Phytosociology of northwestern KwaZulu-Natal

by

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Co-supervisor: Mrs. M.S. Deutschländer

In die begin het God die hemel en aarde geskep.

(Gen. 1:1)

Toe het God gesê: "Laat daar uit die aarde groenigheid voortkom, groen plante wat saad gee en vrugtebome op die aarde, wat elkeen na sy aard vrugte dra en waarvan die saad in sy vrug sit."

(Gen. 1:11)

Toe het God gesê: "Kom Ons maak die mens as Ons verteenwoordiger, Ons beeld."

(Gen. 1:26)

Verder het God gesê: "Let op! Ek gee aan julle al die plante wat saad gee op die hele aarde; ook al die bome wat vrugte dra en saad gee. Dit sal julle kos wees."

(Gen. 1:29)

Toe het God gekyk na alles wat Hy gemaak het en dit was baie goed.

(Gen. 1:31)

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To the Lord.

Abstract

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In depth studies of the vegetation of large parts of southern Africa, including detailed maps and descriptions of vegetation units are mainly limited to small areas. Meanwhile, various agricultural practises have led to destruction or deterioration of the quality of natural grassland ecosystems. The agricultural sector in developed and rapidly developing areas of southern Africa is confronted with problems like veld deterioration and the loss of natural areas that effectively contribute to the depopulation of rural areas.

The necessity to identify, classify and describe the vegetation types and communities within the Grassland Biome was stressed by Mentis and Huntley (1982). The aim of the Grassland Biome Project is to integrate knowledge, comprehension and expertise, which will enable scientists to forecast the results of the available options of grassland management programmes. The phytosociological classification of northwestern KwaZulu-Natal forms part of this project.

Known previous vegetation studies of this area were conducted on a large scale and a considerable time ago, which underlines the necessity for a more comprehensive and

phytosociologically refined investigation of this area.

The study area lies in the northern part of KwaZulu-Natal and comprises the Drakensberg mountains and slopes in the west and undulating plains and bushveld valleys in the east and south. Relevès were compiled in 526 stratified random sample plots over an area of 9300 km², comprising the northwestern part of KwaZulu-Natal. The vegetation was classified by means of TWINSPAN and Braun-Blanquet procedures.

A phytosociological investigation of this vegetation revealed great variation in floristic composition. Further refinement of the data disclosed five major vegetation types containing nine plant communities. The topography and geology of the study area contributes greatly to the diversity of the vegetation, but poor agricultural practises have caused deterioration of the vegetation.

Uittreksel

Fitososiologie van die Noordwestelike KwaZulu-Natal

deur

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Plantegroei studies van groot gedeeltes van Suid-Afrika, wat gedetaileerde kaarte en akkurate beskrywings van die plantegroei eenhede insluit, is meestal beperk tot klein areas. Die grasveld ekosisteme van Suid-Afrika word tans bedreig en vernietig deur verskeie landboupraktyke terwyl die landbou sektor in ontwikkelende areas van suidelike Afrika gekonfronteer word deur probleme soos agteruitgang van die veld en verlies van natuurlike areas. Hierdie faktore dra by tot die ontvolking van die platteland.

Mentis en Huntley (1982) het die noodsaaklikheid van die klassifikasie en beskrywing van plantegroeitipes en gemeenskappe in die Grasveldbioom van Suid-Afrika beklemtoon. Die doel van die Grasveld Bioom Projek is om kennis en kundigheid aangaande die doeltreffendheid van bestaande bestuursprogramme te versamel en te verwerk om sodoende akkurate voorspellings moontlik te maak. Die fitososiologiese klassifikasie van die noordwestelike KwaZulu-Natal vorm deel van hierdie projek. Bekende plantegroeistudies wat hierdie area insluit, is lank terug en op 'n groot skaal gedoen wat die noodsaaklikheid van 'n resente, fitososiologies verfynde klassifikasie beklemtoon.

Die studie area is geleë in die noordwestelike KwaZulu-Natal en sluit die Drakensberge en hange in die weste, sowel as golwende vlaktes en bosveld koppies in die ooste en suide in. 'n Totaal van 526 relevès is saamgestel in 'n area van ongeveer 9 300 km². Die data is geklassifiseer deur middel van TWINSPAN en Braun-Blanquet prosedures.

'n Ondersoek van die data het op groot variasies in die floristiese samestelling van die plantegroei gedui. By verdere ondersoek is vyf hoof plantegroei tipes met nege plantgemeenskappe geïdentifiseer. Die topografie en geologie van die studie area dra grootliks by tot die diversiteit in die plantegroei, maar swak boerdery praktyke het agteruitgang van die plantegroei tot gevolg gehad.

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Chapter 1: Introduction

South Africa is a land of great diversity regarding its climate and physiography. Ranges from desert with little rainfall and high temperature variations, to coastal forests with seasonal rainfall and humid, warm conditions, including plains, mountains, valleys and hills are found The result of this diversity is different habitat conditions and hence different vegetation types. These factors are responsible for the rich and varied flora that exists in South Africa (Germishuizen 1982). The disappearance of natural habitats and the danger of extinction of species are some of the consequences of mining, urbanisation, industrialisation and mismanagement and exploitation of natural resources.

The Grassland Biome covers approximately 27% of South Africa and is one of the most important agricultural areas, both in terms of extensive crop production and intensive stock farming (Mentis & Huntley 1982). The different kinds of exploitation and utilisation have had adverse effects on the grassland areas. Little of the natural vegetation is left and the remnants thereof are poorly conserved. The South African Grassland Biome Project was launched with the ultimate goal to produce a classification of the vegetation and an associated ecological interpretation. This should form a basis on which future programmes for natural resource management can be built, while conserving the natural resources of the area (Mentis & Huntley 1982; Scheepers 1986).

As an agricultural entity KwaZulu-Natal is the most intensively farmed regions in South Africa and has the highest investment and return per unit of area in the Republic of South Africa (Schulze 1982). Within the study area most of the farmers resort to stock farming, emphasising the need and importance of natural grassland. Crop production and cultivated fields only occur on a smaller scale.

Four nature reserves occur in the study area. The Rugged Glen Nature Reserve and Royal Natal National Park are situated on the extreme west of the study area on the border between the Free State and KwaZulu-Natal. Spioenkopdam Nature Reserve is situated

more centrally and Mfifiyela Nature Reserve occurs on the southern border of the study area. Afforestation is commencing in some areas and already two state forests have been declared namely Monks Cowl and Cathedral Peak State Forests.

The study area displays a diversity of topographic features. It includes the high altitude Drakensberg in the west as well as the lower foothills and the undulating plains situated more central as well as the valleys and hills to the east. Acocks (1953, 1988) conducted broadscale vegetation studies, which included the study area. The grassland of the study area comprises the largest part of the study area and conforms to the Southern Tall Grassveld (#65), described by Acocks (1953, 1988). It is dominated by *Themeda triandra* and *Hyparrhenia* species and can be divided into Open Thornveld that is dominated by *Acacia* species and Shrub Forest, which are dominated by various woody species.

The Southern Tall Grassveld is marginal and transitional to the Valley Bushveld (#23) which is found in the valleys of numerous rivers and dominated by species of a more tropical nature. These valleys are hot and receive less rain than the intervening ridges. The Valley Bushveld occurs as narrow belts on the steep, less arid, sides of the valleys, particularly towards the north.

Numerous papers were devoted to the phytosociology of the vegetation of different parts of the Grassland Biome. Some examples are Van Wyk & Bredenkamp 1986, Bezuidenhout 1988, Bloem 1988, Bredenkamp **et. al.** 1989, Turner 1989, Kooij 1990, Du Preez 1991, Matthews 1991, Fuls **et. al.** 1992, Smit 1992, Coetzee 1993 and Eckhardt 1993.

The northwestern part of KwaZulu-Natal was identified as an area where little or no phytosociological data exist. A phytosociological study of this area was proposed to contribute to a better understanding and knowledge of the Grassland biome. A study of this area was undertaken with the goals of the Grassland Biome Project in mind. The

collected data was therefore also used for the identification of potential conservation areas. The identification of such areas is considered most important by the Department of Environmental Affairs in ensuring the preservation of genetic resources and the diversity of species. Ultimately the results of all the phytosociological studies will be synthesised and a map of the vegetation units will be produced.

Chapter 2: Physical environment

2.1 The study area - physical and historical

The study area is situated in northwestern KwaZulu-Natal and extends from 28° 57'E to 30° 00'E and 28° 00'S to 29° 00'S (Figure 2.1). The Free State and Lesotho borders demarcate the western border of the study area. The study area covers approximately 9300 km² and embraces areas of different physiognomic appearances, such as the high Drakensberg in the west with the lower foothills, the undulating plains situated more centrally and valleys and hills to the east and south (Figure 2.2 & 2.3). This varied and complex physiognomy cause gradients along climatic and other natural factors, as well as a variety of edaphic, geological, human distribution and agricultural factors (Edwards 1967).

In the study area only two large towns occur, i.e. Ladysmith and Colenso, with Estcourt on the southern border of the study area, while smaller towns, such as Bergville and Winterton also occur in the area. Throughout the area large black settlement areas occur. Mkukwini, Zwelisha, Ezakheni, Bonjajeni and Kwamija are situated to the western part of the study area and Driefontein, Watersmeet, Peacetown, Kurkintulloch, White City and Danskraal are located close to Ladysmith.

From the beginning of the present century, disturbances to the natural environment became more enhanced, due to continued growth in the human population and expansion of commercial and agricultural enterprises. These disturbances have been most severe in the areas covered by black settlements due to relatively high human and livestock densities. Agriculture in these areas consists essentially of intensive pasturing and cultivation, often on small patches located on steep slopes. The veld is continuously overgrazed, which give rise to problems such as the stripping of the topsoil over large areas and subsequent erosion and deterioration of the vegetation, soil and human life standards.

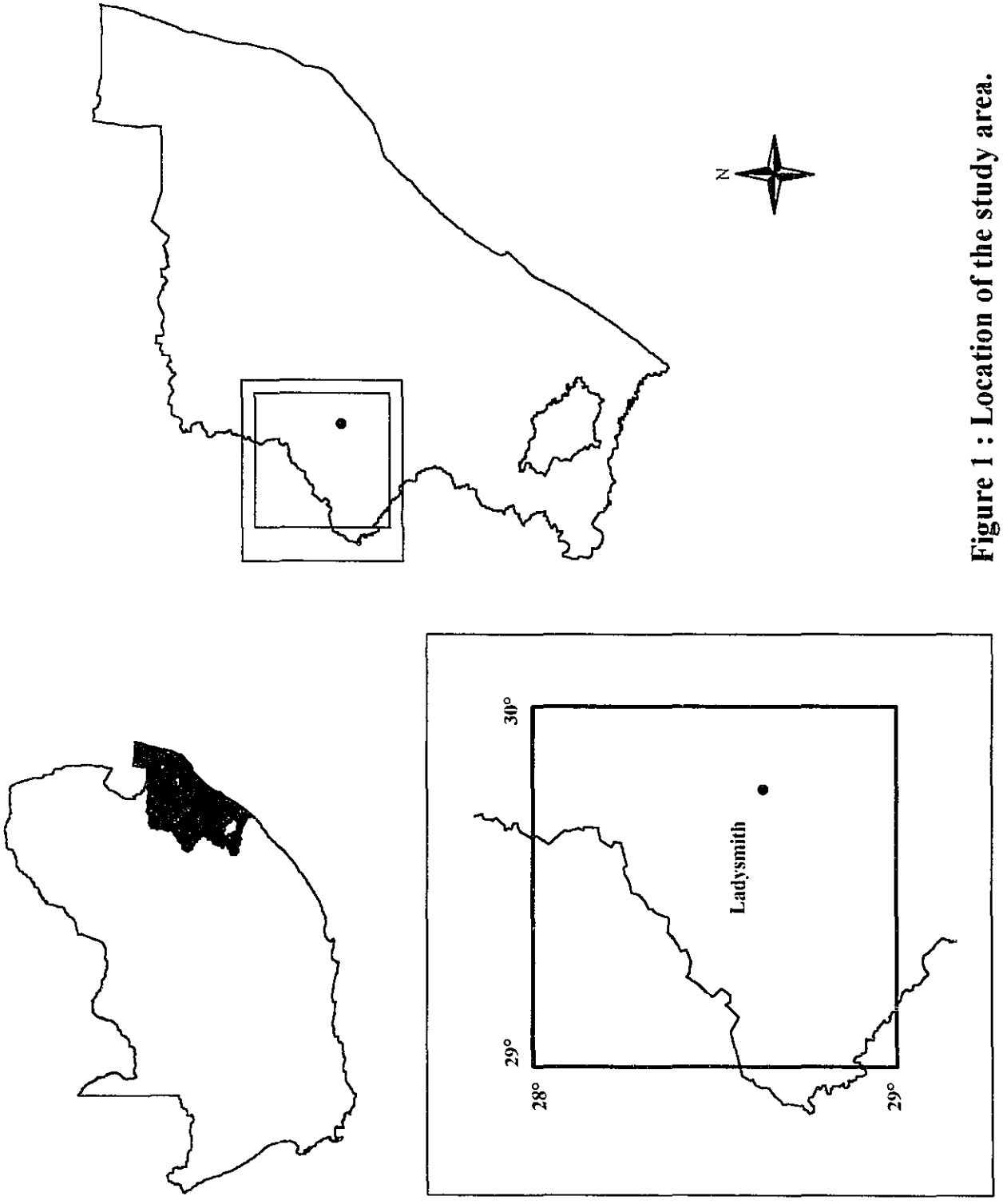


Figure 1 : Location of the study area.

Since earliest times of settlement there has been a general intensification of farming, reflected in the upward trend in stock numbers and areas under crop production as well as cultivation of commercial forests (Edwards 1967).

2.2 Physiography

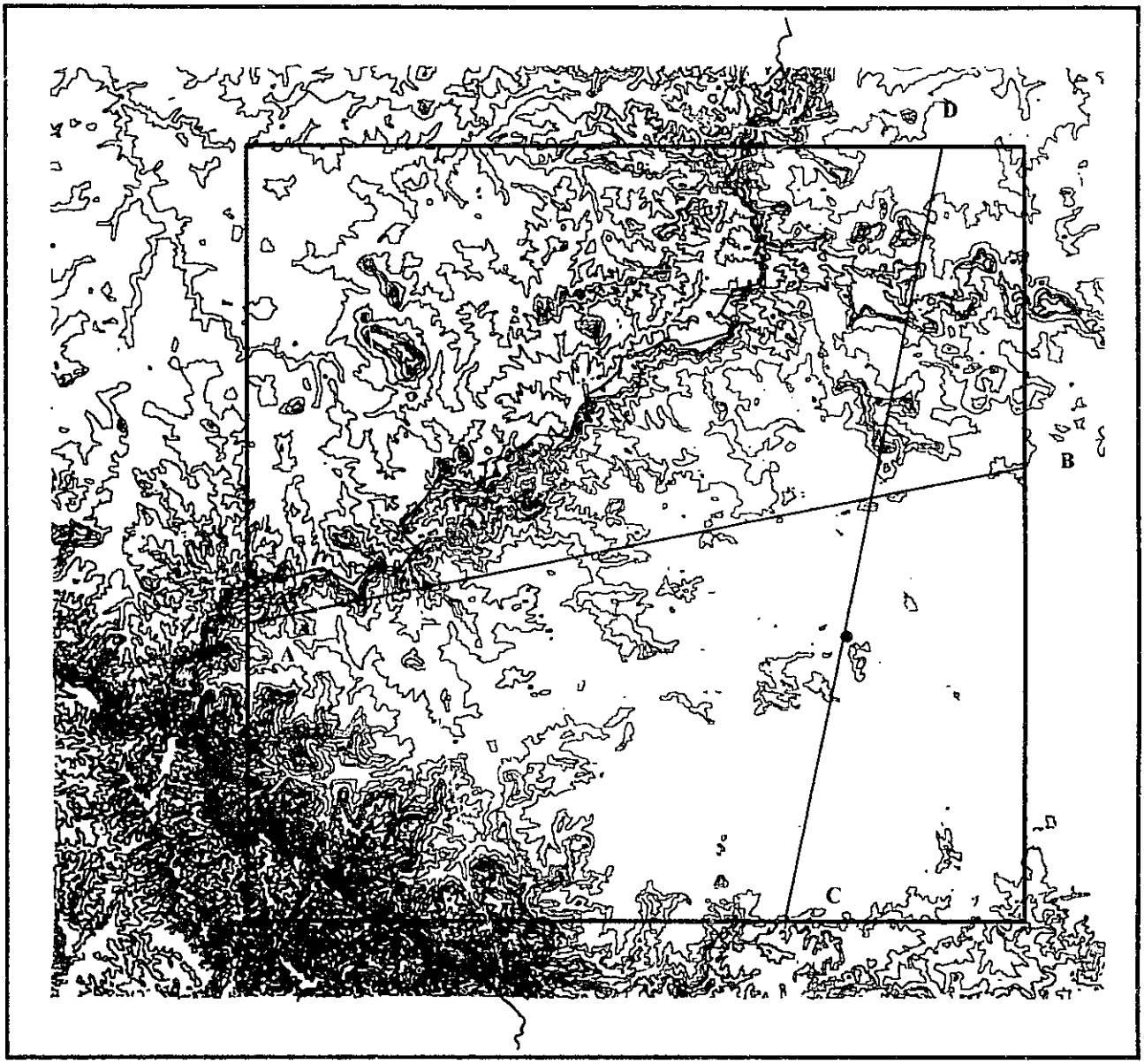
Morphologically, South Africa may be divided into the Interior Plateau and the surrounding Marginal Regions. The great escarpment that can be traced as an arc roughly parallel to the coast separates the two regions with the most impressive section, the Natal Drakensberg, in the east (Du Toit 1954, Wellington 1955).

KwaZulu-Natal, in particular, is noted for the variety of scenery presented by the varied physiography, ranging from mountains to plateaux, plains, deeply incised river valleys and coastal hinterlands (Phillips 1973). In 1967 Turner classified Natal into 49 physiographic regions of which eight occur in the study area. These eight regions can be grouped into four main physiographic regions, i.e. Mountain Regions, Plateau regions, Basin Plainlands and Low Lying Regions (Schulze 1982). The distribution of these areas are shown in Figure 2.4, with the key to the physiographic regions given in Table 2.1 (Phillips 1973).

a. The Mountain Regions

#1. The Lesotho Plateau and High Drakensberg Escarpment

This elevated plateau region known as Lesotho is the highest landmass in southern Africa. The surface of the plateau is bevelled across basalts of the Stormberg series; the widespread outpouring of lava which brought to a close, in early Jurassic times, the great accumulation of sediments known as the Karoo System. The lavas are exposed along the vertical face of the eastern escarpment - the High Drakensberg - that forms the KwaZulu-Natal Lesotho boundary. The plateau is tilted gently to the south-west and a system of perennial rivers and streams are fed by the high summer rainfall and heavy winter snows.



● Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Altitude

Altitude of the study area, contours 100m interval
750 - 1 100
1 100 - 1 450
1 450 - 1850
1 850 - 2 200
2 200 - 2 550
2 550 - 2 950
2 950 - 3 300

Figure 2.2 Contours of the study area (100m interval) with transects AB and CD (See Figure 2.3)

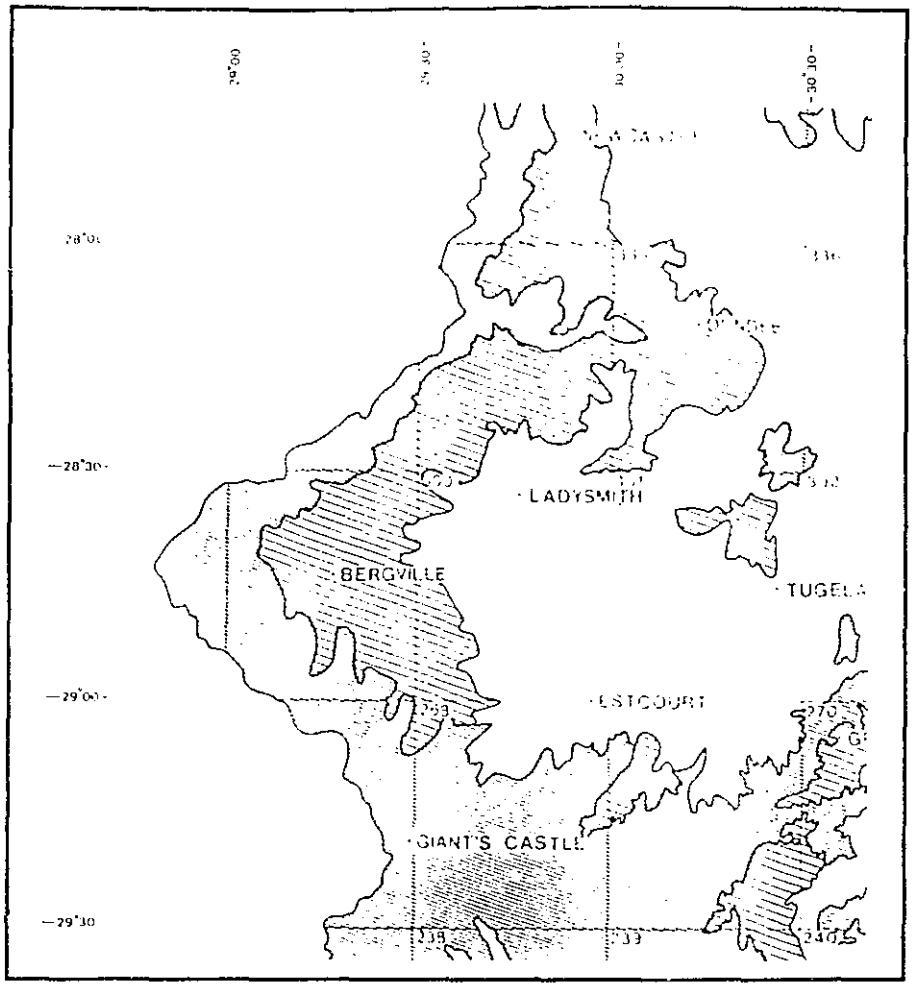


Figure 2.5 : Generalised soil potential of the study area (Schulze 1982).

#2. The Spurs and Foothills of the High Drakensberg

A borderland of spurs and foothills lies along the foot of the great escarpment. The area is deeply incised by the many streams and rivers which rise on the High Drakensberg. The more elevated points near the escarpment correlate with outliers that stand out above the highveld of the Free State farther to the north. The general level of this region is, however, the same as that of the highveld, and hence carries the so-called "African" landsurface of denudation.

#3. The Highveld of the Free State and the Low Drakensberg Escarpment

Between Mount aux Sources and Majuba, the highveld of the Free State is typical of the great interior of the plainlands of southern Africa. From the north to the south the highveld is bevelled across Beaufort and Ecca sediments. The border between KwaZulu-Natal and the Free State lies along the crest of an escarpment known as the Low Drakensberg.

#4. The Spurs and Foothills of the Low Drakensberg

A narrow zone of spurs and foothills extend along the entire length of the Low Drakensberg escarpment. These erosional features are carved in the shales and sandstones of the Beaufort and Ecca series. Moisture laden winds from the Indian Ocean are intercepted along the escarpment and dense clumps of indigenous forests nestle within its sheltered kloofs and ravines.

b. Plateau Regions

#7. The Biggarsberg Range

The narrow divide that separates the basin of the Buffalo from that of the Tugela River is known as the Biggarsberg. The remnant of the highveld is capped by strata of the Beaufort series, or in places by thick sills of intrusive Dolerite. The range is deeply dissected by a network of small streams.

c. Basin Plainlands

#17. The Winterton-Estcourt-Muden Plain

This region may be described as the transition country between the KwaZulu-Natal uplands and the Tugela thornveld. Beaufort beds extend well to the east of Estcourt, further east the underlying rocks are exposed. Several rivers that rise in the foothills of the High Drakensberg traverse this grassveld in the west.

#18. The Bergville-Ladysmith-Elandslaagte Plain

This, the northern part of the upper Tugela plainland, stretches from Bergville beyond Ladysmith to the extremely flat country in the vicinity of Elandslaagte. The underlying rocks are mainly Ecca, the upthrow of the Tugela fault being reflected in the displacement of the Beaufort contact. The discontinuity of the geological horizon between north and south is further evident in the appearance of a vast zone of Dolerite between Colenso and Ladysmith.

#22. The Ngagane Plain

This plain lies between the Biggarsberg and the low ridge of country the Horn and Incandu rivers, and extends westwards from the Dundee Plain to the Low Drakensberg escarpment. The underlying rocks belong to the Upper Ecca series and superficial deposits of the lateritic "ouklip" are widespread. High rainfall is noted along the foothills of the Drakensberg and the kloofs are filled with dense patches of indigenous forest.

d. Low-lying regions

#34. Valley of the Tugela River

The combined waters of its own catchment above Colenso have accomplished the spectacular excavation of this rugged and forbidding region. This stretch of the river is aligned along the great Tugela fault, a line of fracture and weakness in the underlying rocks which has contributed in the rapidity in which the valleys has advanced inland.

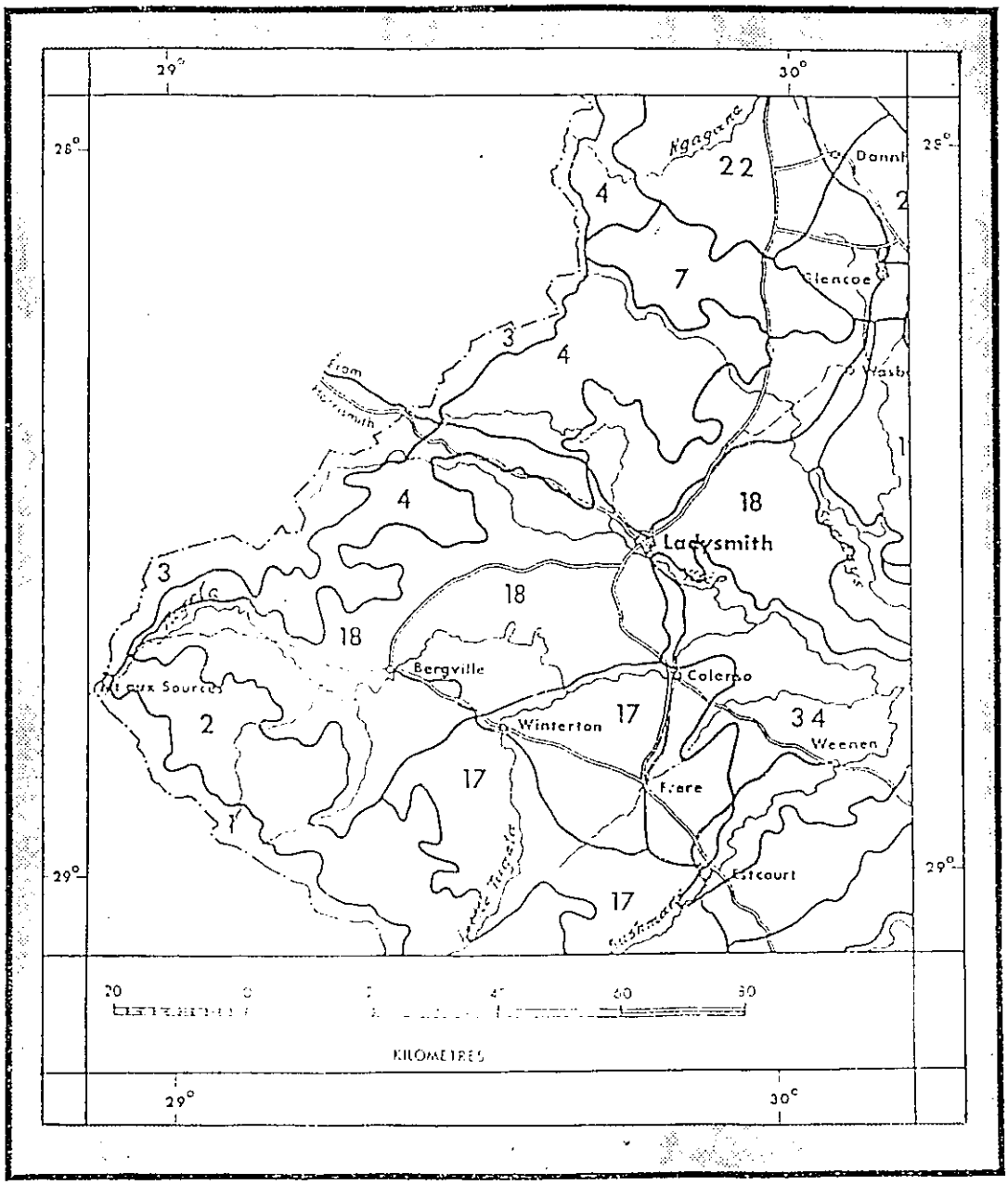


FIGURE 2.4 : PHYSIOGRAPHIC REGIONS OF THE STUDY AREA (AFTER EDWARDS

TABLE 2.1: KEY TO PHYSIOGRAPHIC REGIONS OF THE STUDY AREA AND SURROUNDING AREAS (AFTER TURNER 1967 AND FIELDWORKERS, SCHULZE 1979)

Region	Typical elevation (m)
A : Mountain Regions	
2 : Spurs & Foothills of the High Drakensberg	1 800 - 2 100 m
3 : OFS Highveld & Low Drakensberg Escarpment	2 000 - 2 100 m
4 : Foothills of the Low Drakensberg	1 350 - 1 800 m
B : Plateau Regions	
7 : Biggarsberg range	1 650 m
C : Basin Plainlands	
17: Winterton-Estcourt-Muden Plain	1 000 - 1 100 m
18: Bergville-Ladysmith-Elandslaagte Plain	1 150 - 1 200 m
22: Ngagane Plain	1 300 - 1 400 m
D : Low Lying Regions	
34: Valley of the Tugela River	100 - 800 m

The study area is situated in the Tugela Basin, which comprises approximately one third of the area of KwaZulu-Natal. Multitudes of small rivers originate in the higher Drakensberg and the lower foothills. The main river in the area, being the Tugela, has its origin in the Drakensberg and runs into the Woodstock dam as well as feeding the Spioenkop Dam, running through the main part of the study area. Smaller rivers, such as the Klip River, that runs through Ladysmith and N'kunzi also form part of the catchment area for the Tugela River.

The high-lying topography of the study area is dominated by the north-south running Drakensberg mountain range levelling out towards the east and south. Height above maritime sea level varies from 1 500 m to 1 000 m in the western mountainous and

northern part of the study area. In the southwestern part of the study area, along the Lesotho border, altitude reaches higher than 3 100 m a.m.s.l., but as a result of inaccessibility no relevès were compiled in this area and is effectively excluded from the rest of the area.

The slopes and foothills of the mountain extend into the undulating plains, valleys and hills in the central, eastern and southern part of the study area. The altitude varies between 900 and 1 400 m a.m.s.l.

2.3 Soil

At the time this data were compiled, the Landtype map for this region was not available and very little published data exists on soil types in the study area. Climatic differences are responsible for soils which have developed in widely diverging directions, while local differences in parent material and topographic position have caused the formation of many soil series with strongly contrasting characteristics (Edwards 1967).

Distrophic Ferralitic soils occur in the well drained upland areas because of the high rainfall and relatively low temperatures of these areas. The natural fertility of these soils is low, acidic and the plant nutrients present are virtually confined to the top soil, which is rich in organic matter. The chemical poverty, however, is balanced by favourable physical properties. In most places the soils are deep and subsoils very friable, pourose and permeable. In general erodability is low and a favourable comparison can be drawn between the Ferralittic soils and soils with a very high agricultural potential (Edwards 1967).

Distinction can be made between red and grey brown Ferralitic soils. The former has reddish brown topsoil, merging into dark red to yellowish subsoil (Phillips 1973). It has developed from Dolerite and forms deposits that are at least partly of doleritic origin. Soils of the second group have formed from shales or sandstone or deposits derived from these rocks. The grey brown topsoils are underlain by yellowish brown subsoil, which

however may turn reddish at deeper levels.

Fersialitic soils are predominant in the relatively moist parts of the Tugela Basin. Many of these Fersialitic soils are friable, pourose and permeable, for a considerable depth (Schulze 1982). Due to great variation in clay content and depth, the production potential level is lower than in the preceding soils, but rates are still high. Instead of mere loose concretions, the Fersialitic soils contain a layer of indurated ironstone ("ouklip"), often situated directly underneath the topsoil.

Next on the scale of decreasing weathering and leaching is the Clay pan soils, which have the greatest extension in the relatively dry part of the Interior Basin. These soils are characterised by grey brown acid topsoil on a dark grey to black, neutral to alkaline clay horizon (Schulze 1982). The topsoil is partly leached but base saturation increases with depth. The Clay pan soils are highly erodible and thus their agricultural potential limited because of extremely unpermeable subsoil.

A group of upland soils, showing a still lower degree of weathering and leaching is the Vertisols ("black turfs"). They have developed from dolerite or transported materials or pediments, which are partly of dolerite origin. These soils are mainly found in the driest parts of the Interior Basin. Due to their low permeability, the Vertisols are highly erodible and subsequently have a moderate agricultural potential (Schulze 1982).

The map depicting the generalised soil potential (Figure 2.5) should be interpreted with caution. It depicts only an overall regional soil potential, which may vary considerably within a region because of local topographical differences (Schulze 1982). Phillips (1973) divided the soils of the study area in the following zones (Table 2.2 & Figure 2.6).

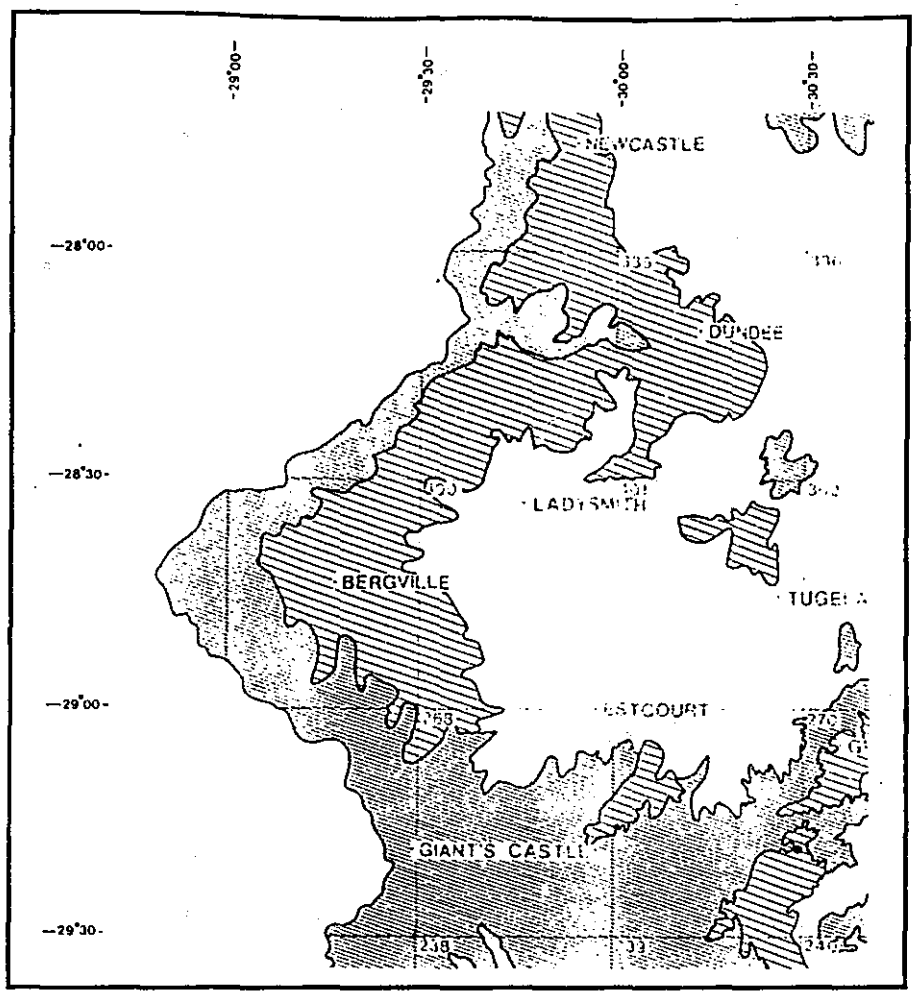


Figure 2.5 : Generalised soil potential of the study area (Schulze 1982).

TABLE 2.2: SOIL ZONES AND KEY SERIES FOR FIGURE 2.6

No.	Soil zones	Key series
1	Leached soils derived from Karoo rocks in the Highland Sourveld	Balmoral, Farningham, Doveton, Griffin, Clovelly, Mispah
3	Soils, many of which contain soft plinthite, derived from agrillaceous Karoo sediments.	Avalon, Southwold, Doveton, Shortlands
4	Soils, many of which contain soft or hard plinthite or a natric horizon, derived from arenaceous Karoo sediments	Leksand, Springfield, Dunbar, Klipfontein, Wasbank Uitvlugt, Wesselsnek, Longlands, Shortlands
5	Soils, most of which contains either plinthic or a natric horizon, derived from agrillaceous Karoo sediments in dry parts.	Avalon, Klipfontein, Estcourt, Shortlands
6	Sodic and calcareous soils derived from agrillaceous Karoo sediments	Estcourt, Arrochar, Bonheim, Rensburg, Arcadia
7	Sodic and calcareous soils derived from arenaceous Karoo sediments	Uitvlugt, Rensburg, Arcadia, Bonheim

2.4 Geology

At the time of the survey and synthesis, the geological map of the study area was not available. This information was obtained as digital data on a 1 : 1 000 000 scale at the Counsel of Geoscience (1997). The geological structure of the study area consists essentially of younger, predominantly sedimentary members of the Karoo system, resting upon a number of ancient, folded, intrusive and intensely metamorphosed formations of the Archaean Basement Complex (Edwards 1967). Geological formations present in the study area are indicated in Figure 2.7 and include the following:

- Vryheid Formation
- Karoo Dolerite
- Volksrust Formation
- Beaufort Group
- Tarkastad Sub-group
- Drakensberg Group.

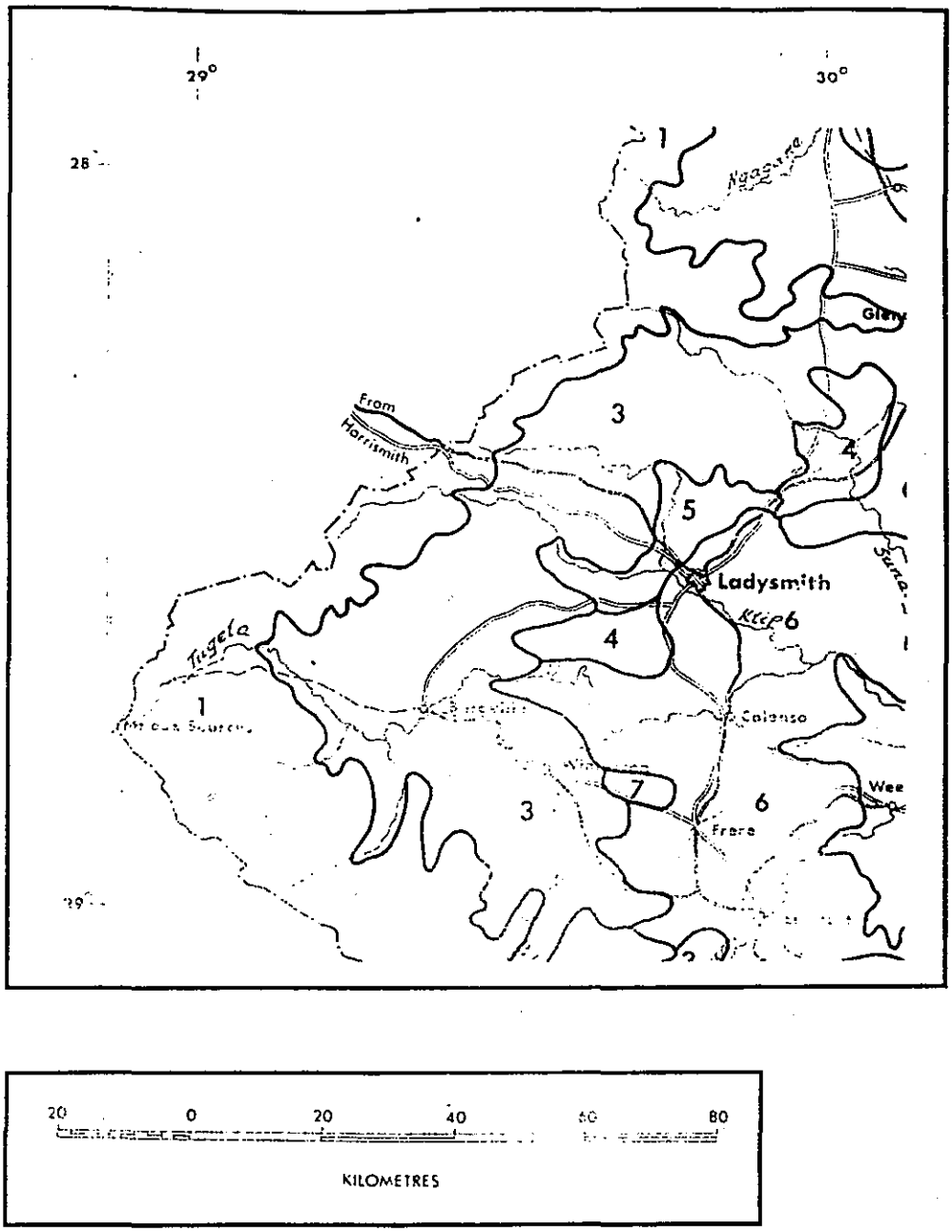


Figure 2.6 : Soil zone map of the study area and surrounding area (Phillips 1973) (For explanation see Table 2.2).

The dominant geological group in the study area is the Karoo Supergroup, comprising alternating bands of fine-grained sandstone, shale and mudstone that were deposited in the slowly subsiding Karoo Basin. The Karoo sedimentation was ended by an extrusion of the volcanic basalt lavas of the Drakensberg Group. At the same time the Karoo sedimentary rocks were intensively intruded by dykes, sills and inclined sheets of Dolerite (Johnson **et. al.** 1976).

The Karoo System occupies about half the area of South Africa and completely covers the study area. It is entirely of continental origin and is subdivided into the Dwyka-, Ecca-, Beaufort- and Stormberg series (Du Toit 1954, King 1972). The Ecca Series is exposed in two belts with the monocline between them. This series is subdivided into three groups. The dark blue to green Lower Ecca shales, resting evenly and sharply on the tillite formed as a periglacial deposit. The Middle Ecca Beds or Coal Measures are the dominant member of the series, covering the largest area, with the Upper Ecca being formed under lacustrine conditions.

- The Lower Ecca, also referred to as the Vryheid formation by SACS (1980), is a periglacial lacustrine deposit on Tillite (Dwyka) (Van der Eyk **et. al.** 1969). It occurs to the south of Newcastle in the Kilbarchan area (Visser & Bishopp, 1976). The shale is fine, laminated and uniformly bleached.

- The Middle Ecca beds are fluviatile and deltaic deposits (Van der Eyk **et. al.** 1969), which, due to the presence of coal bearing seams, are referred to as "Coal Measures". According to Visser & Bishopp (1976), the greatest part of the sheet area lying below the Great Escarpment is occupied by Middle Ecca sediment with numerous dolerite intrusions. It consists mainly of sandstone that is of the Vryheid formation (Land Type Survey Staff 1990). The beds are thick, whitish to yellowish in colour, and fine to coarse grained. Micaceous and felspathic varieties are common, while sandstone alternate with softer micaceous flagstones and sandy shale layers.

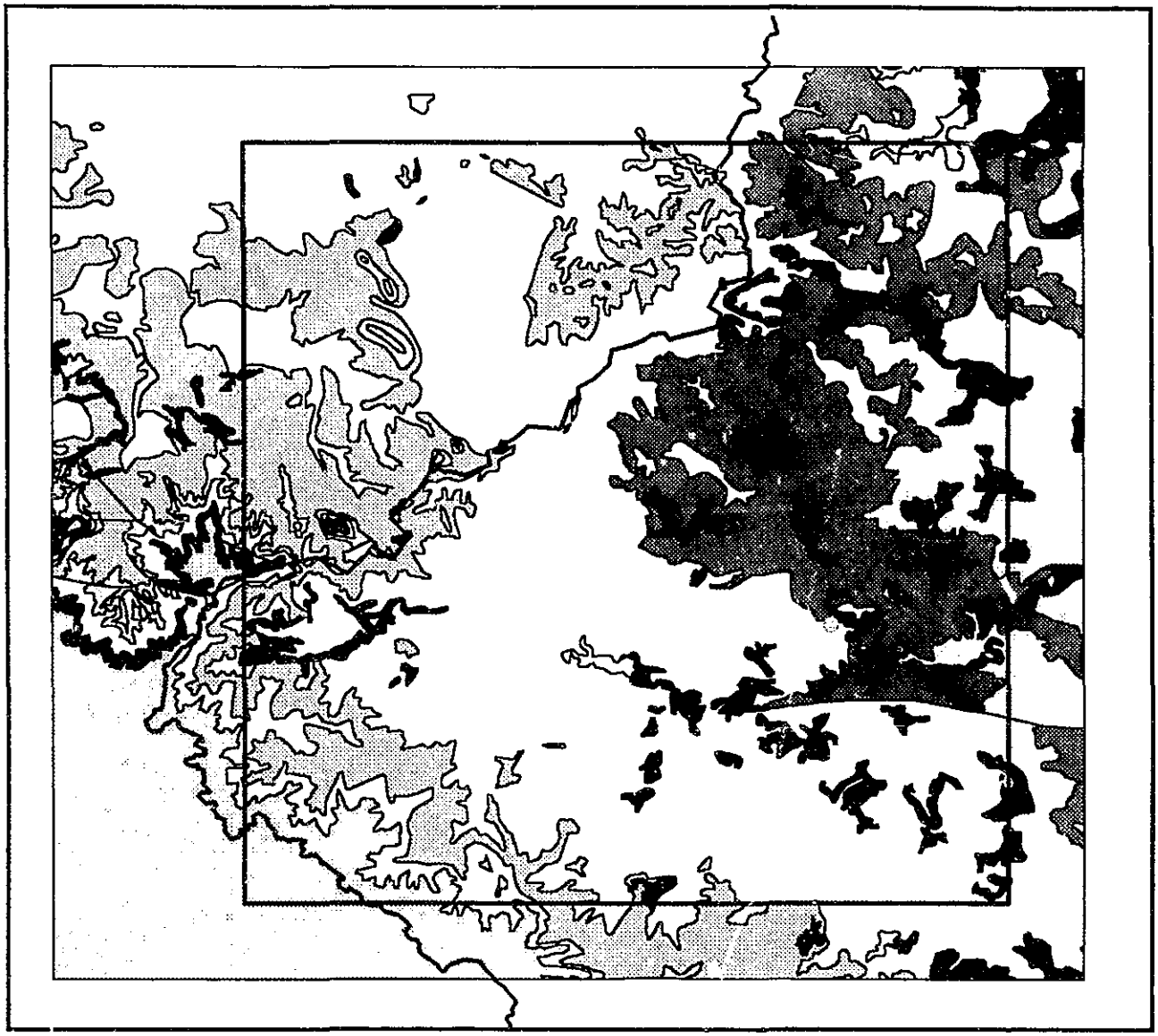


Figure 2.7: Geological map of the study area.

Conglomerate bands occur sporadic at or near the base (Van der Eyk **et. al.** 1969, Visser & Bishopp 1976). Most of the shale in which the coal seams occur is well-bedded (Visser & Bishopp 1976). These beds occur in the study area in the region referred to as the Plainlands. The thick upper sandstone layer of the lower transition zone is a prominent topographical feature (Visser & Bishopp 1976).

- The Upper Ecca Stage, termed the Volksrust Shale Formation by SACS (1980), was deposited under lacustrine conditions (Van der Eyk **et. al.** 1969). This formation forms a belt along the foothills of the Drakensberg and varies in width. The base of the Upper Ecca Stage is not well defined along the escarpment, due to the soft beds at the top of the Middle Ecca Stage (Visser & Bishopp 1976). The main constituent is blue-black to blue-grey shale, which weathers very easily. The weathered shale, and that bleached by intrusive dolerite, is buff or yellow.

The Beaufort Series was formed in the late perian to mid-triassic time period and rests upon Upper Ecca shales surrounding the Lesotho plateau. It occupies approximately 25% of the Tugela Basin and includes the Low Drakensberg (Van der Eyk **et. al.** 1969). Visser & Bishopp (1976) recognise three groups of this series.

- The Lower Beaufort Stage or the Adelaide Subgroup (SACS 1980) sediments form the greatest part of the Great Escarpment (Visser & Bishopp 1976). Prominent sandstone bands mark the contact between Lower Beaufort and Upper Ecca, provided it is not covered with scree. Arenaceous sediments, very similar to those of the Upper Ecca, predominate in the lower portion of the Lower Beaufort and form prominent cliffs and ledges.

Light coloured fine to medium-grained feldspathic sandstone bands with lenticular grid layers alternate with blueish or buff sandy shale or blue shale. Sandy, micaceous, poorly bedded shale and mudstone with some intercalated bands of sandstone constitute the rest of the Lower Beaufort Stage. The sandstone is easily observed in the landscape, while the

blueish to greenish grey and buff scaly strata weathers rather easily to sandy clays (Visser & Bishopp 1976). Thin bands of carbonaceous shale in which plant impressions occur are found in the coal seams.

- The Middle Beaufort Stage occurs west of the Great Escarpment at altitudes of approximately 2 000 m. It consists mainly of resistant sandstone with few scaly bands forming the capping of a dissected plateau. Characteristics of this sandstone are the grit layers and lavas that contain angular pieces of feldspar, pebbles and pieces of bone. Clay pellet conglomerate is commonly found with the grit, while small ferruginous partings give rise to lateritic material on bare weathered surfaces (Visser & Bishopp 1976).

- Only a few outliers of the Upper Beaufort Stage occur on secondary watersheds. It consists mainly of mudstone with a couple of thin bands of greenish, grey sandstone or sandy shale (Visser & Bishopp 1976).

The Stormberg Series consists of sediments overlain by volcanic lavas. The former was exposed in the great spurs protruding from the High Drakensberg and in isolated mesas nearby. Three groups of sediments are distinguished.

- The Molteno beds, following conformably upon the upper Beaufort, are dominated by coarse grained, felspathic, "glittering" sandstone.
- The Red beds are mainly formed by purple and red mudstone and shales.
- The Cave Sandstone is an extraordinary uniform rock, consisting of white, pale yellow or pink massive fine-grained sandstone made of rounded quartz grains. These sediments are mid- to late-Triassic in age whereas the Molteno and Red Beds were of fluviatile and lacustrine origin, the cave sandstone formed from windblown sand, was probably of desert origin.

During the late-Triassic the Karoo sediments were crowned with the Stormberg lavas. These volcanic beds constitute the Lesotho plateau, bonding the Tugela Basin in the west.

Although exposed to weathering for some 100 million years, their thickness in the high Drakensberg is still 1 300 - 1 450 m. The lavas consist of a great number of evenly superposed flows, ranging in thickness from a few feet to over 50 m. The rock is brownish or purplish grey to black basalt, consisting of alternating compact and highly amygdaloidal varieties.

2.5 Climate

Van der Eyk **et. al.** (1969) describes the climate of KwaZulu-Natal as warm, temperate and rainy. The study area lies in the high rainfall area of South Africa (Weather Bureau, 1986). According to Köppen's classification the climate is mainly of the Cwb Type, a warm, temperate, rainy with markedly dry winters and warm summers (Köppen & Geiger 1936). Temperature and rainfall in the study area are greatly influenced by altitude and topographical ranges.

Climatological data were obtained from The Institute for Soil, Climate and Water (1994), and used in conjunction with certain maps from Schulze (1982). Rainfall and temperature data were only used when the station's credibility exceeded 75%. The Institute for Soil, Climate and Water divided the study area into 16 homogenous climate zones according to rainfall and temperature criteria.

Climatic diagrams for selected areas and climate zones are represented in Figure 2.8. Additional data for all the climate zones are available in Tables 2.3, 2.4 & 2.5 (The Institute for Soil, Climate and Water 1994).

2.5.1 Precipitation

Schulze and McGee (1978) considered water to be the most important climatic parameter that influences the gross features of the vegetation differences on earth. The reservoir of soil water available for plantlife is derived in the form of rainfall, fog, snow and hail.

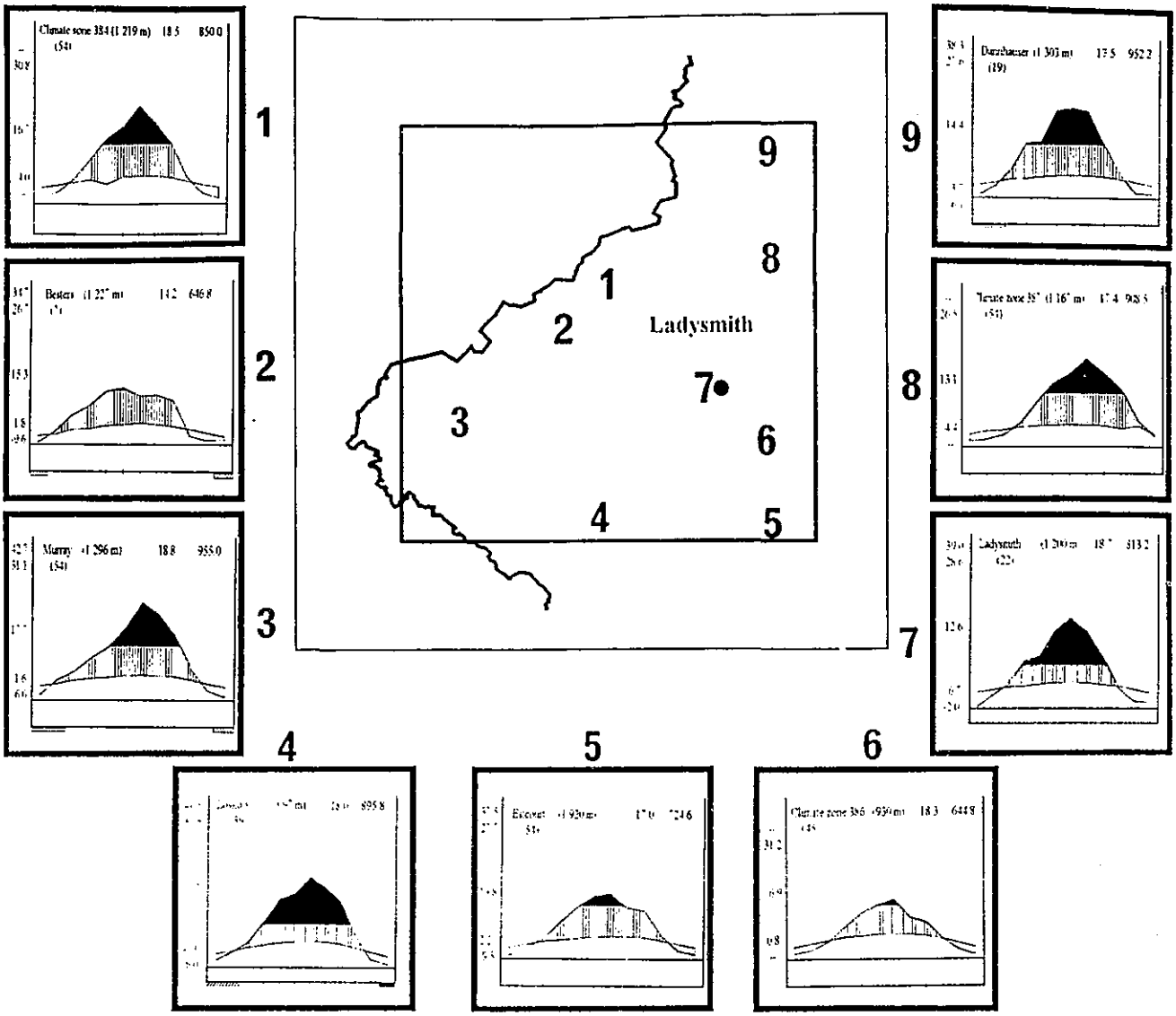
2.5.1.1 Rainfall

The mean annual precipitation (MAP) characterises the quantity of water that is available to a region in the long run. It therefore gives an upper limit to the agricultural potential of a region, if other factors are in no way limiting to growth (Van der Eyk **et. al.** 1969).

The study area lies in a summer rainfall area where part of the precipitation is of orographic origin, especially in the beginning of summer. Later in the season precipitation results from convectional instability (Van der Eyk **et. al.** 1969). The highest MAP recorded in the area is in the high Drakensberg at Cathedral Peak rainfall station (1 500 mm per annum). The mountain areas clearly receive a higher annual precipitation than the other areas, such as the Tugela Ferry rainfall station, where the lowest figure was recorded (650 mm). A distinct rainfall gradient can be observed, leading from west to east, from the high mountain areas to the low plains in the east.

The main growing season, according to Schulze (1982), starts as early as the beginning of October in the high mountain areas, but only as late as middle November in the Bergville area. The length of the moisture growing season, derived as the time between the beginning and the end of the moisture growing season varies, depending on the soil moisture balance of the area. For the greater part of the study area, the average time for the moisture growing season to start is the beginning of November. High rainfall areas correspond significantly with areas where the moisture growing season starts early, as well as areas with a long moisture growing season, like the mountain areas, despite being frequently exposed to frost. The growing season can be up to 250 days.

In certain areas of Natal, there is often a humid period, when precipitation exceeds evapotranspiration. When this period ends plants begin to draw upon moisture stored in the soil. The moisture growing season ends in the beginning of April in the drier parts of northern Natal around Dundee and Newcastle, while extending through June and July in the west of the study area. However, in these high elevation areas growth would probably cease earlier than June or July because of the incidence of frost.



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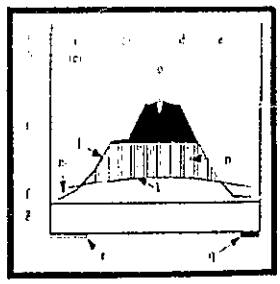


Twelve month period starts with July on left hand side. (a) Name of station; (b) Altitude (m); (c) Number of years of observation; (d) Mean annual temperature; (e) Mean annual precipitation (mm); (f) Mean daily minimum temperature of coldest month; (g) Absolute minimum temperature; (h) Mean daily maximum temperature of hottest month; (i) Absolute maximum temperature; (j) Mean range of temperature; (k) Curve of mean monthly temperature (1unit = 10°C); (l) Curve of mean monthly precipitation (1 unit = 20mm); (m) Dry season; (n) Wet season; (o) Mean monthly precipitation over 100 mm per month; (q) Months with mean daily minimum temperature under 0°C; (r) Months with absolute daily minimum temperature under 0°C.

FIGURE 2.8 : CLIMATIC DIAGRAMS FOR SELECTED AREAS AND CLIMATE ZONES IN THE STUDY AREA.

2.5.1.2 Fog

Fog is an important ecological agent if taken into account that at the foothill of the Drakensberg, the orographic fog contribution is an additional 403 mm per annum, which is a third of the annual precipitation (Schulze & McGee 1978). Though fog often occurs in the mountain regions, this figure may be considerably less for the greater part of the study area. The coalescence of fog droplets on foliage and branches of trees leads to dripping on the ground and thus contributes to soil moisture (Deall **et. al.** 1989). Schulze & McGee (1978) stated that summer fog predominates in the summer rainfall areas, but the occurrence of winter fog in the early mornings in the low-lying basin plainlands is commonly observed. This fog is the result of cold-air drainage on calm winter nights (Deall **et. al.** 1989).

2.5.1.3 Snow

In South Africa snow occurs sporadically. Along the Drakensberg escarpment it falls mainly during May to August. The contribution of snow to soil moisture can therefore be regarded as minimal.

2.5.1.4 Hail

Convectional thunderstorms are often accompanied by hail, but does not contribute significantly to soil moisture. Its damaging effect on indigenous vegetation is also minimal. According to Tyson **et. al.** (1976), the Natal escarpment experiences more than 100 days on which thunderstorms are recorded and only eight on which hail is recorded. These numbers decrease with increasing distance from the Drakensberg, from which can be assumed that the occurrence of hail will be minimal in the greater part of the study area. The highest occurrence of hail is during November and December.

TABLE 2.3: INFORMATION FOR RAINFALL STATIONS IN THE STUDY AREA

Zone #	Years of data	Alt. (m.)	Lat / Long	M.A.P.	Station
360	23	1974	29° 00'S 29° 13'E	1510.8	Cathedral peak
371	41	1463	28° 57'S 29° 12'E	1300.0	Cathedral peak
372	73	1520	29° 10'S 29° 52'E	882.7	Lowland
375	53	1167	29° 01'S 29° 29'E	910.8	Heartsease
376	50	1280	28° 40'S 29° 02'E	998.6	Clifford Chamber
377	45	1130	28° 44'S 29° 21'E	740.9	Bergville
378	47	1220	28° 38'S 29° 27'E	707.8	Venterslaager
379	55	1768	28° 32'S 29° 00'E	766.3	Boschkloof
382	66	1769	27° 58'S 29° 08'E	694.5	Buckland Downs
383	49	1654	27° 28'S 29° 54'E	1006.1	Laingsnek
384	54	1219	28° 24'S 29° 37'E	850.0	Mooreside
385	44	1158	28° 33'S 30° 25'E	762.9	Residence
386	45	594	28° 45'S 30° 27'E	644.8	Tugela Ferry
387	54	1167	28° 15'S 28° 58'E	908.5	Balbrogie
388	47	1295	28° 11'S 30° 09'E	794.5	Glencoe
526	53	1265	27° 46'S 30° 25'E	695.9	Waaihoek

2.5.2 Temperature

Tables 2.4 & 2.5 give information for temperature figures in the different climate zones. According to Schulze & McGee (1978), temperature as such is not a significant factor in determining major regional differences in vegetation. It is however a basic climatological parameter, used as a control by which nature limits man's agricultural activities (Schulze 1982). What is important is the direct influence on water availability and thus temperature plays, on a meso- and microscale, a role in determining floristic variations.

