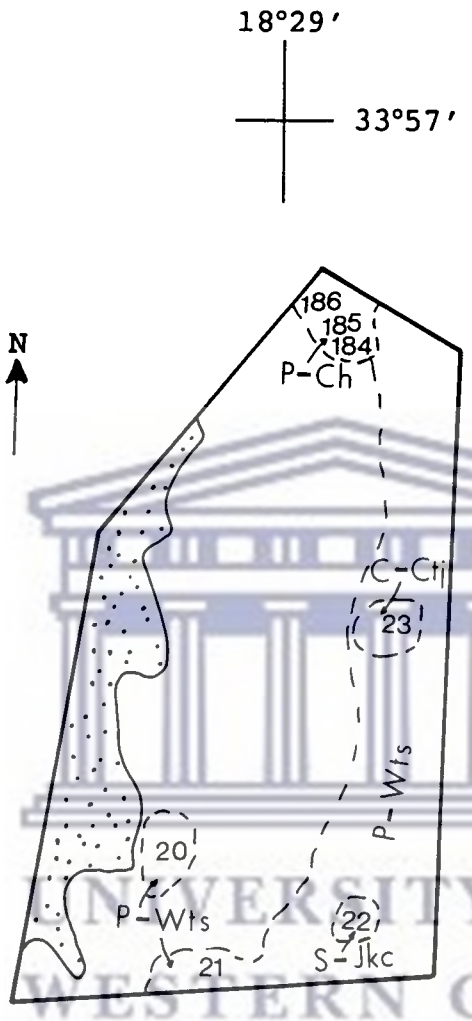
Fig. 15. Vegetation map of Rietvlei Flats; 3318 CD 15.



⁞⁞ Dense alien infestation
-- Approximate community boundary
11 Relevé number and location
(11 - "poor" relevé)

Scale: ——————
300 m

Fig. 16. Vegetation map of Rocklands Dune; 3418 BA 7, 3418 BA 8.



⣿ Dense alien infestation

-- Approximate community boundary

11 Relevé number and location

Scale: ——————

300 m

Fig. 17. **Vegetation map of Rondebosch Commonage; 3318 CD 25.**

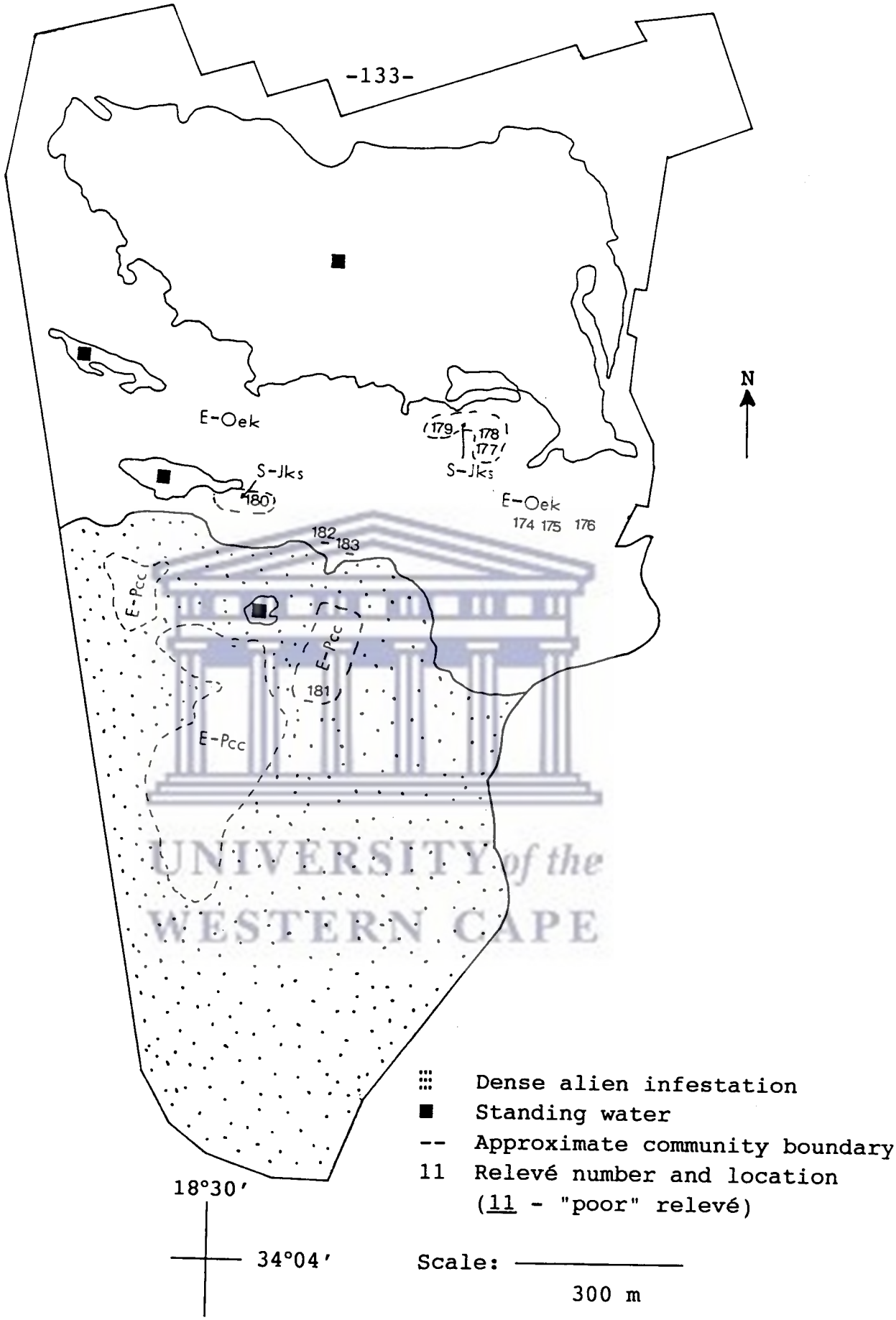
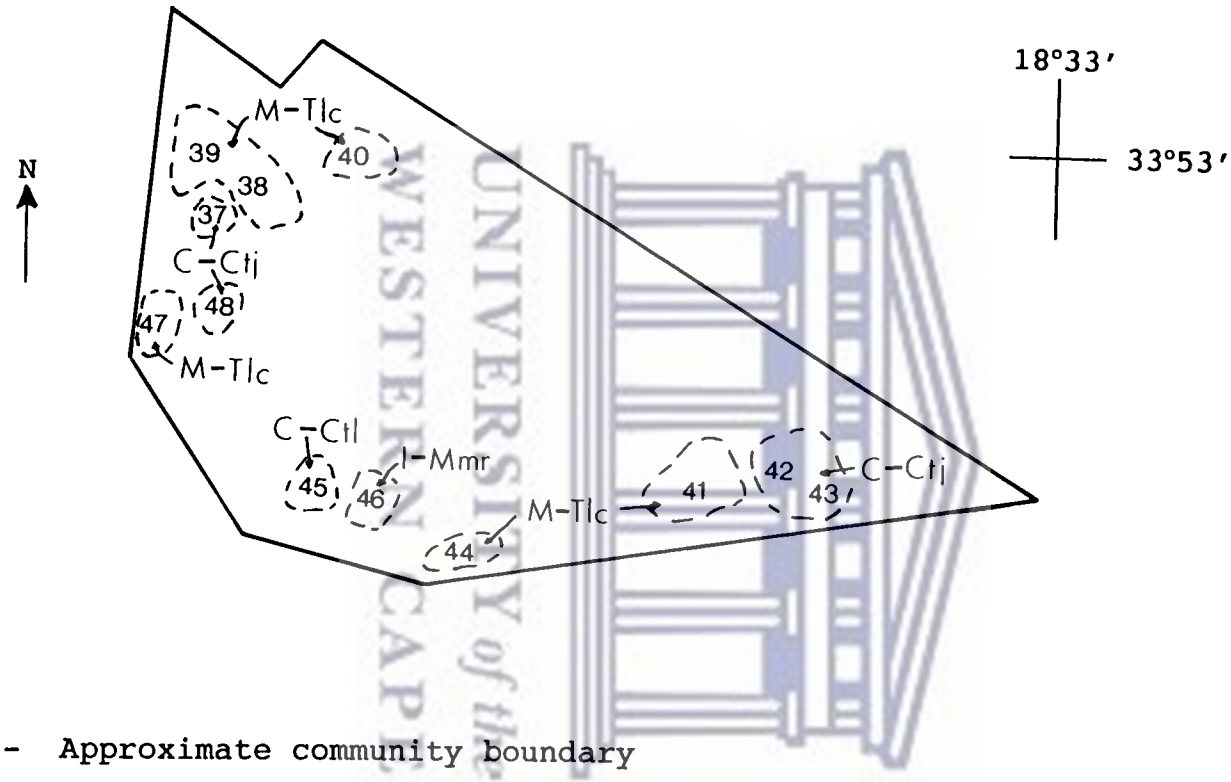


Fig. 18. **Vegetation map of Rondevlei Nature Reserve; 3418 AB 10, 3418 BA 6.**



-- Approximate community boundary

11 Relevé number and location

Scale: ——————

300 m

Fig. 19. Vegetation map of Sixth Base Ordinance Depot; 3318 DC 11.