It cannot be argued that temperature influences rate of plant growth and other physical processes, while certain plant mechanisms have adapted to seasonal and/or diurnal temperature fluctuations. Summer maxima and winter minima are regarded as more important in determining plant distribution (Schulze 1982, Schulze & McGee 1978)

Schulze (1982) pointed out that high and low temperatures are closely related to the physiographic divisions of Natal. According to this statement the low-lying areas will be characterised by higher temperatures, while the higher foothills and the high mountain areas will be characterised by relatively lower temperatures. Information regarding mean monthly maximum and minimum temperature data and temperature stations is given in Tables 2.4 & 2.5.

2.6. Vegetation

The veld types described by Acocks (1988) and vegetation types by Low and Rebelo (1996) are depicted in Figure 2.9 & 2.10 respectively. The main part of the study area is described by Acocks as Southern Tall Grassveld (#65), dominated by *Themeda* and *Hyparrhenia*. Altitude ranges from 600 to 1 350 m a.m.s.l., though below 1 050 m a.m.s.l. the veld is transitional to Valley Bushveld (#23).

Two variations are recognised in the Southern Tall Grassveld, namely Open Thornveld and Scrub Forest, both of which occur in the study area. The Open Thornveld is an open savanna of *Acacia sieberiana* in sourish mixed grassveld with patches of *Hyparrhenia* species. Erodible subsoil is present with shallow topsoil, causing severe erosion in some areas. Hillsides and the deeper valleys have an *Acacia caffra* savanna, which is marginal to the Valley Bushveld. This savanna appears to be natural, but is slowly spreading up the valleys. The Scrub Forest is dominated by woody species and is present throughout the study area.

The Natal Sour Sandveld (Acocks #66) is present on poorly drained, shallow, sandy soils. It is generally a very open savanna of *Acacia sieberiana* in a poor sourveld. The Scrub Forest of the hills is similar to that of the Southern Tall Grassveld, but rather more tropical. Granger (1996) described both these veld types as Natal Central Bushveld (#25), an open savanna with scattered *Acacia sieberiana* trees, a variable herbaceous layer and secondary grassland. Granger (1996) concluded that this vegetation type is highly transformed and poorly conserved and because of intensive grazing and fire, it requires careful management.

TABLE 2.4: GENERAL INFORMATION FOR TEMPERATURE STATIONS IN STUDY AREA

Zone		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
360	Max	21.4	21.1	20.5	18.9	16.6	14.5	14.6	16.9	19.6	20.0	20.3	21.3
	Min	12.6	12.5	11.9	9.5	7.5	5.4	5.0	6.3	8.1	9.2	10.3	11.8
371	Max	25.9	25.5	24.3	21.9	20.4	18.4	18.8	19.8	22.8	22.4	24.7	25.3
	Min	14.1	4.2	13.0	9.6	6.2	3.5	3.8	5.4	8.7	9.8	11.7	13.2
372	Max	25.9	6.5	5.2	2.6	21.3	19.5	20.0	22.0	25.1	23.8	23.9	26.5
	Min	13.1	3.2	10.8	7.0	1.7	-2.2	-2.4	0.0	5.5	9.7	10.5	11.9
375	Max	32.1	3.1	0.8	8.6	26.1	23.4	23.8	25.6	27.0	29.2	31.0	32.3
	Min	15.3	5.4	13.1	9.2	4.5	0.2	0.7	4.2	8.0	11.1	13.0	14.6
376	Max	30.7	30.8	8.5	6.5	24.1	22.2	22.5	24.9	7.1	28.3	30.0	31.6
	Min	15.5	5.8	14.4	0.7	6.7	4.2	4.0	6.7	8.8	12.2	13.3	14.8
377	Max	30.6	1.2	0.3	28.9	26.7	24.8	25.2	26.8	7.9	29.8	30.4	31.4
	Min	14.9	15.4	3.4	9.3	3.3	0.6	0.4	3.1	7.2	10.7	12.4	14.1
378	Max	30.7	30.8	8.5	6.5	24.1	22.2	22.5	24.9	7.1	28.3	30.0	31.6
	Min	15.5	5.8	4.4	0.7	6.7	4.2	4.0	6.7	8.8	12.2	13.3	14.8
379	Max	26.5	4.7	25.1	21.3	18.2	16.2	16.5	18.4	3.0	24.1	24.4	26.7
	Min	13.0	1.8	10.7	6.4	3.7	1.2	2.0	2.4	4.3	7.8	9.3	11.6
382	Max	24.3	23.3	21.6	9.9	14.0	14.1	14.1	17.1	9.7	22.2	22.6	24.0
	Min	11.4	1.0	10.0	7.0	1.0	0.7	0.7	2.4	4.9	8.1	9.3	10.7
383	Max	24.5	4.0	23.2	1.5	19.0	16.4	16.4	19.1	1.4	23.1	23.0	24.4
	Min	11.6	10.9	9.4	5.4	1.2	-2.2	-2.1	0.9	4.4	8.3	9.5	11.1
384	Max	30.7	0.8	8.5	6.5	24.1	22.2	22.5	24.9	7.1	28.3	30.0	31.6
	Min	15.5	15.8	4.4	0.7	6.7	4.2	4.0	6.7	8.8	12.2	13.3	14.8
385	Max	29.6	9.2	27.5	25.9	23.0	20.7	20.9	23.8	6.4	27.3	28.8	29.7
	Min	16.9	6.6	15.2	1.7	6.4	3.1	2.9	6.6	10.3	13.1	14.7	16.1
386	Max	31.2	0.2	29.0	7.0	24.2	21.3	21.0	23.9	26.3	28.1	28.9	30.4
	Min	16.2	6.1	4.8	0.8	5.2	0.8	0.8	4.2	7.9	12.2	14.2	15.8
387	Max	26.5	25.6	5.6	3.4	21.8	18.3	18.2	21.1	1.6	24.3	25.5	26.3
	Min	15.4	15.0	14.1	0.4	7.7	4.7	4.4	8.1	9.3	11.7	13.9	14.3
388	Max	27.5	27.0	5.6	4.4	22.0	19.5	19.6	22.4	24.6	26.1	26.6	27.4
	Min	14.8	14.7	3.3	10.0	5.8	2.4	2.4	5.2	8.2	11.6	12.8	14.0
526	Max	29.1	29.4	28.4	26.2	23.1	20.3	20.6	23.7	6.0	26.4	28.7	29.6
	Min	16.1	6.4	4.8	11.5	7.8	4.3	4.8	7.4	0.8	12.3	14.4	15.9

The Valley Bushveld (Acocks #23) is described as the vegetation that occurs in numerous river valleys draining into the Indian Ocean. These valleys are hot and receive less rain than the intervening ridges. In this dense bush there is less undergrowth and it includes few of the veld grasses and none in an important role, though shade grasses are plentiful. Lubke (1996) described this vegetation as the Valley Thickets (#5), vegetation with a closed canopy of dominant evergreen woody species up to six meter in height. These Thickets are invasive into savanna and grassland. A number of large reserves conserve these thickets, but they are under threat at locations where there is intensive, poorly managed farming.

TABLE 2.5: MEAN MONTHLY MAXIMUM AND MINIMUM TEMPERATURES FOR CLIMATE ZONES

Zone #	Alt. (m.)	Lat / Long	Station
360	1871	28° 59'S 29° 14'E	Cathedral Peak
371	1463	28° 57'S 29° 14'E	Cathedral Peak
327	1477	29° 23'S 29° 53'E	Aberdeen Angus S
375	1143	28° 55'S 29° 28'E	Athur's Seat
376	1200	28° 42'S 29° 14'E	Killarny, Bergville
377	1121	28° 24'S 29° 19'E	Avondale, Bergville
378	1200	28° 42'S 29° 14'E	Killarny, Bergville
379	1646	28° 10'S 28° 43'E	Rietkuil
382	1829	28° 17'S 29° 11'E	Harrismith (Bos)
383	1773	27° 21'S 30° 09'E	Wakkerstroom
384	1200	28° 42'S 29° 14'E	Killarny, Bergville
385	1060	28° 33'S 29° 47'E	Ladysmith (Con)
386	854	28° 51'S 30° 05'E	Weenen (TNK)
387	1402	28° 12'S 29° 58'E	Balbrogie
388	1247	28° 10'S 30° 14'E	Dundee
526	1257	27° 59'S 30° 01'E	Broadfields

The Highland Sourveld and Dohne Sourveld (Acocks #44a & b) is the vegetation of the Drakensberg extending over the top of the escarpment. Forest and Sourveld variations are recognised. The forests are dominated by evergreen woody species like *Podocarpus* and *Leucosidea*. The Grassveld, which is presumed to replace these Forests is, in the more level parts, a pure grassveld, with some shrubiness on the mountain slopes. Grazing easily degrades the veld. Low and Rebelo (1996) divided this vegetation type into Wet Cold Highveld Grassland (Bredenkamp **et. al.** 1996a) (#41) and the Moist Upland Grassland (Bredenkamp **et. al.** 1996b) (#42), separated by altitude. Elements of the Afromontane Forests (Lubke & McKenzie 1996) (#2) are also included.

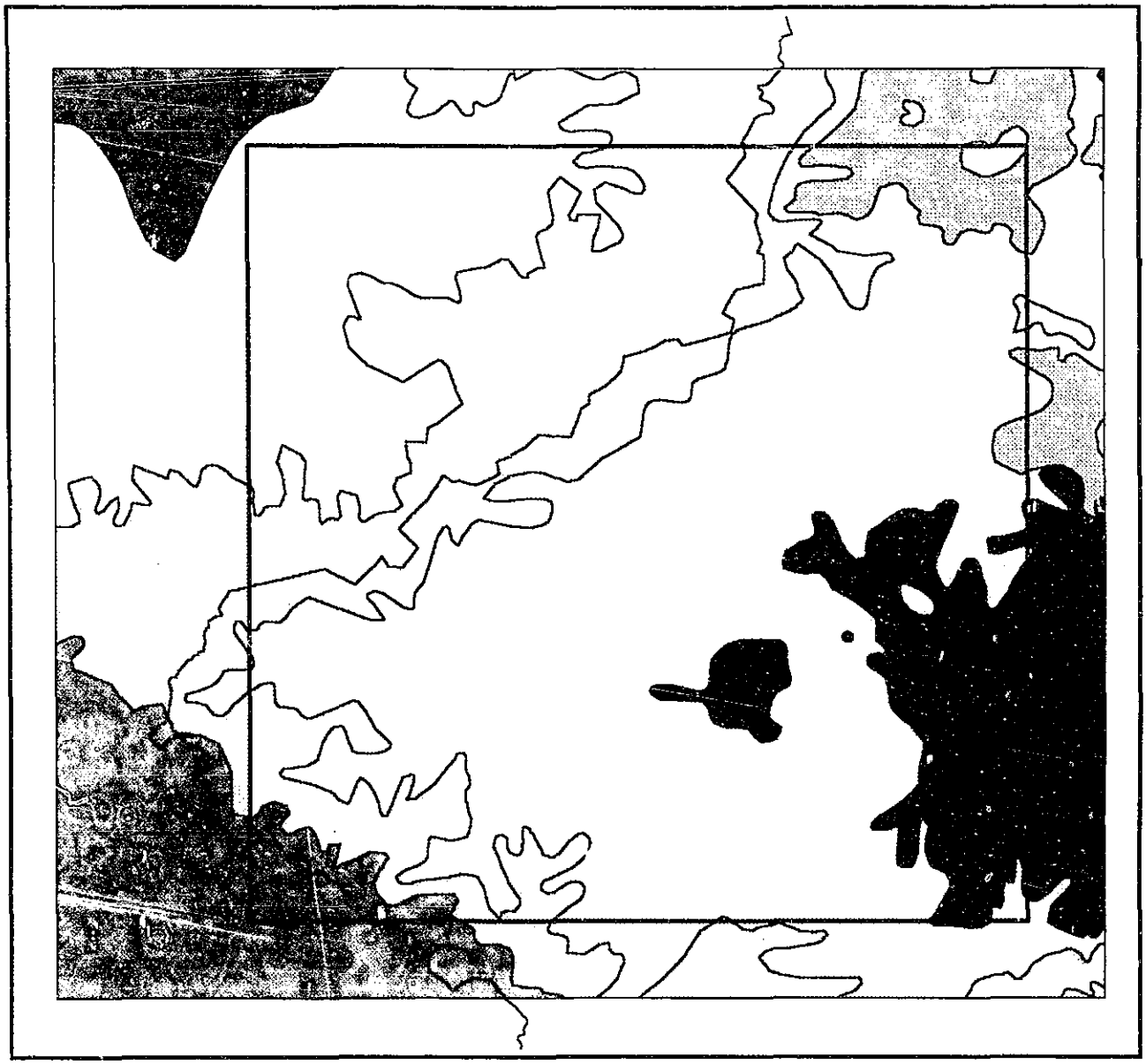
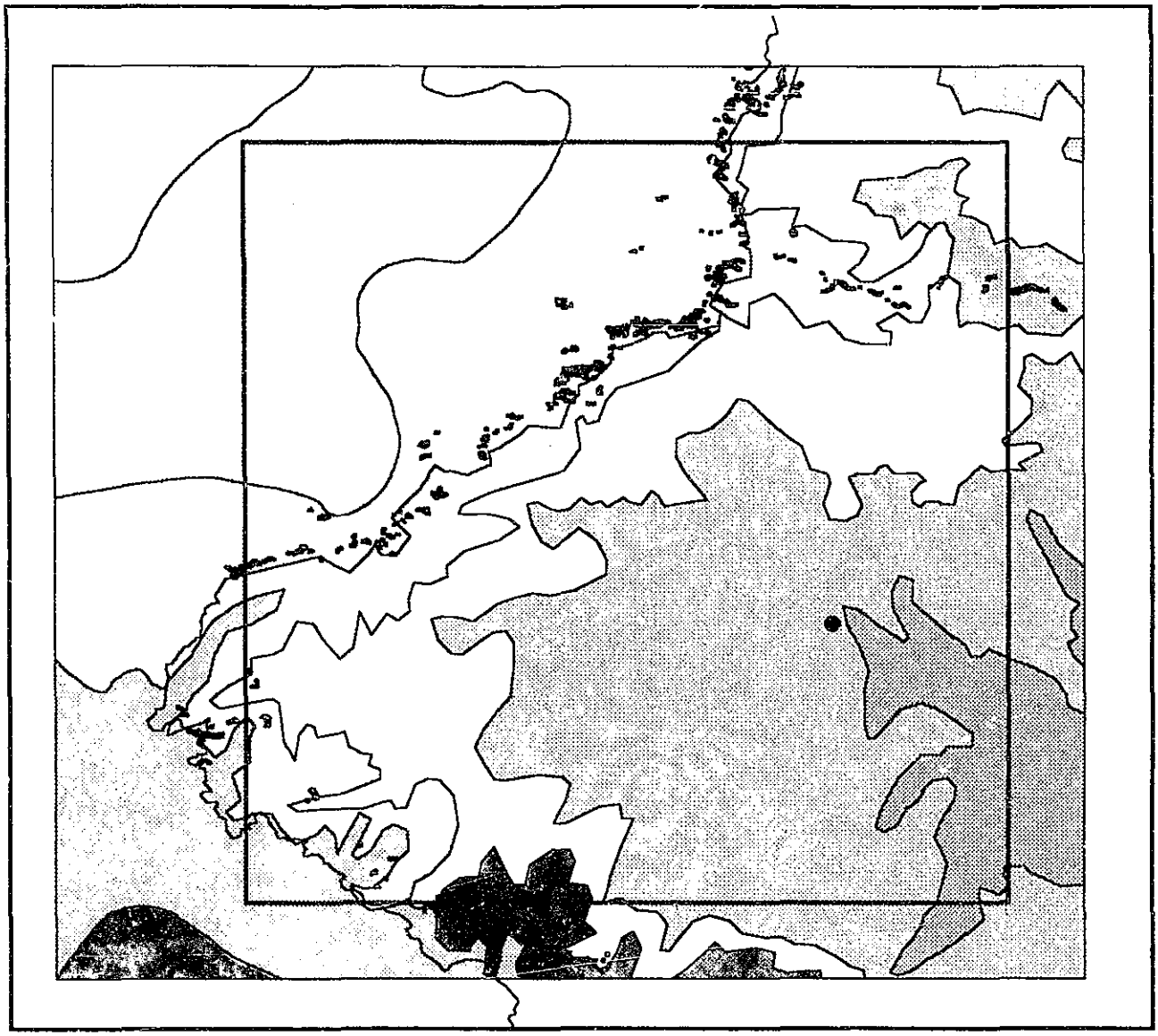


Figure 2.9: Distribution of Acocks Veld Types in the study area and surrounding areas.



Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Low and Rebelo Vegetation Types
Afromontane Forest (#2)
Valley Thickets (#5)
Natal Central Bushveld (#25)
Moist Cool Highveld Grassland (#39)
Moist Cold Highveld Grassland (#40)
Wet Cold Highveld Grassland (#41)
Moist Upland Grassland (#42)
North-eastern Mountain Grassland (#43)
Afro Mountain Grassland (#45)
Alti Mountian Grassland (#46)

Figure 2.10: Distribution of the Low and Rebelo Vegetation Types in the study area and surrounding areas.

At altitude of higher than 1 750 m a.m.s.l., the Wet Cold Highveld Grassland (Bredenkamp **et. al.** 1996a) (#41) is present in the study area. Structurally this is classified as grassland, but a woody layer may form dense thickets in places. Occasional snow and frequent burning have a major influence on the vegetation. This veld type is well conserved in the Golden Gate National Park, though severe erosion can be observed in places.

The *Themeda* - *Festuca* Alpine Veld (Acocks #58) is present on the Drakensberg at altitude ranging from 1 850 to 2 150 m a.m.s.l. It is a short, dense grassveld, varying from sweet to mixed, dominated by *Themeda* with an admixture of the usual grassveld species. A form of fynbos is a natural part of this vegetation, especially on the eastern side of the Drakensberg. Elements of this Veld Type are present in three vegetation types described by Low and Rebelo (1996), namely South-eastern Mountain Grassland (Lubke **et. al.** 1996) (#44), Afro Mountain Grassland (Granger & Bredenkamp 1996a) (#45) and Alti Mountain Grassland (Granger & Bredenkamp 1996b) (#46).

Chapter 3: Methods

The study area is demarcated on the Topographical map 2727 Harrismith, scaled 1:250 000. Since the Land Type Series map and the Geological map of the area had not yet been published at the time of the survey, the area was stratified according to the classification of Acocks (1953, 1988). Five main veld types are present, i.e. the Southern Tall Grassland (#65), Highland and Dohne Sourveld (#44a & b), Valley Bushveld (#23), *Themeda - Festuca* Alpine Veld (#58) and Natal Sour Sandveld (#66). Within these broad classifications the vegetation and physical environment were studied and sampled.

A reconnaissance survey was conducted in order to identify the main vegetation types and dominant plant species and to form a basic idea of the topography, physiography as well as land-use of the area.

3.1 Sample plots: number, size and distribution

The number of sample plots to be distributed in a given area depends on various factors, such as the scale of the classification, environmental heterogeneity and the accuracy required for the classification (Bredenkamp 1982).

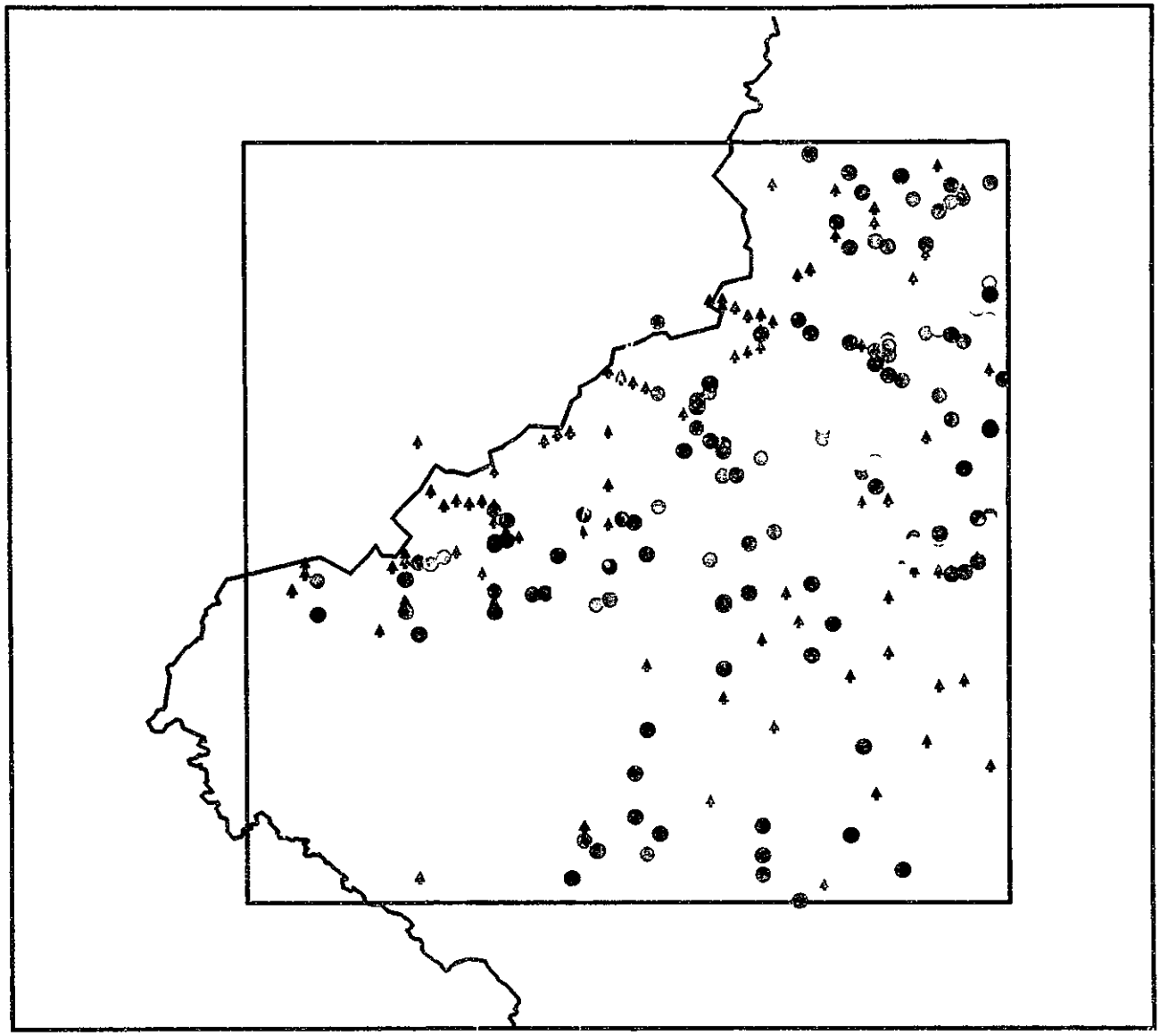
Stratification was primarily based on the veld types according to Acocks' classification (1953, 1988), but was severely restricted in certain areas such as the high mountains, by the inaccessibility of the areas. The Zurich-Montpellier approach of phytosociology (Braun-Blanquet 1964) was followed as recommended by Werger (1973) and Bredenkamp (1982). The position of each sample plot within a relative homogeneous stratification unit was chosen subjectively, provided that the sample plots adequately represented the plant communities concerned. This approach has been successfully applied in South Africa and more specifically in the Grassland Biome (e.g. Bezuidenhout **et. al.** 1988; Behr & Bredenkamp 1988; Bredenkamp **et. al.** 1989; Bezuidenhout & Bredenkamp 1991; Kooij **et. al.** 1990a, b, c; Matthews 1991; Smit 1992).

On a local scale topography was used as a further stratification method in the field, i.e. crest, scarp, midslope, footslope and valley bottoms were stratified within the previously stratified units. Combining the stratification methods described above produces a scale hierarchical approach and also ensures that samples may be associated with environmental variables which can be used to model the relationship between the vegetation and those variables.

The vegetation in the study area varies from grassland, through woodland and forests. Due to species diversity and uneven topography, sample plot sizes of 10 x 10 m for grassland vegetation (Bredenkamp 1975) and 10 x 20 m for woodland and forest vegetation (Bredenkamp 1982) were chosen. The shape of these sample plots were generally square and was only adapted to circumstances where it was necessary, e.g. in ravines or along water courses (Matthews 1991). A total of 526 sample plots were assessed during the growing seasons (December to April) of the years 1994 and 1995 (Figure 3.1).

3.2 Sampling method

A standardised and widely used sampling technique for general vegetation surveying in South Africa is the Braun-Blanquet method (Bredenkamp 1982), which also proved very successful. In order to make the results of the vegetation classification of different areas compatible and comparable, the same techniques were applied in this study as throughout the Grassland Biome Project.



Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Monocymbium cerisiiforme - Andropogon shirensis sub-community
Sample plots of the Monocymbium cerisiiforme - Cymbopogon excavatus sub-community
Sample plots of the Hyparrhenia anamesa - Hyparrhenia dregeana community
Sample plots of the Trachypogon spicatus and
Diospyros lycioides - Eragrostis chloromelas communities
Sample plots of the Hyparrhenia hirta - Themeda triandra community
Sample plots of the Maytenus heterophylla - Acalypha angustata community
Sample plots of the Maytenus heterophylla - Rhus pentheri community
Sample plots of the Rhoicissus tridentata - Achyranthes aspera community
Sample plots of the Mariscus congestus - Arundinella nepalensis community

Figure 3.1: Distribution of sample plots in the study area (Community names were allocated to sample plots after classification.

3.3 Floristic analysis

During the survey all plant species in the sample plots and the cover and/or abundance of each species were estimated according to the following Braun-Blanquet cover abundance scale (Mueller-Dombois & Ellenberg 1974):

r : one or few individuals (rare), with less than one percent cover of the total area of the sample plot

+ : infrequent with less than one percent cover of total sample plot area

1 : frequent with low cover, or infrequent but with higher cover, 1-5% cover of the total sample plot area

2 : abundant with 5-25% cover of total sample plot area,

A : >5-12%

B : >12-25%

3 : >25-50% cover of the total sample plot area, irrespective of the number of individuals

4 : >50-75% cover of the total sample plot area, irrespective of the number of individuals

5 : >75% cover of the total sample plot area, irrespective of the number of individuals.

Names of taxa are in accordance with those listed in Arnold and De Wet (1993).

3.4 Habitat analysis

The distribution of plant communities is closely related to environmental conditions (Gauch 1982). Therefore the physical environment has to be dealt with thoroughly in these studies, as it plays an important role in the ecological interpretation of the floristic data (Bezuidenhout 1988). A sample plot represents an area of similar habitat factors, including vegetation physiognomy. The habitat factors investigated in this study were the following:

Geographic position

Altitude- and longitude positions for each relevè were obtained from a Global Positioning System (GPS) (Ensign from Trimble Navigation) in the field.

Geology

Information was obtained from the computer program GIS (Geographical Information Systems). Digital data was obtained from the Counsel of Geoscience (1997).

Climate zone

For each sample plot the climate zone was annotated by making use of the climate zone map, obtained from the Institute for Soil, Climate and Water (1994).

Topography

The following topographical positions were distinguished

- crests
- scarps
- midslopes
- footslopes
- valley bottoms, floodplains or drainage lines.

Altitude, slope and aspect of the slope were determined for each sample plot.

Rockiness

The area of the sample plot covered by surface rock is an estimated percentage:

0 0 to 5%

1 6 to 10%

2 11 to 25%

3 26 to 35%

4 36 to 60%

5 > 60%.

Rock size was determined as follows:

1 no rocks
2 small
3 hand held
4 rocks
5 boulders

General observations

These include extent of erosion, utilisation, disturbances of the vegetation and management practices, where possible.

3.5 Data processing

A list of observations of a sample plot with all its floristic and associated environmental data is called a relevè. The floristic data sets of 1994 and 1995 were subjected to the Two-Way **I**ndicator **Sp**ecies **An**alysis technique (TWINSPAN) (Hill 1979) and subsequently refined by Braun-Blanquet procedures. TWINSPAN was applied to derive a first approximation of the vegetation units. These classifications were further refined by the application of Braun-Blanquet procedures to determine the plant communities. Both the techniques are contained within the mainframe computer programme BBNEW that is available at the Botany Department of the University of Pretoria.

A phytosociological table showing the vegetation lines was used to compile a synoptic table of the datasets. This synoptic table summarised and confirmed the vegetation types. Each major vegetation type was subsequently further analysed by TWINSPAN and afterwards refined by means of Braun-Blanquet procedures to determine the plant communities within the major vegetation types.

Chapter 4: Results

Based on the most prominent species throughout the study area, the vegetation is considered as a *Hyparrhenia hirta - Themeda triandra* major vegetation type. By means of TWINSPAN classification and subsequent refinement by Braun-Blanquet procedures, this major vegetation type was divided into the following vegetation types and communities (Diagram 4.1):

a . The High Altitude mountain vegetation type (Diagram 4.2) (Chapter 5)
1. The *Monocymbium ceresiiforme - Alloteropsis semialata* community
1.1. The *Monocymbium ceresiiforme - Andropogon schirensis* sub-community
1.2. The *Monocymbium ceresiiforme - Cymbopogon excavatus* sub-community

b . The Open Thornveld vegetation type (Diagram 4.3) (Chapter 6)
1. The *Hyparrhenia anamesa - Hyparrhenia dregeana* community
2. The *Trachypogon spicatus - Diheteropogon amplectens* community
3. The *Diospyros lycioides - Eragrostis chloromelas* community
4. The *Hyparrhenia hirta - Themeda triandra* community

c . The Woodland vegetation type (Diagram 4.4) (Chapter 7)
1. The *Maytenus heterophylla - Acalypha angustata* community
2. The *Maytenus heterophylla - Rhus pentheri* community

d. The Thicket vegetation type (Chapter 8)
1. The *Rhoicissus tridentata - Achyranthes aspera* community

e. The Wetland vegetation type (Chapter 8)
1. The *Mariscus congestus - Arundinella nepalensis* community

The relevés compiled in the study area are classified into vegetation types and communities due to differences in species composition. Geology, climate zones, topography, degree of rockiness, altitudinal differences and geographical position are used to ecologically interpret the vegetation types, communities and sub-communities (Diagram 4.1).

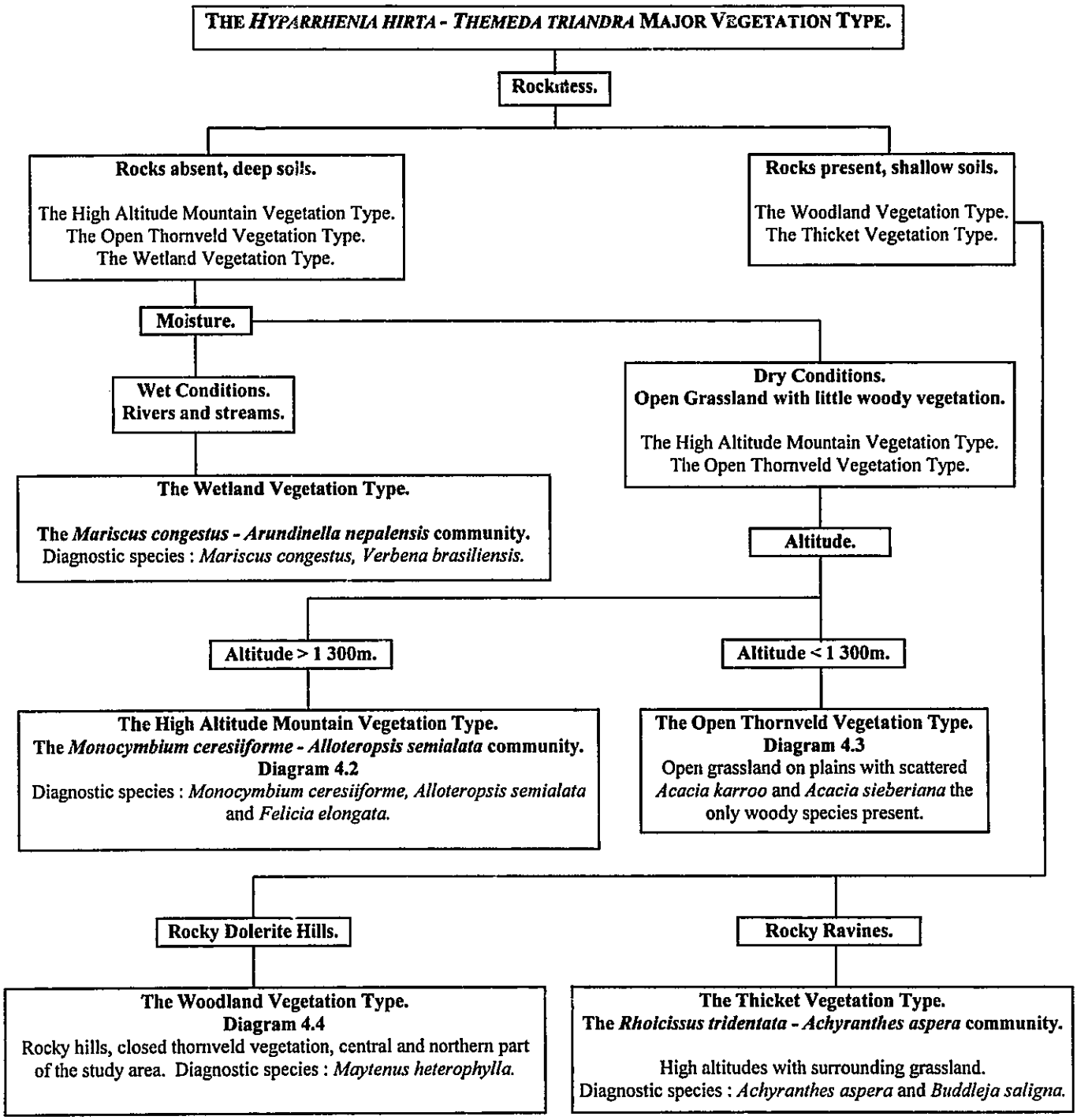
The absence of rocks in the Wetland -, *Monocymbium ceresiiforme* - *Alloteropsis semialata* -, and Open Thornveld Vegetation Types distinguishes them from the Woodland - and Thicket Vegetation Types. In most vegetation types where rocks are absent, soils are generally deep and sandy, but the texture may be sandy - loam and even clayey in the Wetland Vegetation Type.

The Wetland Vegetation Type is differentiated from the others due to the wet conditions that prevail, at least seasonally. Sample plots of this vegetation type are located in bottomlands in close vicinity of streams and rivers. The vegetation is described as the *Mariscus congestus* - *Arundinella nepalensis* community.

In the *Monocymbium ceresiiforme* - *Alloteropsis semialata* - and Open Thornveld Vegetation Types a low occurrence of woody species was recorded. The difference in altitude and associated differences in temperature and water, resulted in major environmental factors, causing differences in species composition. At altitudes higher than 1 300 m a.m.s.l. the vegetation is the *Monocymbium ceresiiforme* - *Alloteropsis semialata* Vegetation Type, whilst the Open Thornveld occur at lower altitudes.

Differences in geology and altitude resulted in the distinction between the Woodland - and Thicket Vegetation Types. The rocks of the Woodland Vegetation Type is of a Karoo Dolerite origin and this Vegetation Type is geographically separated from the Thicket Vegetation Type as the former is located in the eastern part of the study area, described by Acocks (1988) as Valley Bushveld. The Thicket Vegetation Type (*Rhoicissus tridentata* - *Achyranthes aspera* community) is generally present at high

DIAGRAM 4.1: A HABITAT INTERPRETATION OF THE VEGETATION TYPES OF THE *HYPARRHENIA HIRTA - THEMEDA TRIANDRA* MAJOR VEGETATION TYPE



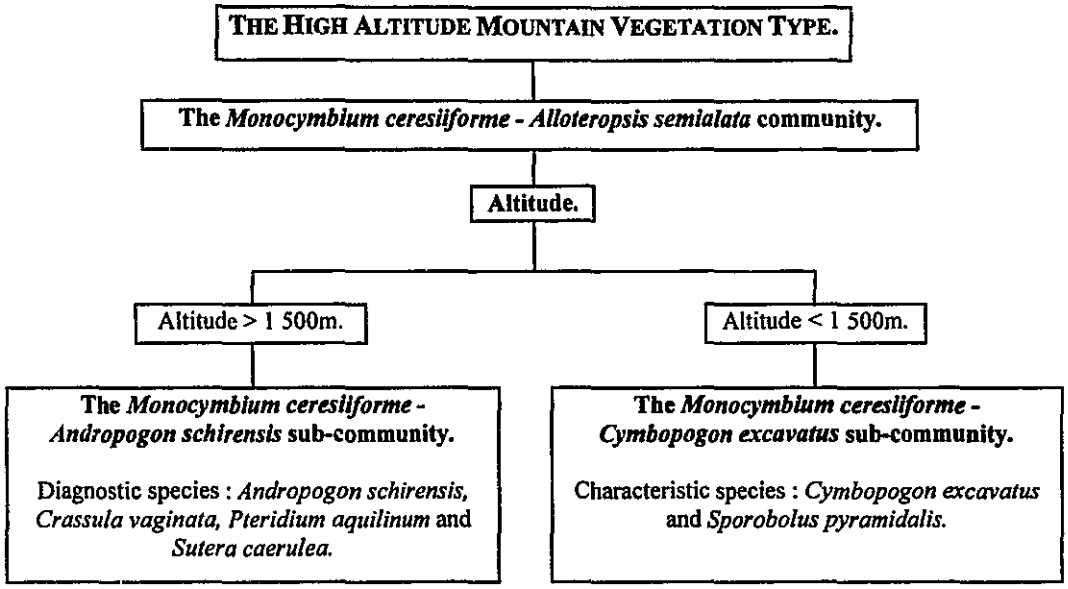
altitudes on the slopes of the Drakensberg and occurs on geological origin other than Karoo Dolerites. In the high mountains the topography includes high cliffs and steep, grassy valleys, whereas the lower slopes of the Drakensberg are gradual. The High Altitude Mountain Vegetation Type is represented by the *Monocymbium ceresiiforme - Alloteropsis semialata* community, which occurs at altitudes higher than 1 300 m a.m.s.l. (Diagram 4.2). The sub-communities of the *Monocymbium ceresiiforme - Alloteropsis semialata* community are distinguished mainly as a result of differences in altitude and in species composition.

At altitudes ranging from 1 300 to 1 500 m a.m.s.l., the vegetation is transitional to Southern Tall Grassveld (#65), as described by Acocks (1988) and is described in this study as the *Monocymbium ceresiiforme - Cymbopogon excavatus* sub-community. Other factors that might play an important role in determining the distribution of this sub-community include rainfall and temperature. A change in these factors correlates with a rapid change in topography.

The Open Thornveld Vegetation Type comprises grasslands on the plains of the Drakensberg footslopes at altitudes lower than 1 300 m a.m.s.l. (Diagram 4.3). The only two woody species that occur frequently in this vegetation type are *Acacia karroo* and *Acacia sieberiana.* The main environmental factors are similar throughout all the sample plots compiled in this vegetation type and it was not possible to interpret the habitat differences between the two sub-communities of this community.

The presence of the descriptive species in the *Hyparrhenia anamesa - Hyparrhenia dregeana* community distinguishes this community from others in the Open Thornveld Vegetation Type. The grass species *Trachypogon spicatus* characterises the *Trachypogon spicatus - Diheteropogon amplectens* community. The presence of the woody species *Diospyros lycioides* distinguishes the *Diospyros lycioides - Eragrostis chloromelas* community. The absence of these species is characteristic of the *Hyparrhenia hirta - Themeda triandra* community.

DIAGRAM 4.2 : THE HIGH ALTITUDE MOUNTAIN VEGETATION TYPE



The communities of the Woodland Vegetation Type are distinguished on basis of the presence and absence of species (Diagram 4.4). The descriptive species *Acalypha angustata* and *Rhus pentheri* distinguish the *Maytenus heterophylla - Acalypha angustata* and *Maytenus heterophylla - Rhus pentheri* communities respectively. The species composition of these communities is also different from the *Maytenus heterophylla - Acalypha angustata* community and is not dominated by woody species to the same degree as the *Maytenus heterophylla - Rhus pentheri* community. These communities are, except for differences in species composition, also geographically separated from the *Maytenus heterophylla - Rhus pentheri* community situated in the Valley Bushveld (Acocks 1988). The *Maytenus heterophylla - Acalypha angustata* community is situated in the Southern Tall Grassveld (Acocks #65). The classification and description of the recognised plant communities and sub-communities of each vegetation type are presented in the following separate chapters.

DIAGRAM 4.3: THE OPEN THORNVELD VEGETATION TYPE

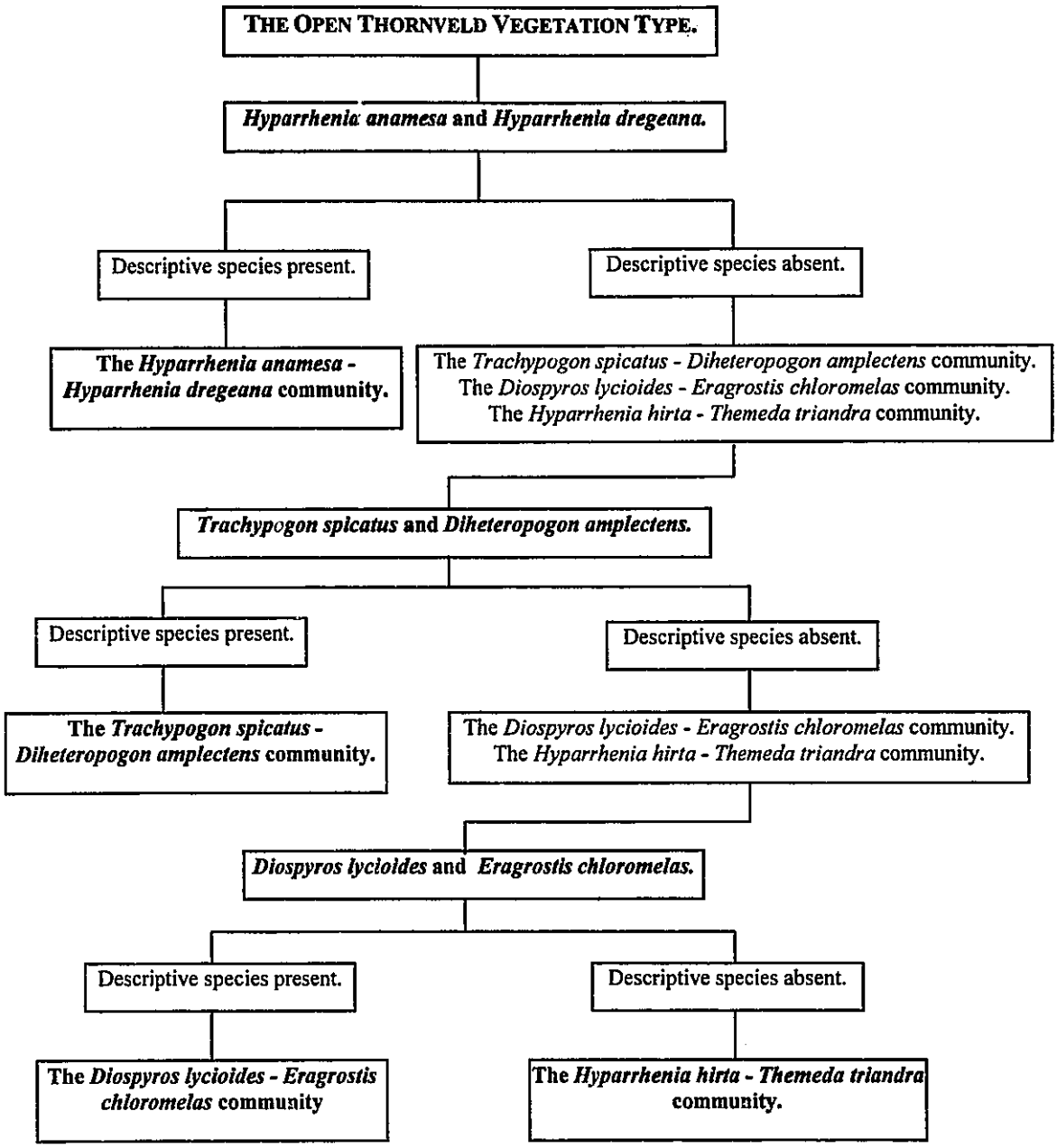
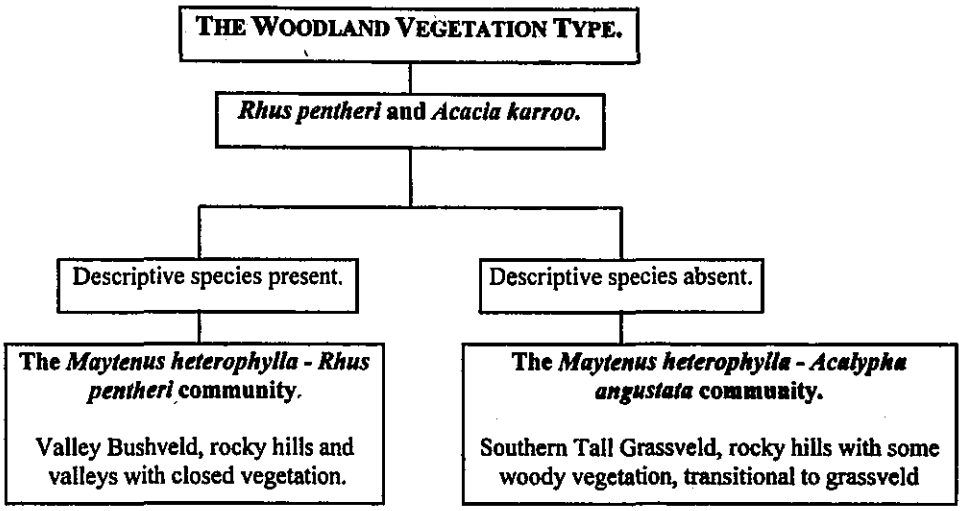


DIAGRAM 4.4: THE WOODLAND VEGETATION TYPE



Chapter 5: The High Altitude Mountain Vegetation Type

5.1 The *Monocymbium ceresiiforme - Alloteropsis semialata* grassland community

This vegetation type is situated in the western part and high altitude northern plains of the study area, along the slopes of the Drakensberg mountains, at altitudes higher than 1 300 m (Figure 5.1).

The floristic composition of this community is given in Table 5.1 with diagnostic species listed in Species group A, namely the grasses *Monocymbium ceresiiforme, Alloteropsis semialata* and the forb *Felicia elongata*. Prominent species that occur throughout this community are the grasses *Hyparrhenia hirta, Eragrostis plana, Tristachya leucothrix, Elionurus muticus* and the forbs *Vernonia natalensis, Berkheya setifera, Gladiolus woodii, Acalypha angustata, Senecio brevidentatus* and *Pelargonium luridum* (Species group AD). It is distinguished from the Open Thornveld and Woodland Vegetation Types due to the absence of species like *Hyparrhenia anamesa, Hyparrhenia dregeana, Trachypogon spicatus, Walafrida tenuifolia, Aloe marlothii, Maytenus heterophylla* and *Acacia karroo*. The absence of a diversity of wetland species and trees distinguish this Vegetation Type from the Wetland and Thicket Vegetation Types.

Classification of the relevès by means of Two Way Indicator Species Analysis (TWINSPAN) and subsequent refinement by Braun-Blanquet procedures resulted in the recognition of the following sub-communities and variations (Table 5.1):

5.1 The *Monocymbium ceresiiforme - Alloteropsis semialata* community
5.1.1 The *Monocymbium ceresiiforme - Andropogon schirensis* sub-community
5.1.1.1 The *Erica drakensbergensis - Helichrysum umbraculigerum* variation
5.1.1.2 The *Sporobolus centrifugus - Aristea woodii* variation
5.1.1.3 The *0394 001 - Trachypogon spicatus* variation
5.1.1.4 The *Loudetia flavida - Tristachya leucothrix* variation
5.1.1.5 The *Andropogon schirensis - Aristida junciformis* variation
5.1.1.6 The *Pteridium aquilinum - Eragrostis plana* variation

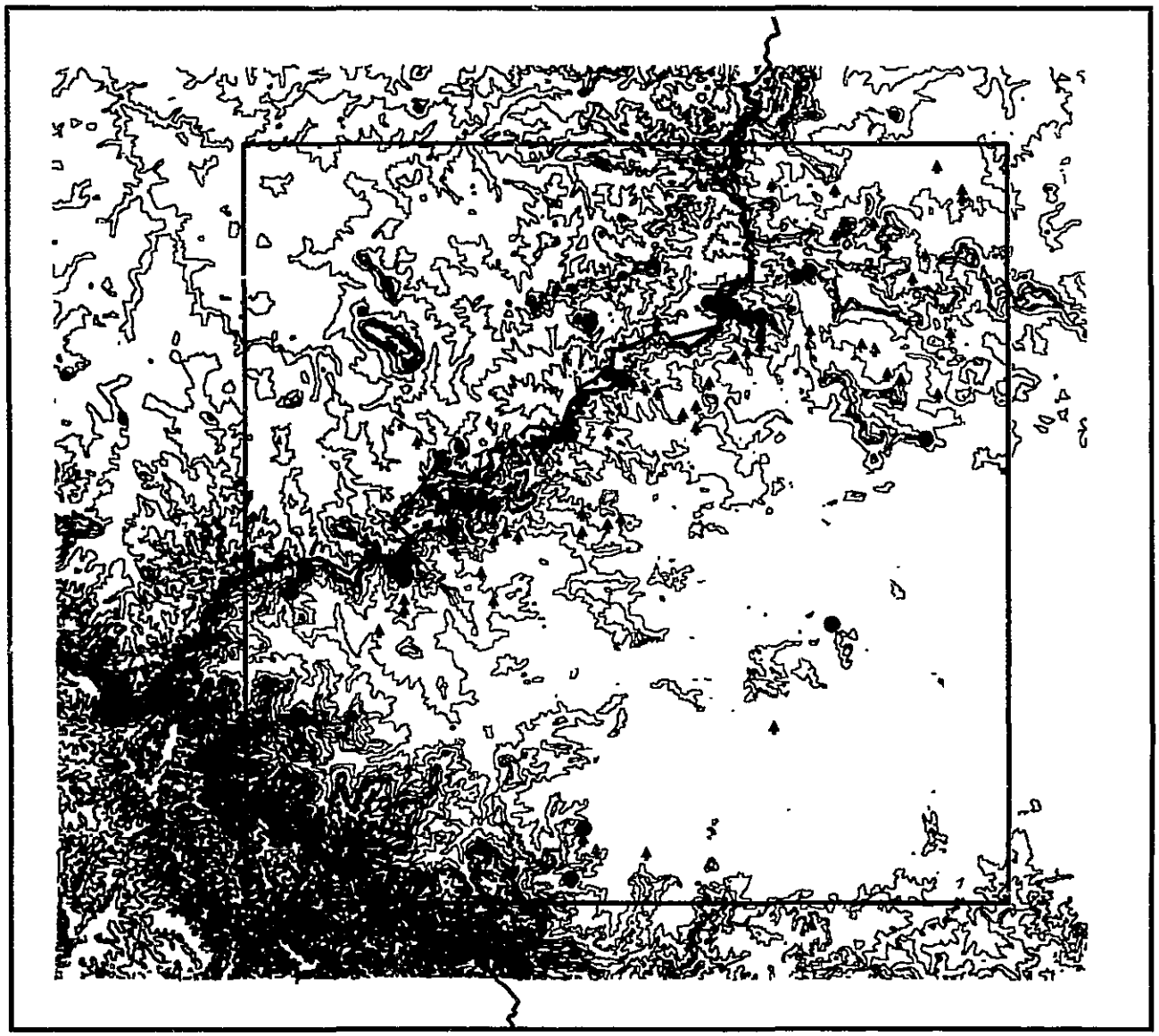


Figure 5.1: Distribution of the High Altitude Mountain Vegetation Type sample plots in the study area (contour interval 100m).

5.1.2 The *Monocymbium ceresiiforme - Cymbopogon excavatus* sub-community

5.1.2.1 The *Eragrostis gummiflua - Eragrostis chloromelas* variation

5.1.2.2 The *Sporobolus africanus - Richardia brasiliensis* variation

5.1.2.3 The *Diheteropogon amplectens - Hypoxis rigidula* variation

5.1.2.4 The *Paspalum scrobiculatum - Acanthospermum australe* variation

5.1.2.5 The *Cephalanthus natalensis - Trachypogon spicatus* variation

5.1.2.6 The *Eriosema cordatum - Helichrysum rugulosum* variation

5.1.2.7 The *Themeda triandra - Berkheya setifera* variation

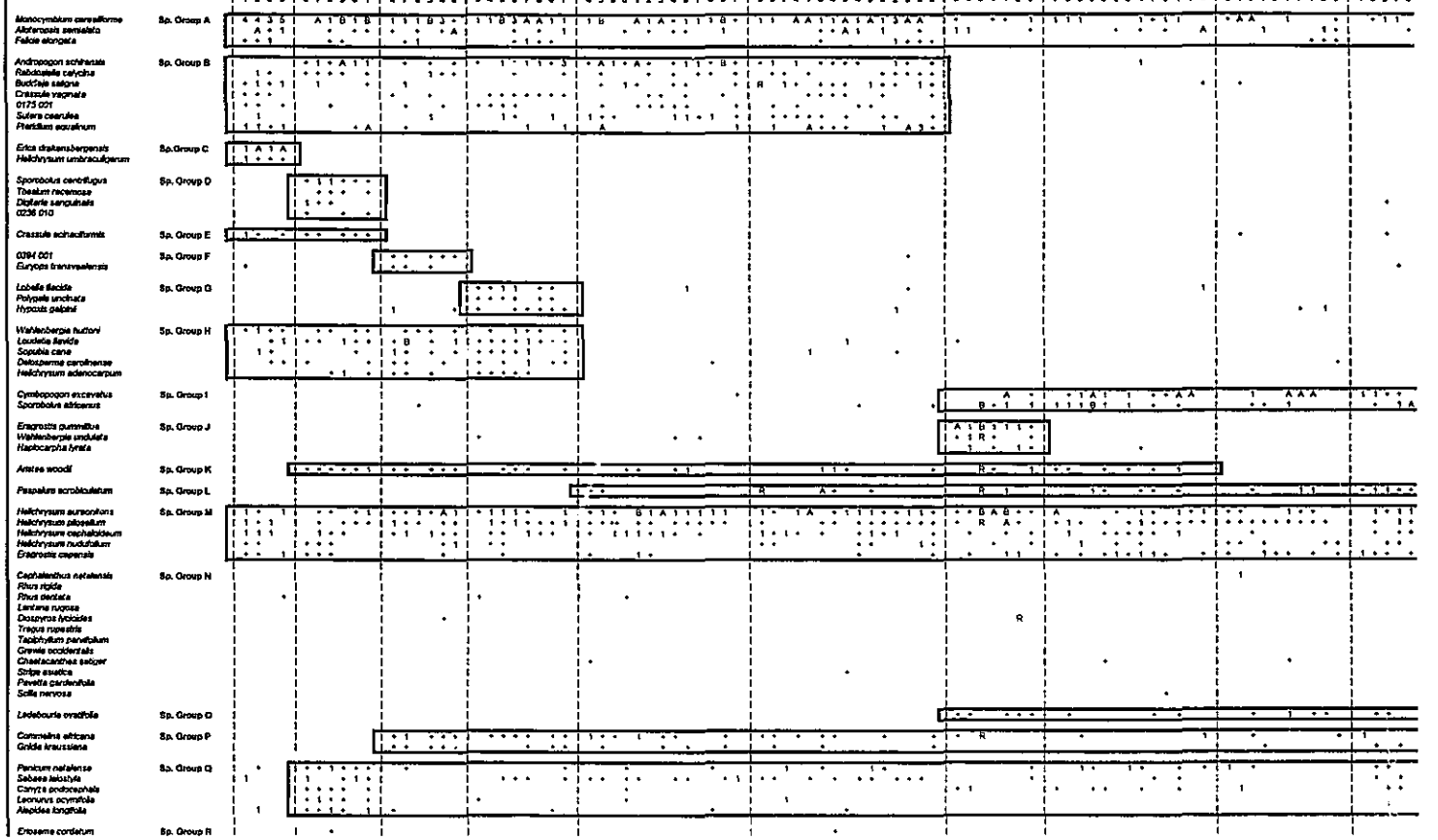
Woody species do occur in some of the variations, but this community is generally described as grassland.

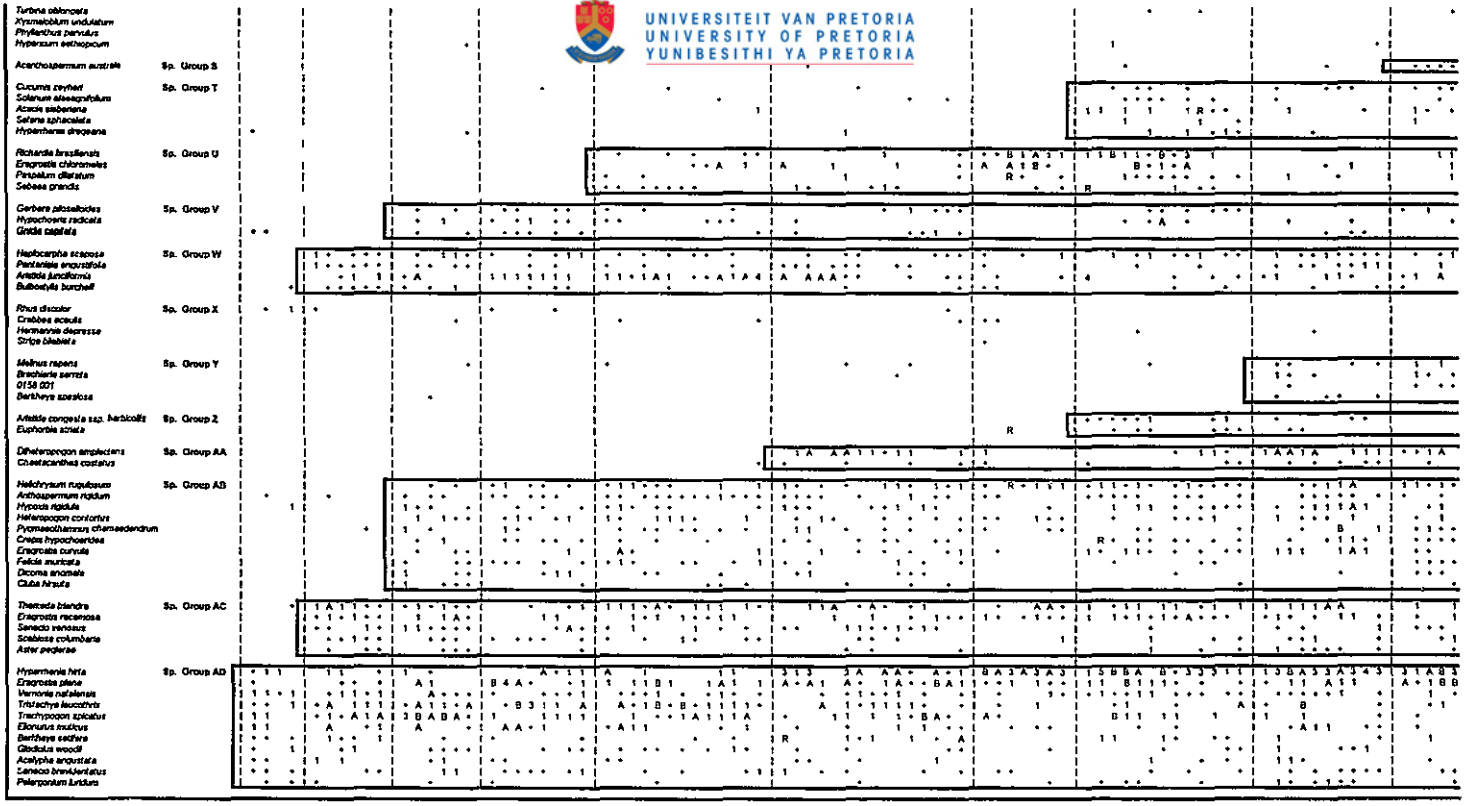
Sample plots of this community are distributed in three veld types described by Acocks (1988) (Figure 5.2), including the Southern Tall Grassveld (#65), the Highland Sourveld and Dohne Sourveld (#44) and Natal Sour Sandveld (#66). *Themeda triandra* and *Hyparrhenia hirta* dominate the Southern Tall Grassveld (#65) which normally occurs at altitude ranging from 600 to 1 350 m, though below 1 050 m a.m.s.l. the vegetation is transitional to Valley Bushveld. At altitudes above 1 050 m a.m.s.l. an open savanna of *Acacia sieberiana* in sourish mixed grassveld is found. According to Low and Rebelo (1996) the Southern Tall Grassveld corresponds to the Natal Central Bushveld (Granger 1996) (#25). However, the sample plots are mostly found in the North-eastern Mountain Grassland (Bredenkamp **et. al.** 1996c) (#43) and Wet Cold Highveld Grassland (Bredenkamp **et. al.** 1996a) (#41) (Figure 5.3).

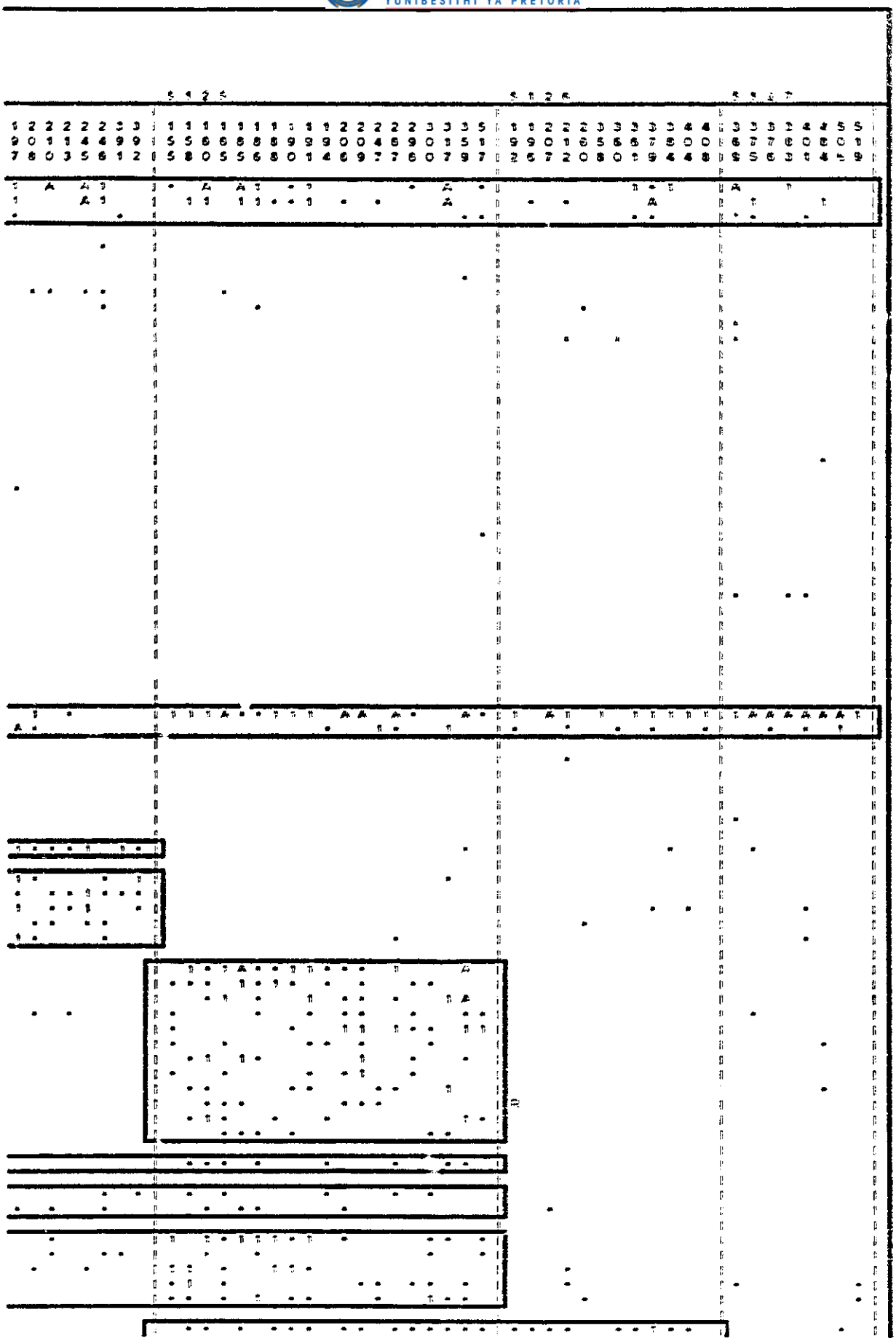
The Highland Sourveld (#44) is situated on the eastern slopes and foothills of the Drakensberg, from 1 350 to 2 150 m a.m.s.l. Frost is severe in winter and snow fall at the higher altitudes. It is an undulating landscape, inscised by numerous valleys with tall grassveld vegetation. A pure grassveld replaces the valley forests on the plains, lacking

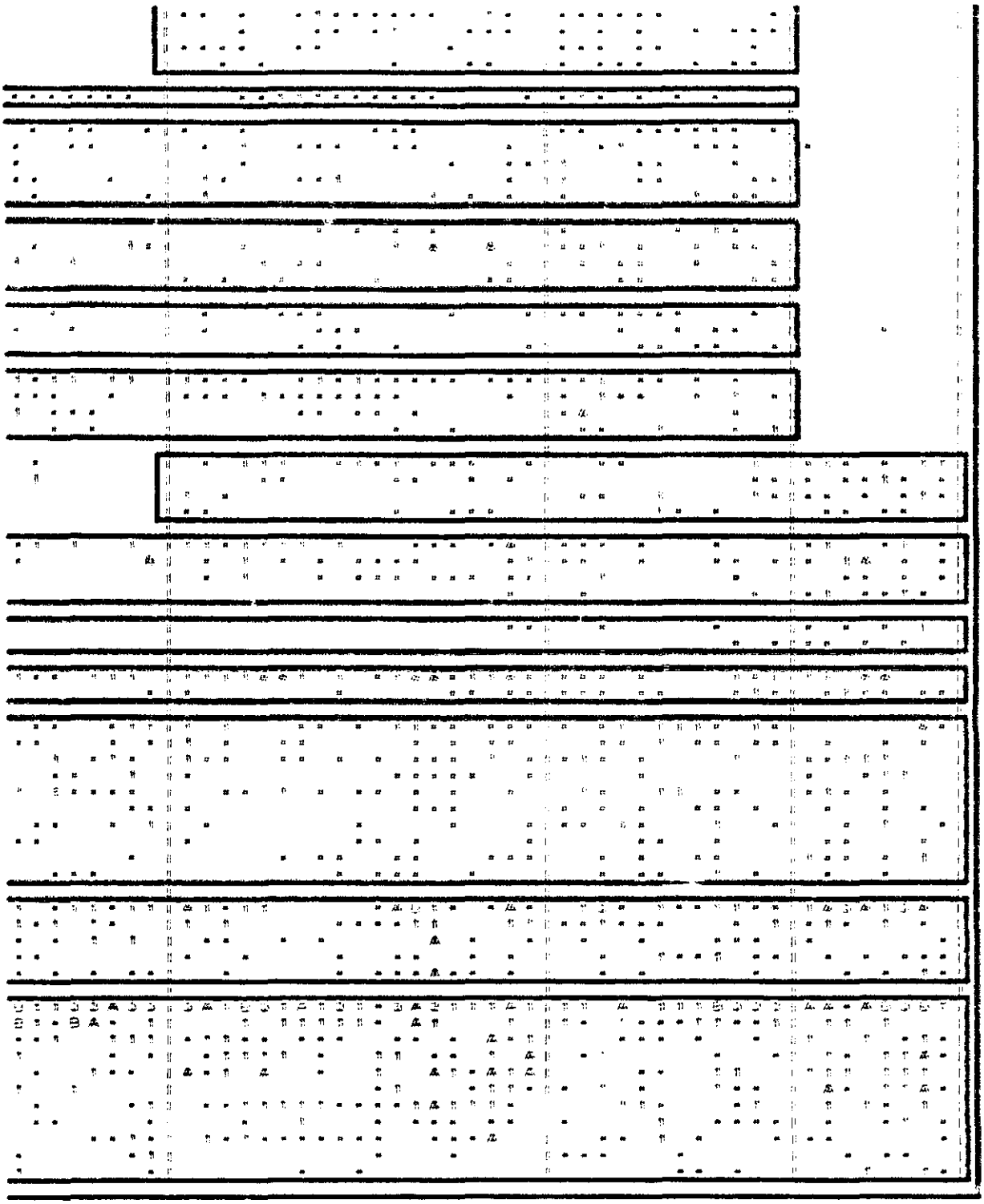
Plant communities of the Monocymbium ceresiiforme - Alloteropsis se

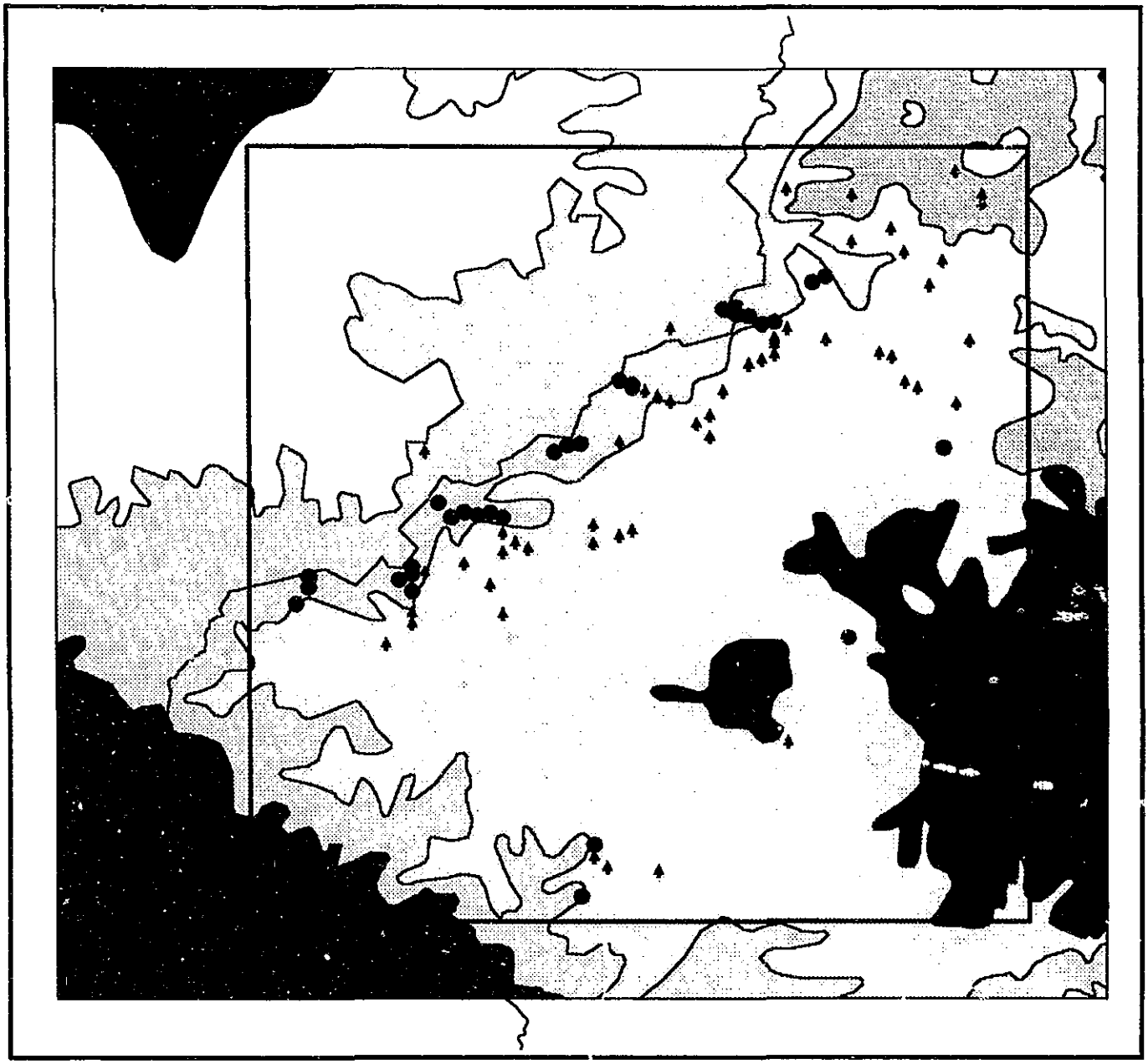
Table 5.1











Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Monocymbium cerisiiforme - Andropogon shirensis sub-community
Sample plots of the Monocymbium cerisiiforme - Cymbopogon excavatus sub-community

Acocks Veld Types
Cymbopogon - Themeda Veld (Sandy) (#48)
Highland Sourveld and Dohne Sourveld (#44)
Highland Sourveld to Cymbopogon - Themeda Transition (Eastern Free State Highveld) (#49)
Natal Sour Sandveld (#66)
Southern Tall Grassveld (#65)
Themeda Veld to Cymbopopogon - Themeda Veld Transition (Patchy) (#53)
Themeda - Festuca Alpine Veld (#58)
Valley Bushveld (#23)

Figure 5.2: Distribution of the High Altitude Mountain Vegetation Type sample plots in Acocks Veld Types of the study area.

thickets and shrubs. The veld is easily reduced to an *Eragrostis plana* disturbed grassland by trampling and selective grazing by cattle. This veld type is included in the Wet Cold Highveld Grassland (#41) described by Bredenkamp **et. al.** (1996a) (Figure 5.3).

Natal Sour Sandveld (Acocks #66) is an open savanna of *Acacia sieberiana*. The shrub forest of the hills is similar to the Southern Tall Grassveld (#65), but more tropical. Altitude ranges from 900 to 1 350 m a.m.s.l. and rainfall from 600 to 900 mm per annum, falling in summer. *Tristachya leucothrix* and *Digitaria tricholaenoides* dominate this veld type. The Natal Sour Sandveld (Acocks #66) is classified by Granger (1996) as Natal Central Bushveld (#25). However, sample plots are mainly located in the North-eastern Mountain Grassland (Bredenkamp **et. al.** (1996c) (#43) and it seems as if the classification of Granger (1996) should be followed and Natal Sour Sandveld (Acocks #66) not recognised as a separate vegetation type.

The Wet Cold Highveld Grassland (Bredenkamp **et. al.** 1996a) (#41) is associated with rocky slopes and ravines of the Drakensberg at altitudes higher than 1 750 m. Soils are shallow lithosoils, mainly representative of the Glenrosa (Orthic A, lithocutanic B) and Mispah (Orthic A, hard rock) soil forms. Sandstones and mudstones of the Beaufort Group are predominant. It is mountain grassland, associated with the typical cool, wet Drakensberg montane climate and severe frost. A woody layer can form dense thickets in this grassland. The North-eastern Mountain Grassland (Bredenkamp **et. al.** 1996c) (#43) comprises the grasslands of the great escarpment mountains. Altitude ranges from 1 400 to 1 900 m a.m.s.l. Soils are mostly shallow, derived from a variety of rock types. This is an area with many rare and endemic species, which are often threatened by expanding forestry. Patches of natural forest occur in this escarpment grassland.

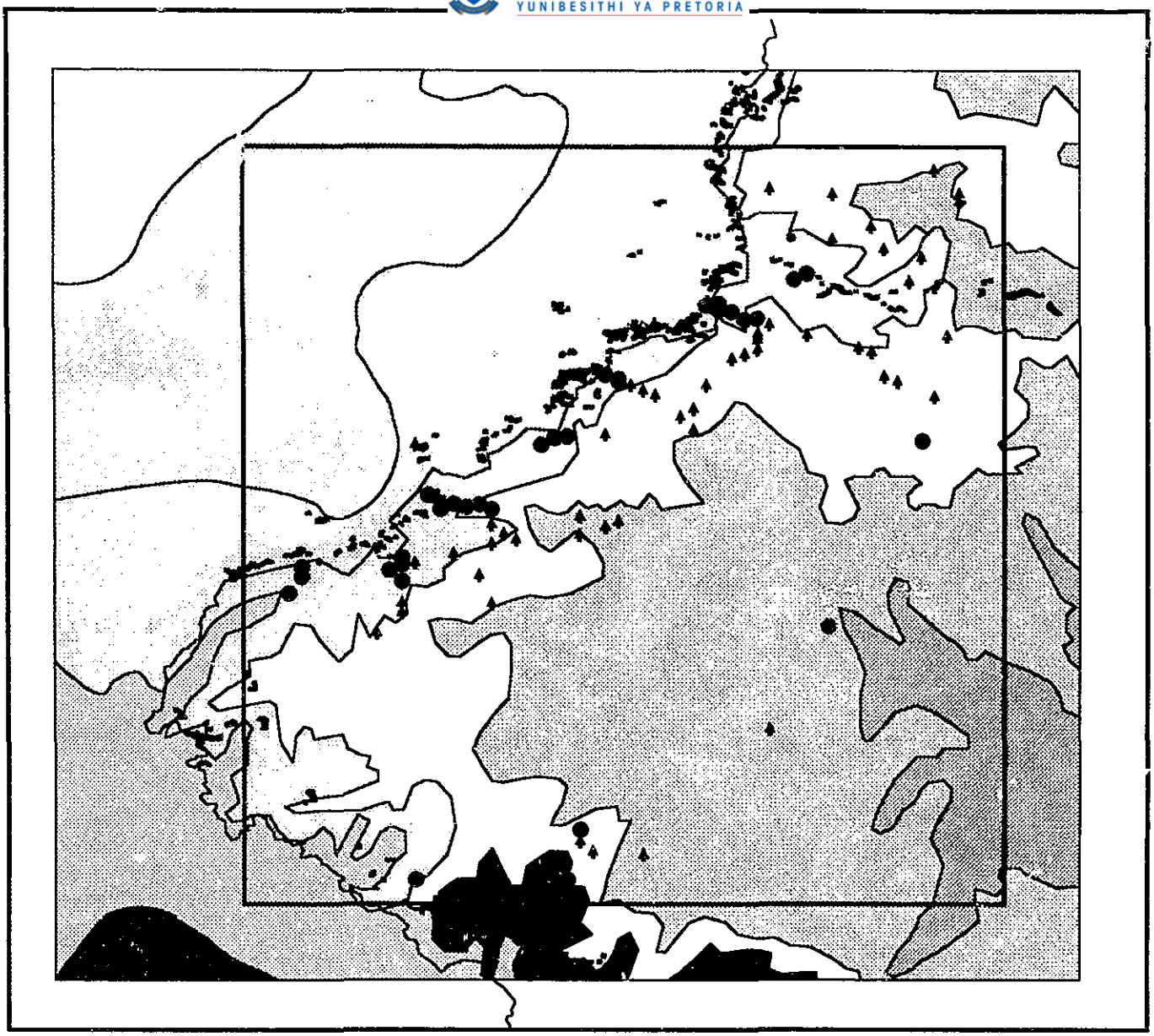


Figure 5.3: Distribution of the High Altitude Mountain Vegetation Type sample plots in Low and Rebelo Vegetation Types of the study area.

It is therefore concluded that this vegetation type probably represents Highveld Sourveld of Acocks and that the southern border of this veld type should be moved southwards (into the Southern Tall Grassveld) to include the high mountain areas. As for the Low and Rebelo vegetation types, it seems as if the Wet Cold Highveld Grassland (Bredenkamp **et. al.** 1996a) (#41) is representing the High Altitude Mountain Vegetation Type. The North-eastern Mountain Grassland (Bredenkamp **et. al.** 1996c) (#43) should be merged with the Cold Highveld Grassland (Bredenkamp **et. al.** 1996a) (#41) in this study area.

Climate zones of importance include 375, 383, 379, 526 and 384. The 375 climate zone is found in the southern part of the study area. Climate zone 383 is situated in high mountains where snow and frost frequently occur for prolonged periods of the year. The 379 and 383 climate zones stretch along the western border of the study area, following the high Drakensberg mountains (Institute for Soil, Water & Climate 1994). The lowest rainfall is recorded in climate zone 379, namely 766.3 mm per annum and the highest 1006.1 mm in climate zone 383. The highest average temperatures are found in the 375 climate zone (33.1°C) and the lowest in the 383 climate zone (-2.2°C).

Sample plots of this community are distributed over various geological formations and groups present in the study area, though primarily on the Tarkastad Subgroup, Beaufort Group and Vryheid Formation (Figure 5.4). The Volksrust Shale Formation forms part of the Northern Facies of the Ecca Shale Formation. It follows conformably on the Vryheid Formation and consists of soft, bluish shale. Fossils are scarce and consist of fish scales and fragments of petrified wood.

The Beaufort Group covers the largest area in the Karoo Basin and reaches a maximum thickness of 6 000 m in the eastern Cape Province. It comprises of alternating arenaceous and agrillaceous sediments that are terrestrial deposits. The agrillaceous deposits are mainly greenish-grey, bluish-grey or red and purple mudstone, which is inclined to weather into blocks. The arenaceous deposits are composed of yellowish, "dirty", i.e.

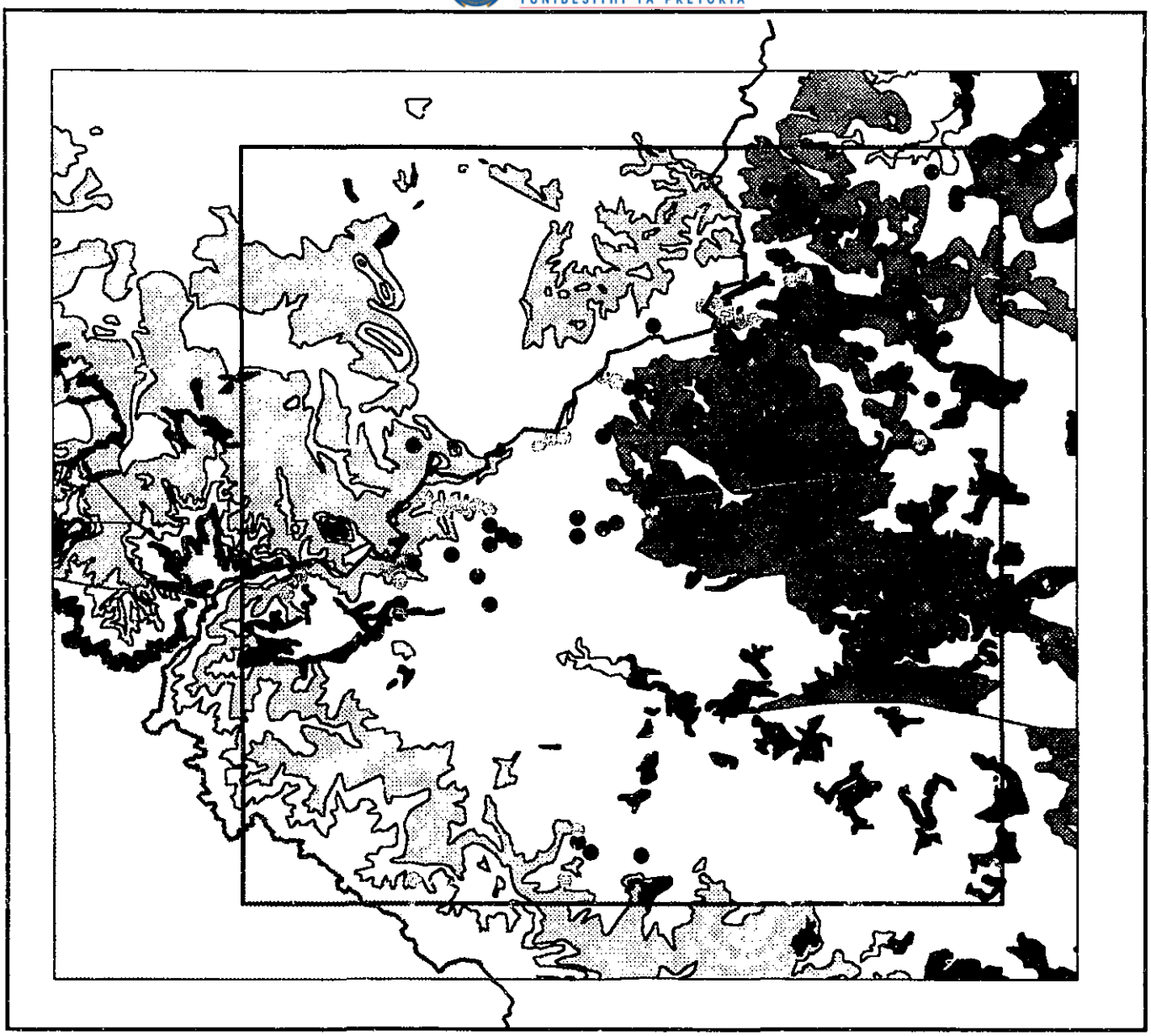
immature sandstones, which are present throughout the group and are characterised by cross-bedding.

The Tarkastad Subgroup consists of the Katberg Formation at the base and the Burgersdorp Formation at the top. The Katberg Formation in the south is composed of pale, greenish-grey and pink sandstone and intercalculations with mudstone become more plentiful towards the North. The Burgersdorp Formation is composed principally of red and green mudstone with numerous calcareous nodules. Reptilian fossils are common and plant remnants are found in the topmost part of the formation.

5.1.1 The *Monocymbium ceresiiforme - Andropogon schirensis* sub-community

Diagnostic species of this sub-community include the grass *Andropogon schirensis*, the forbs *Crassula vaginata, 0175 001, Pteridium aquilinum* and *Sutera caerulea* as well as the characteristic forbs *Rhabdosiella calycina* and shrub *Buddleja saligna*. It is distinguished from the *Monocymbium ceresiiforme - Cymbopogon excavatus* sub-community by the absence of species groups I, J, N, O, R, S, T, X, Y and Z (Table 5.1). The grass species *Monocymbium ceresiiforme* (Species group A) has a high cover in this sub-community. Other prominent species include the grasses *Tristachya leucothrix, Trachypogon spicatus* (Species group AD) and the forbs *Helichrysum aureonitens* and *Helichrysum pilosellum* (Species group M).

The distribution of this sub-community generally conforms to the Wet Cold Highveld Grassland (Bredenkamp **et. al.** 1996a). Three climate zones are represented in this vegetation type, namely 375, 383 and 379. Sample plots of this sub-community are situated in the mountainous western part of the study area at high altitudes (> 1 500 m a.m.s.l.). Snow occurs with severe frost for most of the winter. In these areas plains are present with steep grassy slopes, sometimes covered with dense woody vegetation. A combination of rainfall, altitude and utilisation is important in determining the different variations. Six variations were recognised in the *Monocymbium ceresiiforme - Andropogon schirensis* sub-community.



- Ladysmith
- Gridlines 28° - 29°S and 29° - 30°E
- KwaZulu-Natal Boundary
- Sample plots of the Monocymbium cerisiiforme - Andropogon shirensis sub-community
- Sample plots of the Monocymbium cerisiforme - Cymbopogon excavatus sub-community

Geological Formations

- Beaufort
- Clarens
- Drakensberg
- Karoo
- Karoo Dolerite
- Molteno
- Tarkastad
- Volksrust
- Vryheid

Figure 5.4: Distribution of the High Altitude Mountain Vegetation Type sample plots in the geological formations of the study area.

5.1.1.1 The *Erica drakensbergensis - Helichrysum umbraculigerum* variation

This is the only variation of the *Monocymbium ceresiiforme - Hyparrhenia hirta* sub-community that is present in the 375 climate zone, with an average rainfall of 910 mm per annum, falling in summer with severe frost in winter (Institute for Soil, Water & Climate 1994). The geology conforms to the Tarkastad Subgroup, which consist mainly of sandstone, weathering to a coarse grainy substrate with low clay content. Rocks are present in this variation, with an average size of 250 mm and a percentage cover of 16 to 30%.

The *Erica drakensbergensis - Helichrysum umbraculigerum* variation is characterised by the diagnostic species group C. It is distinguished from other variations in the *Monocymbium ceresiiforme - Andropogon schirensis* sub-community by the absence of species groups D, F, G, K, L, P, Q, U, V, W, AA, AB and AC, as well as the absence of the grass species *Andropogon schirensis* (Species group B) (Table 5.1). Prominent species are the grasses *Monocymbium ceresiiforme* (Species group A), *Alloteropsis semialata* (Species group AD) and the forbs *Helichrysum cephaloideum* (Species group M) and *Vernonia natalensis* (Species group AD).

This veld is prone to degradation due to over-utilisation and selective grazing by cattle. However, the presence of the palatable species *Monocymbium ceresiiforme* and *Alloteropsis semialata*, as well as the absence of unpalatable species such as *Eragrostis plana* is an indication that the veld is suitable for grazing and is therefore often over-utilised. The short growing season and leached soils make it difficult to stock at high rates (Acocks 1988).

5.1.1.2 The *Sporobolus centrifugus - Aristea woodii* variation

This variation is present in the 383 climate zone, with an average rainfall of 1006.1 mm per annum, falling mostly in summer. For most of the winter season severe frost occur with snow. An average annual minimum temperature of -2.2 °C is recorded. The Acocks Veld Type in this variation is the Highland Sourveld (#44) and represents the sour

grassveld variation. Low and Rebelo (1996) described this variation as Wet Cold Highveld Grassland (Bredenkamp **et. al.** 1996a) (#41), a grassland with occasional thickets. Sample plots of this variation are located in the Beaufort Group and Volksrust Formation. Soils are shallow and rocks are larger than 500 mm.

Utilisation is more pronounced than in the *Erica drakensbergensis - Helichrysum umbraculigerum* variation and unpalatable grass species, such as *Sporobolus centrifugus* (Species group D), *Loudetia flavida* (Species group H) and *Eragrostis racemosa* (Species group AC) are noted (Table 5.1). However, the presence of palatable species, such as *Andropogon schirensis* (Species group B), *Panicum natalense* (Species group Q), *Themeda triandra* (Species group AC), and *Trachypogon spicatus* (Species group AD) indicates that the veld of this variation is in a good condition.

The *Sporobolus centrifugus - Aristea woodii* variation is characterised by the diagnostic species group D and is further distinguished from the other variations in this sub-community by the absence of species groups C, F, G, P, U, V and AB. Grass species that have a high cover in this variation are *Monocymbium ceresiiforme* (Species group A), *Andropogon schirensis* (Species group B), *Panicum natalense* (Species group Q), *Themeda triandra, Eragrostis racemosa* (Species group AC), *Tristachya leucothrix* and *Trachypogon spicatus* (Species group AD). Prominent forbs include *Crassula acinaciformis* (Species group E), *Aristea woodii* (Species group K), *Haplocarpha scaposa* and *Pentanisia angustifolia* (Species group W). The *Erica drakensbergensis - Helichrysum umbraculigerum* and *Sporobolus centrifugus - Aristea woodii* sub-communities occur in the Highland Sourveld (Acocks #44). The forb *Crassula acinaciformis* (Species group E) is characteristic to both these variations.

5.1.1.3 The *0394 001 - Trachypogon spicatus* variation

This variation is present in the 379 climate zone, average annual rainfall 766.3 mm per annum. This climate zone is situated along the western border of the study area on the flatter patches along the escarpment. The geology conforms to the Tarkastad Sub-group,

which consists of sandstone and weathers to shallow lithosoils. Rocks are absent, and sample plots were situated in areas where slopes were not pronounced. The *0394 001 - Trachypogon spicatus* variation is found exclusively in the Highland Sourveld (Acocks #44) and the Wet Cold Highveld Grassland (#41) (Bredenkamp **et. al.** 1996a).

The presence of diagnostic species group F and the absence of species groups C, D, E, G, L, U and AA distinguish this variation from other variations in the *Monocymbium ceresiiforme - Andropogon schirensis* sub-community (Table 5.1). The veld is in good condition with little or no signs of utilisation and various palatable species occur, such as *Monocymbium ceresiiforme* (Species group A), *Themeda triandra* (Species group AC), *Tristachya leucothrix* and *Trachypogon spicatus* (Species group AD).

Many forbs, such as *Crassula vaginata* (Species group B), *Aristea woodii* (Species group K), *Helichrysum aureonitens, Helichrysum pilosellum* (Species group M), *Commelina africana* (Species group P), *Haplocarpha scaposa* (Species group W) and *Senecio venosus* (Species group AC) have high cover values.

5.1.1.4 The *Loudetia flavida - Tristachya leucothrix* variation

Diagnostic species group G characterises this variation. Species group H is common to this and the previous three variations. The species indicate moist conditions and shallow soils on the rocky hills where these variations are found. The *Loudetia flavida - Tristachya leucothrix* variation is found in the 379 climate zone at altitudes between 1 850 and 2 150 m a.m.s.l. on the Tarkastad Sub-group and Beaufort Group geological formations, which weathers to a shallow sandy soil. Rocks are generally absent, but soils are shallow on slopes with an incline of less than 5°. Acocks (1988) described this as the Highland Sourveld (#44), but Bredenkamp **et. al.** (1996c) refers to this area as the North-eastern Mountain Grassland (#43).

Utilisation in this variation is severe. The absence of palatable grass species such as *Eragrostis curvula* (Species group AB), *Themeda triandra* (Species group AC) and

Hyparrhenia hirta (Species group AD), as well as the presence of unpalatable species such as *Panicum natalense* (Species group Q), *Loudetia flavida* (Species group H), *Aristida junciformis* (Species group W) and *Eragrostis plana* (Species group AD) (Table 5.1) indicate over-utilisation and degradation. The main result of mismanagement in this veld type is the conversion of this veld into a Karoid False Fynbos (Acocks 1988).

As a result of the drier conditions that prevails in this variation, the herbaceous layer is well developed, with species such as *Crassula vaginata* (Species group B), *Helichrysum aureonitens, Helichrysum pilosellum* (Species group M), *Commelina africana* (Species group P) and *Senecio brevidentatus* (Species group AD), with high cover abundance values.

5.1.1.5 The *Andropogon schirensis - Aristida junciformis* variation

This variation is recognised by the absence of species groups C, D, E, F, G, H and AA and the presence of species group U (Table 5.1). It is found in the northern and central areas of the 383 climate zone that stretches along the western border of the study area on the escarpment and foothills of the Drakensberg. The average rainfall for this climate zone is 1 006.1 mm per annum (Institute for Soil, Water & Climate 1994). It is present on the Beaufort Geological Group.

The *Andropogon schirensis - Aristida junciformis* variation is found in the Highland Sourveld (#44) described by Acocks (1988), and the Wet Cold Highveld Grassland (#41) described by Bredenkamp **et. al.** (1996a). Relevès were present on footslopes of less than 6° with little or no rocks present. Utilisation varies and a combination of palatable and unpalatable grass species occur in this variation, such as *Andropogon schirensis* (Species group B), *Aristida junciformis* (Species group W) and *Themeda triandra* (Species group AC), *Monocymbium ceresiiforme* (Species group A), *Tristachya leucothrix, Trachypogon spicatus* (Species group AD). The forbs *Helichrysum aureonitens, Helichrysum pilosellum, Helichrysum cephaloideum* (Species group M) and *Anthospermum rigidum* (Species group AB) (Table 5.1) have high cover values.

5.1.1.6 The *Pteridium aquilinum - Eragrostis plana* variation

This variation is present in the southern part of the 383 climate zone (Rainfall 1006.1 mm per annum) and is distinguished from other variations by the presence of species groups L and AA as well as the absence of species groups C, D, E, F, G and H (Table 5.1). Relevès representing this variation were present on the footslopes of the Drakensberg with a slope not exceeding 5°. Bredenkamp **et. al.** (1996a) described this area as the Wet Cold Highveld Grassland (#41). Relevès of this variation are not restricted to a single geological formation, but the Karoo Dolerite, Beaufort Group and Tarkastad Sub-group geological formations are represented.

Utilisation seems to be higher in this variation than in the *Andropogon schirensis - Aristida junciformis* variation. Grass species such as *Monocymbium ceresiiforme* (Species group A), *Aristida junciformis* (Species group W), *Diheteropogon amplectens* (Species group AA), *Hyparrhenia hirta* and *Eragrostis plana* (Species group AD), the fern *Pteridium aquilinum* (Species group B) and the forb *Helichrysum aureonitens* (Species group M) have high cover abundance values.

5.1.2 The *Monocymbium ceresiiforme - Cymbopogon excavatus* sub-community

The sample plots of this sub-community are mostly situated in the Southern Tall Grassveld (Acocks #65), but some relevès of Natal Sour Sandveld (Acocks #66) are found in one variation. Southern Tall Grassveld (#65) is described by Acocks (1988) as being dominated by *Themeda triandra* and *Hyparrhenia hirta*. Altitudes ranges from 1 350 m a.m.s.l. and are lower than the *Monocymbium ceresiiforme - Andropogon schirensis* sub-community which occurs at altitudes above 1 500 m a.m.s.l. The Southern Tall Grassveld (Acocks #65) is however divided into Open Thornveld and Shrub Forest. The Open Thornveld is an open savanna of *Acacia sieberiana* in sourish mixed grassveld. Topsoil is shallow and consequently prone to erosion.

Rainfall in the *Monocymbium ceresiiforme - Cymbopogon excavatus* sub-community is between 600 to 900 mm per annum. It is markedly different from the North-eastern

Mountain Grassland (Bredenkamp **et. al.** 1996c) (#43), which is said to be a pure grassland occurring at altitudes of 1 400 to 1 900 m a.m.s.l. and rainfall of 700 to 1 100 mm per annum (Institute for Soil, Water & Climate 1994).

The data from relevès as well as descriptions from Acocks show a correspondence to the Natal Central Bushveld (Granger 1996) (#25), rather than to North-eastern Mountain Grassland (Bredenkamp **et. al.** 1996c) (#43).

Except for variation 5.2.5., which is located on the crests of rocky hills, rocks are absent in this sub-community. The remainder of relevès is found on footslopes of hills, with a slope of less than 5°. Utilisation varies in the different variations and the presence of various unpalatable species as well as various forbs give an indication that this sub-community might be prone to degradation.

Various geological formations are represented in this sub-community, but the Beaufort Group and Tarkastad Sub-group tend to dominate. It consists of a thick bed of sandstone at the base, followed by an alteration of sandstone, and brownish-red and green mudstone.

The *Monocymbium ceresiiforme - Cymbopogon excavatus* sub-community is found on the footslopes of the Drakensberg in the western and northern parts of the study area. The sample plots are mainly located in climate zones 384, 387 and 526. In these climate zones the highest average maximum temperature of 31.6°C was recorded in the 384 climate zone, situated on the western side of the study area on the footslopes of the Drakensberg. The lowest average minimum temperature of 2.4°C was recorded in the 388 climate zone, situated in the northern part of the study area stretching from west to east.

The average yearly rainfall is the highest in climate zone 387, namely 908.5 mm per annum. Only a small percentage of the sample plots are, however, found in this zone. The largest proportion of the sample plots is found in the 384 climate zone with an

average rainfall of 850 mm per annum (Institute for Soil, Water & Climate 1994).

The *Monocymbium ceresiiforme - Cymbopogon excavatus* sub-community is further characterised by the presence of the grasses *Cymbopogon excavatus* and *Sporobolus africanus* (Species group I). It is distinguished from the *Monocymbium ceresiiforme - Andropogon schirensis* sub-community by the absence of species groups B, C, D, E, F, G and H (Table 5.1). The diagnostic species of the High Altitude Mountain Vegetation Type, namely *Monocymbium ceresiiforme,* is not as dominant in this sub-community as in the previous. Other species that tend to dominate locally are the grasses *Diheteropogon amplectens* (Species group AA), *Themeda triandra* (Species group AC) and *Hyparrhenia hirta* (Species group AD). These grasses occur throughout the study area. *Hyparrhenia hirta* (Species group AD) is more prominent in this sub-community than in the *Monocymbium ceresiiforme - Andropogon schirensis* sub-community. Seven variations were recognised in this sub-community.

5.1.2.1 The *Eragrostis gummiflua - Eragrostis chloromelas* variation

This variation is found in little depressions, slightly wetter than the surrounding areas in the 526 climate zone, which is situated in the northern part of the study area. The average rainfall is 695.9 mm per annum, falling during the summer. Geology conforms to the Vryheid- and Volksrust Formations weathering to a shallow, sandy soil. Rocks are absent and sample plots are situated on the footslopes of hills with slopes of less than 5°. Sample plots of this variation are found in the Natal Sour Sandveld (Acocks #66), which is similar to the Natal Central Bushveld (#25), described by Granger (1996).

Little or no evidence of utilisation has been noted in this variation, but the veld seems to be in a degraded condition. This can be derived from the presence of unpalatable species, such as *Eragrostis gummiflua* (Species group J) and *Eragrostis chloromelas* (Species group U) and the presence of various forbs, such as *Richardia brasiliensis* (Species group U), together with the absence or low cover of palatable grass species (Table 5.1).

The *Eragrostis gummiflua* - *Eragrostis chloromelas* variation is characterised by the presence of species group J, consisting of the grass *Eragrostis gummiflua* and the diagnostic forb species *Wahlenbergia undulata* and *Haplocarpha lyrata*. The grass *Eragrostis gummiflua* occurs throughout the study area. It is distinguished from other variations by the absence of species groups N, R, S, X, Y and Z. Species with a high cover abundance in this variation are the grasses *Eragrostis chloromelas* (Species group U), *Themeda triandra, Eragrostis racemosa* (Species group AC), *Hyparrhenia hirta* and *Eragrostis plana* (Species group AD) as well as the forbs *Richardia brasiliensis* (Species group U) and *Helichrysum rugulosum* (Species group AB).

5.1.2.2 The *Sporobolus africanus - Richardia brasiliensis* variation

Representative sample plots of this variation are found on various geological formations, but mainly the Volksrust Formation. It occurs in areas where a slope of less than 6° and little or no rocks are present, but soils are shallow and sandy. The *Sporobolus africanus - Richardia brasiliensis* variation is distinguished from the other variations due to the presence of species group K, L, M, O, P, Q, T, U, V, W and Z and the absence of species groups J, N, R, S, X and Y (Table 5.1).

Prominent grasses in this variation are *Cymbopogon excavatus* (Species group I), *Aristida congesta* ssp. *barbicollis* (Species group Z), *Eragrostis curvula* (Species group AB), *Themeda triandra, Eragrostis racemosa* (Species group AC), *Hyparrhenia hirta* and *Eragrostis plana* (Species group AD). The forbs *Helichrysum pilosellum* (Species group M), *Richardia brasiliensis* (Species group U), *Helichrysum rugulosum, Anthospermum rigidum, Crepis hypochoeridea* (Species group AB) and *Vernonia natalensis* (Species group AD) have high cover values. The prominent forb stratum, the presence of various unpalatable grass species and a high degree of *Acacia sieberiana* seedlings present indicate that this variation is already degrading and might require careful management.

5.1.2.3 The *Diheteropogon amplectens - Hypoxis rigidula* variation

Sample plots of this variation are located in the Southern Tall Grassveld (Acocks #65) in areas where there is marked evidence of utilisation on shallow and sandy soils. This vegetation corresponds with the Natal Central Bushveld (Granger 1996) (#25), poorly conserved as well as being highly transformed (Low and Rebelo 1996). The presence of highly erodible, shallow duplex soils, require careful management by fire and grazing. As this vegetation is situated in areas with slope less than 5° with no rocks on the soil surface, the area is heavily trampled and intensive utilisation by cattle will have a pronounced effect on the vegetation. The sample plots of this variation is situated in the Beaufort geological group.

This variation is recognised by the presence of species groups L, M, O, P, Q, T, U, V, W, Y and Z as well as the absence of species groups J, K, R, S, X and Y (Table 5.1). It is found in the 384 climate zone with an average rainfall of 850 mm per annum and a maximum temperature of 31.6°C during December (Institute for Soil, Water & Climate 1994). Species that have a high cover abundance in this variation are the grasses *Diheteropogon amplectens* (Species group AA), *Themeda triandra, Eragrostis racemosa* (Species group AC), *Hyparrhenia hirta* (Species group AD) and the forbs *Helichrysum pilosellum* (Species group M), *Haplocarpha scaposa* (Species group W) and *Hypoxis rigidula* (Species group AB).

5.1.2.4 The *Paspalum scrobiculatum - Acanthospermum australe* variation

This variation is found in the northern part of climate zone 384, with an average rainfall of 850 mm per annum and a maximum temperature of 31.6°C in December (Institute for Soil, Water & Climate 1994). It is located mainly on the Beaufort Geological Group, but elements of the Volksrust Formation are also present in this variation. Relevès of this variation are situated on the escarpment of the Drakensberg, on the footslopes of hills with a slope of less than 6°.

Despite shallow, sandy topsoil, no rocks are present in these sample plots. Elements of the Highland Sourveld (Acocks #44) as well as the Southern Tall Grassveld (Acocks #65) are present in this variation. Bredenkamp **et. al.** (1996c) described this vegetation as North-eastern Mountain Grassland (#43). It is characterised by the presence of species groups L, M, O, P, Q, S, T, U and Y and the absence of species groups J, K, N, R and X. Evidence of heavy utilisation is present, this is reflected in the high percentage occurrence of forbs like *Helichrysum pilosellum, Helichrysum cephaloideum* (Species group M), *Acanthospermum australe* (Species group S), *Haplocarpha scaposa, Pentanisia angustifolia* (Species group W), *Helichrysum rugulosum, Pygmaeothamnus chamaedendrum* (Species group AB) and *Vernonia natalensis* (Species group AD). An admixture of palatable and unpalatable grass species, such as *Paspalum scrobiculatum* (Species group L), *Diheteropogon amplectens* (Species group AA), *Themeda triandra* (Species group AA), *Hyparrhenia hirta* and *Eragrostis plana* (Species group AD) occur in this variation.

5.1.2.5 The *Cephalanthus natalensis - Trachypogon spicatus* variation

This variation represents the scattered woody clumps of vegetation on rocky hills occasionally found in the Southern Tall Grassveld (Acocks #65). Various woody species represented are characteristic species of this specific vegetation, but they do also occur throughout the study area. These include *Cephalanthus natalensis, Rhus dentata, Rhus rigida, Diospyros lycioides, Tapiphylum parvifolium* and *Pavetta gardenifolia* (Species group N). Various climate zones and geological formations are represented. The main characteristic of this variation is the rockiness of the sample plots (up to 75%, average rock size more than 1 000 mm), with the Mispah soil form dominant (Orthic A, hard rock) (Macvicar **et. al.** 1977).

Species group N characterises this variation (Table 5.1). Species with high cover values include the grasses *Cymbopogon excavatus* (Species group I), *Panicum natalense* (Species group Q), *Melinis repens, Brachiaria serrata* (Species group Y), *Diheteropogon amplectens* (Species group AA), *Themeda triandra* (Species group AC), *Hyparrhenia*

hirta, *Tristachya leucothrix* and *Trachypogon spicatus* (Species group AD). Prominent forbs include *Eriosema cordatum*, *Turbina oblongata* (Species group Q), *Acanthospermum australe* (Species group S), *Haplocarpha scaposa* (Species group W), *Helichrysum rugulosum*, *Hypoxis rigidula*, *Pygmaeothamnus chamaedendrum* (Species group AB), *Vernonia natalense*, *Berkheya setifera and Acalypha angustata* (Species group AD). This mixture of palatable and unpalatable grass species, together with the prominent forb layer, is an indication of a high utilisation factor.

5.1.2.6 The *Eriosema cordatum - Helichrysum rugulosum* variation

This variation occurs mainly in the 384 climate zone, with an average rainfall of 850 mm per annum. It is situated on the escarpment of the Drakensberg, where the geology conforms to the Beaufort group. Relevès representing this variation occur on footslopes of hills where rocks are absent and the slope is less than 6°. It is distinguished from other variations in this sub-community by the presence of species groups I and R to AD, as well as the absence of species groups J to Q (Table 5.1).

This variation has an appearance of heavily utilised grassland, with areas of bare soil in some places. The presence of unpalatable grass species such as *Cymbopogon excavatus* (Species group I), *Eragrostis chloromelas* (Species group U), *Eragrostis plana* (Species group AD) and various forb species give an indication that degradation can become a problem.

5.1.2.7 The *Themeda triandra - Berkheya setifera* variation

This variation is distinguished from other variations in the *Monocymbium ceresiiforme - Cymbopogon excavatus* sub-community by the presence of species groups X to AD as well as the absence of species groups J to W (Table 5.1). This variation represents the Southern Tall Grassveld (#65), described by Acocks (1988). The geology of the distribution area of this variation, is representative of the Beaufort Group.

Three grass species dominate in this variation, namely *Cymbopogon excavatus* (Species group I), *Themeda triandra* (Species group AC) and *Hyparrhenia hirta* (Species group AD), with *Diheteropogon amplectens* (Species group AA), *Trachypogon spicatus* and *Elionurus muticus* (Species group AD) being conspicuous.

Chapter 6: The Open Thornveld Vegetation Type

The Open Thornveld Vegetation Type is present in the central and eastern part of the study area. This vegetation type is characteristic of the plains adjacent to the footslopes of the Drakensberg at altitudes lower than 1 500 m a.m.s.l (Figure 6.1). The topography conforms to undulating plains interspersed with open rocky hills. Rocks may be present on the soil surface and soils tend to be sandy or sandy-loam. Grasses dominate the vegetation and few individuals of woody species are noted in the different communities. The only woody species that occur frequently throughout the vegetation type are the trees *Acacia karroo* and *Acacia sieberiana*. The absence of other woody species, as well as the grass *Monocymbium ceresiiforme*, distinguishes this vegetation type from the Woodland- and High Altitude Mountain Vegetation Type. Species that generally dominate in the Open Thornveld Vegetation Type include the grasses *Hyparrhenia hirta, Themeda triandra, Cymbopogon excavatus, Eragrostis plana, Eragrostis, curvula* and *Eragrostis racemosa.*

By means of TWINSPAN and Braun-Blanquet procedures, the following communities were identified:

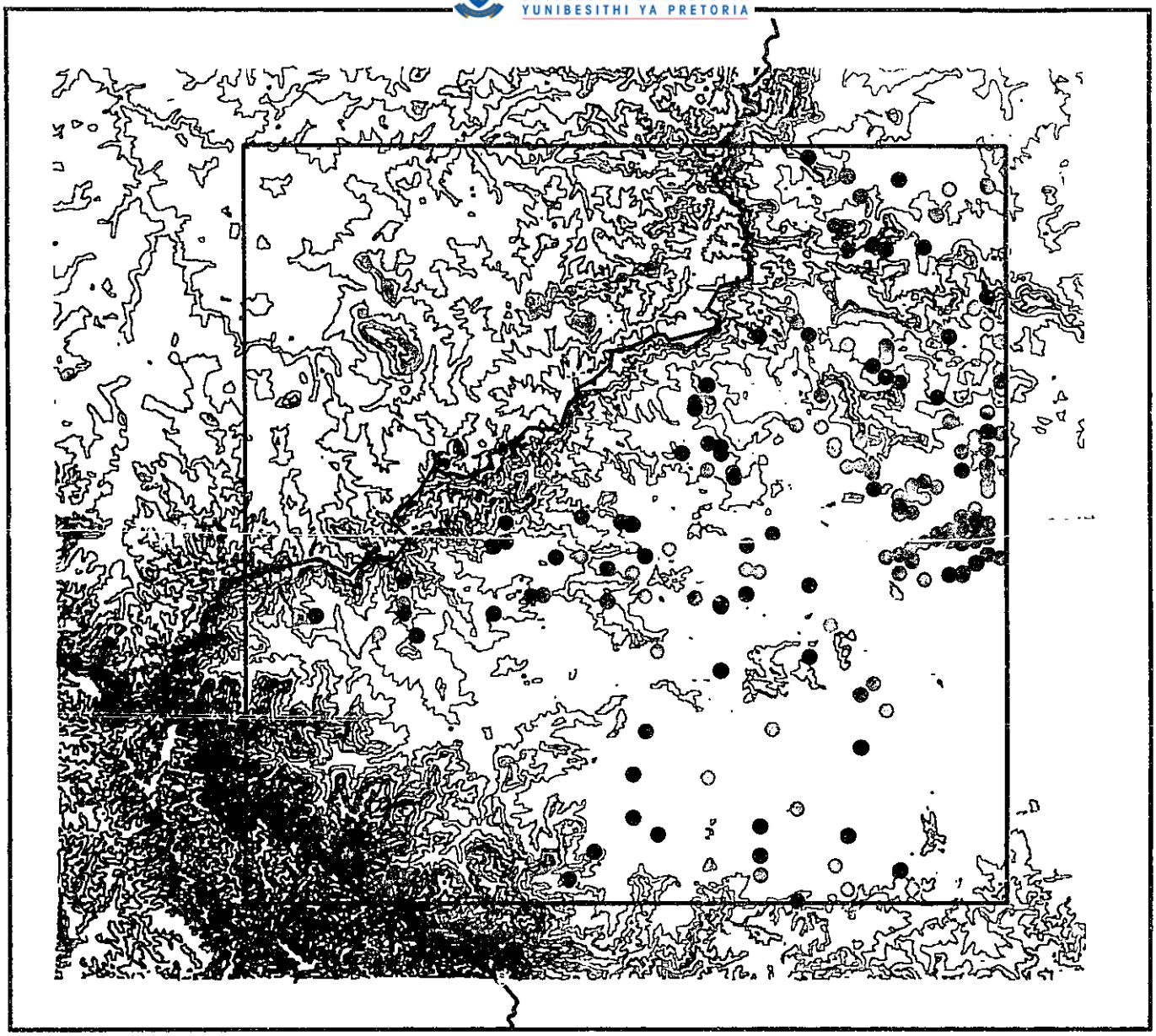
6.1 The *Hyparrhenia anamesa - Hyparrhenia dregeana* community (Table 6.1)

6.2 The *Trachypogon spicatus - Diheteropogon amplectens* community (Table 6.2)

6.3 The *Diospyros lycioides - Eragrostis chloromelas* community (Table 6.2)

6.4 The *Hyparrhenia hirta - Themeda triandra* community (Table 6.3)

The grasses *Hyparrhenia anamesa* and *Hyparrhenia dregeana* are diagnostic, with *Trachypogon spicatus, Diheteropogon amplectens* and *Diospyros lycioides* being characteristic species in the *Hyparrhenia anamesa - Hyparrhenia dregeana-*, the *Trachypogon spicatus - Diheteropogon amplectens-* and the *Diospyros lycioides - Eragrostis chloromelas* communities respectively.



Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Hyparrhenia anamesa - Hyparrhenia dregeana community
Sample plots of the Trachypogon spicatus and
Diospyros lycioides - Eragrostis chloromelas communities
Sample plots of the Hyparrhenia hirta - Themeda triandra community

Altitude

Altitude of the study area, contours 100m interval
750 - 1 100
1 100 - 1 450
1 450 - 1850
1 850 - 2 200
2 200 - 2 550
2 550 - 2 950
2 950 - 3 300

Figure 6.1: Distribution of the Open Thornveld Vegetation Type sample plots in the study area (contour interval 100m).

Sample plots of the Open Thornveld Vegetation Types are distributed over intensive areas in the study area and this is the main vegetation type of the study area. Acocks (1988) described this type of vegetation as the Southern Tall Grassveld (#65) (Figure 6.2) where *Themeda* and *Hyparrhenia* dominate. Altitude of Southern Tall Grassveld (#65) ranges from 600 to 1 350 m a.m.s.l., though below 1 050 m a.m.s.l. the vegetation is transitional to Valley Bushveld (#23). At altitudes above 1 050 m a.m.s.l. an open savanna with *Acacia sieberiana* in sourish mixed grassveld is found.

This vegetation type corresponds to the Natal Central Bushveld (Granger 1996) (#25), but vegetation composition suggests that this is a grassland with scattered trees, rather than bushveld (Figure 6.3). Sample plots are located in the Natal Central Bushveld (Granger 1996) (#25) as well as the North-eastern Mountain Grassland (Bredenkamp **et. al.** 1996c) (#43) which comprises the grasslands of the great escarpment mountains. Soils are mostly shallow, derived from a variety of rock types.

The Natal Central Bushveld (Granger 1996) (#25) covers a large portion of the KwaZulu-Natal midlands at altitudes of 600 to 1 350 m a.m.s.l. Soils are shallow, derived from mudstones and shales on duplex subsoils. Granger (1996) describes the vegetation as an open savanna, with scattered *Acacia sieberiana, Acacia karroo* and *Acacia nilotica.* The herbaceous layer is quite variable with secondary grassland, dominated by patches of *Hyparrhenia hirta.*

The Volksrust Formation and Beaufort Group are mostly represented in the area of this vegetation type, with some sample plots located on the Vryheid Formation (Figure 6.4). The Vryheid Formation is characterised by thick beds of yellowish to white, crossbedded sandstone and grit, which alternate with beds of soft, dark-grey, sandy shale and a few seams of coal. This formation follows on the Pietermaritzburg Shale Formation, from the southern part of KwaZulu-Natal northwards. Along the northern rim of the Basin it rests either on the Dwyka Formation or on an uneven floor of pre-Karoo formations.

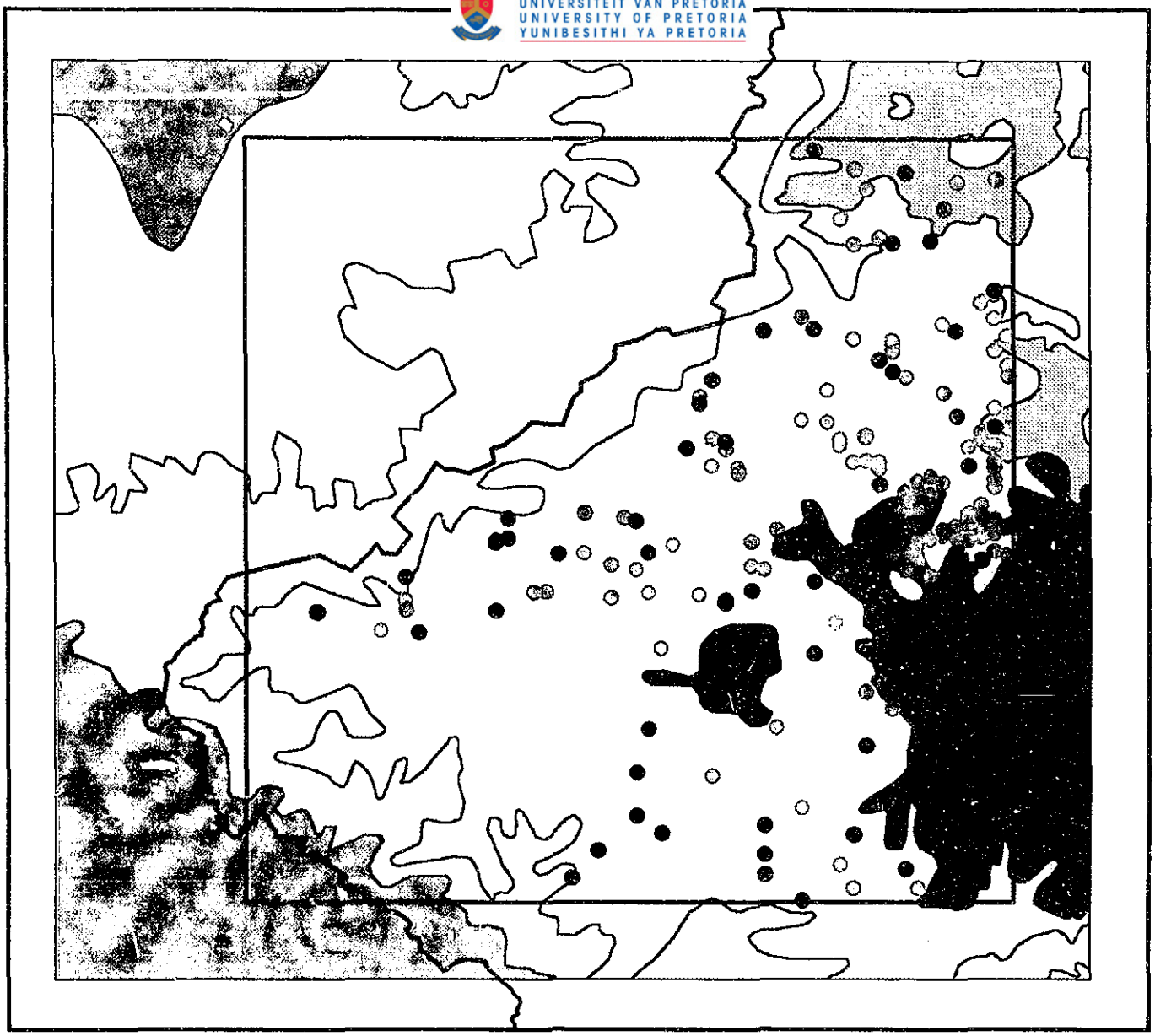


Figure 6.2: Distribution of the Open Thornveld Vegetation Type sample plots in Acocks Veld Types of the study area.

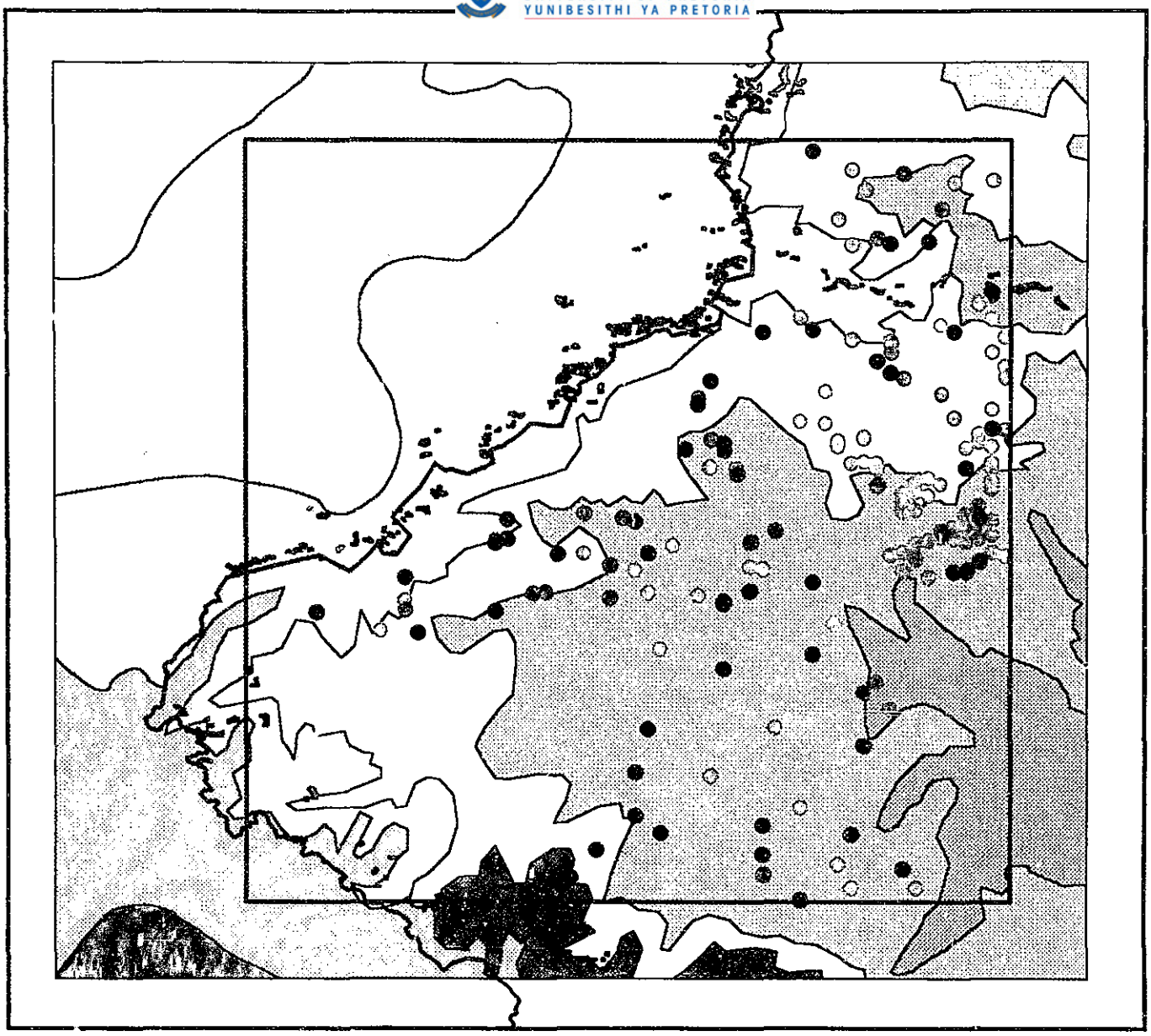


Figure 6.3: Distribution of the Open Thornveld Vegetation Type sample plots in Low and Rebelo Vegetation Types of the study area.