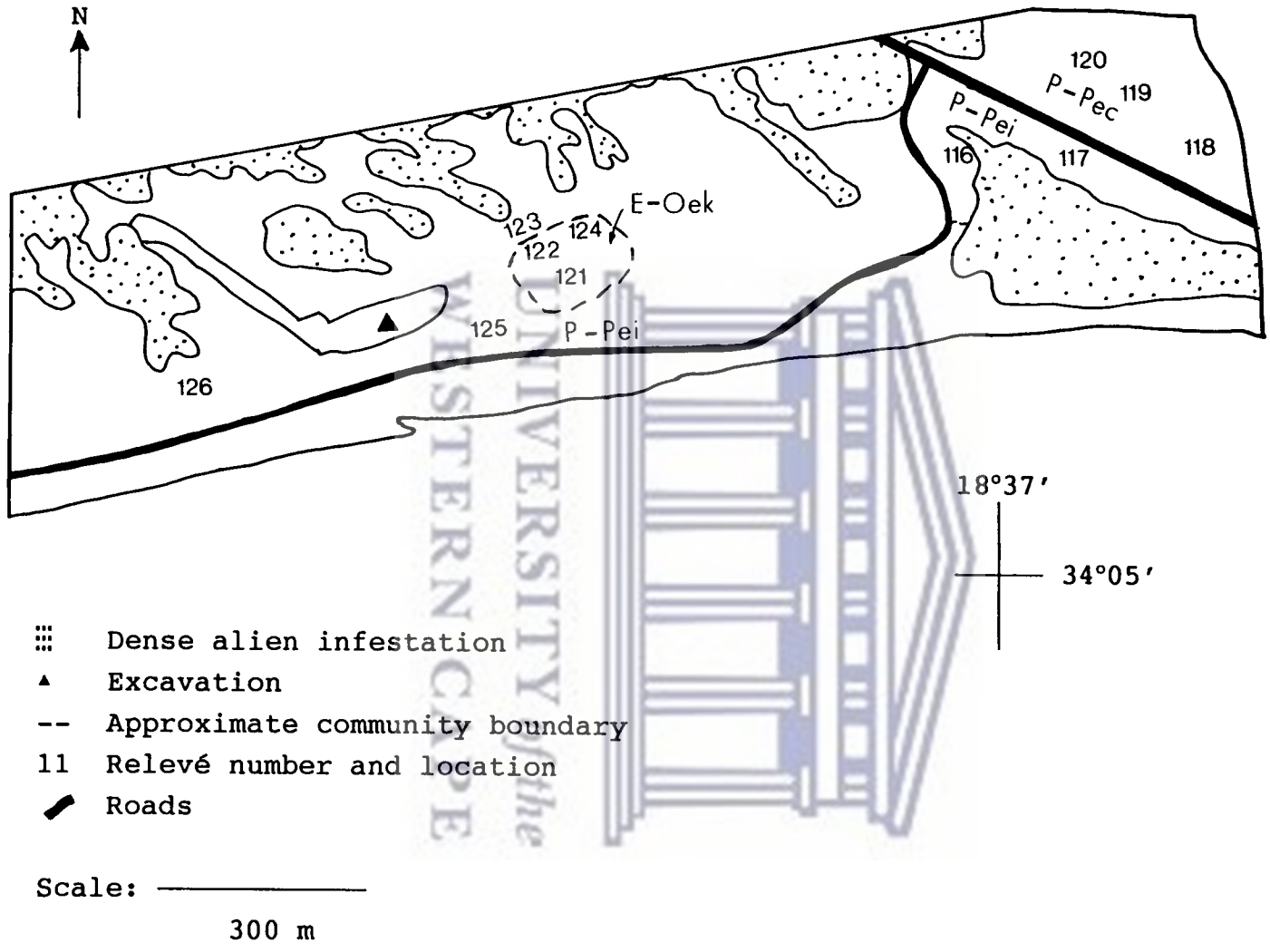
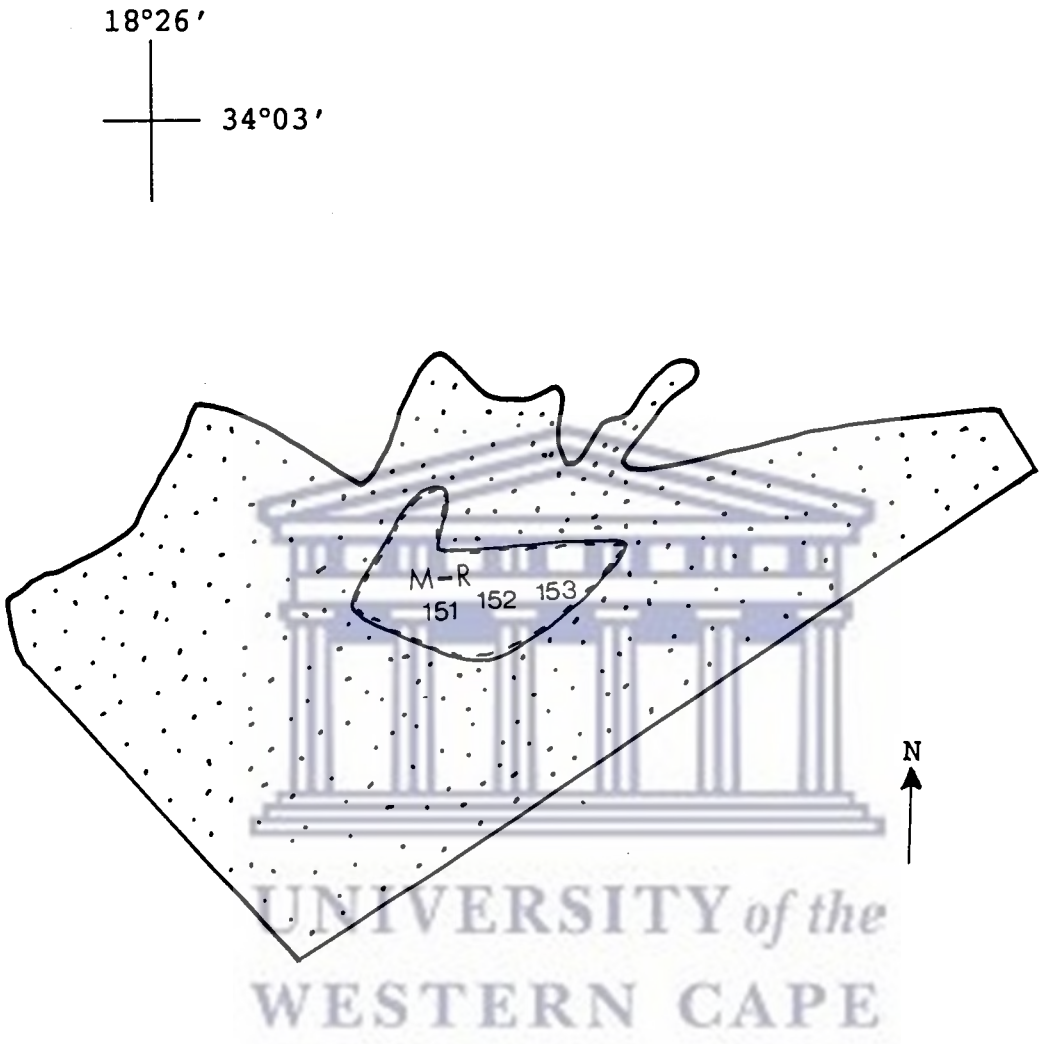


Fig. 20. Vegetation map of Strandfontein-Mnandi Coastal Dunes; 3418 BA 8.



⣿ Dense alien infestation
-- Approximate community boundary
11 Relevé number and location

Scale: ——————
300 m

Fig. 21. Vegetation map of Tokai Forest Reserve; 3418 AB 9.