Like the Vryheid Formation, the Volksrust Shale Formation forms part of the Northern Facies of the Ecca Shale Formation. It extends from the southern part of KwaZulu-Natal, right round the northern rim of the basin, where it merges into the Tierberg Shale Formation. It follows conformably on the Vryheid Formation and consists of soft, bluish shale. The Beaufort Group covers the largest area in the Karoo and is composed of an alternation of arenaceous and agrillaceous sediments which are terrestrial deposits.

The main climate zones present in the Open Thornveld Vegetation Type include the 374, 385, 386 and 387 zones. The highest rainfall occurs in the 387 climate zone (908.5), with the most moderate temperatures (average maximum 26.5°C, average minimum 4.4°C) (Institute for Soil, Water & Climate 1994). The 387 climate zone is situated in the north-eastern part of the study area. The lowest occurs in the 386 climate zone, with 644,8 mm per annum. In the 386 climate zone, extreme temperature ranges are present, with the average maximum of 31.2°C and the average minimum 0.8°C. This climate zone is located in the eastern-central part of the study area.

6.1 The *Hyparrhenia anamesa - Hyparrhenia dregeana* community

The vegetation is an open savanna of tall grasses and *Acacia spp.* Sample plots are located in depressions on the footslopes of hills in close vicinity of streams. Various grasses and forbs present in the different variations indicate that the sample plots are located in disturbed areas. Soils are deep and well drained and rocks are absent. The Beaufort geological Group is predominantly represented (Figure 6.5). The grass *Hyparrhenia hirta* dominates and *Eragrostis plana,* with the forb *Helichrysum rugulosum* (Species group O) is also prominently present.

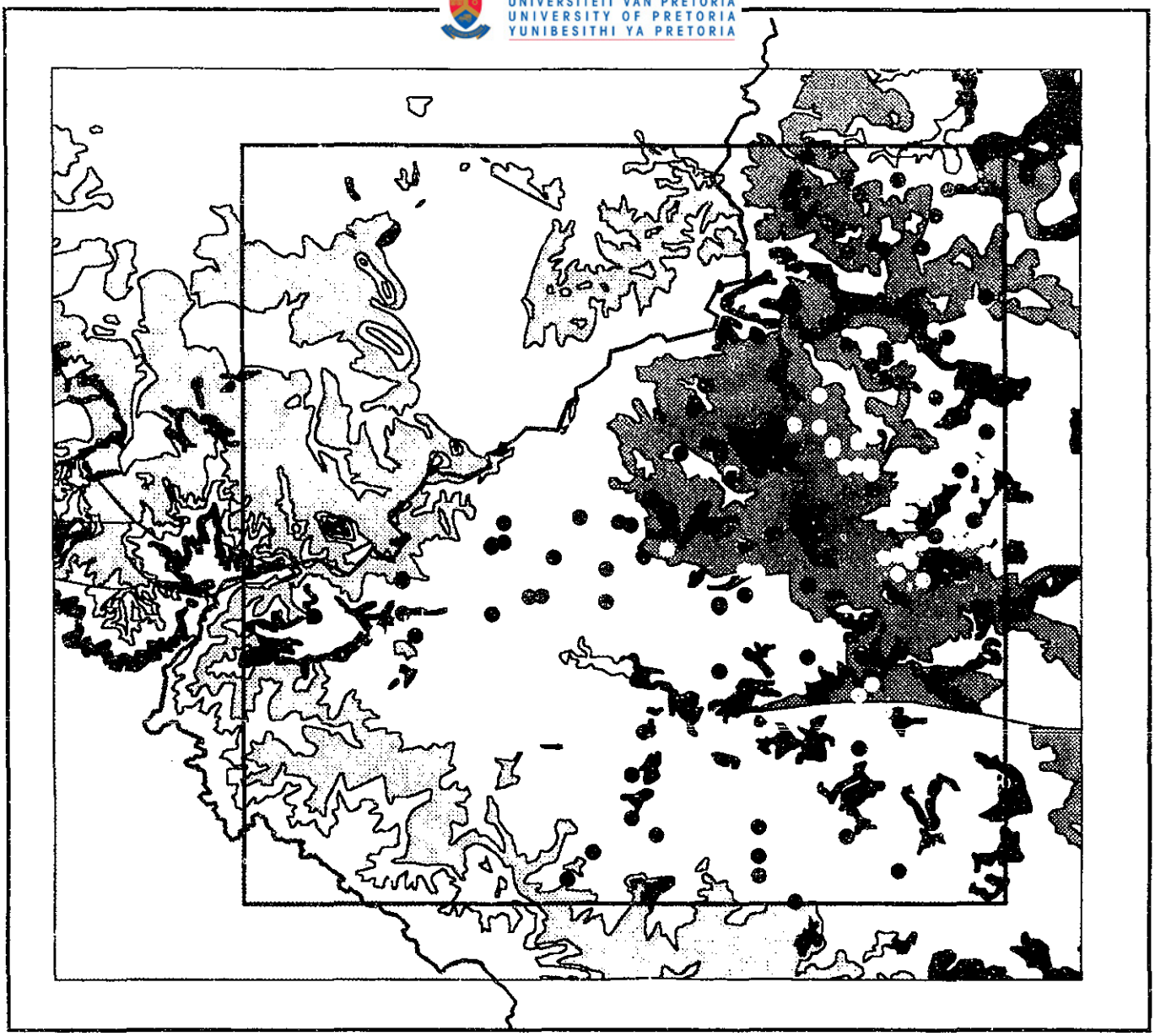


Figure 6.4: Distribution of the Open Thornveld Vegetation Type sample plots in the geological formations of the study area.

The presence of the diagnostic species *Hyparrhenia anamesa* and *Hyparrhenia dregeana* (Species group A) (Table 6.1) distinguishes this community from other communities in the Open Thornveld vegetation type. Various Veld Types (Acocks 1988) (Figure 6.6) and Vegetation Types (Low & Rebelo 1996) (Figure 6.7) are represented.

Two sub-communities and six variations were recognised by means of TWINSPAN classification and subsequent Braun-Blanquet procedures.

6.1.1 The *Hyparrhenia anamesa - Hermannia depressa* sub-community

Sample plots representing this sub-community are distributed throughout the study area and in close vicinity of streams. The variations of the *Hyparrhenia anamesa - Hermannia depressa* forms part of a moisture gradient with the *Eragrostis curvula - Melinis repens* variation on dry and the *Imperata cylindrica - Eragrostis plana* variation in moist conditions. Moisture- and degradation gradients were noted and these can be used to distinguish among the variations.

Various geological formations are present, but the Beaufort Group is predominantly found in the area of this plant community. Rocks are absent and soils are sandy-loam and deep. Careful management has to be applied to prevent vegetation degrading and soil erosion in this sub-community.

The vegetation corresponds to the Southern Tall Grassveld (#65), described by Acocks (1988) as an open savanna dominated by *Hyparrhenia hirta* and *Themeda triandra.* The *Hyparrhenia anamesa - Hermannia depressa* sub-community is characterised by the presence of species group B (Table 6.1). The grass species *Paspalum scrobiculatum* and *Eragrostis capensis* (Species group B) are associated with moist, disturbed areas. The grass *Hyparrhenia hirta* (Species group P) dominates in this sub-community, with *Eragrostis plana, Eragrostis curvula, Sporobolus africanus, Cymbopogon excavatus, Hyparrhenia anamesa* and the forb *Helichrysum rugulosum* (Species group P) also present.

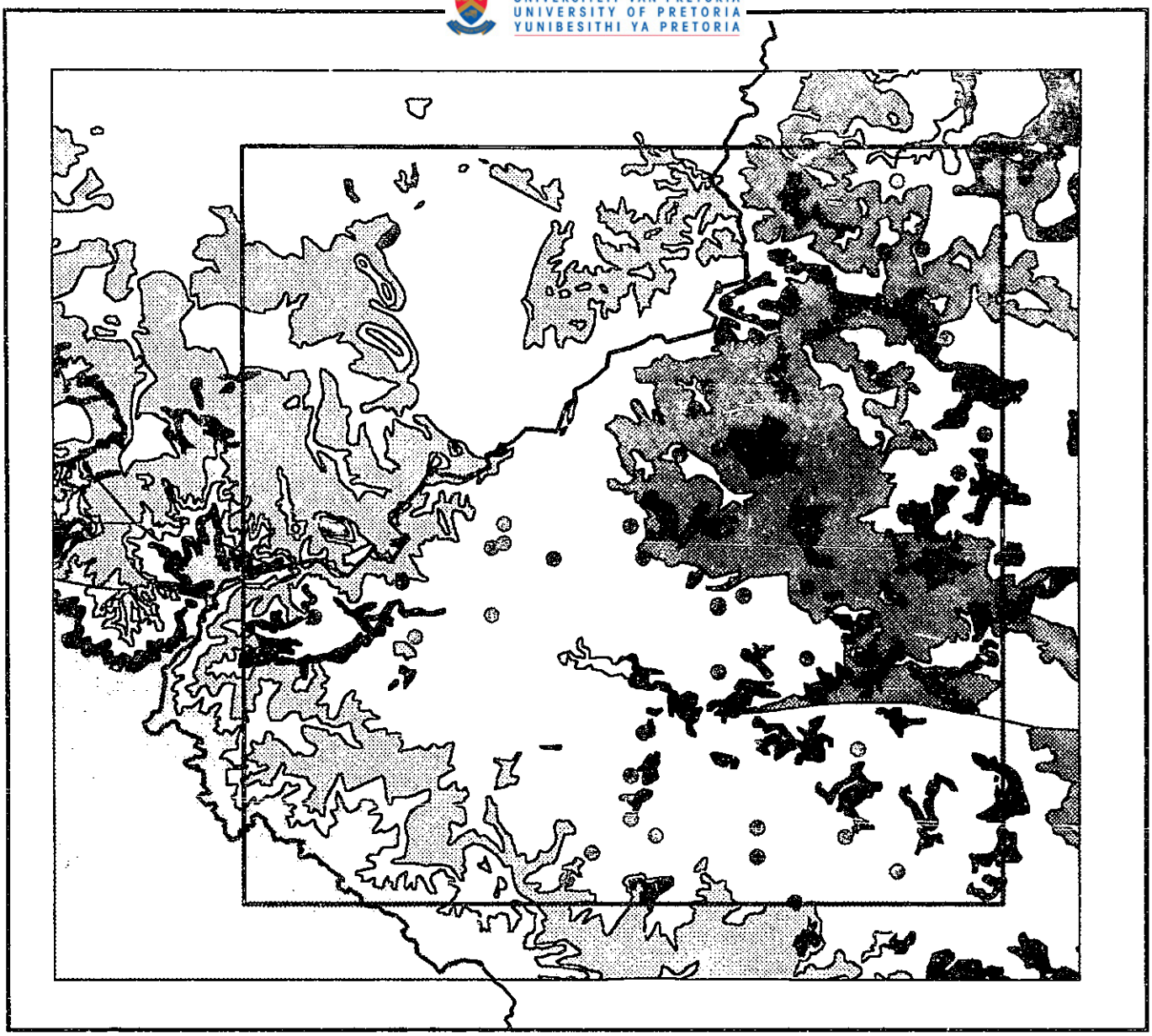
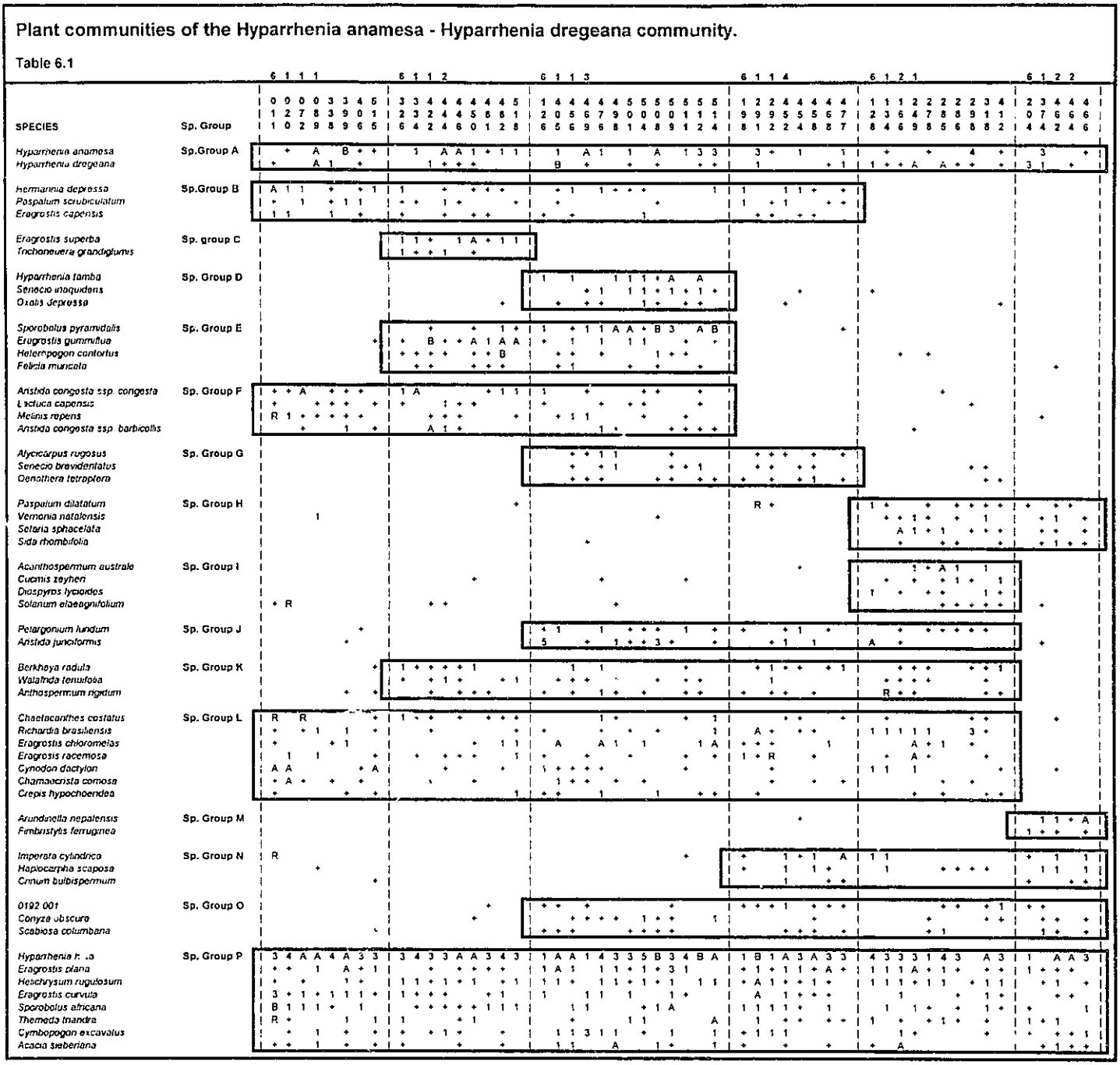
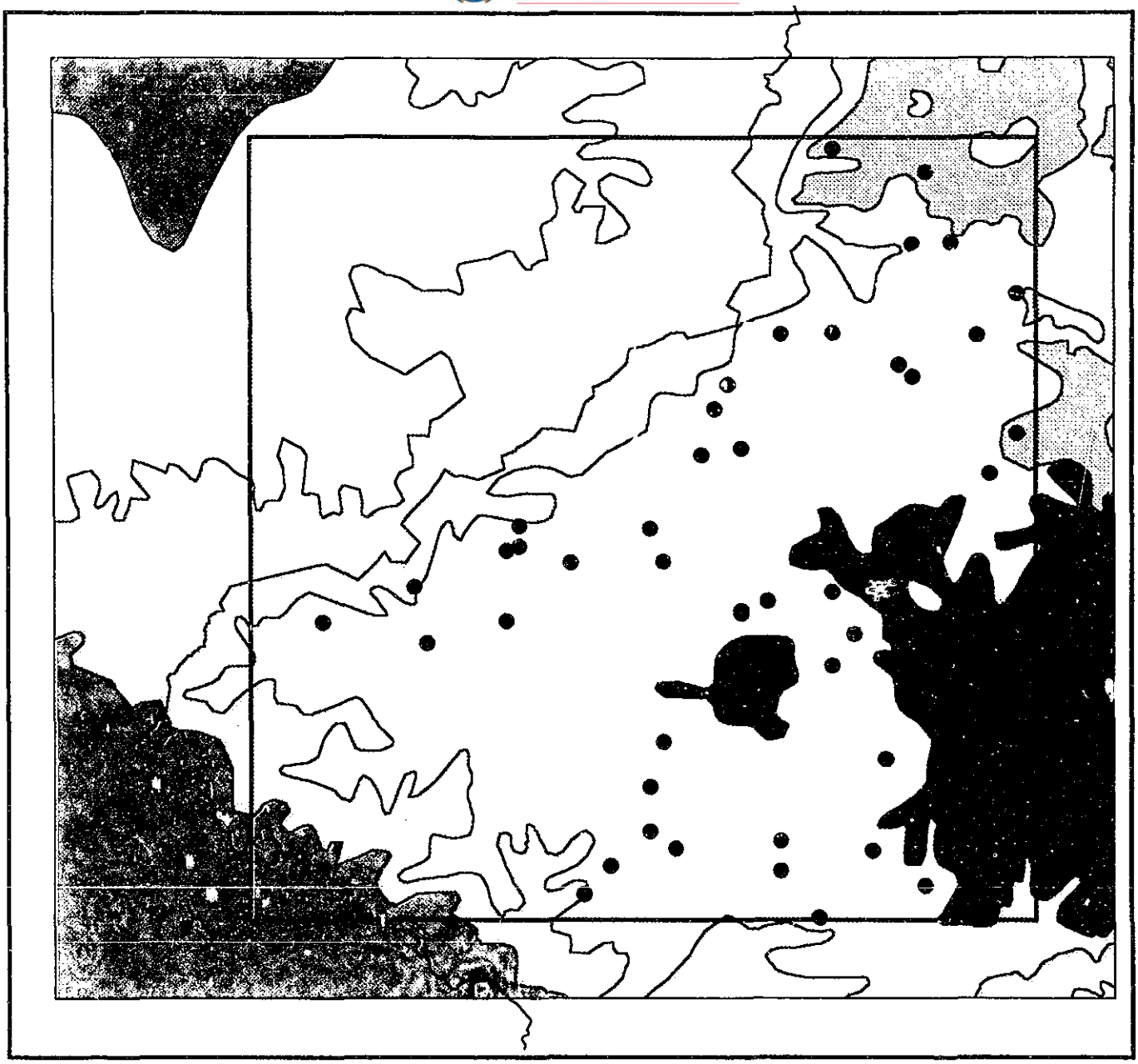


Figure 6.5: Distribution of the Hyparrhenia anamesa - Hyparrhenia dregeana community sample plots in the geological formations of the study area.

Plant communities of the Hyparrhenia anamesa - Hyparrhenia dregeana community.

Table 6.1





Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Hyparrhenia anamesa - Hyparrhenia dregeana community

Acocks Veld Types
Cymbopogon - Themeda Veld (Sandy) (#48)
Highland Sourveld and Dohne Sourveld (#44)
Highland Sourveld to Cymbopogon - Themeda Transition (Eastern Free State Highveld) (#49)
Natal Sour Sandveld (#66)
Southern Tall Grassveld (#65)
Themeda Veld to Cymbopopogon - Themeda Veld Transition (Patchy) (#53)
Themeda - Festuca Alpine Veld (#58)
Valley Bushveld (#23)

Figure 6.6: Distribution of the Hyparrhenia anamesa - Hyparrhenia dregeana sample plots in Acocks Veld Types of the study area.

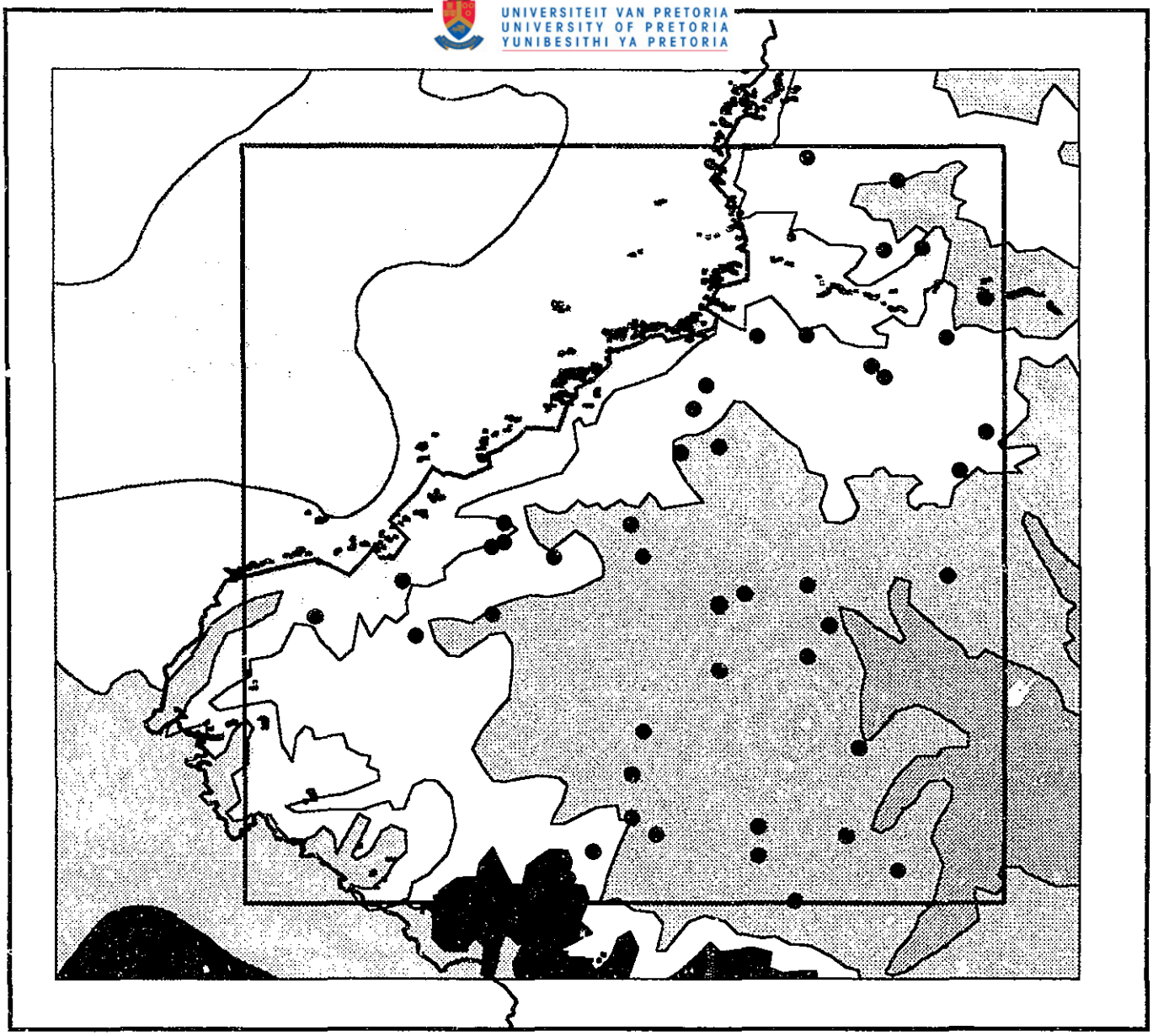


Figure 6.7: Distribution of the Hyparrhenia anamesa - Hyparrhenia dregeana community sample plots in Low and Rebelo Vegetation Types of the study area.

6.1.1.1 The *Eragrostis curvula - Melinis repens* variation

Sample plots representing this variation are found on the undulating footslopes and valley bottoms, near streams, distributed throughout the study area. No diagnostic species group characterises this variation, but the absence of species groups C, D, E and K (Table 6.1) distinguishes the *Eragrostis curvula - Melinis repens* variation from other variations in the *Hyparrhenia anamesa - Hermannia depressa* sub-community. The grass *Hyparrhenia hirta* (Species group P) dominates in this variation with *Aristida congesta* ssp. *congesta*, *Melinis repens* (Species group F), *Eragrostis curvula* and *Sporobolus africanus* (Species group P) also abundantly present.

The vegetation is an open savanna with scattered *Acacia sieberiana* shrubs and seedlings. According to Low and Rebelo (1996) this is secondary grassland with a variable herbaceous layer that is subjected to continuous grazing by game and cattle. This disturbed appearance is reflected in the presence of the mentioned grasses. Various climate zones and geological formations are encountered in the distribution area of this variation. Rocks are absent, soils are sandy-loam and deep.

6.1.1.2 The *Eragrostis superba - Eragrostis gummiflua* variation

The *Eragrostis superba - Eragrostis gummiflua* variation is characterised by species group C and is further distinguished from other variations in the *Hyparrhenia anamesa - Hermannia depressa* sub-community by the absence of species groups D, G, J and O (Table 6.1). As a result of more pronounced grazing pressure species such as the grasses *Eragrostis superba* (Species group B), *Eragrostis gummiflua* (Species group D), *Hyparrhenia anamesa* (Species group O) and the forbs *Chaetacanthus costatus* (Species group K) and *Helichrysum rugulosum* (Species group O) have become more prominent. The high cover abundance values of these species resulted in a more disturbed appearance of this variation than the *Eragrostis curvula - Melinis repens* variation.

The vegetation of the *Eragrostis superba - Eragrostis gummiflua* variation is described as sourish mixed grassveld on shallow topsoil that is prone to erosion. Careful management is therefore required to maximise the carrying capacity of the vegetation. This sub-

community falls in the 374 climate zone with an average rainfall of 720 mm per annum (Institute for Soil, Water & Climate 1994). On the undulating footslopes where this variation is found, no rocks are present and sandy-loam soils prevail. The geology conforms to the Beaufort Group.

6.1.1.3 The *Sporobolus pyramidalis - Hyparrhenia tamba* variation

The *Sporobolus pyramidalis - Hyparrhenia tamba* variation is similar to the *Eragrostis superba - Eragrostis gummiflua-* and *Eragrostis curvula - Melinis repens* variations, but it has been grazed severely. This is evident in the high occurrence of unpalatable grass species such as *Hyparrhenia tamba* (Species group D) (Table 6.1), *Sporobolus pyramidalis* (Species group E), *Eragrostis plana, Cymbopogon excavatus* and *Hyparrhenia anamesa* (Species group P), some of which also occur in the previous variations, but less prominent. The presence of various forb species is an indication of the high utilisation factor.

The average rainfall of 720 mm per annum is similar to that of the *Eragrostis superba - Eragrostis gummiflua* variation. Most of the sample plots representing this variation are located in the south of the study area on the Beaufort geological Group. Typically, rocks are absent and soils are sandy-loam, located on footslopes with little or no incline, close to streams, associated with moist conditions.

The *Sporobolus pyramidalis - Hyparrhenia tamba* variation is characterised by species group D, containing the diagnostic species *Senecio inaequidens* and *Oxalis depressa*. It is further distinguished from other variations by the presence of species groups E, F, G, J, K, O and the absence of species groups C and N (Table 6.1).

6.1.1.4 The *Imperata cylindrica - Eragrostis plana* variation

No diagnostic species group is identified for this variation, but it is distinguished from other variations by the absence of species groups C, D, E, F and the presence of species groups G, J, K, N and O (Table 6.1). Prominent species in this variation include the

grasses *Hyparrhenia hirta, Eragrostis plana* and *Sporobolus africanus* and the forb *Helichrysum rugulosum* (Species group P). The presence of the species *Imperata cylindrica* (Species group N) and *0192 001* (Species group O) indicate seasonal wetland conditions. Sample plots of this variation are situated nearby streams on deep sandy-loam soils from various geological formations. Rocks are absent.

Utilisation varies and the species present indicate the moist conditions that prevail. Similar to other variations in the *Hyparrhenia anamesa - Hermannia depressa* sub-community, the sample plots occur on disturbed areas that require careful management to prevent further degradation.

6.1.2 The *Hyparrhenia dregeana - Paspalum dilatatum* sub-community

Sample plots representing this sub-community are distributed through the central and northern part of the study area and are also situated nearby streams, associated with wet conditions. The dominant Beaufort Geological Group weathers to deep sandy-loam to clayey soils. The *Hyparrhenia dregeana - Paspalum dilatatum* sub-community is distinguished from the *Hyparrhenia anamesa - Hermannia depressa* sub-community by the presence of species group H as well as the absence of species groups B to G (Table 6.1). Utilisation is high and evidence of degradation and disturbances are noted.

The *Hyparrhenia dregeana - Paspalum dilatatum* sub-community is divided into two variations.

6.1.2.1 The *Hyparrhenia dregeana - Richardia brasiliensis* variation

This variation is characterised by species group I and is distinguished from the *Arundinella nepalensis - Fimbristylis ferruginea* variation by the presence of species groups J, K and L as well as the absence of species group M (Table 6.1). Prominent species include the grasses *Paspalum dilatatum, Setaria sphacelata* (Species group H), *Hyparrhenia hirta, Eragrostis plana* and *Hyparrhenia dregeana* (Species group P) as well as the forbs *Richardia brasiliensis* (Species group L) and *Helichrysum rugulosum*

(Species group P). Utilisation is severe and the presence of various forbs such as *Acanthospermum australe* and *Solanum elaeagnifolium* (Species group I) indicates degradation.

Characteristically no rocks are present and soils are sandy-loam and deep. Various geological formations and climate zones are represented in the distribution area of this variation.

6.1.2.2 The *Arundinella nepalensis - Fimbristylis ferruginea* variation

Sample plots representing this variation are likewise located nearby streams in the central part of the study area. The moist conditions that prevail are indicated by the presence of species group L (Table 6.1), consisting of the grass *Arundinella nepalensis* and the sedge *Fimbristylis ferruginea.* This variation is relatively poor in species. A degree of heavy utilisation by cattle was noted, with areas showing signs of degradation.

This variation occurs on the Beaufort Group geological formation. Rocks are absent and the soils are sandy-loam and deep. The 384 climate zone occurs in this variation with an average rainfall of 850 mm per annum. Prevailing moist condition resulted in the absence of species present in species groups I, J, K and L. Various forbs, usually associated with slightly drier conditions are present. This distinguishes this variation from the *Hyparrhenia dregeana - Richardia brasiliensis* variation.

6.2 The *Trachypogon spicatus - Diheteropogon amplectens* community

Sample plots of this community are located on the footslopes of hills where the slope is less than 5°, but some plots are located on crests and slopes of hills where rockiness may be as high as 40%. This community represents the Southern Tall Grassveld (Acocks #65) (1988) (Figure 6.9) and is distinguished by the absence of the grass species *Hyparrhenia anamesa, Hyparrhenia dregeana* and the woody species *Diospyros lycioides.* The presence of the grass species *Trachypogon spicatus* distinguishes this community from the *Hyparrhenia hirta - Themeda triandra* community.

Sample plots of this community are distributed throughout the study area, but are generally present at altitudes lower than 1 500 m a.m.s.l (Figure 6.8). Various climate zones and geological formations are represented in the distribution area of this community. Where present, rocks may cover up to 40% of the area, but soils are generally deep and sandy. Sub-communities are recognised on the basis of presence and absence of species. It is difficult to correlate the sub-communities with environmental factors.

Intensive grazing has caused degradation in this vegetation and this is evident in the high degree of unpalatable grass species and various forbs as well as bare soil, trampling of soil and the overall appearance of a short grassveld. This intensive grazing has resulted in a different species composition from that of other communities in the Open Thornveld Vegetation Type and also resulted in a change in species prominence.

Classification of the relevès by means of Two Way Indicator Species Analysis (TWINSPAN) and subsequent refinement by Braun Blanquet procedures resulted in the recognition of the following sub-communities (Table 6.2):

6.2.1 The *Hermannia depressa - Anthospermum rigidum* sub-community

6.2.2 The *Diheteropogon amplectens - Phyllanthus parvulus* sub-community

6.2.3 The *Hypoxis iridifolia - Eragrostis racemosa* sub-community

This community is distinguished from the *Diospyros lycioides - Eragrostis chloromelas* community by the presence of characteristic species groups A, B, C and D as well as the absence of species group I (Table 6.2). Intensive grazing is a prominent factor in this community and the presence of various forbs gives an indication of degradation. The vegetation is grassveld, that appear short, mainly as a result of a high grazing pressure, with forbs well represented in the herbaceous layer.

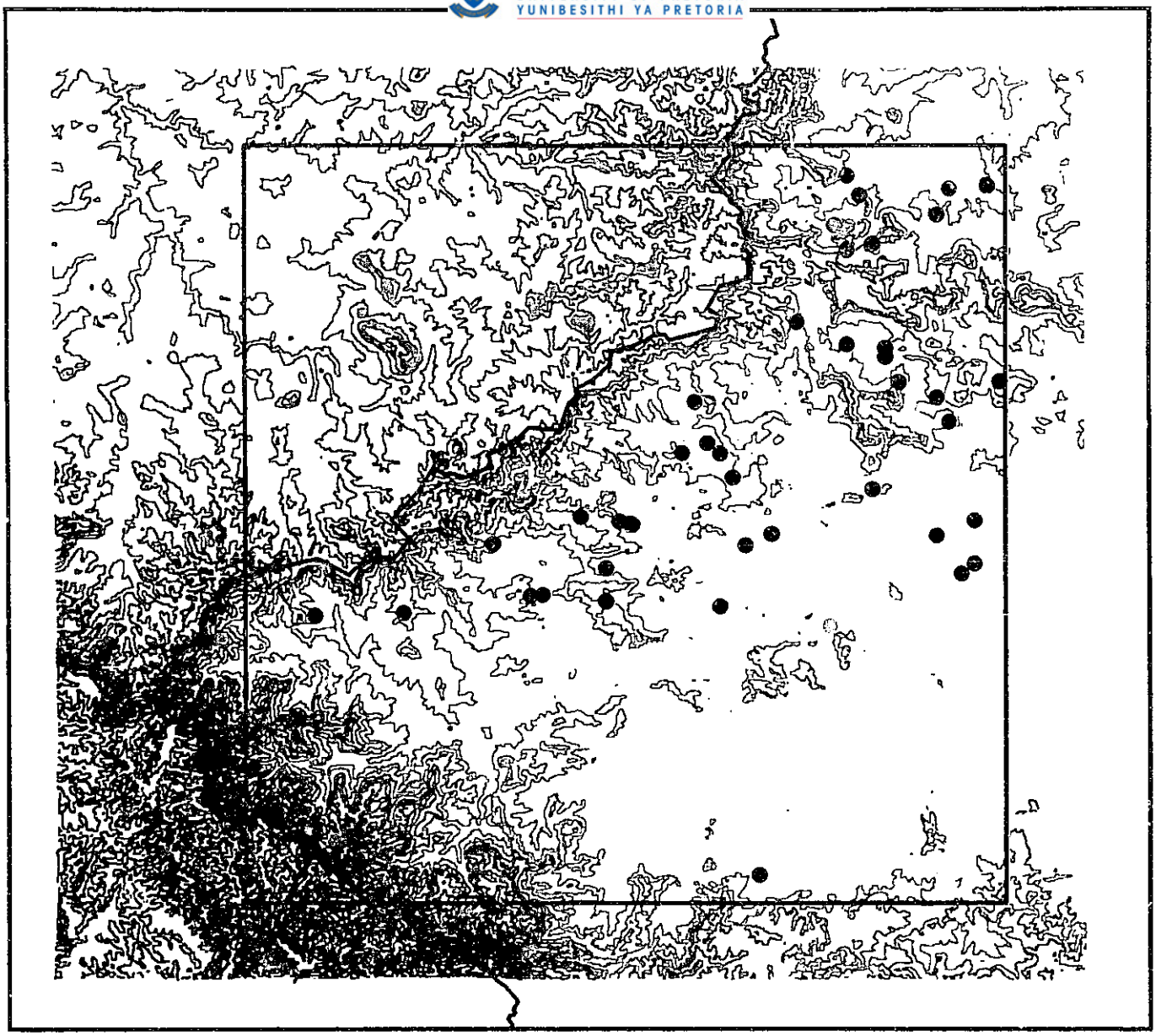


Figure 6.8: Distribution of the Trachypogon spicatus - Diheteropogon amplectens and Diospyros lycioides communities sample plots in the study area (contour interval 100m).

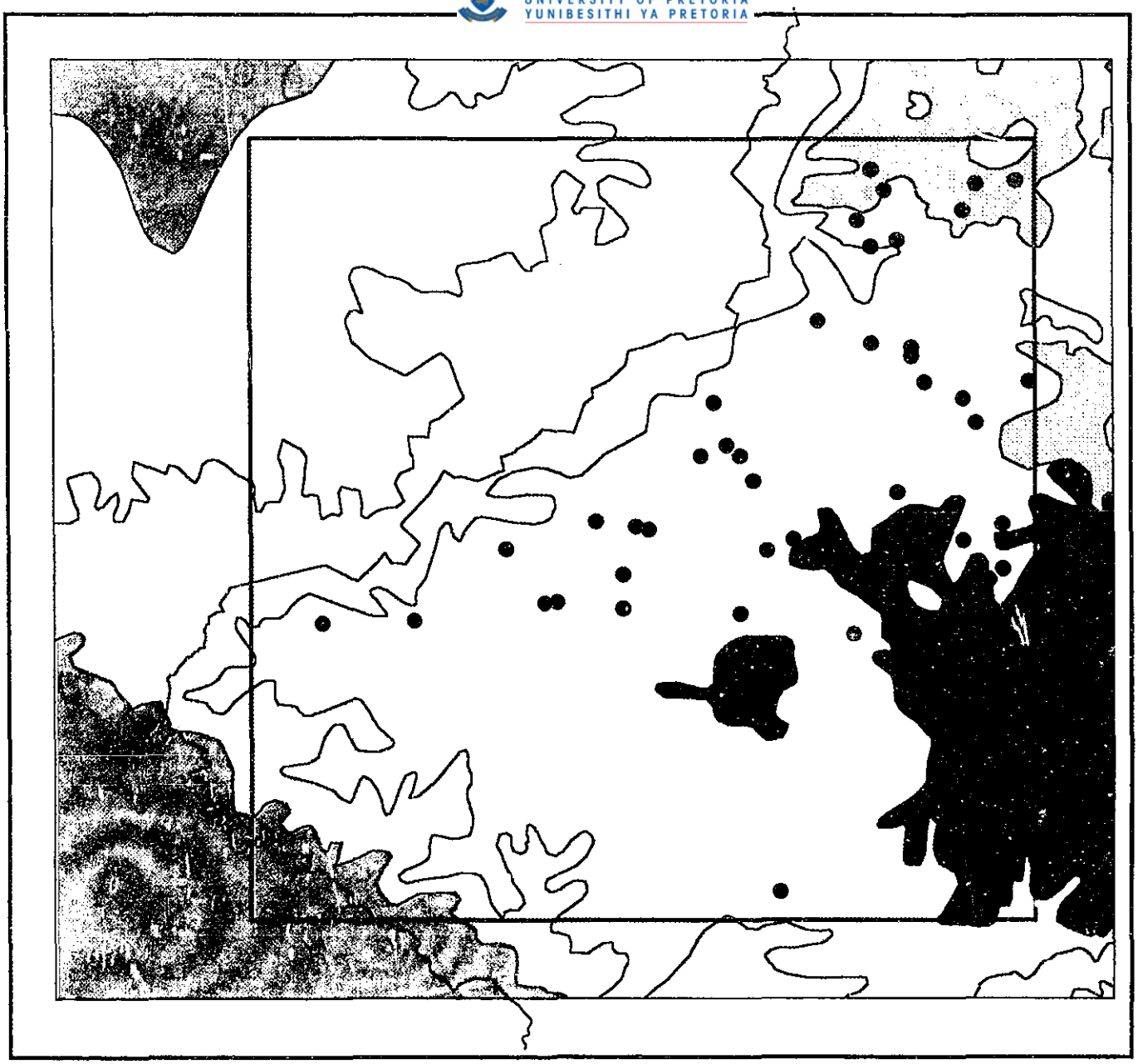
Sample plots are distributed in the northern and central eastern part of the study area over various climate zones as well as geological formations (Figure 6.10). Rocks are generally absent, but on the crests and slopes of hills, rockiness of the soil surface can be as high as 40%. Where rocks are absent, soils are deep and sandy. The reaction of vegetation to different grazing pressures and different management regimes probably resulted in different variations of sub-communities.

6.2.1 The *Hermannia depressa - Anthospermum rigidum* sub-community

Sample plots of this variation are located on the slopes and footslopes of rocky hills in the central to eastern part of the study area. Various forb species are present because of intensive utilisation, but they are not dominant. This is an indication of degradation and the vegetation appears as a short grassveld, often as a result of grazing pressure.

Prominent forb species include the species of species group L, *Helichrysum rugulosum* and *Hermannia depressa* (Species group O) (Table 6.2). This variation is characterised by the presence of the woody species *Acacia karroo* (Species group B). The *Hermannia depressa - Anthospermum rigidum* sub-community is dominated by grass species such as *Diheteropogon amplectens, Trachypogon spicatus* (Species group A), *Hyparrhenia hirta, Cymbopogon excavatus* and *Themeda triandra* (Species group P).

This sub-community occurs in various climate zones and on geological formations and represents the Southern Tall Grassveld (Acocks #65).



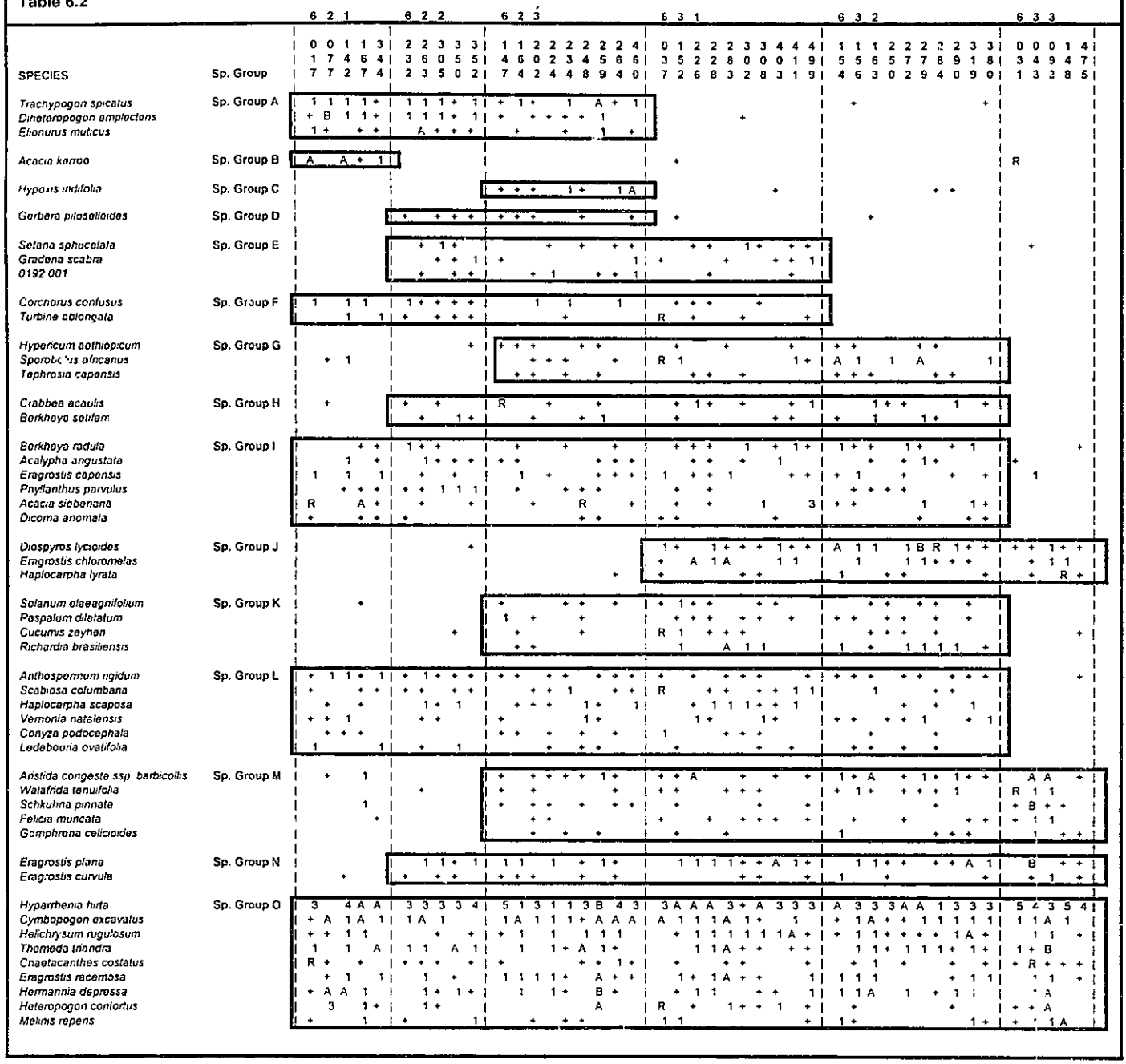
Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Trachypogon spicatus and Diospyros lycioides - Eragrostis chloromelas communities

Acocks Veld Types
Cymbopogon - Themeda Veld (Sandy) (#48)
Highland Sourveld and Dohne Sourveld (#44)
Highland Sourveld to Cymbopogon - Themeda Transition (Eastern Free State Highveld) (#49)
Natal Sour Sandveld (#66)
Southern Tall Grassveld (#65)
Themeda Veld to Cymbopopogon - Themeda Veld Transition (Patchy) (#53)
Themeda - Festuca Alpine Veld (#58)
Valley Bushveld (#23)

Figure 6.9: Distribution of the Trachypogon spicatus - Diheteropogon amplectens and Diospyros lycioides - Eragrostia chloromelas communities sample plots in Acocks Veld Types of the study area.

Plant communities of the Trachypogon spicatus - Diheteropogon amplectens and Diospyros lycioides - Ergrostis chloromelas communities.

Table 6.2



6.2.2 The *Diheteropogon amplectens - Phyllanthus parvulus* sub-community

The presence of species groups D, E, H, N as well as the absence of B, C, G, K and M (Table 6.2) distinguish this sub-community. Prominent species include the forbs *Corchorus confusus, Turbina oblongata* (Species group F), *Acalypha angustata, Phyllanthus parvulus* (Species group I), *Anthospermum rigidum* (Species group L) and the grasses *Diheteropogon amplectens, Elionurus muticus* (Species group A), *Eragrostis curvula* (Species group N), *Hyparrhenia hirta* and *Themeda triandra* (Species group O). Similar to the *Hermannia depressa - Anthospermum rigidum* sub-community, intensive utilisation of the vegetation resulted in short grassland with forbs prominent in the herbaceous layer.

6.2.3 The *Hypoxis iridifolia - Eragrostis racemosa* sub-community

This sub-community occurs in various climate zones and on geological formations. Sample plots of this variation are located on the slopes and footslopes of rocky hills. Rocks are present and the cover can be as high as 40%.

The presence of species group C characterises the *Hypoxis iridifolia - Eragrostis racemosa* sub-community. The absence of species group B and the presence of G, K and M (Table 6.2) distinguish it from other sub-communities. As other sub-communities in the *Trachypogon spicatus - Diheteropogon amplectens* community, the vegetation has been utilised intensively and this is noted in the presence of the numerous forb species present in species groups G, I, L and M. The grasses *Hyparrhenia hirta, Cymbopogon excavatus* and *Eragrostis racemosa* (Species group P) are the dominant species in this sub-community.

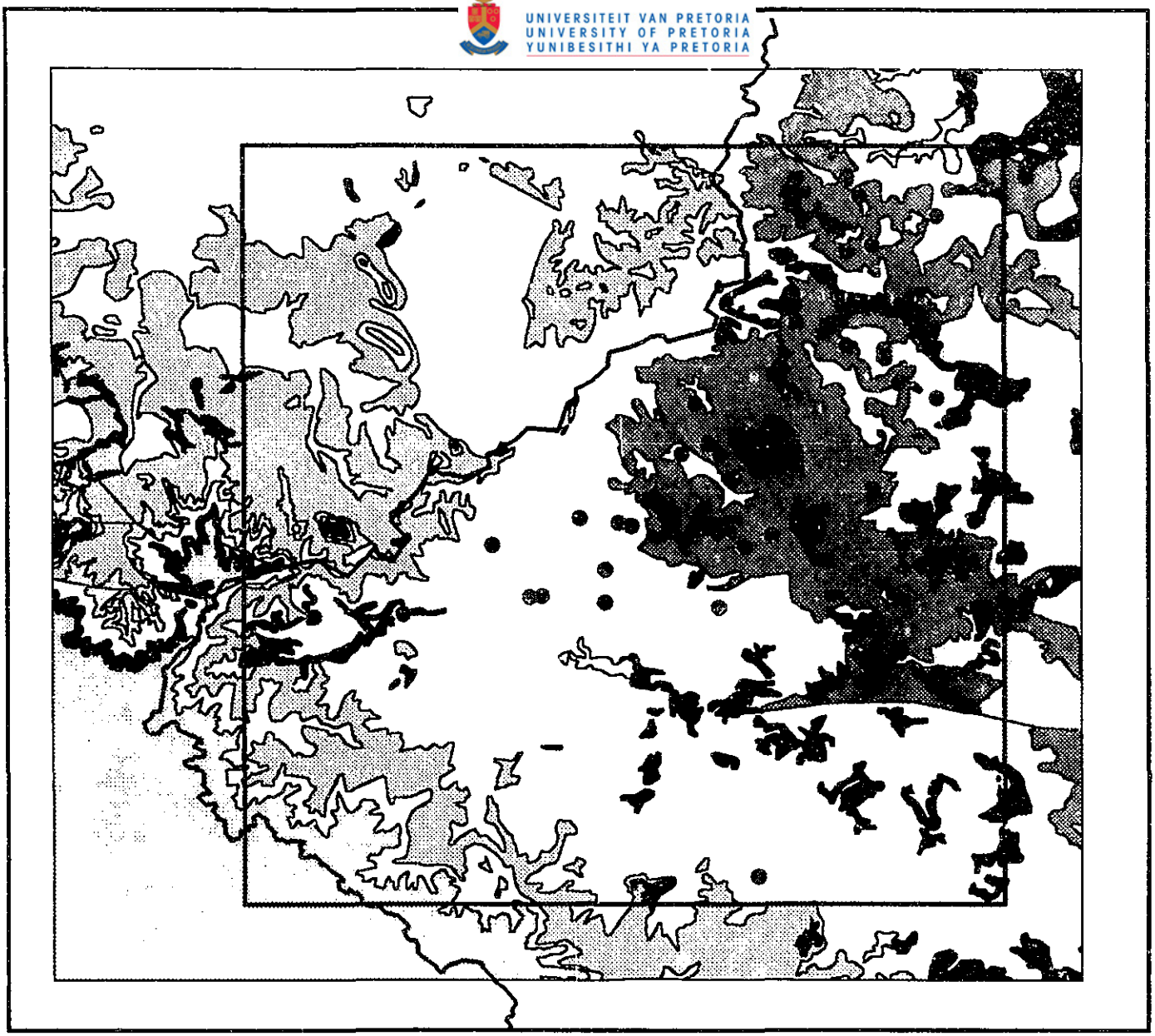


Figure 6.19: Distribution of the Trachypogon spicatus - Diheteropogon amplectens and Diospyros lycioides - Eragrostis chloromelas communities sample plots in geological formations of the study area.

6.3 The *Diospyros lycioides - Eragrostis chloromelas* community

The *Diospyros lycioides - Eragrostis chloromelas* community is characterised by the presence of species group J and is distinguished from the *Trachypogon spicatus - Diheteropogon amplectens* community by the absence of species groups A, B, C and D (Table 6.2). Sample plots of this community are situated in the northern and central parts of the study area. Intensive grazing has had a pronounced effect on the vegetation. An appearance of a short grassveld with many forbs in the herbaceous layer is noted.

Prominent species in this community include the grasses *Eragrostis chloromelas* (Species group J), *Aristida congesta* ssp. *barbicollis* (Species group M), *Eragrostis plana* (Species group N), *Hyparrhenia hirta, Cymbopogon excavatus, Themeda triandra, Eragrostis racemosa* (Species group O) and the forbs *Helichrysum rugulosum, Chaetacanthus costatus* and *Hermannia depressa* (Species group O).

Habitat factors are similar to that of the *Trachypogon spicatus - Diheteropogon amplectens* community and the distribution of sample plots are therefore indicated on Figures 6.8, 6.9 & 6.10. As a result of the presence and absence of species three sub-communities were recognised, namely:

6.3.1 The *Eragrostis plana - Themeda triandra* sub-community

6.3.2 The *Diospyros lycioides - Aristida congesta* ssp. *barbicollis* sub-community

6.3.3 The *Hyparrhenia hirta - Melinis repens* sub-community

6.3.1 The *Eragrostis plana - Themeda triandra* sub-community

The intensive grazing pressure on this vegetation resulted in a variety of forbs being prominent in this sub-community. These include *Crabbea acaulis* (Species group H), *Berkheya radula* (Species group I), *Solanum elaeagnifolium* (Species group K), *Anthospermum rigidum, Scabiosa columbaria, Haplocarpha scaposa* (Species group L), *Helichrysum rugulosum* and *Hermannia depressa* (Species group O). The grazing pressure is also evident in the presence of unpalatable grass species such as *Eragrostis chloromelas* (Species group J), *Eragrostis plana* (Species group N) and *Cymbopogon*

excavatus (Species group O). The woody species *Diospyros lycioides* (Species group J) is also prominent. The vegetation is heavily grazed grassland with short grass and forbs being prominently present.

This sub-community occurs in various climate zones and on geological formations. Sample plots of this variation are located on the footslopes and in close vicinity of rocky hills, distributed throughout the study area. Rocks are generally absent and soils are sandy and deep.

6.3.2 The *Diospyros lycioides - Aristida congesta* ssp *barbicollis* sub-community

Sample plots of this variation are located on the footslopes of rocky hills and are distributed in the northern and central part of the study area. The *Diospyros lycioides - Aristida congesta* ssp. *barbicollis* sub-community is distinguished from other sub-communities by the presence of species groups G to L and the absence of A to F (Table 6.2). Various climate zones and geological formations are represented.

The effect of intensive grazing is also evident in this sub-community and bare soil, erosion, trampling of the soil as well as the presence of unpalatable grass species and forbs are noted. Prominent grasses include *Eragrostis chloromelas* (Species group J), *Aristida congesta* ssp. *barbicollis* (Species group M), *Eragrostis plana* (Species group N), *Hyparrhenia hirta, Cymbopogon excavatus* and *Themeda triandra* (Species group O). The forbs *Berkheya radula* (Species group I), *Richardia brasiliensis* (Species group K), *Anthospermum rigidum, Vernonia natalensis* (Species group L), *Helichrysum rugulosum* and *Hermannia depressa* (Species group O) have high cover values.

6.3.3 The *Hyparrhenia hirta - Melinis repens* sub-community

Similar to other sub-communities, utilisation is severe and various forbs and unpalatable grass species are represented. Rocks are generally absent and sample plots are located on footslopes of rocky hills.

Prominent species in this sub-community include the grasses *Eragrostis chloromelas* (Species group J), *Aristida congesta* ssp. *barbicollis* (Species group M), *Hyparrhenia hirta, Cymbopogon excavatus, Melinis repens* (Species group O) and the forbs *Schkuhria pinnata, Gomphrena celicioides* (Species group M), *Helichrysum rugulosum* and *Chaetacanthus costatus* (Species group O). The absence of species groups A to I as well as K and L distinguishes this sub-community from others in the *Diospyros lycioides - Eragrostis chloromelas* community (Table 6.2).

6.4 The *Hyparrhenia hirta - Themeda triandra* grassland community

This community is open grassland plains close to rocky hills, dominated by a few species. It is the most intensively utilised community in the study area and like other communities in the Open Thornveld Vegetation Type, few woody species occur in the *Hyparrhenia hirta - Themeda triandra* grassland community. It is characterised by species group Q, consisting of species that are found widely spread throughout the study area (Table 6.3).

Different sub-communities are recognised as a result of absence of species as well as differences in dominance of certain species, rather than the presence of diagnostic species groups. Grasses are dominant in this community, especially *Hyparrhenia hirta, Themeda triandra* and *Cymbopogon excavatus*, with the woody species *Acacia sieberiana* (Species group I) and *Acacia karroo* (Species group M) lending an appearance of an open savanna to most of the sub-communities.

Low species diversity is characteristic of this community, which may be a result of previous utilisation, but present over-utilisation and subsequent degradation is noted in only a few sub-communities. This community (Figure 6.11) represents the Southern Tall Grassveld (#65) described by Acocks (1988). It is an open savanna of *Acacia sieberiana* in sourish mixed grassveld, dominated by *Hyparrhenia hirta*. This corresponds to a combination of North-eastern Mountain Grassland (Bredenkamp **et. al.** 1996c) (#43) and Natal Central Bushveld (#25) described by Granger (1996) as predominantly a grassland area with patches of forest occurring in sheltered ravines, gorges and valleys of the

escarpment (Figure 6.12).

Various geological formations are represented, the Beaufort Group and Volksrust Formation are predominant in the distribution area of this community (Figure 6.13). Climate zones present include mainly the 386, 387 and 385 zones. Average rainfall per annum varies between 644.8 mm (climate zone 386) and 908.5 mm (climate zone 387), usually as thunderstorms during the summer season. These climate zones are located in the central eastern part of the study area (Institute for Soil, Climate and Water 1994).