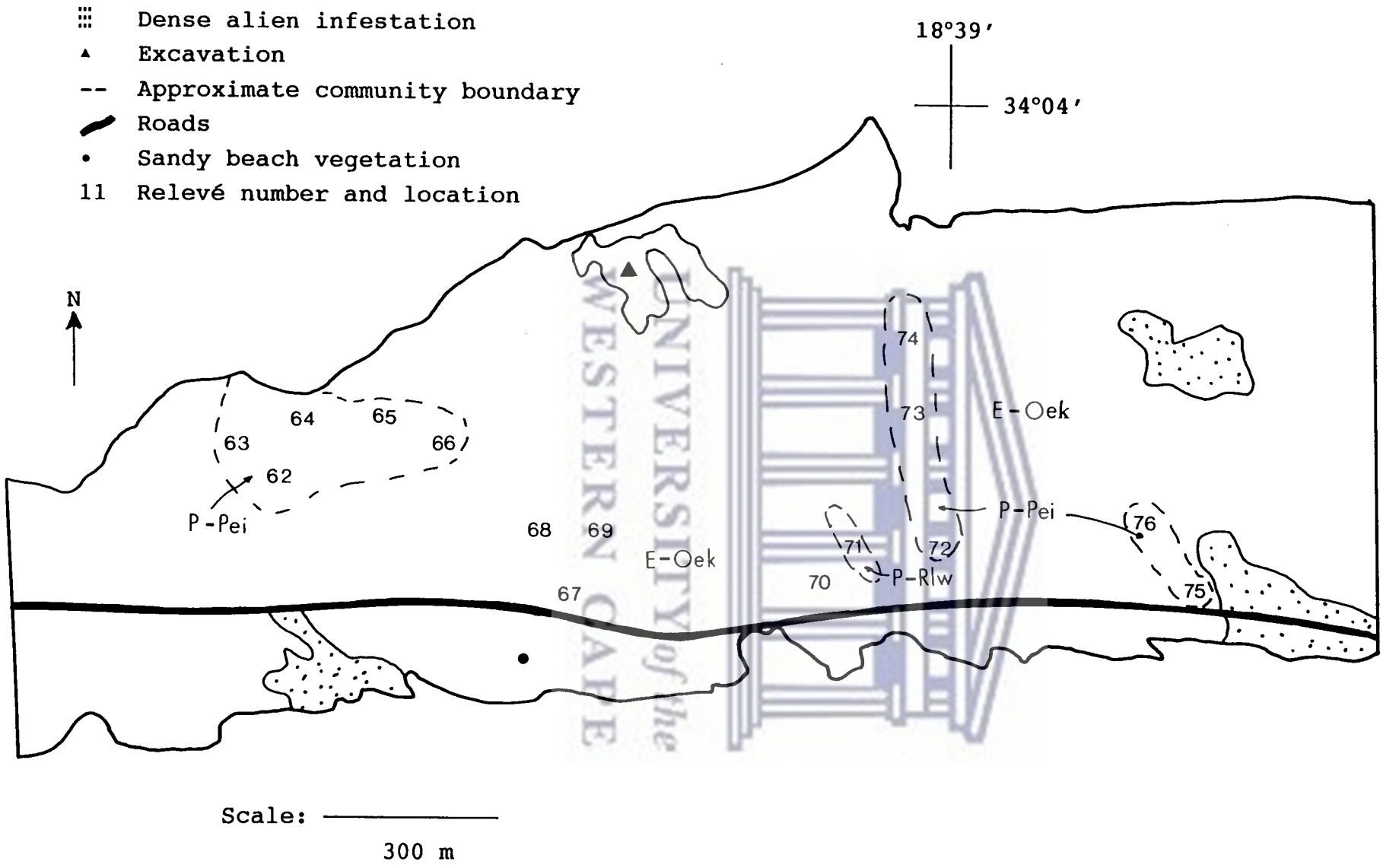


Fig. 22. Vegetation map of Wolfgat Nature Reserve; 3418 BA 8.

CONCLUSIONS

The plant communities occurring in the study area are grouped into a single syntaxon, the Ehrhartetea villosae Class. This class contains communities formerly delimited as Strandveld (West Coast Strandveld) and Coastal Fynbos (Sand Plain Lowland Fynbos). The class is subdivided into 2 subclasses, 4 orders, 8 alliances and 15 associations. Ten of these associations were divided into subassociations which, together with the remaining associations, constitutes the 25 communities in the study. These communities were mappable at the 1:10 000 scale. Approximate boundaries of communities are indicated in each study site.

Similar communities to Boucher's (1987) Eucleo-Ischyrolepion eleocharidis Alliance (Ehrharto-Eucleetalia racemosae Order), Erico-Aspalathion Alliance (Ehrharto-Ericetalia coarctatae Order) and Phylico-Salvion africana-luteae Alliance (Ehrharto-Phylicetalia cephalanthae Order) were encountered.

The plant communities occurring at Rietvlei Flats are unique; Strandveld communities are normally associated with alkaline, calcareous sand but, unlike all other Strandveld communities encountered, these occur on acidic, non-calcareous sand.

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CHAPTER 3

VEGETATION-SOIL RELATIONSHIPS

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VEGETATION-SOIL RELATIONSHIPS

INTRODUCTION

The previous paper dealt with a description of the syntaxonomic units identified in this study. Twenty-five communities were identified, grouped into 15 associations, 8 alliances, 4 orders, 2 subclasses and 1 class. It was shown that, in most cases, there was a correlation between the communities and major qualitative factors such as substrate type (acid vs. alkaline sands) and soil drainage/moisture regime. This suggested that a range of other environmental factors were involved. The objective of this paper was to detail the relationships between the species, communities and soil environmental factors.

METHODS

Soil data collection

Soil samples, taken from each major habitat sampled floristically-structurally at each study site were collected. The top 15 cm of soil was collected after the litter layer was removed. Each sample - three replicates were taken from each habitat - consisted of four bulked sub-samples which were thoroughly mixed and pooled. The soil was subsequently air-dried and analyzed at the Soil Science Section, Elsenburg.

Chemical and physical properties (viz. pH, macro-nutrients, % organic matter, texture and bulk density) of the topsoil

were determined. Soil drainage/moisture regime assessments were done visually in the field and placed into 2 ordinal classes: 1 = free-draining (dry) and 5 = poorly-drained (temporary moist) soil.

Data analysis

Comparisons between the plant communities, using mean values for the soil parameters, were performed using one-way analysis of variance (ANOVA) at the 0.05 level. Where significant differences between plant communities were indicated, further analyses were performed using the Tukey method of multiple comparisons (at the 95% confidence level) among pairs of means based on unequal sample sizes (Sokal & Rohlf 1981, STATGRAPHICS 1986).

Canonical Correspondence Analysis (CCA), a direct ordination technique of the CANOCO program (Ter Braak 1988), was performed using the chemical (including bulk density) and physical soil data separately on the floristic data set. The ordination diagrams express not only a pattern of variation in species composition but also the main relations between the species, communities and each of the environmental variables (Jongman et al. 1987). CCA incorporates environmental variables into the ordination analysis by specifying that the axes are linear combinations of environmental variables. Generally, a species has its maximum abundance in the communities close to its point, and is absent from communities far from that

point (Ter Braak 1987).

Groups of communities (with similar values for the environmental variable showing the best correlation with the first axis) were delimited on the ordination diagrams. These community groups were analysed in relation to the environmental variables and the phytosociological classification (Chapter 2, Table 1).

RESULTS & DISCUSSION

Comparisons between communities

Table 1 shows the results of the one-way ANOVA on the plant communities with respect to the soil variables. It is apparent that there are significant differences between soil characteristics of the plant communities, except in the case of % medium sand values. Important relationships are discussed below.

Vegetation-environment relationships

Soil chemical properties

The relationship between the overall CCA ordination of species, communities and the variables (Fig. 1) is statistically very significant (Monte Carlo permutation test, P = 0.01). The first and second axis eigenvalues are 0.554 and 0.423 respectively. This suggests a good separation of the species along these axes (Jongman et al. 1987). This is substantiated by the very high species-environment correlations of 0.974 and 0.952 for the first two axes respectively, indicating that the measured

Table 1. One-way analysis of variance (ANOVA) showing differences in soil environmental variables measured in each community. Mean values with the same letter are not significantly different (according to the Tukey-test at the 95% confidence level).

Community	pH[1]	P[2]	Ca[3]	Mg[3]	Na[3]	K[3]	%clay	%silt	%coarse sand	%medium sand	%fine sand	bulk density[4]	%N	%organic matter
1	5.93b	9.08ab	11.58a	6.20ab	3.25a	0.62a	2.00ab	2.00b	24.84ab	25.99	45.17ab	1.56ab	0.05ab	1.00ab
2	5.93b	9.08ab	11.58a	6.20ab	3.25a	0.62a	2.00ab	2.00b	24.84ab	25.99	45.17ab	1.56ab	0.05ab	1.00ab
3	5.93b	9.08ab	11.58a	6.20ab	3.25a	0.62a	2.00ab	2.00b	24.84ab	25.99	45.17ab	1.56ab	0.05ab	1.00ab
4	5.97b	3.96ab	9.92a	6.30ab	3.80a	0.50a	2.00ab	0.67ab	27.38ab	28.82	41.80ab	1.56ab	0.04ab	0.80ab
5	8.20c	24.00b	84.33b	6.58ab	6.13ab	1.37ab	1.33ab	1.33ab	2.41a	1.99	92.93b	1.31a	0.05ab	1.07ab
6	8.12c	24.93b	80.83b	6.14a	5.86ab	1.40ab	1.56a	2.00b	2.22a	24.11	70.11b	1.41a	0.07ab	1.33ab
7	8.00c	21.17ab	98.17b	7.13ab	6.84ab	1.59ab	4.00b	0.01a	6.09a	21.17	68.74ab	1.39ab	0.07ab	1.47ab
8	8.15c	23.43b	72.47b	5.76a	5.49a	1.36ab	1.55a	1.27b	14.95a	36.61	45.64a	1.48ab	0.05a	1.00a
9	8.03c	14.87ab	79.48b	6.95b	5.61a	1.53b	1.73a	1.33b	23.32a	35.43	38.53a	1.44a	0.07ab	1.40ab
10	7.73bc	19.93ab	74.00b	6.23ab	5.20ab	1.27ab	2.00ab	0.67ab	29.66ab	40.81	26.87a	1.49ab	0.09ab	1.87ab
11	8.24c	17.04ab	74.81b	5.44a	5.66ab	1.38ab	1.50a	1.50b	9.53a	43.99	44.73ab	1.48ab	0.05ab	0.83ab
12	8.45c	6.89ab	91.00b	7.50ab	6.46ab	1.94b	3.00ab	2.00b	11.01a	50.12	33.87ab	1.44ab	0.05ab	0.90ab
13	8.25c	29.35b	71.25b	4.83a	3.92ab	1.52ab	3.00ab	0.01a	9.12a	43.45	49.43ab	1.60ab	0.06ab	1.10ab
14	8.25c	29.35b	71.25b	4.83a	3.92ab	1.52ab	3.00ab	0.01a	9.12a	43.45	49.43ab	1.60ab	0.06ab	1.10ab
15	8.47c	6.10ab	90.50b	7.05ab	6.38ab	1.89b	2.67ab	2.00b	9.24a	53.57	32.52ab	1.45ab	0.04ab	0.80ab
16	6.28bc	5.40ab	14.37a	7.80b	8.90b	1.00ab	2.00ab	1.60b	48.72b	23.28	24.40a	1.54ab	0.06ab	1.24ab
17	6.40bc	4.09ab	39.93ab	6.52ab	5.30ab	1.45ab	2.67ab	2.00b	20.03ab	37.72	37.58ab	1.52ab	0.04ab	0.87ab
18	6.56bc	24.69b	55.72b	9.64b	6.56ab	1.58ab	2.40ab	2.00b	6.44a	29.34	59.82ab	1.40a	0.10b	2.08b
19	5.10ab	0.15a	3.80a	4.85a	4.91ab	0.28a	2.00ab	0.01a	29.66ab	56.70	11.64a	1.58ab	0.03ab	0.60ab
20	3.73a	2.80ab	5.32a	4.93a	4.59ab	0.47a	2.00ab	0.67ab	18.25ab	40.50	38.59ab	1.47ab	0.04ab	0.80ab
21	5.73b	2.27a	7.48a	4.28a	3.63a	0.31a	1.00a	1.00ab	0.83a	22.38	74.74b	1.53ab	0.02a	0.47a
22	5.33b	1.99a	7.83a	4.53a	3.41a	0.37a	1.50a	1.17ab	22.95ab	40.49	33.09a	1.59b	0.04a	0.77a
23	5.00ab	1.54a	6.32a	4.31a	4.14a	0.36a	2.00ab	1.20ab	9.21a	47.88	38.31ab	1.59ab	0.03a	0.60a
24	4.22ab	4.21a	3.88a	4.21a	3.91a	0.31a	1.67ab	1.00ab	15.28a	43.49	38.56ab	1.54ab	0.05ab	0.97ab
25	4.80ab	7.55ab	7.67a	5.05a	4.33a	0.39a	4.00b	1.33ab	38.22ab	32.64	23.81a	1.43ab	0.12b	2.47b
F	30.45***	5.13***	22.60***	3.69***	3.49***	10.37***	2.74***	1.67*	4.67***	1.36	2.74***	3.35***	2.58***	2.61***

[1]: KCl
[2]: ppm
[3]: mmol/kg
[4]: g/ml

$F_{.05[24,108]} = 1.61$
$F_{.01[24,108]} = 1.95$
$F_{.001[24,108]} = 2.40$

* = P < 0.05
** = P < 0.01
*** = P < 0.001

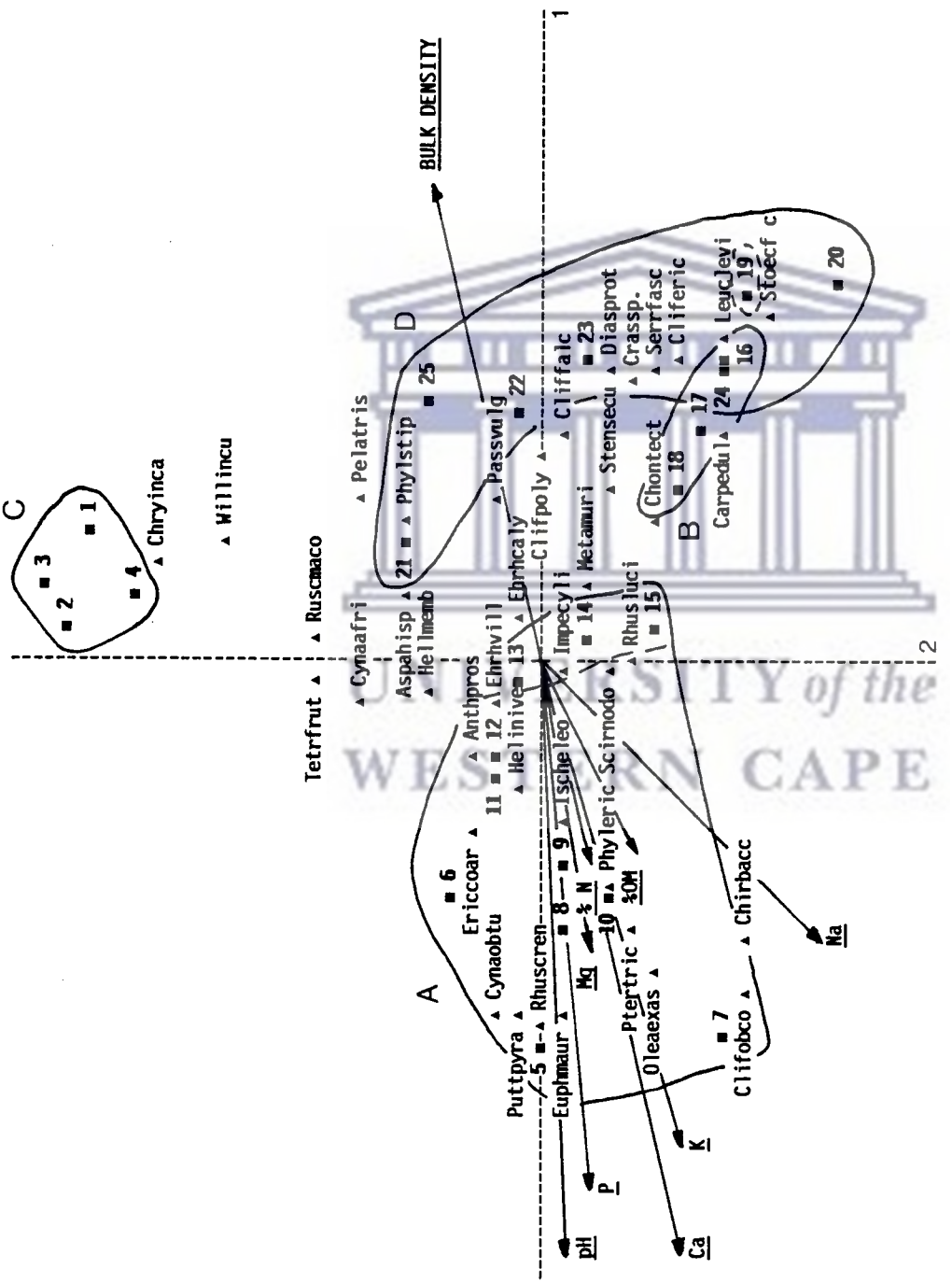

Fig. 1. Canonical correspondence analysis (CCA) diagram of species and communities with soil chemical variables and bulk density. The environmental variables are represented by arrows, species by ▲ and communities by ■ . Community groups A, B, C and D are encircled. The broken lines indicate communities of a specific order (see text). Eigenvalues: axis 1 = 0.554; axis 2 = 0.423. See Appendix 1 for full species names.

environmental variables do account for the main variation in the species composition. Table 2 shows the canonical coefficients that define the first two axes and the correlations of the environmental variables with these axes. From the correlations in Table 2 it can be inferred that the first axis mainly represents Ca and pH gradients and the second axis a Na gradient. Also, the environmental variables with long arrows (i.e. Ca, pH, P, K and Na - Fig. 1) are more strongly correlated with the ordination axes than those with short arrows, and therefore more closely related to the pattern of variation in species composition (Jongman et al. 1987). Although Mg, %N and % organic matter (OM) values were significantly different between communities, they are not considered to be related to vegetation distribution; it is realized, however, that organic matter to a large extent controls soil nutrient status.