Classification of the relevès by means of Two Way Indicator Species Analysis (TWINSPAN) and subsequent refinement by Braun-Blanquet procedures resulted in the recognition of the following sub-communities and variations (Table 6.3):

6.4.1 The *Aloe marlothii - Conyza podocephala* sub-community

6.4.2 The *Diheteropogon amplectens - Tristachya leucothrix* sub-community

6.4.3 The *Helichrysum rugulosum - Anthospermum rigidum* sub-community

6.4.4 The *Eragrostis gummiflua - Vernonia oligocephala* sub-community

6.4.4.1 The *Eragrostis gummiflu - Eragrostis plana* variation

6.4.4.2 The *Eragrostis racemosa - Eragrostis capensis* variation

6.4.4.3 The *Sporobolus pyramidalis - Crabbea hirsuta* variation

6.4.5 The *Cyperus obtusiflorus - Abildgaardia ovata* sub-community

6.4.6 The *Acacia karroo - Themeda triandra* sub-community

6.4.7 The *Acacia karroo - Aristida bipartita* sub-community

6.4.8 The *Paspalum dilatatum - Eragrostis plana* sub-community

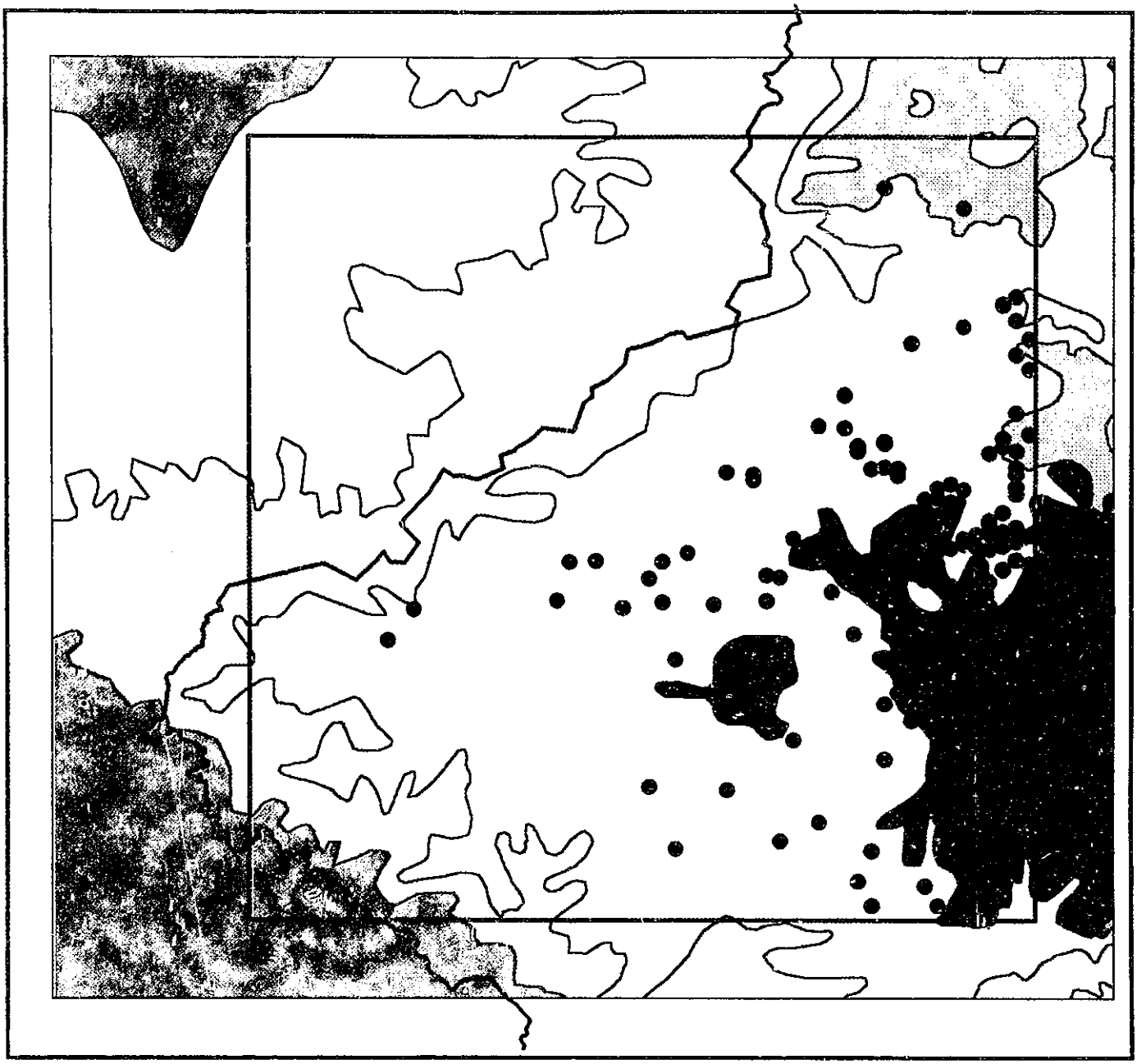
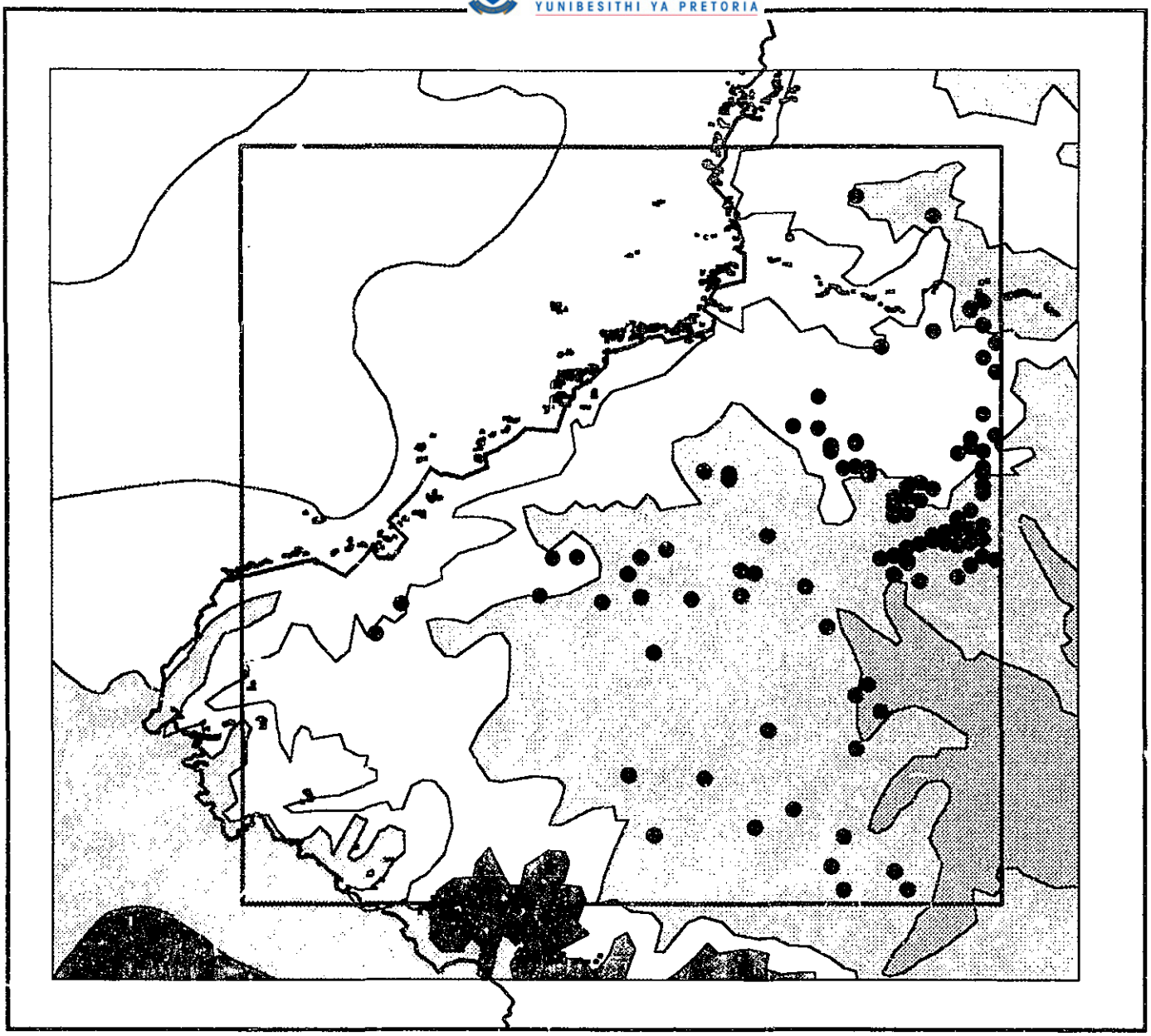


Figure 6.11: Distribution of the Hyparrhenia hirta - Themeda triandra community sample plots in Acocks Veld Types of the study area.



Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Hyparrhenia hirta - Themeda triandra community

Low and Rebelo Vegetation Types
Afromontane Forest (#2)
Valley Thickets (#5)
Natal Central Bushveld (#25)
Moist Cool Highveld Grassland (#39)
Moist Cold Highveld Grassland (#40)
Wet Cold Highveld Grassland (#41)
Moist Upland Grassland (#42)
North-eastern Mountain Grassland (#43)
Afro Mountain Grassland (#45)
Alti Mountian Grassland (#46)

Figure 6.12: Distribution of the Hyparrhenia hirta - Themeda triandra community sample plots in Low and Rebelo Vegetation Types of the study area.

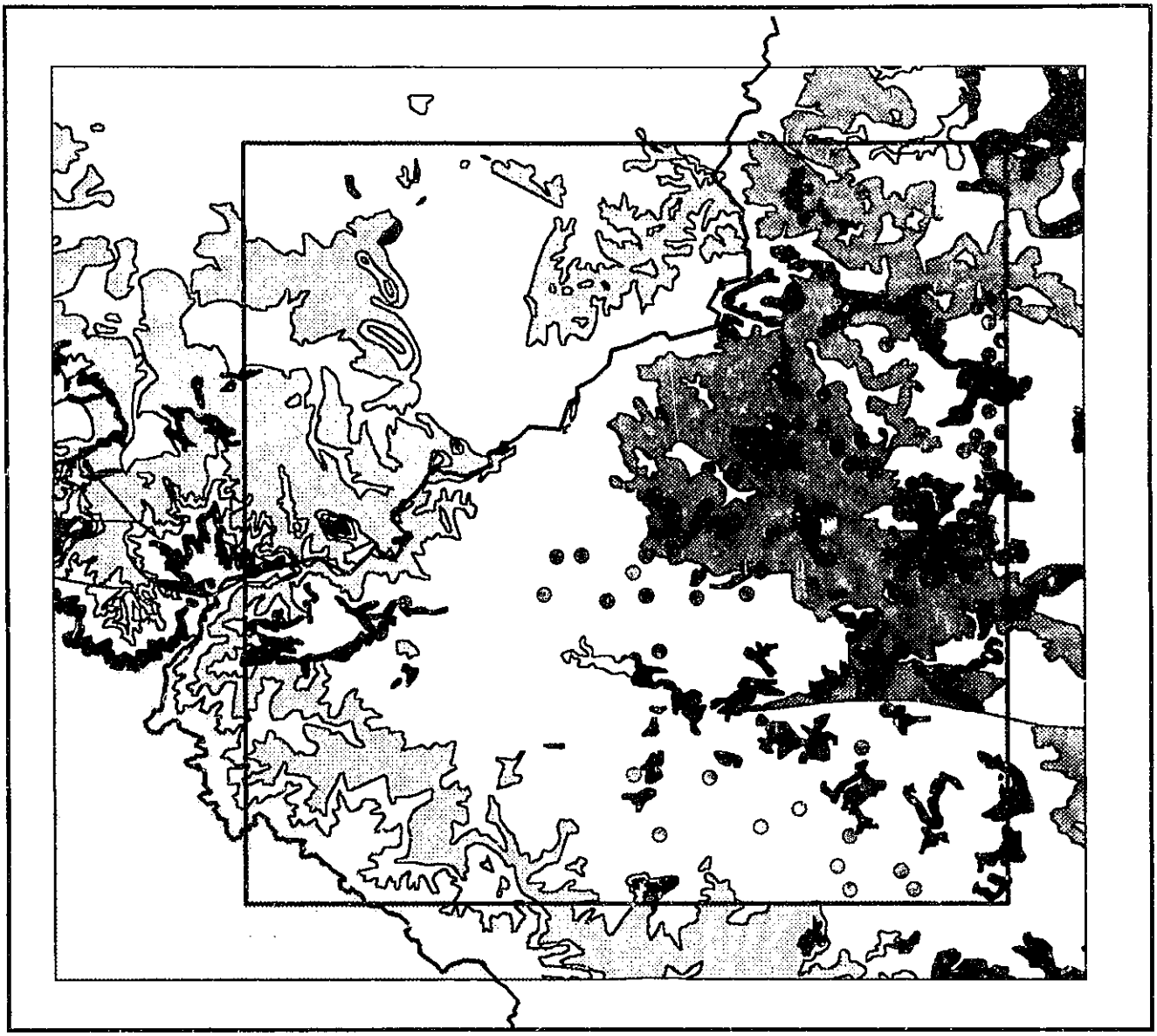
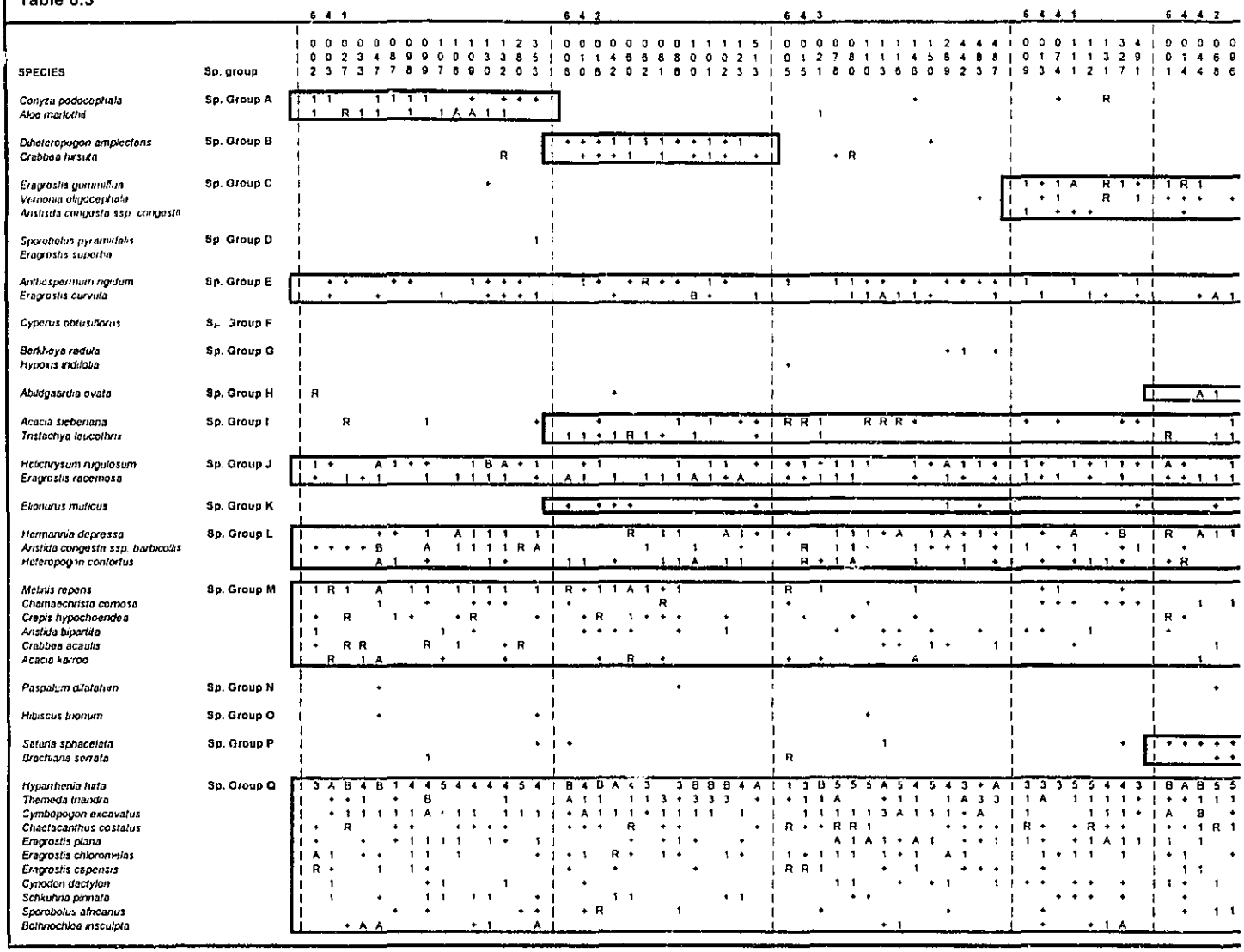
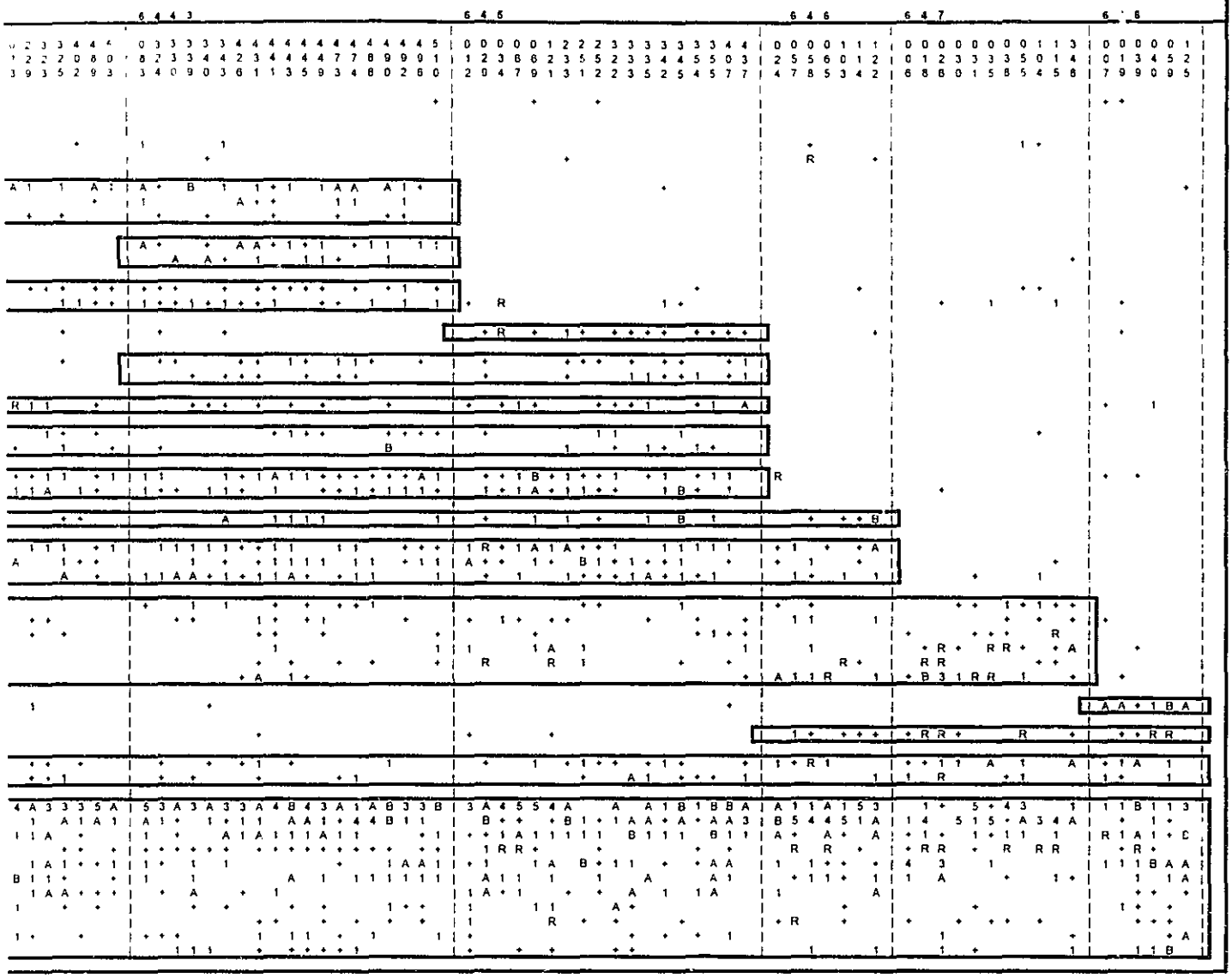


Figure 6.13: Distribution of the Hyparrhenia hirta - Themeda triandra community sample plots in geological formations of the study area.

Plant communities of the Hyparrhenia hirta - Themeda triandra community

Table 6.3





6.4.1 The *Aloe marlothii - Conyza podocephala* sub-community

This sub-community is characterised by species group A (Table 6.3), consisting of the forb *Conyza podocephala* and the woody succulent *Aloe marlothii*, the presence of which gives a characteristic physiognomic structure to the sub-community. These species are also found in various other communities and vegetation types in the study area.

Other species that are prominent include the grasses *Aristida congesta* ssp. *barbicollis* (Species group L), *Melinis repens* (Species group M), *Hyparrhenia hirta, Cymbopogon excavatus* (Species group Q) and the forb *Helichrysum rugulosum* (Species group J). Utilisation in this sub-community is more severe than in other sub-communities and this is indicated by the presence of the characteristic species. Rocks are generally absent, but the soil is shallow and sandy.

6.4.2 The *Diheteropogon amplectens - Tristachya leucothrix* sub-community

Sample plots representing this sub-community are situated in the central eastern part of the study area on crests and footslopes of rocky hills. Species group B is characteristic of the *Diheteropogon amplectens - Tristachya leucothrix* sub-community and it is further distinguished from other sub-communities by the absence of species groups A, C, D, F, G, H, N, O and P (Table 6.3).

Various geological formations are present in the distribution area of this sub-community. Climate zones 386 and 387 are represented, with average annual rainfall of 644.8 and 908.5 mm per annum, respectively (Institute for Soil, Water and Climate 1994). The rockiness of the soil of this sub-community separates it from other sub-communities (average 30 %). The characteristic grass species, *Diheteropogon amplectens* indicates shallow, rocky soils (Van Oudtshoorn 1991). Dryness as well as a high utilisation factor is evident.

6.4.3 The *Helichrysum rugulosum - Anthospermum rigidum* sub-community

No characteristic species group is identified for this sub-community, but is recognised by the absence of species groups A, B, C, D, F, G, H, N, O and P (Table 6.3). Prominent grasses include *Eragrostis racemosa* (Species group J), *Aristida congesta* ssp. *barbicollis* (Species group L), *Hyparrhenia hirta, Themeda triandra, Cymbopogon excavatus, Eragrostis plana* and *Eragrostis chloromelas* (Species group Q). The forbs *Anthospermum rigidum* (Species group E), *Helichrysum rugulosum* (Species group J), *Hermannia depressa* (Species group M) and *Chaetacanthus costatus* (Species group A) have high cover values.

This is a tall grassveld and the presence of *Acacia sieberiana* seedlings (Species group J) is an indication of bush encroachment, probably as a result of the severe grazing of sub-community. The *Helichrysum rugulosum - Anthospermum rigidum* sub-community is located in the eastern part of the study area. This sub-community represents a transition from the Southern Tall Grassveld (Acocks #65) to the Valley Bushveld (Acocks #23). This is also indicated by the location of sample plots in the North-eastern Mountain Grassland (Bredenkamp **et. al.** 1996c) (#43) and Natal Central Bushveld (#25), described by Granger (1996)

6.4.4 The *Eragrostis gummiflua - Vernonia oligocephala* sub-community

Sample plots of this sub-community are distributed in the central, eastern and southern parts of the study area on the footslopes of rocky hills. Various climate zones are represented in this distribution area. The presence of the characteristic grass species *Eragrostis gummiflua* is associated with water logged soils of the Beaufort Group Geological Formation. Characteristically, rocks are absent and deep soils were noted.

Species group C characterises the *Eragrostis gummiflua - Vernonia oligocephala* sub-community (Table 6.3). Prominent species in this sub-community include the grasses *Eragrostis gummiflua* (Species group C), *Eragrostis racemosa* (Species group J), *Hyparrhenia hirta, Themeda triandra, Cymbopogon excavatus, Eragrostis chloromelas*

(Species group Q) and the forbs *Helichrysum rugulosum* (Species group J), *Hermannia depressa* (Species group L) and *Chaetacanthus costatus* (Species group Q).

Refinement of results obtained from TWINSPAN by means of Braun-Blanquet procedures resulted in the recognition of three variations.

6.4.4.1 The *Eragrostis gummiflua - Eragrostis plana* variation

This variation is characterised by the absence of a diagnostic species group, and is distinguished from other variations in the *Eragrostis gummiflua - Vernonia oligocephala* sub-community due to the absence of species groups D, G and H, as well as the absence of the grasses *Eragrostis capensis* and *Sporobolus africanus* (Species group Q) (Table 6.3). Species that are prominent in this sub-community include the grasses *Eragrostis gummiflua* (Species group C), *Hyparrhenia hirta, Themeda triandra, Cymbopogon excavatus, Eragrostis plana* (Species group Q) and the forb *Helichrysum rugulosum* (Species group J).

Sample plots representing this sub-community is situated on the plains in the central eastern part of the study area. Rocks are absent and soils are deep and sandy. This sub-community represents a transition between dry sub-communities, for instance the *Aloe marlothii - Conyza podocephala* and *Helichrysum rugulosum - Anthospermum rigidum* sub-communities and sub-communities located in areas with a higher moisture regime. Veld condition is generally good.

6.4.4.2 The *Eragrostis racemosa - Eragrostis capensis* variation

No characteristic species group is recognised for this variation. The presence of species group H and the absence of D and G (Table 8.1) distinguish this variation from other variations in the *Eragrostis gummiflua - Vernonia oligocephala* sub-community. Moist conditions are evident in the presence of the sedge species *Abildgaardia ovata* (Species group H), which is absent from the drier sub-communities and variations. Other prominent species include the grasses *Eragrostis gummiflua* (Species group C),

Eragrostis racemosa (Species group J), *Hyparrhenia hirta, Themeda triandra, Eragrostis plana, Eragrostis capensis* (Species group Q) and the forbs *Helichrysum rugulosum* (Species group J), *Hermannia depressa* (Species group L) and *Chaetacanthus costatus* (Species group Q).

Various geological formations and climate zones are found in the distribution area of this variation. Sample plots are distributed in the central, central eastern and southern parts of the study area. The vegetation of this variation is located in areas that are grazed more intensive than the *Eragrostis gummiflua - Eragrostis plana* variation. Evidence of this utilisation is noted, but vegetation is found to be in a good condition. Rocks are absent and soils are deep and sandy.

6.4.4.3 The *Sporobolus pyramidalis - Crabbea hirsuta* variation

Similar to variations 6.3.4.1 and 6.3.4.2, rocks are absent and soil deep and sandy in the *Sporobolus pyramidalis - Crabbea hirsuta* variation. The Beaufort geological Group is present in this area with greenish-grey, bluish-grey or red and purple mudstone, which is inclined to weather into blocks.

Sample plots are located in the central and southern parts of the study area. The vegetation of this grassveld plains is transitional to vegetation in moist areas of the Valley Bushveld (Acocks #23), but little or no woody elements are present. The characteristic species group D is evidence of a disturbed condition that prevails in this variation, also present in various other communities and vegetation types. The grass layer is dominant with *Sporobolus pyramidalis* (Species group D), *Eragrostis gummiflua* (Species group C), *Eragrostis racemosa* (Species group J), *Heteropogon contortus* (Species group L), *Hyparrhenia hirta, Themeda triandra* and *Cymbopogon excavatus* (Species group Q) present as prominent species.

The vegetation is grazed intensively and is in a more degraded condition than the *Eragrostis racemosa - Eragrostis capensis* variation. This is evident from the presence

of forb species *Berkheya radula* and *Hypoxis iridifolia* (Species group G) as well as the presence of unpalatable species such as *Sporobolus pyramidalis* (Species group D), *Eragrostis gummiflua* (Species group C) and *Bothriochloa insculpta* (Species group Q). In some sample plots *Acacia sieberiana* seedlings (Species group I) as well as the grass *Bothriochloa insculpta* (Species group Q) are present, also indicating degradation and bush encroachment.

6.4.5 The *Cyperus obtusiflorus - Abildgaardia ovata* sub-community

This sub-community is characterised by the presence of the sedge *Cyperus obtusiflorus* (Species group F) and is distinguished from other sub-communities by the presence of species groups G, H, I, J, K, L, M and the absence of species groups A, B, C, D, E, N and O (Table 6.3). The presence of *Cyperus obtusiflorus* and *Abildgaardia ovata* is an indication of moist conditions that prevail in this sub-community. Other prominent species include the grasses *Eragrostis racemosa* (Species group J), *Hyparrhenia hirta, Themeda triandra, Cymbopogon excavatus* (Species group Q) and the forbs *Helichrysum rugulosum* (Species group J) and *Hermannia depressa* (Species group L).

Rocks are absent and deep, sandy soils prevail. Various geological formations and climate zones are present in the distribution area of this sub-community. Sample plots are distributed in the central and central eastern parts of the study area. The vegetation is grassveld and because of intensive grazing the grassveld appears short and degradation is evident in some sample plots.

6.4.6 The *Acacia karroo - Themeda triandra* sub-community

This sub-community represents vegetation that is usually present at a high moisture regime, but is located in areas with a low average rainfall (644.8 mm per annum, climate zone 386) (Institute for Soil, Water and Climate 1994). Here it is normally found on flat plains with dolerite rocks and deep soils with high clay content.

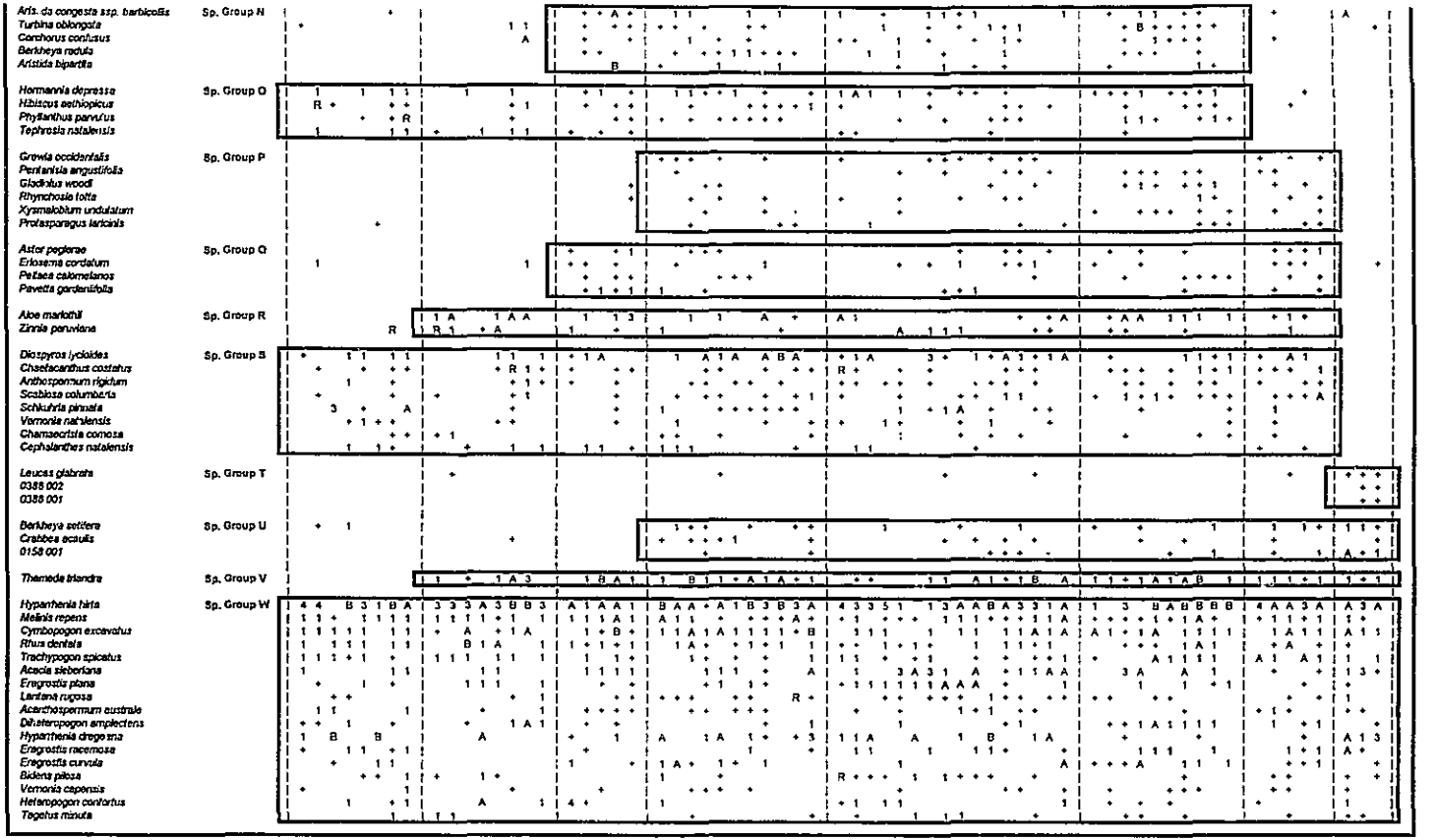
Acacia karroo seedlings and trees (Species group M) are abundantly found in this sub-community and are an indication of high soil clay content. No characteristic species group is identified. The species composition of this sub-community is similar to the Southern Tall Grassveld (#65), but described by Acocks (1988) as being part of the Valley Bushveld (#23). Prominent species include the grasses *Setaria sphacelata* (Species group O), *Hyparrhenia hirta, Themeda triandra, Eragrostis plana, Eragrostis chloromelas* (Species group Q) and the forb *Hibiscus trionum* (Species group O). Sample plots of this sub-community are located in the eastern part of the study area and the presence of the grass *Setaria sphacelata* (Species group P) is further indication of the high moisture content of the soil.

The high abundance of *Themeda triandra* (Species group Q) gives an indication of veld in a good condition, although signs of intensive grazing are noted.

6.4.7 The *Acacia karroo - Aristida bipartita* sub-community

No characteristic species group is recognised, but this sub-community is distinguished from other sub-communities by the absence of species groups A to L as well as the presence of species group O (Table 6.3). Although the rainfall is low (386 climate zone, average 644.8 mm per annum) (Institute for Soil, Water and Climate 1994), sample plots are situated nearby streams that are temporarily flooded during the raining season. The soils are clayey (vertic) soils, explaining the presence of a high percentage of *Acacia karroo* trees, shrubs and seedlings (Species group M). Rocks were noted in some of the sample plots.

A high utilisation was noted, resulting in absence or low percentage of those palatable grass species that are found to be dominant or prominent in other sub-communities. The presence of large bare areas of ground gives an indication of degradation. The dominant grass in this sub-community is *Themeda triandra* (Species group Q) and a decrease in the dominance of *Hyparrhenia hirta* (Species group Q) was noted.


Aris. da congesta ssp. barbicollis
Turbina oblongata
Cenchrus confusus
Berkheya radula
Aristida bipartita
Sp. Group N
Hermannia depressa
Hibiscus aethiopicus
Phyllanthus parvulus
Tephrosia natalensis
Sp. Group O
Grewia occidentalis
Pentarrhinia angustifolia
Gladiolus woodii
Rhynchosia totta
Xysmalobium undulatum
Protasparagus laricinus
Sp. Group P
Aster peglerae
Eriosema cordatum
Pelaea calomelanos
Pavetta gardeniifolia
Sp. Group Q
Aloe marlothii
Zinnia peruviana
Sp. Group R
Diospyros lycioides
Chaetacanthus costatus
Anthospermum rigidum
Scabiosa columbaria
Schkuhria pinnata
Vernonia natalensis
Chamaecrista comosa
Cephalanthes natalensis
Sp. Group S
Leucas glabrata
0388 002
0388 001
Sp. Group T
Berkheya setifera
Crabbea acaulis
0158 001
Sp. Group U
Themeda triandra
Sp. Group V
Hyparrhenia hirta
Melinis repens
Cymbopogon excavatus
Rhus dentata
Trachypogon spicatus
Acacia sieberiana
Eragrostis plana
Lantana rugosa
Acanthospermum australe
Dichanthium annulatum
Hyparrhenia dregeana
Eragrostis racemosa
Eragrostis curvula
Bidens pilosa
Vernonia capensis
Heteropogon contortus
Tagetes minuta
Sp. Group W

6.4.8 The *Paspalum dilatatum - Eragrostis plana* sub-community

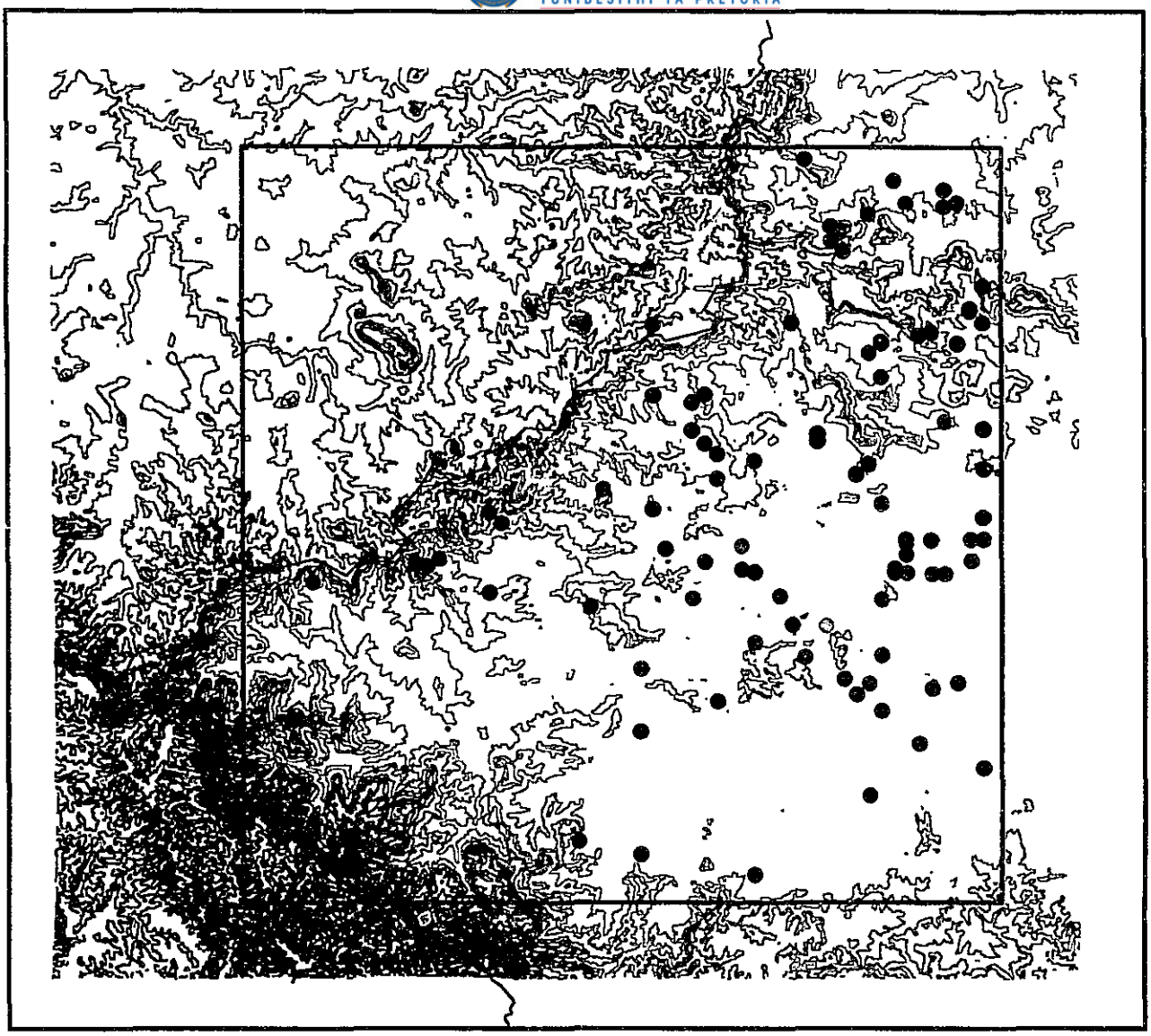
Sample plots representing the vegetation of this sub-community is associated with a high moisture regime in the soil. These areas are temporarily inundated and located near streams or rivers, resulting in the presence of the characteristic grass species *Paspalum dilatatum* (Species group N). The *Paspalum dilatatum - Eragrostis plana* sub-community is distinguished by the absence of species groups A to M (Table 6.3).

Chapter 7: The Woodland Vegetation Type

The relevès representing the *Maytenus heterophylla - Acalypha angustata-* and *Maytenus heterophylla - Rhus pentheri* communities are separated by TWINSPAN from the rest of the data set to form the Woodland Vegetation Type (see Chapter 4). This Vegetation Type is dominated by woody species, although in some cases the vegetation merges into grassveld. As a result of the origin of the nutrient rich soil, namely from Dolerite, the vegetation can be classified as sweet veld, resulting in intensive grazing by cattle, causing changes in dominance of species in some communities. The result of this intensive grazing pressure on the vegetation is the creation of disturbed areas with forbs prominent in the herbaceous layer.

These woodlands are restricted to the crests and slopes of rocky hills in the eastern and central parts of the study area (Figure 7.1). The hills were formed from sills and dykes of Karoo Dolerite origin (Figure 7.2). Due to the small size of these dolerite dykes and sills, they are not mapped on the 1 : 1 000 000 Geological Map. Subsequently they are not identified by means of the ARC-INFO computer programme that was used to derive the geology represented in the sample plots. The Dolerite was, however, noted during the field survey. Karoo Dolerite is a dark-grey to nearly black, igneous rock, popularly known as "Ysterklip", which intrude the sedimentary rocks of the Karoo Sequence. The occurrence and distribution of this rock is therefore mainly limited to the central Karoo Basin and the adjacent areas. The texture of dolerite varies considerably, mostly being fine- to medium grained, but coarse-grained types are also found.

A result of the woody nature of the communities where this vegetation type is located, a physiognomy different from the surrounding grassland areas is created. This vegetation consists of a grass layer with a shrubby woody element that becomes dominant in the case of the *Maytenus heterophylla - Rhus pentheri* community. The presence of the woody species *Maytenus heterophylla* is diagnostic to the Woodland Vegetation Type.



Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Maytenus heterophylla - Acalypha angustata community
Sample plots of the Maytenus heterophylla - Rhus pentheri community

Altitude

Altitude of the study area, contours 100m interval
750 - 1 100
1 100 - 1 450
1 450 - 1850
1 850 - 2 200
2 200 - 2 550
2 550 - 2 950
2 950 - 3 300

N

Figure 7.1: Distribution of the Woodland Vegetation Type sample plots in the study area.

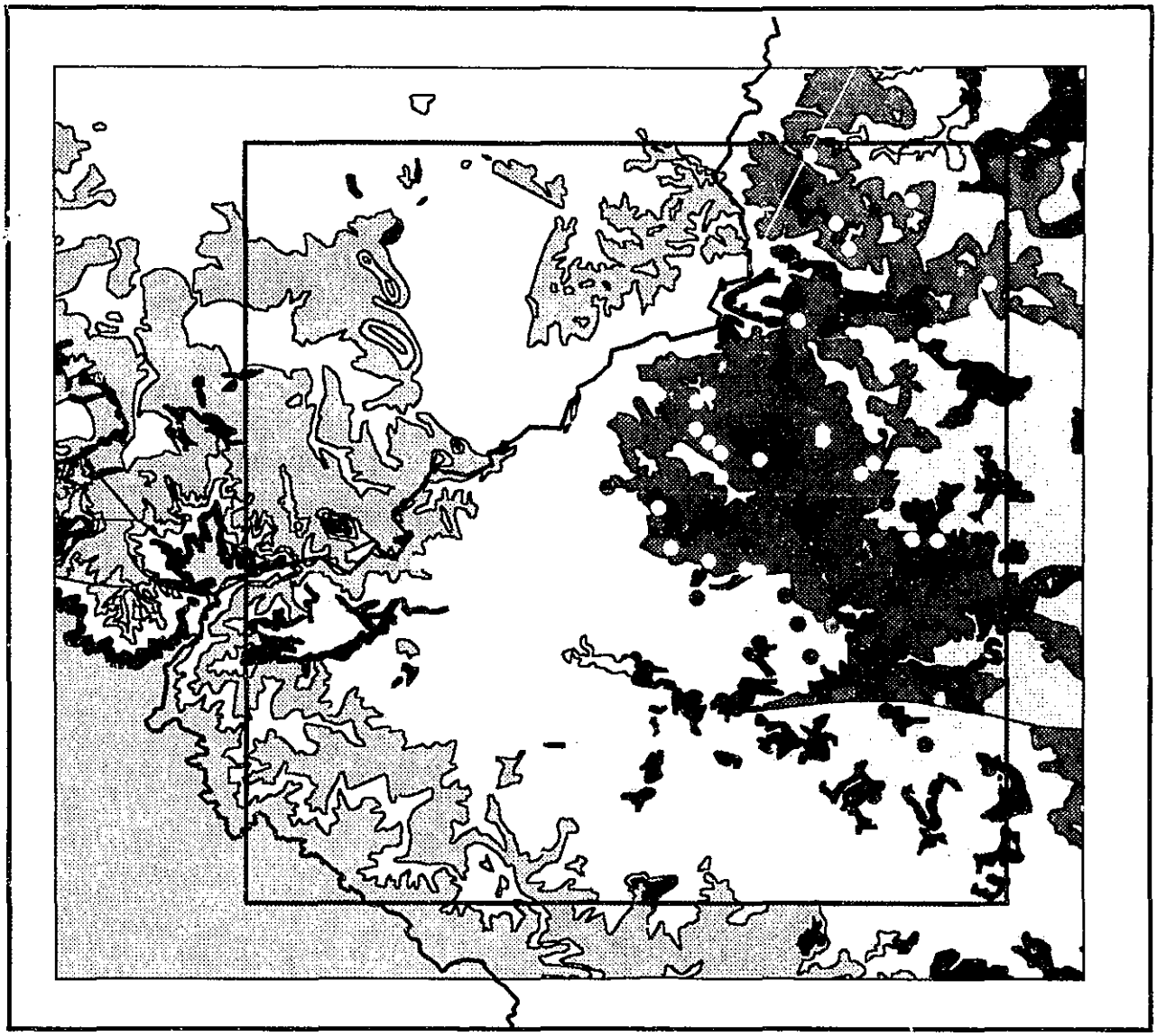


Figure 7.2: Distribution of the Woodland Vegetation Type sample plots in geological formations of the study area.

The absence of *Monocymbium ceresiiforme* separates this vegetation type from the Grassveld Vegetation Type. Various woody species occur abundantly in the sub-communities and variations of the Woodland Vegetation Type. The tree *Rhus dentata* differentiates this Vegetation Type from the Open Thornveld Vegetation Type. The Southern Tall Grassveld (Acocks #65) and the Valley Bushveld (Acocks # 23) are represented in the Woodland Vegetation Type.

The Woodland Vegetation Type is divided by TWINSPAN into the following communities:

7.1. The *Maytenus heterophylla - Acalypha angustata* community

7.2. The *Maytenus heterophylla - Rhus pentheri* community

Although the *Maytenus heterophylla - Acalypha angustata* community contain elements of grassveld, the geological substratum as well as the presence and absence of characteristic and diagnostic species resulted in the inclusion into the Woodland Vegetation Type. Acocks (1988) described this area as an open savanna with *Acacia* species in a sourish, mixed grassveld, abundant on dolerite. The vegetation on the hillsides is marginal to the Valley Bushveld and Scrub Forest, which merges into the Valley Bushveld (Acocks #23) (Figure 7.3). The *Maytenus heterophylla - Rhus pentheri* community is representative of the true Valley Bushveld.

Climate zones present in the Woodland Vegetation Type's distribution area include 374, 378, 384, 385, 386, 387 and 526 zones. Rainfall varies between 908.5 (387 climate zone) and 644.8 mm per annum (386 climate zone). The highest average temperature of 31.6°C is recorded in the 378 and 384 climate zones and the lowest of 0.8°C in the 386 climate zone (Institute for Soil, Water and Climate 1994). These climate zones are located in the central, eastern, southern and northern parts of the study area.

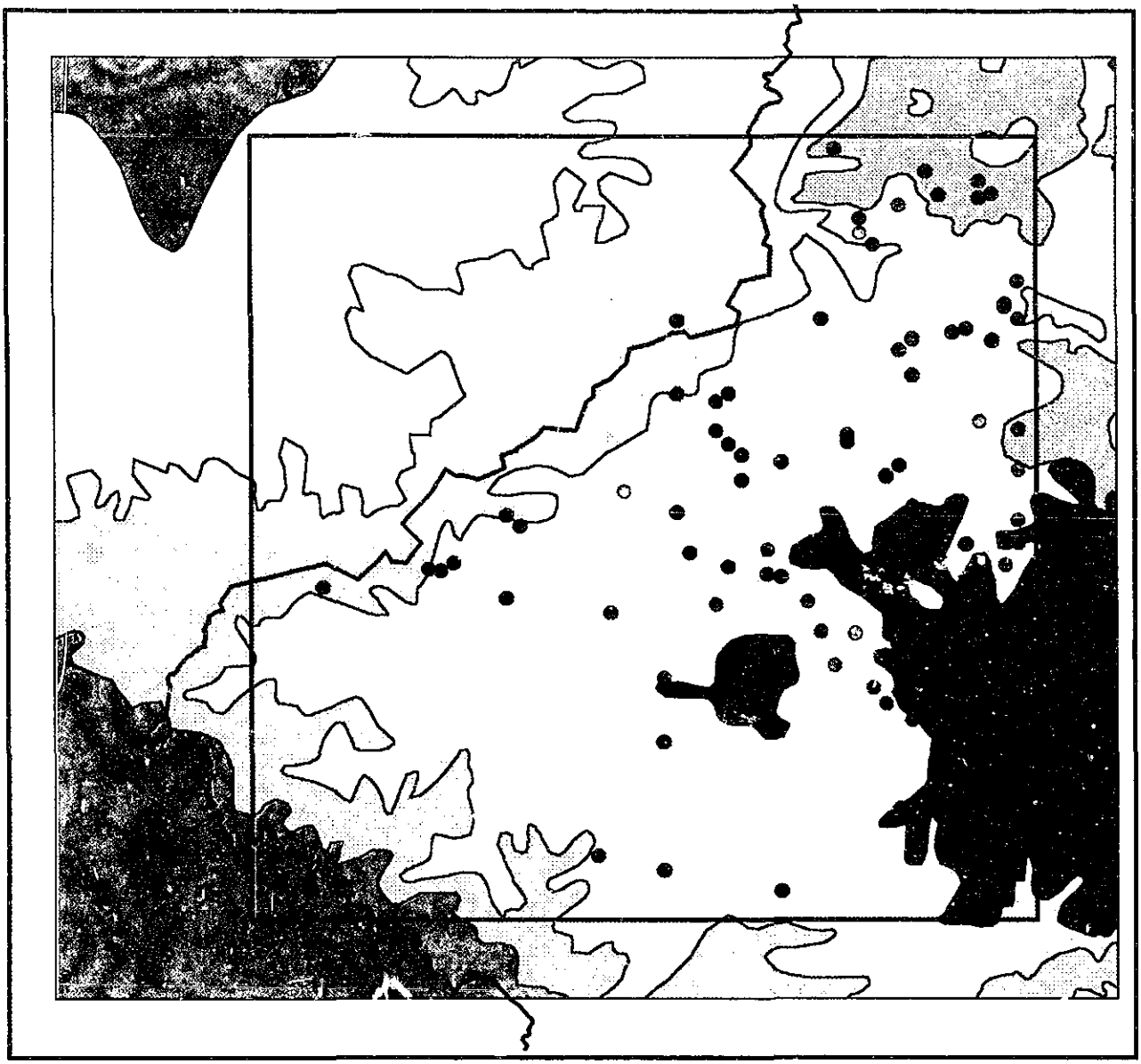


Figure 7.3: Distribution of the Woodland Vegetation Type sample plots in Acocks Veld Types of the study area.

7.1 The *Maytenus heterophylla - Acalypha angustata* community

Two Way Indicator Species Analysis (TWINSPAN) separated this community from the *Maytenus heterophylla - Rhus pentheri* community. The classification by means of TWINSPAN and subsequent refinement by means of Braun-Blanquet procedures, resulted in the recognition of the following sub-communities and variations (Table 9.1):

7.1.1 The *Trachypogon spicatus - Cheilanthes viridus* sub-community

7.1.1.1 The *Euclea crispa - Pelargonium luridum* variation

7.1.1.2 The *Aloe marlothii - Cheilanthes viridus* variation

7.1.2 The *Acacia sieberiana - Helichrysum rugulosum* sub-community

7.1.2.1 The *Cussonia paniculata - Melinis repens* variation

7.1.2.2 The *Diospyros lycioides - Cymbopogon excavatus* variation

7.1.2.3 The *Acacia sieberiana - Lippia javanica* variation

7.1.2.4 The *Elionurus muticus - Diheteropogon amplectens* variation

7.1.2.4.1 The *Eragrostis curvula - Diheteropogon amplectens* sub-variation

7.1.2.4.2 The *Scabiosa columbaria - Elionurus muticus* sub-variation

7.1.2.5 The *Hyparrhenia dregeana - Leucas glabrata* variation

The *Maytenus heterophylla - Acalypha angustata* community represents the Southern Tall Grassveld (#65) described by Acocks (1988), with some elements of the Natal Sour Sandveld (#66) (Figure 7.4). Granger (1996) described the greater part of this community as the Natal Central Bushveld (#25), lying at lower altitudes. However, elements of the North-eastern Mountain Grassland (Bredenkamp **et. al.** 1996c) (#43) and the Wet Cold Highveld Grassland (Bredenkamp **et. al.** 1996a) (#41) both present at higher altitudes, are also found (Figure 7.5).

Plant communities of the Maytenus heterophylla - Acalyph

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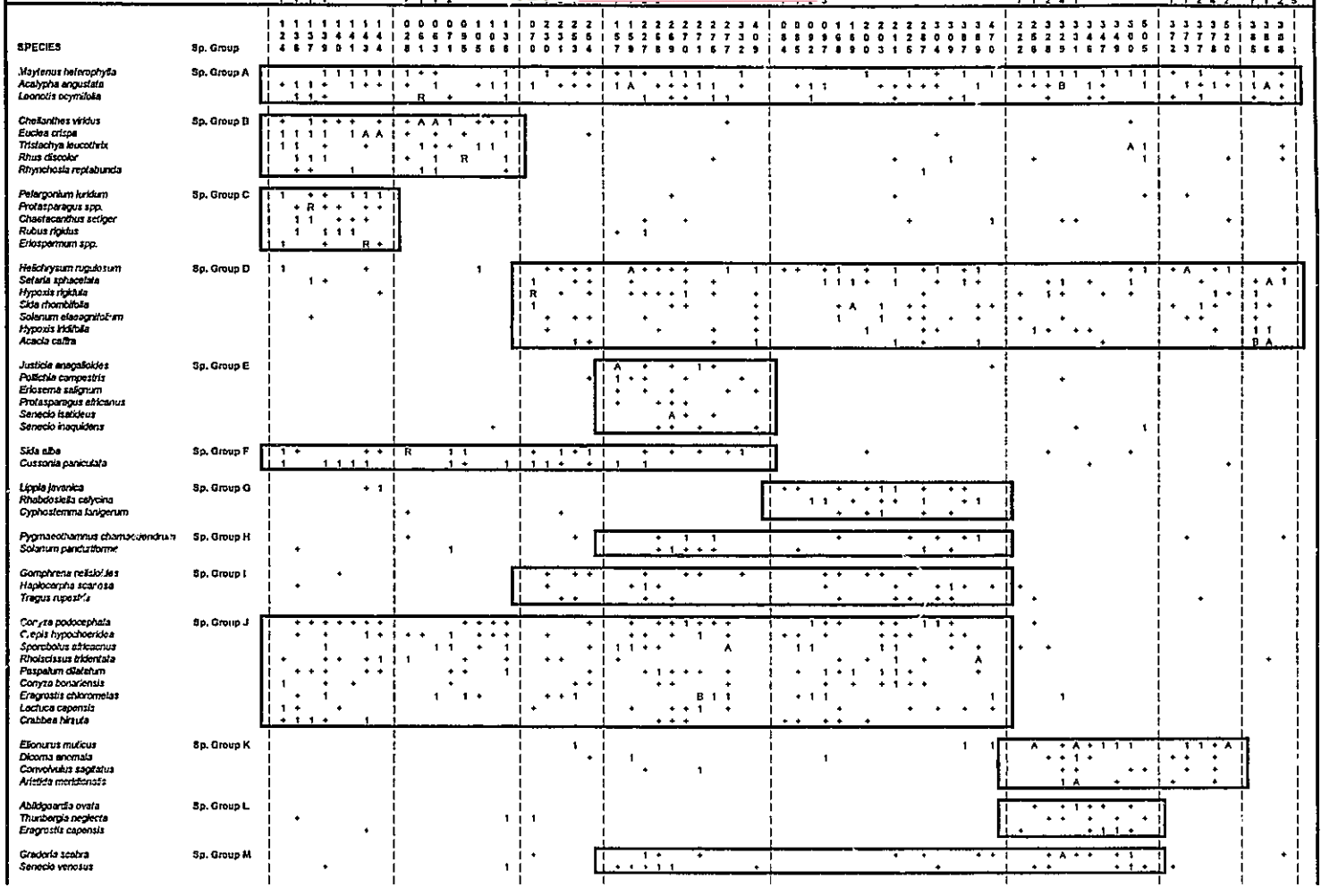
Table 7.1

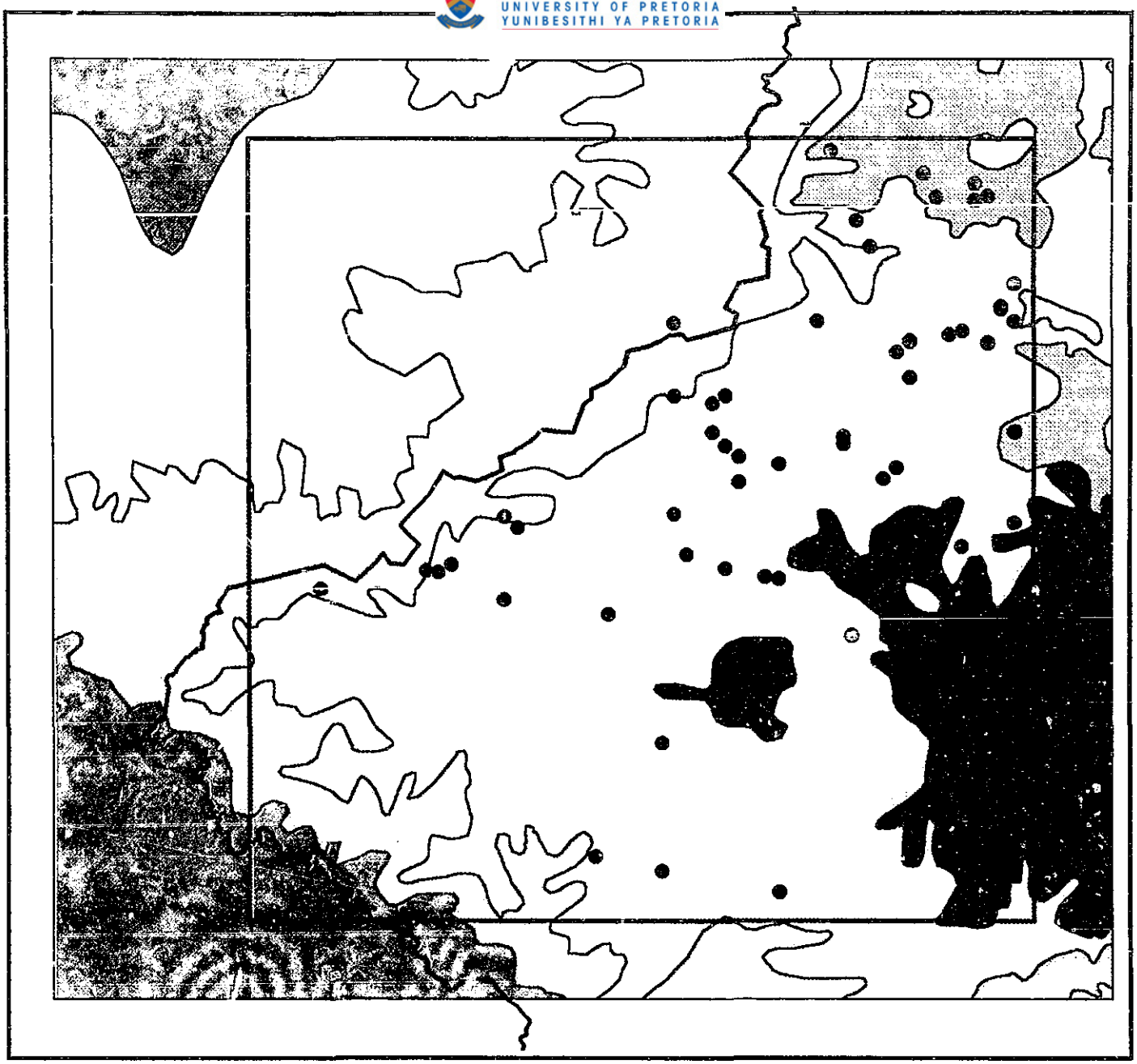


Sample plots of this community are located on slopes of rocky hills. A high degree of rockiness is characteristic, except for the *Hyparrhenia dregeana - Leucas glabrata* variation. Soils represent the Mispah form (Orhtic A, hard rock) (Macvicar **et. al.** 1977). The vegetation of the rocky hills tends to be open with shrubby elements of woody species. The woody layer is less prominent than in the *Maytenus heterophylla - Rhus pentheri* community, mostly found in the Valley Bushveld (Acocks #23). The characteristic species *Acalypha angustata* (Species group A) is widely distributed throughout the study area and is associated with open grassveld.

These communities are difficult to reach due to steep slopes and high degree of rockiness. The geology comprises of Karoo Dolerite sills and dykes, present as rocky hills (Figure 7.6). The vegetation of this community is over-utilised, thus causing encroachment of woody species not normally present. This over-utilisation is also confirmed by the prominent forbs in the herbaceous layer.

This community is distinguished from the *Maytenus heterophylla - Rhus pentheri* community by the presence of the forbs *Acalypha angustata* and *Leonotis ocymifolia* (Species group A) (Table 7.1). The general species present (Species group W) as well as species that are prominent in most of the sub-communities and variations indicate that this community should be regarded as grassveld that is transitional to the *Maytenus heterophylla - Rhus pentheri* community. Many of these species are widely distributed throughout the grassveld in the study area. A woody succulent species that is conspicuous on most hillslopes is *Aloe marlothii* (Species group R), creating a conspicuous physiognomy.

Climate zones that are present in the distribution area of the *Maytenus heterophylla - Acalypha angustata* community includes zones 378, 384, 385, 387 and 526 (Institute for Soil, Climate and Water 1994). Rainfall varies from a minimum of 695.9 (climate zone 526) to a maximum of 908.5 mm (climate zone 387) per annum. A moisture gradient is present in this community.



Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Maytenus heterophylla - Acalypha angustata community

Acocks Veld Types
Cymbopogon - Themeda Veld (Sandy) (#48)
Highland Sourveld and Dohne Sourveld (#44)
Highland Sourveld to Cymbopogon - Themeda Transition (Eastern Free State Highveld) (#49)
Natal Sour Sandveld (#66)
Southern Tall Grassveld (#65)
Themeda Veld to Cymbopopogon - Themeda Veld Transition (Patchy) (#53)
Themeda - Festuca Alpine Veld (#58)
Valley Bushveld (#23)

N

Figure 7.4: Distribution of the Maytenus heterophylla - Acalypha angustata community sample plots in Acocks Veld Types of the study area.