Bulk density is negatively correlated with all the soil chemical variables (the highest negative correlation being with Ca, r = -0.680) (Table 3). The relationships between the vegetation and bulk density will be dealt with under the discussion of soil physical properties. The macro-nutrients show a positive correlation with each other and with pH (Calcium shows the highest positive correlation with pH, r = 0.943).

Four community groups (A, B, C and D) are delimited (Fig. 1). The ordination diagram confirms that the groups are separated, on the first axis, along a Ca, pH, P and K

Table 2. Soil chemical (with bulk density) coefficients and correlations with the first two axes of CCA.

Axis variable	Coefficients		Correlations	
	Axis1	Axis2	Axis1	Axis2
pH	-0.61	0.21	-0.87	-0.04
P	-0.14	-0.16	-0.79	-0.06
Ca	-1.21	-1.67	-0.89	-0.26
Mg	-0.28	0.81	-0.43	-0.08
Na	0.16	-1.04	-0.42	-0.56
K	1.18	-0.77	-0.71	-0.27
Bulk density	0.11	-0.52	0.71	0.23
% N	0.70	1.96	-0.31	-0.09
% Organic matter	-0.65	-1.92	-0.30	-0.11

Table 3. Correlation coefficients between soil chemical variables and bulk density.

pH	1.0000							
P	.7423	1.0000						
Ca	.9425	.7465	1.0000					
Mg	.5314	.3137	.5525	1.0000				
Na	.5352	.3090	.5947	.7425	1.0000			
K	.9057	.6391	.9335	.6971	.6632	1.0000		
Bulk density	-.5280	-.4871	-.6800	-.5669	-.6115	-.5693	1.0000	
% Nitrogen	.2406	.4937	.3417	.4152	.3041	.3223	-.4353	1.0000
% Organic matter	.1973	.4600	.3065	.4325	.3137	.2850	-.4616	.9893
	pH	P	Ca	Mg	Na	K	Bulk density	% Nitrogen

gradient (considered to show similar trends on account of their high inter-correlations). Community group B occupies an intermediate position between groups A and D (thus indicating its close floristic links with these groups). Community group C (an outlier) occupies an extreme position, separated from the others along the second (Na gradient) axis. This indicates that community group C represents communities with a narrow distribution range and contains species which are highly selective in their habitat requirements.

A synopsis of the main patterns of community group and species distribution with regards to the soil chemical variables follows.

Community group A

Fig. 1 indicates that community group A (communities 5-15) occurs in soils with high Ca, pH, P, K and Na values. Species associated with this group include differential and common species (Chapter 2, Table 1) such as Rhus crenata, Euphorbia mauritanica, Cynanchum obtusifolium, Putterlickia pyracantha, Cliffortia obcordata, Chironia baccifera, Olea exasperata, Erica coarctata, Anthospermum prostratum, Phylica ericoides, Pterocelastrus tricuspidatus, Helichrysum niveum, Ischyrolepis eleocharis (5-12, order Tetragonio-Ischyrolepidetalia eleocharis) and Imperata cylindrica (13-15, order Passerino-Chondropetaletalia tectorum).

Community group B

This community group (16-18) occurs in soils with intermediate Ca, pH, P and K levels but high Na levels. Species associated with this group include differential and common species such as Leucadendron levisanus, Cliffortia ericifolia and Chondropetalum tectorum (order Passerino-Chondropetaletalia tectorum).

Community group C

This community group (1-4) is found in soils with low Ca, pH, P, K and Na levels. This group constitutes the Tetragonio-Ruschietalia macowanii order with differential species being Willdenowia incurvata and Chrysanthemoides incana.

Community group D

This community group (19-25) occurs in soils which are low in Ca, pH, P, and K but rich in Na. Stoebe cf cinerea, Carpobrotus edulis, Phylica stipularis, Cliffortia polygonifolia, Crassula sp., Cliffortia falcata, Serruria fasciflora and Diastella proteoides are differential and common species of the Passerino-Cliffortietalia falcatae order (20-25). Community 19 (order Passerino-Chondropetaletalia tectorum) does not contain differential species but is dominated by Juncus krausii (not indicated on diagram).

Soil Ca levels range from 3.80 to 98.17 mmol/kg (mean 48.52

mmol/kg). Highly significant differences exist between the communities (see Table 1). Musil & Midgley (1990) found a range of 6.91 to 10.53 mmol/kg between different seasons in a Sand Plain Lowland Fynbos community at Pella. This compares well with an analogous community (22) which has a mean value of 7.83 mmol/kg.

pH values range from 3.73 (extremely acid) to the strongly alkaline value of 8.47 (mean 6.85). As indicated in Table 1, differences between communities are highly significant. The extreme acid value of 3.73 was recorded at Tokai Forest Reserve (community 20). Low (1983) and Musil & Midgley (1990) recorded average pH values of 4.25 and 4.40, respectively, for Sand Plain Lowland Fynbos communities. According to Salisbury & Ross (1978) soil pH generally ranges from 3-9.

Soil P values range from 0.15 to 29.35 ppm (mg/l) with a mean value of 12.49 ppm. Table 1 indicates that differences between the plant communities are highly significant. Soil P levels generally range from 0.001 to 20 ppm (Bidwell 1979).

K levels range from 0.28 to 1.94 mmol/kg (mean 1.08 mmol/kg). Differences between communities are highly significant (Table 1). Musil & Midgley (1990) recorded values ranging between 0.24 to 0.56 mmol/kg for a Sand Plain Lowland Fynbos community at Pella (analogous to

community 22 (0.37 mmol/kg)).

Na levels range from 3.25 to 8.90 mmol/kg (mean 5.14 mmol/kg). Highly significant differences exist between communities (Table 1). Comparative values for a Sand Plain Lowland Fynbos community at Pella (0.24 to 0.56 mmol/kg) (Musil & Midgley 1990) is much lower than the mean value (3.41 mmol/kg) of an analogous community (22).

Soil physical properties

The relationship between the overall CCA ordination of species, communities and the soil physical environmental variables (Fig. 2) is, as is the case with the soil chemical variables, statistically very significant (Monte Carlo permutation test, P = 0.01). The first and second axis eigenvalues are 0.464 and 0.348 respectively. This suggests a fairly good separation of the species along these axes. The high species-environment correlations for the first two axes (0.937 and 0.941) provides additional support. Table 4 shows the canonical and correlation coefficients of the environmental variables with the first two axes. The correlations indicate that the first axis mainly represents a bulk density gradient while the second axis mainly separates the species and communities along a soil drainage/moisture regime gradient. Also, the length of the environmental arrows suggests that bulk density, soil drainage/moisture regime, % medium sand and % fine sand are important in vegetation distribution. Although % coarse

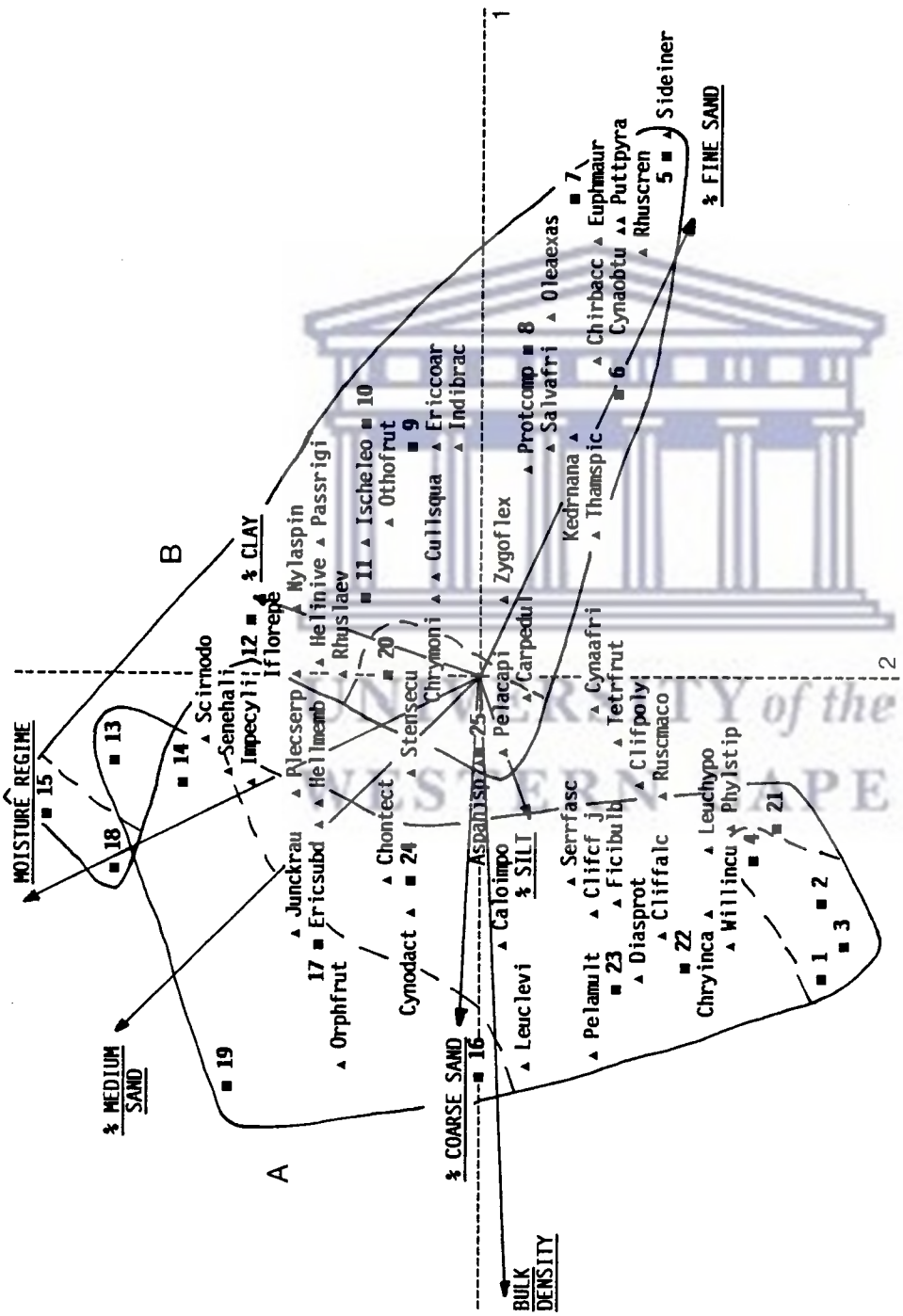

Fig. 2. Canonical correspondence analysis (CCA) diagram of species and communities with soil physical variables. The environmental variables are represented by arrows, species by ▲ and communities by ■ . Community groups A and B are encircled. Broken lines indicate communities of a specific order (refer to text). Eigenvalues: axis 1 = 0.464, axis 2 = 0.348. See Appendix 1 for full species names.

sand, % silt and % clay values were significantly different between communities (Table 1), they are not considered to be related to vegetation distribution.

The highest correlations between variables (Table 5) are between % fine and medium sand (r = -0.776) and between bulk density and % medium sand (r = 0.528).

Two main community groups (A and B) are delimited (Fig. 2). The diagram confirms that the groups are mainly separated along a bulk density gradient on the first axis, with community group A occurring in high bulk density soils. The communities within the groups are separated further along moisture regime, % medium sand and % fine sand gradients.

A synopsis of the main patterns of community group and species distribution with regards to the soil physical variables follows.

Community group A

The diagram (Fig. 2) indicates that this community group (1-4; 13-14, 16-17, 19; 21-24) represents communities occurring in soils with high bulk density, low (1-4; 21-24) to high (13-14, 16-17, 19) moisture status, low (1-4; 21; 16) to high (22-24; 13-14, 17, 19) % medium sand and low (1-4; 22-24; 16-17, 19) to high (21; 13-14) % fine sand.

Species associated with this group include differential and common species such as Willdenowia incurvata, Chrysanthemoides incana (1-4, order Tetragonio-Ruschietalia macowanii), Phylica stipularis, Cliffortia polygonifolia,

Table 4. Soil physical coefficients and correlations with the first two axes of CCA.

Axis variable	Coefficients		Correlations	
	Axis1	Axis2	Axis1	Axis2
Moisture regime	-0.4	0.5	-0.3	0.8
% Clay	0.1	0.1	0.1	0.4
% Silt	0	0	-0.2	-0.1
% Coarse sand	2.7	3.1	-0.5	0
% Medium sand	3.3	3.8	-0.5	0.7
% Fine sand	4.6	4.7	0.6	-0.4
Bulk density	-1.0	-0.6	-0.9	-0.1

Table 5. Correlation coefficients between soil physical variables.

	Moisture regime	%Clay	%Silt	%Coarse sand	%Medium sand	%Fine sand	Bulk density
Moisture regime	1.0000						
% Clay	.3077	1.0000					
% Silt	.0975	-.2870	1.0000				
% Coarse sand	-.0276	.0837	.0763	1.0000			
% Medium sand	.5008	.1409	-.0459	.1789	1.0000		
% Fine sand	-.3081	-.1638	-.0664	-.7545	-.7755	1.0000	
Bulk density	.1021	-.1595	-.1515	.3567	.5284	-.5486	1.0000

Calopsis impolitus, Pelargonium multicaule, Leucospermum hypophyllocarpodendron, Cliffortia falcata, Serruria fasciflora, Diastella proteoides, Erica subdivaricata, Cliffortia cf juniperina (21-24, order Passerino-Cliffortietalia falcatae), Imperata cylindrica, Leucadendron levisanus, Orphium frutescens, Chondropetalum tectorum and Juncus krausii (13-14, 16-17, 19, order Passerino-Chondropetaletalia tectorum).

Community group B

This community group (5-12; 20, 25; 15, 18) represents communities occurring in soils with low bulk density, low (5-10; 20, 25) to high (11-12; 15, 18) moisture status, low (5-7; 25; 18) to high (8-12; 20; 15) % medium sand and low (8-12; 20, 25; 15) to high (5-7; 18) % fine sand.

The differential and common species associated with this group include Rhus crenata, Sideroxylon inerme, Euphorbia mauritanica, Cynanchum obtusifolium, Putterlickia pyracantha, Chironia baccifera, Olea exasperata, Thamnochortus spicigerus, Kedrostis nana, Indigofera brachystachya, Erica coarctata, Cullumia squarrosa, Nylandtia spinosa, Helichrysum niveum, Ischyrolepis eleocharis, Passerina rigida, Chrysanthemoides monilifera, Otholobium fruticans, Zygophyllum flexuosum, Ifloga repens (5-12, order Tetragonio-Ischyrolepidetalia eleocharis), Carpobrotus edulis, Cynodon dactylon, Stenotaphrum secundatum (20, 25, order Passerino-Cliffortietalia falcatae), Imperata cylindrica, Chondropetalum tectorum,

Senecio halimifolius, Plecostachys serpyllifolia, Scirpus nodosus and Juncus krausii (15, 18, order Passerino-Chondropetaletalia tectorum).

Bulk density values range from 1.31 to 1.60 g/ml (mean 1.49 g/ml).

Values for % medium sand range from 1.99 to 53.57 % (mean 34.03 %) and those for % fine sand from 11.64 to 92.93 % (mean 46.46 %).

Differences between communities are highly significant (Table 1).

CONCLUSIONS

There are significant differences between communities with respect to most of the environmental variables.

Canonical correspondence analysis proved to be a useful procedure for analysing vegetation-soil relationships. Soil Ca, pH, P, K and Na levels, bulk density, moisture regime/drainage, % fine sand and % medium sand are important in determining these relationships.

The analyses of species-environment correlations and correlations of variables with the ordination axes indicate that the soil chemical variables are more important in determining relationships than are physical variables. Also, the community groups delimited in the ordination with soil chemical variables are much more homogeneous and are

more congruent with the phytosociological classification (Chapter 2, Table 1). However, the ordination with soil physical variables proved valuable in explaining the complex relationships between vegetation and soil further.

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GENERAL SUMMARY & RECOMMENDATIONS

GENERAL SUMMARY & RECOMMENDATIONS

The Braun-Blanquet approach of vegetation survey proved effective in identifying the plant communities of the priority conservation sites. The Code of Phytosociological Nomenclature was also successfully applied to the syntaxa delimited after successive refinement of the TWINSPAN classification. The plant communities of the twenty-one sites were grouped under the Ehrhartetea villosae Class, with twenty-five communities ultimately being recognised.

Vegetation maps of the study sites, indicating approximate community boundaries, were successfully drawn from 1:10 000 orthophoto maps.

There is a complex relationship between vegetation and soil chemical and physical properties. Analyses, however, indicated that the main soil properties determining vegetation-soil relationships are Ca, pH, P, K and Na levels, bulk density, moisture regime/soil drainage, % medium sand and % fine sand - chemical properties are regarded as being more important.