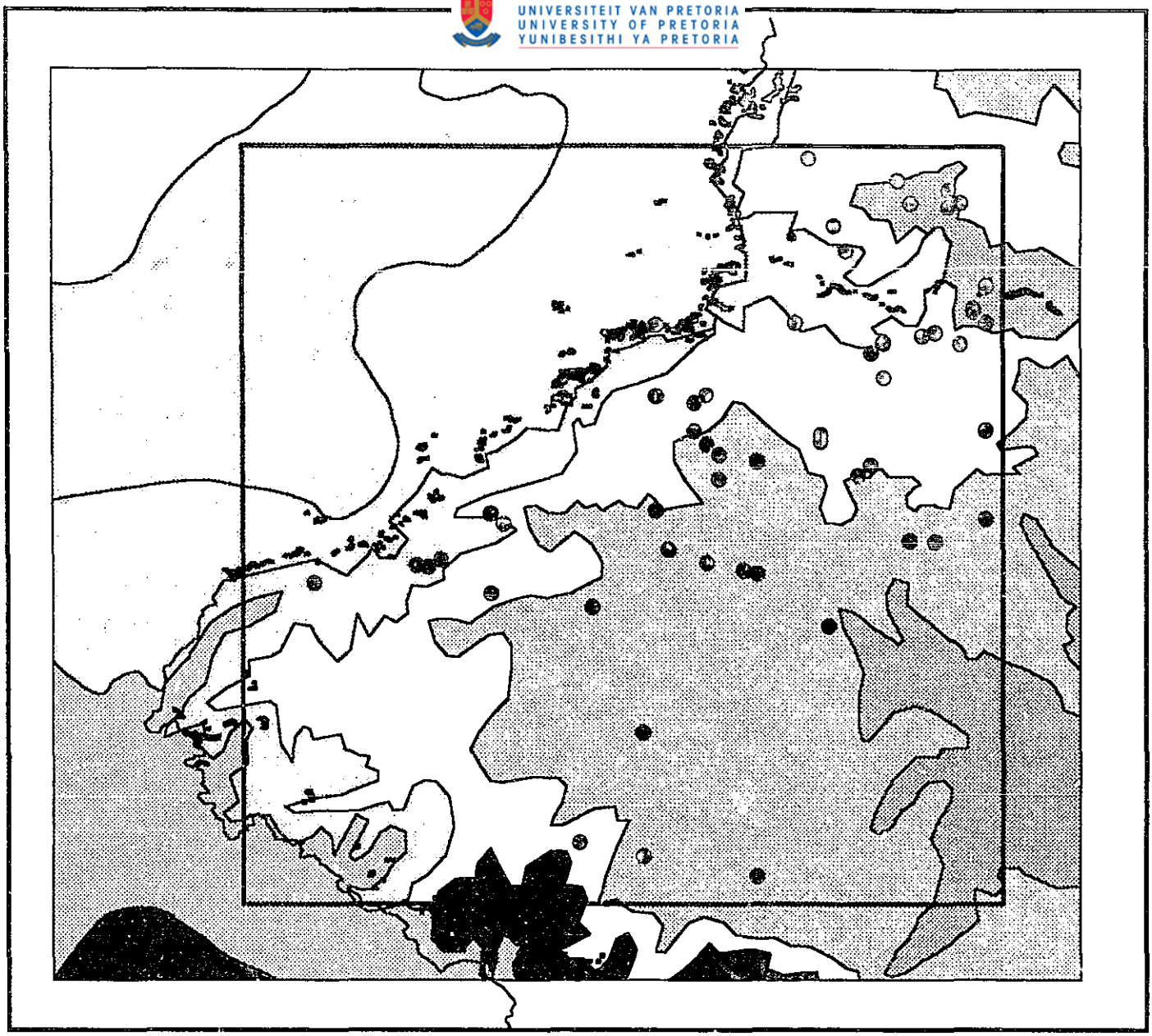


Figure 7.5: Distribution of the Maytenus heterophylla - Acalypha angustata community sample plots in Low and Rebelo Vegetation Types of the study area.

Certain sample plots occur in the dry northern and central eastern parts, while others are present in the central and southern parts, where rainfall is higher. Some sample plots are located in the high mountain areas with a high rainfall and mist. The average rainfall figures of the different climate zones are relative low when compared to a rainfall of 1510.8 mm per annum in the 360 climate zone. The 360 climate zone is situated in the western part of the study area in the high mountain regions.

Only small differences in altitude were noted in the different variations of the *Maytenus heterophylla - Acalypha angustata* community. Altitude ranges from 1 000 - 1 400 m. Only in some cases are altitudinal differences important in differentiating between variations. Climatic and geographical differences are however important in determining the distribution of the variations.

7.1 1. The *Trachypogon spicatus - Cheilanthes viridis* sub-community

Sample plots representing this sub-community are located on the crests and slopes of rocky hills in the eastern central and northeastern parts of the study area. Shallow soils of the Mispah soil form are predominantly found, rockiness is high and the rock cover varies between 15 and 60%. The size of the rocks is in the 500 - 1 000 mm class. Species that are diagnostic to this community, include the xerophytic fern *Cheilanthes viridis*, the woody species *Euclea crispa* and the forb *Rhynchosia reptabunda* as well as the grass species *Tristachya leucothrix* and the dwarf shrub *Rhus discolor* (Species group B) (Table 9.1).

This sub-community is found in the Southern Tall Grassveld (#65), described by Acocks (1988). This correlates with the North-eastern Mountain Grassland (#43) described by Bredenkamp **et. al.** (1996c) as predominantly grassland on shallow lithosoils, derived from a variety of rock types.

Utilisation is severe and most sample plots represent disturbed areas, with species like *Conyza podocephala* (Species group I) and various other forb species present. Due to

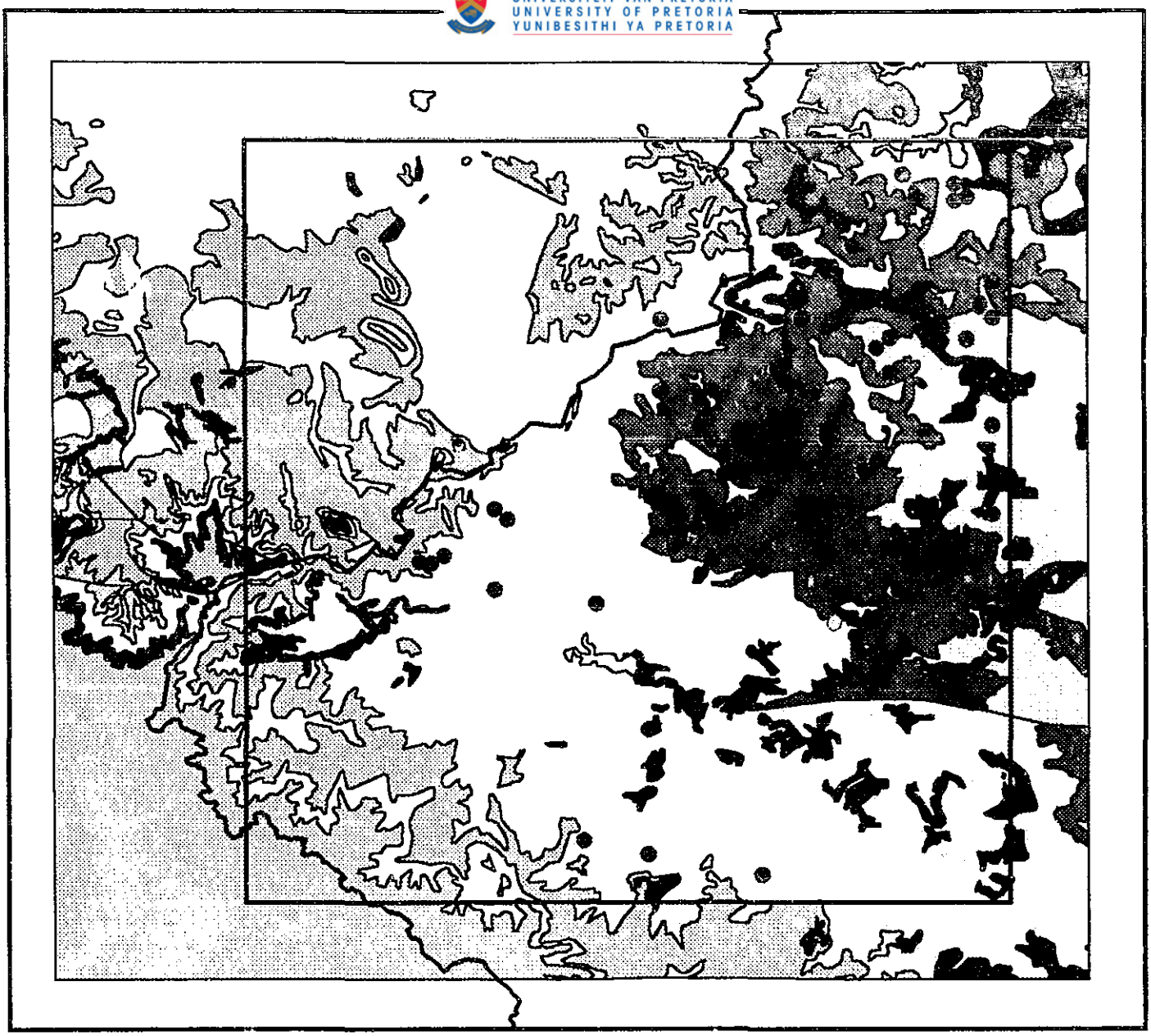
differences in floristic composition, altitude, geographical position and climatic influences, this sub-community is divided into two variations.

7.1.1.1 The *Euclea crispa - Pelargonium luridum* variation

Sample plots representing this variation are located on crests and slopes (20°) of rocky hills in the northeastern part of the study area. The altitude ranges from 1 200 to 1 400 m a.m.s.l. The Southern Tall Grassveld (#65), described by Acocks (1988) is represented. Bredenkamp **et. al.** (1996c) described this vegetation as North-eastern Mountain Grassland (#43). The *Euclea crispa - Pelargonium luridum* variation is found in the 387 climate zone with an average rainfall of 908.5 mm per annum. Mean average temperatures vary between a maximum of 26.5 °C in January and a minimum of 4.4 °C during July. Soils are shallow and rock cover varies between 31 and 60%, rocks of up to 1 000 mm diameter are found.

This variation is characterised by Species Group C (Table 7.1), consisting of the characteristic forb species *Pelargonium luridum, Protasparagus spp., Chaetacanthus setiger, Eriospermum* spp. and *Rubus rigidus*. Prominent species occurring in this variation, but not found in the *Aloe marlothii - Cheilanthes viridus* variation, include the grass species *Eragrostis racemosa, Eragrostis curvula* (Species group W) and the forb species *Lactuca capensis* and *Crabbea hirsuta* (Species group J). It is further distinguished by the absence of species groups R and V.

The grazing intensity is not severe, partly as a result of inaccessibility, subsequently a high vegetation cover is noted. However, the presence of many forbs and unpalatable grass species, such as *Paspalum dilatatum* (Species group J), *Melinis repens* and *Cymbopogon excavatus* (Species group W) is an indication that the vegetation of this variation is indeed disturbed to a certain state.



Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Maytenus heterophylla - Acalypha angustata community

Geological Formations

Beaufort
Clarens
Drakensberg
Karoo
Karoo Dolerite
Molteno
Tarkastad
Volksrust
Vryheid

N

Figure 7.6: Distribution of the Maytenus heterophylla - Acalypha angustata community sample plots in geological formations of the study area.

7.1.1.2 The *Aloe marlothii - Cheilanthes viridus* variation

The absence of species group C and the presence of species groups R and V (Table 7.1) distinguish this variation from the *Euclea crispa - Pelargonium luridum* variation. Sample plots of this variation occur at altitudes (1 000 to 1 200 m a.m.s.l.) lower than the *Euclea crispa - Pelargonium luridum* variation and under slightly drier conditions. Sample plots representing this variation are present on the crests and slopes of rocky hills distributed throughout the eastern central parts of the study area. Various climate zones are represented, the average rainfall is however lower than in the *Euclea crispa - Pelargonium luridum* variation (650 - 750 mm per annum) (Institute for Soil, Climate and Water 1994). Slopes of 20° incline, rocks with diameter of 1 000 mm and cover of 40% are present in this variation.

Utilisation and grazing in this variation varies considerably, from areas with little evidence of grazing to sample plots representing a disturbed condition. This is evident in the many forb species and individuals that are present, but not necessarily dominating the vegetation. Prominent species include the grasses *Hyparrhenia hirta, Melinis repens* and *Cymbopogon excavatus* (Species group W), the fern *Cheilanthes viridus* (Species group B), the woody succulent *Aloe marlothii* (Species group R) and *Rhus dentata* (Species group W). This variation is poor in species.

7.1.2 The *Acacia sieberiana - Helichrysum rugulosum* sub-community

This sub-community is characterised by the presence of Species Group D with the characteristic species *Helichrysum rugulosum, Setaria sphacelata, Hypoxis rigidula, Sida rhombifolia, Solanum elaeagnifolium, Hypoxis iridifolia* and *Acacia caffra,* as well as the absence of Species Groups B and C (Table 7.1).

The *Acacia sieberiana - Helichrysum rugulosum* sub-community is found on the crests and slopes of rocky hills with a well developed herbaceous layer. The woody layer is represented by a few tree species, namely *Cussonia paniculata* (Species group F), *Grewia occidentalis* (Species group P), *Aloe marlothii* (Species group R), *Diospyros lycioides,*

Cephalanthus natalensis (Species group S), *Rhus dentata* and *Acacia sieberiana* (Species group W). Most of these species are present as shrubs and seedlings. Various climate zones and veld types are represented in the distribution area of this sub-community. The high degree of rockiness (30 - 50 % cover) resulted in the presence of the Mispah form. The average rock size varies between 250 and 1000 mm. This sub-community is divided into five variations.

7.1.2.1 The *Cussonia paniculata - Melinis repens* variation

This variation is situated in the central and eastern parts of the study area at altitudes ranging from 1 000 to 1 200 m a.m.s.l. Sample plots are located on crests and slopes of rocky hills. The average rock cover is more than 45% and rocks are larger than 500 mm. The vegetation, described by Granger (1996) as Natal Central Bushveld (#25), is an open savanna with scattered *Acacia* species and secondary grassland, dominated by *Hyparrhenia hirta*.

The woody component is well developed, with the trees *Cussonia paniculata* (Species group F), *Aloe marlothii* (Species group R), *Maytenus heterophylla* (Species group A), *Rhus dentata* and *Acacia sieberiana* (Species group W) prominent. The herbaceous layer is prominent with *Helichrysum rugulosum* (Species group D), *Hermannia depressa* (Species group O) and various other forb species.

Prominent grass species that occur in this variation include *Aristida congesta* ssp. *barbicollis* (Species group N), *Themeda triandra* (Species group V), *Hyparrhenia hirta, Melinis repens* and *Cymbopogon excavatus* (Species group W). No diagnostic species group is recognised, but this variation is distinguished from other variations in the *Acacia sieberiana - Helichrysum rugulosum* sub-community due to the absence of species groups G, H, K, L, M, P, T and U (Table 7.1).

7.1.2.2 The *Diospyros lycioides - Cymbopogon excavatus* variation

Sample plots of this variation are distributed throughout the central and northern parts of the study area, and are situated on the crests and slopes of rocky hills in the Natal Central Bushveld (#25) (Granger 1996). A high cover of rocks is present (60 %), with sizes in the order of 500 mm diameter. Sample plots of this variation are distributed in various climate zones, the average rainfall is 650 to 750 mm per annum. A high degree of utilisation, with further habitat factors like rockiness, steep slope incline and shallow soils combined, result in a vegetation that is sensitive to grazing. The effect of grazing is evident in the numerous forbs present, including *Acalypha angustata* (Species group A), *Helichrysum rugulosum* (Species group D), *Conyza podocephala* (Species group J), *Berkheya radula* (Species group N), *Hermannia depressa, Phyllanthus parvulus* (Species group O), *Scabiosa columbaria* and *Schkuhria pinnata* (Species group S).

The *Diospyros lycioides - Cymbopogon excavatus* variation is characterised by species group E (Table 7.1). Woody species occurring in this variation include *Grewia occidentalis* (Species group P), *Diospyros lycioides* (Species group S), *Rhus dentata* and *Acacia sieberiana* (Species group W). This variation is grassland being invaded by tree species as a result of poor agricultural practises.

7.1.2.3 The *Acacia sieberiana - Lippia javanica* variation

Various climate zones and veld types are represented in this variation. Sample plots are distributed in the northern and eastern parts, also in the high altitude mountains in the west of the study area. As is characteristically of the *Maytenus heterophylla - Acalypha angustata* community, steep and rocky slopes also prevail in this variation. The rock cover is more than 45% and rocks can be as big as 1 000 mm diameter. Utilisation is severe and this is reflected in many forbs in the herbaceous layer.

The *Acacia sieberiana - Lippia javanica* variation is characterised by species group G (Table 7.1). The forb layer is prominent, with species like *Helichrysum rugulosum* (Species group D), *Lippia javanica, Rhabdosiella calycina* (Species group G),

Hermannia depressa (Species group O), *Anthospermum rigidum* (Species group S), *Lantana rugosa* and *Bidens pilosa* (Species group W) prominent. Other species that have a high cover include the grass species *Themeda triandra* (Species group V), *Hyparrhenia hirta, Eragrostis plana, Hyparrhenia dregeana, Melinis repens, Cymbopogon excavatus* (Species group W) as well as the woody species *Diospyros lycioides* (Species group S), *Rhus dentata* and *Acacia sieberiana* (Species group W).

7.1.2.4 The *Elionurus muticus - Diheteropogon amplectens* variation

This variation is distributed through the central, central-western and southern parts of the study area, in various climate zones and veld types. The soil form is exclusively of the Mispah form as a result of a high degree of rockiness. Steep slopes and crests of rocky hills with a dominant herbaceous layer and few woody species are characteristic of this variation, as indicated by the characteristic species group K, consisting of *Elionurus muticus, Dicoma anomala, Convolvulus saggitatus, Aristida meridionalis* and *Rhus pentheri* (Table 7.1).

Species that have a high cover in this variation are the grasses *Trachypogon spicatus* (Species group W), *Themeda triandra* (Species group V), *Hyparrhenia hirta, Cymbopogon excavatus, Diheteropogon amplectens* and *Eragrostis curvula* (Species group W). The forbs *Acalypha angustata* (Species group A), *Chaetacanthus costatus, Anthospermum rigidum* and *Scabiosa columbaria* (Species group S), the woody succulent *Aloe marlothii* (Species group R) and the woody species *Diospyros lycioides* (Species group S) and *Rhus dentata* (Species group W) are also prominent.

Differences in climate as well as grazing intensity, veld management in the past and subsequently a slight difference in species composition caused the development of two sub-variations.

7.1.2.4.1 The *Eragrostis curvula - Abildgaardia ovata* sub-variation

This sub-variation is characterised by species group L and is distinguished from the *Scabiosa columbaria - Aster peglerae* sub-variation by the presence of species groups M, N and O as well as the absence of the woody species *Grewia occidentalis* (Species group P) (Table 7.1). Prominent grasses in this sub-variation include *Elionurus muticus* (Species group K), *Trachypogon spicatus* (Species group W), *Themeda triandra* (Species group V), *Hyparrhenia hirta, Melinis repens, Cymbopogon excavatus, Diheteropogon amplectens* and *Eragrostis curvula* (Species group W). The forbs *Turbina oblongata* (Species group N), *Hermannia depressa* (Species group O), *Scabiosa columbaria* (Species group S), the woody succulent *Aloe marlothii* (Species group R) and the tree *Acacia sieberiana* (Species group A) have high cover abundance values.

This sub-variation is distributed throughout the central western and southern parts of the study area, predominantly in the 378 climate zone with an average rainfall of 707.8 mm per annum. This is lower than the average rainfall of the *Scabiosa columbaria - Aster peglerae* sub-variation (850.00 mm per annum) (Institute for Soil, Climate and Water 1994). The vegetation of the *Eragrostis curvula - Abildgaardia ovata* sub-variation is associated with open rocky hills in the Southern Tall Grassveld (Acocks 1988) (#65) or the Natal Central Bushveld (Granger 1996) (#25). Few woody elements, except for *Aloe marlothii* (Species group R), *Rhus dentata, Acacia sieberiana* (Species group W) and *Diospyros lycioides* (Species group S) are present.

Slopes on the rocky hills are steep, up to 25°, and the rockiness percentage of the soil surface is more than 46%, with rocks exceeding 500 mm diameter. Grazing is severe, but veld condition is good with grass species, such as *Trachypogon spicatus* (Species group W), *Themeda triandra* (Species group V), *Hyparrhenia hirta, Diheteropogon amplectens* and *Eragrostis curvula* (Species group W) dominant.

7.1.2.4.2 The *Scabiosa columbaria - Aster peglerae* sub-variation

This sub-variation is found on slopes of rocky hills, comprising the Karoo Dolerite geological Formation. Soils are shallow and of the Mispah soil form (Macvicar **et. al.** 1977), rockiness is characteristically high (40%) and the rocks are up to 1 000 mm diameter. Sample plots of this variation are situated in the North-eastern Mountain Grassland (#43), described by Bredenkamp **et. al.** (1996c) and the Highland Sourveld (#44), described by Acocks (1988) as a pure grassveld with scrubbiness on the slopes. The 384 climate zone, with an average rainfall of 850.0 mm per annum is represented.

The vegetation has been utilised more severely than the *Diheteropogon amplectens - Abildgaardia ovata* sub-variation, this is noticeable in the lower presence of palatable grass species mentioned in the *Eragrostis curvula - Abildgaardia ovata* sub-variation. Unpalatable grass species with a high cover such as *Elionurus muticus* (Species group K), *Melinis repens* and *Cymbopogon excavatus* (Species group W), with various herbaceous species, such as *Acalypha angustata* (Species group A), *Aster peglerae* (Species group Q), *Chaetacanthus costatus* and *Scabiosa columbaria* (Species group S) occur in this sub-variation.

7.1.2.5 The *Hyparrhenia dregeana - Leucas glabrata* variation

Sample plots representing this variation are located on hill slopes situated in the 384 climate zone with an average rainfall of 850.0 mm per annum. Rocks are absent and soils are deep, yellow and grey sandy-loam, derived from sandstone and shales of the Beaufort Group. This variation is situated in the Wet Cold Highveld Grasslands (#41), described by Bredenkamp **et. al.** (1996a) as moderately dense grassland, dominated by grasses.

A well developed woody component is present, consisting of *Acacia caffra* (Species group D) and *Acacia sieberiana* (Species group W), as well as a prominent grass layer of *Themeda triandra* (Species group V), *Hyparrhenia hirta, Cymbopogon excavatus, Eragrostis curvula* and *Hyparrhenia dregeana* (Species group W). This variation is characterised by the presence of species group T as well as the absence of species groups

B, C and E to S (Table 7.1). Very few forb species are present, because of the dominant grass layer, with only *Acalypha angustata* (Species group A), *Sida rhombifolia, Hypoxis iridifolia* (Species group D), *Leucas glabrata* (Species group T), *Berkheya setifera* (Species group U) and *Tagetus minuta* (Species group W) occurring frequently.

7.2 The *Maytenus heterophylla - Rhus pentheri* community

The Two Way Indicator Species Analysis (TWINSPAN) (Hill 1979) separated this woodland community from the *Maytenus heterophylla - Acalypha angustata* community. Classification of the relevés by means of TWINSPAN and subsequent refinement by Braun-Blanquet procedures resulted in the recognition of the following sub-communities, variations and sub-variations (Table 7.2):

7.2.1 The *Acacia karroo - Acacia nilotica* sub-community

7.2.1.1 The *Panicum maximum - Bothriochloa insculpta* variation

7.2.1.2 The *Eragrostis superba - Sporobolus pyramidalis* variation

7.2.1.2.1 The *Buddleya loricata - Aloe marlothii* sub-variation

7.2.1.2.2 The *Vepris lanceolata - Ziziphus mucronata* sub-variation

7.2.1.2.3 The *Euclea natalensis - Hyparrhenia hirta* sub-variation

7.2.1.2.4 The *Eragrostis superba - Aristida congesta* ssp. *barbicollis* sub-variation

7.2.1.2.5 The *Acacia karroo - Heteropogon contortus* sub-variation

7.2.2 The *Rhus dentata - Paspalum dilatatum* sub-community

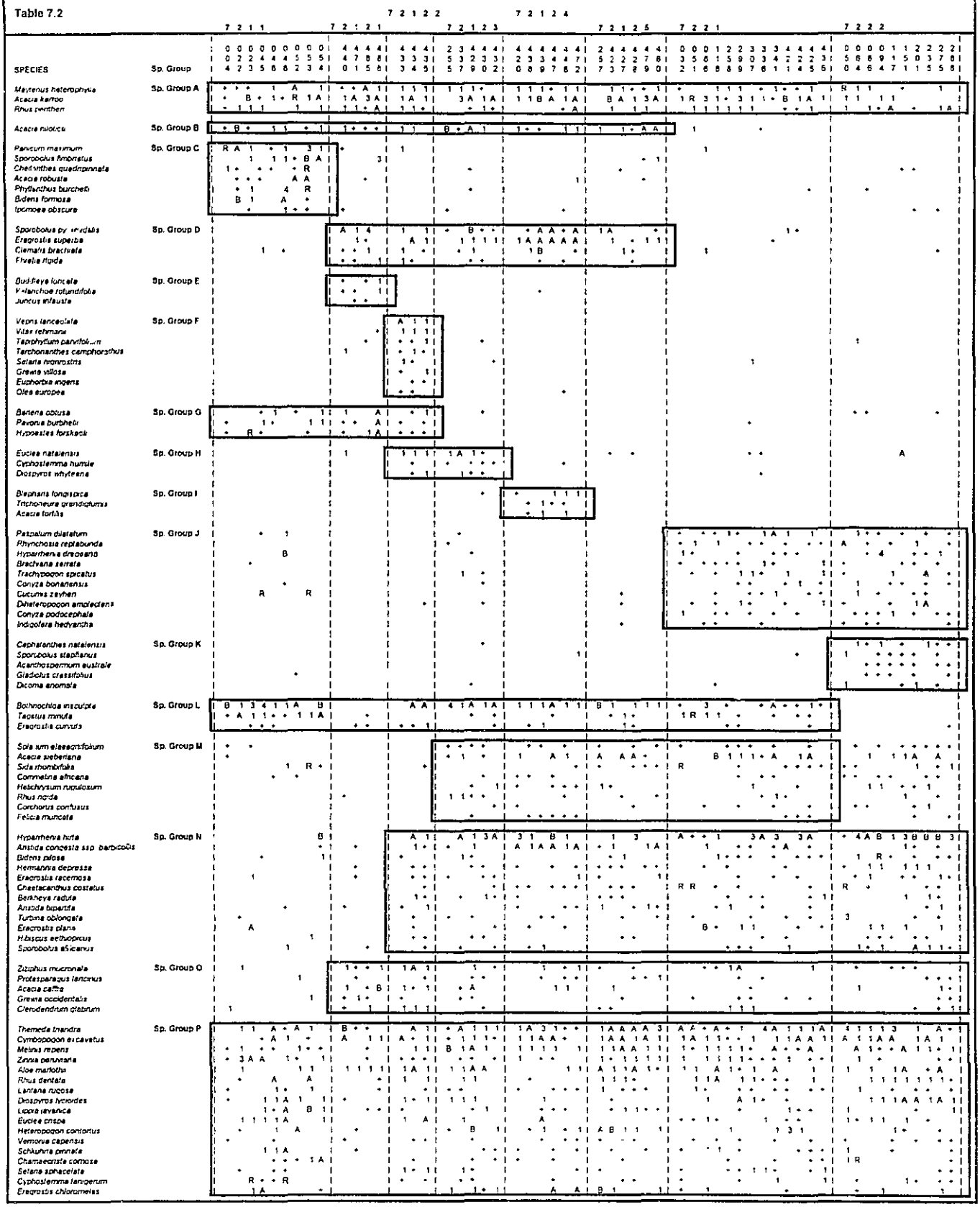
7.2.2.1 The *Acacia sieberiana - Bidens pilosa* variation

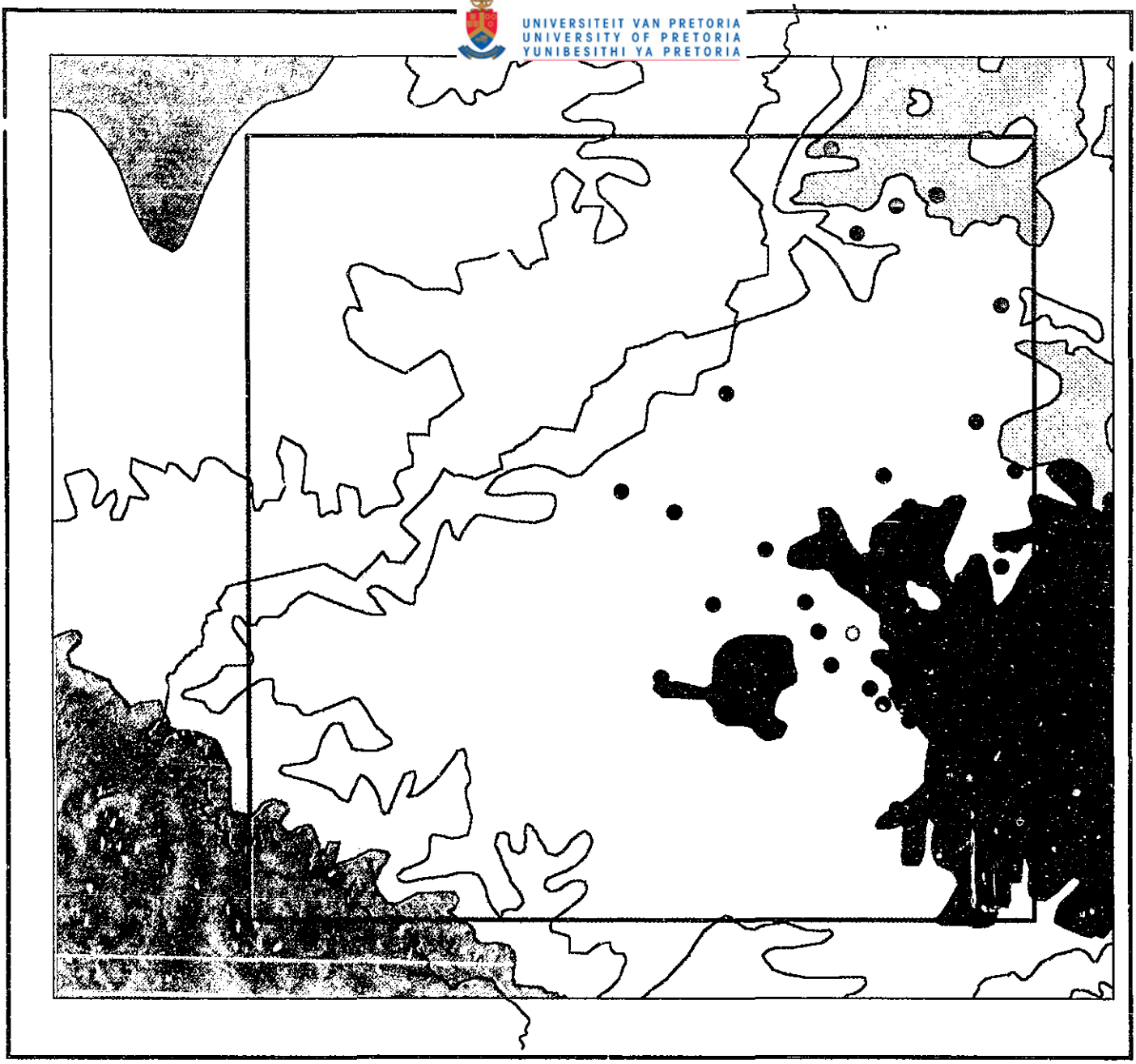
7.2.2.2 The *Cephalanthus natalensis - Diospyros lycioides* variation

Sample plots of this community are found mainly in the Valley Bushveld (#23), described by Acocks (1988) as the vegetation found in the valleys of numerous rivers draining into the Indian Ocean (Figure 7.7). These valleys are hot and receive less rain than the intervening ridges, from 500 to 900 mm per annum. It is described by Low and Rebelo (1996) as Valley Thickets (Lubke 1996) (#5), vegetation with a closed canopy of

Plant communities of the Maytenus heterophylla - Rhus pentheri community

Table 7.2

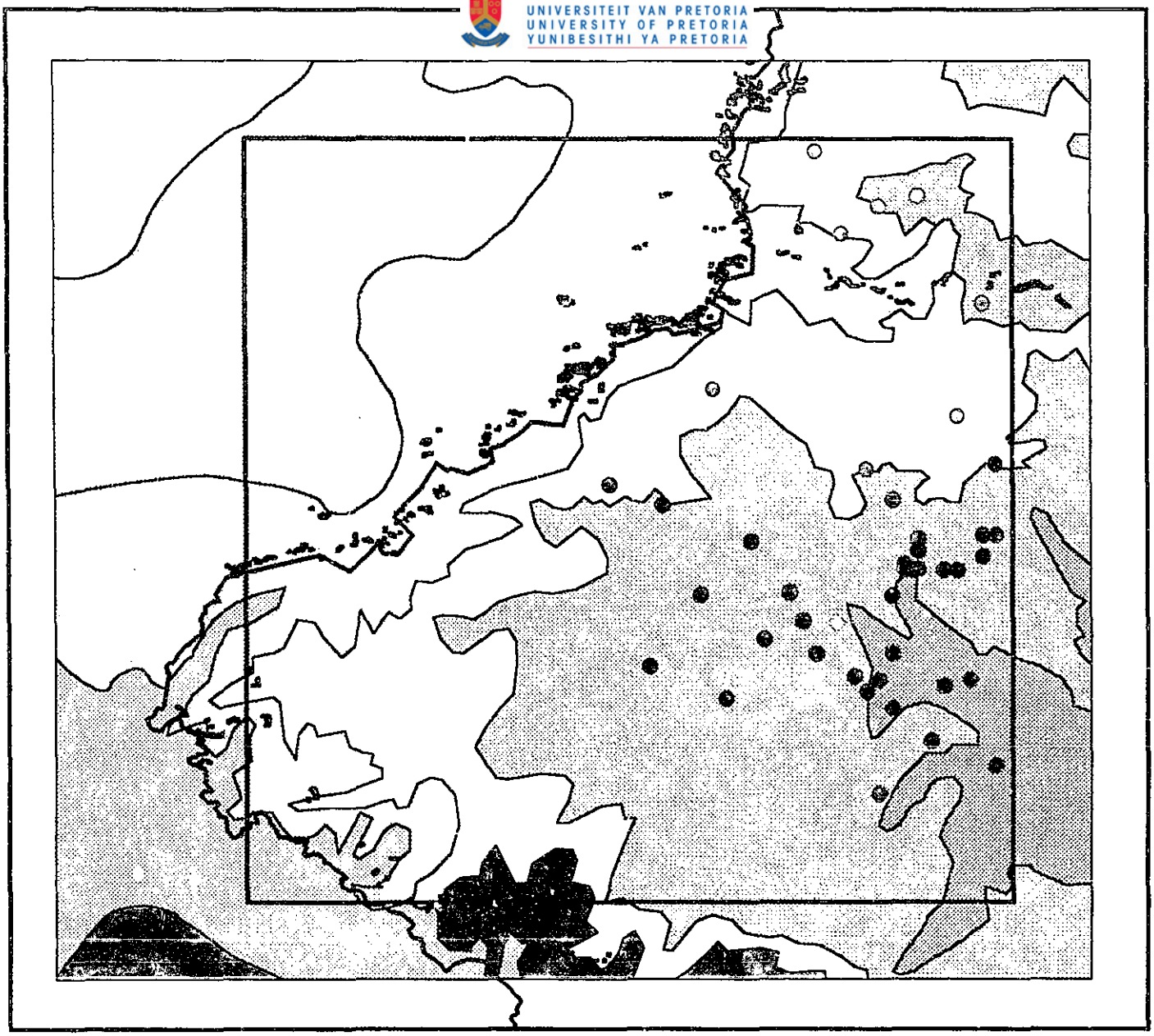




Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Maytenus heterophylla - Rhus pentheri community

Acocks Veld Types
Cymbopogon - Themeda Veld (Sandy) (#48)
Highland Sourveld and Dohne Sourveld (#44)
Highland Sourveld to Cymbopogon - Themeda Transition (Eastern Free State Highveld) (#49)
Natal Sour Sandveld (#66)
Southern Tall Grassveld (#65)
Themeda Veld to Cymbopopogon - Themeda Veld Transition (Patchy) (#53)
Themeda - Festuca Alpine Veld (#58)
Valley Bushveld (#23)

Figure 7.7: Distribution of the Maytenus hetrophylla - Rhus pentheri community sample plots in Acocks Veld Types of the study area.



Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Maytenus heterophylla - Rhus pentheri community

Low and Rebelo Vegetation Types
Afromontane Forest (#2)
Valley Thickets (#5)
Natal Central Bushveld (#25)
Moist Cool Highveld Grassland (#39)
Moist Cold Highveld Grassland (#40)
Wet Cold Highveld Grassland (#41)
Moist Upland Grassland (#42)
North-eastern Mountain Grassland (#43)
Afro Mountain Grassland (#45)
Alti Mountian Grassland (#46)

N

Figure 7.8: Distribution of the Maytenus heterophylla - Rhus pentheri community sample plots in Low and Rebelo Vegetation Types of the study area.

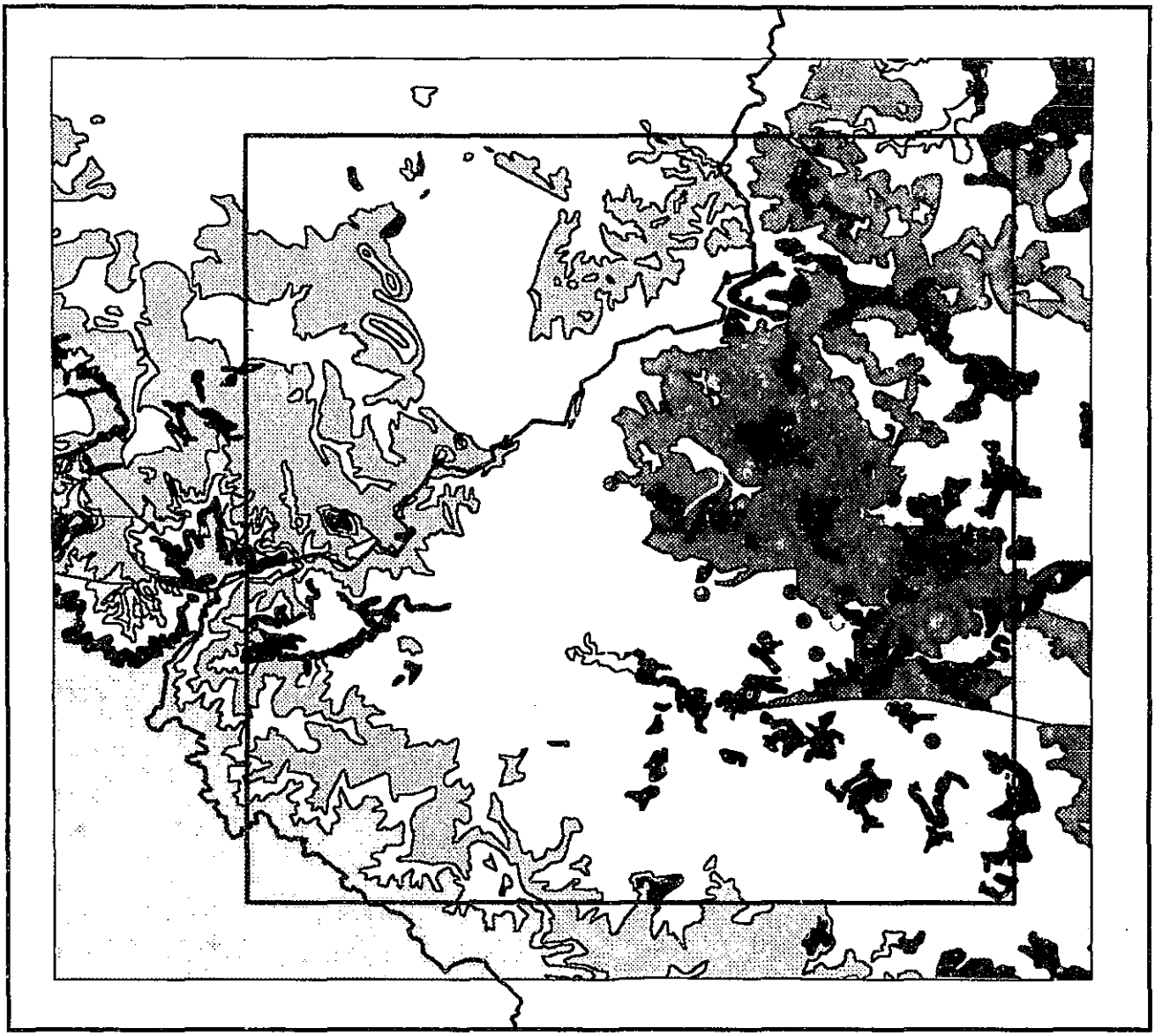
up to 6 m in height, dominated by woody, species (Figure 7.8). A great diversity of species is found in this thicket.

Sample plots representing this community are mostly located on crests, slopes and footslopes of rocky hills. Rockiness is characteristic of the habitat, with rock size in the order of 500 mm diameter, and a cover of 40 - 50%. The soil form in this community is mostly the Mispah form (Orthic A, hard rock) (Macvicar **et. al.** 1977). Where sample plots are located on the footslopes, less rocks are present, but soils are generally shallow and sandy.

General species for the area are listed under Species groups A and P (Table 7.2). These species include the grasses *Themeda triandra, Cymbopogon excavatus, Melinis repens, Heteropogon contortus, Setaria sphacelata* and *Eragrostis chloromelas* (Species group P). Woody species include *Acacia karroo, Maytenus heterophylla, Rhus pentheri* (Species group A), *Rhus dentata, Diospyros lycioides* and the liana *Rhoiscissus tridentata.* The forbs *Zinnia peruviana, Lantana rugosa, Lippia javanica, Vernonia capensis, Schkuhria pinnata, Cyphostemma lanigerum* and *Chamaecrista comosa* (Species group P) are present in this community. A conspicuous species that is present on most hill slopes is the succulent woody species *Aloe marlothii* (Species group P), giving a characteristic physiognomy that is easily recognised in this community.

The geology comprises of Karoo Dolerite, present as rocky hills in the study area (Figure 7.9). The texture of dolerite varies considerably. Most of it is fine- to medium grained, but coarse-grained types are also found.

According to the Climate Zone Map supplied by The Institute for Soil, Climate and Water (1994), the sample plots representing this community occur mainly in climate zone 386. The average annual rainfall is 644.8 mm per annum, peaking during the months of December and January with more than 200 mm, occurring mainly in the form of thundershowers.



Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Maytenus heterophylla - Rhus pentheri community

Geological Formations

Beaufort
Clarens
Drakensberg
Karoo
Karoo Dolerite
Molteno
Tarkastad
Volksrust
Vryheid

N

Figure 7.9: Distribution of the Maytenus heterophylla - Rhus pentheri community sample plots in geological formations of the study area.

An average maximum temperature of 31.2°C is reached in January and an average minimum temperature of 0.8°C during June and July. As a result of the low rainfall, slope and rockiness, the vegetation of these sub-communities and variations are not always suitable for grazing. However, a high degree of utilisation is noted. This high grazing intensity is reflected in the presence of unpalatable grass species such as *Bothriochloa insculpta* (Species group L), *Cymbopogon excavatus* and *Melinis repens* (Species group P), outweighing the palatable grass *Themeda triandra* (Species group P).

The presence of many forbs in the herbaceous layer is also an indication of over-utilisation and degradation. This poor veld condition is associated with a strong woody component, possibly indicating bush encroachment.

7.2.1 The *Acacia karroo - Acacia nilotica* sub-community

This sub-community occurs on the crests, slopes and footslopes of rocky hills in the southeastern and central parts of the study area.

The landscape where this sub-community occurs is characterised by high hills incised with deep valleys in the south-east and undulating plains with interspersed rocky hills to the west. Altitude ranges from 900 to 1 200 m a.m.s.l. Trees cover these hills and the ground layer consists mainly of forbs, though the plains are dominated by grass species. The tree *Acacia nilotica* (Species group B) is diagnostic for this sub-community (Table 7.2).

Other prominent species include the trees *Rhus pentheri* (Species group A), *Acacia karroo, Maytenus heterophylla* and *Aloe marlothii* (Species group P) the grasses *Bothriochloa insculpta* (Species group L), *Themeda triandra, Cymbopogon excavatus* and *Melinis repens* (Species Group P). Two variations are recognised in this sub-community.

7.2.1.1 The *Panicum maximum - Bothriochloa insculpta* variation

Sample plots of this variation occur on slopes of rocky hills in the Valley Bushveld (#23) (Acocks 1988) or the Valley Thickets (#5), as described by Lubke (1996), at altitudes of less than 1 200 m a.m.s.l. Sample plots are located in the central eastern part of the study area and is geographically separated from the *Eragrostis superba - Sporobolus pyramidalis* variation. Utilisation varies and the vegetation appears disturbed, this is noted in the prominence of forbs in the herbaceous layer. Erosion was also noted in some areas. In adjacent areas where grazing was noticeably moderate, the grass layer is in good condition. Rock sizes of up to 1 000 mm diameter, with an average rock cover of 45% were observed.

This variation is present in the 386 climate zone (Institute for Soil, Climate and Water 1994). This is a dry zone with an average rainfall of only 644.8 mm per annum. Species group B characterises this variation, with the grasses *Panicum maximum* and *Sporobolus fimbriatus*, the forbs *Cheilanthes quadripinnata, Phyllanthus burchellii, Bidens formosa* and *Ipomoea obscura* and the tree *Acacia robusta* (Table 7.2). This variation is distinguished from other variations by the absence of species groups D, E, F, H, I, J, K, M, N and O.

Prominent grass species in this variation include *Panicum maximum, Sporobolus fimbriatus* (Species group C), *Bothriochloa insculpta* (Species group L) and *Themeda triandra* (Species group P). The forbs *Tagetus minuta* (Species group L), *Zinnia peruviana* and *Lippia javanica* (Species group P) and the trees *Maytenus heterophylla, Rhus pentheri* (Species group A), *Acacia karroo, Diospyros lycioides* and *Euclea crispa* (Species group P) have high cover abundance values.

7.2.1.2 The *Eragrostis superba - Sporobolus pyramidalis* variation

This variation is found on crests and footslopes of rocky hills in the Valley Bushveld (#23), described by Acocks (1988) and the Natal Central Bushveld (Granger 1996) (#25) and Valley Thickets (#5) (Lubke 1996) in the southeastern and central part of the study

area. On the slopes and crests of hills, rock cover is between 31 and 60% of the soil surface, with sizes between 500 and 1 000 mm diameter. The soil form present in these areas is mostly the Mispah form (Macvicar **et. al.** 1977). On the footslopes however, rocks are absent. The geology of the area is represented by the Karoo Dolerite geological formation.

Utilisation varies in the different sub-variations, but is generally high, as indicated by the presence of species that are indicative of poor veld conditions. The presence of shallow and, in some cases, duplex soils on the footslopes is problematic in the sense that erosion can become a serious problem. Various climate zones are represented, including 386 and 374, with an average rainfall of 644.8 and 720 mm per annum respectively (Institute for Soil, Water and Climate 1994). Low rainfall, rockiness, presence of poor soils and heavy utilisation are detrimental to the veld.

Species group D is characteristic of this variation and includes the grasses *Sporobolus pyramidalis* and *Eragrostis superba*, the creeper *Clematis brachiata* and the tree *Ehretia rigida*. The *Eragrostis superba* - *Sporobolus pyramidalis* variation is further distinguished by the absence of species groups C, J and K. The geographical position of the sample plots is important for the general physiognomy of the sub-variations. Sample plots situated to the east are inclined to be dominated by tree species, together with grass species usually associated with dry conditions, while sample plots at slightly higher altitudes located to the centre of the study area, are likely to be a more open savanna. Five sub-variations are recognised in this variation.

7.2.1.2.1 The *Buddleya loricata - Aloe marlothii* sub-variation

Occurring in the Natal Central Bushveld (Granger 1996) (#25) at altitudes of more than 1 000 m, it is described as an open savanna with various *Acacia* species. Sample plots representing this sub-variation are located on slopes and footslopes of hills in the central part of the study area. It has been grazed intensively and this is noted in the occurrence of unpalatable grass species, such as *Sporobolus pyramidalis* (Species group D) and

Cymbopogon excavatus (Species group P). Various woody species present include *Acacia nilotica* (Species group B), *Acacia karroo, Rhus pentheri* (Species group A), *Ziziphus mucronata* (Species group O), *Maytenus heterophylla* and *Aloe marlothii* (Species group P).

The absence of rocks is beneficial to veld condition and this is noted in the absence of *Bothriochloa insculpta* (Species group L). This is an unpalatable grass species that can colonise disturbed areas (Van Oudtshoorn 1991). Species group E characterises this sub-variation and the absence of species groups F, H, I, M and N (Table 7.2) distinguishes it from the other sub-variations. According to Low and Rebelo (1996), soils are shallow, derived from shales and mudstone and are characterised by subsoil, which are either duplex or dominated by black clays, hence the presence of *Acacia nilotica* (Species group A) and *Acacia karroo* (Species group P).

7.2.1.2.2 The *Vepris lanceolata - Ziziphus mucronata* sub-variation

This sub-variation is located in the area of Monte Cristo in the southeastern part of the study area. Located in the 386 climate zone with an average rainfall of 644.8 mm per annum, with warm temperatures on slopes and footslopes of hills that have been moderately utilised. This sub-variation is rich in species.

The *Vepris lanceolata - Ziziphus mucronata* sub-variation is characterised by species group F, consisting of species usually found in the Valley Thickets (#5), described by Lubke (1996). This vegetation consists of a great diversity of evergreen woody species, forming a closed canopy of up to 6 m in height. It is distinguished from other sub-variations in the *Eragrostis superba - Sporobolus pyramidalis* variation by the absence of species groups E, H and M (Table 7.2).

Prominent species in this sub-variation include the grasses *Eragrostis superba* (Species group D), *Bothriochloa insculpta* (Species group L), *Hyparrhenia hirta* (Species group N), *Themeda triandra, Cymbopogon excavatus* and *Setaria sphacelata* (Species group P).

The forbs *Hypoestis forskaolii* (Species group G), *Rhoicissus tridentata* and *Zinnia peruviana* (Species group P) is also prominent. The woody species of species group F as well as *Euclea natalensis* (Species group H), *Maytenus heterophylla, Acacia karroo, Rhus pentheri* (Species group A), *Ziziphus mucronata, Acacia caffra, Clerodendrum glabrum* (Species group O), *Aloe marlothii, Diospyros lycioides* and *Euclea crispa* (Species group P) have high cover values in this sub-variation.

The location of this sub-variation in the Valley Bushveld (Acocks 1988) (#23), together with a high degree of rockiness (45%) on the hill slopes cause the soil to be shallow and prone to erosion. The high percentage of dominant woody species contributes to a low grazing potential in this sub-variation.

7.2.1.2.3 The *Euclea natalensis - Hyparrhenia hirta* sub-variation

No characteristic species group is recognised in this sub-variation, but it is distinguished from the other sub-variations by the presence of species group H and the absence of E, F, G and I (Table 7.2). Various unpalatable grass species were noted, for example *Sporobolus pyramidalis* (Species group D), *Bothriochloa insculpta* (Species group L), *Cymbopogon excavatus, Melinis repens* and *Eragrostis chloromelas* (Species group P). The presence of these unpalatable species might be an indication of moderate utilisation. According to Granger (1996), this sub-variation represents the Natal Central Bushveld (#25) where highly erodible, shallow, duplex soils require careful management. The woody species *Maytenus heterophylla, Acacia karroo* (Species group A), *Euclea natalensis* (Species group H), *Rhus rigida* (Species group M), *Aloe marlothii* and *Diospyros lycioides* (Species group P) are also prominent.

A high percentage of rock cover is present (50%) on slopes of hills where this sub-variation occurs. The soils are shallow and large rocks, in the order of 500 mm diameter, are present. Sample plots representing this sub-variation occur in areas where the Natal Central Bushveld (Granger 1996) (#25) merges into the Valley Thickets (Lubke 1996) (#5) in the central part of the study area.

7.2.1.2.4 The *Aristida congesta* ssp *barbicollis* - *Eragrostis superba* sub-variation

This sub-variation is found on the footslopes of hills that have been severely utilised. Evidence of intensive grazing is noted in the high cover of unpalatable grass species such as *Sporobolus pyramidalis* (Species group D), *Bothriochloa insculpta* (Species group L), *Aristida congesta* ssp. *barbicollis* (Species group N), *Cymbopogon excavatus* and *Melinis repens* (Species group P). This sub-variation is characterised by species group I (Table 7.2). Prominent grass species include *Sporobolus pyramidalis, Eragrostis superba* (Species group D), *Bothriochloa insculpta* (Species group L), *Hyparrhenia hirta, Aristida congesta* ssp. *barbicollis* (Species group N), *Themeda triandra, Cymbopogon excavatus* and *Melinis repens* (Species group P). The woody species *Acacia karroo, Maytenus heterophylla* (Species group A) and the forbs *Felicia muricata* (Species group M), *Chaetacanthus costatus* (Species group N) and *Lantana rugosa* (Species group P) have high cover values in this sub-variation.

Tree density is low as a result of the low rock cover and subsequently deeper soils. This sub-variation represents the Natal Central Bushveld (#25), described by Granger (1996). The geology conforms to Karoo Dolerite. Various climate zones are represented in this sub-variation.

7.2.1.2.5 The *Acacia karroo* - *Heteropogon contortus* sub-variation

Sample plots representing this sub-variation are found on footslopes of hills with a rock cover of 45%. This sub-variation is widely distributed over various climate zones, geological formations and veld types, but is mostly found in the southeastern part of the study area.

The vegetation of the *Acacia karroo* - *Heteropogon contortus* sub-variation is severely grazed, resulting in the presence of undesirable species, such as *Bothriochloa insculpta* (Species group L), *Sida rhombifolia* (Species group M), *Hermannia depressa* (Species group N), *Cymbopogon excavatus, Melinis repens, Zinnia peruviana, Aloe marlothii* and *Lippia javanica* (Species group P). Species present with high cover abundance include the tree species *Rhus pentheri, Acacia karroo, Maytenus heterophylla* (Species group A),

Acacia nilotica (Species group B) and *Acacia sieberiana* (Species group M). A visible effect of the over-utilisation is bare soil or very little vegetation. A grass species that is conspicuously absent from most sample plots is *Hyparrhenia hirta* (Species group N).

The *Acacia karroo - Heteropogon contortus* sub-variation is distinguished from the other sub-variations by the absence of species groups E, F, G, H and I (Table 7.2).

7.2.2 The *Rhus dentata - Paspalum dilatatum* sub-community

This sub-community is characterised by species group J and is distinguished from the *Acacia karroo - Acacia nilotica* sub-community by the absence of species groups A to H (Table 7.2). It occurs on hills and footslopes of rocky hills in the central-eastern and northern parts of the study area. Average rock size varies between 500 and 1 000 mm diameter and rock cover is more than 35%. The Mispah soil form is predominant. Various climate zones are represented, but rainfall varies between 600 and 900 mm per annum (Institute for Soil, Water and Climate 1994).

Grass species that occur abundantly in this sub-community include *Hyparrhenia hirta, Eragrostis plana, Sporobolus africanus* (Species group N), *Themeda triandra, Cymbopogon excavatus* and *Melinis repens* (Species group P). Prominent forbs include *Solanum elaeagnifolium* (Species group M), *Bidens pilosa* (Species group N), *Zinnia peruviana, Aloe marlothii* and *Lantana rugosa* (Species group P). The woody species *Acacia karroo* (Species group A), *Acacia sieberiana* (Species group M) and *Rhus dentata* (Species group P) have high cover values. This sub-community is divided into two variations.

7.2.2.1 The *Acacia sieberiana - Bidens pilosa* variation

The Mispah soil form is predominantly found in this variation. Rocks are present on an average of 31 - 45% and the average size varies between 400 and 1 000 mm diameter. Sample plots of this variation are found on hills and footslopes of rocky hills in the Southern Tall Grassveld (#65) (Acocks 1988). As a result of the wide distribution of the

sample plots, this variation is not confined to one climate zone or geological formation and is distributed over the eastern, central and northern parts of the study area.

No diagnostic species group is recognised for this variation, but it is distinguished from the *Cephalanthus natalensis - Diospyros lycioides* variation due to the absence of species group K and the presence of species group L (Table 7.2). The tree *Rhus pentheri* (Species group A), the grass *Bothriochloa insculpta* and the forb *Tagetus minuta* (Species group L) have high cover abundance values in this variation. Mixtures of palatable and unpalatable species occur in this community, indicating grazing pressure, but good potential exists with proper management. The high cover of *Acacia karroo* (Species group A) and *Acacia sieberiana* (Species group M) seedlings indicates bush encroachment.

Palatable grass species include *Hyparrhenia hirta* (Species group N), *Themeda triandra* and *Setaria sphacelata* (Species group P). Unpalatable grass species with a high percentage cover include *Bothriochloa insculpta* (Species group L), *Aristida congesta* ssp. *barbicollis, Eragrostis plana* (Species group N), *Melinis repens* and *Cymbopogon excavatus* (Species group P). Other prominent species include the forbs *Tagetus minuta* (Species group L), *Solanum elaeagnifolium* (Species group M), *Lantana rugosa, Zinnia peruviana* (Species group P), the woody succulent *Aloe marlothii* and trees *Maytenus heterophylla, Rhus pentheri* (Species group A), *Acacia sieberiana* (Species group L), and *Rhus dentata* (Species group O).

7.2.2.2 The *Cephalanthus natalensis - Diospyros lycioides* variation

Species group K characterises this variation from the *Acacia sieberiana - Bidens pilosa* variation as well as the absence of species group L (Table 7.2). Physiognomically this variation is different from the previous because of a less prominent woody component and stronger developed herbaceous layer. It is also different from the previous variation due to a high cover of *Hyparrhenia hirta* (Species group N), *Themeda triandra* and *Cymbopogon excavatus* (Species group P) as well as the presence of the woody species

Rhus dentata and *Diospyros lycioides* (Species group P).

This variation occurs on crests and slopes of rocky hills that have been grazed moderately to severely. The distribution of the sample plots stretches through several climate zones, geological formations and veldtypes. Rainfall varies between 600 and 900 mm per annum. Rocks are prominent in this community and the size varies between 200 - 1 000 mm diameter with an average cover between 31 and 60%. The slope varies according to terrain unit between 5° and 25°.

Chapter 8: The Wetland and Thicket Vegetation Types

Thickets are present as patches in the grassland in deep rocky valleys. The Wetland Vegetation Type is found in close vicinity of standing and slow flowing water.

Classification of the relevès by means of Two Way Indicator Species Analysis (TWINSPAN) and subsequent refinement by Braun-Blanquet procedures resulted in the recognition of the following communities (Table 8.1):

8.1 The *Rhoicissus tridentata - Achyranthes aspera* thicket community
8.1.1 The *Leucosidea sericea - Podocarpus henkelii* sub-community
8.1.2 The *Cussonia natalensis - Acacia caffra* sub-community
8.2 The *Mariscus congestus - Arundinella nepalensis* wetland community
8.2.1 The *Sporobolus africanus - Paspalum dilatatum* sub-community
8.2.2 The *Schoenoplectus corymbosus - Fimbristylis ferruginea* sub-community

8.1 The *Rhoicissus tridentata - Achyranthes aspera* thicket community

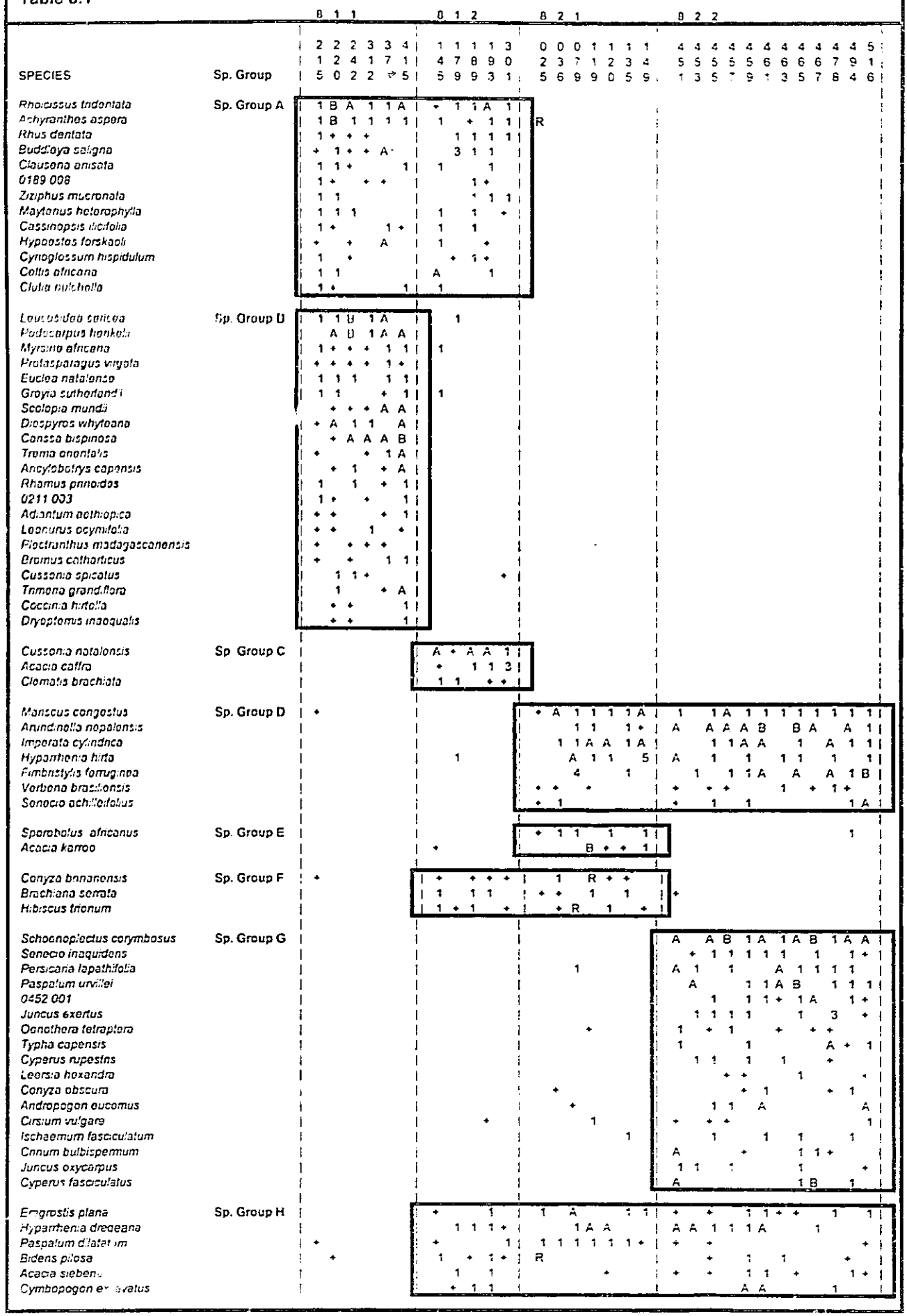
The vegetation of this community represents thickets distributed in the northern and western parts of the study area. Rockiness is characteristic (45-60%) and slopes are steep (30°). The woody component is dominant and the herbaceous layer consists mainly of forbs and climbers. Various geological formations and climate zones are represented and sub-communities are interpreted on geographical, altitudinal and floristic differences (Figure 8.1).