Representative samples of each community need to be conserved to ensure their future survival, thus cognisance should be taken of their distribution and area. Table 1 indicates that Driftsands Nature Reserve, Macassar Dunes, Rietvlei Flats, Rondebosch Commonage, Strandfontein-Mnandi Coastal Dunes and Tokai Forest Reserve are unique in that they contain restricted communities. These communities should thus receive the highest priority within the study

area. Driftsands Nature Reserve and the Macassar Dunes also contain the highest number of communities per site (8 and 5, respectively). Kenilworth Racecourse, Kraaifontein Forest Reserve and Eskom Powerline Reserve contain the highest concentrations of threatened species within the study area; these sites clearly play an important role in threatened plant conservation. Table 2 shows that the Eucleo-Oleetum exasperatae kedrostietosum (community 8) is quite extensive while the others are limited in extent (especially the Willdenowio-Ruschietum macowanii thamnochortetosum (community 2), Passerino-Cliffortietum hirtae (community 25) and Stenotaphro-Juncetum krausii cynodontetosum (community 19)). Thus, most of the communities are already threatened and need to be conserved at all costs (since their future viability depends on effective gene flow) while, if needed, integrated development proceed in an area containing communities (e.g. the Eucleo-Oleetum exasperatae kedrostietosum) which are well represented elsewhere.

Information on the plant communities of other priority conservation sites is also required. Investigations on the physiological tolerance ranges of the flora of the Rietvlei Flats area, in particular, could also prove interesting since those communities were clearly separated from the others in analyses. The long-term viability of the remnant communities needs to be investigated, taking into account aspects such as gene flow (through corridor linkages between remnant communities) and viable population sizes of, especially, threatened species.

Table 1. Distribution of plant communities and number of threatened species within priority conservation sites.

SITES	: COMMUNITIES	: NUMBER OF THREATENED SPECIES^
CAPE FLATS NATURE RESERVE EXTENSION	: 8, 11, 14	: 1
DRIFTSANDS NATURE RESERVE	: 6, 8, 11, 12*, 13*, 14, 15, 17	: 1~
DURBANVILLE RACECOURSE	: 22, 23	: 2
ESKOM POWERLINE RESERVE	: 22	: 7
KENILWORTH RACECOURSE	: 18, 24	: 19
KRAAIFONTEIN FOREST RESERVE	: 19, 23	: 8
MACASSAR DUNES	: 5*, 6, 7*, 8, 9	: 2
MILNERTON RACECOURSE	: 16, 22	: 2
MITCHELL'S PLAIN-KHAYELITSHA FLATS	: 8, 11	: 1
N7/N1 INTERCHANGE	: 16, 17, 22	: 4
NORTHPINE COMMONAGE	: 21	: 1
PELIKAN PARK-ZEEKOEVLEI FLATS	: 8, 9, 11, 15	: 1
PENHILL ESTATE	: 21	: 1
RIETVLEI FLATS	: 1*, 2*, 3*, 4*	: 3
ROCKLANDS DUNE	: 8, 9	: 1
RONDEBOSCH COMMONAGE	: 17, 19, 24, 25*	: 3
RONDEVLEI NATURE RESERVE	: 6, 8, 18	: 5
SIXTH BASE ORDINANCE DEPOT	: 14, 16, 17, 22	: 4
STRANDFONTEIN-MNANDI COASTAL DUNES	: 8, 9, 10*	: 0
TOKAI FOREST RESERVE	: 20*	: 1
WOLFGAT NATURE RESERVE	: 8, 9, 11	: 1

* - communities restricted to a site
^ - data from McDowell, C. & Low, B. 1990. Conservation priority survey of the Cape Flats. Unpublished report, University of the Western Cape, Bellville.
~ - new record

Table 2. Total area, species richness and distribution of communities.

Community number	Total area (ha)	Species richness	Number of sites	Location (area in ha)
1	5.8	5	1	Rietvlei Flats
2	0.87	9	1	Rietvlei Flats
3	34.5	14	1	Rietvlei Flats
4	3.16	17	1	Rietvlei Flats
5	1.37	32	1	Macassar Dunes
6	14.5	25	3	Rondevlei N.R.(13.65), Driftsands N.R.(0.63), Macassar Dunes(0.22)
7	2.35	35	1	Macassar Dunes
8	587.7	52	9	Driftsands N.R.(206.25), Wolfgat N.R.(115), Pelikan Park-Zeekoevlei Flats(111.45), Rondevlei N.R.(70), Macassar Dunes (50.42), Mitchell's Plain-Khayelitsha Flats(32.50), CFNR Ext.(12.60), Strandfontein-Mnandi Coastal Dunes(1.63), Rocklands Dune(0.45)
9	87.86	56	5	Strandfontein-Mnandi Coastal Dunes(33.50), Rocklands Dune(26.25), Pelikan Park-Zeekoevlei Flats(15.08), Wolfgat N.R.(11.10), Macassar Dunes(1.93)

Table 2 (cont.)

10	6.9	18	1	Strandfontein-Mnandi Coastal Dunes
11	6.1	34	5	Pelikan Park-Zeekoevlei Flats(2.33), Mitchell's Plain-Khayelitsha Flats(1.35), CFNR Ext.(1.33), Wolfgat N.R.(0.55), Driftsands N.R.(0.54)
12	13.92	24	1	Driftsands N.R.
13	1.05	12	1	Driftsands N.R.
14	56.33	16	3	Driftsands N.R.(55), CFNR Ext.(0.95), Sixth B.O.D.(0.38)
15	1.9	13	2	Pelikan Park-Zeekoevlei Flats(1.55), Driftsands N.R.(0.35)
16	21.5	40	3	Milnerton Racecourse(18.50), N 7 / N 1 Interchange(2.65), Sixth B.O.D.(0.35)
17	3.37	37	4	Sixth B.O.D.(1.65), N 7 / N 1 Interchange(0.75), Rondebosch Commonage(0.60), Driftsands N.R.(0.37),
18	2.9	19	2	Rondevlei N.R.(1.82), Kenilworth Racecourse(1.08)
19	0.92	14	2	Kraaifontein F.R.(0.65), Rondebosch Commonage(0.27)

Table 2 (cont.)

20	4.05	13	1	Tokai Forest Reserve
21	1.95	45	2	Penhill(1), Northpine Commonage(0.95)
22	35.18	69	5	Eskom Powerline Reserve(25.50), Durbanville Racecourse(4.75), Sixth B.O.D.(3.44), N 7 / N 1 Interchange(1.11), Milnerton Racecourse(0.38)
23	2.86	29	2	Kraaifontein F.R.(2.57), Durbanville Racecourse(0.29)
24	52.87	39	2	Kenilworth Racecourse(41.25), Rondebosch Commonage(11.62)
25	0.9	19	1	Rondebosch Commonage

N.R. = Nature Reserve
CFNR Ext. = Cape Flats Nature Reserve Extension
B.O.D. = Base Ordinance Depot
F.R. = Forest Reserve

APPENDIX 1

APPENDIX 1

Species abbreviations used in tables and ordination diagrammes (Specimen collection numbers - UWC Herbarium).

Anth aeth = Anthospermum aethiopicum L.
(C. Boucher/P. Shepherd 4540)

Anth pros = Anthospermum prostratum Sonder
(R.H. Compton 677)

Aspa cord = Aspalathus cordata (L.) R. Dahlgren

Aspa hisp = Aspalathus hispida Thunb.

Calo impo = Calopsis impolitus (Kunth) Linder
(Low 536)

Carp acin = Carpobrotus acinaciformis (L.) L. Bolus

Carp edul = Carpobrotus edulis (L.) N.E. Br.
(C. Boucher/P. Shepherd 4811)

Cass mari = Cassine maritima (Bolus) L. Bolus
(L. Willems 30)

Cass pera = Cassine peragua L.

Ceph proc = Cephalophyllum procumbens (Haw.) L. Bolus
(Dowry 4)

Chir bacc = Chironia baccifera L.

Chon micr = Chondropetalum microcarpum (Kunth) Pill.
(Low 812)

Chon nudu = Chondropetalum nudum Rottb.
(Low 377)

Chon tect = Chondropetalum tectorum (L.f.) Rafin.
(Low 55)

Chry inca = Chrysanthemoides incana (Burm. f.) Norlindh
(Low 291)

Chry moni = Chrysanthemoides monilifera (L.) Norlindh
(Moffett 2778)

Ciss cape = Cissampelos capensis L.f.
(C. Boucher/P. Shepherd 4934)

Clif cf j = Cliffortia c.f. C. juniperina L.f.
(C. Boucher/P. Shepherd 4790)

Clif eric = Cliffortia ericifolia L.f.