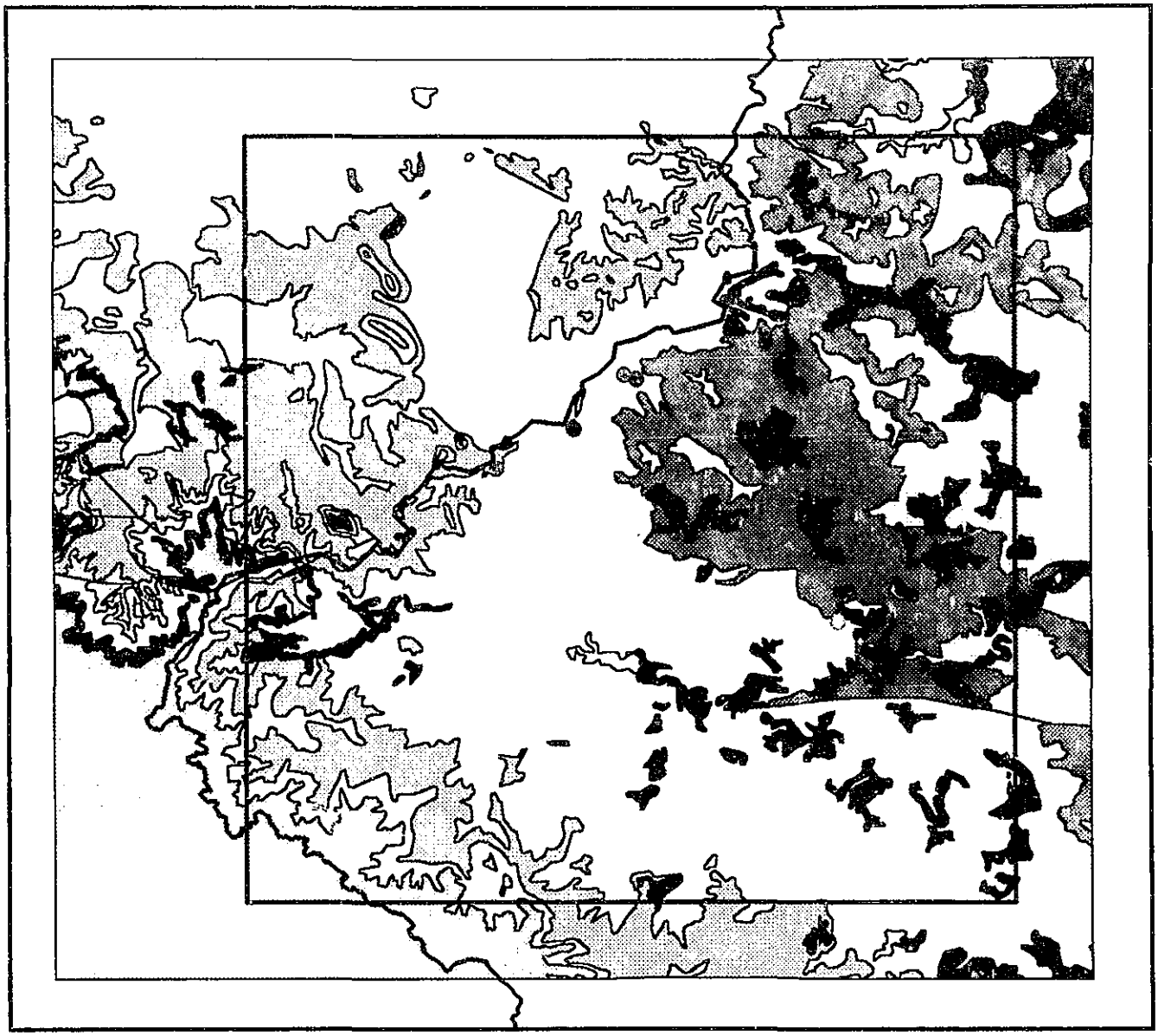
The *Rhoicissus tridentata - Achyranthes aspera* thicket community is characterised by species group A and is distinguished from the *Mariscus congestus - Arundinella nepalensis* wetland community by the absence of species groups D, E and G.

Diagnostic species include *Achyranthes aspera* and *Buddleya saligna* (Table 8.1). Two sub-communities were recognised in this community.

Plant communities of the Thickets and Wetland Vegetation Types

Table 8.1





Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Rhoicissus tridentata - Achyranthes aspera community

Geological Formations

Beaufort
Clarens
Drakensberg
Karoo
Karoo Dolerite
Molteno
Tarkastad
Volksrust
Vryheid

Figure 8.1: Distribution of the Thicket Vegetation Type sample plots in geological formations of the study area.

8.1.1 The *Leucosidea sericea - Podocarpus henkelii* sub-community

Patches of dense thickets in narrow, steep valleys in the grassland represent this sub-community. It is present at altitudes, exceeding 1 400 m and varies from small to intensive patches. The vegetation is similar to the Highland Sourveld and Dohne Sourveld forests (Acocks 1988) (#44) (Figure 8.2). Elements of both the Afromontane Forest (#2) and the Wet Cold Highveld Grassland (#41) described by Bredenkamp **et. al.** (1996a) are found (Figure 8.3). The vegetation of this sub-community is associated with rocky slopes and ravines with shallow soils.

The *Leucosidea sericea - Podocarpus henkelii* sub-community is characterised by species group B and is distinguished from the other communities by the absence of species groups C to H (Table 8.1). The woody layer of this sub-community is well developed and prominent species include *Leucosidea sericea, Podocarpus henkelii, Euclea natalensis, Diospyros whyteana, Carissa bispinosa* and *Trema orientalis.* The well developed woody component is responsible for a closed canopy and trees reach a height of twenty metres.

8.1.2 The *Cussonia natalense - Acacia caffra* sub-community

Sample plots representing this sub-community are found in the northern part of the study area at altitudes lower than 1 500 m a.m.s.l. Various climate zones are included in this sub-community. Rockiness is not as high and slopes are not as steep and subsequently soils are deeper than in the *Leucosidea sericea - Podocarpus henkelii* sub-community. The Scrub forest, described by Acocks (1988) as part of the Southern Tall grassveld (#65) is represented and is described by Granger (1996) as Natal Central Bushveld (#25), which are present at altitudes ranging from 600 to 1 350 m a.m.s.l.

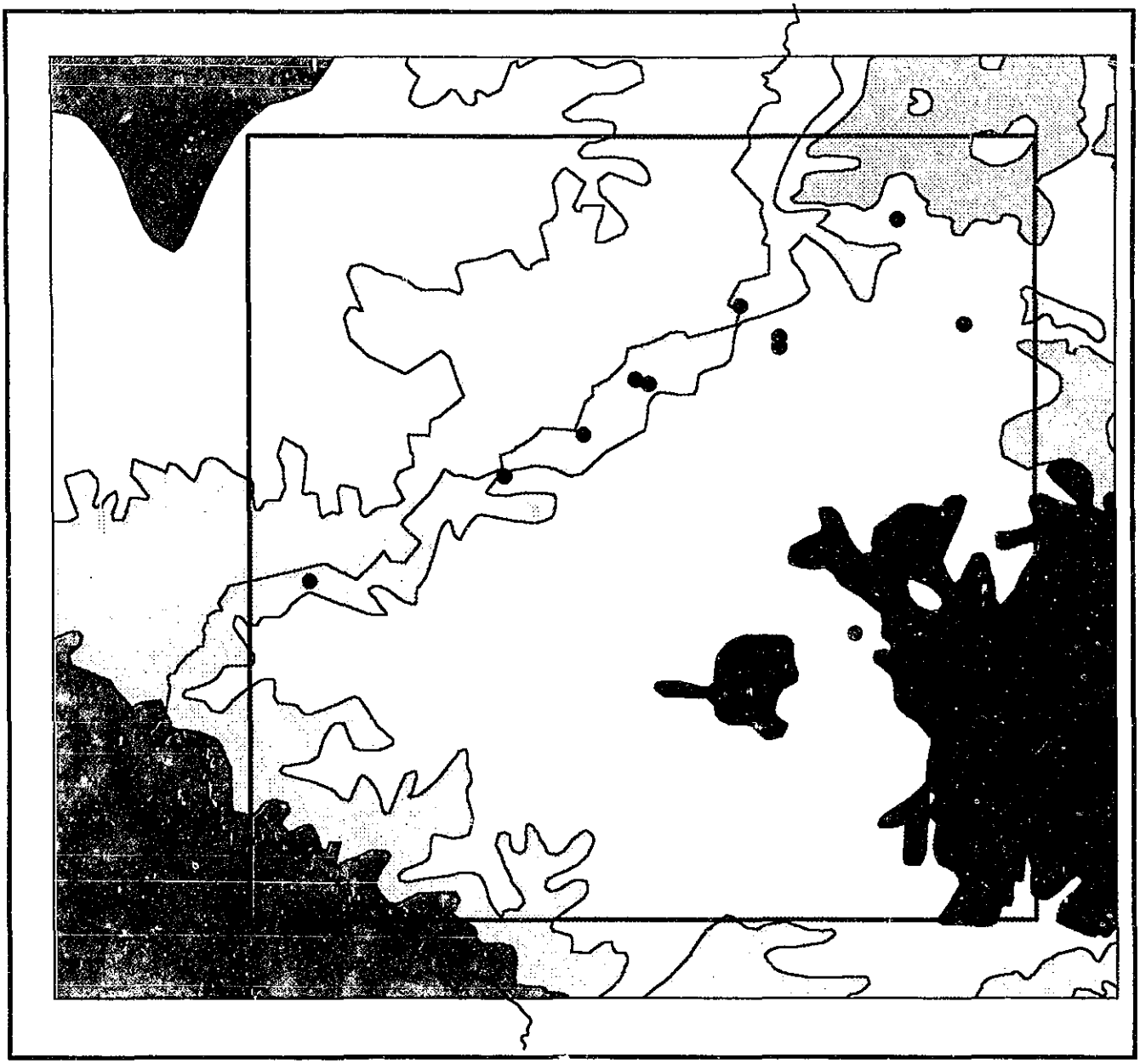


Figure 8.2: Distribution of the Thicket Vegetation Type sample plots in Acocks Veld Types of the study area.

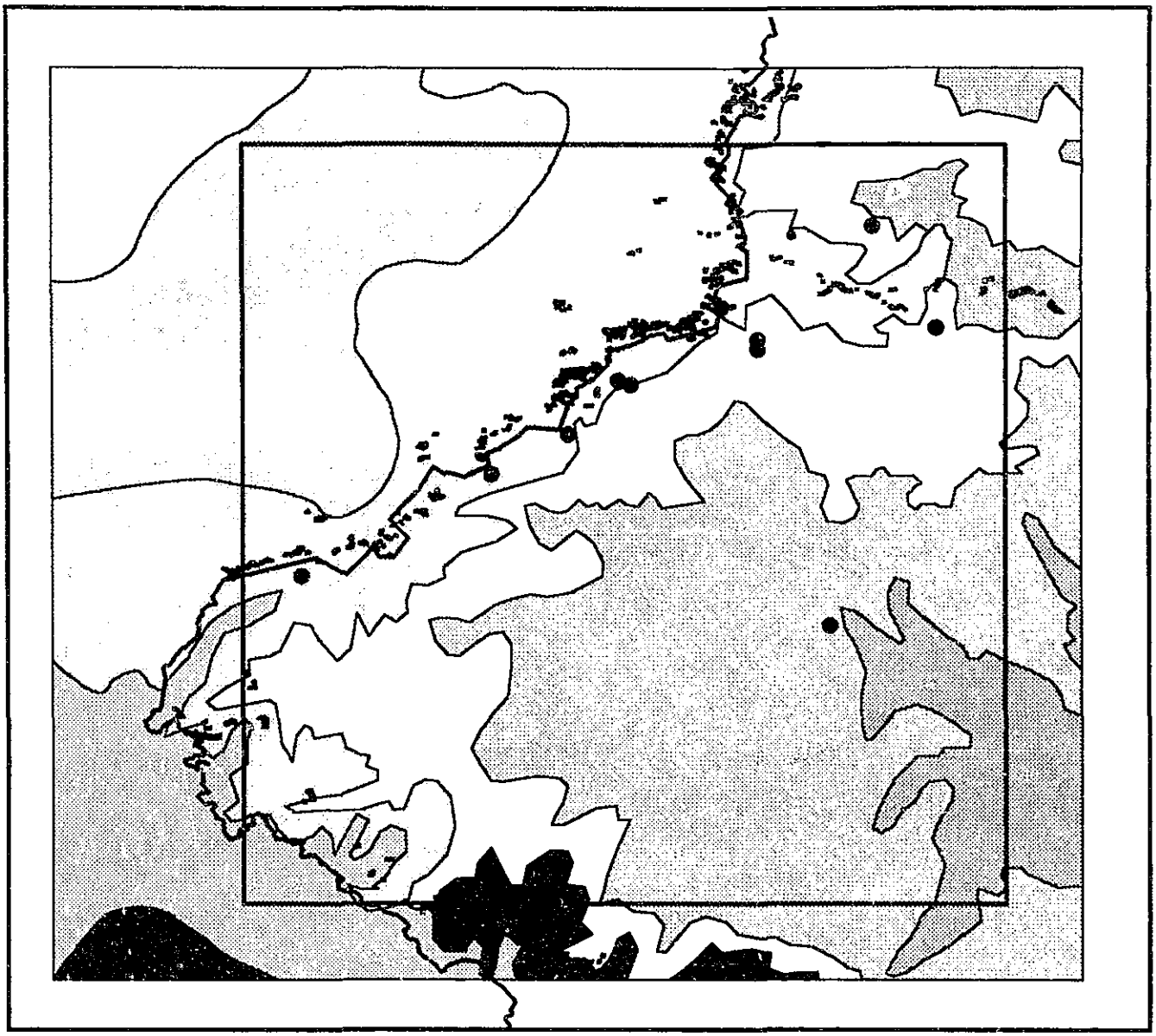


Figure 8.3: Distribution of the Thicket Vegetation Type sample plots in Low and Rebelo Vegetation Types of the study area.

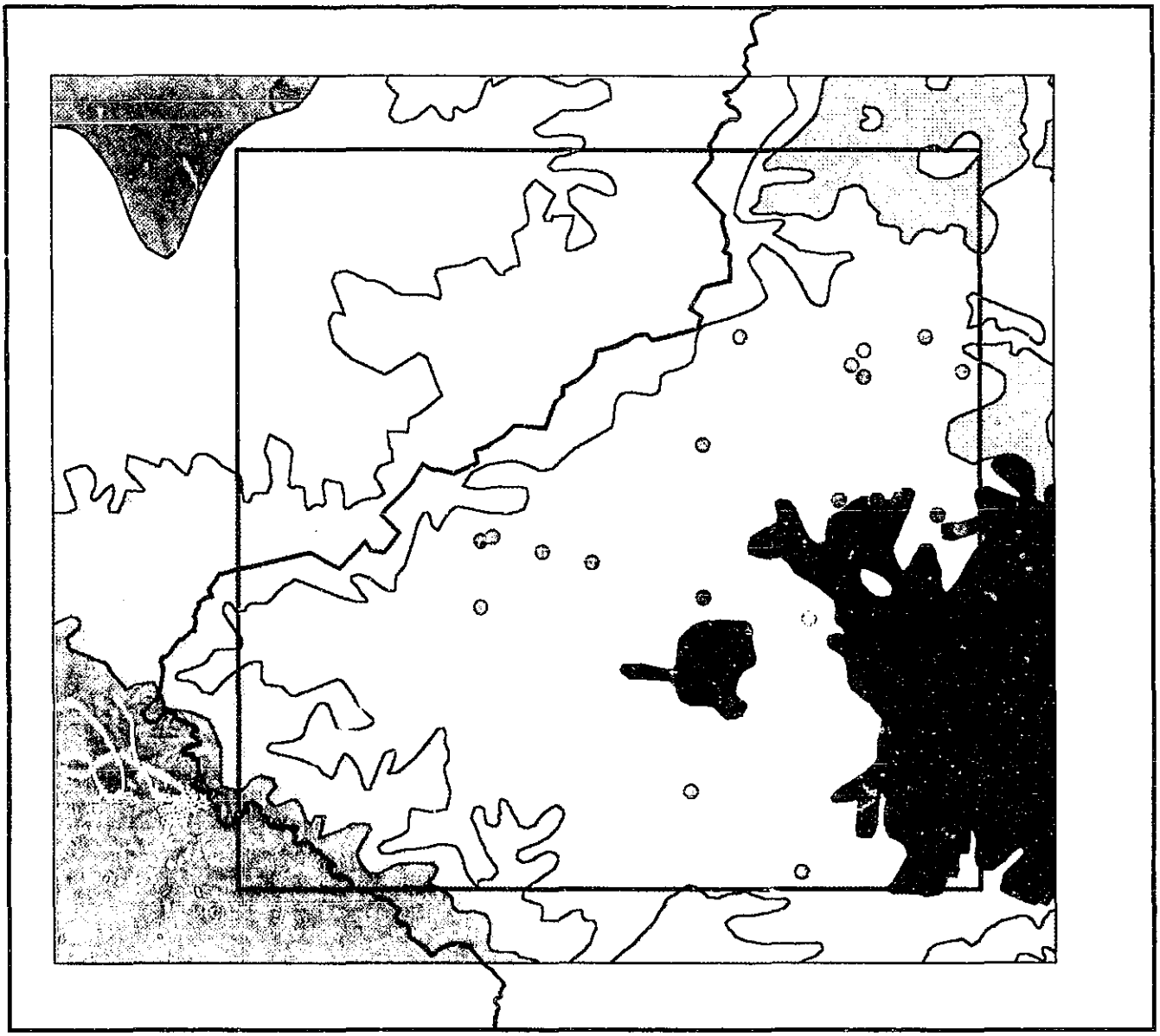
Prominent species include the woody species *Rhus dentata, Buddleya saligna, Ziziphus mucronata* (Species group A), *Cussonia natalensis, Acacia caffra* (Species group C), the climbers *Rhoicissus tridentata* (Species group A), *Clematis brachiata* (Species group C), the forbs *Achyranthes aspera* (Species group A), *Bidens pilosa* (Species group H) and the grass *Hyparrhenia dregeana* (Species group H) (Table 8.1). The woody component is dominant and is responsible for a closed canopy, with trees reaching a height of ten metres, not as high as in the *Leucosidea sericea - Podocarpus henkelii* sub-community.

The *Cussonia natalensis - Acacia caffra* sub-community is characterised by diagnostic species group C and is distinguished from other sub-communities by the absence of species groups B, D, E, G as well as the presence of species groups A, C, F and H. Species that are present in this and the *Mariscus congestus - Arundinella nepalensis* sub-community include woody and herbaceous species that are usually associated with disturbed areas.

8.2 The *Mariscus congestus - Arundinella nepalensis* wetland community

Prominent species usually associated with wet conditions represent the vegetation found in the *Mariscus congestus - Arundinella nepalensis* community. The differences between the sub-communities are a result of a moisture gradient, confirmed by the species composition. Various climate zones and geological formations are present and sample plots are distributed in the Southern Tall Grassveld (#65) (Acocks 1988) (Figure 8.4). Species group D is characteristic of this community and the absence of species groups A, B and C distinguishes it from the *Rhoiscissus tridentata - Achyranthes aspera* thicket community (Table 8.1).

Prominent species include the diagnostic sedge *Mariscus congestus* and forb *Verbena brasiliensis* and the characteristic species *Arundinella nepalensis, Imperata cylindrica* and *Fimbristylis ferruginea* (Species group D). Two sub-communities were recognised in this community.



Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Mariscus congestus - Arundinella nepalensis community

Acocks Veld Types

Cymbopogon - Themeda Veld (Sandy) (#48)
Highland Sourveld and Dohne Sourveld (#44)
Highland Sourveld to Cymbopogon - Themeda Transition (Eastern Free State Highveld) (#49)
Natal Sour Sandveld (#66)
Southern Tall Grassveld (#65)
Themeda Veld to Cymbopopogon - Themeda Veld Transition (Patchy) (#53)
Themeda - Festuca Alpine Veld (#58)
Valley Bushveld (#23)

Figure 8.4: Distribution of the Wetland VegetationType sample plots in Acocks Veld Types of the study area.

8.2.1 The *Sporobolus africanus - Paspalum dilatatum* sub-community

The vegetation of this sub-community occurs in the riverbeds in the central-eastern part of the study area. The *Sporobolus africanus - Paspalum dilatatum* sub-community is characterised by species group E and is distinguished from the *Schoenoplectus corymbosus - Fimbristylis ferruginea* sub-community by the presence of species group F and the absence of species group G (Table 8.1). Rocks are generally absent and soils are deep. The geology is representative of the Vryheid Formation, which weathers to a sandy-loam to clayey soil (Figure 8.5).

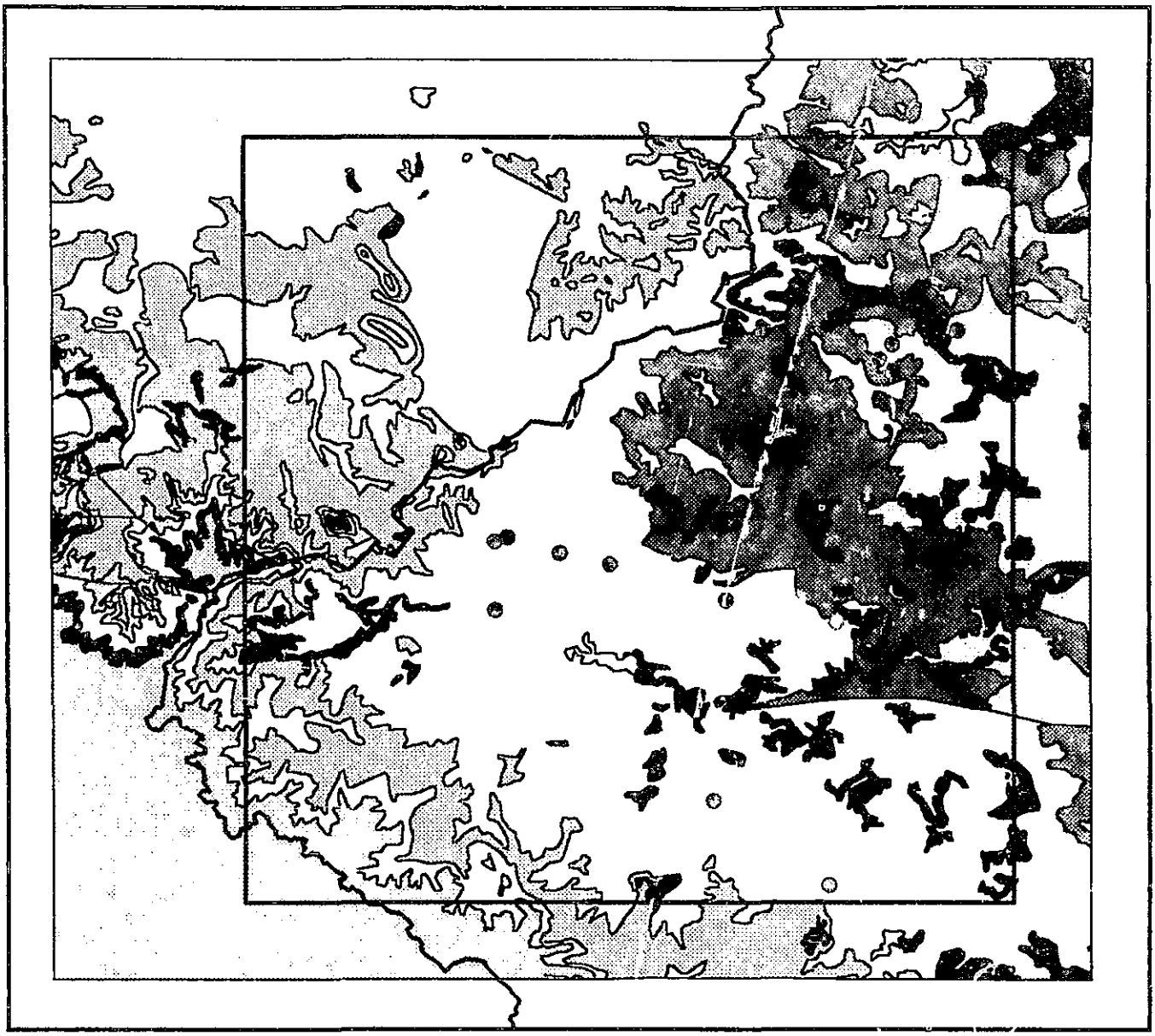
The presence of the woody species *Acacia karroo* (Species group F) and the grass *Paspalum dilatatum* (Species group H) is an indication that the clay content of the soil is higher than the soil present in the *Schoenoplectus corymbosus - Fimbristylis ferruginea* sub-community.

Species that are prominent in this sub-community include the grasses *Arundinella nepalensis, Imperata cylindrica, Hyparrhenia hirta* (Species group D), *Sporobolus africanus* (Species group E), *Paspalum dilatatum* (Species group H) and the forb *Mariscus congestus* (Species group D). The species composition of the *Sporobolus africanus - Paspalum dilatatum* sub-community indicates a wet habitat, but is not as waterlogged as the *Schoenoplectus corymbosus - Fimbristylis ferruginea* sub-community.

8.2.2 The *Schoenoplectus corymbosus - Fimbristylis ferruginea* sub-community

This sub-community is characterised by species group G, containing the diagnostic species *Schoenoplectus corymbosus, Persicaria lapathifolia, Paspalum urvillei* and *Juncus exertus* (Table 8.1). The presence of sedges like *Mariscus congestus, Fimbristylis ferruginea* (Species group D), *Schoenoplectus corymbosus* and the forb *Persicaria lapathifolia* (Species group G) indicate waterlogged conditions, permanently inundated with water. Sample plots representing this sub-community are located in riverbeds in the central and southern part of the study area. The geology conforms to the Beaufort Group. Rocks are absent and the soils are deep and sandy. The presence of the tree *Acacia*

sieberiana (Species group H), that is absent from the *Sporobolus africanus* - *Paspalum dilatatum* sub-community, gives an indication of the sandy character of the soil.



Ladysmith
Gridlines 28° - 29°S and 29° - 30°E
KwaZulu-Natal Boundary
Sample plots of the Mariscus congestus - Arundinella nepalensis community

Geological Formations

Beaufort
Clarens
Drakensberg
Karoo
Karoo Dolerite
Molteno
Tarkastad
Volksrust
Vryheid

N

Figure 8.5: Distribution of the Wetland Vegetation Type sample plots in geological formations of the study area.

Chapter 9: Conclusions

The application of the Braun-Blanquet technique, as applied by Behr & Bredenkamp (1988), Du Preez & Bredenkamp (1991) and Eckhardt (1993) in the present study area was proven to be successful. Results obtained with the subjective placement of sample plots proved to be successful in distinguishing between vegetation types and communities. Broad-scale stratification was based on Acocks (1988) and Low and Rebelo (1996). The lack of land type and geological data was limiting, but a comparison of results with previous studies proved favourable with other methods.

The validity of vegetation types, described by Low and Rebelo (1996) is confirmed, although some of the borders should be moved in order to accommodate variations in the vegetation. These differences were noted as the relevè data used in the present study provides more detailed information than the reconnaissance work of previous researchers.

The application of TWINSPAN proved to be successful in order to derive a first approximation of the data and environmental factors such as geology, rainfall and altitude verified the approximation. The use of Braun-Blanquet procedures to determine smaller variations in the broad communities is useful in spite of the lack of diagnostic species groups in some cases. In these cases a combination of species groups are used to describe a certain community. It can be concluded that successful results can be obtained with the proper application of the Braun-Blanquet and TWINSPAN techniques in combination with environmental factors such as rainfall, altitude, geology and topography.

Mapping of these vegetation types and communities will be possible as vegetation types correspond to Low and Rebelo vegetation types, although minor corrections must be made in some instances. In the case of the Woodland Vegetation Type, the distribution corresponds with Dolerite formations in the study area.

Various human influences affect the natural state of the vegetation of the study area, the main being utilisation by cattle, afforestation and other agricultural practises. While afforestation causes immediate and irreversible damage to the natural vegetation of an area, poorly practised agricultural practises and over-utilisation by cattle also have a long-term effect on the vegetation of an area. Natural factors influencing the vegetation include topography, rainfall, altitude and geology.

In the study area the main influence on the vegetation is utilisation by cattle. Prolonged periods of over-utilisation have caused severe damage to vegetation, in some cases to such an extent that secondary problems such as sheet and gully erosion is taking place. The midlands and footslopes of the Drakensberg mountains are areas where these effects are noted.

In the southwestern parts of the study area, where little or no relevès were compiled due to inaccessibility and time limitations an additional survey is proposed. In these areas the vegetation was noted to be different from the High Altitude Mountain Vegetation Type. A fynbos element seems to dominate in this vegetation and this difference can be ascribed to differences in climate and soil properties. In order to complete the knowledge of the high altitude grasslands it is imperative that these areas be sampled and classified.

Results pertinent to the vegetation of the present study area are discussed below under separate headings.

The High Altitude Mountain Vegetation Type

This vegetation type is predominantly a grassland area along the escarpment, but patches of natural forests occur in the sheltered gorges, ravines and valleys. The spreading of woody vegetation from the gorges and ravines into the open grassland appears to be restricted by fire (Tainton 1981). The grasslands are therefore considered fire-climax grasslands (Du Preez & Bredenkamp 1991). In the KwaZulu-Natal Drakensberg a relative high percentage of the grassland is conserved, but forest patches as opposed to

the grasslands are still regarded as relicts. This perception might change as evidence of the long history of grasslands becomes increasingly recognised. These evidence include fossil pollen evidence reported by Meadows and Linder (1993), which indicated that South African grasslands are at least 12 000 years old, with a high level of endemism which suggests a long evolutionary history.

The status of South African grasslands is often discussed and many grassland types are often considered as primary (O'Connor & Bredenkamp 1997) although the species composition and degraded state of the Open Thornveld Vegetation Type suggest that this is secondary. The secondary status could have been caused by the continued utilisation of the veld by previous local inhabitants who lived in this area and moved through the area many years ago.

In the *Monocymbium ceresiiforme - Alloteropsis semialata* community an average of 37 species were sampled in the sample plots. The *Cephalanthus natalensis - Trachypogon spicatus* variation has an average number of 48 species per sample plot of 100m². This is the highest average number of species per sample plot in the study area. This indicates a high alpha phytodiversity. Bredenkamp **et. al.** (1996) concluded that this is an area with many rare and endemic plant species, which are often threatened by the expanding forestry industry.

It seems that the *Monocymbium ceresiiforme - Andropogon schirensis* sub-community represents the Highland Sourveld (Acocks #44) and Wet Cold Highveld Grassland (Low & Rebelo #41) at high altitudes and rainfall. However, the *Monocymbium ceresiiforme - Cymbopogon excavatus* sub-community is situated at lower altitudes (though above 1 300 m a.m.s.l.) representing a transitional zone between the Highland Sourveld (Acocks #44) and Southern Tall Grassveld (#65) or Wet Cold Highveld Grassland (Low & Rebelo #41) and Natal Central Bushveld (25). This vegetation is not typical of the North-eastern Mountain Grassland (#43) indicated on the map of Low and Rebelo (1996).

Although moderate utilisation by cattle has caused some damage to the natural vegetation of this vegetation type, there are still some areas where the vegetation is representative of a natural state. As a result of the high species number per sample plot as well as the scenic beauty, these areas can be considered to have a high conservation status.

The Open Thornveld Vegetation Type

Located on the footslopes of the Drakensberg mountains at altitudes lower than 1 300 m a.m.s.l., the Open Thornveld Vegetation Type is present. This vegetation has been subjected to severe utilisation by cattle and, in some places, poor agricultural practises. This has caused the alteration of the natural vegetation in this area to the extent that several variations are recognised, as discussed in Chapter 6. This vegetation type covers the largest part of the study area. In this vegetation type the *Hyparrhenia anamesa - Hyparrhenia dregeana* and *Hyparrhenia hirta - Themeda triandra* communities have low average number of species per relevè, namely 25 and 26 respectively. These two communities have little woody species present and is representative of grasslands with evidence of moderate to severe utilisation.

The *Trachypogon spicatus - Diheteropogon amplectens* and *Diospyros lycioides - Eragrostis chloromelas* communities have respectively an average of 36 and 34 species per relevè. Utilisation is severe in these communities and this is evident in the high number of forb species present. This intensive utilisation created a limitation in the present study as sampling had to be carried out on smaller areas of apparently natural vegetation which might not be representative of the natural state of the grassland.

This vegetation is described by Granger (1996) as Natal Central Bushveld (#25), an open savanna with scattered tree species. Grasses such as *Hyparrhenia hirta, Themeda triandra* and *Cymbopogon excavatus* dominate this vegetation. As with the higher altitude grasslands of the Drakensberg, fires prevent the rapid spread of woody vegetation into the grasslands.

The Woodland Vegetation Type

Distributed in the central and eastern part of the study area are localised areas of Karoo Dolerite origin, forming dykes and sills. In these areas the vegetation has a characteristic physiognomy and is described as the Woodland Vegetation Type. The distribution of plant communities in this vegetation type is a reflection of the mosaic pattern of the dominant geological formation present in the Woodland Vegetation Type. This vegetation type is dominated by woody species such as *Maytenus heterophylla, Acacia sieberiana, Acacia karroo, Rhus pentheri, Diospyros lycioides* and *Euclea crispa.* However, in the case of the *Maytenus heterophylla - Acalypha angustata* community that is situated in the northern parts of the study area, the vegetation is transitional to grassland, the occurrence of woody species is limited to only a few species. This vegetation corresponds to the Southern Tall Grassveld (Acocks #65).

On the map of Low and Rebelo (1996) sample plots of the *Maytenus heterophylla - Acalypha angustata* community are located in North-eastern Mountain Grassland (#43) and Natal Central Bushveld (#25). This pattern is also reflected in the distribution area of the *Maytenus heterophylla - Rhus pentheri* community. Sample plots are located in Valley Bushveld (Acocks #25) and Southern Tall Grassveld (#65) or in the Natal Central Bushveld (Low & Rebelo #26) and Valley Thickets (#5). An average number of 43 species per relevè is noted in this community. The greater number of woody species in the Woodland Vegetation type is ascribed to the drier, warmer climate and the lower occurrence of frost.

In the *Maytenus heterophylla - Rhus pentheri* community, an average number of 40 species per relevè is noted. As this vegetation type is restricted to rocky hills in the central parts of the study area and in most cases not covering extensive areas, it can be assumed that transformation of this vegetation type is extreme.

The Thicket Vegetation Type

The Thicket Vegetation Type has an average number of 38 species per relevè. As it is situated at high altitudes in the Drakensberg mountains, associated with rocky slopes and ravines, it does not cover extensive areas. The possibility of severe damage to this vegetation type by means of careless fires and exploitation means that care must be taken to conserve as much of this vegetation type as possible. The spreading of this vegetation into the surrounding grasslands appears to be restricted by fire (Tainton 1981).

The Wetland Vegetation Type

An average number of 21 species per relevè is noted in this vegetation type. Severe damage is caused to these riparian communities as a result of utilisation and trampling by cattle. Regular flooding contributes to the disturbance of the vegetation and exotic species are often associated with this vegetation type.

The importance of wetland conservation is underlined by the phenomenon of different species composition of neighbouring marsh areas. This phenomenon is mentioned by Smit (1992) and Fuls (1993). Species diversity might thus be easily overlooked if one marsh is to be taken as representative of wetland species diversity. Other reasons for wetland conservation include their functions as water storage systems, stream flow regulators, flood attenuators, water purifiers, erosion control agents and specialised habitats for various animals (Begg 1986, Walmsley 1988).

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Species List

During the field survey a total of 97 families and 630 species were identified. They are numbered and listed according to Arnold and De Wet (1993).

PTERIDOPHYTA

EQUISETACEAE

0000050 **Equisetum** L.

0000050-100 **Equisetum ramosissimum** Desf.

DENNSTAEDTIACEAE

0000260 **Pteridium** Scop.

0000260-100 **Pteridium aquilinum** (L.) Kuhn

ADIANTACEAE

0000300 **Adiantum** L.

0000300-50 **Adiantum aethiopicum** L.

0000340 **Cheilanthes** Swartz

0000340-800 **Cheilanthes hirta** Swartz var. **hirta**

0000340-1480 **Cheilanthes quadripinnata** (Forssk.) Kuhn

0000340-1900 **Cheilanthes viridis** (Forssk.) Swartz var. **viridis**

0000360 **Pellaea** Link

0000360-200 **Pellaea calomelanos** (Swartz) Link var. **calomelanos**

ASPIDIACEAE

0000620 **Dryopteris** Adans.

0000620-300 **Dryopteris inaequalis** (Schlechtd.) Kuntze

0000660 **Rumohra** Raddi

0000660-100 **Rumohra adiantiformis** (G. Forst.) Ching

BLECHNACEAE

0000690 **Blechnum** L.

0000690-50 **Blechnum attenuatum** (Swartz) Mett. var. **attenuatum**

GYMNOSPERMAE

PODOCARPACEAE

0013000 **Podocarpus** l'Herit. ex Pers.

0013000-200 **Podocarpus falcatus** (Thunb.) R. Br. ex Mirb.

0013000-300 **Podocarpus henkelii** Stapf ex Dallim. & Jacks.

0013000-400 **Podocarpus latifolius** (Thunb.) R. Br. ex Mirb.

ANGIOSPERMAE
MONOCOTYLEDONAE

TYPHACEAE

0049000 Typha L.

0049000-20 **Typha capensis** (Rohrb.) N.E. Br.

POACEAE

9900100 Ischaemum L.

9900100-200 **Ischaemum fasciculatum** Brongn.

9900170 Urelytrum Hack.

9900170-100 **Urelytrum agropyroides** (Hack.) Hack.

9900280 Elionurus Kunth ex Willd.

9900280-100 **Elionurus muticus** (Spreng.) Kunth

9900370 Imperata Cyr.

9900370-50 **Imperata cylindrica** (L.) Raeuschel

9900380 Miscanthus Anderss.

9900380-500 **Miscanthus junceus** (Stapf) Pilg.

9900460 Sorghum Moench

9900460-300 **Sorghum bicolor** (L.) Moench subsp. **arundinaceum** (Desv.) de Wet & Harlan

9900530 Eulalia Kunth.

9900530-200 **Eulalia villosa** (Thunb.) Nees

9900630 Bothriochloa Kuntze

9900630-100 **Bothriochloa bladhii** (Retz.) S.T. Blake

9900630-150 **Bothriochloa insculpta** (A. Rich.) A. Camus

9900640 Dichanthium Willemet

9900640-100 **Dichanthium aristatum** (Poir.) C.E. Hubb.

9900710 Andropogon L.

9900710-200 **Andropogon appendiculatus** Nees

9900710-500 **Andropogon eucomus** Nees

9900710-1600 **Andropogon schirensis** A. Rich.

9900720 Cymbopogon Spreng.

9900720-200 **Cymbopogon excavatus** (Hochst.) Stapf ex Burtt Davy

9900720-400 **Cymbopogon plurinodis** (Stapf) Stapf ex Burtt Davy

9900720-600 **Cymbopogon validus** (Stapf) Stapf ex Burtt Davy

9900730 Hyparrhenia Fourn.

9900730-100 **Hyparrhenia anamesa** Clayton

9900730-300 **Hyparrhenia cymbaria** (L.) Stapf

9900730-500 **Hyparrhenia dregeana** (Nees) Stapf

9900730-1000 **Hyparrhenia hirta** (L.) Stapf

9900730-2100 **Hyparrhenia tamba** (Steud.) Stapf

	9900750 **Monocymbium** Stapf
9900750-100	**Monocymbium ceresiiforme** (Nees) Stapf
	9900780 **Trachypogon** Nees
9900780-100	**Trachypogon spicatus** (L. f.) Kuntze
	9900800 **Heteropogon** Pers.
9900800-100	**Heteropogon contortus** (L.) Roem. & Schult.
	9900810 **Diheteropogon** (Hack.) Stapf
9900810-100	**Diheteropogon amplectens** (Nees) Clayton
	9900830 **Themeda** Forssk.
9900830-100	**Themeda triandra** Forssk.
	9900890 **Digitaria** Haller
9900890-1000	**Digitaria diagonalis** (Nees) Stapf var. **diagonalis**
9900890-1400	**Digitaria eriantha** Steud.
9900890-2700	**Digitaria monodactyla** (Nees) Stapf
9900890-3370	**Digitaria sanguinalis** (L.) Scop.
9900890-4100	**Digitaria ternata** (A. Rich.) Stapf
9900890-4400	**Digitaria tricholaenoides** Stapf
	9900940 **Alloteropsis** C.B. Presl
9900940-250	**Alloteropsis semialata** (R. Br.) Hitchc. subsp. **semialata**
	9901040 **Brachiaria** (Trin.) Griseb.
9901040-700	**Brachiaria eruciformis** (J.E. Sm.) Griseb.
9901040-1700	**Brachiaria serrata** (Thunb.) Stapf
	9901070 **Paspalum** L.
9901070-100	**Paspalum dilatatum** Poir.
9901070-200	**Paspalum notatum** Fluegge
9901070-550	**Paspalum scrobiculatum** L.
9901070-600	**Paspalum urvillei** Steud.
	9901100 **Urochloa** Beauv.
9901100-400	**Urochloa mosambicensis** (Hack.) Dandy
9901100-500	**Urochloa panicoides** Beauv.
	9901120 **Echinochloa** Beauv.
9901120-100	**Echinochloa colona** (L.) Link
	9901160 **Panicum** L.
9901160-2800	**Panicum maximum** Jacq.
9901160-3100	**Panicum natalense** Hochst.
	9901280 **Setaria** Beauv.
9901280-1050	**Setaria incrassata** (Hochst.) Hack.
9901280-1500	**Setaria nigrirostris** (Nees) Dur. & Schinz
9901280-1800	**Setaria pallide-fusca** (Schumach.) Stapf & C.E. Hubb.
9901280-2500	**Setaria sphacelata** (Schumach.) Moss var. **sphacelata**
9901280-3200	**Setaria verticillata** (L.) Beauv.

	9901340 **Melinis** Beauv.
9901340-275	**Melinis repens** (Willd.) Zizka subsp. **repens**
	9901390 **Pennisetum** Rich.
9901390-1300	**Pennisetum sphacelatum** (Nees) Dur. & Schinz
9901390-1750	**Pennisetum unisetum** (Nees) Benth.
	9901590 **Leersia** Swartz.
9901590-200	**Leersia hexandra** Swartz
	9901730 **Arundinella** Raddi
9901730-100	**Arundinella nepalensis** Trin.
	9901740 **Tristachya** Nees
9901740-450	**Tristachya leucothrix** Nees
	9901751 **Loudetia** Steud.
9901751-300	**Loudetia flavida** (Stapf) C.E. Hubb.
9901751-600	**Loudetia simplex** (Nees) C.E. Hubb.
	9902140 **Phragmites** Adanson
9902140-100	**Phragmites australis** (Cav.) Steud.
	9902430 **Agrostis** L.
9902430-500	**Agrostis eriantha** Hack. var. **eriantha**
9902430-1050	**Agrostis montevidensis** Spreng. ex Nees
	9902620 **Aristida** L.
9902620-400	**Aristida bipartita** (Nees) Trin. & Rupr.
9902620-800	**Aristida congesta** Roem. & Schult. subsp. **barbicollis** (Trin. & Rupr.) de Winter
9902620-850	**Aristida congesta** Roem. & Schult. subsp. **congesta**
9902620-1300	**Aristida diffusa** Trin. subsp. **diffusa**
9902620-2000	**Aristida junciformis** Trin. & Rupr. subsp. **junciformis**
9902620-2100	**Aristida meridionalis** Henr.
9902620-2900	**Aristida scabrivalvis** Hack. subsp. **scabrivalvis**
	9902740 **Tragus** haller
9902740-100	**Tragus berteronianus** Schult.
9902740-400	**Tragus racemosus** (L.) All.
	9902830 **Sporobolus** R. Br.
9902830-200	**Sporobolus africanus** (Poir.) Robyns & Tournay
9902830-600	**Sporobolus centrifugus** (Trin.) Nees
9902830-1400	**Sporobolus fimbriatus** (Trin.) Nees
9902830-2700	**Sporobolus pyramidalis** Beauv.
9902830-3300	**Sporobolus stapfianus** Gand.
	9902860 **Eragrostis** Wolf
9902860-1500	**Eragrostis capensis** (Thunb.) Trin.
9902860-1700	**Eragrostis chloromelas** Steud.
9902860-2300	**Eragrostis curvula** (Schrad.) Nees
9902860-3200	**Eragrostis gummiflua** Nees
9902860-5800	**Eragrostis plana** Nees
9902860-6500	**Eragrostis pseudosclerantha** Chiov.

9902860-6700 **Eragrostis racemosa** (Thunb.) Steud.
9902860-7500 **Eragrostis sclerantha** Nees subsp. **sclerantha**
9902860-8100 **Eragrostis superba** Peyr.

9902940 Microchloa R. Br.
9902940-100 **Microchloa caffra** Nees

9902960 Cynodon Rich.
9902960-300 **Cynodon dactylon** (L.) Pers.

9902980 Harpochloa Kunth
9902980-100 **Harpochloa falx** (L. f.) Kuntze

9903010 Chloris Swartz
9903010-600 **Chloris virgata** Swartz

9903020 Eustachys Desv.
9903020-200 **Eustachys paspaloides** (Vahl) Lanza & Mattei

9903340 Pogonarthria Stapf
9903340-300 **Pogonarthria squarrosa** (Roem. & Schult.) Pilg.

9903530 Trichoneura N.J. Anderss.
9903530-200 **Trichoneura grandiglumis** (Nees) Ekman var. **grandiglumis**

9903740 Koeleria Pers.
9903740-50 **Koeleria capensis** (Steud.) Nees

9904170 Festuca L.
9904170-1000 **Festuca scabra** Vahl

9904280 Bromus L.
9904280-50 **Bromus catharticus** Vahl

CYPERACEAE
0459000 Cyperus L.
0459000-1900 **Cyperus esculentus** L.
0459000-2000 **Cyperus fastigiatus** Rottb.
0459000-4700 **Cyperus obtusiflorus** Vahl var. **obtusiflorus**
0459000-6400 **Cyperus rupestris** Kunth var. **rupestris**

0459030 Mariscus Gaertn.
0459030-500 **Mariscus congestus** (Vahl) C.B. Cl.
0459030-2900 **Mariscus squarrosus** (L.) C.B. Cl.

0462000 Kyllinga Rottb.
0462000-200 **Kyllinga alba** Nees

0467000 Fuirena Rottb.
0467000-1100 **Fuirena pubescens** (Poir.) Kunth

0468010 Schoenoplectus Palla
0468010-300 **Schoenoplectus corymbosus** (Roth. ex Roem. & Schult.) J. Raynal var. **corymbosus**

	0471000 **Fimbristylis** Vahl
0471000-600	**Fimbristylis ferruginea** (L.) Vahl
	0471010 **Bulbostylis** Kunth
0471010-400	**Bulbostylis burchellii** (Fical. & Hiern) C.B. Cl.
	0471020 **Abildgaardia** Vahl
0471020-150	**Abildgaardia ovata** (Burm. f.) Kral
	0512000 **Coleochloa** Gilly
0512000-300	**Coleochloa setifera** (Ridley) Gilly
	ARACEAE
	0748000 **Zantedeschia** Spreng.
0748000-200	**Zantedeschia albomaculata** (Hook.) Baill. subsp. **albomaculata**
	COMMELINACEAE
	0896000 **Commelina** L.
0896000-100	**Commelina africana** L. var. **africana**
0896000-700	**Commelina erecta** L.
	0904000 **Cyanotis** D. Don
0904000-500	**Cyanotis speciosa** (L. f.) Hassk.
	JUNCACEAE
	0936000 **Juncus** L.
0936000-1300	**Juncus exsertus** Buchen. subsp. **exsertus**
0936000-1700	**Juncus inflexus** L.
0936000-2300	**Juncus oxycarpus** E. Mey. ex Kunth
	ASPHODELACEAE
	0985010 **Trachyandra** Kunth
0985010-500	**Trachyandra asperata** Kunth var. **asperata**
0985010-4500	**Trachyandra reflexipilosa** (Kuntze) Oberm.
0985010-4800	**Trachyandra saltii** (Bak.) Oberm. var. **saltii**
	0989000 **Anthericum** L.
0989000-500	**Anthericum cooperi** Bak.
0989000-700	**Anthericum fasciculatum** Bak.
	ERIOSPERMACEAE
	1012000 **Eriospermum**
1012000	**Eriospermum spp.**
	ASPHODELACEAE
	1024000 **Kniphofia** Moench
1024000-1900	**Kniphofia galpinii** Bak.
	1026000 **Aloe** L.
1026000-1200	**Aloe bainesii** T. -Dyer
1026000-6600	**Aloe greatheadii** Schonl. var. **greatheadii**
1026000-9700	**Aloe marlothii** Berger subsp. **marlothii**

ALLIACEAE

1046000 Agapanthus l'Herit.

1046000-1600 **Agapanthus nutans** Leighton

HYACINTHACEAE

1086000 Scilla L.

1086000-300 **Scilla nervosa** (Burch.) Jessop

1088000 Eucomis l'Herit.

1088000-300 **Eucomis autumnalis** (Mill.) Chitt. subsp. **clavata** (Bak.) Reyneke

1090000 Drimiopsis Lindl.

1090000-200 **Drimiopsis burkei** Bak.

1090010 Ledebouria Roth.

1090010-300 **Ledebouria cooperi** (Hook. f.) Jessop

1090010-1100 **Ledebouria ovatifolia** (Bak.) Jessop

1090010-1200 **Ledebouria revoluta** (L. f.) Jessop

DRACAENACEAE

1110000 Sansevieria Thunb.

1110000-200 **Sansevieria hyacinthoides** (L.) Druce

ASPASRAGACEAE

1113010 Protasparagus Oberm.1

1113010 **Protasparagus spp.**

1113010-300 **Protasparagus africanus** (Lam.) Oberm.

1113010-3200 **Protasparagus laricinus** (Burch.) Oberm.

1113010-6600 **Protasparagus virgatus** (Bak.) Oberm.

AMARYLLIDACEAE

1167000 Haemanthus L.

1167000-1750 **Haemanthus humilis** Jacq. subsp. **hirsutus** (Bak.) Snijman

1167010 Scadoxus Raf.

1167010-400 **Scadoxus puniceus** (L.) Friis & Nordal

1168000 Boophane Herb.

1168000-100 **Boophane disticha** (L.f.) Herb.

1177000 Brunsvigia heist.

1177000-1100 **Brunsvigia natalensis** Bak.

1189000 Crinum L.

1189000-300 **Crinum bulbispermum** (Burm. f.) Milne-Redh. & Schweick.

1189000-1100 **Crinum graminicola** Verdoorn

HYPOXIDACEAE

1230000 Hypoxis L.

1230000-100 **Hypoxis acuminata** Bak.

1230000-300 **Hypoxis argentea** Harv. ex Bak. var. **argentea**

1230000-1800 **Hypoxis galpinii** Bak.

1230000-2100 **Hypoxis hemerocallidea** Fisch. & Mey.

1230000-2250 **Hypoxis iridifolia** Bak.

1230000-3000 **Hypoxis multiceps** Buchinger ex Bak.
1230000-3600 **Hypoxis oblonga** Nel
1230000-4200 **Hypoxis rigidula** Bak. var. **rigidula**

IRIDACEAE

1265000 Moraea Mill.
1265000-1520 **Moraea brevistyla** (Goldbl.) Goldbl.

1295000 Aristea Ait.
1295000-4200 **Aristea woodii** N.E. Br.

1301000 Hesperantha Ker-Gawl.
1301000-300 **Hesperantha baurii** Bak. subsp. **baurii**

1303000 Dierama K. Koch
1303000-1400 **Dierama medium** N.E. Br.

1311000 Gladiolus L.
1311000-3300 **Gladiolus crassifolius** Bak.
1311000-3550 **Gladiolus dalenii** van Geel
1311000-14100 **Gladiolus woodii** Bak.

ORCHIDACEAE

1428000 Brachycorythis Lindl.
1428000-600 **Brachycorythis tenuior** Reichb. f.

MYRICACEAE

1874000 Myrica L.
1874000-100 **Myrica brevifolia** E. Mey. ex C. DC.
1874000-1000 **Myrica serrata** Lam.

ULMACEAE

1898000 Celtis L.
1898000-100 **Celtis africana** Burm. f.

1902000 Trema Lour.
1902000-100 **Trema orientalis** (L.) Blume.

DICOTYLEDONAE

MORACEAE

1961000 Ficus L.
1961000-1500 **Ficus natalensis** Hochst. subsp. **natalensis**
1961000-2450 **Ficus thonningii** Blume

PROTEACEAE

2035000 Protea L.
2035000-1200 **Protea caffra** Meisn. subsp. **caffra**

SANTALACEAE

2118000 Thesium L.

2118000-2800 **Thesium costatum** A.W. Hill var. **costatum**

2118000-13500 **Thesium racemosum** Bernh.

2118000-16700 **Thesium utile** A.W. Hill

POLYGONACEAE

2195000 Rumex L.

2195000-1300 **Rumex sagittatus** Thunb.

2201000 Polygonum L.

2201000-1800 **Polygonum plebium** R. Br.

2201030 Persicaria Mill.

2201030-600 **Persicaria lapathifolia** (L.) S.F. Gray

CHENOPODIACEAE

2223000 Chenopodium L.

2223000-300 **Chenopodium ambrosioides** L.

AMARANTHACEAE

2299000 Amaranthus L.

2299000-800 **Amaranthus hybridus** L. subsp. **hybridus** var. **hybridus**

2309000 Kyphocarpa (Fenzl) Lopr.

2309000-100 **Kyphocarpa angustifolia** (Moq.) Lopr.

2312000 Cyathula Blume.

2312000-1000 **Cyathula uncinulata** (Schrad.) Schinz

2314000 Pupalia Juss.

2314000-200 **Pupalia lappacea** (L.) A. Juss. var. **lappacea**

2328000 Achyranthes L.

2328000-100 **Achyranthes aspera** L. var. **aspera**

2338000 Gomphrena L.

2338000-100 **Gomphrena celosioides** Mart.

AIZOACEAE

2376000 Limeum L.

2376000-3500 **Limeum viscosum** (Gay) Fenzl subsp. **viscosum** var. **viscosum**

MESEMBRYANTHEMACEAE

2405009 Aptenia N.E. Br.

2405009-100 **Aptenia cordifolia** (L.f.) Schwant. var. **cordifolia**

2405033 Delosperma N.E. Br.

2405033-3100 **Delosperma carolinense** N.E. Br. var. **carolinense**

ILLECEBRACEAE

2467000 Pollichia Ait.

2467000-100 **Pollichia campestris** Ait.

CARYOPHYLLACEAE

2490000 Silene L.

2490000-100 **Silene burchellii** otth var. **burchellii**

2502000 Dianthus L.

2502000-1600 **Dianthus mooiensis** F.N. Williams subsp. **mooiensis** var. **mooiensis**

RANUNCULACEAE

2541010 Knowltonia Salisb.

2541010 **Knowltonia spp.**

2542000 Clematis L.

2542000-100 **Clematis brachiata** Thunb.

2546000 Ranunculus L.

2546000-400 **Ranunculus multifidus** Forssk.

PAPAVERACEAE

2852000 Argemone L.

2852000-200 **Argemone ochroleuca** Sweet subsp. **ochraleuca**

BRASSICACEAE

2883000 Lepidium L.

2883000-100 **Lepidium africanum** (Burm. f.) DC. subsp. **africanum**

2965000 Rorippa Scop.

2965000-600 **Rorippa nudiuscula** Thell.

CAPPARACEAE

3082000 Cleome L.

3082000-1600 **Cleome monophylla** L.

3101000 Capparis L.

3101000-600 **Capparis tomentosa** Lam.

CRASSULACEAE

3166000 Kalanchoe Adans.

3166000-2700 **Kalanchoe rotundifolia** (Haw.) Haw.

3168000 Crassula L.

3168000-100 **Crassula acinaciformis** Schinz

3168000-300 **Crassula alba** Forssk. var. **alba**

3168000-9600 **Crassula dependens** H. Bol.

3168000-33600 **Crassula vaginata** Eckl. & Zeyh. subsp. **vaginata**

PITTOSPORACEAE

3252000 Pittosporum Banks ex Gaertn.

3252000-300 **Pittosporum viridiflorum** Sims

ROSACEAE

3333010 Pyracantha M.J. Roemer

3333010-200 **Pyracantha coccinea** M.J. Roem.

	3353000 Rubus L.
3353000-1300	**Rubus rigidus** J.E. Sm.
	3376000 Agrimonia L.
3376000-25	**Agrimonia bracteata** E. Mey. ex C.A. Mey.
	3379000 Leucosidea Eckl. & Zeyh.
3379000-100	**Leucosidea sericea** Eckl. & Zeyh.
	3388000 Cliffortia L.
3388000-5800	**Cliffortia linearifolia** Eckl. & Zeyh.
3388000-680	**Cliffortia nitidula** (Engl.) R.E. & Th. Fries jr. subsp. **pilosa** Weim.
	FABACEAE
	3446000 Acacia Mill.
3446000-90300	**Acacia ataxacantha** DC.
3446000-90700	**Acacia caffra** (Thunb.) Willd.
3446000-91500	**Acacia gerrardii** Benth. var. **gerrardii**
3446000-92300	**Acacia karroo** Hayne
3446000-92850	**Acacia mearnsii** de Wild.
3446000-93400	**Acacia nilotica** (L.) Willd. ex Del. subsp. **kraussiana** (Benth.) Brenan
3446000-94100	**Acacia robusta** Burch. subsp. **robusta**
3446000-94600	**Acacia sieberiana** DC. var. **woodii** (Burtt Davy) Keay & Brenan
3446000-95000	**Acacia tortilis** (Forssk.) Hayne subsp. **heteracantha** (Burch.) Brenan
	3452000 Dichrostachys (A. DC.) Wight & Arn.
3452000-600	**Dichrostachys cinerea** (L.) Wight & Arn. subsp. **nyassana** (Taub.) Brenan
	3467000 Elephantorrhiza Benth.
3467000-200	**Elephantorrhiza elephantina** (Burch.) Skeels
	3506000 Schotia Jacq.
3506000-300	**Schotia brachypetala** Sond.
	3536010 Chamaecrista Moench
3536010-600	**Chamaecrista comosa** E. Mey. var. **comosa**
3536010-1100	**Chamaecrista stricta** E. Mey.
	3607000 Calpurnia E. Mey.
3607000-100	**Calpurnia aurea** (Ait.) Benth. subsp. **aurea**
	3657000 Lotononis (DC.) Eckl. & Zeyh.
3657000-1800	**Lotononis calycina** (E. Mey.) Benth.
3657000-3400	**Lotononis eriantha** Benth.
3657000-3800	**Lotononis foliosa** H. Bol.
	3673000 Argyrolobium Eckl. & Zeyh.
3673000-2400	**Argyrolobium pauciflorum** Eckl. & Zeyh. var. **pauciflorum**
3673000-3900	**Argyrolobium tuberosum** Eckl. & Zeyh.
3673000-4100	**Argyrolobium velutinum** Eckl. & Zeyh.
	3688000 Medicago L.
3688000-670	**Medicago laciniata** (L.) Mill.

	3702000 Indigofera L.
3702000-1700	**Indigofera arrecta** Hochst. ex A. Rich.
3702000-7000	**Indigofera dregeana** E. Mey.
3702000-10500	**Indigofera hedyantha** Eckl. & Zeyh.
3702000-10800	**Indigofera hilaris** Eckl. & Zeyh.
3702000-15500	**Indigofera obscura** N.E. Br.
3702000-19000	**Indigofera sanguinea** N.E. Br.
3702000-21100	**Indigofera tenuissima** E. Mey.
3702000-23100	**Indigofera zeyheri** Spreng. ex Eckl. & Zeyh.
	3718000 Tephrosia Pers.
3718000-1200	**Tephrosia capensis** (Jacq.) Pers. var. **capensis**
3718000-5200	**Tephrosia natalensis** H.M. Forbes subsp. **natalensis**
	3747000 Sesbania Scop.
3747000-1200	**Sesbania punicea** (Cav.) Benth.
	3802000 Stylosanthes Swartz
3802000-100	**Stylosanthes fruticosa** (Retz.) Alston
	3804000 Zornia J.F. Gmel.
3804000-300	**Zornia linearis** E. Mey.
3804000-400	**Zornia milneana** Mohlenbr.
	3810000 Alysicarpus Desv.
3810000-300	**Alysicarpus rugosus** (Willd.) DC. subsp. **rugosus**
	3865000 Neorautanenia Schinz
3865000-300	**Neorautanenia ficifolius** (Benth.) C.A. Sm.
	3866000 Teramnus P. Br.
3866000-100	**Teramnus labialis** (L. f.) Spreng. subsp. **labialis**
	3870000 Erythrina L.
3870000-1100	**Erythrina zeyheri** Harv.
	3897000 Rhynchosia Lour.
3897000-1300	**Rhynchosia caribaea** (Jacq.) DC.
3897000-4600	**Rhynchosia nervosa** Benth. & Harv. var. **nervosa**
3897000-5700	**Rhynchosia reptabunda** N.E. Br.
3897000-7000	**Rhynchosia totta** (Thunb.) DC. var. **totta**
	3898000 Eriosema (DC.) G. Don
3898000-300	**Eriosema burkei** Benth.
3898000-400	**Eriosema cordatum** E. Mey.
	3907000 Sphenostylis E. Mey.
3907000-100	**Sphenostylis angustifolia** Sond.
	3909000 Lablab Adans.
3909000-200	**Lablab purpureus** (L.) Sweet subsp. **uncinatus** Verdc.
	3910020 Macrotyloma (Wight & Arn.) Verdc.
3910020-100	**Macrotyloma axillare** (E. Mey.) Verdc. var. **axillare**

GERANIACEAE

3924000 Geranium L.

3924000-1800 **Geranium schlechteri** Knuth

3925000 Monsonia L.

3925000-200 **Monsonia angustifolia** E. Mey. ex A. Rich.

3925000-300 **Monsonia attenuata** Harv.

3928000 Pelargonium l'Herit.

3928000-2400 **Pelargonium bowkeri** Harv.

3928000-9700 **Pelargonium luridum** (Andr.) Sweet

OXALIDACEAE

3936000 Oxalis L.

3936000-4500 **Oxalis corniculata** L.

3936000-5300 **Oxalis depressa** Eckl. & Zeyh.

3936000-18100 **Oxalis purpurascens** Salter

LINACEAE

3945000 Linum L.

3945000-400 **Linum thunbergii** Eckl. & Zeyh.

RUTACEAE

3991000 Zanthoxylum L.

3991000-100 **Zanthoxylum capense** (Thunb.) Harv.

3991000-200 **Zanthoxylum davyi** (Verdoorn) Waterm.

4076000 Vepris Comm. ex A. Juss.

4076000-150 **Vepris lanceolata** (Lam.) G. Don

4091000 Clausena Burm. f.

4091000-100 **Clausena anisata** (Willd.) Hook. f. ex Benth.

PTAEROXYLACEAE

4157000 Ptaeroxylon Eckl. & Zeyh.

4157000-100 **Ptaeroxylon obliquum** (Thunb.) Radlk.

MELIACEAE

4175000 Melia L.

4175000-100 **Melia azedarach** L.

POLYGALACEAE

4273000 Polygala L.

4273000-2900 **Polygala hottentotta** Presl

4273000-7300 **Polygala uncinata** E. Mey. ex Meisn.

EUPHORBIACEAE

4299000 Phyllanthus L.

4299000-200 **Phyllanthus burchellii** Muell. Arg.

4299000-1100 **Phyllanthus heterophyllus** E. Mey. ex Muell. Arg.

4299000-2100 **Phyllanthus parvulus** Sond.

	4407000 Acalypha L.
4407000-200	**Acalypha angustata** Sond. var. **glabra** Sond.
4407000-400	**Acalypha caperonioides** Baill.
4407000-900	**Acalypha glabrata** Thunb. var. **glabrata**
	4448000 Clutia L.
4448000-1600	**Clutia hirsuta** E. Mey. ex Sond. var. **hirsuta**
4448000-3200	**Clutia pulchella** L. var. **pulchella**
	4498000 Euphorbia L.
4498000-4300	**Euphorbia clavarioides** Boiss. var. **clavarioides**
4498000-6250	**Euphorbia damarana** Leach
4498000-13900	**Euphorbia ingens** E. Mey. ex Boiss.
4498000-22100	**Euphorbia pulvinata** Marloth
4498000-24900	**Euphorbia striata** Thunb. var. **striata**
	ANACARDIACEAE
	4594000 Rhus L.
4594000-800	**Rhus chirindensis** Bak. f
4594000-1500	**Rhus dentata** Thunb.
4594000-1700	**Rhus discolor** E. Mey. ex Sond.
4594000-2950	**Rhus gerrardii** (Harv. ex Engl.) Schonl.
4594000-3900	**Rhus lancea** L. f.
4594000-4200	**Rhus lucida** L.
4594000-4600	**Rhus microcarpa** Schonl.
4594000-5300	**Rhus pentheri** Zahlbr.
4594000-5600	**Rhus pyroides** Burch. var. **pyroides**
4594000-6100	**Rhus rigida** Mill.
	CELASTRACEAE
	4626000 Maytenus Molina
4626000-400	**Maytenus heterophylla** (Eckl. & Zeyh.) N.K.B. Robson
4626000-700	**Maytenus mossambicensis** (Klotzsch) Blakelock var. **mossambicensis**
4626000-1800	**Maytenus undata** (Thunb.) Blakelock
	ICACINACEAE
	4671000 Cassinopsis Sond.
4671000-100	**Cassinopsis ilicifolia** (Hochst.) Kuntze
	SAPINDACEAE
	4784000 Pappea Eckl. & Zeyh.
4784000-100	**Pappea capensis** Eckl. & Zeyh.
	4836000 Hippobromus Eckl. & Zeyh.
4836000-100	**Hippobromus pauciflorus** (L. f.) Radlk.
	GREYIACEAE
	4855000 Greyia Hook. & Harv.
4855000-300	**Greyia sutherlandii** Hook. & Harv.
	RHAMNACEAE
	4861000 Ziziphus Mill.
4861000-100	**Ziziphus mucronata** Willd. subsp. **mucronata**

4875000 Rhamnus L.

4875000-100 **Rhamnus prinoides** l'Herit.

VITACEAE

4917000 Rhoicissus Planch.

4917000-600 **Rhoicissus tridentata** (L. f.) Wild & Drum. subsp. **cuneifolia** (Eckl. & Zeyh.) N.R. Urton

4918000 Cissus L.

4918000-200 **Cissus cussonioides** Schinz

4918010 Cyphostemma (Planch.) Alston

4918010-600 **Cyphostemma cirrhosum** (Thunb.) Descoings ex Wild & Drum. subsp. **cirrhosum**

4918010-1400 **Cyphostemma humile** (N.E. Br.) Descoings ex Wild & Drum. subsp. **humile**

4918010-1800 **Cyphostemma lanigerum** (Harv.) Descoings ex Wild & Drum.

4918010-3300 **Cyphostemma sulcatum** (C.A. Sm.) J.J.M. v.d. Merwe

TILIACEAE

4953000 Corchorus L.

4953000-200 **Corchorus asplenifolius** Burch.

4953000-400 **Corchorus confusus** Wild

4957000 Sparrmannia L. f.

4957000-200 **Sparrmannia ricinocarpa** (Eckl. & Zeyh.) Kuntze

4966000 Grewia L.

4966000-1700 **Grewia occidentalis** L.

4966000-2600 **Grewia villosa** Willd.

MALVACEAE

4995000 Malvastrum A. Gray

4995000-100 **Malvastrum coromandelianum** (L.) Garcke

4998000 Sida L.

4998000-250 **Sida alba** L.

4998000-900 **Sida rhombifolia** L.

5002000 Anoda Cav.

5002000-100 **Anoda cristata** (L.) Schltr.

5007000 Pavonia Cav.

5007000-100 **Pavonia burchellii** (DC.) R.A. Dyer

5007000-1200 **Pavonia transvaalensis** (Ulbr.) A. Meeuse

5013000 Hibiscus L.

5013000-300 **Hibiscus aethiopicus** L. var. **ovatus** Harv.

5013000-3600 **Hibiscus microcarpus** Garcke

5013000-4300 **Hibiscus pusillus** Thunb.

5013000-5300 **Hibiscus trionum** L.

	STERCULIACEAE
	5053000 Dombeya Cav.
5053000-200	**Dombeya burgessiae** gerr. ex Harv.
5053000-300	**Dombeya cymosa** Harv.
5053000-600	**Dombeya rotundifolia** (Hochst.) Planch. var. **rotundifolia**
	5056000 Hermannia L.
5056000-3100	**Hermannia boraginiflora** Hook.
5056000-4300	**Hermannia coccocarpa** (Eckl. & Zeyh.) Kuntze
5056000-7100	**Hermannia depressa** N.E. Br.
5056000-10100	**Hermannia floribunda** Harv.
5056000-10700	**Hermannia geniculata** Eckl. & Zeyh.
5056000-12100	**Hermannia grandistipula** (Buchinger ex Hochst.) K. Schum.
5056000-15900	**Hermannia lancifolia** Szyszyl.
5056000-28700	**Hermannia transvaalensis** Schinz
	5059000 Waltheria L.
5059000-100	**Waltheria indica** L.
	OCHNACEAE
	5112000 Ochna L.
5112000-1300	**Ochna serrulata** (Hochst.) Walp.
	CLUSIACEAE
	5168000 Hypericum L.
5168000-100	**Hypericum aethiopicum** Thunb. subsp. **aethiopicum**
	FLACOURTIACEAE
	5304000 Scolopia Schreb.
5304000-200	**Scolopia mundii** (Eckl. & Zeyh.) Warb.
	5315000 Trimeria Harv.
5315000-100	**Trimeria grandifolia** (Hochst.) Warb.
	OLINIACEAE
	5428000 Olinia Thunb.
5428000-100	**Olinia emarginata** Burtt Davy
	THYMELAEACEAE
	5435000 Gnidia L.
5435000-150	**Gnidia anthylloides** (L. f.) Gilg.
5435000-320	**Gnidia caffra** (Meisn.) Gilg.
5435000-500	**Gnidia capitata** L. f.
5435000-2700	**Gnidia kraussiana** Meisn. var. **kraussiana**
5435000-3400	**Gnidia microcephala** Meisn.
5435000-4850	**Gnidia polyantha** Gilg.
5435000-5850	**Gnidia sericocephala** (Meisn.) Gilg ex Engl.
	5461000 Passerina L.
5461000	**Passerina spp.**
	5465000 Dais L.
5465000-100	**Dais cotinifolia** L.

COMBRETACEAE

5538000 Combretum Loefl.

5538000 **Combretum erythrophylium** (Burch.) Sond.

MYRTACEAE

5559000 Psidium L.

5559000-200 **Psidium guajava** L.

ONAGRACEAE

5795000 Epilobium L.

5795000-100 **Epilobium capense** Buch. ex Hochst.

5804000 Oenothera L.

5804000-450 **Oenothera indecora** Cambess. subsp. **bonariensis** Dietr.

5804000-900 **Oenothera rosea** l'Herit. ex Ait.

5804000-1100 **Oenothera tetraptera** Cav.

HALORAGACEAE

5836000 Gunnera L.

5836000-100 **Gunnera perpensa** L.

ARALIACEAE

5872000 Cussonia Thunb.

5872000-200 **Cussonia natalensis** Sond.

5872000-450 **Cussonia paniculata** Eckl. & Zeyh. subsp. **sinuata** (Reyneke & Kok) De Winter.

5872000-600 **Cussonia spicata** Thunb.

APIACEAE

5922000 Alepidea de la Roche

5922000-1750 **Alepidea longifolia** E. Mey. var. **angusta** Duemmer

5992000 Heteromorpha Cham. & Schlectd.

5992000-600 **Heteromorpha trifoliata** (Wendl.) Eckl. & Zeyh.

6033000 Pimpinella L.

6033000-300 **Pimpinella reenensis** Rech. f.

6038000 Sium L.

6038000-100 **Sium repandum** Welw. ex Hiern

6116000 Peucedanum L.

6116000-1700 **Peucedanum magalismontanum** Sond.

6116000-2300 **Peucedanum platycarpum** E. Mey. ex Sond.

ERICACEAE

6237000 Erica L.

6237000-19800 **Erica drakensbergensis** Guth. & Bol.

MYRSINACEAE

6313000 Myrsine L.

6313000-100 **Myrsine africana** L.

6314000 Rapanea Aubl.

6314000-100 **Rapanea melanophloeos** (L.) Mezz

EBENACEAE

6404000 **Euclea** Murray

6404000-400 **Euclea crispa** (Thunb.) Guerke subsp. **crispa**

6404000-1000 **Euclea natalensis** A. DC. subsp. **natalensis**

6406000 **Diospyros** L.

6406000-400 **Diospyros austro-africana** de Winter var. **rubriflora** (de Winter) de Winter.

6406000-1400 **Diospyros lycioides** Desf. subsp. **lycioides**

6406000-2900 **Diospyros whyteana** (Hiern) F. White

OLEACEAE

6428000 **Chionanthus** L.

6428000-200 **Chionanthus foveolatus** (E. Mey.) Stearn subsp. **foveolatus**

6434000 **Olea** L.

6434000-450 **Olea europaea** L. subsp. **africana** (Mill.) P.S. Green

6438000 **Menodora** Humb. & Bonpl.

6438000-100 **Menodora africana** Hook.

6440000 **Jasminum** L.

6440000 **Jasminum spp.**

LOGANIACEAE

6473000 **Buddleja** L.

6473000-100 **Buddleja auriculata** Benth.

6473000-600 **Buddleja saligna** Willd.

6473000-700 **Buddleja salviifolia** (L.) Lam.

GENTIANACEAE

6481000 **Sebaea** Soland. ex R. Br.

6481000-1500 **Sebaea filiformis** Schinz

6481000-1700 **Sebaea grandis** (E. Mey.) Steud.

6481000-2200 **Sebaea leiostyla** Gilg

6503000 **Chironia** L.

6503000-1200 **Chironia palustris** Burch. subsp. **palustris**

APOCYNACEAE

6558000 **Acokanthera** G. Don

6558000-200 **Acokanthera oppositifolia** (Lam.) Codd

6559000 **Carissa** L.

6559000-200 **Carissa bispinosa** (L.) Desf. ex Brenan subsp. **bispinosa**

6562020 **Ancylobotrys** Pierre

6562020-100 **Ancylobotrys capensis** (Oliv.) Pichon

ASCLEPIDACEAE

6777000 **Xysmalobium** R. Br.

6777000-1500 **Xysmalobium undulatum** (L.) Ait. f.

6778010 **Aspidoglossum** E. Mey.

6778010-1500 **Aspidoglossum lamellatum** (Schltr.) Kupicha

	6787010 Pachycarpus E. Mey.
6787010-2700	**Pachycarpus schinzianus** (Schltr.) N.E. Br.
	6791000 Asclepias L.
6791000-100	**Asclepias adscendens** (Schltr.) Schltr.
6791000-200	**Asclepias affinis** (Schltr.) Schltr.
6791000-700	**Asclepias brevipes** (Schltr.) Schltr.
6791000-900	**Asclepias burchellii** Schltr.
6791000-3100	**Asclepias fruticosa** L.
6791000-5700	**Asclepias stellifera** Schltr.
	6849000 Sarcostemma R. Br.
6849000-100	**Sarcostemma viminale** (L.) R. Br.
	6885000 Stapelia L.
6885000-6900	**Stapelia leendertziae** N.E. Br.
	6885070 Orbeopsis Leach
6885070-700	**Orbeopsis lutea** (N.E. Br.) Leach subsp. **lutea**
	688700 Huernia R. Br.
6887000-2300	**Huernia hystrix** (Hook. f.) N.E. Br. var. **hystrix**
	CONVOLVULACEAE
	6993000 Convolvulus L.
6993000-2050	**Convolvulus sagittatus** Thunb. subsp. **sagittatus** var. **sagittatus**
	7003000 Ipomoea L.
7003000-3300	**Ipomoea obscura** (L.) Ker-Gawl. var. **obscura**
7003000-4200	**Ipomoea purpurea** (L.) Roth
	7008010 Turbina Rafin.
7008010-100	**Turbina oblongata** (E. Mey. ex Choisy) A. Meeuse
	BORAGINACEAE
	7043000 Ehretia P. Br.
7043000-200	**Ehretia rigida** (Thunb.) Druce
	7064000 Cynoglossum L.
7064000-350	**Cynoglossum hispidum** Thunb.
	VERBENACEAE
	7138000 Verbena L.
7138000-200	**Verbena brasiliensis** L.
7138000-400	**Verbena tenuisecta** Briq.
7138000-500	**Verbena venosa** Gill. & Hook.
	7144000 Lantana L.
7144000-200	**Lantana camara** L.
7144000-600	**Lantana rugosa** Thunb.
	7145000 Lippia L.
7145000-100	**Lippia javanica** (Burm. f.) Spreng.

7148000 Plexipus Rafin.

7148000-100 **Plexipus adenostachyus** (Schauer) R. Fernandes

7148000-600 **Plexipus hederaceus** (Sond.) R. Fernandes var. **natalensis** (H. Pearson) R. Fernandes

7186000 Vitex L.

7186000-900 **Vitex rehmannii** Guerke

7191000 Clerodendrum L.

7191000-800 **Clerodendrum glabrum** E. Mey. var. **glabrum**

7191000-1500 **Clerodendrum ternatum** Schinz var. **ternatum**

7191000-1700 **Clerodendrum triphyllum** (Harv.) H. Pearson var. **triphyllum**

LAMIACEAE

7211000 Ajuga L.

7211000-100 **Ajuga ophrydis** Burch. ex Benth.

7212000 Teucrium L.

7212000-150 **Teucrium kraussii** Codd

7212000-200 **Teucrium trifidum** Retz.

7264000 Leonotis (Pers.) R. Br.

7264000-1620 **Leonotis ocymifolia** (Burm. f.) Iwarsson var. **raineriana** (Visiani) Iwarsson

7268000 Leucas Burm. ex R. Br.

7268000-200 **Leucas glabrata** (Vahl.) Sm. var. **glabrata**

7281000 Stachys L.

7281000-2600 **Stachys natalensis** Hochst. var. **natalensis**

7328000 Mentha L.

7328000-100 **Mentha aquatica** L.

7347000 Pycnostachys Hook.

7347000-200 **Pycnostachys reticulata** (E. Mey.) Benth.

7350000 Plectranthus l'Herit.

7350000-1600 **Plectranthus hereroensis** Engl.

7350000-1950 **Plectranthus madagascariensis** (Pers.) Benth. var. **ramosior** Benth.

7350000-3100 **Plectranthus spicatus** E. Mey. ex Benth.

7350030 Rabdosiella Codd

7350030-100 **Rabdosiella calycina** (Benth.) Codd

7359000 Syncolostemon E. Mey. ex Benth.

7359000-200 **Syncolostemon concinnus** N.E. Br.

7359000-900 **Syncolostemon rotundifolius** E. Mey. ex Benth.

7365000 Hemizygia (Benth.) Briq.

7365000-400 **Hemizygia canescens** (Guerke) Ashby

7366010 Becium Lindl.

7366010-290 **Becium obovatum** (Lam.) Pichi-Serm. var. **obovatum** (E. Mey. ex Benth.)

SOLANACEAE

7400000 Withania Pauquy

7400000-100 **Whithania somnifera** (L.) Dun.

7401000 Physalis L.

7401000-800 **Physalis viscosa** L.

7407000 Solanum L.

7407000-200 **Solanum aculeastrum** Dun.
7407000-2300 **Solanum elaeagnifolium** Cav.
7407000-2700 **Solanum giganteum** Jacq.
7407000-3200 **Solanum incanum** L.
7407000-4900 **Solanum panduriforme** E. Mey.
7407000-5000 **Solanum pseudocapsicum** L.
7407000-5300 **Solanum retroflexum** Dun.
7407000-5400 **Solanum rigescens** Jacq.
7407000-6400 **Solanum supinum** Dun.

7415000 Datura L.

7415000-600 **Datura stramonium** L.

SCROPHULARIACEAE

7493000 Halleria L.

7493000-200 **Halleria lucida** L.

7519000 Sutera Roth

7519000-1700 **Sutera aurantiaca** (Burch.) Hiern
7519000-2500 **Sutera caerulea** (L. f.) Hiern
7519000-9300 **Sutera polelensis** Hiern subsp. **polelensis**

7558000 Limosella L.

7558000-400 **Limosella grandiflora** Benth.
7558000-600 **Limosella maior** Diels

SELAGINACEAE

7568010 Walafrida E. Mey.

7568010-1000 **Walafrida densiflora** (Rolfe) Rolfe
7568010-3000 **Walafrida tenuifolia** Rolfe

7579000 Veronica L.

7579000-200 **Veronica anagallis-aquatica** L.

7597010 Alectra Thunb.

7597010-1870 **Alectra sessiliflora** (Vahl) Kuntze var. **sessiliflora**

7614000 Graderia Benth.

7614000-100 **Graderia scabra** (L. f.) Benth.
7614000-200 **Graderia subintegra** Mast.

7616000 Sopubia Buch.-Ham. ex D. Don

7616000-100 **Sopubia cana** Harv. var. **cana**

7622000 Buchnera L.

7622000-700 **Buchnera reducta** Hiern

7625000 Striga Lour.

7625000-100 **Striga asiatica** (L.) Kuntze
7625000-300 **Striga bilabiata** (Thunb.) Kuntze
7625000-450 **Striga elegans** Benth.
7625000-600 **Striga gesnerioides** (Willd.) Vatke ex Engl.

BIGNONIACEAE

7761000 Kigelia DC.

7761000-100 **Kigelia africana** (Lam.) Benth.

PEDALIACEAE

7778000 Ceratotheca Endl.

7778000-500 **Ceratotheca triloba** (Bernh.) Hook. f.

GESNERIACEAE

7823000 Streptocarpus Lindl.

7823000-1700 **Streptocarpus galpinii** Hook. f.
7823000-4800 **Streptocarpus vandeleurii** Bak. f. & S. Moore

ACANTHACEAE

7914000 Thunbergia Retz.

7914000-400 **Thunbergia atriplicifolia** E. Mey. ex Nees
7914000-1150 **Thunbergia neglecta** Sond.

7941000 Chaetacanthus Nees

7941000-100 **Chaetacanthus burchelli** Nees
7941000-300 **Chaetacanthus setiger** (Pers.) Lindl.

7972000 Crabbea Harv.

7972000-100 **Crabbea acaulis** N.E. Br.
7972000-200 **Crabbea angustifolia** Nees
7972000-300 **Crabbea hirsuta** Harv.

7973000 Barleria L.

7973000-3200 **Barleria obtusa** Nees

7980000 Blepharis Juss.

7980000-2840 **Blepharis integrifolia** (L. f.) E. Mey. ex Schinz var. **integrifolia**
7980000-3000 **Blepharis longispica** C.B. Cl.

8032000 Hypoestes Soland. ex R. Br.

8032000-200 **Hypoestes forskaolii** (Vahl) R. Br.

8094000 Justicia L.

8094000-100 **Justicia anagalloides** (Nees) T. Anders.

PLANTAGINACEAE

8116000 Plantago L.

8116000-500 **Plantago longissima** Decne.
8116000-1000 **Plantago virginica** L.

RUBIACEAE

8136060 **Kohautia** Cham. & Schlechtd.

8136060-100 **Kohautia amatymbica** Eckl. & Zeyh.
8136060-575 **Kohautia caespitosa** Schnizl. subsp. **brachyloba** (Sond.) D. Mantell
8136060-800 **Kohautia cynanchica** DC.
8136060-1600 **Kohautia virgata** (Willd.) Brem.

8136070 **Conostomium** Cuf.

8136070-100 **Conostomium natalense** (Hochst.) Brem. var. **glabrum** Brem.

8136200 **Oldenlandia** L.

8136200-750 **Oldenlandia herbacea** (L.) Roxb. var. **herbacea**

8230000 **Cephalanthus** L.

8230000-100 **Cephalanthus natalensis** Oliv.

8348000 **Pentanisia** Harv.

8348000-100 **Pentanisia angustifolia** (Hochst.) Hochst.
8348000-230 **Pentanisia prunelloides** (Klotzsch ex Eckl. & Zeyh.) Walp. subsp. **prunelloides**

8351000 **Vangueria** Juss.

8351000-400 **Vangueria infausta** Burch. subsp. **infausta**

8351020 **Pygmaeothamnus** Robyns

8351020-100 **Pygmaeothamnus chamaedendrum** (Kuntze) Robyns var. **chamaedendrum**
8351020-400 **Pygmaeothamnus zeyheri** (Sond.) Robyns var. **zeyheri**

8351030 **Tapiphyllum** Robyns

8351030-100 **Tapiphyllum parvifolium** (Sond.) Robyns

8352000 **Canthium** Lam.

8352000-100 **Canthium ciliatum** (Klotzsch) Kuntze
8352000-800 **Canthium mundianum** Cham. & Schlechtd.

8383000 **Pavetta** L.

8383000-2030 **Pavetta gardeniifolia** A. Rich. var. **gardeniifolia**
8383000-4300 **Pavetta zeyheri** Sond.

8438000 **Anthospermum** L.

8438000-1770 **Anthospermum rigidum** Eckl. & Zeyh. subsp. **pumilum** (Sond.) Puff

8464000 **Richardia** L.

8464000-100 **Richardia brasiliensis** Gomes

8475000 **Spermacoce** Gaertn.

8475000-100 **Spermacoce natalensis** Hochst.
8475000-300 **Spermacoce senensis** (Klotzsch) Hiern

DIPSACACEAE

8546000 **Scabiosa** L.

8546000-600 **Scabiosa columbaria** L.

	8599000 **Cucumis** L.
8599000-400	**Cucumis hirsutus** Sond.
8599000-1600	**Cucumis zeyheri** Sond.
	6280000 **Coccinia** Wight & Arn.
8628000-200	**Coccinia hirtella** Cogn.
	CAMPANULACEAE
	8668000 **Wahlenbergia** Schrad. ex Roth
8668000-5550	**Wahlenbergia huttonii** (Sond.) Thulin
8668000-5850	**Wahlenbergia krebsii** Cham. subsp. krebsii
8668000-13100	**Wahlenbergia undulata** (L.f.) A. DC.
	LOBELIACEAE
	8681000 **Cyphia** Berg.
8681000-1600	**Cyphia elata** Harv. var. **elata**
	8694000 **Lobelia** L.
8694000-550	**Lobelia angolensis** Engl. & Diels
8694000-4200	**Lobelia flaccida** (Presl) A. DC. subsp. **flaccida**
	8695000 **Monopsis** Salisb.
8695000-525	**Monopsis decipiens** (Sond.) Thulin
	ASTERACEAE
	8751000 **Vernonia** Schreb.
8751000-700	**Vernonia capensis** (Houtt.) Druce
8751000-2000	**Vernonia hirsuta** (DC.) Sch. Bip.
8751000-2400	**Vernonia natalensis** Sch. Bip. ex Walp.
8751000-2450	**Vernonia neocorymbosa** Hilliard
8751000-3000	**Vernonia oligocephala** (DC.) Sch. Bip. ex Walp.
8751000-3075	**Vernonia poskeana** Vatke & Hildebr. subsp. **botswanica** Pope
	8900000 **Aster** L.
8900000-2000	**Aster peglerae** H. Bol.
8900000-2500	**Aster squamatus** (Spreng.) Hieron.
	8919000 **Felicia** Cass.
8919000-3600	**Felicia elongata** (Thunb.) O. Hoffm.
8919000-6900	**Felicia muricata** (Thunb.) Nees subsp. **muricata**
	8925000 **Nidorella** Cass.
8925000-1500	**Nidorella resedifolia** DC. subsp. **resedifolia**
	8926000 **Conyza** Less.
8926000-300	**Conyza bonariensis** (L.) Cronq.
8926000-500	**Conyza chilensis** Spreng.
8926000-1200	**Conyza obscura** DC.
8926000-1600	**Conyza podocephala** DC.
8926000-1625	**Conyza scabrida** DC.
	8936000 **Brachylaena** R. Br.
8936000-200	**Brachylaena elliptica** (Thunb.) DC.

	8937000 Tarchonanthus L.
8937000-100	**Tarchonanthus camphoratus** L.
	8992050 Pseudognaphalium Kirp.
8992050-200	**Pseudognaphalium oligandrum** (DC.) Hilliard & Burtt
	9006000 Helichrysum Mill.
9006000-100	**Helichrysum adenocarpum** DC. subsp. **adenocarpum**
9006000-1800	**Helichrysum athrixiifolium** (Kuntze) Moeser
9006000-1950	**Helichrysum auriceps** Hilliard
9006000-2870	**Helichrysum cephaloideum** DC.
9006000-3600	**Helichrysum cooperi** Harv.
9006000-3700	**Helichrysum coriaceum** Harv.
9006000-4350	**Helichrysum dasymallum** Hilliard
9006000-7200	**Helichrysum glomeratum** Klatt
9006000-7750	**Helichrysum herbaceum** (Andr.) Sweet
9006000-8100	**Helichrysum hypoleucum** Harv.
9006000-8360	**Helichrysum interjacens** Hilliard
9006000-10900	**Helichrysum miconiifolium** DC.
9006000-12100	**Helichrysum nudifolium** (L.) Less.
9006000-13100	**Helichrysum oreophilum** Klatt
9006000-13370	**Helichrysum pallidum** DC.
9006000-14130	**Helichrysum pilosellum** (L. f.) Less.
9006000-15900	**Helichrysum rugulosum** Less.
9006000-16900	**Helichrysum setosum** Harv.
9006000-18270	**Helichrysum subluteum** Burtt Davy
9006000-19900	**Helichrysum umbraculigerum** Less.
	9037000 Stoebe L.
9037000-3300	**Stoebe vulgaris** Levyns
	9043000 Metalasia R. Br.
9043000-1010	**Metalasia densa** (Lam.) Karis
	9055000 Athrixia Ker-Gawl.
9055000-500	**Athrixia elata** Sond.
9055000-900	**Athrixia phylicoides** DC.
	9090000 Geigeria griesselich
9090000-1200	**Geigeria burkei** Harv. subsp. **diffusa** (Harv.) Merxm.
	9094000 Callilepis DC.
9094000-600	**Callilepis leptophylla** Harv.
	9130000 Acanthospermum Schrank
9130000-100	**Acanthospermum australe** (Loefl.) Kuntze
	9148000 Xanthium L.
9148000-100	**Xanthium spinosum** L.
9148000-200	**Xanthium strumarium** L.
	9155000 Zinnia L.
9155000-200	**Zinnia peruviana** (L.) L.

	9232000 **Chrysanthellum** Rich.
9232000-100	**Chrysanthellum indicum** DC.
	9237000 **Bidens** L.
9237000-300	**Bidens formosa** (Bonato) Sch. Bip.
9237000-500	**Bidens pilosa** L.
	9291000 **Schkuhria** Roth
9291000-100	**Schkuhria pinnata** (Lam.) Cabr.
	9311000 **Tagetes** L.
9311000-200	**Tagetes minuta** L.
	9326010 **Inulanthera** Kallersjo
9326010-100	**Inulanthera calva** (Hutch.) Kallersjo
	9336000 **Phymaspermum** Less. emend. Kallersjo
9336000-50	**Phymaspermum acerosum** (DC.) Kallersjo
	9356000 **Schistostephium** Less.
9356000-200	**Schistostephium crataegifolium** (DC.) Fenzl ex Harv.
9356000-500	**Schistostephium griseum** (Harv.) Hutch.
	9358000 **Artemisia** L.
9358000-300	**Artemesia afra** Jacq. ex Willd.
	9406000 **Cineraria** L.
9406000-2200	**Cineraria lyrata** DC.
	9411000 **Senecio** L.
9411000-500	**Senecio achilleifolius** DC.
9411000-1000	**Senecio affinis** DC.
9411000-1950	**Senecio anomalochrous** Hilliard
9411000-3600	**Senecio brevidentatus** M.D. Henderson
9411000-5900	**Senecio conrathii** N.E. Br.
9411000-6300	**Senecio coronatus** (Thunb.) Harv.
9411000-9100	**Senecio erubescens** Ait. var. **crepidifolius** DC.
9411000-11650	**Senecio gregatus** Hilliard
9411000-12000	**Senecio harveianus** Macowan
9411000-12600	**Senecio hieracioides** DC.
9411000-13100	**Senecio inaequidens** DC.
9411000-13500	**Senecio inornatus** DC.
9411000-13700	**Senecio isatideus** DC.
9411000-27500	**Senecio venosus** Harv.
	9417000 **Euryops** Cass.
9417000-9100	**Euryops transvaalensis** Klatt subsp. **setilobus** (N.E. Br.) B. Nord.
	9427020 **Chrysanthemoides** Tourn. ex Medik.
9427020-100	**Chrysanthemoides monilifera** (L.) T. Norl. subsp. **canescens** (DC.) T. Norl.
	9431000 **Ursinia** Gaertn.
9431000-2500	**Ursinia nana** DC. subsp. **nana**

	9432030 Haplocarpha Less.
9432030-200	**Haplocarpha lyrata** Harv.
9432030-500	**Haplocarpha scaposa** Harv.
	9438000 Berkheya Ehrh.
9438000-3300	**Berkheya echinacea** (Harv.) O. Hoffm. ex Burtt Davy subsp. **echinacea**
9438000-6500	**Berkheya radula** (Harv.) De Wild.
9438000-7050	**Berkheya rhapontica** (DC.) Hutch. & Burtt Davy subsp. **rhapontica**
9438000-7600	**Berkheya setifera** DC.
9438000-7700	**Berkheya speciosa** (DC.) O. Hoffm. subsp. **lanceolata** Roessl.
9438000-9400	**Berkheya zeyheri** (Sond. & Harv.) Oliv. & Hiern subsp. **zeyheri**
	9462000 Cirsium Mill. emend. Scop.
9462000-200	**Cirsium vulgare** (Savi) Ten.
	9501000 Dicoma Cass.
9501000-100	**Dicoma anomala** Sond.
9501000-1100	**Dicoma macrocephala** DC.
9501000-2700	**Dicoma zeyheri** Sond. subsp. **zeyheri** FP
	9528000 Gerbera L.
9528000-900	**Gerbera jamesonii** H. Bol. ex Adlam
9528000-1250	**Gerbera piloselloides** (L.) Cass.
	9561000 Tolpis Adans.
9561000-100	**Tolpis capensis** (L.) Sch. Bip.
	9572000 Hypochoeris L.
9572000-400	**Hypochoeris radicata** L.
	9593000 Launaea Cass.
9593000-300	**Launaea rarifolia** (Oliv. & Hiern) L. Boulos
	9595000 Sonchus L.
9595000-100	**Sonchus asper** (L.) Hill subsp. **asper**
9595000-300	**Sonchus dregeanus** DC.
9595000-600	**Sonchus integrifolius** Harv. var. **integrifolius**
9595000-900	**Sonchus nanus** Sond. ex Harv.
9595000-1200	**Sonchus wilmsii** R.E. Fr.
	9596000 Lactuca L.
9596000-100	**Lactuca capensis** Thunb.
	9605000 Crepis L.
9605000-200	**Crepis hypochoeridea** (DC.) Thell.

Sample plots and Coordinates

Rel.	Lat. (S)	Lon. (E)	Rel.	Lat. (S)	Lon. (E)
1	28° 22' 40"	29° 59' 35"	2	28° 23' 56"	29° 58' 08"
3	28° 25' 43"	29° 38' 50"	4	28° 25' 27"	29° 58' 50"
5	28° 25' 42"	29° 58' 0[illegible]"	6	28° 25' 12"	29° 58' 23"
7	28° 25' 12"	29° 58' 02"	8	28° 26' 39"	29° 58' 05"
9	28° 28' 39"	29° 57' 23"	10	28° 27' 14"	29° 58' 35"
11	28° 25' 38"	29° 56' 12"	12	28° 26' 55"	29° 54' 07"
13	28° 27' 48"	29° 53' 55"	14	28° 29' 04"	29° 51' 39"
15	28° 28' 56"	29° 52' 48"	16	28° 30' 38"	29° 54' 07"
17	28° 30' 46"	29° 54' 20"	18	28° 31' 03"	29° 54' 36"
19	28° 31' 15"	29° 55' 18"	20	28° 33' 56"	29° 55' 06"
21	28° 31' 12"	29° 57' 46"	22	28° 31' 04"	29° 57' 27"
23	28° 31' 04"	29° 58' 00"	24	28° 30' 54"	29° 58' 12"
25	28° 30' 38"	29° 58' 12"	26	28° 32' 17"	29° 58' 42"
27	28° 32' 35"	29° 59' 00"	28	28° 29' 20"	29° 58' 46"
29	28° 30' 20"	29° 55' 46"	30	28° 31' 26"	29° 56' 46"
31	28° 33' 00"	29° 57' 09"	32	28° 32' 46"	29° 57' 07"
33	28° 33' 02"	29° 57' 32"	34	28° 29' 17"	29° 56' 01"
35	28° 29' 32"	29° 56' 00"	36	28° 29' 30"	29° 56' 21"
37	28° 29' 32"	29° 57' 08"	38	28° 30' 00"	29° 56' 59"
39	28° 30' 06"	29° 57' 00"	40	28° 30' 12"	29° 56' 32"
41	28° 30' 22"	29° 57' 27"	42	28° 29' 48"	29° 58' 14"
43	28° 33' 47"	29° 56' 27"	44	28° 33' 55"	29° 56' 18"
45	28° 33' 48"	29° 55' 04"	46	28° 33' 48"	29° 54' 59"
47	28° 34' 15"	29° 53' 39"	48	28° 33' 43"	29° 52' 18"
49	28° 33' 49"	29° 52' 34"	50	28° 33' 22"	29° 51' 34"
51	28° 33' 24"	29° 51' 41"	52	28° 33' 30"	29° 51' 25"
53	28° 33' 38"	29° 51' 33"	54	28° 33' 43"	29° 51' 44"
55	28° 33' [illegible]	29° 51' 26"	56	28° 33' 52"	29° 51' 04"
57	28° 32' 37"	29° 52' 44"	58	28° 32' 42"	29° 52' 44"
59	28° 32' 49"	29° 52' 00"	60	28° 30' 56"	29° 54' 05"
61	28° 31' 09"	29° 54' 03"	62	28° 31' 21"	29° 53' 36"
63	28° 31' 05"	29° 52' 34"	64	28° 31' 22"	29° 52' 45"
65	28° 31' 37"	29° 52' 56"	66	28° 32' 18"	29° 52' 09"
67	28° 32' 30"	29° 50' 50"	68	28° 24' 06"	29° 56' 34"
69	28° 23' 36"	29° 57' 46"	70	28° 22' 20"	29° 58' 45"
71	28° 22' 21"	29° 58' 46"	72	28° 22' 34"	29° 58' 54"
73	28° 22' 57"	29° 57' 01"	74	28° 21' 00"	29° 58' 06"
75	28° 18' 40"	29° 59' 06"	76	28° 18' 40"	29° 59' 04"
77	28° 18' 33"	29° 59' 00"	78	28° 17' 42"	29° 59' 31"
79	28° 17' 50"	29° 58' 14"	80	28° 16' 35"	29° 58' 13"
81	28° 15' 24"	29° 59' 24"	82	28° 15' 36"	29° 59' 17"
83	28° 13' 59"	29° 58' 26"	84	28° 13' 53"	29° 58' 35"
85	28° 12' 58"	29° 57' 51"	86	28° 12' 50"	29° 57' 46"
87	28° 12' 42"	29° 57' 40"	88	28° 12' 09"	29° 58' 07"
89	28° 11' 53"	29° 58' 06"	90	28° 10' 39"	29° 58' 07"
91	28° 10' 52"	29° 58' 21"	92	28° 11' 00"	29° 58' 02"

Rel.	Lat. (S)	Lon. (E)	Rel.	Lat. (S)	Lon. (E)
93	28° 27' 04"	29° 49' 01"	94	28° 25' 50"	29° 48' 35"
95	28° 25' 54"	29° 48' 33"	96	28° 25' 48"	29° 49' 06"
97	28° 25' 05"	29° 49' 30"	98	28° 25' 15"	29° 49' 20"
99	28° 25' 10"	29° 48' 03"	100	28° 23' 12"	29° 48' 31"
101	28° 23' 21"	29° 48' 34"	102	28° 23' 57"	29° 46' 56"
103	28° 23' 42"	29° 46' 14"	104	28° 23' 32 "	29° 46' 00"
105	28° 23' 16"	29° 45' 32"	106	28° 22' 42"	29° 45' 50"
107	28° 21' 59"	29° 43' 45"	108	28° 19' 39"	29° 45' 17"
109	28° 19' 40"	29° 45' 17"	110	28° 22' 09"	29° 45' 23"
111	28° 25' 17"	29° 47' 43"	112	28° 26' 27"	29° 53' 22"
113	28° 26' 48"	29° 52' 37"	114	28° 27' 38"	29° 51' 56"
115	28° 27' 37"	29° 51' 58"	116	28° 27' 33"	29° 52' 07"
117	28° 28' 13"	29° 50' 55"	118	28° 28' 12"	29° 50' 55"
119	28° 28' 17"	29° 51' 10"	120	28° 28' 19"	29° 48' 12"
121	28° 28' 20"	29° 51' 16"	122	28° 32' 17"	29° 51' 25"
123	28° 12' 46"	29° 57' 24"	124	28° 12' 45"	29° 57' 07"
125	28° 12' 48"	29° 57' 36"	126		
127			128		
129			130		
131			132		
133	28° 15' 01"	29° 55' 42"	134	28° 15' 02"	29° 55' 37"
135	28° 15' 02"	29° 55' 37"	136	28° 14'38"	29° 54' 17"
137	28° 14' 38"	29° 54' 17"	138	28° 14' 40"	29° 54' 18"
139	28° 14' 56"	29° 53' 07"	140	28° 15' 25"	29° 50' 56"
141	28° 15' 29"	29° 50' 55"	142	28° 15' 31"	29° 50' 56"
143	28° 15' 35"	29° 56' 46"	144	28° 15' 31"	29° 56' 47"
145	28° 14' 19"	29° 54' 51"	146	28° 14' 27"	29° 54' 40"
147	28° 15' 58"	29° 50' 47"	148	28° 16' 38"	29° 50' 48"
149	28° 16' 08"	29° 50' 43"	150	28° 15' 44"	29° 50' 57"
151	28° 21' 44"	29° 55' 51"	152	28° 21' 44"	29° 55' 51"
153	28° 19' 51"	29° 54' 05"	154	28° 19' 51"	29° 54' 05"
155	28° 18' 39"	29° 51' 30"	156	28° 18' 39"	29° 51' 30"
157	28° 16' 16"	29° 49' 55"	158	28° 16' 16"	29° 49' 55"
159	28° 18' 13"	29° 50' 54"	160	28° 18' 13"	29° 50' 54"
161	28° 15' 57"	29° 48' 06"	162	28° 15' 57"	29° 48' 06"
163	28° 15' 39"	29° 47' 00"	164	28° 15' 39"	29° 47' 00"
165	28° 14' 55"	29° 44' 52"	166	28° 14' 55"	29° 44' 52"
167	28° 13' 54"	29° 43' 10"	168	28° 13' 54"	29° 43' 10"
169	28° 14' 03"	29° 32' 37"	170	28° 14' 03"	29° 32' 37"
171	28° 14' 05"	29° 41' 23"	172	28° 14' 05"	29° 41' 23"
173	28° 13' 32"	29° 40' 06"	174	28° 13' 39"	29° 39' 12"
175	28° 13' 39"	29° 39' 12"	176	28° 13' 02"	29° 38' 24"
177	28° 13' 02"	29° 38' 24"	178	28° 13' 02"	29° 38' 24"
179	28° 12' 54"	29° 37' 55"	180	28° 12' 54'	29° 37' 55"
181	28° 12' 28"	29° 36' 56"	182	28° 12' 28"	29° 36' 56"
183	28° 12' 20"	29° 37' 27"	184		
185	28° 14' 48"	29° 40' 53"	186	28° 14' 48"	29° 40' 53"
187	28° 15' 03"	29° 40' 18"	188	28° 15' 3"	29° 40' 18"
189	28° 15' 19"	29° 40' 30"	190	28° 15' 19"	29° 40' 30"

Rel.	Lat. (S)	Lon. (E)	Rel.	Lat. (S)	Lon. (E)
191	28° 16' 04"	29° 40' 10"	192	28° 16' 04"	29° 40' 10"
193	28° 16' 04"	29° 40' 10"	194	28° 16' 27"	29° 39' 25"
195	28° 16' 27"	29° 39' 25"	196	28° 16' 50"	29° 38' 32"
197	28° 16' 50"	29° 38' 32"	198	28° 18' 53"	29° 36' 40"
199	28° 18' 53"	29° 36' 40"	200	28° 19' 36"	29° 36' 2
201	28° 19' 36"	29° 36' 24"	202	28° 20' 12"	29° 35' 45"
203	28° 20' 12"	29° 35' 45"	204	28° 20' 44"	29° 35' 34"
205	28° 20' 44"	29° 35' 34"	206	28° 21' 23"	29° 34' 15"
207	28° 21' 23"	29° 34' 15"	208	28° 19' 39"	29° 32' 07"
209	28° 21' 23"	29° 34' 15"	210	28° 19' 18"	29° 31' 29"
211	28° 19' 39"	29° 32' 07"	212	28° 18' 52"	29° 30' 06"
213	28° 19' 18"	29° 31' 29"	214	28° 18' 20"	29° 29' 31"
215	28° 18' 52"	29° 30' 06"	216	28° 18' 00"	29° 28' 54"
217	28° 18' 20"	29° 29' 51"	218	28° 18' 33"	29° 29' 55"
219	28° 18' 00"	29° 28' 56"	220	28° 18' 33"	29° 29' 55"
221	28° 18' 33"	29° 29' 55"	222	28° 22' 23"	29° 35' 39"
223	28° 22' 23"	29° 35' 39"	224	28° 23' 26"	29° 36' 55"
225	28° 23' 26"	29° 36' 55"	226	28° 24' 15"	29° 37' 33"
227	28° 24' 15"	29° 37' 33"	228	28° 26' 09"	29° 38' 08"
229	28° 26' 09"	29° 38' 08"	230	28° 24' 48"	29° 40' 04"
231	28° 24' 48"	29° 40' 04"	232	28° 30' 38"	29° 41' 55"
233	28° 30' 38"	29° 41' 55"	234	28° 31' 32"	29° 39' 15"
235	28° 31' 32"	29° 39' 15"	236	28° 23' 30"	29° 23' 42"
237	28° 23' 30"	29° 23' 42"	238	28° 23' 14"	29° 53' 29"
239	28° 23' 14"	29° 53' 29"	240	28° 23' 00"	29° 24' 56"
241	28° 23' 00"	29° 24' 56"	242	28° 22' 46"	29° 25' 10"
243	28° 22' 52'	29° 25' 58"	244	28° 22' 52"	29° 25' 58"
245	28° 22' 47"	29° 28' 01"	246	28° 22' 47"	29° 28' 01"
247	28° 29' 39"	29° 29' 48"	248	28° 29' 39"	29° 29' 48"
249	28° 24' 14"	29° 34' 16"	250	28° 24' 14"	29° 34' 16"
251	28° 25' 33"	29° 36' 46"	252	28° 25' 33"	29° 36' 46"
253	28° 26' 12"	29° 37' 50"	254	28° 26' 12"	29° 37' 50"
255	28° 28' 39"	29° 32' 16"	256	28° 28' 39"	29° 32' 16"
257	28° 27' 03"	29° 28' 16"	258	28° 27' 03"	29° 28' 16"
259	28° 29' 15"	29° 26' 17"	260	28° 29' 15"	29° 26' 17"
261	28° 30' 42"	29° 26' 55"	262	28° 30' 42"	29° 26' 55"
263	28° 03' 08"	29° 58' 06"	264	28° 03' 08"	29° 58' 06"
265	28° 03' 44"	29° 56' 50"	266	28° 03' 44"	29° 56' 50"
267	28° 04' 21"	29° 56' 13"	268	28° 04' 21"	29° 56' 13"
269	28° 04' 40"	29° 55' 37"	270	28° 04' 40"	29° 55' 37"
271	28° 03' 21"	29° 55' 17"	272	28° 03' 21"	29° 55' 17"
273	28° 01' 52"	29° 54' 44"	274	28° 01' 52"	29° 54' 44"
275	28° 04' 24"	29° 52' 26"	276	28° 04' 24"	29° 52' 26"
277	28° 02' 36"	29° 51' 41"	278	28° 02' 36"	29° 51' 41"
279	28° 03' 52"	29° 48' 25"	280	28° 03' 52"	29° 48' 25"
281	28° 03' 45"	29° 46' 52"	282	28° 03' 45"	29° 46' 52"
283	28° 02' 18"	29° 47' 19"	284	28° 02' 18"	29° 47' 19"
285	28° 00' 49"	29° 44' 42"	286	28° 00' 49"	29° 44' 42"
287	28° 00' 54"	29° 44' 02"	288	28° 00' 54"	29° 44' 02"
289	28° 05' 25"	29° 54' 53"	290	28° 05' 25"	29° 54' 53"

Rel.	Lat. (S)	Lon. (E)	Rel.	Lat. (S)	Lon. (E)
291	28° 07' 58"	29° 53' 05"	292	28° 07' 58"	29° 53' 05"
293	28° 10' 43"	29° 52' 41"	294	28° 10' 43"	29° 52' 41"
295	28° 08' 48"	29° 53' 24"	296	28° 08' 48"	29° 53' 24"
297	28° 08' 08"	29° 50' 32"	298	28° 08' 08"	29° 50' 32"
299	28° 05' 13"	29° 49' 56"	300	28° 06' 20"	29° 49' 55"
301	28° 06' 20"	29° 49' 55"	302	28° 07' 42"	29° 49' 36"
303	28° 07' 42"	29° 49' 36"	304	28° 08' 13"	29° 47' 08"
305	28° 08' 13"	29° 47' 08"	306	28° 07' 21"	29° 46' 16"
307	28° 07' 21"	29° 46' 16"	308	28° 06' 13"	29° 46' 05"
309	28° 06' 13"	29° 46' 05"	310	28° 03' 18"	29° 41'58"
311	28° 03' 18"	29° 41' 58"	312		
313			314	28° 09' 59"	29° 44' 13"
315	28° 09' 59"	29° 44' 13"	316	28° 10' 26"	29° 43' 53"
317	28° 10' 26"	29° 43' 53"	318	28° 29' 54"	29° 30' 35"
319	28° 29' 54"	29° 30' 35"	320	28° 30' 05"	29° 28' 54"
321	28° 30' 05"	29° 28' 54"	322	28° 32' 24"	29° 26' 42"
323	28° 32' 24"	29° 26' 42"	324	28° 33' 45"	29° 30' 51"
325	28° 33' 45"	29° 30' 51"	326	28° 32' 25"	29° 31' 44"
327	28° 32' 25"	29° 31' 44"	328	28° 31' 46"	29° 33' 33"
329	28° 31' 46"	29° 33' 33"	330	28° 31' 46"	29° 33' 33"
331	28° 32' 49"	29° 36' 41"	332	28° 33' 38"	29° 40' 23"
333	28° 33' 38"	29° 40' 23"	334	28° 34' 43"	29° 44' 41"
335	28° 34' 43"	29° 44' 41"	336	28° 35' 32"	29° 42' 27"
337	28° 35' 32"	29° 42' 27"	338	28° 35' 25"	29° 39' 13"
339	28° 35' 25"	29° 39' 13"	340	28° 35' 43"	29° 35' 34"
341	28° 35' 43"	29° 35' 34"	342	28° 35' 33"	29° 31' 43"
343	28° 35' 33"	29° 31' 43"	344	28° 35' 58"	29° 28' 56"
345	28° 35' 58"	29° 28' 56"	346	28° 36' 22"	29° 27' 11"
347	28° 36' 22"	29° 27' 11"	348	28° 33' 27"	29° 39' 17"
349	28° 33' 27"	29° 39' 17"	350	28° 35' 33"	29° 22' 55"
351	28° 35' 33"	29° 22' 55"	352	28° 35' 27"	29° 23' 58"
353	28° 35' 27"	29° 23' 58"	354	28° 32' 29"	29° 24' 59"
355	28° 32' 29"	29° 24' 59"	356	28° 31' 05"	29° 21' 57"
357	28° 31' 05"	29° 21' 57"	358	28° 30' 37"	29° 20' 33"
359	28° 30' 37"	29° 20' 33"	360	28° 29' 54"	29° 19' 54"
361	28° 29' 54"	29° 19' 54"	362	28° 27' 29"	29° 14' 25"
363	28° 28' 36"	29° 15' 08"	364	28° 28' 12"	29° 16' 24"
365	28° 28' 26"	29° 17' 54"	366	28° 28' 26"	29° 17' 54"
367	28° 28' 13"	29° 18' 09"	368	28° 28' 13"	29° 18' 09"
369	28° 28' 37"	29° 19' 24"	370	28° 28' 37"	29° 19' 24"
371	28° 25' 54"	29° 19' 26"	372	28° 28' 54"	29° 19' 26"
373	28° 29' 42"	29° 20' 07"	374	28° 29' 42"	29° 20' 07"
375	28° 36' 09"	29° 19' 36"	376	28° 36' 09"	29° 19' 36"
377	28° 35' 15	29° 19' 30"	378	28° 35' 15"	29° 19' 30"
379	28° 31' 24"	29° 19' 53"	380	28° 31' 24"	29° 19' 53"
381	28° 33' 55"	29° 18' 10"	382	28° 33' 55"	29° 18' 10"
383	28° 32' 15"	29° 16' 32"	384	28° 32' 15"	29° 16' 32"
385	28° 32' 34"	29° 15' 35"	386	28° 32' 34"	29° 15' 35"
387	28° 33' 09"	29° 14' 20"	388	28° 33' 09"	29° 14' 20"
389	28° 33' 01"	29° 13' 29"	390	28° 23' 33"	29° 13' 29"

Rel.	Lat. (S)	Lon. (E)	Rel.	Lat. (S)	Lon. (E)
391	28° 32' 56"	29° 13' 05"	392	28° 32' 56"	29° 13' 05"
393	28° 33' 08"	29° 12' 23"	394	28° 32' 27"	29° 12' 33"
395	28° 33' 02"	29° 12' 19"	396	28° 33' 02"	29° 12' 19"
397	28° 33' 27"	29° 11' 40"	398	28° 33' 27"	29° 11' 40"
399	28° 34' 22"	29° 12' 02"	400	28° 34' 22"	29° 12' 02"
401	28° 36' 07"	29° 12' 27"	402	28° 36' 07"	29° 12' 27"
403	28° 36' 54"	29° 12' 53"	404	28° 36' 54"	29° 12' 53"
405	28° 38' 41"	29° 13' 19"	406	28° 38' 41"	29° 13' 19"
407	28° 38' 29'	29° 10' 20"	408	28° 38' 29"	29° 10' 20"
409	28° 34' 26"	29° 05' 09"	410	28° 34' 26"	29° 05' 09"
411	28° 37' 06"	29° 05' 58"	412	28° 37' 06"	29° 05' 58"
413	28° 33' 12"	29° 04' 38"	414	28° 33' 12"	29° 04' 38"
415	28° 33' 59"	29° 04' 18"	416	28° 33' 59"	29° 04' 18"
417	28° 35' 17"	29° 03' 23"	418	28° 35' 17"	29° 03' 23"
419	28° 37' 48"	29° 43' 16"	420	28° 37' 48"	29° 43' 16"
421	28° 40' 22"	29° 44' 21"	422	28° 40' 22"	29° 44' 21"
423	28° 42' 08"	29° 47' 28"	424	28° 42' 08"	29° 47' 28"
425	28° 43' 21"	29° 48' 44"	426	28° 43' 21"	29° 48' 44"
427	28° 40' 17"	29° 50' 11"	428	28° 40' 17"	29° 50' 11"
429	28° 35' 50"	29° 50' 24"	430	28° 35' 50"	29° 50' 24"
431	28° 42' 29"	29° 49' 02"	432	28° 42' 29"	29° 49' 02"
433	28° 42' 55"	29° 54' 44"	434	28° 42' 27"	29° 56' 01'
435	28° 42' 27"	29° 56' 01"	436	28° 44' 38"	29° 50' 52'
437	28° 44' 38"	29° 50' 52"	438	28° 47' 17"	29° 53' 47"
439	28° 47' 17"	29° 53' 47"	440	28° 49' 13"	29° 58' 39"
441	28° 58' 48"	29° 52' 36"	442	28° 58' 48"	29° 52' 36"
443	28° 57' 20"	29° 51' 19"	444	28° 57' 20"	29° 51' 19"
445	28° 54' 37"	29° 47' 49"	446	28° 54' 37"	29° 47' 49"
447	28° 51' 25"	29° 49' 23"	448	28° 51' 25"	29° 49' 23"
449	28° 47' 37"	29° 48' 29"	450	28° 47' 37"	29° 48' 29"
451	28° 23' 44"	29° 37' 08"	452	28° 23' 44"	29° 37' 08"
453	28° 15' 01"	29° 40' 16"	454	28° 15' 01"	29° 40' 16"
455	28° 17' 20"	29° 49' 41"	456	28° 17' 20"	29° 49' 41"
457	28° 18' 14"	29° 50' 54"	458	28° 18' 14"	29° 50' 54"
459	28° 33' 22"	29° 28' 41"	460	28° 33' 22"	29° 28' 41"
461	28° 32' 30"	29° 24' 36"	462	28° 32' 30"	29° 24' 36"
463	28° 31' 16"	29° 20' 54"	464	28° 31' 16"	29° 20' 54"
465	28° 31' 37"	29° 19' 52"	466	28° 31' 37"	29° 19' 52"
467	28° 36' 58"	29° 19' 37"	468	28° 36' 58"	29° 19' 37"
469	28° 46' 17"	29° 31' 29"	470	28° 46' 17"	29° 31' 29"
471	28° 41' 19"	29° 31' 40"	472	28° 41' 19"	29° 31' 40"
473	28° 39' 55"	29° 32' 04"	474	28° 39' 55"	29° 32' 04"
475	28° 36' 23"	29° 37' 28"	476	28° 36' 23"	29° 37' 28"
477	28° 36' 11"	29° 37' 54"	478	28° 36' 11"	29° 37' 54"
479	28° 39' 13"	29° 40' 08"	480	28° 39' 13"	29° 40' 08"
481	28° 41' 28"	29° 37' 46"	482	28° 41' 28"	29° 37' 46"
483	28° 46' 08"	29° 41' 54"	484	28° 46' 08"	29° 41' 54"
485	28° 43' 52"	29° 37' 05"	486	28° 43' 52"	29° 37' 05"
487	28° 49' 58"	29° 36' 01"	488	28° 49' 58"	29° 36' 01"
489	28° 52' 28"	29° 43' 28"	490	28° 52' 28"	29° 43' 28"

Rel.	Lat. (S)	Lon. (E)	Rel.	Lat. (S)	Lon. (E)
491	28° 56' 58"	29° 46' 46"	**492**	28° 56' 58"	29° 46' 46"
493	28° 58' 32"	29° 45' 19"	**494**	28° 58' 32"	29° 45' 19"
495	28° 58' 49"	29° 47' 07"	**496**	28° 58' 49"	29° 47' 07"
497	28° 59' 46"	29° 43' 04"	**498**	28° 59' 46"	29° 43' 04"
499	28° 57' 44"	29° 40' 56"	**500**	28° 57' 44"	29° 40' 56"
501	28° 56' 10"	29° 40' 36"	**502**	28° 56' 10"	29° 40' 36"
503	28° 53' 53"	29° 40' 25"	**504**	28° 53' 53"	29° 40' 25"
505	28° 56' 07"	29° 31' 15"	**506**	28° 56' 07"	29° 31' 15"
507	28° 58' 00"	29° 25' 59"	**508**	28° 58' 00"	29° 25' 59"
509	28° 54' 29"	29° 32' 05"	**510**	28° 54' 29"	29° 32' 05"
511	28° 49' 44"	29° 30' 38"	**512**	28° 49' 44"	29° 30' 38"
513	28° 49' 44"	29° 30' 38"	**514**	28° 53' 09"	29° 30' 31"
515	28° 53' 09"	29° 30' 31"	**516**	28° 51' 57"	29° 36' 39"
517	28° 55' 50"	29° 27' 48"	**518**	28° 55' 50"	29° 27' 48"
519	28° 55' 01"	29° 26' 00"	**520**	28° 55' 01"	29° 26' 00"
521	28° 54' 02"	29° 26' 14"	**522**	28° 54' 02"	29° 26' 14"
523	28° 55' 54"	29° 15' 42"	**524**	28° 55' 54"	29° 15' 42"
525	28° 58' 00"	29° 13' 44"	**526**	28° 58' 00"	29° 13' 44"