Clif falc = Cliffortia falcata L.f.
(A.B. Low 833)

Clif hirt = Cliffortia hirta Burm. f.
(Low 461)

Clif obco = Cliffortia obcordata L.f.
(Weitz 396)

Clif poly = Cliffortia polygonifolia L.
(C. Boucher/P. Shepherd 4556)

Colp comp = Colpoon compressum Bergius
(A.B. Low 300)

Cras sp. = Crassula sp.

Cull squa = Cullumia squarrosa (L.) R. Br.
(Low 81)

Cyna afri = Cynanchum africanum R. Br.
(C. Boucher/P. Shepherd 4591)

Cyna obtu = Cynanchum obtusifolium L.f.
(Low 405)

Cyno dact = Cynodon dactylon (L.) Pers.
(Low 772)

Dias prot = Diastella proteoides (L.) Druce
(C. Boucher/P. Shepherd 4287)

Ehrh caly = Ehrharta calycina Smith
(C. Boucher/P. Shepherd 4754)

Ehrh vill = Ehrharta villosa Schultes f.
(C. Boucher/P. Shepherd 4665)

Eric coar = Erica coarctata Wendl.
(G.D. Morris 236)

Eric cocc = Erica coccinea L.
(F. Weitz 60)

Eric subd = Erica subdivaricata Bergius
(A.B. Low 327)

Erio afri = Eriocephalus africanus L.

Eucl race = Euclea racemosa Murray
(Low 393)

Euph maur = Euphorbia mauritanica L.

Fici bulb = Ficinia bulbosa (L.) Nees
(Low 657)

Fici dune = Ficinia dunensis Levyns
(Low 477)

Heli nive = Helichrysum niveum (L.) Less.

Heli patu = Helichrysum patulum (L.) D. Don

Hell memb = Hellmuthia membranacea (Thunb.) R. Haines & K. Lye (Low 382)

Iflo repe = Ifloga repens (L.) Hilliard & B.L. Burtt.

Impe cyli = Imperata cylindrica (L.) Raeuschel
(Low 297)

Indi brac = Indigofera brachystachya E. Meyer
(Low 285)

Isch eleo = Ischyrolepis eleocharis (Nees) Linder
(Low 815a)

Junc krau = Juncus krausii Hochst.

Kedr nana = Kedrostis nana (Lam.) Cogn.

Leuc hypo = Leucospermum hypophyllocarpodendron (L.) Druce (Raitt 451)

Leuc levi = Leucadendron levisanus (L.) Bergius

(Raitt 765)

Ligh tene = Lightfootia tenella Lodd.

Meta muri = Metalasia muricata (L.) D. Don

(A.B. Low 322)

Nyla spin = Nylandtia spinosa (L.) Dumort.

(F.M. Weitz 508)

Olea exas = Olea exasperata Jacq.

(Engelbrecht 23)

Orph frut = Orphium frutescens (L.) E. Meyer

Otho coro = Othonna coronipifolia L.

(Low 422)

Otho frut = Otholobium fruticans (L.) Stirton

(M.C. Heginbotham 245)

Pass rigi = Passerina rigida Wikstrom

(Low 621)

Pass vulg = Passerina vulgaris Thoday

(F.M. Weitz 35a)

Pela betu = Pelargonium betulinum (L.) L'Her.

(Low 558)

Pela capi = Pelargonium capitatum (L.) L'Her.

(Low 421)

Pela mult = Pelargonium multicaule Jacq.

Pela tris = Pelargonium triste (L.) L'Her.

(C. Boucher/P. Shepherd 4593)

Phyl ceph = Phylica cephalantha Sonder

(A.B. Low 333)

Phyl eric = Phylica ericoides L.

(F. Weitz 86)

Phyl stip = Phylica stipularis L.

(Low 332)

Plag unio = Plagiochloa uniolae (L.f.) Adamson & Sprague

Plec serp = Plecostachys serpyllifolia (Bergius) Hilliard & B.L. Burtt.

Prot cape = Protasparagus capensis (L.) Oberm. (A.B. Low 337)

Prot comp = Protasparagus compactus (T.M. Salter) Oberm.

Pter tric = Pterocelastrus tricuspidatus (Lam.) Sonder (F. Weitz 75)

Putt pyra = Putterlickia pyracantha (L.) Szyszyl. (Low 418)

Rest cf b = Restio c.f. R. bifurcus Masters (Low 56)

Rhus cren = Rhus crenata Thunb.

Rhus glau = Rhus glauca Thunb.

Rhus laev = Rhus laevigata L. (Weitz 436)

Rhus luci = Rhus lucida L. (Weitz 440)

Rusc maco = Ruschia macowanii (L. Bolus) Schwantes (Dowry 28)

Salv afri = Salvia africana-lutea L. (Low 261)

Scir nodo = Scirpus nodosus Rottb. (Low 468)

Sene hali = Senecio halimifolius L. (Loubser 3926)

Serr cf t = Serruria c.f. S. trilopha Salisb. ex J. Knight

Serr fasc = Serruria fasciflora Salisb. ex J. Knight (Scheffler 5401)

Side iner = Sideroxylon inerme L.

Sola quad = Solanum quadrangulare Thunb. ex L.f.

Sten secu = Stenotaphrum secundatum (Walter) Kuntze
(E.C. Geduld 2)

Stoe capi = Stoebe capitata Bergius
(M. Thompson 19)

Stoe cf c = Stoebe c.f. S. cinerea Thunb.
(A.B. Low 372)

Stoe plum = Stoebe plumosa (L.) Thunb.
(Low 1312)

Stru stri = Struthiola striata Lam.
(Low 720)

Tetr frut = Tetragonia fruticosa L.
(L.E. Taylor 6014)

Tham luce = Thamnochortus lucens Poir.
(Low 151)

Tham spic = Thamnochortus spicigerus (Thunb.) Sprengel
(Low 272)

Thes spic = Thesium spicatum L.
(Low 545)

Visc cape = Viscum capense L.f.
(Low 580)

Will incu = Willdenowia incurvata (Thunb.) Linder
(Low 269)

Will tere = Willdenowia teres Thunb.
(A.B. Low 350)

Zygo flex = Zygophyllum flexuosum Ecklon & Zeyher
(S.M. Johnson 1393)

Zygo fulv = Zygophyllum fulvum L.
(Low 401)

APPENDIX 2

APPENDIX 2

Hierarchical classification of the plant communities occurring in priority conservation sites on the Cape Flats.

Class
- Subclass
  - Order
    - Alliance
      - Association
        - Subassociation

Ehrhartetea villosae
- Ehrharto-Tetragonienea fruticosae
  - Tetragonio-Ruschietalia macowanii
    - Ruschio-Willdenowion incurvatae
      - Willdenowio-Ruschietum macowanii
        - passerinetosum (comm 1)
        - thamnochortetosum (comm 2)
      - Willdenowio-Chrysanthemetum incanae (comm 3)
    - Ruschio-Tetragonion fruticosae
      - Ruschio-Tetragonietum fruticosae (comm 4)
  - Tetragonio-Ischyrolepidetalia eleocharis
    - Ischyrolepido-Eucleion racemosae
      - Eucleo-Protasparagetum compacti
        - salvietosum (comm 5)
        - cynanchetosum (comm 6)
      - Eucleo-Oleetum exasperatae
        - ericetosum (comm 7)
        - kedrostietosum (comm 8)
    - Ischyrolepido-Passerinion rigidae
      - Passerino-Phylicetum ericoidis
        - indigoferetosum (comm 9)
        - cullumietosum (comm 10)
      - Passerino-Rhoetum laevigatae
        - willdenowietosum (comm 11)
        - ficinietosum (comm 12)

Ehrharto-Passerinenea vulgaris
- Passerino-Chondropetaletalia tectorum
  - Chondropetalo-Imperation cylindricae
    - Imperato-Metalasietum muricatae
      - passerinetosum (comm 13)
      - rhoetosum (comm 14)
    - Imperato-Chondropetaletum tectorum (comm 15)
  - Chondropetalo-Cynodontion dactyli
    - Cynodonto-Chondropetaletum tectorum
      - leucadendretosum (comm 16)
      - juncetosum (comm 17)
    - Stenotaphro-Juncetum krausii
      - senecionetosum (comm 18)
      - cynodontetosum (comm 19)
- Passerino-Cliffortietalia falcatae
  - Cliffortio-Metalasion muricatae
    - Metalasio-Restionetum (comm 20)
    - Metalasio-Thamnochortetum lucentis
      - phylicetosum (comm 21)
      - calopsietosum (comm 22)
  - Cliffortio-Passerinion vulgaris
    - Passerino-Willdenowietum teretis
      - cliffortietosum (comm 23)
      - stenotaphretosum (comm 24)
    - Passerino-Cliffortietum hirtae (comm 25)